

BEFORE THE 'BEGINNING'

Although organized study of aquaculture and fisheries in the U.S. did not begin until the middle of the 19th century, fish harvest, especially along the coast, was extremely important long before European colonization at the beginning of the 17th century. It is likely that fish and shellfish were harvested by Native Americans living here thousands of years earlier, and apparently fishermen from several European nations were catching and curing codfish on the Grand Banks off Newfoundland at the beginning of the 16th century. Later, the first settlers at Jamestown and Plymouth depended on the harvest of fish and shellfish to augment their meager diets of Indian corn and other vegetable crops.

CULTURE OF FISH IN THE U.S. PRIOR TO 1900

Work in fish culture apparently began in the U.S. in the early 1830s. In 1831 or 1832, the exact year has not been determined with certainty, one Henry Robinson of Orange County New York imported the common carp from France to ponds on his farm near Newburgh. Apparently the fish spawned. Soon he was stocking them regularly in the nearby Hudson River (Nico, 2011 and Parker, 1989). In 1853, Theodatus Garlick and H. A. Ackley, physicians in Cleveland, performed the first successful artificial fertilization of fish eggs in the U.S., when they mixed eggs and sperm taken from brook trout. Later, they designed and constructed the nation's first fish hatchery (Anonymous, 2005). Then in 1857, Garlick published a treatise on the propagation of salmon and trout. In 1864, Seth Green and Stephen Answorth of Rochester, New York established a private trout hatchery near Caledonia. In 1870, the State of New York assumed the responsibility for its operation. Parker (1989) commented that fish culture in the U.S. was primarily in the hands of the private sector until around 1870. California established its first two hatcheries in 1870. The first federal fish hatchery was not established until 1872 when the U.S. Fish Commission constructed the Baird Hatchery on the McCloud River in California.

Congress in 1871 authorized the creation of the U.S. Fish Commission, and at the same time, authorized the establishment of the National Fish Hatchery System. Later President Grant (1869-1877) appointed Spencer F. Baird, a naturalist, Assistant Secretary of the Smithsonian Institution to that office. After his appointment, Baird organized the Bureau of Fisheries. In establishing the Bureau, Baird insisted "that to study only the food fishes would be of little importance, and that useful conclusions must rest upon a broad foundation of investigations purely scientific in character. The life history of species of economic value should be understood from beginning to end, but no less requisite is to know the histories of animals and plants on which they feed or upon which their food is nourished; the histories of their enemies and friends, as well as the currents, temperatures, and other

physical phenomena of the waters in relation to migration reproduction and growth” (Needham, 1941).

Although fish culture in the U.S. had its beginning in the private sector around the middle of the 19th century, by the end of the century the situation had changed dramatically. By 1900, dozens of state and federal hatcheries were producing literally millions of fry and fingerlings of both coldwater and warmwater species for stocking. In 1897 the U.S. Fish Commission published the first version of *A Manual of Fish-Culture*. It was revised in 1900. It would be the standard reference on fish culture for the next half century.

FISH CULTURE AT AUBURN PRIOR TO 1900

Information published by Yeager and Stevenson (2000) indicated that the first work in fish culture at the institution was initiated by Professor J. S. Newman, first Director of the Alabama Agricultural Experiment Station, in the mid-1880s. Newman constructed two small ponds on a small intermittent stream, just south of the President’s home, on the site that ultimately would become the Donald E. Davis Arboretum (Figure 1). The pond was stocked with common carp. Data obtained from this early work was later utilized in the preparation of the first-ever Experiment Station Bulletin published at Auburn. In *Bulletin Number 1*, Newman describes procedures for the production of common carp in ponds. There is no indication that this early work on fish culture was continued beyond this point.

FISH CULTURE IN THE U.S. IN THE EARLY 1900s

A view of what was happening in fishery science in the U.S. during this early period is available by considering the subject matter of the papers delivered at the Sixty-third Annual Meeting of the American Fisheries Society in Columbus, Ohio, September 18, 19 and 20, 1933. While these papers were delivered in 1933, much of the research on which they were based had been completed earlier in the 1930s. Altogether, 46 papers were delivered at the meeting. Seven of them dealt with administration, policy, regulations, etc. A list of 11 subject matter areas and the number of publications in each category are shown in Table 1. Almost one-half of the publications (17) dealt with the biology of several species of fishes, and twelve were concerned with the hatchery production of salmonids (5) and warm-water-fish (7). Very little of the information presented at the meeting had any bearing on the construction and management of small man-made ponds for fishing in Alabama. Note that the subject matter in virtually all of these papers pertained to research and management in natural lakes and streams in the public domain. In 1930, the Soil Conservation Act was still 5 years in the future; consequently, there was little concern for pond building and or fisheries work on private land. It is likely that in most states it would have

been illegal to expend public funds on fish management on private lands.

As detailed in the preceding section, fish culture in the U.S. began in the private sector around the middle of the 19th century, but by the end of the century, it was rapidly becoming a public enterprise. By the early 1900s, federal and state hatcheries had been established throughout much of the nation. Quickly the establishment of hatcheries became a political ‘football.’ Soon construction of hatcheries, especially those operated by the National Fish Hatchery System, became a clear indication of the level of the national influence of local U.S. Senators and Representatives. The Private John Allen Federal Fish Hatchery at Tupelo, MS was authorized in 1901 after local Congressman John Allen gave a fiery speech on the House floor in which he intoned: “Fish will travel overland for miles to get to the water we have at Tupelo... thousands and millions of unborn fish are clamoring to this Congress for an opportunity to be hatched at the Tupelo Hatchery.” Alabama was late in climbing on the fish hatchery ‘band-wagon.’ The State Hatchery at Estaboga was not established until 1926, and federal hatcheries at Marion and Carbon Hill were not established until 1934 and 1938, respectively.

As detailed in the preceding paragraphs, most of the efforts in fish culture in the U.S. in the early 20th century were directed toward producing large numbers of fingerlings and yearlings of various species of game fish in government hatcheries for stocking in public waters; consequently, it is surprising that very early in the century interest began to develop in culturing fish in ponds on farms for recreational fishing. In the following paragraphs, I have recounted some of the comments by several authors on this subject. The comments are generally indicative of the level of understanding of the principles of pond fish culture for recreational fishing in the early 20th century.

In 1902, J. J. Stranahan (1902) published a paper in Transactions of the American Fisheries Society entitled *Fish Culture on the Farm*. In the publication, the author provided clear instructions on the construction of ponds, including the preparation of a “core trench.” In addition, he provided recommendations on the stocking of the pond. These are presented in the author’s own words: “Not over two or more species should be put into any pond of a few acres or less. If the bottom of the pond is soft, suitable for the growth of aquatic vegetation, then the large-mouth bass should be introduced by all means, if bass are to be selected at all. The best all round fish for small ponds, north or south, is, in the opinion of the writer, what is known as the marble or mottled catfish in the north and the speckled catfish in the south (*Ameirus nebulosis* – from nebulous or cloudy).”

1. “Taking the country as a whole, the writer believes that what is known as the blue-gill sunfish north and bream south is the best fish for small ponds. In stocking your pond, half a dozen pairs of each

species are a great plenty and even those will overstock your pond the first year.

2. If black bass are to be introduced it is well to also put in brook minnows such as chubs, shiners, suckers, etc. One of the most fruitful causes of failure of fish-culture on the farm is over production.
3. At the end of the spawning season of the second year your pond should be drawn off and surplus fish turned into the nearby stream or lake. It is a hard matter to advise just how many fish of each species should be returned to the pond, the natural inclination being to make it too many. One hundred of your yearling black bass and twice that number of bream and catfish is plenty for each acre of water.”

J. L. Leary (1904), published a paper in Volume 33 of the Transactions of the American Fisheries Society entitled *Construction of Ponds and Pond-Culture Methods*. He wrote: “While good ponds with an abundance of water are the first needs yet the choice of brood stock cannot be overestimated. The mistake that many fish culturists make is over stocking the pond and should be carefully guarded against. This may vary with climate, but taking one acre as a pond basis, thirty pairs of fair sized brood bass, two and one half to three pounds each, and fifty pairs may not be extreme. One hundred pairs of the following fish: crappie, rock bass, strawberry bass, and twenty pairs of channel catfish or carp.”

Charles H. Townsend (1907) published a paper entitled *The Cultivation of Fishes in Natural and Artificial Ponds*, in the Eleventh Annual Report of the New York Society. He wrote:

1. “It should be made clear that the instructions which follow will be of little use to those who suppose that the pond can be filled with fishes and left to care of itself. To be made productive it will require intelligent care and considerable work.
2. If the waters contain black bass or other fishes, which have become stunted from overcrowding and the exhaustion of the natural food supply, it is important to reduce their number by any methods of fish catching that will prove effective and to restore the food supply by introducing other species.
3. All ponds, whether natural or artificial, containing food fishes should be stocked with brook-minnows, shiners, chubs, fresh-water killifish and other small species to constitute a food supply.
4. About one-quarter of an ordinary pond should be as shallow as 10-12 inches and planted with pond weeds.

5. In stocking water it is not necessary to have large numbers of adult fish. For a pond about an acre in extent, twenty pairs of black bass will be sufficient, and perhaps fifty pairs of other kinds mentioned. When conditions are right the progeny of the first year will usually stock the pond to the limit of its natural food supply.
6. The large-mouth bass is one of the best species for ponds. It grows faster and larger than the small-mouth bass. Under the best of conditions, with a good food supply, and considerable area and depth of water either species will increase in size at the rate of about a pound a year.” “The calico bass (*Pomoxis sparoides* = *nigromaculatus*) and crappie are highly recommended for ponds. They may be kept in ponds with bass, perch or sunfishes, thrive with little care and will stand rather warm water.
7. Blue-gill sunfish (*Lepomis pallidus* = *macrochirus*) is the largest of the sunfishes. It thrives in ponds and will live in as warm water as any native food fish.
8. If you must have a fish pond and do not intend to give it any attention, stock it with catfish (*Ameiurus nebulosus*). They will come as near as any to raising themselves you can get except carp.”

L. L. Dyche presented a paper entitled *Possibilities of an Acre Fish Pond* on September 9, 1913 at the 43rd Annual Meeting of the American Fisheries Society (Dyche, 1914a). In this paper he reported results on the quantity of fish produced in an approximately 1-acre hatchery pond, during the period 1910-1913, in Kansas. The pond was initially stocked with largemouth bass, crappie, bluegill sunfish, green sunfish, bullheads, hickory shad, carp and goldfish in an effort to produce large brood fish for use in other hatchery applications. Later, it was stocked with yearling bass and adult crappie, adult bullheads and large channel catfish, plus a large number of fingerlings of various kinds, being discarded by the hatchery. During the period, the fish were fed at intervals with chopped liver and meat, chopped fish (primarily carp), chopped corn, kafir corn and miscellaneous bread and table scraps.

The pond was drained during the period April 25-30, 1913, and according to the author, some 6,780 pounds of fish were recovered. This astounding total did not include the weight of a large number of smaller fish. According to hatchery records, 1,100 pounds of largemouth bass were recovered. All of these fish weighed at least 1-pound each. Additionally, 745 pounds of large bluegills, weighing 0.5 pound each; 612 pounds of black crappie, weighing at least 1.75 pounds each; 1,986 pounds of bullheads, weighing at least 1.0 pound each and 380 pounds of channel catfish, weighing at least 4.0 pounds each were recovered. These data represent the first that I have been able to locate in which the actual production resulting from stocking several species

of warm-water predatory and prey fishes in a pond were reported.

In 1914, Lewis L. Dyche, Fish and Game Warden for the State of Kansas, published a Bulletin entitled *Ponds, Pond Fish and Pond Fish Culture* (Dyche, 1914b). At the same time, he was serving as Professor of Systematic Zoology and Curator of Mammals, Birds, and Fishes at the University of Kansas. In the Bulletin, he comments that he had been interested in fish ponds and fishing since boyhood and that he had visited and talked with the owners of a large number of fish ponds throughout the State before writing it. He noted that he was also thoroughly familiar with the fish hatchery work being conducted by the Kansas State Fish and Game Department. Some excerpts from the extensive publication are reproduced in several following paragraphs:

1. "Good artificial ponds, constructed where they can be properly managed, can be made to serve a number of purposes, one of the chief ones is to be used as reservoirs for the storage of vast amounts of water that now runs out of the country. This water, flowing in swollen streams through and out of the state, does little if any good and in many cases, does a vast amount of damage.
2. Judging from what is known of the nature and food habits of the black bass, it would not seem advisable to place them in ponds.
3. In view of what has been stated concerning our knowledge of the crappies and their ability to adapt themselves to the various waters and climatic conditions of Kansas, they must be considered as among our very best general-purpose pond fishes.
4. There are a number of varieties of sunfish in Kansas, as stated before, and most of them do well in ponds. The sunfishes, especially the common green and pond varieties native to Kansas, are more or less omnivorous in their habits, eating a considerable amount of vegetable matter, various kinds of insects, worms, small minnows and young fish, sometimes including specimens of their own kind. For this reason, I very much doubt the value of their presence in ponds.
5. We know of ponds that have bass, crappie, catfishes and sunfishes in them. They all seem to get along very well in a way.
6. The entire subject of the relationship of various kinds of fishes in ponds of various sizes needs to be carefully studied to determine just what species can be reared together to advantage under known conditions.

7. It is quite important that the proper kinds of aquatic plants be grown in waters where fish are to be raised. Almost any kind of water plant is better than nothing.”

In 1915, Professor George C. Embury of Cornell University published a lengthy work entitled *The Farm Fishpond*. It included detailed instructions on pond construction plus considerable information on the biology of the various species of plants and animals that could be stocked in ponds in New York State. Some of the author’s comments lifted from the work are:

1. “A fish pond in order to be successful must provide (1) suitable spawning grounds, (2) abundant forage, and (3) shelter in which young and old may escape their natural enemies.
2. Aquatic plants are the first organisms to be planted in the pond. They should be started as early in the spring as possible.
3. The propagation of minute organisms in great numbers as food for young fishes has been accomplished by the Chinese, Japanese, and more recently the Germans. For this purpose, they have used various organic fertilizers including the manure of sheep and horses. During the last few years the Germans have experimented with various commercial inorganic fertilizers, but at the present time, their use is little understood, and there is a great difference of opinion as to their use.
4. By placing well-rotted manure in these ponds at the rate of about three quarts per square yard of pond area and one week later by introducing mud and vegetation from some pond known to contain the necessary organisms, it is probable that during the next three weeks, there will be enough Protozoa, minute Crustaceae and the like, to feed all the young fish that may appear. Since there is no known method of controlling the reproduction of aquatic insects in large numbers, one will have to depend on their chance occurrence.
5. The first year during the fore part of June, the forage fishes, goldfish and golden shiners, should be added to the number of one-hundred pairs of each.
6. Advanced fry of edible fishes may be planted when available during the first summer, fingerlings in September and October, but yearlings or larger, should not be planted until the second summer. The suggested number of edible fishes per acre of water are about twenty-five pairs of adult black bass or fifty pairs of any other kind, from two to three thousand fingerlings, or from four to six thousand advanced fry.

- 7. In a pond run merely to meet the demands of a family or two, there will hardly be a desire to harvest the total output at one time; consequently, there will be no special outlay for fishing equipment. Fishing with hook and line will no doubt be the proper method in a number of cases. Many times, however, the largest and most desirable fishes refuse to be caught by ordinary methods of angling, and one must resort to the use of such contrivances as the set line, the seine and the fish trap.**
- 8. A few individuals of all species, particularly perch and black bass may be large enough to catch at the end of the second summer, but the average fish will require three summers at least before it is fit for the table. If it is desired to make a catch before the end of the second summer, a trap or the seine should always be employed.**
- 9. After the pond has been in operation for three or four years, there will be a few overgrown fishes lying in deep water. Every effort should be made to remove them, for they are very destructive. If all other methods fail, the pond should be drained. Pond draining should take place in the fall or early spring.”**

There is little indication that any of the publications considered above was based on actual research in ponds; although they did reflect a considerable amount of observation of existing ponds. Among the first to be based on field work was published by A. H. Wiebe in 1930. He recounted the results of several years of research that he had done on the effect of fertilization (organic and inorganic) on plankton and fish production in small ponds at the Bureau of Fisheries Research Station in Fairport, IA. He drew the following conclusions from this research:

- 1. “In three small ponds fertilized either with superphosphate, soybean meal or shrimp bran, plankton production was greater than in a similar pond which received no fertilizer. Of the three fertilizers, soybean meal seemed to be the most effective.**
- 2. In two small ponds fertilized with a 3:1 mixture of sheep manure and superphosphate, both organic matter and “net” plankton were greater than in a similar pond receiving no fertilization. All of the ponds were stocked with fish. The differences in the fertilized and unfertilized ponds were more obvious when fish production was taken into consideration.”**

IN THE 'BEGINNING'

This lengthy story-line of the evolution of the Auburn Fisheries Program generally begins with the establishment of the Auburn Outing Club in 1927,¹ but the history of the establishment of the Club actually begins a few years earlier with the construction of Lake Wilmore, southeast of the town of Auburn on Moore's Mill Creek and an unnamed tributary of that Creek.

LAKE WILMORE AND THE AUBURN OUTING CLUB

The Alabama Polytechnic Institute (later Auburn University) constructed Lake Wilmore in the mid-20s as a water supply for the Institution when wells drilled earlier no longer met its needs. Apparently, Moore's Mill Creek contained a good native population of the red-eye bass. An excellent fishery for the species developed after a section was impounded as Lake Wilmore. Several persons in the community enjoyed the fishing in the newly established Lake. As a result, they encouraged some of their friends to join them in establishing an Outing Club in order to purchase the fishing privileges for the Lake.

According to a short history of the Auburn Outing Club written by Professor F. E. Guyton, an entomologist, shortly before his death (July 31, 1978), a meeting was arranged by Professor Charles Hixon (Professor of Mechanical Engineering and Director of Shops) and Professor Bede Bidez (Auburn Bandmaster) in a room in Broun Hall on the College Campus. At the meeting, the Auburn Outing Club was officially established with Professor Charles Hixon as President, Professor Faye E. Guyton (Assistant Professor of Zoology and Entomology) as Treasurer and Dr. Redding Sugg (Assistant Professor of Bacteriology and Pathology) as Secretary. Supposedly, club membership finally reached a level of some 60 families in the Auburn community.

Soon thereafter, the Auburn Outing Club purchased fishing privileges on the Lake and quail hunting privileges on the surrounding land for \$120 per quarter, payable to API. Apparently, purchasing fishing privileges allowed the membership to become involved in the management of the Lake. According to Guyton, they constructed a small brood pond on the un-named tributary where they raised bass and tadpoles to be released into in the Lake.¹

¹ Judge Joe Bailey (now deceased), long-time Secretary and Treasurer of the Auburn Outing Club kindly provided much of the information on Lake Auburn. As an aide, Joe Bailey was one of the "Gofers" who worked with the Fisheries Program about the time the Department of Fisheries and Allied Aquacultures was established.

Lake Wilmore is no longer part of the water supply for the City of Auburn, although it is managed by the Auburn City Water Works Board. Rather, it is part of Lake Wilmore Park, located just northeast of Ogletree Elementary School on Ogletree Road.

GUYTON'S FISH COLLECTION

Although it would have little to do with the basic 'Swingle-Smith' story, the Fisheries Program at Auburn had its informal beginning sometime in the late 20's when Guyton (Figure 2) began to collect, preserve and catalog fish from local Alabama streams. According to Yeager and Stevenson (2000), he came to Auburn in 1921. Nothing is known of why and when he began to collect fish. As noted previously, he was primarily an entomologist. Apparently his collection is one of the oldest, if not the oldest, in the Lower South. It has been used extensively in Auburn's teaching program over the years.

David Werneke who is the present Curator of the University Fish Collection comments that the oldest material is dated in 1928. He further noted that Guyton apparently sent much of his early material to Carl Hubbs at the University of Michigan. Later, Hubbs returned some of the material which became the 'base' for Auburn's current collection.

THE LAKE AUBURN EXPERIENCE¹

In the late 20s, the Auburn Outing Club decided to construct and manage its own recreational fishing pond. As indicated in a preceding Section, there was little reliable information about how this should be done, but they 'ploughed' ahead with the information that they had. The early results of their efforts were really dismal, but it was these results that provided the impetus for the beginning of the Auburn Fisheries Program.

CONSTRUCTION

Professor Guyton did not explain why the Club decided to construct their own lake, but in 1931 they purchased the Echols Tract (24 acres) and Wright Tract (6 acres), located along on an un-named tributary of Chewacla Creek, south of the present-day Shell Toomer Parkway, just west of present-day Chewacla State Park. Land around Auburn was extremely cheap in 1931. Unfortunately, club members had little money with which to purchase even cheap land. According to Guyton, Dean of the School of Agriculture and Director of the Agricultural Experiment Station, Marion J. Funchess, worked out the details whereby the Club could finance the purchase of the land, clear it and build the dam. In the same year, the dam was constructed on the small creek to impound a 12.5-acre lake (Lake Auburn) on the 30-acre tract (Figure 3). A watershed of approximately 1,000 acres supplied water for the creek

and the lake. The cost of construction of the dam was approximately \$968, and the total cost of the entire outdoor recreation facility was around \$2,256.

MANAGEMENT AND RESULTS

According to personal notes made by H. S. Swingle, he, F. E. Guyton and M. L. Nichols, Professor of Agricultural Engineering, were assigned the responsibility for the construction and management of the pond. These individuals were all employees of the Alabama Agricultural Experiment Station at the Alabama Polytechnic Institute. In preparation for carrying out their responsibility, they likely reviewed the literature on the subject and contacted the public agencies for their recommendations. In a preceding Section, I have described some of the information available on the subject at that time, but I am not certain how much of it that they might have seen.

It is likely that the 'managers' really did not fully understand what was expected of them in the construction and management of Lake Auburn, and it is also likely that the members of the Club did not know either. Obviously, they wanted a good place to fish, but had no idea of what that meant. Generally, fishing anywhere in East Central Alabama in the early 30s would have been uniformly poor. In their wildest dreams, none of them could even imagine the kind of fishing that would be available later in a well-managed farm pond.

At this point, the 'managers' seemed to have had no idea where they were going and obviously no idea how to get there. Even though they were members of the Experiment Station staff, fish farming was a completely new world for them. There were few fishery managers in the South in the early 30s, so it is unlikely that any of the 'managers' had ever talked with one. It would not have helped them very much if they had. No one anywhere knew anything about building and managing 'terrace-water' ponds for fishing. They were essentially "flying blind" with an extremely steep learning curve ahead of them. The idea that it would be possible to establish a predator-prey relationship in a fertilized man-made pond, and manage it so as to produce good fishing over a long period, was beyond their comprehension at that point.

It is really difficult to know what they knew about stocking ponds. As I have shown in a preceding Section, there was some information available on the subject in the published literature, but I cannot be sure that they ever saw any of it before they stocked Lake Auburn. In 1943, Swingle and Smith published a paper reviewing experiences obtained in managing the pond over a 10-year period. Their Literature Cited section listed only papers that they had published previously.

The construction of Lake Auburn was apparently completed in 1931, and it

probably filled with water during the fall and winter. In the spring of 1932, the “managers,” stocked 49 adult shellcrackers (4 per acre) and 121 adult bluegills (10 per acre) (Table 2).

In June, approximately 3,000 *Gambusia* were added for mosquito control to meet Alabama Department of Public Health requirements. Then in July of that year, they stocked 1,250 bluegill fingerlings (about 1-inch in length) and in October they stocked an additional 1,000 bluegill fingerlings and 259 red-eye bass fingerlings (4-inch). This last stocking also included approximately 150 largemouth bass fingerlings (Swingle and Smith, 1943). *Chara* sp. was planted in the pond to provide cover for small fish, and cattails (*Typha* sp.) were allowed to grow around the margins of the pond. There is no indication of where they obtained the fish for stocking; probably they were seined from Lake Wilmore or from some other local pond. Almost certainly the red-eye bass were obtained from that lake or from the small stream supplying water to it.

With 121 adult bluegills spawning several times during the summer of 1932, it is likely by October that there were multiple thousands of small sunfish in the pond. The pond was opened to fishing in the spring of 1933, and although Swingle and Smith did not comment on it, it is likely that large numbers of fish could be caught by hook and line; but they would have been little more than ‘eyes and fins’ – much too small to be kept. Estimated total catch for the year was approximately 28 pounds, per acre. Only approximately 4 pounds of the total were bluegills and shellcrackers. Some 7 pounds of bullheads were taken. The authors comment that in the fall there were still thousands of small bream in the pond. Fishing was even worse in 1934 (19 pounds per acre). Apparently it was easy to catch hundreds of small bream; most of them too small to keep. The catch of bream fell to 0.7 pound per acre. It is likely that at the end of the fishing season in 1933, Club Members, including Dean and Director Marion J. Funchess, were not very pleased with the efforts of their ‘managers.’

This experience underscores the lack of experience and understanding on the part of the ‘managers.’ Anyone with even a minimal knowledge of the biology of bluegills would have understood that, given the fecundity of the species, disaster awaited the stocking of 121 adults in a newly-filled pond in the spring when there was virtually nothing to control their numbers.

One important positive result of this early effort was the obvious decision that the bluegill sunfish would be the “stack-pole” around which they would build their model fishing pond. In the first year, they stocked more than 2,250 bluegills of various sizes. From experience, they knew that it spawned readily in ponds. Further, it had been the most common fish caught when they fished local ponds.

FROM LAKE AUBURN'S 'ASHES'

Obviously, the fishing in Lake Auburn must have been extremely disappointing, but what happened following this unhappy experience was truly amazing.

The Funchess contribution to the initiation of the Auburn Fisheries Program was discussed in considerable detail in the '*Dedication*' Section, and will not be recounted here; except to repeat the assertion that without his significant 'in-put' in the early 30s, there would have been no Program, and to note once more that the reasons opposing his involvement were more compelling than those encouraging it.

Before Experiment Station funds could be used for fish culture research, a formal project proposal had to be developed and approved. Funchess directed that H. S. Swingle, F. E. Guyton and F. S. Arant, all faculty of the Department of Zoology and Entomology, prepare it. The proposal directed that Swingle, E. V. Smith, from the Department of Botany and Plant Pathology, and G. D. Scarseth, from the Department of Agronomy and Soils, would be Co-Project Leaders.

Once the Project received Experiment Station approval and the Alabama Attorney General had agreed that indeed fish could be considered to be 'live-stock,' it was time to get to work to see if the problems encountered in the management of Lake Auburn fishing could be solved through research. Initially, salaries for Swingle, Smith and Scaseth were not a problem. They were already employed. For example, in the 1934-1935 academic year, Swingle received a salary of \$3,060. Some \$260 of the total came from funds appropriated by the Alabama Legislature for funding the Experiment Station. The remainder (\$2,800) was provided from the so-called Adams Funds. The Adams Act was approved by Congress in 1906, for the purpose of increasing funding for the nation's Agricultural Experiment Stations. Each state received \$30,000 to support the funding of basic research in the sciences supporting agriculture. At that time, the Adams funds were supporting Swingle's research on a project entitled *Physiology of Insects with Reference to Their Control*. Apparently, after approval of the new fish culture project, he spent time on both projects, at least for a time.

Similarly, obtaining funds for construction was not a major problem either, at least initially. In 1933, President Roosevelt had unveiled the so-called *Civil Works Administration (CWA)* as part of his 'New Deal.' Funds from this source were utilized to construct the first ponds for the research. As a result of public opposition, funding from this source was terminated in March, 1934. The CWA was replaced in 1935 by the so-called *Works Progress Administration (WPA)*; however, I find no record indicating that WPA funds were used for construction of the ponds on the South Auburn Farm.

Funchess also encouraged the 'Investigators' on the new AES research project to submit a proposal for funds needed for supplies, equipment, etc., under the provisions of the Purnell Act. The Purnell Act was passed by Congress in 1925. It provided additional funds for agricultural research and increased the types of projects that could be supported.

Later, the proposal entitled *Production of Food for Fresh-Water Fish* was submitted to USDA. Following are some excerpts:

“The trend in American agriculture seems to be toward a new social order in which the farmer cultivates fewer acres and has more leisure time than before.”

“In the early days the open stream offered good fishing to the enthusiast, but muddying of the streams due to erosion from cultivated fields, overfishing and other factors have so reduced the fish population in the average Alabama stream that it is usually no longer a satisfactory place to fish. Due to these conditions fishing in ponds is much more satisfactory than fishing in streams.”

“Farm fish ponds in Alabama would serve a very useful purpose in supplying a supply of fresh meat to the table throughout the year. This is lacking in the diet of most farm families, especially during the long hot summer when it is impossible to keep fresh meat for any length of time due to a lack of refrigerating facilities.”

“The construction of farm ponds on small streams would utilize a portion of the acreage retired from cultivation, tend to conserve water, and aid in the preventing floods on larger streams.”

“There are, at present, more than 800 small ponds throughout Alabama which have been constructed by farmers for the purpose of raising fish. . . . The production of fish in these small ponds varies from a few pounds to several hundred pounds per acre yearly. . . . From these records it appears that the production of fish per acre could be considerably increased. This cannot be done, however, without definite experimental data upon which recommendations can be based.”

“Probably the most important single problem in increasing fish production is that of increasing the amount of food available for the fish. This involves the study of the production of plankton, higher aquatic plants, aquatic insects and other aquatic animals. . . . This project contemplates the study of methods of increasing the abundance of the above organisms and a study of the effects of such increases upon the amount of fish produced per acre.”

“The Departments of Zoology-Entomology, Botany and Plant Pathology, and

Agronomy and Soils are cooperating in this project. H. S. Swingle of the Department of Zoology-Entomology, and E. V. Smith of the Department of Botany and Plant Pathology will cooperate upon all of the biological phases of this project. G. D. Scarseth of the Department of Agronomy and Soils will conduct chemical studies with the use of fertilizers and with the suspended colloids in pond waters.”

It is unfortunate that the proposal did not include a section on *Review of Literature*. Without that, we cannot know what the ‘Investigators’ knew about the work that they were about to begin. For example, we cannot know whether or not they were familiar with the papers published by Stranahan (1902), Townsend (1907), Dyche (1913), Embury (1915) or Wiebe (1930), reviewed in a preceding Section.

Likely this proposal was the source of considerable consternation in the U.S.D.A Office responsible for the administration of the Purnell Act. It was a ‘stretch’ to link this project to improving the life of farm families. Further, apparently the Administrator was concerned with its likely infringement on the responsibilities of the Biological Survey Division of the U.S. Department of the Interior (Yeager and Stevenson, 2000). Finally, with strong support of Director Funchess, it was approved. Apparently the funds approved for the project were first made available July 1, 1934.

THE LONG JOURNEY BEGINS

As detailed in a preceding Section, by the end of 1933 it was obvious that the efforts to manage Lake Auburn, so as to provide good fishing for members of the Auburn Outing Club, were dismal failures. Apparently, the information available to the ‘managers’ had been woefully inadequate. Fortunately, Director Funchess had decreed that this state of ignorance was unacceptable. Unfortunately, the Lake Auburn experience had provided few guidelines as to where the research should begin. Subsequently, the faculty (Swingle, Guyton and Arant), chosen by the Director to write the first Project, had decided that determining how to increase food production in ‘man-made’ ponds should be the first consideration. It would have been interesting to have had the opportunity to hear the discussion that led to the decision that increasing fish food production was the place where the ‘Journey’ would begin.

THE PURNELL PROJECT IN 1934

Initially, the research on “*increasing the production food for fresh water fish*” was designated as the Purnell Project because most of the non-personnel costs of the work were supported by funds made available by the Purnell Act. It would carry the same title through 1936.

We cannot be certain what the ‘Investigators’ knew when they began their research on increasing the production of food for freshwater fish, but they did not begin on a completely ‘barren’ landscape. Manuring to increase the production of food fish in ponds had been an accepted practice in Europe for hundreds of years, and in China for a much longer period. All of the chemical procedures that they would use had been standardized many years earlier. All of the limnological methods and specialized equipment that they would need had been in use in the study of productivity in natural lakes for several decades. The biology of the organisms, both plant and animal, that they would be working with was well known. Inorganic fertilizers were widely used in agriculture, and their chemistry and modes of action were well understood. Further, as detailed in a preceding Section, A. H. Wiebe (1930), had published a paper in which he commented that the “fact that the addition of fertilizers increases the productivity of fish ponds seems to be fairly well established.”

Apparently by 1934, it was understood that pond fertilization would likely result in both an increase in the production of fish food organisms and fish, but there were still many questions to be answered, including:

1. The comparative efficacy of organic and inorganic fertilizer materials.
2. The most effective formulations of inorganic fertilizers.
3. Amount of fertilizer required.
4. Frequency of application.

THE ‘INVESTIGATORS’

Director Funchess assigned H. S. Swingle, an entomologist (one-half time), E. V. Smith, a plant physiologist (one-fourth time) and G. D. Scarseth, a soil scientist (one-fourth time) as co-investigators of the Purnell Project.

Homer Scott Swingle (Figure 5) was born July 29, 1902 near Columbus, OH. He belonged to a family who produced fresh vegetables for the Columbus market. He was awarded a B.S. Degree by Ohio State University in 1924 and an M.S. Degree in Zoology-Entomology in 1925. He held the position of Assistant Entomologist with the U.S. Bureau of Entomology in Fort Valley, GA from 1925-1929. In 1929 he joined the faculty of the Alabama Agricultural Experiment Station as Associate Entomologist. As noted previously, two years later (1931), he accepted the responsibility as one of the ‘managers’ in the construction and management of Lake Auburn. In 1933, he was chosen by Funchess to help prepare the proposal for a new Experiment Station research project on Fish Culture. When it was finally approved, he became one of the ‘Investigators’ on the Project.

Edwin V. Smith (E. V.) (Figure 5) was also assigned to the Project by Funchess. He was born in Ozark, AL in 1905, and he was raised on a farm nearby. He earned a degree at the Alabama Polytechnic Institute in 1928. He was encouraged by Funchess to continue his education. Later he would receive M.S. and Ph.D. Degrees in plant physiology from Iowa State University. He returned to Auburn and a position as Associate Professor of Botany in 1931. He served as Associate Dean and Assistant Director from 1944 until 1951. In 1951, he replaced Funchess as Dean and Director. He retired in 1971.

George D. Scarseth was an Associate Soil Scientist in the Department of Agronomy and Soils when the Fish Culture Project was approved in 1933. In 1934, Funchess assigned him to its team of ‘Investigators’ on a one-fourth-time basis. He brought with him a wealth of knowledge on chemical fertilizers. The use of these materials in fish culture would become a central element in the success of the project.

Generally, in the presentations that will follow, I use the term ‘Investigators’ to describe the contributions of Swingle, Smith and others assigned to the Project. Everyone assigned to it apparently worked closely as a team, so it is difficult to determine individual contributions. In the authorship of publications, Smith is listed as the first author in those papers specifically dealing with plants, either plankton or rooted aquatics. In those dealing specifically with fish, Swingle is generally listed as first author.

Smith and Swingle apparently worked on every aspect of the development of the Project in the early days; they ‘learned-by-doing.’ And they had to learn literally everything: designing and constructing experimental ponds, seining fish and counting them without killing them, sexing fish, collecting plankton, identifying zooplankton, water analysis, weed identification, the actions of individual fertilizers and their interaction in pond water.

LABORATORY FACILITIES

The ‘Investigators’ needed a considerable quantity of specialized laboratory equipment (Foerst centrifuge, electric oven, a balance, glassware, etc.) and dedicated laboratory space, almost from the very beginning of the Project. In the 1935 Annual Report, they reported the results of the effect of fertilization on plankton production. So at that early date, their research required a fully functional limnology laboratory. Unfortunately, I have been unable to find any information on the laboratory facilities available to them in the earliest days of the Fish Culture Project. Apparently in the late 30s, they were given the use of the Miller House for this purpose (Figure 10). It was located southeast of Comer Hall, about where the northern end of Funchess Hall is located today. Once, they had access to the house, they developed a limnology laboratory in one of the front rooms.

CONSTRUCTION OF EXPERIMENTAL PONDS

Obviously, much of the proposed research would involve the use of man-made ponds (aquatic 'field plots'). Further, there would have to be a number of these experimental 'units' of equal size. This would require a sizeable area of relatively flat land. Also, there had to be a relatively dependable source of water. They needed a location near a relatively permanent stream, not subject to severe flooding, adjacent to a relatively large area of level land. After searching for a suitable site near Auburn (Beaver Creek, Heard Creek, and Huguley Spring Creek), the research team finally chose an area near the south boundary of the Experiment Station for the establishment of the South Auburn Farm.

The South Auburn Farm was located on the northern margin of the Fall Line Hills District of the East Gulf Coastal Plain Physiographic Section (Osborne, et al., 1992). McNutt (1981) comments that the soils in that area are primarily of the Marvyn-Cowart-Uchee Complex and that they are deep, well drained and moderately well drained with a sandy surface layer and a loamy and clayey subsoil, formed in marine sediments of the Coastal Plain.

Today that site is located along East University Drive (Highway 147), just west of Parkerson Mill Creek. The water supply for the ponds was a small unnamed tributary of Parkerson Mill. West of the site, the stream divides into two even smaller streams. One crosses '147' at its intersection with Wire Road. The second passes under Wire Road and parallels the south side of the highway westward. This stream contained several species of 'wild' fish that could gain easy access to the water supply pond for most of the year.

Before the 'ink-was-hardly-dry' on the funding agreement with USDA, under the Purnell Act, the first dirt was being moved; thus initiating a research pond-building program that would continue for over three-quarters century. This first pond construction event is described in Appendix Table 1. The Table also includes a brief description of most of the construction and maintenance projects undertaken by 'Investigators' on the various Farms operated by the Auburn Fish Program for the next eight decades.

Construction began in 1933 with the use of funds provided by the Civil Works Administration. First, they began the construction of the 1.8-acre water supply lake (Farm Pond 1) with the use of mules and slip scrapes (Figures 6 and 7). While the dam was being raised, a 3-inch galvanized metal pipe was laid through its base to provide water for experimental ponds being constructed below it. At the same time, a series of 20 rectangular ponds ('D' Series), 1/130-acre in area, was being excavated just below it (Figures 8 and 9). Construction on these facilities was completed early in 1934 and the first experiments were initiated before the end of the year.

EXPERIMENTATION

The 'investigators' wasted little time getting their research program underway. Construction on Farm Pond 1 was completed in May, 1934, and as soon as it began to fill, they stocked it (Table 3). Similarly, construction of the 'D' Ponds was completed in June of that year and as soon as they could be filled, research was initiated in them as well. Over the next 6 or so years, they would complete an amazing number of experiments in virtually every area of aquatic biology and ecology. Considering the facilities and man-power available, their accomplishments were almost unbelievable. As we will see, however, the large number of different experiments was 'purchased' by elimination of replications of treatments in individual experiments.

Remember, at that point, the long-term goal of the Fisheries Program was to develop methods for producing good quality, sustainable recreational fishing in man-made, 'terrace-water' ponds, constructed on private farms; however, their more immediate goal was to develop methods of increasing the production of natural food for fish in those ponds (the Purnell Project).

Only two experiments were completed in 1934. They are described in the following paragraphs:

MALARIAL MOSQUITO LARVAE IN MAN-MADE PONDS

The Alabama Department of Public Health took a dim view of the new research on the construction and management of farm fish ponds at Auburn. They saw this research as ultimately leading to a 'boom' in the construction of small ponds in rural areas of the State, and a commensurate 'boom' in the establishment of new habitat for Anopheline mosquitos, the insect vector for malaria. As a result, the Department required that *Gambusia* be stocked in all new ponds constructed in the State.

In 1930 malaria was a serious problem in much of the Lower South, and a strenuous effort was being made throughout the region to limit the extent of its habitat. Faust (1932) commented that in 1930 more than half of all the counties in the southern United States showed some mortality from malaria. He noted that the mortality was as high as 20 deaths per 100,000 persons in a significant number of these counties and that in 66, the rate was as high as 50 per 100,000. In a single county it had reached 300 per 100,000.

The author further noted that only 9 of Alabama's 67 counties reported no deaths from malaria in 1930. The average mortality for the entire state was slightly over 12 per 100,000 persons. It was as high as 20 in 16 counties, and in Greene and Houston, it exceeded 50. Mortality from the disease was especially high in the region between the Tombigbee and Alabama Rivers. As a result of this serious public health problem, the 'Investigators'

assiduously sampled pond waters on the South Auburn Farm with their white 'dippers' in all of the early experiments.

In this 1934 research in the newly constructed 'D' Ponds, the 'Investigators' measured the abundance of mosquito larvae in ponds containing water hyacinths and in ponds without the plants. On September 15, 1934, an average of 9.4 larvae per pond were recovered in a total of five 'dips' with a white 'dipper,' in 18 ponds containing hyacinths. In two ponds without the plants, an average of 1.0 larvae per pond were recovered. The 'count' was repeated on September 27. At that time, an average of 22.0 larvae per pond were captured in the 18 ponds containing hyacinths. Only an average of 2 per pond were captured in the two ponds without the plants.

Sometime between September 27 and November 15, all hyacinths were removed from the 18 ponds. In larvae counts on November 15, none were found in 17 ponds, and one was found in two of the ponds. Five were recovered in one of the ponds that was extremely muddy. At the same time, an average of 13.8 per pond were captured in the four new ponds (the Funchess Ponds) that had also been stocked with hyacinths.

After repeated sampling over a several-year period, the 'Investigators' generally concluded that Anopheline mosquitos were seldom present in ponds without severe weed infestations.

THE FIRST EXPERIMENT IN FARM POND 1

Aquaculture has been defined as "*the planned or purposeful intervention in the production of aquatic animals*" (Shell, 1993). Obviously, within this broad definition, the construction and management of earthen ponds for the production of fish for recreational purposes is a form of aquaculture. 'Recreational Aquaculture' generally differs from 'Commercial Aquaculture' only in manner by which the fish produced are harvested and marketed. This is an important difference because of some of the economic forces involved. However, there are more similarities than differences between the two.

The first experiment conducted as part of the new Fish Culture Project and also the first experiment in 'Recreational Aquaculture' was conducted in Farm Pond 1. As noted in a preceding paragraph, this pond was completed in May of 1934. It had been filling with stream water during the final stages of construction. As a result, the 1.8-acre pond was actually stocked with a few fish from the stream before construction was completed. Table 3 includes data on the numbers and sizes of the species stocked by the 'Investigators.' Note that the characteristics of fish stocked in Farm Pond 1 in 1934 were similar to those stocked in Lake Auburn earlier (Table 2); except that some fingerlings were stocked in Lake Auburn, but none in Farm Pond 1. Remember, as the water supply pond, it received no fertilization. In October,

1934, the pond was drained, the fish counted and weighed (Table 3) and returned to the pond (Figure 11). This same procedure would be followed as the experiment continued for several years.

This procedure of stocking a pond for a new experiment by returning the fish harvested from the previous experiment would be used numerous times in other experiments in the coming years. Frankly, I have never understood the 'Investigators' reason for doing so. There was nothing that they could really learn that had any 'real-world' application. Further, when the pond was drained, all of the accumulated food chain for the forage fish (bacteria, algae, phytoplankton, zooplankton and insects) would be discarded over a matter of a few hours. It would likely take months to completely re-build it. In the meantime, the forage fish would have very little food available to them. It is also likely that the shortage of food for this prolonged period of time would affect egg production in the fish in the experiment the following spring. The 'Investigators' finally realized the nature of the lost forage fish food problem, and commented on it in the 1940 Annual Report. However, they did not seem to be concerned about the sudden change in the nature of the predator-prey relationship resulting from crowding of all of the fish together, as draining progressed.

Considering the 'Fish Recovered' data in Table 3, it is obvious that fishing in Farm Pond 1 in the spring of 1935 would have been as un-rewarding as it had been in Lake Auburn. Approximately 72 percent of the total weight of fish recovered were fingerlings and fry of bluegill, crappie and bullheads.

RESEARCH DOCUMENTATION

From the beginning, Swingle and Smith worked tirelessly in the field and laboratory, but they never failed to take the time to keep meticulous records on what they were doing, and why the experiments gave the results they did, and used many 'pages' trying to explain what all of this data meant (Figure 5). With time, they probably understood that they were collecting data they would never use, but in the beginning they thought that it was wise to collect and keep everything. Their first Annual Report covered the period July 1, 1935 to December 31, 1936. Over time, their Annual Reports increased almost exponentially in length. The single volume for 1936-1936 soon became two volumes. This practice of keeping meticulous records persisted in the Fisheries Program for many years.

In the mid-70s, as the Program expanded, its size became such that preparation of Annual Reports had to be discontinued in its original form. It was requiring so much secretarial time that they had little time to do anything else. Needless-to-say, without the availability of these early Annual Reports, it would be virtually impossible to write about the early history of the Fisheries Program.

The 'Investigators' not only kept meticulous and voluminous field records, but they also converted these materials into a wide variety of excellent, well received publications. They wrote tirelessly for newspapers, farm journals, fish and game departments, and for professional audiences. In addition, from the beginning, they took pictures, and lots of them. These are invaluable today.

THE PURNELL PROJECT IN 1935

The research completed in 1934 did not advance the 'Investigators' very far in their quest for developing good fishing in man-made ponds, but with most of their facilities completed, they expected to be able to move more rapidly in achieving that goal in 1935. At the same time, they had learned some extremely valuable lessons on how to conduct experiments involving live fish in earthen ponds.

THE 'INVESTIGATORS'

H. S. Swingle (one-half time), E. V. Smith (one-half time) and G. D. Scarseth (one-fourth time) continued to serve as 'Investigators' for the Fish Culture Project in 1935. It is interesting that Swingle's official contribution to the project was two-times as great as for Smith and Scarseth. It really is not clear what Funchess intended with this arrangement in personnel. It is likely, however, that other AES commitments limited their participation.

CONSTRUCTION OF EXPERIMENTAL PONDS

As indicated in Appendix Table 1, only Pond C-1 of the 'C' Series was constructed in 1935 (Figure 12). While new pond construction was limited, a substantive change was made in the 'D' Series. Experimentation in 1934 had revealed that seepage was extremely high in all of the ponds; consequently, the bottom and sides of each pond were lined with 6 inches of Susquehanna clay. This treatment solved the seepage problem, but contributed to significantly increased turbidity.

EXPERIMENTATION

The research conducted in 1934 on the relationship between the presence of aquatic plants and Anopheline mosquitos was an important contribution to the future of the construction and utilization of farm fish ponds in Alabama, but it did not contribute very much to the goal of increasing food for fish in them. In 1935, the 'Investigators' began to seriously address that question. Three of the experiments that they completed were related to pond fertilization, and the fourth one involved the continuing experiment in Farm Pond 1 on pond stocking.

FERTILIZATION AND ORGANIC MATTER PRODUCTION

Well before the 1930s, hydrobiologists were aware that the production of plankton (phytoplankton and zooplankton) was an important 'link' in the 'food-chain' for fish; however, while fishery managers generally understood the relationship, there had been little interest in trying to quantify it or to use it to increase fish production. Biologists with the responsibility of managing fish populations in natural waters (streams and natural lakes) could see no practical way of increasing the production of plankton. But for hatchery biologists, the possibilities were far different.

In the early 30s, fish hatchery managers throughout the country were constantly being encouraged to increase the production of fish in their units for distribution. It seemed that there were never enough trout, bass and other game species to meet all of the requests for fish for stocking. Consequently, it is not surprising, as detailed in a preceding Section that a large share of the research reports presented at the Sixty-third Annual Meeting of the American Fisheries Society dealt with hatchery management (Table 1). By 1933, research to increase the production of fish in hatcheries throughout the country was well under way.

One of the reports at the AFS meeting was especially pertinent to the research work that would shortly begin at Auburn. Joe Hogan, manager of the State Fish Hatchery at Lonoke, AR presented a paper entitled *Experiments with Commercial Fertilizers in Rearing Largemouth Black Bass Fingerlings*. In the report Logan comments: "in an effort to increase the production of bass, forage minnows, commercial fertilizer and cottonseed meal were used in some of the ponds during the summer." He also commented that "this is the first season that commercial fertilizer and cottonseed meal have been placed in the ponds."

Typically, largemouth bass fingerlings were produced in hatcheries using forage minnows as a food source. In 1932, eight earthen ponds, 0.85-acre each, at the hatchery were stocked with fingerling bass. Then beginning June 27, ponds were fertilized at bi-weekly intervals with 50 pounds of cottonseed meal and either (four ponds) with 25 pounds of superphosphate or 25 pounds of 6-8-6 (N-P₂O₅-K₂O). After the ponds were drained in late September, Logan concluded: "it is our opinion that the four ponds fertilized with superphosphate were superior to ponds fertilized with 6-8-6 alone. It is also indicated that probably under similar conditions at least five or six thousand No. 3 bass can be produced in one of these ponds with fertilizer and without forage minnows."

Logan cited no references in his report, so I cannot determine why he used these particular fertilizer 'mixtures.' He credits Dr. H. S. Davis of the Bureau of Fisheries with providing 'helpful suggestions and information.' Perhaps

Dr. Davis provided him with information on possible ‘mixtures.’

Three experiments were conducted by the ‘Investigators’ on pond fertilization in 1935 – all of them in the ‘D’ Series. Remember that these ponds were completed in June, 1934, and that they were used in the same year in research on the problem of malarial mosquitos in man-made ponds. Now the ‘Investigators’ were ready to begin research on their main concern – *increasing the production of natural foods for fish in ‘terrace-water’ ponds.*

EXPERIMENT 1

During the period June and July, 1935, the ‘Investigators’ conducted an experiment on the production of plankton, measured as the dried weight of organic matter, in samples of water removed from the ponds, in response to the application of different fertilizer mixtures. In the experiment, 17 of the 20 ponds received applications of nitrate of soda, superphosphate, either alone or in various combinations with muriate of potash (KCl), and calcium carbonate (Table 4). Two of the ponds (5 and 11) received no fertilizer and one pond (14) received cottonseed meal.

Eleven ponds receiving nitrate, phosphorus, potassium, and calcium carbonate were divided into three groups. One group of four ponds (1, 2, 3 and 4), received larger quantities of these fertilizers. A second group (13, 15, 16, 17 and 18) received lesser quantities, and the third group (19 and 20) received even lower quantities. Rates of fertilizer application for all ponds are shown in Table 4. Water samples were collected from each pond using ‘dippers’ on June 20, June 27, July 5 and July 18. In the laboratory, the quantity (milligrams per liter) of dried organic matter was determined for each sample.

Organic matter production data for the various ‘Fertilizer Treatment-Sampling Date’ combinations for all ponds are presented in Table 5. Even though there were relatively high levels of variation in the data, especially between sampling dates, the ‘Investigators’ concluded the following:

1. Ponds receiving nitrate alone, phosphate alone, nitrate plus calcium carbonate, or phosphate plus calcium carbonate, did not result in the production of more plankton (dry organic matter) than in ponds receiving no fertilizer.
2. Nitrate plus phosphate did increase the production of plankton slightly.
3. Plankton production was highest when muriate of potash and calcium carbonate were added to the mixture of superphosphate and nitrate of soda.

4. Plankton production in ponds receiving nitrate plus phosphate was 4 to 6 times greater than in ponds receiving no fertilizer.
5. Plankton production, in virtually all of the ponds, regardless of fertilizer mixture applied, declined sharply between June 20 and July 18.
6. The 'High' rate of application resulted in production of more plankton than either the use of the 'Medium' or 'Low' rates as determined in the June 20 samples; but in the July 18 samples, production associated with that level of application was no better than production with the low rate.

Remember that 11 of the ponds received a combination of nitrate, phosphorus, potassium and calcium carbonate and that they were divided into three sub-groups depending on the quantity ('High,' 'Medium' or 'Low') of fertilizer applied. Data on the production of organic matter in these ponds have been extracted from Table 5, and re-arranged as Table 6. These data lead the 'Investigators' to conclude: "the effect of different rates of application of nitrate, phosphate, potassium and lime on plankton (dry organic matter) production was 'inconclusive at best'."

The twelve individual means in Table 6, were used to create a chart which shows their change over time (Figure 13). With the chart data it is possible to obtain an even better picture of the variation involved. It is obvious that there was some problem with five samples collected on June 27 from ponds receiving the 'Medium Rate' of fertilization. Organic matter content estimates were completely out of the range of content in all of the other ponds on that date. Strangely this effect, whatever it was, was not present on sampling dates either before or after. As a result, it is likely that these aberrant values were the result of sampling or analysis errors.

EXPERIMENT 2

A second experiment on pond fertilization was also conducted in the 'D' Ponds in 1935. It was designed to study the relationship between fertilization and organic matter (plankton) and fish production. To prepare for this experiment, fresh water was added to the ponds and allowed to remain for a period of time to remove any left-over fertilizers from Experiment 1. Experiment 2 involved the use of several combinations of commercial fertilizers. These combinations were somewhat different than those used in Experiment 1 (compare Tables 4 and 7). Bluegill fingerlings were stocked at rates of 100 or 200 per pond (13,157 or 26,314 per acre). The experiment was initiated September 9, 1935, and was conducted in two Phases. It was not completed until May 1, 1936.

PHASE 1 (WATER SAMPLES COLLECTED WITH 'DIPPERS')

Various combinations of inorganic fertilizers (superphosphate, ammophos, sodium nitrate, ammonium sulfate, muriate of potash, calcium carbonate) were applied, as applicable, to each pond on May 22, June 19, July 29 and September 3, 1935 (Table 7). Two of the ponds (5 and 11) received no fertilizer. Except in one case, each pond received the same fertilizer combination throughout the period. One pond received only poultry laying mash weekly. Six of the ponds (3, 16, 17, 18, 19 and 20) all received the same fertilizer (superphosphate, nitrate of soda and muriate of potash).

Water sampling began in late September 30, 1935, utilizing 'dippers' (Phase 1) to collect the samples. Samples were also collected September 27, October 4 and October 10. Data (milligrams of dry organic matter per liter of water) obtained from water collected on these four dates in the 20 ponds are presented in Table 7.

Data on organic matter production in Phase 1 of Experiment 2 (September 30-October) were extremely variable. For example, dried organic matter measured in the September 27 samples from ponds treated alike varied from 21.0 (Pond 16) to 314.4 mg/L (Pond 3). Ranges for other 'Sampling Date-Pond Combinations' were almost equally great.

PHASE 2 (WATER SAMPLES COLLECTED WITH SPECIAL DEVICE)

After completion of Phase 1 of Experiment 2, the 'Investigators' decided that the use of 'dippers' selectively sampled the shallower waters of the ponds where most of the organic matter was located, and that the estimate for the quantity of plankton for the entire pond was being biased upward. As a result, they constructed a device that sampled a column of water from the surface to within 4 inches of the bottom. Samples (Phase 2) using the device were taken five times between November 11 and December 13, 1935. These data are presented in Table 8.

Samples for Phase 2 were collected on five dates between November 11 and December 13, 1935. Data on dried organic matter production are presented in Table 8. Generally, values for all combinations of 'Fertilizers' and 'Sampling Dates' were much lower than in Phase 1 (Table 7). Of course, all of these samples were collected well into the late fall when water temperatures were much lower. Further, variation was generally lower; although not much in relative terms.

The 'Investigators' commented concerning the data obtained from sampling using both devices in Phase 1 and Phase 2 (Tables 7 and 8):

1. Sodium nitrate, superphosphate and calcium nitrate when applied

separately did not result in increased production of organic matter when compared to production in ponds receiving no fertilizer.

2. Greatly increased production resulted from applications of the following fertilizers:
 - a. Superphosphate, nitrate of soda and calcium carbonate.
 - b. Superphosphate, nitrate of soda, muriate of potash and calcium carbonate.
 - c. Superphosphate, nitrate of soda and muriate of potash.
 - d. Superphosphate and ammonium phosphate.
 - e. Ammonium phosphate and calcium carbonate.
 - f. Ammonium phosphate and calcium sulfate.

WATER CHEMISTRY STUDY

As part of Experiment 1, the 'investigators' measured pH, phosphorus, nitrate and ammonia concentrations in waters of the experimental ponds on several dates. These data are presented in Tables 9 and 10. Concerning these data, the 'Investigators' commented that "chemical analyses did not completely explain differences in plankton production." They would make hundreds of analyses on pond waters in the various experiments in the following years, but generally they made little use of any of the results; although, in a few situations, the analyses were useful in understanding problems that they encountered from the interaction between chemical fertilizers and water quality in the various 'D' Pond experiments. For example, average pH values were somewhat lower in Ponds D-7 (4.18), D-9 (5.43) and D-12 (5.65). All three of these ponds received ammonium phosphate in their fertilization treatment. Ammonium phosphate is an "acid-forming" fertilizer.

Average phosphate concentrations were extremely low for two of the sampling dates: October 16 (0.52 mg/L) and December 3 (0.58), but somewhat higher on September 18 (2.86) and November 11 (4.59). All ponds received their first fertilizer application on September 11 and the second on November 2. Phosphate concentrations were highest when measurements were made soon after a fertilizer treatment. These data suggest that the chemical compounds in the fertilizers began to be taken out of solution relatively soon by physical and/or biological processes. A similar relationship is also obvious in the nitrate data.

RECREATIONAL AQUACULTURE

As detailed in the description of Experiment 2 in the 'D' Series in the preceding Section, bluegill fingerlings were stocked at two rates in ponds receiving differing mixtures of fertilizer (Table 8). This work represents a 'halting' step on the path in learning to stock 'terrace-water' ponds for high quality, sustainable recreational fishing. Meanwhile, research in Farm Pond 1

continued on the 'track' established with the unsatisfactory management of Lake Auburn.

THE CONTINUING EXPERIMENT IN FARM POND 1

Remember the research in Farm Pond 1 was conducted on a continuing basis. The pond was drained each year, the fish removed, counted and weighed. Generally, all of the fish that were removed on draining were returned to the pond; although in some years, some might be removed and others added when they were restocked.

As detailed in the preceding Section, when Farm Pond 1 was drained in October 1934, the recovered fish were counted, weighed and returned to the pond as stock in preparation for the 1935 experiment. These stocking data are presented in Table 11. The pond was drained again in December 1935. The data on fish recovered at that time are also presented in Table 11. The data show that over one-half of the weight of fish recovered were yellow bullheads and chub suckers which would have been of little value to fishermen. The problem of 'wild' fish entering the pond continued to be extremely troubling in their effort to 'manage' the population in that pond. Only 11 bluegills and 12 red-eyed bass were large enough to be considered 'harvestable' (Swingle, 1950). This population would have provided little quality fishing in 1935.

This continuing experiment in Farm Pond 1 was contributing very little to 'Investigator' efforts to learn how to produce good fishing in 'terrace-water' ponds. Fortunately, they were learning how to manage fish and ponds in conducting experiments – something that that they had not known before.

'EXPERIMENT' AT SAND MOUNTAIN

While the 1935 Annual Report of the Purnell Project did not mention it, a really important development in pond stocking was beginning at the Sand Mountain Substation of the Alabama Agricultural Experiment Station at Crossville in DeKalb County in 1935. There is no indication that the 'Investigators' were involved in any way with this 'experiment.' It was not mentioned in the Annual Reports until 1940; however, a year earlier Swingle and Smith (1939) had published a paper describing the fish pond work there in detail. The paper notes that the ponds were constructed and managed by R. C. Christopher, who was Superintendent at that time. Apparently, he was not conducting an experiment. Rather, he wanted to store some water on the farm, and decided to add fish to provide fishing for Substation personnel. I am sure, however, that the expenditure of Experiment Station funds had to be justified. As a result, he kept records on what he did. There is no indication of when the 'Investigators' became aware of the work and of the fishing records being kept until later.

According to data presented by Swingle and Smith (1939), a recently constructed (1935) 'terrace-water pond' (The 'Upper' Pond) at the Substation was stocked in 1935 with the combination of aquatic animals shown in Table 12. The pond, when full, covered approximately 2 acres, but averaged closer to 1.75 acres for much of the year. No data were presented on the weight of animals stocked. Further, there is no indication where the animals were obtained; however, I suspect that the fingerling bass came from the State Hatchery at Estaboga.

I suspect that the construction, stocking and management of this pond later played a pivotal role in the evolution of the Fisheries Program at Auburn, but I have been unable to find any information that suggests that Swingle and Smith were involved at all in the early stages of its development. They would not stock fingerling largemouth bass in an experimental pond on the South Auburn Farm until February, 1939; although their July, 1938 publication *Management of Farm Fish Ponds* recommended that either 200 crappie or 200 largemouth bass along with 1500 bream be stocked per acre in ponds that would be fertilized. A review of pond stocking records for the South Auburn Farm suggests that they were not really aware of the 'experiment' at Sand Mountain until about the time they were preparing the 1938 publication. I have been unable to find any indication that they were involved in the decision to include the stocking of largemouth bass fingerlings in the 'Upper Pond' in 1935.

THE PURNELL PROJECT IN 1936

In the 1936 Annual Report, the 'Investigators' continued to identify their research as the Purnell Project. They made significant progress in 1935. They were rapidly learning to conduct complex research in hydrobiology; something none of them had never done before. They had also learned that plankton production in small earthen ponds was highly variable, but even with a high level of experimental error, it was obvious that applications of a combination of nitrogen, phosphorus and potassium resulted in significant increases in dried organic matter (plankton) production when compared to ponds receiving no fertilizer.

'INVESTIGATORS'

H. S. Swingle, E. V. Smith and G. D. Scarseth continued to provide leadership for the Project through at least part of the year. However, Scarseth left during the year. Notes prepared by Swingle indicated that Dr. J. W. Tidmore of the Department of Agronomy and Soils participated in the Project during the year, but provided no other details. In 1936, Swingle's participation was increased from one-half to three-fourths time. Smiths' contribution remained at one-fourth time.

CONSTRUCTION

As noted in Appendix Table 1, there was no pond construction in 1936.

EXPERIMENTATION

The most striking change in experimentation in 1936 compared to 1935, was the sharp increase in both the kinds and amounts of data that were being obtained from the experiments. Several of these experiments conducted in 1936 are described in the following material.

POND BIOLOGY

The 'Investigators' devoted a considerable amount of time in 1936 studying the biology of different components of the ecosystems within their experimental ponds.

PHYTOPLANKTON IN THE 'D' SERIES

Remember that the 'Investigators' had begun an experiment (Experiment 2) in the 'D' Series in late 1935 that was to be continued into 1936. Beginning in January 1936, they began the process of identifying plankton in water samples collected from the ponds. Samples were collected January 3, January 17, February 14, February 26 March 13 and March 17, 1936. With 6 sampling dates and 20 ponds, there were 120 'Sampling date-Pond number' combinations.' Diatoms were identified in 80 of these 120 combinations (Table 13). *Euglena* (25 samples) and *Dinobryon* (18 samples) were also quite common. The 'Investigators' also spent a considerable amount of time on this exercise, but there is little indication that they ever made any use of the data.

ZOOPLANKTON IN THE 'D' SERIES

Zooplankton taxa were also identified in water samples taken from the 'D' Ponds on 8 dates between January 3 and April 17, 1936. Copepods were identified in 91 of the 160 'Sample date-Pond number' combinations. Ciliated protozoa (66 samples), rotifers (60 samples), cladocera (36 samples), ostracods (36 samples) and *Diffugia* (Sarcodina) (22 samples), were also common.

FOOD HABITS OF FISH IN THE 'D' SERIES AND LAKE AUBURN

In the fall of 1936, a small number of bluegills, crappie, bullheads and chub suckers were seined from Farm Pond 1 and Lake Auburn, and taken to the laboratory to determine what food(s) they had consumed. Some conclusions from this investigation were:

1. Smaller bluegills apparently had fed primarily on microcrustaceans and insect larvae.
2. Microcrustaceans and insect larvae were also the primary food consumed by small crappie, but one larger specimen (4 inches) had consumed a minnow.
3. Small chub suckers had fed on phytoplankton and microcrustaceans.

BIOLOGICAL POTENTIAL OF THE BLUEGILL

Remember that Pond C-1 (0.118-acre) was constructed in 1935 (Figure 12). It was used as a bluegill brood pond in 1936. It was stocked with 5 male and 5 female adults in the early spring (Table 14). It was drained November 19, 1936. In that period of time the 5 female bluegills produced at least 12,357 progeny (105,000 per acre). It is not known how many might have been removed for stocking in experiments. Using this minimum value, fry and fingerlings produced per female was approximately 2,471. This is a somewhat smaller number than expected. These females could have spawned two to three times during this period. They apparently grew extremely well. When stocked, males and females weighed approximately 0.2-pound each, but there is no indication of the average weights of the individual females.

POND FERTILIZATION

As detailed in a preceding Section, an experiment conducted in the 'D' Ponds in 1935 (Experiment 1), clearly demonstrated that applying chemical fertilizer mixtures containing nitrate, phosphate and potassium, periodically to earthen ponds, significantly increased organic matter (dried) production compared to production in ponds receiving 'no fertilizer' (Tables 4 and 5). Also, as detailed there, on completion of that experiment the 'Investigators' initiated Experiment 2, in two Phases. The details of the design of these experiments were also described in that Section. Remember that water samples taken from the ponds in September and October, 1935 (Experiment 2, Phase 1), were collected with the use of 'dippers' (Table 7). However, in samples taken in November and December, 1935, a new collection device was used (Phase 2). Data obtained with the use of the new device are presented in (Table 8). The data presented in both Tables simply reinforced the conclusions reached in Experiment 1 (Tables 4 and 5): fertilizers containing combinations of nitrogen, phosphorus and potassium, when added to ponds, resulted in the production of significantly more dried organic matter (plankton) than in ponds receiving no fertilizer.

THE CONTINUATION OF EXPERIMENT 2 (PHASE 2) FROM 1935 INTO 1936

The 1936, 'D' Series experiment on pond fertilization represents the continuation of Experiment 2 (Phase 2) which was initiated in the late summer (September) of 1935. Table 16 includes the fertilizer combinations used in each pond, beginning November, 1935. In the 1936 research, all water samples were collected with the 'new' collecting device. Samples were collected on 7 days in January (2), February (2), March (2) and April (1).

Results (mg/L of dry organic matter) are presented in Table 15. They are quite variable, even with ponds treated alike. For example, Ponds 3, 16, 17, 18, 19 and 20 received the same fertilizer (superphosphate, nitrate of soda and muriate of potash). Average organic matter (dried) production for each of those six ponds, over all sampling dates, varied between 5.9 and 30.8 mg/L, with an average of 11.77. Obviously, data obtained from Pond 19 are 'outliers.' Estimates for that pond varied between 4.2 and 544.6 mg/L. They don't seem to be part of the same Experiment.

In Table 16, data from Tables 8 and 15 are summed across all 12 sampling dates from November 11, 1935 through April 8, 1936. I have used the 'sums' rather than the individual estimates. The sums seem more appropriate where they will be used for comparisons with fish production estimates, which are also 'accumulated' or 'summed' values. These data show that total organic matter collected from ponds receiving 'no fertilizer' (Ponds 5 and 11) ranged between 65.2 and 63.7 mg/L, respectively. Except in Pond 6 (superphosphate only), Pond 13 (calcium nitrate only), Pond 10 (nitrate of soda only), Pond 15 (laying mash only), total dried organic matter collected was higher than in those ponds receiving 'no fertilizer. Swingle and Smith (1938) utilized some of the data from this experiment in preparing Table 6 of their 1938 publication *Fertilizers for Increasing the Natural Food for Fish in Ponds*.

With respect to the lack of replications in their experiments, the 'Investigators' at this stage were not overly concerned with the statistical analysis of their data. Further in 1936, small sample statistical methods were still in its infancy. Fisher's first edition of *Statistical Methods for Research Workers* had been published in 1925 (Fisher, 1925) and Snedecor's first edition of *Statistical Methods* would not be published until 1937 (Snedecor, 1937). Consequently, in their experiments, they were looking for differences between treatment means that were large enough that statistical analysis was not necessary. Still it is interesting to consider the analysis of a small set of their data. Ponds 3, 16, 18, 19 and 20 received the same fertilizer 'mixture' in Experiment 2. Data from Table 16 showed that estimated organic matter production for these ponds were 101.3, 110.3, 145.3, 369.6 and 93.2 mg/L. In the following analysis, I have removed the estimate from Pond 19 (369.6 mg/L) from the data set. It is an obvious 'outlier.' Something was going on in that pond that was not going on in the other ponds receiving the same

treatment.

The mean for the 'corrected' data set is 112.52, the standard deviation is 22.94, and the standard error of the mean is 11.47. The t value for $P = 0.05$ and with 3 d.f. is 3.182. With these statistical values, the confidence interval would range from 75.76 to 148.74. So there is a 95 percent chance that the actual mean of the data set would be within this range. Excluding the estimate from Pond 19, this range would include all of the individual estimates in the experiment. These results would suggest that the effect of fertilizer treatments on organic matter production in all of the ponds was similar, except in 19. However, the 'no fertilizer' mean of 64.45 mg/L $[(65.2 + 63.7) \div 2]$, for Ponds 5 and 11 was far out of this range, which indicates that the two means were likely drawn for different populations.

Based on the results of the pond fertilization experiments in 1935 and 1936 (Experiment 2), the 'Investigators' generally concluded the following:

1. The production of total plankton as expressed by the production of dry organic matter could be increased in earthen ponds by periodic additions of inorganic fertilizers containing nitrogen, phosphorus and potassium.
2. The efficiency with which the elements in the fertilizers were incorporated into plankton was related to the ratio of N, P_2O_5 and K_2O in the materials and to the chemical composition of the compounds.

FERTILIZATION AND FISH PRODUCTION

Remember that Experiment 2 was initiated in early September, 1935. It was designed to continue to evaluate effect of fertilization on plankton (dried organic matter) production and also on fish production. To accomplish these two objectives, all of the 20 'D' Series except 2 and 17 were stocked with 100 bluegill fingerlings each when they were filled in September, 1935. Ponds 2 and 17 were stocked with 200 recently hatched 'fry.'

The Ponds were drained May 1, 1936, and the fish in each pond counted and weighed. The fish were weighed in pounds and ounces, but I have converted them to the decimal system. These data on the weight of fish recovered are also presented in Table 16. It was quickly obvious in reviewing the original data that the weights of fish recovered from those 1/130-acre ponds were piteously small. In Pond 13, only 0.54 pound of fish was recovered; however, when extrapolated to 'pounds-per-acre,' the weight was a respectable 76 pounds. With such small quantities of fish involved, weighing errors, even small ones, must have been a constant problem for the 'Investigators.'

Data presented in Table 16 show that fish production (extrapolated to

pounds-per-acre) in the 20 ponds ranged between 79.0 and 374.9 pounds per acre with an average of 213.24 pounds. Survival of stocked bluegills varied between 50 percent (Pond 19) and 99 percent, (Pond 11), but did not seem to affect the fish production estimates. In fact, it appeared that lower survival tended to result in increased production. Also remember that ponds 2 and 17 were stocked with 200 recently hatched fry each as compared with the 100 fingerlings stocked in the other 18 ponds. Fish production in those two ponds was near the upper end of the range, but not the highest. These results lead the 'Investigators' to conclude: "there was a strong positive correlation between plankton production and the production of fingerlings of the largely insectivorous bluegill sunfish".

Remember that ponds 3, 16, 18, 19 and 20 received the same fertilizer treatment (Table 16). Fish production in those ponds was: 251.9, 224.2, 196.6, 248.1 and 274.2 pounds per acre, respectively. At first glance, it appears that the fish production data in this set is somewhat less variable than the dried organic matter production data. Also, there is no indication that fish production in Pond 19 was an 'outlier.' Apparently, whatever caused the large deviation in organic matter production did not have an effect on fish production. Average fish production in those five ponds was 239.00 pounds per acre. The standard deviation is 29.60. The standard error of the mean is 13.23. The t value at $P = 0.05$ and 4 d.f. is 2.776. With this combination of values, the Confidence Interval for this data set ranged from 202.27 to 275.73 pounds per acre. Only one of the estimates (Pond 18 – 196.6 pounds) was outside this range. Again, the 'no fertilizer' estimates of 188.5 (Pond 5) and 90.3 (Pond 11) were far outside.

As noted previously, fish farmers had known for hundreds of years that the production of some species, grown in ponds, could be increased by adding organic matter as fertilizers, but Experiment 2 is likely among the first controlled experiments conducted in the United States to demonstrate that the production of fish could be increased by the periodic addition of inorganic fertilizers to ponds. This was an extremely important contribution. There are many problems associated with the use of organic matter as fertilizers. The use of inorganic materials instead solves many of them.

The dried organic matter (plankton) and fish production data from the 18 ponds stocked with 100 fish, are presented in Table 16 and are graphed in Figure 14. It is obvious from the graphed data that there is only a limited degree of correlation ($r = 0.275$) between the two variables. The variation is excessive. It is also obvious that the data from Pond 12 and Pond 19 are likely 'outliers.' For some reason, they do not seem to be part of the same population. In both, dried organic matter (plankton) production was extremely high compared to fish production. They were also 'outliers' on most of the plankton sampling dates. In Figure 15, these two estimates have been removed. Now the correlation seems more obvious. The correlation

coefficient is quite strong ($r = 0.541$), and indicates that in this experiment the production of bluegills was positively correlated with dried organic matter production.

Beginning in mid-summer of 1936, the 'Investigators' conducted a second experiment on the relationship between organic matter (plankton) and fish production (Table 17). It was similar in many respects to Experiment 2 (Phase 2) described in the preceding Section. The primary difference was that in this experiment, they made a special effort to evaluate two different stocking rates (100 versus 200 per pond) of bluegills. Remember that in the 1935-1936 Experiment they concluded:

1. There was a strong positive correlation between organic matter production and fish production.
2. Fish production was higher in ponds receiving regular applications of inorganic fertilizers than in ponds receiving no fertilizer.

These were essentially the same conclusions from the second 1936 Experiment. They learned almost nothing new from it. Further, the effort to evaluate the two stocking rates of bluegills was a failure because in the '100-per-pond' treatment, they stocked fingerlings; while in the '200-per-pond' treatment, they stocked recently-hatched fry.

The 'Investigators' used results of this Experiment as the basis for the first significant publication reporting the results of their research. The publication *The Relationship between Plankton Production and Fish Production in Ponds* appeared in Volume 68 (1939) of Transactions of the American Fisheries Society. There was no mention of the 1935-1936 Experiment 2 (Phase 2) experiment in the article.

RECREATIONAL AQUACULTURE

As detailed in the preceding Section, when Farm Pond 1 was drained in the late fall of 1935, the fish were counted, weighed and some of them returned to the pond. These fish became the stock for the 1936 Experiment (Table 18). This combination reflects the 'Investigator's' continued commitment to the use of adult fish established in the stocking of Lake Auburn.

Obviously, from our perspective, some 75 years later, the fish population in Farm Pond 1 was still a 'mess.' When it was drained in December, 1936, only 7 adult bluegills, 3 adult largemouth bass and 12 adult white crappie were recovered (Table 18). Further, almost 80 pounds of bluegill fry and fingerlings were also recovered. Almost half of the total weight (241.9 pounds) recovered consisted of yellow bullheads and chub suckers. The parents of these fish had entered the pond from the water supply stream.

COMMERCIAL AQUACULTURE

It is not likely that the 'Investigators' were concerned with commercial aquaculture in 1936, but their experiment on the production of goldfish apparently was not really conducted to obtain information on Recreational Aquaculture either. This would have to be considered the first experiments that they conducted that would have direct commercial implications.

GOLDFISH PRODUCTION

The Swingle Pool had an area of approximately 0.031- acre. It was stocked in February, 1936 with 10 adult goldfish. The pool was fertilized in June and July with 10 pounds of ammonium phosphate per application. The pool was drained October 4, 1936, and 354 goldfish with a total weight of 11.50 pounds were recovered. The extrapolated weight was 368 pounds per acre.

The Funchess Pond had an area of 0.094 acre. It was stocked with 15 large goldfish in April, 1936. Enough fertilizer was added to the pond during the experimental period to maintain a good plankton 'bloom.' The pond was drained November 25, 1936, and 5,463 fish weighing 68.25 pounds were recovered. This weight included 13 of the original stock, weighing 3.44 pounds. The extrapolated total production was 723 pounds per acre.

AN UNINTENTIONAL 'FEEDING' EXPERIMENT

In the 1935-1936 Experiment (Experiment 2, Phase 2) described in a preceding paragraph to evaluate the effect of various combinations of fertilizer on fish production, one of the ponds (15) received poultry laying mash on a weekly basis. Dried organic matter production (61.1 mg/L) was similar to those ponds (5 and 11) receiving 'no fertilizer,' (65.2 and 63.7mg/L, respectively) (Table 16); however, fish production (333.9 Pounds/A) in that Pond was among the highest in the Experiment. Obviously most of the 'mash' was being consumed by the fish.

IMPORTANT PUBLICATIONS IN 1936

The first publication related to Recreational Aquaculture prepared by the 'Investigators,' *Fish Ponds in Alabama*, was published in *Journal of the Alabama Academy of Science* in 1936.

THE BANKHEAD-JONES PROJECT IN 1937

The Bankhead-Jones Act was passed by Congress and signed by the President in 1935. One of its primary sponsors was the senior Senator from Alabama. John Bankhead was the eldest son of a politically powerful farm family in Marion County. He was also a powerful force in the U.S. Senate with

a strong interest in scientific agriculture. He played a leading role in getting the Bankhead-Jones Farm Tenant Act of 1937 enacted. The Bankhead-Jones Act became a major source of federal funding for the nation's Agricultural Experiment Stations. Some of the Funds provided by this Act were used to support Auburn's fledgling Fisheries Program. As a result, in 1937, the Purnell Project became known as the Bankhead-Jones Project.

When the 'Investigators' began their research in 1937, they had two full years of experience 'under-their-belts.' In this short period, they had demonstrated that they could increase the production of fish in earthen ponds through the addition of inorganic fertilizers, and they were 'light-years' ahead in their knowledge of how to conduct experiments in fish production in ponds. At the same time, it was still not clear that they knew where they were going. They still had no real understanding of what constituted a good 'fish-pond.' At that time, probably none of them had ever fished in one.

INVESTIGATORS

H. S. Swingle and E. V. Smith continued to lead the Project in 1937. Both were given additional time to work on the project. Swingle's time was increased from three-fourths to full-time and Smith's from one-fourth to three-fourths. Notes made later by Swingle indicated that Dr. F. S. Arant of the Department of Zoology-Entomology participated to some extent, but he did not include any reference to time assigned.

CONSTRUCTION

As detailed in Appendix Table 1, pools of the 'A' Series were constructed in January and February of 1937. These 30 pools were circular with an area of 0.005 acre. They were lined with concrete, had sloping sides and flat bottoms. They were constructed north of the 'D' Series and west of Parkerson Mill Creek. Most of the site today is under East University Drive.

Ponds C-2, C-3 and C-4 were also constructed during the year; along with Farm Pond 2 and Farm Pond 3 of the 'Farm Pond' Series. Farm Pond 2 was constructed south of Farm Pond 1, on another tributary of Parkerson Mill Creek. This tributary apparently 'carried' a substantial amount of spring water. Farm Pond 3 was constructed northeast of Farm Pond 1, and became the first of the so-called 'terrace water,' ponds available for research on the South Auburn Farm. Ponds B-1, B-2 and B-3 of the original group were also completed.

In 1937 the research facilities available to the 'Investigators' on the South Auburn farm were sadly deficient in many respects. For example, they found it virtually impossible to prevent 'wild' fish invasions. The creek supplying water to the supply pond (Farm Pond 1) contained a number of adults and fry

of several species. These 'wild' fish entered the supply pond throughout the year. Often they spawned heavily in the experiments. In filling or re-filling the 'D' Ponds, 'wild' fry easily passed through the wire-mesh screens on their water supply lines. Given the problems with facilities, it is surprising that the 'Investigators' learned anything of value. These inadequate facilities limited the research they could do.

In retrospect, it is interesting to speculate how they came to be in this situation with regard to facilities. Obviously in the mid-30s what they could build was seriously constrained by the limited amount of funds available. But, at the same time, it was obvious that they did not initially have a good 'feel' for the nature of the research that they needed to do. Remember, however, that their vision when they began the Purnell-funded Project in 1934 was severely restricted. Under the proposal approved by the Office of Experiment Stations, their primary objective was to learn how to increase food production for fish in earthen ponds. With that limited objective, the 'D' Series were likely acceptable, but they could do little more than that. They were too small.

LABORATORY FACILITIES

In 1937, the 'Investigators' began some rather sophisticated experiments on ratios of nitrogen and phosphorus required in fertilizers for fish ponds. For this work they utilized glass containers. The work was conducted in laboratory space in a greenhouse located directly behind Comer Hall (Figure 16).

EXPERIMENTATION

Experimentation in 1935 and 1936 clearly demonstrated that adding inorganic fertilizers containing sources of nitrogen and phosphorus to small earthen ponds resulted in increased production of both dried organic matter (plankton) and fish when compared with ponds receiving no fertilizers. With these accomplishments, it would be interesting to see what the 'Investigators' would do next.

By the end of 1937, the 'Investigators' had learned an awful lot about aquatic ecology. They understood that:

1. Both unfertilized and fertilized earthen ponds had fairly well defined 'carrying capacities' of fish
2. With these limiting 'carrying capacities,' growth of each fish in a pond is 'density dependent.'
3. The 'carrying capacity' of a pond could be increased significantly

through the periodic application of appropriate inorganic fertilizers.

While these conclusions might seem rather simple for most of us today, they were significant 'milestones' in the education of an entomologist and a plant physiologist. They also underscore the unique ability of these 'Investigators' to understand complicated relationships in aquatic ecology with the very minimum of information available to them, and up to a certain point, at least, inductive logic is a powerful 'engine in research; especially in those situations where the availability of suitable facilities is severely limited.

EXPERIMENTS ON PHYTOPLANKTON PRODUCTION

By 1937, as detailed in preceding Sections, the 'Investigators' had demonstrated that various combinations of inorganic salts containing nitrogen, phosphorus and potassium would increase both the production of dried organic matter (plankton) and fish in earthen ponds; however, they knew little of the most efficient ratio of these elements, or the amount required for maximum production. Experiments under controlled conditions in a greenhouse in glass containers were designed to provide some of that information. This research was initiated in January, 1937 in the greenhouse behind Comer Hall (Figure 16). It revealed that phytoplankton production responded equally well to the application of inorganic salts of nitrogen and phosphorus in N:P ratios ranging from 3:1 to 6:1. Swingle and Smith (1938) describe the procedures utilized in these experiments in detail.

Later experiments revealed that 'production' also responded positively to the addition of a potassium salt (potash) to the growth medium and that response was generally equal with N:P:K ratios ranging from 8:2:2 to 8:2:10. In later pond experiments it was determined that a substantial quantity of phosphorus was precipitated as an iron-phosphorus compound, and was not available for the production of phytoplankton. As a result, the proportion of phosphorus in the ratio was doubled. When expressed as the ratio of $\text{N}_2\text{O}_3:\text{P}_2\text{O}_5:\text{K}_2\text{O}$, it becomes 8:8:2.

EXPERIMENTS ON BLUEGILL BIOLOGY

By 1937, the 'Investigators' had decided that the bluegill would be the primary forage fish to be used in the management of 'terrace-water' ponds for recreational fishing, but there were still lots of things concerning their biology that they did not know.

GROWTH OF BLUEGILL FRY

The 'Investigators' stocked Pond D-17 with 50 bluegill fry on May 31, 1937 (Table 19). Originally this pond was to be a replication of the 50 fish 'stocking-rate' in a preceding experiment, but massive mortality required that

it be drained and re-stocked. It was also fertilized with a mixture of ammonium phosphate, superphosphate, muriate of potash and basic slag. Mortality of the stocked fry in this experiment was also excessive. Only 29 of the 50 fish stocked (58 percent) were recovered. The 29 recovered fish weighed 1.50 pounds, with an average weight of 0.052 pound (23 grams) each (Table 19). The extrapolated weight in the pond was 195 pounds per acre. In a preceding experiment in Pond D-2, 41 (50 had been stocked) surviving three-and one-half year-old fish had actually lost weight. They had averaged 0.066-pound each (30 grams) when stocked, but only 0.063 pound (28.6 grams) when recovered.

Based on these results, the 'Investigators' concluded:

"It would also appear, therefore, that small ponds should be stocked with a definite number of fry from a hatchery for best results."

This statement was correct, but it had nothing to do with the experiment. The 50 fish stocked as fry in Pond D-17 were equivalent to 6,500 per acre. As shown in the preceding experiment, this stocking rate was much too high by several orders of magnitude.

AN UN-PLANNED EXPERIMENT ON BLUEGILL GROWTH

In late February, 1937, the 'Investigators' stocked Pond D-18 with 30 white crappie fry (no weight given). Later, several bluegill fry entered the pond through the water supply line. On draining, the five bluegills with a total weight of 0.081 pound were recovered. One of the recovered fish had reached a weight of approximately 0.25 pound. From this un-planned experiment, the 'Investigators' concluded:

"Where not crowded and where sufficient food is available, bluegill bream may reach a catchable size (2 ½ to 4 oz.) by the end of their first year."

So far as I am able to determine, this is the first estimate available to them of the first year growth potential of bluegill in earthen ponds receiving inorganic fertilization.

EXPERIMENTS ON POND MANAGEMENT

With the pond fertilization 'riddle' largely solved, the 'Investigators' turned their attention to the management of ponds for recreational fishing.

BLUEGILL STOCKING RATES

In a preceding Section it was noted that by 1933 there was a large 'body' of

information available on the optimum stocking rates for the production of various species of 'game' fishes in earthen ponds under hatchery conditions. However, there was little agreement on the stocking rates for newly filled earthen ponds for the purpose of establishing a population of fish that would provide 'good' fishing annually over a long period of time. At that time, ponds for fishing were generally stocked by transferring a few fish from a neighbor's pond or a local creek. Hatchery fish were also generally available, but no one knew how many of what kind should be stocked.

The 'Investigators' conducted an experiment in the 'D' Series from February 25 to November 6, 1937 to determine the optimum stocking rate for bluegills in earthen ponds. Some details on the stocking are presented in Table 20. In two of the ponds (D-2 and D-5), they stocked 50 (6,500 per acre), three-year-old bluegills, each with an average weight of 0.066 pound (30 grams). Note that these would have been severely stunted fish. One of these (D-5) received no fertilizer. A single pond (D-3) was stocked with 25 (3,250 per acre) fish from the same source, and three ponds (D-6, D-11 and D-12) were stocked with 10 fish each (1,300 per acre). One of these ponds (D-11) received no fertilizer.

It is difficult to determine why the 'Investigators' chose these three stocking rates for the experiment. In all of the preceding 'D' Series experiments in which bluegill were stocked, 100 fish were stocked in most cases and 200 in a few. It seems likely that they chose these rates with the use of an algebraic process utilizing data from a preceding experiment (Table 17). They apparently summed and averaged the fish production ('carrying capacity') estimates for each of the fertilizer treatments and stocking rates presented in the Table: (312.0, 357.0, 362.9, 431.8, 523.9, 588.0, 225.9, 229.7, 358.3, and 326.7 pounds per acre, respectively). Data from the 'unfertilized' ponds (D-5 and D-10) were excluded. The average of 372 pounds was divided by 0.25 pound per fish. A 0.25-pound bluegill would be a desirable catch for most fishermen; however, it is more likely that this average weight (0.25-pound) was obtained from the experiment conducted in Pond D-18 in 1937. Dividing 372 pounds by 0.25 pound would equal 1,488 fish per acre, or 10 per 'D' Pond. Some of you might remember Swingle going through this same algebraic exercise in his class, *Management of Impounded Waters*. Similarly, following the same procedure for the unfertilized ponds, the estimate for the best stocking rate would be 99 pounds $[(92.7 + 105.7) \div 2]$. This estimate of 99 pounds per acre divided by 0.25 pound per fish, would equal 396 fish. In a later publication, Swingle (1950), describes this algebraic process in greater detail. In that publication he also used an 'F/C' ratio of 4.0 to determine the stocking rate for bass

Six of the ponds received periodic applications of a mixture of ammonium sulfate, superphosphate, muriate of potash and basic slag. This specific fertilizer mixture was chosen for this experiment, although it had never been

evaluated in an earthen pond. A similar mixture without muriate of potash had been applied in two 'D' Ponds in a preceding experiment (Table 17). Remember, the application of that particular mixture had given the highest bluegill production in any experiment (588 pounds per acre, extrapolated).

Results of the experiment are presented in Table 20. Note that because of variable survival, I am using data on average weights. Survival was relatively poor in ponds stocked with 50 fish. Only 41 of 50 stocked fish were recovered from Pond D-2, and 32 of 50 from Pond D-5. Regardless of stocking rate, fish in ponds receiving 'no' fertilizer (Ponds D-5 and D-11) lost weight. Fish stocked at the rate of 50 per pond (D-2), even though it received fertilizer, also lost weight. Fish in ponds stocked at rates of either 25 (Pond D-3) or 10 (Pond D-6 and Pond D-12) each, all gained weight. Gains in the ponds stocked with 10 fish were higher than in the pool stocked with 25.

The 'Investigators' interpreted the results of the experiment as follows:

1. At the end of the experiment the average weight of the bream varied inversely with the number present.
2. It was apparent from the above results that fish growth was dependent upon the number of fish present.
3. If rapid growth is desired, the number of fish must be limited.
4. It would appear therefore, that in stocking a new pond, the number of bream added should be limited.
5. If the pond is fertilized, a maximum of 1,500 bream fry may be added; if unfertilized, 400 bream fry per acre is sufficient.

USE OF WHITE CRAPPIE AS A PREDATOR

In another experiment in the 'D' Series in 1937, on February 25, the 'Investigators' stocked Pond D-7 with 50 (6,500 per acre), three and one-half-year-old stunted bluegills and 2 crappie fingerlings (Table 21) with the intent of determining whether crappie would 'control' the number of bluegill fry produced in the pond. With this stocking rate, they were in effect establishing an 'over-crowded' bluegill population. When the pond was drained there were only 7 bluegill fry present. Remember that in a preceding experiment that Pond D-2 (Table 18) was also stocked with 50 bluegills and that the stocked fish had lost weight. When that pond was drained there were only 550 fry present. They concluded on the basis of the results obtained in this current experiment, from a single pond (D-7) that crappie did indeed 'control' the number of bluegill fry produced. This conclusion later proved to be incorrect. Further, it affected the design of several valuable

experiments in the following years. Several factors can affect the production of fry in a pond. Predation is only one of them. In this experiment it is more likely that the lack of growth in the stocked bluegills was the primary cause of the low production of fry.

It is interesting that in choosing a fish that might be able to control the number of bluegill fry, the 'Investigators' chose the crappie. Apparently, they never considered the largemouth bass. It may have been the result of the fact that when bass had been stocked as adults in Lake Auburn and Farm Pond 1 earlier, they had failed to spawn. This conclusion significantly slowed their progress in learning how to produce good fishing in 'terrace-water' ponds.

The 'Investigators' also hoped to use this experiment to determine the growth rate of bluegill fingerlings in a fertilized pond without competition from their off-spring. This experiment is indicative of their understanding of aquatic ecology in 1937. With a stocking rate of 6,500 3-year-old fingerlings per acre, one would not expect much growth. As shown in Table 21, the average weight of the stocked bluegills was 19.1 grams. At draining it was 21.1 grams. The reduced number (50 to 43) probably accounts for most of this increase. It is surprising that they did not use the 1,500 per acre, stocking rate for this experiment.

THE CONTINUING EXPERIMENT IN FARM POND 1

The stocking and draining of Farm Pond 1, as described in preceding Sections was continued in 1937. The fish listed in Table 22 were recovered when the pond was drained on December 14, 1936. Some of them were immediately restocked. Early the following year, some additional fish were also stocked. All of those listed as stocked in the Table were 'in-place' in the spring of 1937. The 1937 Annual Report did not include data on weight of the fish stocked. The pond was drained on November 15, 1937, and the fish removed, and weighed (Table 22).

On November 15, 1937 they removed approximately 241.9 pounds of fish from the pond. Approximately 173 pounds of the fish removed (71 percent) consisted of bluegill fry and fingerlings, white crappie and bullheads. Fishing in the pond in 1937 would have been even poorer than it had been in Lake Auburn in 1934. The largemouth bass adults still did not spawn. Later, the 'Investigators' would understand why, but at this point they had seen little to convince them that this species could be used to stock 'terrace-water' ponds.

CONTINUATION OF THE SAND MOUNTAIN 'EXPERIMENT'

As detailed in a preceding Section (The Purnell Project in 1935), the 'Upper'

Pond at the Sand Mountain Substation was stocked with a combination of aquatic animals which included bull frogs, yellow bullheads, bluegills, golden shiners and fingerling largemouth bass in 1935 (Table 12) (Swingle and Smith, 1939). Although the details are scanty, apparently personnel at the Substation began to fish the pond in 1937, and fortunately they maintained records on what they caught. The 1937 fishing records indicated that 12 bass weighing a total of 22.5 pounds and 72 bluegills weighing 20.0 pounds were removed. If these records are correct, they suggest that a good recreational fishing pond had been established, and excellent fishing obtained in around two years.

As detailed earlier, there is no indication that the 'Investigators' were aware of this 'Experiment.' Although it clearly demonstrated the value of stocking fingerling bass to control bluegill reproduction, they did not include bass fingerlings in any of their experiments until 1939.

PROGRESS IN RECREATIONAL AQUACULTURE POND RESEARCH

By the end of 1937, the 'Investigators,' through the use of several severely compromised experiments, learned an awful lot about aquatic ecology, and they also learned a great deal about the management of fish populations in ponds. For example, they had learned that:

1. Density and growth of fish in a pond, at least for a short period of time, could be controlled by stocking a specific number of fish.
2. Because of uncertainty of the production of fry by individual females, the use of adult stocking should be discouraged.
3. The stocking of approximately 1300 bluegill fingerlings per acre (10 per 'D' Pond) resulted in much better growth than when stocked at either 3,250 or 6,500 per acre.
4. The use of fry from a hatchery would likely provide the most predictable results in establishing a desired density of fish.
5. They also had learned that any combination of fish species that might be used in the establishment of fish populations that result in good fishing, would have to include the bluegill.
6. Crappie could control the number of bluegill fry produced in a small pond.

IMPORTANT PUBLICATIONS IN 1937

The 'Investigators' published only a single paper in 1937, and it was not

directly related to recreational aquaculture. In that year the Experiment Station published a manuscript in the Mimeograph Series, prepared by H. S. Swingle and D. G. Sturkie, a Professor of Agronomy, entitled *Raising Earthworms in Tubs*.

THE BANKHEAD-JONES PROJECT IN 1938

At the beginning of 1938, the 'Investigators' had accumulated sufficient information to allow them to make recommendations on pond fertilization. They also understood that the bluegill sunfish would have to be included in ponds managed for recreational fishing in Alabama. Further, they had a general understanding of the stocking rates for the species in fertilized and un-fertilized ponds, and they also had a largely un-defined understanding that bluegill growth would not be acceptable unless some way could be found to limit the competition with their off-spring for food resources produced in the pond. With this information available, it would be interesting to see what experiments they would conduct in 1938.

'INVESTIGATORS'

H. S. Swingle (Full-time) and E. V. Smith (One-half time) continued their roles as leaders of the Fish Culture Project in 1938. Apparently, the extent of their contribution remained the same as in 1937.

There is no record of when the 'Investigators' first began to utilize a Field Crew in their research on the South Auburn Farm. However, there is a photograph in the Auburn University Archives that is labeled 'Fisheries Field Crew of 1938.' This photograph is shown here as Figure 11. These individuals and those that followed them are the 'un-sung' heroes of the Auburn Fisheries Program. Unfortunately, it is virtually impossible to adequately document their contribution.

The third person from the left, in the photograph, Eddie T. Ogletree, known as 'Ed. T,' generally served as the un-official 'leader' of the crew. For years, he and his wife Bertha lived in a house located near where the water tanks at the east end of the Farm Pond 11 dam are located today. At that location, he also served as 'watch-man' for the Sougahatchee Farm. Bertha also played an important role in the development of the early Fisheries Program. Over the years, she became highly proficient in fitting netting to welded metal frames to make 'dip- nets.'

CONSTRUCTION

At the beginning of 1938, the 'Investigators' had only three ponds (Farm Pond 1, Farm Pond 2 and Farm Pond 3) available for experimentation on the South Auburn Farm that were generally similar to those 'terrace-water' ponds being

constructed and managed by farmers in Alabama. One of those (Farm Pond 1) was the water supply pond for all of the smaller ponds ('A' Series, 'C' Series and 'D' Series) in the valley below. As noted previously, it was virtually useless for any kind of experimentation because of 'wild' fish contamination. Farm Pond 2 was subject to flooding, and there was no practical way to exclude 'wild' fish from it either. The watershed providing water to Farm Pond 3 was too small. Usually, it lost about half of its area during the summer. They needed much larger ponds and a relatively large number of them. The South Auburn site was simply too small to meet their needs; however, they did continue construction there in 1938 by building one more 'terrace-water' pond – Farm Pond 4. This was the last pond constructed on that Farm.

I have no idea when the 'Investigators' first became aware that it would be extremely difficult, if not impossible, to solve problems related to providing good fishing in 'terrace-water' ponds with the facilities available to them at South Auburn. It would have been extremely interesting to have been a party to the discussions between Funchess and the 'Investigators' on the need for a larger research facility. He had already invested a considerable amount of Experiment Station money in their efforts in that area, and in 1938 they seemed no-where near developing a pond where the fishing was any better than it had been in Lake Auburn. They had done little to improve the lives of Alabama farm people; however, remember that they had only been at work for about 4 years. Still it was somewhat surprising that the Director would even consider the development of a new facility on the basis of what they had done so far.

Now they were talking to him about spending some 'real' money. The land at South Auburn had essentially been free, but there was no way to develop additional 'terrace-water' ponds in that immediate area or any other areas on Experiment Station land in the vicinity. As a result, it was apparent that they needed to search for a suitable site off the Station that they could purchase. Now they were talking about purchasing a relatively large tract of level land with a permanent stream running through it. By 1938, the Experiment Station funding situation had improved somewhat, but the Director still did not have very much money for the purchase of additional land or for the expansion of research facilities for the Fisheries Program. He could easily have denied their request, especially when he considered their accomplishments. However, they made their case for a new, larger site, and Funchess agreed to their proposal. With his approval they immediately began to search for a site with the physical characteristics that they needed. This decision was another extremely critical 'milepost' in the evolution of the Auburn Fisheries Program. It was the second critical decision made by Funchess. The first had been his decision to establish a new Experiment Station Project on research on the management of farm fish ponds.

According to comments by H. S. Swingle, the 'Investigators' first looked for a site on land that the Experiment Station already owned in the Auburn area, but they quickly discovered that none of the available College land met their criteria. Apparently Funchess had agreed to purchase a new tract of land, if necessary, so they began to survey 'creek bottoms' on private land around the Auburn area.

EXPERIMENTATION

In 1938, the 'Investigators' continued to collect a considerable amount of experimental data. Much of it was collected without any clear understanding of how they might use it. However, in the area of pond fertilization, they were rapidly moving ahead in developing practical applications. Several of the experiments related to pond fertilization and pond management conducted in 1938 are described in the following paragraphs.

POND FERTILIZATION

The 'Investigators' conducted their first research on pond fertilization in 1935, and in the following two years they had made substantial progress in utilizing inorganic materials to increase fish production; however, there were still several areas that required further work.

FERTILIZER MIXTURES AND FISH PRODUCTION

In 1938, the 'Investigators' conducted an experiment in the 30 concrete pools of the 'A' Series. Remember that they were constructed in 1937. Some of the details of the experiment are presented in Table 23. Most of the pools received different quantities of chemical fertilizers, so as to establish different Nitrogen:Phosphate:Potassium ratios (N-P-K) in each. Most of the pools were stocked with 75 bluegill fry. Note that in the thirty pools that there were no replications of any treatment, except that Ponds A-5 and A-17 received no fertilizer.

In ponds receiving chemical fertilizers and stocked with bluegills, total weights of fish recovered ranged from 281.2 to 399.2 grams (Table 23). No fish were recovered from Pool A-12. Note that I have taken the liberty of converting the original data in ounces to grams. The weight of fish recovered in all pools receiving fertilizer and stocked with bluegills was significantly higher than in Pools A-5 and A-17 which received no fertilizer – 131.5 and 108.9 grams, respectively. The weight of fish recovered was similar in pools receiving several different fertilizer combinations. The mortality rates of stocked bluegills were quite variable. Excluding Pools A-5, A-7, A-12, A-17, A-20 and A-21, the mortality rate ranged from 14.7 to 94.7 percent. The average for 14 pools was 61.4 percent. However, these differences seemed to have little effect on the weight of fish recovered. Note that the highest

production, 539.8 g, was in Pool A-28 which was fertilized with manure only. The second highest production, 426.4 g, was in Pool A-23, which was fertilized with cotton seed meal plus inorganic fertilizer (1.0-5.0-0.25).

CONTROL OF POND WEEDS WITH FERTILIZATION

Small, relatively shallow 'terrace-water' ponds provide the ideal environment for the establishment and growth of rooted aquatic plants (weeds). Apparently, in newly constructed ponds, seeds of these plants are introduced on the feet or possibly in the feces of water birds. Generally, not many years pass before these ponds become literally filled with them. These weeds were not an early concern for the 'Investigators' working on the South Auburn Farm. There, all of the ponds were drained yearly, and sometimes more often. In the larger ponds, portions of the bottoms dried after draining. Under these conditions, rooted plants had only a limited opportunity to become established.

When the 'Investigators' began to respond to requests for assistance by pond-owners across the State, they quickly discovered that the presence of rooted pond weeds was the number one problem – by a wide margin. Obviously, there were many problems related to fish population structure, but pond-owners were not aware of them because it was next to impossible for them to fish their ponds filled with weeds.

While the 'Investigators' had never conducted specific experiments on weed control in ponds, they had observed that the shading effect of 'heavy' phytoplankton blooms seemed to restrict the growth of rooted aquatic plants. However, in the beginning, they had strongly advised that weedy ponds not be fertilized. They felt strongly that fertilization of such ponds would only increase the growth of weeds (Smith and Swingle, 1941).

In 1938, the 'Investigators' decided to attempt to control dense growths of Southern naiad (*Najas guadalupensis*) in three gravel-pit ponds on private land in Montgomery County (2-, 4- or 18- acres in area) supplied with clear artesian water. Beginning in August, they began to broadcast a mixture of inorganic fertilizers over the surface of the ponds with special effort to obtain good coverage in areas with the densest concentration of the weeds. Applications were made so that each acre of water received approximately 40 pounds of ammonium sulfate, 60 pounds of 16 percent superphosphate, 5 pounds of muriate of potash and 15 pounds of dolomitic limestone. Another application was added in September. In the fall, dense 'mats' of filamentous algae began to grow around the weeds. As a result, the *Najas* became wrapped-up, weighted-down and light-starved.

RECREATIONAL AQUACULTURE

In 1938, the 'Investigators' knew how to fertilize ponds to produce sufficient natural food to obtain good growth of bluegills, but they did not understand how to use that information to produce good fishing. They were still convinced that white crappie were the answer to the problem of excessive bluegill reproduction, but then, 1938 was a new year.

CRAPPIE AND FORAGE FISH POPULATIONS IN THE 'C' PONDS

This year marked the first time that all four of the 'C' Ponds (C-1, C-2, C-3 and C-4) were available for experimentation. All of the ponds had an area of 0.0118-acre each. It is obvious, when reviewing the experiments conducted in them in 1938, that the 'Investigators' really were not sure what they should do with them.

EXPERIMENT IN Pond C-1

Pond C-1 was stocked on June 20, 1938 with 236 bluegill fry (2,000 per acre), 24 crappie fingerlings (204 per acre) and *Gambusia* (Table 24). The pond was fertilized with combination of 6-8-4 (cotton fertilizer) plus 10 pounds of nitrate of soda. When the pond was drained on November 18, 1938, it was found to contain approximately 21.0 pounds of fish (178 pounds per acre) (Table 24). None of the fish had reached a 'harvestable' size (Swingle, 1950). There were only 296 bluegill fry. This pond was stocked with bluegill fry near the end of June, so it is likely that in the 141-day experimental period that few of the stocked fish would have spawned. Also with the stocking of bluegill fry that late, it is not surprising that they only reached an average weight of 0.048 pound (22 grams) – far short of the 0.25 pound (113 g) desired. Further, it is not likely that this stocking combination would have produced acceptable fishing in 1939. The crappie had little to eat other than insects and each other for the entire period, so it is not surprising that they only reached an average weight of 0.090 pound (41 grams). At this point in 1938, the 'Investigators' still had no idea of how to stock a pond to provide good fishing.

EXPERIMENT IN Pond C-2

Because of the way it was stocked (Table 24), Pond C-2 produced very little other than large goldfish in the 148-day experimental period. Apparently bluegill fry entered the pond through the water supply pipe. There were 296 of them in the pond when it was drained. Surprisingly, crappie spawned in the pond.

EXPERIMENT IN Pond C-3

Bluegills almost doubled their weight in this experiment, and reached an average weight of approximately 0.25 pound (Table 24); however, the crappie were unable to 'control' the number of young bluegills produced. The pond would have been hopelessly overcrowded with the species in 1939.

EXPERIMENT IN Pond C-4

This experiment was essentially a replication of the one conducted in Pond C-3, and the results were quite similar. The crappie were again unable to control the number of bluegills hatched in the pond.

THE CONTINUING EXPERIMENT IN FARM POND 1

In 1938, the 'Investigators' continued the Experiment in Farm Pond 1, begun in 1934; whereby fish recovered on draining each year were counted, weighted and returned to the pond for another year. In 1937, they had recovered the fish listed in Table 25. Most of them were returned to the pond. The pond was drained again on December 8, 1938. Data on the fish removed are also presented in Table 25. A total of 384.7 pounds, of all species, were recovered. Approximately 81.4 percent of the total weight were either fry or fingerlings. Obviously the fishing in this pond in the spring of 1939 would have been even worse than it had been in Lake Auburn.

STOCKING EXPERIMENTS IN FARM PONDS 2, 3 AND 4

By 1938, Farm Pond 2 (0.5 acre), Farm Pond 3 (1.3 acres) and Farm Pond 4 (1.3 acres) were also available for experiments. For the first time, the 'Investigators' had three ponds available that were generally similar to 'terrace-water' ponds being constructed throughout Alabama – ponds which they were attempting to learn to manage. Unfortunately, as detailed in a preceding Section, only Farm Pond 4 was really suitable for use in experiments.

STOCKING BLUEGILLS ALONE IN FARM POND 2

On March 4, 1938, Farm Pond 2 (0.50 acre) was stocked with 750 bluegill fingerlings (Table 26). During the experimental period, the pond received periodic applications of a mixture of ammonium sulfate, superphosphate, muriate of potash and basic slag. When the pond was drained on November 30, 1938, the 'Investigators' found that 65 percent of the stocked fish had died. The remaining 263 fish weighed 31.6 pounds (0.120-pound per fish), but most of the weight was 'tied-up' in fry and fingerlings – 46.6 pounds. In addition, there were 62.2 pounds of yellow bullheads and 49.3 pounds of chub suckers.

BLUEGILL FINGERLINGS AND CRAPPIE FRY IN FARM POND 3

Remember that in a single 'D' Pond (D-7) experiment in 1937, the 'Investigators' stocked 50 bluegill sub-adults and 2 crappie fry (Table 21). When the pond was drained, it appeared that the crappie had apparently reduced the production of fry to a considerable extent. As a result, they decided to repeat the experiment on a larger scale in Farm Pond 3 in 1938; consequently, on March 24, 1938, they stocked the pond (1.2 acres) with 1,800 bluegill fingerlings (1,500 per acre) and 240 crappie fingerlings (200 per acre) (Table 27). The pond received periodic applications of a mixture of superphosphate, ammonium sulfate, and muriate of potash.

When the pond was drained on November 28, 1938, it was quickly obvious that survival of the stocked fish was extremely poor – 15.9 percent for the bluegills and 22.1 percent for the crappie (Table 27). The pond had lost much of its water by the time it was drained. With such a high mortality rate they could not evaluate the efficacy of crappie predation on bluegill fry. But under these conditions, it did not appear that crappie were very effective. When the pond was drained, there were 29,778 bluegill fry in the pond. The predators should have eliminated many of them over the winter, but when fishing began the following spring, it would likely have been as poor as it had been in Lake Auburn.

BLUEGILLS, CRAPPIE AND FLATHEAD CATFISH IN FARM POND 4

For some reason, the 'Investigators' continued to be enamored with the use of adult bluegills for stocking ponds, and despite the fact that they had recommended the use of hatchery fingerlings, after the evaluation of the 1937 experiments, they stocked Farm Pond 4 with 10 adult bluegills (less than 8 per acre) and 134 fingerling white crappie (100 per acre). Later they stocked 9 large, adult flathead catfish (Table 28). When they drained the pond December 3, 1938, they found that once again, sometime during the experimental period that most of the adult bluegills and crappie had died. As a result, there would have been very few adult fish in the pond for the fishermen the following spring, and the large number of fry and fingerlings (8,408) of both species would have made the situation much worse.

An analysis of the results of the experiments in Farm Pond 1, Farm Pond 2, Farm Pond 3, and Farm Pond 4 must have been extremely discouraging for the 'Investigators.' They were not much closer to providing acceptable fishing in newly-constructed 'terrace water' ponds than when they first stocked Lake Auburn. They had learned an awful lot about aquatic ecology since 1933, but they still didn't have much understanding about the characteristics of individual species or the relationship between species.

They concluded:

“Apparently, it is necessary to add carnivorous fish to eat up most of the small fish if satisfactory growth and satisfactory production is to be secured.”

They were only partly correct in this conclusion. Production (388.4 pounds per acre) was not bad. In fact, it was slightly greater than the theoretical ‘carrying capacity’ (372 pounds) used to establish the 1,500 per acre stocking rate, detailed in a preceding Section. They had solved the ‘quantity’ problem, but not the more important problem of ‘quality.’

THE CONTINUING ‘EXPERIMENT’ AT SAND MOUNTAIN

While the ‘Investigators’ were ‘plodding’ slowly ahead in their efforts to establish a good fishing population at the South Auburn Farm by stocking bluegills and white crappie, personnel at the Sand Mountain Substation were continuing to enjoy excellent bass and bluegill fishing in their “Upper” Pond (Swingle and Smith, 1939).

Fishing in the ‘Upper’ Pond by Substation personnel continued in 1938. Records indicate that they removed by fishing some 310 bluegills, weighing 80 pounds and 52 bass weighing 85 pounds from the ‘Upper’ Pond (Table 29). Apparently, more fish were taken by fishing, but were returned to the pond. In the meantime, they had also constructed and stocked a second pond (the ‘Lower’ Pond). It was stocked with 2,000 fingerling bluegills, an undetermined number of yellow bullheads and golden shiners, 5 adult largemouth bass and an undetermined number of fingerling bass. Also, this pond received an undetermined number of fish in the over-flow from the ‘Upper’ Pond. It was fished lightly in 1938, and in the following year, fishing removed 164 bluegills weighing 45 pounds, 14 largemouth weighing 25 pounds and 11 yellow bullheads weighing 7 pounds (Table 29). So far as I can determine, these are the first published records from any source which demonstrate the quality of fishing that could be obtained from stocking of largemouth bass fingerlings with bluegills and golden shiners in ‘terrace-water’ ponds. It is still not clear when the ‘Investigators’ became involved with these ponds. The lack of specific data on the stocking of both ponds indicates that they were not involved as late as August, 1937, when the fingerling bass were added to the ‘Lower’ Pond; however, it is likely that they must have visited Sand Mountain in 1938. It is clear, however, from notes in the 1939 Annual Report that they were actively involved in that year. Whenever they first became aware of the fishing records (Table 29), they must have impressed them deeply.

Although Funchess must have been aware of the Sand Mountain ‘Experiment,’ there is no indication of it in the Annual Reports. However, it is likely that he knew of it and probably even fished there. His interest in what was going on up there would help to explain his willingness to use extremely

scarce Experiment Station resources to purchase an area for the development of a new fisheries research farm.

OUTREACH

As will become patently obvious as the history of the Auburn Fisheries Program unfolds, commitment to 'outreach' (extension) is becoming increasingly important to the 'Investigators. In the long-term, I suspect that it ultimately played a more important role in than either 'teaching, or 'research' in the establishment of Auburn's international reputation.

As detailed in a preceding Section, H. S. Swingle, an entomologist, was involved in 'outreach' in recreational fishing before there was a research project. Although he was not acting in an official capacity, as one of the 'managers' for the construction and management of Lake Auburn, he was able to focus some of the scientific capabilities of the Institution on the practical problem of developing a good fishing pond for the Auburn Outing Club. After the Purnell Project was approved in 1934, 'Investigator' interest in Lake Auburn increased. Then in 1938 heavy flooding broke the dam. With the loss of the dam and the fish population, 'Investigators' redoubled their 'outreach' efforts to manage the pond and its fishing. Swingle and Smith (1943) wrote:

“By 1938, methods for the fertilization of ponds and considerable information on other phases of management had been worked out. This information was applied to the management of Lake Auburn and as more information became available, past practices were changed and improved methods were used”

The broken dam at Lake Auburn was quickly rebuilt and in the fall of 1938, they re-stocked the pond. Largely relying on the results obtained from stocking Pond D-7 with 2 crappie fry and 50 bluegill fingerlings in 1937 (Table 22), they stocked Lake Auburn with 17,771 bluegill fingerlings, 50 adult bluegills and shellcrackers and 2,287 white crappie fingerlings, and prepared for good fishing in 1939.

IMPORTANT PUBLICATIONS IN 1938

Five publications written by the "investigators" were published in 1938, two of them in professional journals:

1. Swingle, H. S. and E. V. Smith. 1938. Fertilizers for increasing the natural food for fish in ponds. Transactions of the American Fisheries Society 68:126-135.
2. Smith, E. V. and H. S. Swingle. 1939a. The relationship between

plankton production and fish production in ponds. Transactions of the American Fisheries Society 68(1):309-315.

These two publications were the first prepared from research conducted by the Auburn 'Investigators,' and presented to professional audiences.

Two of the five publications were Progress Reports for the *Alabama Game and Fish News*. They were part of the Experiment Station Mimeograph Series:

1. Construction of farm ponds (July); Management of farm fish ponds (July).
2. Raising fish worms for bait (November).

It is truly amazing that Swingle and Smith would prepare and distribute *Management of Farm Fish Ponds* at this time. At the end of 1938, they knew virtually nothing about managing 'terrace-water' ponds for fishing. I am even more surprised that Director Funchess would allow them to do so. He did not get his 'Nickname' – "Facts-Funchess," from allowing the publication of poorly documented research. While the '*Mimeograph Series*' was not a 'high-grade' AES publication, it was none-the-less an official publication, and it had to be reviewed by an Experiment Station Reading Committee before it was published.

I am not certain when Funchess made the final decision to develop a new research facility for the Fisheries Program. The beginning of the preparation of this 'publication' in late 1937 or early 1938 might have been undertaken to help him make the decision in the 'Investigator's' favor.

Management of Farm Fish Ponds recommended the following stocking combinations:

Unfertilized Ponds

400 bream

50 largemouth bass or crappie

Fertilized Ponds

1500 bream

200 largemouth bass or crappie

They had no experimental evidence that any of these stocking combinations would produce good fishing. Their research had repeatedly shown that crappie would not control bluegill reproduction, and they had never conducted an experiment with a bass-bluegill stocking combination. The recommendation for stocking largemouth likely was a result of the Sand

Mountain 'Experiment.'

Another recommendation in the publication:

"The best results have been secured by stocking fry or fingerling fish as near the same size as possible. Bass, catfish or crappie should be placed in the pond at the same time as the bream. This should be done so that all will have an equal start, since these young fish compete with each other for food."

This recommendation was based on a guess and a poor one. They would learn later that bass will starve if they have to wait months before bluegills are large enough to spawn, and if they do survive, first-year growth will be sorely limited

THE BANKHEAD-JONES PROJECT IN 1939

At the end of 1938, the 'Investigators' seemed to be committed to adult bluegill stocking and the use of fingerling crappie for controlling bluegill reproduction, and for establishing populations for fishing in 'terrace-water' ponds. Fortunately, the review of fishing records at the Sand Mountain Substation seemed to provide them with a broader perspective and a way forward.

'INVESTIGATORS'

H. S. Swingle and E. V. Smith continued to provide leadership for the Bankhead-Jones Project in 1939. Swingle devoted full-time to the Project and Smith one-half time.

CONSTRUCTION

As noted in a preceding Section, no additional construction was initiated at the South Auburn Farm after the completion of Farm Pond 4 in 1938. Remember that at some time in 1938, Funchess apparently had given the 'Investigators' his approval for the development of new, enlarged facilities for fisheries research which included the purchase of additional land, if necessary. Early in 1939, they were continuing the search for a suitable site that they had begun a year earlier. The 1939 Annual Report simply indicates that they were continuing to 'survey sites for new ponds.'

Swingle recounted (Personal Communications) the efforts to find a suitable site. In their search, they had driven north up the un-paved Oak Bowery Road (Alabama 147), north of Auburn numerous times, but because of the heavy forest cover along the west side of the road, just north of

Soughahatchee Creek and the sharp grade of the old road, they had never considered the possibility that they would find a suitable site there. On one of their many trips, they finally noted a rough, farm road leading westward from the Oak Bowery Road. The remnant of that road is still in use. It exits just south of the Ireland Building and courses westward to Farm Pond 11 (Figure 18). They finally decided to follow that road. They discovered that after a short distance, it entered the margin of a large, gently sloping, narrow pasture with a relatively large stream, an un-named tributary of Soughatchee Creek, coursing its full length, along its western margin. I have chosen to use the name Funchess Creek to identify it in this book. Assuming that the tract was for sale, they had found their site. It had everything they needed, including a large amount of good clay soil along the eastern margin of the pasture. In their survey they determined that the 'vee-shaped' pasture was relatively narrow at its north end, but opened onto a broad flood plain along Soughahatchee Creek to the south (Figure 18).

The site which would become the 'Soughahatchee Farm' was located on the west side of the old Oak Bowery Road, bordering the north side of Soughahatchee Creek, and extending northward to the so-called 'Farmville Road' (County Road 72). Actually, the tract consisted of three smaller tracts with different owners (Figure 18A and Appendix Table 2). I have been unable to locate any information on the flow of events here. I have not found a record indicating exactly when they located the site, or when they determined that the three owners would be willing to sell.

I assume by late 1939 they had identified the 'Soughatchee Creek' site and had determined that all of it was available for purchase. It is also likely that later in the year that the purchasing process was underway. It is also likely that they conducted a topographical survey of part of the site, and were making preliminary decisions and plans on placement of ponds.

Fortunately, the site was only a short drive from the campus. They did not appreciate that fact at this time, but the location would make it possible to use the facility to excellent advantage in the teaching program several years later.

EXPERIMENTATION

As detailed in the preceding Sections, the 'Investigators' began their research on pond fertilization in 1935, and by 1937, they had determined the best mixture of inorganic fertilizers for promoting maximum production of organic matter (plankton) in earthen ponds. In 1934, studies were initiated in Farm Pond 1 on the South Auburn Farm to determine the best species combination for stocking 'terrace-water' ponds.

In this Section on Experimentation, remember that not all of the experiments

described in the Annual Reports are discussed. As detailed in a preceding Section, generally only those experiments reported here dealt, more-or-less directly, with the goal of producing good fishing in 'terrace-water' ponds and which provided the information leading to the publication of Agricultural Experiment Bulletin 254, *Management of Farm Fish Ponds* in 1942.

WEED CONTROL RESEARCH

Recall that in the 1938 Annual Report, the 'Investigators' reported the results of their first research on the control of weeds in ponds; however, it was primarily a by-product of research on pond fertilization. Later, in observing private ponds in the area, they realized that weed control was a serious management problem and that it was not possible to produce good fishing in ponds choked with weeds. As a result, they began a long-term study on this problem – a study that would continue for many years.

Two of the 1939 experiments on this subject will be described in the following paragraphs.

CONTROLLING POND WEEDS WITH FERTILIZATION – THE GRAVEL PIT EXPERIMENTS

In a preceding Section, an experiment initiated in 1938 to control the pond weed *Najas* in three abandoned gravel-pit ponds in Montgomery County was described. This experiment was continued in 1939 by making applications of inorganic fertilizer in April, May, June, July and October. By the middle of April, all the weeds in the pond appeared to be covered by algal mats. In early May, most of the *Najas* appeared to be dead. As it died, its stems broke free of the bottom and floated to the surface where decomposition continued.

CONTROLLING POND WEEDS WITH HERBICIDES – THE 'A' POOLS EXPERIMENTS

As detailed in the preceding Section, the 'Investigators' had had limited success in the control of pond weeds with the use of fertilization – a situation where the use of fertilizer resulted in the development of thick 'mats' of filamentous algae that covered the weeds, depriving them of sunlight. In 1939, they decided to use a new approach – controlling weeds with herbicides. This research represented the beginning of a long series of experiments on chemical weed control that would establish Auburn as a national leader in this field. Over the years, this research would result in the receipt of a large amount of extramural funding – much of it would be used to support graduate student research in this area.

In early June, they installed soil-filled, wooden boxes on the bottom of 14 of the concrete pools in the 'A' Series. The pond weed *Najas sp.* was

established in each of these boxes and allowed to grow until it completely 'choked' each pond. Later, duplicate ponds were treated with different concentrations of sodium arsenite, sodium thiocyanate or sodium chlorate. Later, observations lead to the following conclusion:

“Sodium arsenite applied at a concentration of 4 p.p.m., killed the weed, but applications of 1- or 2 p.p.m., were not effective. Sodium thiocyanate and sodium chlorate were not effective at the concentrations tested.”

In another experiment, sodium chlorate, a mixture of sodium arsenite and sodium chlorate (1-1), or creosote-kerosene (1-9) were sprayed on plots of floating-leaf *Potamogeton* in Lake Auburn, but the treatments were ineffective.

RECREATIONAL FISHING RESEARCH – EVALUATING POND STOCKING COMBINATIONS

As noted in a preceding paragraph, at the beginning of 1939, the 'Investigators' had little to show for their efforts to produce good fishing in 'terrace-water' ponds; however, as a result of reviewing stocking and fishing records for ponds on the Sand Mountain Substation, in 1938 (Swingle and Smith, 1939), they seemed to realize for the first time the potential of stocking fingerling largemouth bass in combination with bluegills. Although the 'Investigators' seemed willing to concede that largemouth bass-bluegill stocking combination might show some promise in establishing good fishing in earthen ponds, they still seemed convinced that the crappie-bluegill combination would ultimately prove to be the best. As a result, they stocked two ponds with each combination. In addition, they experimented with two other combinations that are of interest. The results of these efforts are discussed in the following paragraphs.

CRAPPIE AND BLUEGILLS IN Pond C-1

This 1939 experiment involved the continuation of the evaluation of a bluegill fry and crappie stocking combination in Pond C-1, begun in 1938 (Table 24). Remember that when Pond C-1 was drained in 1938, the fish were recovered, counted and weighed and returned to the pond in preparation for the 1939 experiment. Data on the fish recovered from Pond C-1 in late November, 1939, are presented in Table 30. Approximately 19 pounds of small bluegills and 9 pounds of small crappie were recovered. These small fish made-up slightly more than one-half of the total weight of fish in the pond (28.62 of 53.18 pounds). Adult bluegills averaged only 0.08 pound each. These results were no more encouraging than those in Pond C-1 in 1938.

Concerning this experiment, the 'Investigators' commented:

“These results would appear to indicate that crappie alone cannot be depended upon to properly balance a pond containing bream.”

Remember that the 1938 publication *Management of Farm Ponds* had recommended their use for this purpose. This result was not unexpected, but their comment did suggest a new awareness that there was a condition of *balance* in ponds containing a combination of species that needed to be considered.

BASS FINGERLINGS AND BLUEGILL FINGERLINGS IN Pond C-2

Some details on the stocking of this experiment are also presented in Table 30. This is one of the first experiments conducted at Auburn on the evaluation of the fingerling bass and fingerling bluegill stocking combination. When it was drained during the period November 25-27, 1939, it contained 42.63 pounds of fish (341.0, pounds per acre). A total of 161 of the original stock of 240 bluegills was recovered. Their average weight was 0.12 pound. This average weight was far short of the desired weight of 0.25 pound, but would have been acceptable to most fishermen.

Survival of stocked bass was extremely low (10 of 24). The high mortality rate was likely the result of ‘cannibalism.’ They had little to eat except each other until the stocked bluegills spawned. The average weight of stocked bass was 0.34 pound – far below the desired weight of 1.0 pound.

Almost one-half of total production (18.2 of 42.6 pounds) consisted of small bluegills. As a result, fishing the following year would have been unacceptable. None of those 12,594 fish recovered would have reached acceptable size.

BASS FINGERLINGS AND BLUEGILL FINGERLINGS IN Pond C-3

This was designed to be a replication of the Pond C-2 experiment in 1938 (Table 30); except that the stocking combination did not include golden shiners. The results obtained in this experiment were generally similar to those obtained earlier. Growth of stocked bluegills was slightly lower (0.08 pound versus 0.12 pound), but then survival of stocked bluegills was considerably higher (194 versus 161) in Pond C-3. Survival of small bluegills was greater in Pond C-3 (15,437 versus 12,594); however, survival of stocked bass was considerably lower (6 of 24).

The ‘Investigators’ would have learned a valuable lesson here. Producing a good fishing population is more complicated than just throwing bass and bluegills together. When bass fingerlings are stocked into a pond where there is no suitable food available, they quickly began to eat each other.

Under these conditions, the largest fish consume the smallest, and so on. In turn, larger individuals benefiting from the consumption of siblings grows rapidly. It is surprising that the mortality of bass in Pond C-3 was not even greater.

BASS FINGERLINGS AND GOLDEN SHINERS IN Pond C-4

Pond C-4 was stocked with 24 bass fingerlings and 24 golden shiners (Table 30). The golden shiners spawned in early April, providing the bass with an excellent, if temporary, food supply. As a result, the bass spawned in late May and early June, and by the last of June, they virtually eliminated the golden shiners. There were 25 remaining in the pond when it was drained in November. The results of this experiment provided a clear indication that the golden shiners alone were not a suitable forage fish for largemouth bass. It is likely that many of the bass remaining in the pond would have starved to death after the shiners were eliminated.

THE CONTINUING EXPERIMENT IN FARM POND 1

In December, 1938, all fish were removed from Farm Pond 1, counted, weighed and returned to the pond. Table 31 includes data on the number and weight of each species recovered in December, 1939 that had been returned to the pond in the later fall of 1938. Many of these fish had been restocked in the pond after it had been drained on December 8, 1938 (see Table 25). The 'Investigators' commented regarding the fish recovered in 1939:

“After three years only 28 bluegills, 8 white crappie, 9 largemouth bass and 212 yellow bullheads had reached harvestable size.”

Fishing in this pond would have been little better than it had been in Lake Auburn in 1934.

Table 32 presents data on the weights of each species recovered from Farm Pond 1, in 1937, 1938 and 1939. It is interesting that over the 3-year period that the weight of fish recovered increased each year. Remember that this pond was unfertilized, and it is unlikely that the natural fertility of the watershed increased during the period. It seems likely that the increase in weight was the result of structural changes in the population. These data indicate that 'carrying-capacity' is not a static quantity, but is a function of the basic fertility of the water in the pond and in structural characteristics of the population. It is likely that the 'Investigators' did not really understand this concept at this time, but over time they would (see Swingle, 1961a).

Note that the ratio of 'weight of forage fish' to 'weight of carnivorous fish', (F/C Ratio), increased with time, suggesting that the weight of the forage fish seemed to be increasing in its relationship with the carnivorous species.

BLUEGILLS, FLATHEAD CATFISH AND SHAD IN FARM POND 2

Farm Pond 2 was stocked in 1939 with bluegills, shad and flathead catfish as indicated in Table 33. This stocking combination suggested that the 'Investigators' were not yet completely convinced that largemouth bass fingerlings could control bluegill reproduction in 'terrace-water' ponds, but they were really 'grasping-at-straws' to think that the flathead catfish could do it. When the pond was drained, 23,734 bluegill fingerlings were recovered. The eight, 4-pound flathead catfish might have eaten many of the large bluegills, but they were not likely to have eaten very many of the small ones. Yellow bullheads and chub suckers gained entrance to the pond during the experiment complicating it even more.

CRAPPIE AND BLUEGILLS IN FARM POND 3

Farm Pond 3 was also stocked with crappie and bluegills, as detailed in Table 34. Unfortunately, the pond lost approximately 75 percent of its area during the drought of 1938, and 84 percent of the stocked bluegills and 78 percent of the stocked crappie had disappeared by November 28. The larger bluegills in the pond (2,462 weighing 114.62 pounds) only averaged 0.047 pound (21 grams) in weight. Further, almost one-half of the fish in the pond (229.56 pounds of 447.22 pounds) were fingerling bluegills. This situation did not bode well for fishing in 1940.

BASS FINGERLINGS AND BLUEGILL FINGERLING IN FARM POND 4

Farm Pond 4 (1.3 acres) was stocked February 1, 1939 with 1,950 advanced bluegill fingerlings and 127 advanced largemouth bass fingerlings (Table 35). Approximately 4,720 *Gambusia* were also stocked at the same time. The bluegills were relatively large when stocked (15 grams each), and likely began to spawn in late April or early May, providing food for the young bass soon after they were stocked. Further, the little 'live-bearers' would have also helped provide the bass with much-needed food until the bluegills began to spawn. The pond also apparently contained an unknown number of crappie that were over-looked when the fish were being removed at draining the year before. The pond received sufficient commercial fertilizer (6-8-4 and nitrate of soda) "to keep a moderate growth of plankton throughout the year."

The pond was drained on December 11, 1939, and approximately 632.2 pounds (486.3 pounds per acre) of fish were removed (Table 35). Included in the total weight removed were 432.4 pounds of adult bluegills, averaging 0.26-pound each; 71.8 pounds of adult bass, averaging 0.80-pound each and 4.50 pounds of adult crappie, averaging 1.1 pounds each. After counting and weighing, the fish were returned as stocking for the 1940 experiment. Regarding the weight recovered, the 'Investigators' commented:

“In this pond there were 508.7 pounds of legal-sized fish....”

There was approximately a 30 percent mortality of stocked bass. The bass were also relatively large when they were stocked (19 grams each). As a result, spawning occurred and large numbers of small bass were seen in the pond during June. The number decreased during the summer, apparently due to cannibalism, and when the pond was drained, only 193 small bass were recovered. The ‘Investigators’ commented:

“This is close to the correct number for this pond. Apparently bass can be depended upon to reduce their own numbers to what the pond will support. This ‘checks’ the results secured on draining the ‘Lower Pond’ at the Sand Mountain Substation. “

For some reason the ‘Investigators’ disregarded the number and weight of crappie present at draining. They were not mentioned in their discussion of the results of the experiment. Recovered crappie included four adults, weighing a total of 4.50 pounds and 241 ‘small’ crappie weighing 36.30 pounds (Table 35). The four adults were likely fish that were inadvertently left in the pond in 1938, but the 241 ‘small’ fish must have been hatched in the pond in the early spring. By the time of draining in December, 1939, these ‘small’ predators were likely competing directly with the bass for food. At draining, there were almost as many pounds of ‘small’ crappie present as ‘small’ bluegill (36.30 versus 49.00 pounds).

While the ‘Investigators’ were not concerned, at this time, with the ratio of the weight of ‘Forage Fish’ to ‘Carnivorous Fish,’ they would be soon. The so-called ‘F/C’ ratio in Farm Pond 4 at the time of draining was approximately 3.40 (481.8/141.4). Here I have included all of the fingerling crappie (36.30 pounds) in the “Carnivorous” group; although some of them probably were still actively competing with bluegills for food.

Obviously, the fishing would have been excellent in Farm Pond 4 in the early fall of 1939, but except for a small amount of ‘test’ fishing, the ‘Investigators’ chose not to begin formal exploitation until the following year.

COMMERCIAL AQUACULTURE – PRODUCTION OF GOLDEN SHINERS

In 1939, the ‘Investigators’ were still committed to developing the technology to provide good recreational fishing in “terrace-water” ponds, but they were also somewhat interested in producing bait minnows for sale to fishermen, as this experiment on the production of golden shiners indicates. Shiner production reached the equivalent of slightly over 1,100 pounds per acre in Pond D-3, stocked with adults and fertilized with inorganic fertilizer. This was the highest production of fish ever achieved in one of the experimental ponds

on the South Auburn Farm at that time.

OUTREACH

As detailed in a preceding Section, the ‘Investigators’ were committed to ‘outreach’ from the beginning of the Fisheries Program. In the beginning, their efforts in this area were confined primarily to improve recreational fishing in Lake Auburn, but by the end of 1938, they expanded their ‘outreach’ horizon. The 1939 Annual Report described the first efforts to provide assistance to owners of local private ponds. The ponds included:

PONDERS POND (TALLAPOOSA COUNTY)

The ‘Investigators’ involvement with ‘Ponders Pond’ has an interesting history. In the midst of the ‘Great Depression,’ Experiment Station Faculty had virtually no money for research, and consequently a number of them spent a considerable amount of time fishing in the newly-created Lake Martin (1926). Mr. Ponder operated a large farm on the route that most of these Auburn fisherman took to the Lake. He had seized the commercial opportunity afforded by having a farm near the Lake by selling fish bait (minnows and worms). The Auburn fishermen, including Guyton, Swingle and likely Funchess, regularly stopped at the farm to purchase bait, and on these visits they learned that there was a pond on the farm that had been constructed some 10 years earlier and stocked with ‘bream’ only. Around 1937, a few adult bass had been added to the pond, but by 1939, very few young bass had been seen or caught. As would be expected, it was providing very poor fishing, so it quickly became one of the first ‘targets’ of their Outreach efforts.

In early 1939, the ‘Investigators’ had never produced a good fishing pond, but they decided that they could improve the fishing in Ponder’s Pond by beginning a program of regular fertilization and by removing all of the large fish they could by fishing. Apparently the fish population responded immediately to these efforts. The ‘Investigators’ later wrote:

“By June the bream were noticeably bigger, and from that time on most of the bream caught were above the legal size limit. This pond is now considered an excellent fish pond by the owners.” The ‘Investigators’ now had their first ‘outreach, success story.

CHOCOLOCCO SPORTSMEN’S CLUB POND

The second private pond receiving early ‘Investigator’ attention was located in Calhoun County, east of Anniston. It was owned and operated by the Choccolocco Sportsmen’s Club. This 25-acre pond had been constructed approximately 13 years earlier, and despite receiving yearly stocking of fish

from both state and federal hatcheries, fishing was getting progressively poorer. Further, the pond was literally filled with weeds.

At the urging of the 'Investigators,' the Club decided to drain the pond and restock it. Remember, that by late 1939, they were aware of the results of the 'Experiment' in the 'Upper' Pond at Sand Mountain. As a result, they stocked it, per acre, with 100 'advanced' largemouth bass fingerlings and 1,000 bluegill fry and fingerlings in December. They had already initiated a fertilization program for the pond.

IMPORTANT PUBLICATIONS IN 1939

Publications prepared by the 'Investigators' in 1939 included the following:

1. Swingle, H. S. and E. V. Smith. 1939a. Fish production in terrace-water ponds in Alabama. Transactions of the American Fisheries Society 69:101-105.
2. Swingle, H. S. and E. V. Smith. 1939b. Increasing fish production in ponds. Transactions of the North American Wildlife Conference 4:332-338.
3. Smith, E. V. and H. S. Swingle. 1939b. Effects of organic and inorganic fertilizers on plankton production and bluegill bream carrying capacity of ponds. Transactions of the American Fisheries Society 69:257-262.

Seven publications were prepared for various state game and fish and agricultural publications. These were extremely important to both the Program and to rural people because they made information about the construction and management of farm ponds, written in non-technical language, widely available.

Two of these publications were designed to educate the public on the matter of closing the season for fishing in Alabama during part of the year. Most states had enacted similar laws to protect spawning fish during part of the year. Such laws appeared to be useful in parts of the country where some species, especially trout, were susceptible to capture during their spawning period. In working with several species of warm-water fish, Swingle and Smith determined that because of their extremely high reproductive potential, a pair of brood fish was capable of producing far more off-spring than would be required to replace the pair. For example, a single female bluegill was capable of producing multiple thousands of eggs, and after fertilization, multiple thousands of fry; when in reality only two of them, growing to mature adults, would be required to replace the brood pair, if for some reason they were lost to the population. Swingle and Smith used this argument to

urge that laws establishing closed seasons for all species in Alabama be repealed.

BANKHEAD-JONES PROJECT IN 1940

In choosing a title for the 1940 Annual Report, the 'Investigators' continued to use the name of the Congressional Act (Bankhead-Jones) which provided a significant amount of the funding for fisheries work at Auburn in that year.

As detailed in the preceding Section, the 'Investigators' had begun the 'Eureka' Experiment in Farm Pond 4 in 1939. When the pond was drained, December 11, 1939, it contained approximately 623 pounds of fish (479 pounds per acre). Included were approximately 481 pounds of bluegills, 101 pounds of largemouth bass, 41 pounds of crappie and less than one pound of *Gambusia*. Comments in the 1939 Annual Report noted that approximately 509 pounds of the total weight removed were fish of 'legal-size.'

The 'Investigators' had conducted their first experiment (mosquito control) in 1934. Some five years later (1939) they had initiated a multi-year experiment that would likely produce extremely good fish production in 1940. It's interesting to see what additional experimentation they would undertake in 1940.

'INVESTIGATORS'

H. S. Swingle and E. V. Smith continued to lead the research effort of the Bankhead-Jones Project in 1940. Both were assigned 'full-time.' Given the amount of work involved in collecting the vast amount of data on the experiments, they must have received some assistance from others in the Experiment Station, but the 1940 Annual Report does not include any other names. The Report does include a comment that when work had begun on the construction of the 'F' Series of ponds on the Sougahatchee Farm, that project personnel began the construction and that some 'field-labor' was involved. There is no record of their names; however, it was likely the same group shown in Figure 17.

CONSTRUCTION – PURCHASE AND DEVELOPMENT OF THE SOUGHAHTCHEE FARM

A preceding Section describing the activities of the Bankhead-Jones Project in 1939, also related some of the events leading to the decision to establish an enlarged fish culture research facility and the efforts to locate a suitable site. This Section contains details on the purchase of the site and the early work to develop it.

SOME CHARACTERISTICS OF THE SITE

As noted in a preceding Section, the site of the so-called 'Soughatchee Farm' was located adjacent to the west side of the Oak Bowery Road (now AL 147), bordering the north side of Soughatchee Creek and extending northward to the so-called 'Farmville Road' (Lee County 72) (Figure 18). When it was purchased, the location of Oak Bowery Road was slightly different than State Highway 147 that would replace it. As a result, the small tract between the Ireland Center and the Highway, and a small tract just south of the intersection of 147 and County Road 72, were 'stranded.'

GEOLOGY AND SOILS

Remember that the South Auburn Farm was located on the northern margin of the East Gulf Coastal Plain and that the soils were formed in the marine sediments in that Physiographic Section. In contrast, the Soughatchee Farm is located at the southern margin of the Piedmont Upland Physiographic Section (Osborne, 1992). The soils there were derived from granite, gneiss and schist found in that Section (McNutt, 1981).

Soils on the South Auburn Farm are of the Marvyn, Cowarts and Uchee Series. Those on the Soughatchee Farm are of the Pacolet and Cecil Series (McNutt, 1981). The characteristics of the soils on the two farms are quite different. The early pond fertilization recommendations were based on experiments utilizing water from Marvyn, Cowarts and Uchee Watersheds, but their early use was in the water for Pacolet and Cecil Watersheds on the Soughatchee and Story Farms.

TRACTS OF PROPERTY INVOLVED

Actually, the Soughatchee Farm consisted of three tracts of land:

1. The Bradley Tract (180 acres).
2. The Evans Tract (340 acres).
3. The Duke Tract (60 acres).

The location of each Tract is shown in Figure 18A. Comments regarding each one are presented in Appendix Table 2. Obviously, the Bradley Tract was the most important one in establishing the Farm. The tract with the permanent stream passing through it provided the ideal location for developing small earthen ponds. The Evans Tract would grow in importance over time, as pond development extended northward.

DWELLINGS ON THE PROPERTY

There were three dwellings (7, 8 and 9) on the Sougahatchee Farm when it was purchased in 1940 and a fourth (10) on a Tract (Dowdell) that would be purchased later. Their location is shown on the map on Figure 18B. Additional information about each one is presented in Appendix Table 3. Two of the dwellings (Numbers 7 and 8), both located on the Evans Tract on the original Farm, had been fine homes in the past, but were somewhat dilapidated in 1940. I have no idea who lived in those buildings when the University purchased them, but later they both served as homes for members of the Field Crew and their families. Later dwelling Number 8 would become the property of Mrs. Frank Turner in the land swap of 1976 (Appendix Table 3).

Dwelling 9 was located near where the eastern end of the Farm Pond 11 dam is located today. It was a typical tenant house; similar to several located on the Story Farm which would be purchased later. There was a well-constructed, out-building located just northeast of this dwelling. It was used as the primary storage building for the Sougahatchee Farm for many years.

In 1940, a road which provided access to farms located west of the Sougahatchee Farm passed south of the front yard of Dwelling 9 (Figures 18 and 19). It joined the old Oak Bowery Road (State Road 147) just southeast of the Ireland Center. I also vaguely remember a dwelling located just southwest of this intersection, but have been unable to find any evidence that it ever existed. Remnants of this old farm road is now located mostly beneath the dam of Farm Pond 11, although traces of it continues westward where it joins Lee County Road 13.

Dwelling Number 10 was located on the Hutchinson Tract. It had also been a fine old building, but it was somewhat dilapidated by the early 50s when I first became aware of it. It was occupied at the time, but I believe that it had been demolished when the University purchased the Tract in 1971.

PLANNING FOR THE DEVELOPMENT OF THE FARM

As noted previously, in preliminary surveys the 'Investigators' had determined that the 'vee-shaped' pasture was relatively narrow at its north end, but opened onto a broad flood plain along Sougahatchee Creek to the south and that a permanent stream traversed the site, north to south. The small un-named tributary was and is a required element in the development of the Sougahatchee Farm. It originated in small springs north of the Farmville Road and on a small watershed east of Highway 147 (Figure 18). Although it was un-named at the time, I have chosen to use the name Funchess Creek in identifying it.

After much study, the 'Investigators' decided to construct a series of 27, one-fourth-acre ponds (the 'F' Series), adjacent to Funchess Creek. The ponds were laid out in four "blocks" as shown in Figures 18D. In the broader valley to the south, they planned the construction of eight, one-acre ponds (the 'E' Series). At that time, the site was heavily forested on the west side of Funchess, and no plans were made to construct ponds in that area at that time.

Laying out the location of the ponds was a relatively easy task. Supplying them with water would be a more difficult matter. At the South Auburn Farm, they had constructed a water supply pond (Farm Pond 1) by constructing a dam on Newman Creek and had piped water, by gravity, through it from that source to the 'C' Series and 'D' Series below. This would have been an ideal solution to the water supply problem at the Soughatchee Farm, but at that time, for several reasons, it was not practical to construct a large water supply pond on Funchess Creek. Some 32 years later (1972) that possibility would be re-visited in the construction of Farm Pond 11. In 1940, the 'Investigators' decided instead to construct a low dam (Figure 20) on Funchess Creek that would impound a relatively small volume of water at an elevation that would allow it to flow into a newly-constructed earthen channel (Figure 21) leading along the eastern margins of the ponds. This so-called 'diversion ditch' would carry water along the eastern margin of the entire 'F' Series; however, because of the gentle 'down-slope' of the site, 'cross-dams' were installed at intervals to maintain enough 'head' to supply the ponds with water (Figure 21). The 'ditch' was terminated at the southern terminus of the 'F' Series where water entered a pipe to supply water for the 'E' Series. The entire water supply for that Series would be underground. Excess water flowing in the 'diversion ditch' passed through a small holding pond (Pond J-3) near the 'Counting Shed' back into Funchess Creek.

SOME ADDITIONAL POND CONSTRUCTION DETAILS

Once the transfer of the property was completed in March of 1940 (Appendix Table 1), construction began immediately. In fact, it is likely that construction actually began before that date. In his largess, Director Funchess had included enough funds to purchase a Pond D-4 bulldozer. This machine was used to 'push-up' the dams for the ponds. Construction on the first 14 of the 'F' Ponds began at the north end of the site, just below the low-dam; near the present location of the dam for Farm Pond 11. A total of 22 'F' Ponds, along with a substantial portion of the water-supply system, were completed in 1940. The remainder were completed the following year (Figure 19).

'Ponds F-1 through F-4 were constructed to be about 70 feet in width and 159 feet in length. The remainder ('Ponds F-5 through F-22) were slightly narrower but longer (55 feet X 200 feet). The ponds were constructed so as to provide a depth of about 4 feet at the deepest end, adjacent to the stream,

and about 2 feet at the shallow end. With this arrangement, water would flow from the 'diversion ditch,' through a pipe, through the dam at the shallow end of each pond. At the deeper end of the pond, a vertical 'stand-pipe' allowed over-flow to pass water through that dam, back into the stream. This pipe could also be set at an angle to adjust the level of the water in the pond from empty to full.

There was a small spring east of the Pittman home on the east side of the Oak Bowery Road (now Alabama Highway 147). This spring provided water for a small permanent stream that coursed southwestward across the Pittman property (Figure 18) before entering a road-side ditch just north of Soughahatchee Creek. The purchase for the Pittman site west of the road, included the narrow strip (0.22 acre) of land from the spring to the ditch on the east side of the road. After the purchase, the 'Investigators' installed a metal pipe through the base of Oak Bowery Road (Alabama 147) so that water from the spring could potentially be used on the Soughahatchee Farm, west of the road.

In the design and construction of the experimental ponds on the Soughahatchee Farm, both Swingle and Smith spent many hours 'on-site.' On one of their return trips from the farm to the campus, with Swingle driving, they encountered Miss Martha North walking along the street. Dr. Smith was actively 'courting' this lovely young lady at the time, and would later marry her. Swingle stopped the truck to give her a ride, but on their trip into town, he noticed that Smith had nothing to say to her. After she exited the vehicle, Swingle asked him why he had been so quiet. Smith replied that his cheek was 'full' of chewing tobacco, and he needed to spit badly, but he did not want to do so because she didn't know that he 'chewed.'

CONSTRUCTION OF THE 'COUNTING SHED'

In the early years, only a single permanent building was constructed on the Soughahatchee Farm. The 'Counting Shed' was constructed in 1947 (Figure 22). The original building was obtained from the R.O.T.C. Unit on campus. It was declared 'surplus property' at the end of World War II. The Field Crew constructed five concrete tanks within the structure. Water for the building was obtained from the lower end of the 'diversion ditch.' It would be renovated several times through the years, but was abandoned in 2011 when the Center for Aquatic Resource Management was completed. It was finally demolished in 2016.

EXPERIMENTATION

In 1940, with much of the basic research on fertilizer mixtures largely completed, the 'Investigators' turned their attention to other aspects of aquatic ecology, and to the practical application of some of the information

which they had obtained in earlier experiments.

PRODUCTIVITY OF UNFERTILIZED AND FERTILIZED PONDS

As detailed in a preceding Section, it was demonstrated by earlier research, in the small 'D' Series that the production of both organic matter (plankton) and fish could be increased with the addition of inorganic fertilizers to the ponds. However, this relationship had not been investigated in larger, 'terrace-water' ponds; consequently, the 'Investigators' conducted a 5-month study on the production of plankton, bottom organisms and fish in Farm Pond 1 (Unfertilized) and in Farm Pond 3 (Fertilized) in 1940.

The results of the study are presented in Table 36. They show that the magnitude of all three characteristics were considerably greater in the fertilized pond. The 'Investigators' commented:

1. "Dipterian larvae made up the largest part of the weight of bottom organisms in both ponds, Chironomidae being the most important family. Phantom midge larvae (Chaoboridae) and Ceratopogonid larvae ranked next in importance. Phantom midge larvae showed a tremendous increase in the fall months in Farm Pond 3. It would seem that these midges thrive better in fertilized ponds.
2. Farm Pond 1 had a greater variety of food at all times than did Farm Pond 3. This is probably due to the softer bottom and the presence of aquatic vegetation in Farm Pond 1."

WEED CONTROL WITH FERTILIZATION

As detailed in the preceding Section, the 'Investigators' had identified weed infestations in ponds as a major problem in their management and had initiated an on-going research effort in this area.

The continuing experiment to control *Najas* in three ponds in Montgomery County with the use of fertilization was described in the two preceding Sections. By the end of 1939, the weeds appeared to be dead and mostly decomposed. Fertilization was continued in the late winter of 1940 to increase fish production in the ponds. In the spring of 1940, the weed appeared again in the largest pond, but with continued fertilization, it soon became covered with filamentous algae, and by November there was no trace of it.

RECREATIONAL AQUACULTURE

As detailed in the preceding Section, in 1939 the 'Investigators,' apparently relying on rather incomplete information from the "Upper Pond" at Sand

Mountain, had sort of 'stumbled' into the 'Eureka' Experiment that they began in Farm Pond 4. Now they had the opportunity to evaluate the quantity and quality of recreational fishing that could be obtained from that particular stocking combination and to see if they could replicate those results in other ponds.

CONTINUED EVALUATION OF STOCKING COMBINATIONS

Through 1938, virtually every predator-prey stocking combination evaluated included the white crappie. Then beginning in 1939, most of the combinations evaluated included fingerling largemouth bass. The preliminary results from the 'Eureka' Experiment in Farm Pond 4 should have ended their devotion to white crappie forever.

BASS AND BLUEGILLS IN FARM POND 1

Remember that from 1934 through 1939, research in Farm Pond 1 consisted of one continuous experiment in which fish recovered in one year, after counting and weighing, were returned to the pond as stock for the following year. After the preliminary success with Farm Pond 4, in 1939, the 'Investigators' decided to alter the use of Farm Pond 1. They decided to utilize it in 1940 to evaluate the bass-bluegill combination in an un-fertilized pond (400 bluegills and 50 bass, per acre). Unfortunately, they confounded the experiment by attempting to determine the feasibility of using bass fry instead of fingerlings in establishing a good fishing population. Consequently, during the period January 13-February 6, 1940, they stocked the pond with a total of 720 bluegill fingerlings (400 per acre). Then on May 9, they stocked 51 bass fry (Table 37). The pond was drained on November 25, 1940. Data on the number and weight of fish recovered are also presented in Table 37.

Note that some 88.4 pounds of 264.9 pounds of fish recovered were 'wild' (Not stocked). Likely chub suckers and yellow bullheads had entered the pond from the stream before the bluegills and bass were stocked. They likely spawned in the early spring of 1940. The presence of this large quantity of 'wild' fish makes it very difficult to learn anything from this experiment. The 'Investigators' commented:

"Although the bream increased from 0.1 ounce to 2.3 ounces in weight (0.006 to 0.144 pound), they did not reach a good harvestable size."

It is highly likely that the presence of these 'wild' fish resulted in bluegill growth being much lower than expected. Further, it is likely that this 'crowding' effect on bluegill growth would intensify in the coming year. Later the presence of 'competing' species would become more important to the 'Investigators' than it was in this experiment. 'Wild' fish are an ever present

problem in establishing a good fishing population in a new pond constructed on a small permanent stream.

Another comment made by the 'Investigators' indicated a rapidly growing understanding of and appreciation for the concept of *balance* between species. As they were apparently beginning to understand, it was at the 'heart' of pond management. They also learned something of the upper limits of the early growth of the largemouth bass. They commented:

"The bass had increased from 0.0006 ounce to 14.8 ounces. In other words, the bass in one season had grown from newly hatched fry to slightly less than a pound average."

Obviously, these fish had an almost unlimited food supply of 'wild' fish fry and fingerlings from the very beginning. These results indicate that when first-year bass grew at a slower rate than that observed in Farm Pond 1 in 1940 that their food supply had been limited to a degree. Unfortunately, this rapid growth of the bass indicated something else about the population. There was simply too much "forage" for the bass to control. I suspect that if they had used fingerling bass instead of fry that the results might have been somewhat different.

At draining, the 'F/C' ratio of the population was approximately 6.0.

BASS, BLUEGILLS, FLATHEAD CATFISH AND SHAD IN FARM POND 2

The experiment in Farm Pond 2 in 1940 was a 'throw-away.' Just when it seemed that they had achieved a 'break-through' in their thinking, they went off on a tangent. This 0.5-acre pond was stocked with 15,500 bluegills weighing a total of 229 pounds, 8 large flathead catfish weighing a total of 38.8 pounds, 46 sub-adult largemouth bass weighing a total 11.1 pounds and 8 shad weighing a total of 0.8 pound (Table 38). Sometime during the year, an undetermined number of crappie and yellow bullheads gained entrance to the pond from the stream. Adult bluegills averaged only 0.092 pound (42 grams) each at draining.

BASS FRY AND BLUEGILL FINGERLINGS IN FARM POND 3

The 'Investigators' used Farm Pond 3 in 1940 to again evaluate the use of bass fry instead of bass fingerlings as a predator in establishing a fish population in a pond containing no fish. For some reason, they thought that producing fry instead of fingerlings would make hatcheries more efficient. It is surprising that they would use this pond for this experiment. They had tried this combination before, and it had not worked very well.

They established the experimental population by stocking 2,250 bluegill

fingerlings on February 6, 1940, and 150 bass fry on May 9 (Table 39). The pond was drained in November, 1940. The 1940 Annual Report did not indicate the exact draining date. The evaluation of the draining data indicated that the bluegills averaged approximately 0.11 pound when they were recovered (Table 39). This was less than one-half of the expected weight with this stocking combination in a fertilized pond. Further the average weight of the adult bass (0.43 pound) was also about one-half of the expected. There were two confounding factors involved in evaluating this experiment: the pond apparently lost much of its area and water during the experimental period; and the effectiveness of the cottonseed meal:superphosphate fertilizer used in the experiment was not well understood.

Survival of the bass fry was surprisingly good (90 percent), but it is likely that they were not large enough, stocked as fry on May 9, to provide much control for bluegill numbers when they started spawning at about the same time. There were almost 47,000 fry and fingerling bluegills in the pond when it was drained. The 'F/C' ratio was 7.3, which indicated a population burdened with too many forage fish. Bass fingerlings would likely have been much more effective in reducing this ratio.

CONTINUATION OF THE 'EUREKA' EXPERIMENT IN FARM POND 4

In the 1939 'Eureka' Experiment in Farm Pond 4, the 'Investigators' continued the procedure of attempting to carry an established fish population from one year to the next. When the pond was drained on December 11, 1939, all fish were counted, weighed and returned to the pond. These fish became the 'stock' for the 1940 experiment (Table 40).

The 1940 experiment was terminated on November 27, 1940. Data on the fish recovered are presented in Table 40. Average size of the adult bluegills was substantially the same when the pond was drained in 1940 as they had been in 1939 (0.26 versus 0.25 pound). This was not the situation with the bass. In this species, average weight declined from 0.80 to 0.38 pound during the year. This was likely the result of the growing competition from the crappie that had accidentally been left in the pond. Note that 'pounds-recovered' was substantially lower than 'pounds-stocked' (632.2 versus 369.67 pounds). This difference is a result of 'poundage' removed by fishing during 1940 not being replaced by recruitment. However, it is likely that if the population had been left intact, this difference would have largely disappeared before the beginning of the next (1941) fishing 'season.'

As noted in a preceding Section, some 'test' fishing of Farm Pond 4 was experienced in 1939, but in February, 1940, the 'Investigators' began a systematic program of exploitation which continued into November when the pond was drained again. The pond was generally fished two times each week

during this period. A 'limit' of 10 bluegills was taken on most days. Fishing was usually continued until the 10 bluegills were caught, but this was not always practical. Some fishing trips ended without that number being caught. All bass, and any legal-size crappie that were caught while fishing for the 'limit' of bluegills, were also kept. Data on the total catch (Number and Weight) for the entire period are presented in Table 41, along with data on fish recovered on draining November 27, 1940.

Data on the number of bluegills removed by fishing from Farm Pond 4, by month in 1940, are presented in Figure 23. Note that the catch in numbers was relatively uniform from month to month because of the systematic fishing schedule described previously. Data on the average weight of bluegills caught each month are shown in Figure 24. The slightly higher averages in April, May and June likely reflect a larger proportion of larger males taken from spawning sites in those months. The Catch Per Unit of Effort for bluegills (CPUE) is shown in Figure 25. Remember that once fishing had begun each day, it was continued until ten bluegills had been caught. In Figure 25, data on the time required to catch the 'limit' each day has been converted to 'catch per hour,' (Catch Per Unit of Effort – 'CPUE') and summed by month. The 'CPUE' remained relatively low during the colder months (February and March), but when the water began to warm in April, it increased sharply. Rates for April, May and June were much higher than any of the other months, and likely reflect catches made on the 'spawning-sites.' The rate began to decline in July. At the end of June, 421 bluegills had been removed from the pond by fishing.

The number of bass taken each month was somewhat more variable than the number of bluegills (Figures 23 and 26), but remember that there was no systematic scheme involved in fishing for this species. Many of them were likely taken incidentally while fishing for bluegills. Data presented in Figure 27 show the average weight of bass caught each month. It generally declined throughout the year from 0.8 pound in February to 0.4 pound in November. The 'CPUE' for bass was also quite variable (Figure 28), but remember that it was generally dependent to the exploitation rate for bluegills.

The quality of fishing in the "Eureka" Pond was likely far better than the 'Investigators' ever imagined that it could be. Certainly, they had likely never experienced anything like it. Standards by which the quality of fishing might be evaluated were virtually non-existent in the South in the late 30s and early 40s. Most people fished in large creeks near their homes. A few might have had the opportunity to fish in a river or even a local mill pond. Private ponds were not at all common. Further, large impoundments were not very widespread at that time. It is likely that the primary catch for most fishermen were long-ear sunfish (*Lepomis megalotis*) and a bluegill every now and then. Catching a small spotted bass (*Micropterus punctulatus*) while fishing for sunfish would have been an unusual event.

Long-ear sunfish never reach a large size. Most of them taken from warm water streams ranged from 3 to 6 inches in length, and most of the catch would weigh less than 0.10 pound each. Further, a spotted bass larger than 0.4 pound would have been a 'monster.' These would have been the 'expected' sizes of their catches. Swingle (1950) called them 'harvestable' sizes. Further, 'creek-fishermen' 'CPUEs' would likely seldom have exceeded two fish per hour.

Remember that 'Target' sizes of bass and bluegills, used by the 'Investigators' to develop stocking rates for earthen ponds, were 1.0 and 0.25 pound, respectively (Swingle, 1950). These are sizes that these species were expected to reach in a fertilized pond after one year. The average fisherman in the South seldom, if ever, caught fish this large. It is highly likely that he/she would have been quite happy with fish half this size.

Data presented in Table 41 show that 'Investigator' fishermen removed 120 adult largemouth bass, weighing 68.5 pounds from Farm Pond 4 in 1940. The average weight was 0.57 pound, which was well below the 'Target' size (1.0 pound), but slightly above the 'harvestable' size (0.40 pound). Most of those early creek fishermen would have been delighted to catch a bass this size. Unfortunately, this average weight was well below its 'Target' or 'potential' size under these cultural conditions. Some fishermen fished Farm Pond 4 exclusively for largemouth bass, but most of them were caught while fishing for bluegills; consequently, there is no reliable estimate of 'CPUEs' for this species.

Remember that an unknown number of white crappie were inadvertently left in Farm Pond 4 in 1938. These fish spawned the following year and added another species to the stocking combination (Table 40). In 1940, fishermen caught 125 adult crappie, weighing 43.8 pounds, with an average weight of 0.35 pound (Table 41). This average weight is higher than Swingle's 'harvestable' weight of 0.26 pound for the species. The total number of crappie caught was slightly higher than the catch of bass (125 versus 120). These catch statistics suggest that the lower than expected rate of growth for the bass may have been the result of competition for food by crappie.

Fishermen also caught 804 bluegills, weighing 228.2 pounds (Table 41). The average weight of 0.34 pound was well above both the 'harvestable' and 'Target' weights. This higher than expected average weight was likely the result of the relatively high density of carnivorous fish in the population which increased the consumption of small forage species; resulting in less competition of the adult bluegills for food. When the pond was drained in November, 1940, the 'F/C' ratio of the recovered population was 3.1 (Table 41), which indicates a tendency toward an over-crowded carnivorous species situation. This situation would have resulted in lower growth for adult bass and crappie, but a higher rate of growth for adult bluegills.

The 'CPUE' for bluegills was exceptional. In April, only 2.3 minutes were required to catch a harvestable bluegill. It is quite likely that neither Swingle nor Smith or few people in Alabama had ever experienced fishing that uniformly good. If Dean and Director Funchess fished in Farm Pond 4 during the spring and summer of 1940, I am certain that he was well pleased. He must have been concerned in 1933 with his decision to allocate extremely scarce Experiment Station resources to fish culture, but the excellent fishing produced in the 'Eureka' Experiment justified his decision.

EVALUATION OF FORAGE FISH FOR STOCKING PONDS – INITIATION OF EXPERIMENT 1 IN THE 'F' SERIES

By the end of 1940, 14 newly completed ponds in the 'F' Series were available for research (Figure 19). The 'Investigators' decided that the first experiment in those new ponds would involve the evaluation of bluegills, red-ears, golden shiners, goldfish, shad and *Gambusia* as forage fish in recreational fishing ponds. The first fish used in this experiment were stocked in November, 1940 (Table 42). Other fish were added in early 1941.

This was the first experiment conducted on the Sougahatchee Farm. The 'Investigators' finally had a substantial number of good ponds to work with. It would be interesting to see what they would do with them. Unfortunately, their first experiment was a disaster. That it was poorly designed is a dreadful understatement. There were too many variables, and confounding was so rampant that it would be virtually impossible to draw any conclusions. Its only value was that it provided a good opportunity to 'practice' research on the new farm, and it provided a wealth of observations that might be used in designing future experiments.

Variables, confounding and problems included:

1. Half the ponds were stocked with bass fry and half with bass fingerlings.
2. Bass fingerlings were stocked at two rates – 50 per pond in 11 ponds and 25 per pond in 2 ponds.
3. Bluegills were stocked at three different rates – 50 per pond in 5 ponds, 400 in one pond and 375 in one pond.
4. Only a single pond (F-11) was stocked with the 'Eureka' combination of bass and bluegills. Unfortunately, it was stocked with fry instead of fingerlings and it received a different fertilizer.
5. Golden shiners were stocked at two rates – 50 per pond in one pond and 100 per pond in one pond.

6. One pond was stocked with no bass.
7. Two ponds were fertilized with soybean meal and superphosphate; the remaining 12 were fertilized with the so- called 'home-mix.'
8. Four of the ponds were not drained; they were continued into 1941.
9. Bass spawned in only one pond.
10. Late in the year, shad were moved from one pond to another.
11. One pond was stocked with only 3 adult red-ears, possibly of the same sex.
12. With so many variables, there were no replications.

Remember that the 'Eureka' Experiment in Farm Pond 4 had been stocked in 1939 with 1,500 advanced bluegill fingerlings, 98 advanced bass fingerlings and approximately 3,600 *Gambusia* per acre, and it was fertilized with cotton fertilizer (6-8-4) and nitrate of soda. Also, remember that white crappie were accidentally stocked in the pond. The 'Eureka' stocking combination was roughly repeated in only Pond F-11 (Table 42) in the first Soughahatchee Farm Experiment, with the exceptions that the bluegill and bass fingerlings were much smaller, fewer *Gambusia* were stocked (352 versus 3,600), no crappie were added, and soybean meal plus superphosphate rather than cotton fertilizer plus nitrate of soda were used to fertilize the pond.

COMMERCIAL AQUACULTURE – PRODUCTION OF GOLDEN SHINERS

In 1940, the 'Investigators' continued to 'dibble-and-dabble' in commercial aquaculture. At that point they were not completely committed to it, but they were learning some valuable lessons on the technology required. On March 5, 1940, Pond C-1 was stocked with 182 golden shiners averaging 1.8 grams each (Table 43). A total of 90 of these fish were transferred to another pond on July 17. On draining, only 555 shiners weighing 8.1 pounds (68.8 pounds per acre) were recovered. 'Wild' bluegills gained entrance to the pond during the summer and 6 large fish weighing 1.1 pounds and 10,292 small fish weighing 27.7 pounds were recovered. This result was in contrast to that obtained in Pond D-3 in 1939, when the equivalent of slightly over 1,100 pounds of shiners were recovered on draining.

OUTREACH

As detailed in preceding Sections, the 'Investigators' were committed to trying to improve the fishing in Lake Auburn after the establishment of the

Auburn Fisheries Program in 1933, and they would continue their 'outreach' efforts with that lake for many years.

By 1940, the futility of trying to establish a good fishing population with bluegills and white crappie was finally accepted by the 'Investigators.' Fishing in Lake Auburn was getting poorer by the month. At that point they should have been sorry that they had not had one or two replications of the 1937, Pond D-7 experiment, where they decided that crappie could control bluegill reproduction. Fortunately, by 1940 they had the Sand Mountain experience and the Farm Pond 4, 'Eureka' Experiment behind them, and they quickly turned to largemouth bass fingerlings to solve Lake Auburn's problems. Unfortunately, they were quickly reminded that it's virtually impossible to 'turn a battleship in a bathtub.' The addition of 2,076 bass fingerlings in June of 1940 had only a very limited impact on the fish population by the end of the year.

Also, as detailed in preceding Section, the 'Investigators' had begun to reach-out to owners of other private ponds in 1939, and by 1940 this list was expanding rapidly. It included:

- Selma Fishing Club
- C. C. Mullins
- T. B. Hill
- Bluegill Fishing Club
- Montgomery Shooting Club
- 'Pretty' Pond
- Union Springs Fishing Club.

IMPORTANT PUBLICATIONS IN 1940

The 'Investigators' prepared four publications in 1940. Three were published in professional journals. Those published in the journals included:

1. Smith, E. V. and H. S. Swingle. 1940a. Control of spatterdock (*Nuphar advena* Ait.) in ponds. Transactions of the American Fisheries Society 70:363-368.
2. Smith, E. V. and H. S. Swingle. 1940b. Winter and summer growth of bluegills in fertilized ponds. Transactions of the American Fisheries Society 70:335- 338.
3. Swingle, H. S. and E. V. Smith. 1940. Experiments on the stocking of fish ponds. Transactions of the Fifth North American Wildlife Conference 5:267-276.

THE BANKHEAD-JONES PROJECT IN 1941

Apparently, the Bankhead-Jones Act, continued to be the primary funding source for fisheries work at Auburn in 1941. The 1941 Annual Report continued to use the name of the Act on its title page. The primary emphasis of the Project in 1941 would be to continue the evaluation the 'Eureka' Experiment for establishing good fishing in 'terrace-water' ponds.

'INVESTIGATORS'

Both H. S. Swingle and E. V. Smith remained with the Project throughout 1941 and both devoted 'full-time' to it. For the first time the list of 'Investigators' in the Annual Report included the names of John M. Lawrence and Ellis E. Prather. They would remain with the Project, except for time in military service, until their respective retirement. The Soughahatchee Farm was purchased in March of 1940 and construction had begun immediately. The establishment of this relatively large research area expanded the requirement for 'Investigator' attention far beyond Swingle and Smith's capacity to provide it. With the research program at South Auburn continuing, Prather and Lawrence were employed to assist with the rapidly increasing work load.

John Lawrence (Figure 29) was born in Cherokee County in 1919. He was awarded the B.S. Degree in Agriculture by the Alabama Polytechnic Institute in 1941. The same year, he joined the Bankhead-Jones Project as an Assistant in Fish Culture. He was awarded the M.S. Degree in Wildlife Management by API in 1943. He served in the U.S. Army from 1943-1945. In 1956, he was awarded the Ph.D. Degree in Zoology by Iowa State University. John's family farm was located in north central Cherokee County. After Weiss Reservoir was completed in 1961, the farm was under 40 feet of Coosa River water.

E. Ellis Prather (Figure 30) was born in Autauga County in 1919. He received the B.S. Degree from Alabama Polytechnic Institute (Wildlife Management) in 1941. After graduation, he worked with Swingle and Smith for a short period before leaving for graduate study at the University of Michigan. He was awarded the Master of Science (Fisheries Biology) Degree by that institution in 1942. On completion of his graduate work, he went on active duty with the U.S. Air Force. He was separated in 1945, returned to Auburn and accepted a position as Assistant in Fish Culture. Because he had remained in Active Reserve in 1945, when the Korean conflict began in 1951, he was re-called to active duty. He was finally separated a second time in 1954.

CONSTRUCTION

Information presented in Appendix Table 1 indicates that construction of pond facilities on the Soughahatchee Farm was moving rapidly forward in

1941. Construction included:

1. The remaining ponds in the 27-pond, 'F' Series (Figure 21).
2. Four ponds in the eight-pond, 'E' Series.
3. Miscellaneous Ponds M-1, T-1 and T-2.
4. Ponds 5, 6 and 7 in the 'Farm Ponds' Series.

The construction of a series of rectangular-shaped ponds in an irregular-shaped valley left several 'waste' areas undeveloped. The 'Investigators' utilized these areas for the construction of several irregular-shaped, so-called 'Miscellaneous' ponds ('M' Series). They would prove to be invaluable as holding ponds for fish going into experiments or after their removal when the experiment had been completed.

There were several sites for 'terrace-water' ponds in various small watersheds on the northern portion of the Sougahatchee Farm. In 1941, the 'Investigators' began to construct ponds on several of them (Figure 31). These ponds were useful in research, but they also stored water. Natural seepage helped to maintain a permanent flow in Funchess Creek, the small stream providing water for the 'E' and 'F' Ponds. Note that the numbering of these ponds extends numbering of the Series (Farm Ponds 1, 2, 3 and 4) established on the South Auburn Farm.

EXPERIMENTATION

In 1941, the 'Investigators' would continue research begun earlier on both the South Auburn and the Sougahatchee Farms. In addition, they would begin work at South Auburn on selective breeding of the largemouth bass for improved growth and feed conversion efficiency.

SELECTION AND BREEDING OF LARGEMOUTH BASS

Experiments conducted by the 'Investigators' on the South Auburn Farm had demonstrated the important role that fingerling largemouth bass could play in the establishment of good fishing populations in 'terrace-water' ponds. Once that research was validated, a next logical step was to produce a more food-efficient, faster growing 'strain' of bass for use in stocking ponds. They began this effort in June, 1941, by stocking individual fingerling largemouth bass in several of the 'A' Pools on the South Auburn Farm, and by feeding each one small goldfish, daily, to a state of satiation (Prather, 1951). This experimental protocol was continued for a period of 12 weeks. At the end of that period, the gain in weight of each individual bass was determined, along with the weight of goldfish that it had consumed. Data obtained in that

experiment revealed that from 1.2 to 24.2 pounds of goldfish were required to obtain 1 pound of gain in the weight of bass.

RECREATIONAL AQUACULTURE

The primary emphasis of research in Recreational Aquaculture in 1941 was on the evaluation of fishing quality in three newly established bass-bluegill populations at South Auburn, the continued evaluation of fishing quality in the 'Eureka' Experiment there, and the evaluation of results obtained from the first experiment on the Sougahatchee Farm to identify new forage fish for use with the bass-bluegill pond stocking combination.

EVALUATION OF FISHING QUALITY

Fishing quality in three newly established bass-bluegill populations (Farm Ponds 1, 2 and 3) was evaluated in 1941, along with the continued evaluation of fishing in the 'Eureka' population in Farm Pond 4. Results obtained in this research are presented and discussed in the following paragraphs.

EXPERIMENT IN FARM POND 1

Comments in the 1941 Annual Report indicated that Farm Pond 1 became so filled with *Najas* in the late spring of 1941 that it was difficult to fish or seine. In late summer, the pond became muddy, which resulted in the death and decomposition of some of the weeds. Fishing indicated that the pond was severely over-crowded with 'small bluegills, and probably with chub suckers and yellow bullheads as well. With such an abundance of forage fish available, bass growth as indicated by fishing was excellent. No records were kept on catch statistics.

EXPERIMENT IN FARM POND 2

Stocking, fishing and draining data for Farm Pond 2 in 1940 and 1941 are shown in Table 44. The pond was fished in 1941, but apparently not on a systematic basis. The total catch was 49.6 pounds (99.2 pounds per acre).

Average weights for bluegills, bass and crappie taken by fishing, are recorded in Table 45. The average weight of bluegills caught (0.19 pound) would likely be acceptable ('harvestable') to most fishermen, but below the 'Target' weight of 0.25 pound. The size of bass caught (1.01 pound) would certainly been highly acceptable – equal or greater than the 'Target' size (1.0 pound). The size of crappie caught (0.48-pound) would also been acceptable in that they were larger than the 'harvestable' size. No records were kept on the amount of fishing effort expended.

Although the average weights of bluegills and white crappie caught were

below the 'Target' size, the quality of fishing in the pond would be considered acceptable. In comparison to the quality of fishing available in local streams, it would be considered exceptional.

EXPERIMENT IN FARM POND 3

Remember that this pond had been stocked in 1940 to determine whether largemouth bass fry could be used to replace fingerlings in the stocking of 'terrace-water' ponds (Table 39). Unfortunately, a severe drought resulted in the reduction of the area of the pond after August of that year. When it was drained in November, 1940, the 'F/C' Ratio was 7.3, which indicated the severe overcrowding of bluegills – the forage species. In fact, at draining, 'small' bluegills represented some 46 percent of the total weight of all fish in the pond. After counting and weighing, all of the fish were returned to the pond. It was drained again on November 13, 1941 (Table 46).

The pond was fished from May, 1941 until just before draining. During this period, approximately 174.3 pounds of fish were removed by fishermen. There is no data available to indicate the amount of effort required to catch them. The average weight of bluegill caught was 0.17 pound and would have been acceptable to most fishermen (Table 45); although it was well below the 'Target' size (0.25 pound). The average weight of the bass was 0.75 pound and would have been acceptable.

CONTINUATION OF THE 'EUREKA' EXPERIMENT IN FARM POND 4

The research effort in Farm Pond 4 in 1941 represented a continuation of the so-called "Eureka" Experiment(s) initiated in 1939. As detailed in a preceding Section, the pond was fished systematically in 1940. Data on the weight of fish recovered by fishing and draining in 1940 were presented in Table 47, and shown in Figures 24-28. The fish recovered in 1940 were returned to the pond for the 1941 experiment. The pond was fished again in 1941, and a total of 210.3 pounds of fish (167.7 pounds per acre) were removed by angling. The total catch in Farm Pond 4 in 1941 was considerably lower than in 1940 (Tables 41 and 47). The 1941 catch included 532 adult bluegills, 45 adult largemouth bass and 31 adult white crappie (Table 47). Comparative catches of bluegill and bass in different months in 1940 and 1941 are shown in Figures 32 and 33. These total catches represent a significant reduction from those for 1940: 34 percent for bluegills, 62 percent for bass and 75 percent for crappie. When the pond was drained November 17, 1941, approximately 405 pounds of fish were recovered (Table 47). In 1940, 717.5 pounds had been removed on draining.

OVERVIEW OF FISHING QUALITY RESEARCH

At the end of 1939, Farm Pond 4 had contained a fish population that would

be a 'model' for all warm water, 'terrace-water' recreational fishing ponds throughout the nation. Unfortunately by 1940, some population characteristics were beginning to become bothersome, and by 1941, there were obviously serious problems developing. The bass were simply not growing the way they should. The average weight of bass caught in 1940 was 0.56 pound (Figure 34). In 1941 it was 0.38 pound, even slightly below Swingle's 'harvestable' size of 0.40 pound. Meanwhile, the average weight of white crappie caught was increasing. It was 0.35 pound in 1940 and 0.45 pound in 1941 (Figure 35).

At the end of 1941, the 'Investigators' had assembled three years of detailed data on the production and exploitation of bass-bluegill combinations in 'terrace-water' ponds. Certainly, they had never had any experience with the analyzing the kind of data they had accumulated.

Table 48 presents data on the weights of bass and crappie adults and fingerlings recovered from Farm Pond 4 on draining in 1939, 1940 and 1941. Apparently in early 1939, the crappie spawned heavily, and by draining, there were 36.3 pounds of crappie fingerlings in the pond. From that time onward, the weight of crappie in the pond was almost the same as the weight of bass. Certainly, the competition for food between the two species must have been intense – intense enough to affect the rate of growth of both species.

Although the presence of crappie in the population in Farm Pond 4 in 1939, 1940, and 1941 resulted in some uncertainty in the over-all effectiveness of the '100 bass-1,500 bluegill' stocking combination, on a sustainable basis, especially when there was a competing species present. From these data, it appeared that the 'Investigators' had finally succeeded in developing of procedures for establishing good fishing in 'terrace-water' ponds. However, there was still much work remaining to be done. The results had not been adequately verified. Also, there was the question of sustainability.

The quality of fishing in Farm Pond 2 and Farm Pond 3 in 1941 was not nearly as good as in Farm Pond 4, and then there was the problem of the effect of crappie on bass growth. Further, the timing of bluegill stocking and the size to be stocked needed to be resolved. Remember that the 1939 Farm Pond 4 population had been established with unusually large fingerlings of both bluegills and bass (14.5 grams and 19 grams each, respectively). Further, the bass were some 9 months old when stocked, and would certainly have spawned in 1939.

While that fish population established in 1939 appeared to be likely to provide good fishing (a 'Balanced Population') indefinitely, it was becoming obvious in 1941 that this might not be the case.

This evaluation of fishing quality in 1940, and the follow-up evaluation in

1941, was likely some of the most important research ever conducted on recreational fishing in ponds by the 'Investigators' at Auburn, and they devoted a considerable amount of space to a discussion of the results in the 1940 and 1941 Annual Reports, but almost none of it was ever published, in any form. Its publication in the language and methodology of modern fishery science would have constituted a major contribution to the field of the dynamics of exploited fish populations. Unfortunately, none of the 'Investigators' at that time were conversant in either the 'language' or the methodology required, and by the time that expertise was available, these experiments were long forgotten and unfortunately there were 'other-fish-to-fry.'

At the end of 1941, the 'Investigators' had stocking, fishing and draining data from four 'pond-years' of research: one year (1941) for Farm Pond 2, one year (1941) for Farm Pond 3, and two years (1940 and 1941) for Farm Pond 4, but these data had apparently raised more questions than they had answers. As a result, they proposed additional research for those specific questions:

1. How heavily can a pond be fished and yet have a weight maintained at near the maximum carrying capacity?
2. Effects of heavy fishing at different times of the year.
3. The effect of periodic draining and re-stocking of ponds on these problems.

The 'Investigators' had obtained some extremely interesting and useful data from their systematic fishing experiments, but as we will see in some forthcoming experiments that was not the way that fishing is 'done.' Fishing is highly personalized. Fishermen fish when they wish to fish and how they wish to fish. Attempting to design experiments to answer those questions proposed by the 'Investigators' would have been virtually impossible. They could not know it then, but it would later become apparent that fishing is the most unpredictable and unmanageable element of the establishment and management of 'terrace-pond' fish populations.

EVALUATION OF FORAGE FISH – COMPLETION OF EXPERIMENT 1

As detailed in the 1940 Annual Report, this experiment was initiated in late 1940. Its design was shown in Table 42. Remember that this is the first experiment initiated on the Sougahatchee Farm. Some of the data obtained from draining seven of the ponds are presented in Table 49. Note that 4 of the 14 ponds were not drained in 1941. Bass survival (percentage of fish surviving) and growth (average weight on draining) were used to evaluate the treatments. Data indicate that survival was generally similar in all seven ponds, averaging around 72 percent. It was highest in Pond F-13 (82 percent)

which was stocked with 50 bass fingerlings and gizzard shad, and lowest in Pond F-3 (64 percent) which was stocked with 50 bass fry and golden shiners.

Bass growth was best in Pond F-3 (0.65 pound). It was stocked with 50 bass fingerlings and gizzard shad; however, 24.9 pounds of shad were removed from Pond F-14 in late September and stocked in Pond F-13. Growth was poorest in Pond F-1 (0.34 pound). It was stocked with 50 bass fry and goldfish. The goldfish spawned in March, 1941, and the fingerlings were too large for the bass fry to eat when they were stocked later in May.

Remember that Pond F-11 was the only pond stocked with the 'Eureka' Combination (Table 42). It was also drained in November, 1941. Data on the fish recovered are presented in Table 50. These results indicate that total production (164.00 pounds per acre) was much lower than expected, and only a fraction of that obtained in the 'Eureka' Experiment. Further, the average weights of both bluegills and bass (0.16 and 0.46 pound, respectively), while of 'harvestable' size, were far below the 'Target' weights of 0.25 and 1.00 pound, respectively. The results of the 'Eureka' Experiment had yet to be duplicated.

EVALUATION OF FORAGE FISH – COMPLETION OF EXPERIMENT 1

The 'Investigators' concluded from the data obtained in this first 'F'- Pond Experiment that:

“Since any bluegills growing too large for bass to eat are a very desirable pan fish, this species appears to be the most desirable of any of those tested.”

THE SECOND FORAGE FISH EVALUATION EXPERIMENT IN THE 'F' SERIES

Remember that the first forage fish evaluation in the 'F' Series was hopelessly confounded. As a result, the 'Investigators' decided to conduct another one in 1941-1942. In this one, they evaluated bluegills, golden shiners, shad, goldfish and *Gambusia*. Unfortunately, this design (Table 51) was little better. There were still no replications.

THE BASS-BLUEGILL EXPERIMENT IN FARM POND 6

Remember that Farm Pond 6 (2.0 A.) was constructed in 1941 on the Sougahatchee Farm, along with the first 14 "F" Ponds (Figure 31). It was stocked March 14, 1941 with 2525 small bluegill fingerlings, 75 small red-ear fingerlings, 184 golden shiners and 172 *Gambusia*. On May 8, 200 bass fry were added. The 'Investigators' commented that the objective of the experiment was to evaluate the golden shiner as a supplemental forage

species. They further commented that the red-ear was added only to make up the required number of sunfish. The pond was not drained in 1941, but seining samples were taken throughout the summer. A sample taken on October 23 indicated that at least some bass, bluegills and red-ears had reached weights of 1.0, 0.08 and 0.24 pound, respectively. They must have been disappointed by the growth of the bluegills, but were delighted by the growth of the bass and red-ears. They must have been surprised by the growth of the red-ears, and the fact that they grew well while the growth of bluegills was considerably less than expected.

COMMERCIAL AQUACULTURE – PRODUCTION OF YELLOW BULLHEADS

Experimentation prior to 1941 indicated an ambivalence by the ‘Investigators’ toward the idea of producing fish in ‘terrace-water’ ponds for sale in fish markets. In 1941, apparently the idea became increasingly acceptable.

Yellow bullheads were stocked in Pond D-5 (Unfertilized) and Pond D-14 (Fertilized) on the South Auburn Farm. At draining, the equivalent of 169 pounds of bullheads per acre were recovered from Pond D-5. ‘Wild’ bluegills gained entrance to the pond during the experiment, and on draining, three large fish (0.5 pound) and 260 small fish (0.25 pound) were also recovered. There were no ‘wild’ fish in Pond D-14 and when it was drained, the equivalent of 234 pounds of bullheads, per acre, were recovered.

OUTREACH

By 1941, the reputation of the Fish Culture Program at Auburn was ‘getting-around.’ There were few good fishing ponds anywhere in the State, and apparently many pond owners strongly believed that the ‘Investigators’ could solve their problems, and the ‘Investigators’ seemed to agree.

In the beginning, most of these requests for assistance were the result of severe aquatic weed infestations, which made fishing virtually impossible. Fortunately in most cases, inorganic fertilizer applied correctly would eventually solve the weed problem; while at the same time, resulting in much better fishing. Over time, these requests for assistance would increase sharply; until they were requiring an inordinate amount of ‘Investigator’ time. Later, the Alabama Cooperative Extension Service would appoint an Extension Specialist to help with some of these requests.

While these ‘outreach’ efforts probably required an inordinate amount of ‘Investigator’ time, they were invaluable in their learning process. Involvement in these ‘off-station’ projects allowed them to work with a broad range of pond management problems in east central Alabama. These were experiences that could not be duplicated at Auburn. They were also

extremely valuable in providing the 'Investigators' with a good indication of likely pond owner involvement in the use of this rapidly developing technology.

IMPORTANT PUBLICATIONS IN 1941

Three publications developed by the 'Investigators' appeared in professional journals in 1941:

1. Smith, E. V. and H. S. Swingle. 1941a. The use of fertilizer for controlling the pond-weed, *Najas guadalupensis*. Transactions of the American Fisheries Society 71:245-251.
2. Smith, E. V. and H. S. Swingle. 1941b. The use of fertilizers for controlling several submerged plants in ponds. Transactions of the American Fisheries Society 71:94-101.
3. Swingle, H. S. and E. V. Smith. 1942b. The management of farm fish ponds with stunted fish populations. Transactions of the American Fisheries Society 71:102-105.

THE BANKHEAD-JONES PROJECT IN 1942

The title page of the 1942 Annual Report indicates that the Bankhead-Jones Act continued to be an important funding source for fisheries work at Auburn. This year would prove to be a momentous one for the Fisheries Program. The 'Investigators' would publish, as an Agricultural Experiment Station *Bulletin*, the results of a decade-long research effort to establish and manage fish populations in 'terrace-water' ponds to provide good, sustainable fishing for farm families. The publication, *Bulletin 254, Management of Farm Fish Ponds*, would firmly establish Auburn's reputation as a major center for fish farming research and fisheries management – a reputation that would have far-reaching ramifications later.

This 1942 Project Report would be the last to use the Annual Report format for presenting the results of fisheries work completed at Auburn. As detailed in a preceding Section, it has been my intention to follow closely the evolution of this early work, and at the same time, to chronicle the learning process of an entomologist and a plant physiologist with no formal training in fisheries or the applied science of aquatic habitats. I have tried to follow the changing levels of their understanding as they moved from experiment to experiment, over an 8-year period. In retrospect, what they have accomplished, given their backgrounds, is truly astounding.

In subsequent Sections, the emphasis will be primarily 'subject-matter' rather than 'time-period' oriented. This shift was made necessary by the major

changes that began to take place in the Fisheries Program following the end of World War II. The national reputation established through the early work, and *the 'turn' of world events* would thrust the old 'terrace-water' mentality and experience across the Southeast and into the furthest corners of the world, expanding its complexity and productivity almost beyond imagination.

'INVESTIGATORS'

Throughout 1942, H. S. Swingle and E. V. Smith continued to work on the Bankhead-Jones Project 'full-time.' The 1942 Annual Report also lists the name of John Lawrence, but it does not indicate his position title. I assume that he was probably still an Assistant in Fish Culture. He was called into military service sometime during the year.

CONSTRUCTION

Although the U.S. was fully involved in World II by 1942, the construction of pond facilities moved rapidly ahead on the Soughatchee Farm. Four additional 1-acre ponds in the 'E' Series were built, completing the eight-pond series (Figures 19). Also, three additional ponds in the 'M' Series (M-2, M-3 and M-4), and seven ponds in the 'H' Series (H-1 – H-7) were completed. By the end of 1942, most of the pond construction on the farm was complete.

By 1942, the Soughatchee Farm was fast becoming a really outstanding research facility. The combination of the 'E' Series and 'F' Series provided the 'Investigators' with 35 earthen 'test tubes,' each with a dependable water supply – ponds that were amenable to a wide variety of experiments related to fish biology, fish production and fish management. Further, the combination of the 'odd-sized' 'M' and 'T' Series provided them with excellent 'containers' for holding fish before and after experiments. Finally, the additional ponds of the Farm Ponds Series (Farm Pond 5, 6 and 7) provided them with a number of honest-to-goodness, 'terrace-water' ponds for the final evaluation of management procedures suggested by their small-pond research on the South Auburn Farm.

The South Auburn and Soughatchee Farms were as different as 'night-and day' in terms of adequacy as research facilities, but there was one important difference that apparently no one considered at the time. In fact, I'm not certain that anyone has fully realized the magnitude of the difference, even today. In moving from the South Auburn Farm to the Soughatchee Farm, the 'Investigators' moved their primary base of research operations only a few miles north. However, from a geological and physiographic perspective, they had moved into another 'world.' As noted in a preceding Section, the South Auburn Farm is located in the Fall Line Hills District of the East Gulf Coastal Plain of the Atlantic Plain Physiographic Region; while the Soughatchee Farm is located in Southern Piedmont District of the Piedmont

Upland Section of the Appalachian Highlands Physiographic Region. Further, the soils on the two farms are also ‘worlds apart.’ Those at South Auburn belong to the Marvyn-Cowart-Uchee Series. They are characterized by a sandy surface and a clayey subsoil. They were formed on marine sediments of the Coastal Plain. The soils at the Soughatchee Farm belong to the Pacolet-Cecil Series. They are characterized by a loamy surface and a clayey subsoil. They were formed from granite, gneiss and schist of the ancient Piedmont Plateau. These rocks are some of the most heat-deformed on earth. The natural fertility of the two soils are also ‘worlds apart.’ As a result, water from rainfall flowing across them is likely to be quite different, as it would be in impoundments where it is collected. A primary effect of these differences is that all of the early pond fertilization work was conducted in the more northern Fall Line Hills District, while the immediate application of the results of that research was in the Southern Piedmont Upland Section.

It is unfortunate that moving from the South Auburn Farm with Farm Pond 1 as the primary water, to the Soughahatchee Farm with Funchess Creek as the primary water source, did not solve the problem of ‘wild fish.’ Funchess Creek also had a native fish population. As a result, the ‘investigators’ had to continue to deal with this problem for many years. Fortunately, with the larger experimental ponds, the addition of a few ‘wild fish’ did not have the same effect here as they did in the much smaller ‘D’ Ponds.

EXPERIMENTATION

In 1942, the ‘Investigators’ continued to conduct experiments on the South Auburn Farm, but their primary research interest had shifted to the Soughahatchee Farm with its much improved and expanded facilities. Unfortunately, their experimental designs did not improve very much. They still had a tendency to investigate multiple problems in the same experiment. For some reason they were unsatisfied with the results obtained in Experiment 1 in the ‘F’ Series on the evaluation of different forage fish stocked with largemouth bass. As a result, in late 1941, they initiated an expanded version of the same Experiment (Experiment 2).

While they would continue to plod along with research in the ‘F’ Series, they would embark on a completely different area of work in the newly completed ‘E’ Series. By 1941, they apparently were convinced that they knew how to establish good fishing in ‘terrace-water’ ponds. Now they wanted to see how ‘fishing quality’ would ‘respond’ to exploitation.

RECREATIONAL AQUACULTURE – EVALUATING FISHING QUALITY IN THE ‘E’ SERIES

Construction of all of the ‘E’ Ponds (1-8) (Figure 19) was completed in the fall of 1942. A portion of the fish required in the first ‘fishing quality’ experiment

was added to the ponds in 1942, and the remainder in 1943. The 'Investigators' commented in the 1943 Annual Report that some of these ponds would be fished in 1944 and then drained that fall. There was no mention at that point of subjecting these ponds to public fishing; although it would have been difficult to apply very much fishing pressure to those eight ponds using only project personnel. As a result, in the early summer of 1944, several of the ponds were 'opened' to public 'fee-fishing.'

OUTREACH

The 'Investigators' continued their outreach efforts in the management of Lake Auburn in 1941. The 2,076 bass fingerlings stocked on June 10, 1940 had not done much to improve fishing in the lake by early 1941; consequently, another 632 were added in May, 1941, and an additional 151 in December. In 1942, the pond was so severely crowded with small crappie that the 'Investigators' recommended that anglers catch and remove as many of the small fish as practical. By the end of 1942, fishermen had removed approximately 5,900. During the summer, bluegills spawned heavily, and large numbers of 'harvestable-sized' fish were taken from spawning beds. Yellow bullheads continued to decline in the catch. The number and size of bass began to increase, and spawned for the first time in the 10-year history of the lake. The population seemed well on its way to a state of 'balance.' It appeared that the 'Investigators' and the Auburn Outing Club with the helpful assistance from a sizeable number of bass fingerlings, finally had themselves a fish pond.

The 'Investigators, also continued to work with a number of other 'private' ponds including:

- Lake Wilmore
- Davis Pond
- Choccolocco Sportsmen's Club Lake
- Union Springs Pond
- Julian Rice Pond
- J. R. Twilley Pond
- Palmers Pond
- Henderson 's Pond

The 1942 Annual Report includes detailed records of the work that they did in these ponds.

IMPORTANT PUBLICATIONS IN 1942

As noted in a preceding paragraph, in April, 1942 the 'Investigators' published Agricultural Experiment Station Bulletin 254, *Management of Farm*

Fish Ponds. For several reasons, it is likely the most important publication ever written by Fisheries Program personnel at Auburn. Apparently, the quality of fishing provided by the “Eureka” Experiment in Farm Pond 4 in 1940 and 1941 convinced the ‘Investigators’ that they knew how to establish and manage fish populations in ‘terrace-water’ ponds. Further, fishing in Farm Ponds 1, 2, and 3 in 1941 had tended to bolster their confidence. As a result, sometime in 1941, they decided that it was time to publish the results of their some 8 years of concentrated research.

They decided to publish their findings as an Agricultural Experiment Station Bulletin. In the Agricultural Experiment Station System, *Bulletins* were primarily a product of ‘settled’ science; where most of the ‘loose-ends’ had been ‘tied-up.’ This was not the case, of course, with their research as the low average size of bass caught in Farm Pond 4 in 1941 indicates. They probably should have published their work in a *Circular* which indicated a situation where the science was less ‘settled,’ but where considerable confirming data had been assembled. It is highly unlikely that ‘Facts’ Funchess would have ever approved the publication of a *Bulletin* on corn production with so little positive data. The only explanation was that he was still mesmerized by the memories of those really nice bluegill males that he had caught in Farm Pond 4 in 1941 – a few might have weighed close to 0.5 pound. Anyway, ‘254’ was published and immediately went ‘platinum.’

It still was a surprising decision. For example, Farm Pond 2 had provided decent fishing in 1941, but when it was later drained, ‘fish-recovered’ included some 23 pounds of adult largemouth bass and 30 pounds of adult white crappie (Tables 48). Farm Pond 3 had also provided good fishing in 1941, but when it was drained in the fall, some 61 percent (211 of 345 pounds), by weight, of ‘fish-recovered’ were bluegill fingerlings (Table 46). Farm Pond 4 had provided good fishing in 1940 and 1941, but the average weight of bass in the catch in 1941 was unacceptable – 0.38 pound (45 fish weighing 17.0 pounds) – below Swingle’s ‘harvestable’ size of 0.40 pound (Table 45). Further, at the time of draining, the total weight of adult white crappie was almost as great as for adult largemouth bass (24.0 versus 36.8 pounds) (Tables 48).

Obviously, by 1941, results of experimentation on the South Auburn Farm provided the ‘Investigators’ with an incomplete data base from which to launch a major publication on the management of fish ponds for recreational fishing in ‘terrace-water’ ponds. It is questionable whether they would have written the *Bulletin* on the basis of those experiments alone. However, by the end of 1941, they had conducted several ‘experiments’ on private ponds in east Alabama as part of their outreach efforts. These generally corroborated the results obtained from the “Eureka” Experiment in Farm Pond 4. Results obtained from their work with Ponders Pond and Choccolocco Lake gave them considerable confidence that they knew how to produce good fishing in

earthen ponds. With time, it would become obvious that the process was considerably more complicated than they could even imagine, but in 1941, those 'little' problems encountered at South Auburn were well below their horizon.

Bulletin 254 was authored by H. S. Swingle (Fish Culturist) and E. V. Smith (Associate Botanist). As noted above, the publication was an immediate success. As a government publication, it was not copyrighted. Soon states across the nation were attaching their own 'cover,' and distributing it. Of course in all of those cases, Auburn and the 'Investigators' were given ample credit for the work.

The authors divided *Bulletin 254* into two basic parts:

- Part I. Principles of Pond Management.
- Part II. Management of Ponds.

Part I listed and discussed seven principles of pond management:

1. The weight of fish which an unfertilized pond can support is dependent upon the fertility of the watershed.
2. The productivity of a pond can be increased by the use of fertilizers.
3. Fish grow rapidly if they have plenty of food – but very slowly if food is scarce.
4. Too many fish in a pond results in small undersized fish and poor fishing.
5. Within one year after stocking, a pond is usually supporting close to the maximum weight of fish for which food is available.
6. If the number of fish in a pond is reduced, the average size of those remaining increases.
7. Bluegill bream cannot be raised successfully in ponds containing only bluegill bream.

The importance of all of these Principles seem self-evident today, but in 1933 when Lake Auburn was first stocked, the 'managers' were likely not aware of a single one of them. It is amazing that in just 8 years (1934-1941), some of the same people who stocked Lake Auburn would be able to prepare *Bulletin 254*. It's also amazing that so few of these principles were clearly demonstrated with well-planned experimentation. Most of them were derived from poorly planned and poorly executed experiments, utilizing the extremely

poor facilities on the South Auburn Farm. But the experiments produced enough, often dis-connected data, to allow the 'inductive reasoning' of the 'Investigators' to supply the 'missing parts.' And, they were unbelievably effective in 'filling-in-the-blanks.'

The effectiveness of the discussion on Principles in the *Bulletin* was significantly enhanced by the illustrations they chose for each one. Pictures of actual fish of the various sizes quickly fixed the attention of the reader on the 'meat' of each Principle involved. They certainly demonstrate the old adage that "a picture is worth a thousand words."

Part II of the publication includes the following topics:

1. Proper Stocking for New Ponds
2. Management of Old Ponds
3. Fertilization of Ponds
4. Fishing
5. Pond Weeds and Their Control
6. Mosquito Control

Table 52 reproduces the Table appearing in the *Bulletin* which contains information on establishing, by stocking, three different combinations of fish in either fertilized or unfertilized ponds. Note that I have made some minor changes in wording and arrangement. This Table developed by the 'Investigators' would lead one to believe that this information was based on 'settled' science. This was certainly not the case. When they began to write the publication in 1941, not a single one of these recommended combinations had been shown in experiments to produce good, sustainable fishing. Data presented in the 1941 Annual Report indicated that there were severe 'structural' problems with all of the populations that had been established in the different ponds of Farm Pond Series, and fished in 1941.

With a few exceptions, the stocking recommendations made by the 'Investigators' worked reasonably well. Fortunately, the bass-bluegill combination is a very "forgiving" one. Given time, just about any combination of the two species, stocked under a wide variety of conditions, would likely come into some semblance of *balance*.

Through time, pond managers have encountered difficulties with some of the recommendations. For example, the use of largemouth bass fry to substitute for fingerlings never became 'settled' practice. Also, there is still

considerable uncertainty on how to use white crappie in ‘terrace-water’ ponds, especially when the populations are being established. Further, their characteristic of explosive, periodic spawning can result in serious problems, especially in smaller ponds. Finally, the statement: “bullhead catfish need not be stocked in ponds built on streams that already contain the fish” is a recommendation for disaster.

The section of ‘254’ on *Fishing* was woefully inadequate, and is likely the best example of the danger involved of publishing before the science is ‘settled.’ When they began to conduct experiments on ‘fishing quality,’ they would quickly understand the complexity of exploitation, especially when fishermen are paying for the privilege. In fact, the ‘Investigators’ would never completely ‘settle’ the science on this issue. They would, after some 25 years, just walk away and leave it behind.

THE POST-254 YEARS (1943-1953)

By 1942, the ‘Investigators’ had ‘caught’ what they had been chasing since 1934 – technology for establishing good, sustainable fishing in ‘terrace-water’ ponds. By publishing *Bulletin 254* (April, 1942), *Management of Farm Fish Ponds*, they were summarizing, for public use, much of the research that they had conducted in Lake Auburn, a number of other private ponds, and on the South Auburn Farm over this 8-year period. Its publication revolutionized warm-water recreational fishing for much of the nation. As noted previously, the publication of *Bulletin 254* might have suggested that the management of farm fish ponds was ‘settled science,’ but this was not true at all. There were ‘loose-ends’ hanging everywhere – all wriggling vigorously for attention. The ‘War-Years’ slowed their efforts to ‘bind’ them securely, but they continued to work at it with all the resources at their command.

This Section will generally discuss the work of the Fisheries Program at Auburn from 1942 through the early 50s; while the following Sections will review its progress in the rapidly changing world following the end of World War II – the era of rapid ‘globalization.’ However, because of the nature of changes taking place, there will be some overlap between the two Sections.

‘INVESTIGATORS’

In July, 1944, E. V. Smith left the Fisheries Program to become Associate Dean of the School of Agriculture and Assistant Director of the Alabama Agricultural Experiment Station. This change resulted in the termination of the work of arguably one of the most productive research ‘teams’ ever assembled at Auburn, or at few other universities. As detailed in a preceding Section, Swingle and Smith had provided leadership for the program from its beginning. They both came from farm backgrounds. Both were indefatigable in their work ethic. They were involved in the planning of the South Auburn

Farm and supervised the beginning of construction of Farm Pond 1 in 1933. They continued to work together to plan and supervise much of the construction on the Sougahatchee Farm, and to begin research there. When they were separated in 1944, after some 10 years of effort, they had developed a completely new field of practical science. They had learned, from 'scratch' how to create good quality, recreational fishing, quickly, in 'terrace-water' ponds. Even more amazing, within a few short years, this technology was in use throughout much of the United States. Unfortunately, because the new science was neither traditional agriculture nor traditional fisheries management, they received relatively little credit for what they had done from the professionals in either of those more traditional fields.

They cooperated in almost endless days of planning, supervising construction, designing experiments, counting weighing and stocking fish, wading hip-deep in mud and muddy water seining and draining ponds, taking water samples, performing chemical analyses, drying and weighing plankton samples, identifying and counting bottom organisms, studying the contents of fish and bullfrog stomachs, data analysis, writing publications, attending meetings and making speeches. A review of the detailed Annual Reports which they prepared leaves one with a sense of astonishment and wonder at the amount of work they did. One is also struck with the width and depth of their intellectual accomplishments in a field foreign to both, and at their use of inductive and deductive reasoning in reaching significant and far-reaching conclusions from data obtained with inferior experimental facilities. When one considers their total 'body-of-work,' it is difficult to comprehend the fact that this 'team' accomplished what they did in slightly over 10 years. Smith's departure also resulted in a 'sea change' in the nature of the investigative team in the Program. The Swingle-Smith team was a team of 'equals.' Both had joined the project at the same time, and both were faculty in the Agricultural Experiment Station. Further, both were likely members of the Auburn Outing Club, and had been concerned about the success or lack thereof of Lake Auburn. Afterwards however, until his retirement, Swingle would provide leadership for 'teams' consisting almost entirely of his ex-students.

Personal comments by H. S. Swingle indicated that Smith told him that, in his new position as an administrator of the Experiment Station, he would do whatever he could to advance the work on farm ponds, but that he would not likely ever be able to increase the Project's share of Experiment Station funds. Smith maintained a keen interest in the Project. It was his contact with officials of the Agency for International Development in Washington that led directly to Auburn's involvement in international aquaculture. Later, as the international staff expanded, on 'soft money,' Smith promised to provide transition funds from the Experiment Station, if those temporary positions had to be terminated, and if there were no other funds available.

CONSTRUCTION

From this point forward, 'Construction' will be described in Sections on 'Improving Facilities' for each Farm separately.

WRAPPING-UP 'LOOSE-ENDS'

As detailed in a preceding Chapter, *Bulletin 254 – Management of Farm Fish Ponds*, published in April, 1942, was based on only a very limited amount of relevant experimental data. This was especially true in the areas of pond stocking, determination of pond balance, management of old ponds and exploitation. As a result, after its publication the 'Investigators' still had a considerable amount of work to do wrapping-up 'loose-ends.'

EXPERIMENTS IN POND STOCKING

Results obtained from experiments conducted on pond stocking through 1945 were reported by Swingle (1949a). Surprisingly, none of the experiments that he described were designed to validate the stocking recommendations presented in *Bulletin 254*. The primary value of this research was in its evaluation of a number of other species of forage for use in farm fish ponds stocked with largemouth bass.

SUMMARIZING THE RESULTS OF POND STOCKING RESEARCH

In 1951, Swingle published another paper (*Experiments with Various Rates of Stocking Bluegill, Lepomis macrochirus Rafinesque, and Largemouth Bass, Micropterus salmoides (Lacépède), in Ponds*) which summarized the results obtained from several additional experiments on pond stocking. It summarized results obtained in three general areas:

1. Use of adult or fingerling fish for stocking.
2. Effect of stocking different numbers of fingerling bluegills.
3. Problems related to variable mortality of stocked bass.

Surprisingly, none of the data obtained from any of these experiments were used to make changes in *Management of Farm Fish Ponds*.

RESEARCH ON THE USE OF 'SHELLCRACKERS' IN POND STOCKING

It is surprising that the 'Investigators' waited so long to consider the use of shellcrackers (red-ears) in the stocking combination for the establishment of bass-bream populations. They were well aware of the positive characteristics of the species as a sport fish, but they had done virtually nothing to

determine what role it might have in establishing and maintaining good fishing populations.

THE 'F' SERIES EXPERIMENT

In 1942 they initiated the first experiment on the stocking of shellcrackers. They stocked three 'F' Ponds as shown in Table 53. These ponds were drained in 1944. Again, there were no replications. They concluded from this meager data that shellcrackers grew more rapidly than bluegills, but conclusions could not be drawn at that time regarding their use in providing good fishing in farm ponds.

THE 'E' SERIES EXPERIMENT

In 1943, they stocked two 'E' Ponds (E-1 and E-2) with largemouth bass and shellcrackers as part of a larger experiment on Fishing Quality (Table 54). The ponds were fished by the public in 1944 and 1945 and drained in late 1945. Table 53 presents data on the catch in 13, 'half-days' of fishing in 1944 in those ponds. Unfortunately, the data from Pond E-2 is of limited value. 'Wild' bluegills gained entrance to the pond shortly after stocking. As a result, almost 20 percent of the total catch in 1944 were bluegills.

Table 55 presents data on the total catch of all species in 13 'half-days' of fishing in 1944. Table 56 presents data on the average weight of bluegills and shellcrackers caught. On reviewing the data from this experiment, the 'Investigators' commented:

“At least one more year of research would be needed before the place of shellcrackers could be determined.”

I have been unable to find the results of any later specific research related to this uncertainty before they began to write the Revision of *Bulletin 254*, sometime in 1946.

EXPLOITATION AND FISHING QUALITY IN THE 'E' PONDS

In the early 40s, it was decided to utilize the newly constructed 'E' Ponds (Figure 19) on the Sougahatchee Farm to evaluate the fishing quality provided by the 'Eureka' stocking combination when subjected to different amounts and types of exploitation. Remember that the 'exploitation' in the original 'Eureka' Experiment was provided by the 'Investigators' plus their guests; however, they quickly realized that this procedure would not be practical in the 'E' Ponds. As a result, they decided that they would allow the 'public' to do the fishing and to charge them for the privilege. The first experiments were initiated in 1942. Fishing was initiated in 1944. Similar experiments would be continued through 1954.

THE 1942-1945 EXPERIMENT

Eight 'E' Ponds were stocked in this experiment in 1942 and 1943 as shown in Table 54; however, public fishing was allowed in only Ponds E-1, E-2, E-3, and E-4. Note that not a single one of these four ponds was stocked following the recommendations published in *Bulletin 254* (Table 52). As noted in a preceding paragraph, Pond E-2 was stocked as a bass-shellcracker combination, but apparently, a large number of small bluegills entered the pond through the water supply connection with the 'diversion ditch.' When the pond was drained in 1945, more pounds of bluegills than shellcrackers were recovered.

When fishermen arrived at the ponds, they registered with 'creel clerks' at a small counting/weighing house constructed adjacent to the ponds. They were allowed to choose which of four ponds they desired to fish (Figure 36). When they had paid the required fee, they were issued a card with the number of the chosen pond on it. However, if they wished to change ponds because they were catching no fish, they were allowed to do so by returning to the counting house for a new card.

The ponds were first opened for public fishing in 1944 (afternoons only) on Monday, June 19; Wednesday, June 21; and Friday, June 23 and afterwards on Monday, Wednesday, and Friday for the next two weeks. After July 7, they were opened only on Friday through August 4. Within this period, fishing privileges were sold for a total of 13 'half days.' Fishermen were allowed to catch 15 bluegills and 2 largemouth bass per purchased permit, and within that limit, they were required to keep all fish caught regardless of size. During the period June 19 through June 26, a rate of 50 cents per person was charged for fishing. In the period June 28 through July 7, each person was charged 50 cents, but 25 cents was returned if they didn't fish. During the period July 14 through August 14, fishermen were charged only 25 cents and that amount was returned if they caught no fish.

NUMBERS OF FISHERMEN FISHING IN 1944

When the four ponds were opened for fishing on Monday, June 19, 1944 ('half-day' 1), a total of 50 people purchased 'permits' (Figure 36). On 'half-day' 2 (Wednesday, June 21), the number increased to 73, and on Friday, June 23 ('half-day' 3) the number almost doubled to 136. Afterwards, however, the number began to decline and on 'half-day' 13 (Friday, August 4), only a single person purchased a 'permit' (Figure 37). Generally, the trends of the number of fishermen fishing each day were similar for all of the ponds.

Some of the 'day-to-day' variation in daily fisherman-numbers, seen in Figure 37, seemed to have been related to day of the week. 'Half-days' 2, 5, 8 were Wednesdays. Apparently many businesses in both Auburn and Opelika

closed on Wednesday afternoons during this period.

The interest in recreational fishing indicated by these data is somewhat surprising. On June 6, 1944, Allied Army landed on the French Coast, and on June 19, the battle for Normandy was still raging. At that point, it was not certain that they could maintain their position; much less advance across France. At the same time, Admiral Nimitz was continuing to 'leap-frog across the Pacific,' and on June 15, his strike force landed on Saipan. Also remember that the rationing of gasoline was in place at that time.

THE 'CATCH' IN 1944

Data on the total catch of all species, for each day, are presented in Figure 38. Data on the total catch of each species for the total period are given in Table 55. The distribution of total catch per 'half-day' (CPUE) generally followed the same pattern as total fishermen per 'half-day' (Figure 37). The important point here is that by the end of 'half-day' 3, fishermen had removed slightly more than 250 pounds of fish from the four ponds. This weight probably represented over 50 percent of the total weight of fish in the ponds when they were opened for fishing.

Data on the average weight (in pounds) of all species caught per fisherman on each 'half-day' in the four ponds (Ponds E-1, E-2, E-3 and E-4) during 13 'half-days' are presented in Table 57 and Figure 39 ('Catch Per Unit of Effort' or CPUE). CPUE was at a level of 2.95 pounds on 'half-day' 1, and just slightly higher (3.14) on 'half-day' 2, and 1.92 on 'half-day' 3. From that point, it continued to decline, reaching 0.81 on the 6th 'half-day' of fishing. It recovered somewhat afterwards, but generally remained below 1.0 for the remainder of the 13-day period. These data presented suggest that at the end of 'half-day' 4 (CPUE = 0.92), that fishermen had apparently decided that the 'fishing quality' was unacceptable. Except for 'half-days' 8 and 9, relatively few fishermen fished. In fact, I suspect that the CPUE of 2.95 on 'half-day' 1 was unacceptable, given all the effort and costs incurred in catching those fish. One would have to conclude from these data that fishermen experienced relatively good fishing for three days. It certainly was not sustainable afterwards.

NUMBER OF FISHERMEN FISHING IN 1945

The Fishing Quality experiment initiated in 1944 was continued in 'E' Ponds 1, 2, 3, and 4 in 1945. The ponds were opened for fishing for a total of 28 'half-days' from Monday, June 11 through September 14. During most of this period, the ponds were open on Mondays and Fridays. This year the catch limit was set at 2 bass and 10 bluegills. Fishermen were required to keep all of the fish that they caught regardless of size. Permits were 50 cents each, with no refund if no fish were caught. If they were unable to catch fish in one

pond, they were allowed to transfer, without charge, by returning to the creel house to obtain a transfer permit.

On 'fishing-day' 1 (Monday, June 11) slightly less than 20 fishermen purchased permits (Figure 40); then on 'fishing-day' 2 (Friday, June 15), some 50 persons purchased them. This same 'low-high' pattern continued on 'fishing days' 3 and 4; however, after 'fishing-day' 5, fewer than 10 fishermen per day purchased permits, except on 'fishing-day' 10.'

Numbers of fishermen fishing the four ponds in 1944 and 1945 are shown in Figure 41. In both years most of the fishermen came to fish in the first five days that the ponds were open.' Afterwards, relatively few people paid to fish.

THE 'CATCH' IN 1945

As noted in the preceding paragraph, Figure 41 presents comparative fishing data for 13 'half-days' in 1944 and 1945. A summary of some additional data obtained from fishing in 1945 is presented in Table 58. As was the case in 1944, most of the total fishing effort for 1945 accrued during the first 5 'half-days.' It is likely that the CPUE at this point became unacceptable to most fishermen. These data are not comparable to those from the first year of fishing (Table 55); primarily because of the change in the "bag-limit" for sunfish from 15 to 10. Also, the total number of 'half-days' of fishing was considerably greater in 1945 (28 versus 13). Since these changes were applicable to all the ponds, there is no way to know what effect they had on the fishermen or the fishing. Regarding the 1945 phase of the experiment the 'Investigators' commented:

"The fish were much less easily caught during the second season than they were during the first "

The bass in Pond E-3 did not spawn in 1945; consequently, 200 bass fingerlings were added July 21. The lack of spawning likely indicates that the population had become severely 'stressed' sometime in late summer of 1944. Note that only 85 of the 200 bass fingerlings stocked in July were recovered on draining.

DRAINING IN 1945

The ponds were drained during the period December 3-6, 1945, and data was collected on the number and weight of fish removed. Some of the data obtained on draining are presented in Table 59. These data provide an estimate of the adult fish that would be available to fishermen if fishing had been continued in 1946.

The data is also indicative of the status of all of the small and intermediate 'sunfish' that were expected to grow into the 'large' size ('harvestable') class within the next year. Most of these data indicate that there were simply too many of them to grow very much in the following 12 months. For example, in Pond E-1, 49,875 small bluegills and shellcrackers, with a total weight of 99.7 pounds, were recovered on draining. Of course the bass would be expected to consume a portion of them, but even with that predation, there would be far too many remaining to grow to the 'harvestable' size of 0.10 pound, and certainly too many to reach the 'Target' size of 0.25 pound. As a result, fishing quality would likely be extremely poor.

The results of this first experiment (1944 and 1945) strongly indicated that the classical "bass-sunfish" population established in the four 'E' Ponds based on the on the 'Eureka" model could not provide good fishing for very long when exposed to high levels of exploitation.

THE 1946-1947 EXPERIMENT

The 1946-1947 Fishing Quality experiment in 'E' Ponds 1, 2, 3, and 4 was similar to the previous one (1942-1945), with the exception that only 100 bass fry, instead of 200, were stocked in each pond. Bluegills were stocked in December, 1945, and the bass fry were added in early May, 1946. There was also another really important difference in the two experiments. World War II had ended in 1945. All of the various war-time restrictions had been lifted, and most of the millions of servicemen involved in the hostilities had returned home. As a result, 'exploitation' in 1946-1947 was 'a world apart' from that of the 1942-1945 experiment.

The ponds were opened to public fishing on Tuesday, April 15, 1947. Fishing was allowed from 1 to 6 pm on Tuesdays and Thursdays. Fishing permits were 50 cents each. Fishermen were required to keep the first 10 bluegills and 3 bass that they caught, regardless of size. The public response to the opening of the ponds was overwhelming. The 'investigators' commented:

"The fishermen were so numerous about the ponds on the second day that they interfered with one another's fishing. Apparently this unusual disturbance on the second day was responsible for the lower catch of fish."

Data on the number of persons fishing each pond in 1947 and the total catch of all species for each pond are presented in Table 60. The average number of persons fishing ranged from 225 to 299. 'Confidence Interval' estimates indicate that 'Stocking Combinations' probably had a significant effect on the number of persons fishing each pond, but not on total catch.

In the 1947 Annual Report the 'Investigators' wrote the following regarding

the first year of fishing for the 1946-1947 Experiment:

“The good fishing afforded in these four ponds attracted more people than could be adequately accommodated... On the first day 85 permits were issued, and the average catch was 2.54 pounds per permit. The second day 223 permits were issued, and the average catch was only 0.84 pound permit... Of the total amount caught during the season, from 31.2 to 58.2 percent per pond were removed during the first two days of fishing. From this time on, until the close of the experiment, the total catch and the number paying to fish decreased.”

Obviously, these four stocking combinations could not produce good fishing on a sustainable basis. With this level of exploitation, relatively good fishing lasted only one day.

THE 1948-1951 EXPERIMENT

Another experiment on the management of fishing quality was conducted in the eight ‘E’ Ponds during the period 1948-1951. The ponds were stocked as shown in Table 61 in 1948 and 1949. The basic experiment was to determine the quality of fishing provided by populations established with four different stocking rates (500, 1,000, 1,500 and 2,500 per acre or per pond) of bluegills. Each stocking rate was replicated in two ponds. All ponds were fertilized according to the usual procedures and schedule.

The ponds were opened for public fishing on Saturday, May 27, 1950. Unfortunately, when fishing began, only the population Pond E-3 was in state of desirable ‘balance,’ and bass spawned only in Pond E-1. Because of the generally poor condition of all of the populations, fishing was allowed only from May 27-July 15, 1950. Although there were serious structural problems in the populations of all of the ‘E’ Ponds when they were first opened for fishing, the fishing quality would have been quite good in some of them, especially for the stocked bluegills; however, after a large share of the original stock had been removed, fishing quality would likely have deteriorated rapidly.

The results of the 1950 fishing in the 1948-1951 experiment should have been extremely disappointing to the ‘Investigators.’ Their ability to establish ‘balanced’ populations by stocking fingerling bluegills and bass had never been a concern. Unfortunately, in this case, seven of eight ponds were in some state of ‘unbalance’ when fishing began.

In 1950, once the ‘unbalanced’ ponds were closed to fishing, the ‘Investigators’ began to apply several management techniques (partial poisoning, seining and winter feeding) to try to bring the populations into “balance.” In the effort to correct the unbalanced situation with feeding, ‘E’

Ponds 1, 2, 3, and 4 received 20 pounds of soybean cake per day, while 'E' Ponds 6, 7, and 8 received 10 pounds. Feeding was discontinued during the period, March 15 through May 18, 1951 because fish were not utilizing the feed. Fish kills related to anoxia occurred in 'E' Ponds 1, 2, 3, 6, and 7 during the spring and summer of 1951.

Several of the ponds were again opened for fishing during the period, Tuesday, May 8-August 13, 1951. Fishing records were maintained only on five ponds ('E' Ponds 1, 2, 3, 4, and 8. Total catch ranged from 120.2 to 277.1 pounds per acre (Table 62), and CPUE's varied from 0.76 ('E'- 2) to 0.99 ('E' Pond 1). Remember, however, that these values are averages for the entire fishing season and that they were likely higher on May 8 and lower on August 13. Unfortunately, the experimental treatments had been altered so extensively that it was difficult to evaluate the catch data. However, the CPUE values suggest that fishing quality was poor for the entire period. Any value less than 1.5 pounds per 'half-day' of fishing would have to be disappointing.

'E' Ponds 1, 2, 3, 6, 7, and 8 were drained in the fall of 1951. Ponds E-4 and E-5 had been drained earlier as a result of extensive 'fish kills.' 'F/C' Ratios for the six populations recovered on draining are presented in Table 63. These 'F/C' data (8.9 to 1727.5) indicate that all of these populations were seriously 'unbalanced' at the time of draining, or that would become seriously 'unbalanced' early the following year. Remember that Swingle (1950) suggested that values in the 3 to 6 range were the most desirable. Fishing quality in all of them would have been unacceptable.

None of the techniques used to correct the 'balance' problems seemed to have worked. When the 'Investigators' published *Bulletin 254* in 1942 and revised it in 1947, they must have believed that they knew how to establish 'balanced' fish populations in 'terrace-water' ponds. These results suggested that there was still much more work to be done. At this point, they did not know how to maintain 'good' quality fishing in populations exposed to high levels of exploitation, and now they had to be concerned as to whether or not they knew how to establish good quality fishing to begin with.

THE 1952-1954 EXPERIMENT

Still another Fishing Quality experiment was conducted in the 'E' Ponds during the period 1952-1954. 'E' Ponds 1, 2, 3, 6, 7 and 8 were each stocked with 1,000 bluegills and 500 shellcrackers, per acre, on January 3, 1952. A total of 125 largemouth bass fry were added to each pond on May 1, 1952. The ponds were fertilized according to the recommended schedule. The design of this experiment was truly surprising. For the first time, the stocking combination utilized generally followed the recommendations of *Bulletin 254 (Revised)*, and the 'Investigators' committed six ponds to the

same treatment. Apparently, the results of the preceding experiment (1948-1951) had severely shaken their confidence in their ability to provide and maintain good fishing in earthen ponds.

The ponds were opened for 'fee' fishing on Wednesday, August 12, 1953, and on Wednesdays and Saturdays through September 11 (a total of 9 days). Fishing on the first and second days was extremely good, but afterwards, 'numbers-caught' declined rapidly. While the catch (numbers) of bluegills might have been acceptable for 2 days, the average size was not. Average weights of all bluegills caught in 'E' Ponds 3, 6 and 7 were disappointing (Table 65). Fishermen probably considered limits of 6-inch bluegills as only marginally acceptable. Similarly, the average weights of bass caught in 'E' Ponds 1, 2, 3, and 8 were much lower than expected and somewhat lower than expected in 'E' Ponds 6 and 7. Attempts to produce good, sustainable fishing in the 'E' Ponds still seemed to be an elusive goal.

The ponds were again opened for 'fee' fishing on Saturday, August 21, 1954, and on Wednesdays and Saturdays through September 11, 1954. In addition, they were also open on September 9 and 10 (a total of 9 days). The fishing was generally poor in all of the ponds. The size of bluegills was again especially disappointing. The 'Investigators' commented in the 1954 Annual Report:

“Toward the end of the fishing 'season, fishermen were including 'Intermediate' fish (3 to 5-inch-groups) in their 'limits.' Fishermen were forced to keep a relatively large number “Intermediate” bluegills (generally inch-groups 3-5) to fill their bag-limits.”

All of the ponds were drained in December, 1954. Data presented in Table 66 gives the number of 'Small', 'Intermediate' and 'Large' bluegills recovered from each pond. There was simply no possibility that this number of 'Small' and 'Intermediate' fish could ever grow into the 'Large' Group. By the spring of 1955, all eight ponds would have been badly 'overcrowded' with 'Intermediate' bluegills. As a result, fishing quality would have been unacceptable again.

OVERVIEW OF RESEARCH ON FISHING QUALITY IN THE 'E' PONDS

At this point, after the completion of three Fishing Quality experiments in the 'E' Ponds, one would have to conclude that the 'Investigators' simply did not know how to maintain good fishing over an extended period of time in these 1-acre ponds when they were heavily fished. In most cases, fishing was relatively good for a few days, but deteriorated rapidly afterwards. Even more troubling was their inability to establish and maintain 'balance' in the ponds initially. At the end of this third experiment, it was obvious that there were more questions than answers. For whatever reason, the 'Investigators'

chose not to pursue Fishing Quality research in these ponds any further. Beginning in 1955, the 'E' Ponds were put in experiments on the production of speckled bullheads, smallmouth buffalo and fathead minnows.

It is unfortunate that this research was terminated at this point. It had the potential of providing a wealth of valuable information on population dynamics in multi-species, exploited populations that was unavailable at other research facilities. Ultimately, it had the potential of providing fisheries managers with methods of analyzing the extremely complex processes of reproduction, growth, natural mortality (predation) and fishing mortality, along with their many interactions. The 'Investigators' did make a halting effort to consider some of these problems, but they abandoned the research when they were unable to maintain good quality fishing after the first few days. They had already decided that one of their problems was that the 'E' Ponds were too small. With this problem in mind they had already begun research on 'fee' fishing in Pond S-6 (25.5 acres) on the Story Farm. The Field Crew had completed construction of the pond in 1947. It was stocked in 1947, and public fishing was initiated a year later.

THE REVISION OF BULLETIN 254

The publication date for the Revision of *Bulletin 254* is January, 1947. It is somewhat surprising that the 'Investigators' went to the trouble of revising it. There were relatively few changes. The primary change was the addition of some life-history data on the shellcracker, and the recommendation that this species be stocked along with bluegills and largemouth bass in the establishment of recreational fishing populations in new ponds. Surprisingly, as detailed in a preceding paragraph, the specific recommendation of replacing 500 bluegills in the stocking combination with 500 shellcrackers had not been established with pond research. However, the use of shellcrackers in stocking ponds for recreational fishing has proven to be very beneficial over time.

It is really unfortunate that the 'Investigators' did not wait until the mid-50s to revise the *Bulletin*. Some of the most important information regarding the management of farm fish ponds was obtained shortly after the *Revision* was completed. Although much of that additional information was eventually published, it was never added to the "Bible" on pond management.

As detailed in a preceding Section, one of the most glaring problems in the original '254' was the "Fishing" Section. The Revision included exactly the same material, even though the data from the Fishing Quality experiments in Farm Pond 4 in 1941 and 1942 were available. Also, when the Revision was being prepared, fishing data from 'E' Ponds 1, 2, 3, and 4 in 1944 and 1945 were available. These data would have demonstrated that exploitation of farm fish ponds was an extremely complex matter.

RESEARCH ON THE DYNAMICS OF FISH POPULATIONS

The publication of *Bulletin 274* (June, 1950), *Relationships and Dynamics of Balanced and Unbalanced Fish Populations* (Swingle, 1950), represents one of the most ambitious research projects ever undertaken by the 'Investigators' at Auburn. To obtain the data used in its preparation, they drained 85 ponds containing established populations. The fish were collected from each pond, divided into several specific groups, and the number and weight in each group counted and weighed. In addition, population data were obtained from four ponds in which all fish were collected with the use of rotenone.

As a result of the study, the 'Investigators' generally concluded that if a population is capable of producing good fishing 'year-after-year,' it should be considered to be in a state of 'balance' and that in this situation all of the relationships within species and between species must also be in 'balance.' Based on this concept and the data they collected, the 'Investigators' determined that 55 of the populations were in a state of 'balance' and 30 were in a state of 'unbalance. Unfortunately, they had no way to determine whether or not any of these populations would produce good fishing continuously. The data presented in a preceding Section on 'fee' fishing in the 'E' Ponds is indicative of the difficulty of predicting how populations respond to exploitation; especially when subjected to high levels.

They also used the data to calculate a number of ratios between weights of different species and weights of different sizes of the same species. These included the 'F/C' Ratio (the total weight of forage fish divided by the total weight of carnivorous fish) and the A_T Value (the percentage of the total weight of all fish that are considered to be of 'harvestable' size).

In the publication, Swingle placed much of the emphasis on the 'F/C' Ratio. Figure 1 in the publication is a frequency distribution of the Ratios in 'balanced' and 'unbalanced' populations. The data indicate that Ratios in 'balanced' populations tended to be somewhat lower than those in 'unbalanced' populations; although there was a considerable amount of overlap.' If there had been equal numbers of populations in the two groups, the 'over-lap' would likely have been much more obvious.

Figure 42 shows the relationship between pounds per acre of forage fish and pounds per acre of carnivorous fish in 29 of the 'balanced' populations in this study. The 'scatter' in the individual data points indicate that there was very little correlation between these two variables. The Correlation Coefficient for the data set is 0.0719. These data indicate that there was little or no relationship between the weights of these two groups of fish in those 28 'balanced' fish populations.

Unfortunately, the material presented in *Bulletin 274* never received much attention, either among pond managers or fishery biologists. Classical fisheries scientists seemed to simply ignore Swingle's population dynamics, as defined in the *Bulletin*. Probably very few of them could see any value in a procedure which required the 'destruction' of the population through draining or the use of rotenone. There are relatively few situations in 'public waters' where the necessary data could be collected. Although Swingle continued to use the various 'values' defined in the *Bulletin* from-time-to-time, he finally understood the futility of their use when he wrote the publication on determining the state of balance in a pond (Swingle, 1956). The procedure described in this publication determined the 'real-time' status of 'balance' in bass-bluegill populations by taking samples of the population using seines.

DETERMINATION OF 'BALANCE' IN FARM FISH PONDS

It is likely that the 'Investigators' quickly realized the general lack of utility of the information presented in *Bulletin 274 (Relationships and Dynamics of Balanced and Unbalanced Fish Populations)*, in the management of 'terrace-water' ponds. As a result, in 1956, they published a paper entitled *Appraisal of Methods of Fish Population Study - Part IV – Determination of Balance in Farm Fish Ponds* (Swingle, 1956). This is probably the most important publication ever developed by the Auburn 'Investigators' on pond management. It would be the last publication based on original research written by the 'Investigators' on the use of largemouth bass and bream for producing recreational fishing in 'terrace-water' ponds. The publication met many of the objections to *Bulletin 274*. Specifically, according to the publication, the state of 'balance' in a population could be determined quickly and easily without draining the pond. It summarized virtually everything that the 'Investigators' had ever learned about the biology of bluegills and largemouth bass and the dynamics of their populations in exploited "terrace-water" populations. Simply stated, they posited that in the summer season, after the bass had spawned, if all physical conditions (pH, temperature, salinity, etc.) were conducive to spawning and if there was evidence that both species had spawned; then 'all-was-well-with-the-world.' The population was in a state of 'balance.' The absence of evidence of spawning in either or both species indicated that there was a problem with "balance" in the population.

The beautiful part of this approach was that this determination could be made quickly with the use of a 15-foot minnow seine. However, the publication also recommended the use of a 50-foot seine principally to "corroborate the conclusions reached from the results with the small seine and to determine the presence of competing species." The large seine was also useful because it often captured adults. Handling each of these adults for only a few seconds was sufficient to determine their relative condition, which was extremely useful in verifying the state of balance as indicated by the small

seine.

PARTIAL POISONING OF OVERCROWDED FISH POPULATIONS

With results obtained in the experiments on exploitation in the 'E' Ponds and of owners of private ponds throughout the State and the Region, it was obvious to the 'Investigators' that in all too many cases, exploited populations became seriously 'unbalanced' a few months after fishing began. In most of these cases, the number of 'intermediate' bluegills in the population literally exploded. As a result, fishing quality deteriorated rapidly. An obvious solution to this problem was the removal a large portion of the 'intermediate' bluegill population with the use of fish toxicants without killing an excessive number of adult fish.

In the early 50s, the 'Investigators' began research on this problem in the eight 'E' Ponds. It involved evaluation of the use of Derris dust, containing five percent rotenone, applied as a thick paste in a single location, along the 'center-line,' or along the margin. An evaluation of the results indicated that application along the margin was the most effective. Later, marginal applications were evaluated in larger ponds. Research also indicted that marginal poisoning was more effective during the middle of the day when, the number of adult fish was at a minimum, in the shallow water of the pond margin and that wind speed was a critical factor in the success of the method. Further, the research demonstrated that the method should not be used unless fingerling bass were available for stocking after the number of 'intermediate' bluegills was reduced substantially. Swingle reported the results of this research in *Circular No. 113*, published by the Alabama Agricultural Experiment Station in March, 1953.

While experimental results indicated that 'over-crowding' by 'Intermediate' bluegills could be reversed through the use of marginal poisoning and the stocking of fingerling bass, they also indicated that the procedure, while effective, was extremely 'tricky.' Only a narrow margin-of-error separated success from disaster, in which too many adult fish were killed. Later, in a class project, Swingle and his students killed so many adult fish in Pond S-3 that it had to be drained and restocked.

Many years later, the problem of 'over-crowding' with 'intermediate' bluegills would largely disappear. As other opportunities for public fishing increased, exploitation rates on farm fish pond populations throughout the Region generally declined. Exploitation of bluegills in many of the populations was virtually eliminated. Exploitation of bass was reduced somewhat, but not nearly as much as for bluegills. Further, over-time, 'catch-and-release' of bass virtually eliminated their removal. Under these circumstances, 'over-crowding' with bluegills was replaced by 'over-crowding' with bass. Unfortunately, this situation is much more difficult to deal with, and by the

time it became so omnipresent, Auburn 'Investigators' had largely lost interest in farm pond management.

A CONTINUING PROBLEM WITH 'LANGUAGE'

The American Fisheries Society was established in 1870. It was well over a half-century old when Swingle and Smith began their work. In that long period, fisheries professionals had developed a 'language' of their own. The Auburn 'Investigators,' steeped in the 'language' of production agriculture and of agricultural research, never bothered to learn the 'language' of the fisheries professionals, and in turn, the fisheries professionals never made an effort to learn the specialized 'language' of Smith and Swingle – the 'language' of population 'balance,' 'F/C' Ratios, 'E' values, 'A_T' values or 'S_F' 'Ratios'. This communication problem was not all that surprising. Relatively few fishery professionals had any experience with man-made, 'terrace-water' ponds; especially any stocked with just largemouth bass and bluegill sunfish and fertilized with cotton fertilizer. In turn, Swingle and Smith had never spent much time in trout streams or on northern pike-walleye-yellow perch lakes. Hatchery managers attending professional meetings were the natural allies of Smith and Swingle, but they had developed their own 'language.'

A good example of the difficult problem faced by Swingle and Smith regarding the matter of different 'languages,' was aptly demonstrated in the Twenty-first Conference of the North American Wildlife Conference in 1956. Swingle attended the Conference and delivered a paper based on his seminal work: *Determination of balance in farm fish ponds* (Swingle, 1956a). In the question and answer session, he was not asked a single question about his presentation. He was asked several questions regarding a comment that he had made concerning the possible excretion of a chemical by fish in ponds that represses reproduction. During this session, he provided a classical Swingle comment regarding the accuracy of the "mark and recovery" method of estimating the number of a given species in a body of water. He commented "you can get the greatest accuracy by using beans and leaving out the fish." While this remark was obviously true, it was probably not well received by professionals who were forced to utilize the method on a daily basis.

Traditional fishery scientists probably had little interest in Swingle's method of determining balance; because it seemed to have little value to them in the management of much more complex fish populations in most public waters. Further, 'terrace-water' ponds were mostly constructed on private property, and in most states, it was illegal to use State funds provide management assistance for them.

PURCHASE AND DEVELOPMENT OF THE STORY FARM

Personal communication with H. S. Swingle indicated that Experiment Station faculty in 'reserve status' were quickly called for 'active duty at the beginning of World War II, and that 'salary-savings' quickly began to accumulate. Apparently Funchess was told unless these funds were utilized that they would be reclaimed by the State. It is not likely that this situation began to develop until early 1942. These developments are fascinating because there must have been many ways the Dean/Director could have utilized those funds, but he chose to significantly increase his investment in the Fisheries Program. The fishing that he likely enjoyed in Farm Pond 4 in 1940 and 1941 must have reinforced his already strong commitment to good fishing in 'terrace-water' ponds. This was the third critical decision made by Funchess. In the first one, he approved the development of a new Experiment Station Project for conducting research on the management of farm fish ponds, and in the second one, he approved the purchase and development of the Soughatchee Farm. This third decision was especially important because it provided the 'Investigators' with a site for the construction of a number of 'terrace-water' ponds. Neither the South Auburn nor the Soughahatchee Farms provided them with that opportunity.

Discussions between the 'Investigators' and the Dean/Director regarding the need for larger 'terrace-water' ponds for experimentation resulted in the use of some of those 'surplus funds' for the purchase of the Story Farm (Figure 18A). Negotiations for the purchase of the 700-acre tract began in late 1943. The University took possession of the property in January, 1944. Pond construction began in April of that year.

The 'Investigators' commented on their plans for the utilization of the Farm:

On this area it is planned to work out various phases of combined land and water utilization. The principal crops will be produced in impounded waters, and methods for the utilization of all water falling upon the land will be developed. The land will be managed in various ways to determine what methods of utilization will best fit into a system of water farming. Since one of the more profitable methods of marketing fish at present would be the selling of fishing privileges, part of the area will be devoted to the experimental management of public fishing areas. The raising of fish and other water crops for marketing will also be studied."

One only has to look at the arrangement of ponds on the farm's watersheds (Figure 43) to appreciate the progress that the 'Investigators' made on their first goal of harvesting 'all water falling upon the land.' The pond 'lay-out,' including the road system and the diversion canals, is a masterpiece of planning, engineering and construction. Unfortunately, they did not make much progress in land management, and apparently, as will become obvious

in the coming years, they did not fully understand what commercial 'water farming' as opposed to experimental 'water farming' really entailed.

After the purchase of the Story Farm, the Agricultural Experiment Station continued to purchase additional land west, north and east of the Story Farm for use by several other Departments. Over time, portions of several of these 'outlying' parcels would become extremely useful in the expansion of the storage of water.

GEOLOGY AND SOILS

The characteristics of the Geology and Soils on the Story Farm were generally similar to those described previously for the Saugahatchee Farm. One difference was the presence of several 'outcrops' of extremely hard igneous rocks on the new farm.

DWELLINGS ON THE FARM

The Story Farm was a typical large, struggling cotton farm on the Piedmont in the period after World War I. It was much too large to be operated by a single family; consequently, the owners had constructed a number of wooden frame houses around the farm to attract laborers. I am not certain who lived in those houses when the land was purchased by the University, but once it was assigned to the fisheries program, several members of the Field Crew and their families lived in them until they were finally demolished. A map (18C) shows the location of five of these houses on the Farm. Comments regarding their specific location and crew members who lived in them are included in Appendix Table 3.

SOME POND CONSTRUCTION DETAILS

As noted earlier, construction of ponds on the Story Farm was initiated in April, 1944, and continued through the remainder of the year. However, 'war-time' restrictions were placed on construction in early 1945. As a result, there was no additional construction until restrictions were lifted following the end of the War in September. The War's end allowed for the continuation of construction, and it also provided immediate access to an unbelievable quantity of war surplus equipment that could be obtained with little cost to the Experiment Station. Three tractors, two with bulldozer attachments, and a 16-yard scraper were obtained under this war-surplus program (Figure 44). Their acquisition greatly facilitated the construction of those large ponds on the Farm.

At the time of purchase, there were three un-named primary streams on the Story Farm (Figure 18). The larger of the three originates in a small valley south of Highway U.S. 280, just south of its junction with County Road 90

(Old Fire-Tower Road). From this point the stream courses generally south then southwestward before leaving the property on its western boundary. Ponds S-8 (1946), S-14 (1946), and S-16 (1948) were constructed on this stream. Later, Pond S-30 (1979) was added. Several miles downstream it joins Loblockee Creek. In 2010, it was officially designated *Swingle Creek* (AWWareness, January 10, 2010). Note that *AWWareness* is the 'online' newsletter of Alabama Water Watch.

A second primary stream, which for our purposes I will call Smith Creek, originates in a small valley south of Highway 280, generally north of its junction with County Road 90 (Old Fire-Tower Road). It is a tributary of Swingle Creek. Ponds S-1 (1944), S-6 (1946), and S-7 (1947) were constructed by building dams on this stream (Figures 18 and 18C).

The annual yields of rain water from both of the watersheds were considerably greater than could be stored in the ponds constructed on them. So to prevent excessive flooding through the ponds, it was necessary to construct diversion ditches to carry the un-needed water around them. Construction of the diversion canal for Smith Creek, which carried flood water past Ponds S-6 (Figure 18E) and S-7, was initiated in 1947, but it was not begun for Pond S-1 until 1949. It was completed for all of the ponds in 1949. Apparently, the diversion ditch for Swingle Creek and Ponds S-8 and S-14 was also begun in 1947. It was completed in 1948.

There are several smaller watersheds within the larger Smith Creek watershed (Figure 18). Larger ponds on those watersheds on the east side of Smith Creek include: Agricultural Engineering Ponds 1 and 2 (AE-1 and AE-2), S-4 and S-5 (Figure 18C). Large ponds in smaller watersheds west off Smith Creek include: AE-3, S-2, S-3, S-22, and S-23 (Figure 18C).

Similarly, a number of smaller ponds were constructed on small watersheds in the larger Swingle Creek watershed (Figure 18C). Pond S-5 was constructed on a small watershed north of the Creek. Ponds S-7 and S-18 were constructed north of Pond S-5. In addition, several ponds were constructed south of the Creek: Ponds S-9, S-10, S-11, S-12, and S-13.

There is one additional watershed of importance on the Story Farm. It is located on its southeast corner, north of Lee Road 72 (Farmville Road). One of the two primary un-named tributaries of Funchess Creek originates there (Figure 18). It is one of the permanent sources of water for the Soughahatchee Farm. Pond S-28 was constructed in that watershed (Figure 18C).

CONSTRUCTION OF BUILDINGS ON THE FARM

Headquarters for all Field Operations for the Fisheries Program was established just south of the old Story Home and just south of the junction of

CR 046 and CR 090, shortly after the Story Farm was purchased. The first buildings placed there were large wooden frame structures constructed by the Field Crew (Figure 45). A portion of one of them was used as a carpentry shop.

In 1952, two concrete-block buildings were constructed on the north end of the Field Headquarters site (Figure 46). The building on the west was used primarily to store fertilizers, and the one on the east was used for the storage of feed. In 1952, large quantities of cottonseed meal 'cake' would have been stored there.

THE ROAD AHEAD 'WIDENS'

As detailed in preceding Sections, fishing pond research at Auburn was 'conceived' and 'given birth' within the narrow confines of the Alabama Agricultural Experiment Station System in the unforgiving 'clutches' of the 'Great Depression.' In the beginning, its mission involved research that would be applied primarily in 'terrace-water' ponds on privately-owned farm land for the benefit of farm families, primarily in Alabama and the lower South. History will show that the work flourished within this severely limited environment. But with the publication of *Bulletin 254* in 1942, and its revision in 1947, an era ended. World War II was finally over, and the road ahead was about to 'widen' rapidly for the old 'pond seiners.'

World War II was truly a world war, and the world would never be the same. It also resulted in far-reaching changes in the Auburn Fisheries Program. For example, salary-savings from faculty in military service were used to purchase the Story Farm. Further, large quantities of war-surplus equipment and materials were used in virtually all aspects of its research program for many years. After the end of hostilities, the nation's interest in various forms of outdoor recreation increased rapidly. The demand for recreational fishing literally 'exploded,' and along with it, a commensurate need for individuals with specialized training in fisheries management. As a result, numerous federal and state agencies strongly encouraged the Alabama Polytechnic Institute to expand its widely recognized warm-water pond research program to include both informal and formal instruction in this field.

Likely, no other single event has expanded the horizon of the Farm Ponds Project as much as the establishment of formal, degree-granting programs. It is difficult to determine when the first formal course in any fisheries-related subject matter was offered for credit at Auburn. The first curriculum leading to the B. S. Degree in Zoology-Entomology with a major in *Fish Management*, was first listed in the 1946-1947 API Catalog. The same Catalog also established requirements for the M.S. Degree. The initiation of a formal teaching program completely re-arranged the dynamics of Program. Now, for the first time, the 'Investigators' received a portion of their salaries from

University teaching funds, and they suddenly had responsibilities for class schedules, preparation of lectures, the arrangement of laboratories and the supervision of graduate research. The long-term effects of the addition of the formal teaching to the Program will be discussed in greater detail in a following Section.

Shortly after the revision of *Bulletin 254*, the 'Investigators' concluded (Swingle, 1949b) that all of the fishing demanded by fishermen could be supplied with existing methodology and that, consequently, there was a need to discover other animals that could produce cash crops in ponds. This shift in emphasis would take the Program into the larger world of experimentation in commercial aquaculture. In this far larger world, they would have to conduct research in a much broader range of topics including: species selection, production systems, nutrition, genetics and breeding, hatchery management, fish pathology and water quality.

As detailed in a preceding Section, in the early days, the 'investigators' did their own 'outreach.' Almost from the very beginning of the program, they spent a considerable amount of time working on private ponds 'off-campus.' Until after the purchase and development of the Sougahatchee and Story Farms, the availability of 'terrace-water' ponds for research was severely limited. Consequently, many of their early studies were conducted in these private ponds. However, as the development of the North Auburn facilities proceeded, they had less-and-less time to spend 'off-campus.'

Extension work ('outreach') in fisheries developed rather slowly through the 40s and 50s. In 1951, the Fisheries Section was established in the Alabama Department of Conservation, and for many years, the primary thrust of the work of the Section was assisting with the management of private ponds. There was little need for the University to duplicate those services; however, with the growing importance of commercial aquaculture in Alabama, the need for outreach increased rapidly, and the Fisheries Section did not provide any of the required services in that area; consequently, inputs by the Alabama Cooperative Extension Service began to increase.

Further, the worlds of aquatic biology and fisheries management were changing rapidly beyond the confines of Alabama and the Alabama Agricultural Experiment Station. For example, during the war-years, American industry had experienced unprecedented growth, and while it shrank somewhat following the end of hostilities, rapid economic expansion soon resumed. Along with the continued expansion of industry, there was steady increase in the use of and demand for more electricity. This growing demand resulted in a rapid increase in the development of hydropower. Soon, large public reservoirs were being constructed on most of the suitable sites on the many rivers in the South. They were designed to provide additional supplies of water, flood control, hydro-power, enhanced water

transportation and recreation. Construction of these reservoirs resulted in a phenomenal growth in the amount of impounded water within the region, and an increasing need for research on the management of fish populations and the resulting exploitation which developed in them.

Construction of the TVA Lakes, beginning in the mid-30s, fueled a revolution in recreational fishing in the mid-South. In the post-war years, this revolution extended into all of the states in the region. As a result, within a relatively short period of time, the quantity of sport fish habitat available to the public, literally 'exploded.' Then in 1950, the U.S. Congress passed the Dingell-Johnson Act or the Federal Aid in Sport Fish Restoration Act. The Act was funded by a 10 percent excise tax collected nationwide on certain items of fishing tackle. Most of these funds were returned to the individual states on a formula basis to support various initiatives related to the improvement of sport fishing in public waters. One of the approved initiatives was the development of access for public use. Through this initiative, thousands of public access points (primarily boat ramps) were constructed around the margins of the impoundments. The millions of additional acres of sport fish habitat, that more-or-less suddenly became available to the public, quickly changed the places where they fished, but it also changed radically the way they fished. As a result of these cascading national events, over time, the importance of 'terrace-water' ponds in providing recreational fishing for the public declined.

The sudden infusion of millions of federal dollars into fish restoration in the individual states caught most of them unprepared. Most of them had little capability in the research and development required in the support of their restoration efforts. As a result, many of them contracted with their respective state universities for this expertise. Further, the availability of these new funds required a rapid expansion in trained personnel. They also sought university assistance with this problem.

These new federal funds and the restoration work they engendered also quickly increased private sector involvement. It quickly began to respond to the state's needs for new facilities, new chemicals and new equipment. In return, the private sector increasingly looked to the universities for assistance in research and development as they worked to meet these needs.

Historically, university involvement in recreational fishing had been restricted primarily to teaching students who would seek employment with state fishery agencies on graduation, or on conducting research in basic aquatic biology and ecology. In this process, untold numbers of studies were conducted on the taxonomy and life histories of thousands of aquatic species. The sudden appearance of new sources of funding quickly forced them out of their 'Ivory Towers' onto the seldom trod path of practical fisheries management.

Following the end of the War, the number of new families in the nation increased dramatically. With these new families came housing 'booms.' Suddenly, there were hundreds of thousands of new lawns, kitchen sinks and bathrooms. The demand for domestic water 'exploded' across the land. Unfortunately, the amount of waste water from these sources increased at a similar rate. This increased volume quickly exceeded the capacity of existing waste-water treatment facilities, and a large share of it found its way, untreated, into local streams. Similarly, with this steady increase in the nation's industrial economy at the end of the War, there was also an increase in the demand for industrial water, and a concomitant increase in the amount of industrial wastes being released into aquatic ecosystems nationwide.

In the early 1960s, a growing environmental movement in the country coalesced around the publication of *Silent Spring* (Carson, 1962). Afterwards, the movement quickly acquired a quasi-religious status when it adopted the Greek Goddess *Gaia* as its patron Saint. The movement attracted a large number of politically active individuals. They lobbied effectively for federal endorsement and support for their 'world-view.' As a result, Congress enacted legislation establishing the Environmental Protection Agency in 1970.

The Rivers and Harbors Act of 1899, was the first federal environmental law. Although it included a number of provisions relating to polluting navigable waters, it included little, if any, enforcement authority. The Water Pollution Control Act was not passed until 1948. It was the first comprehensive legislation dealing with water pollution in the nation. It established the basis for federal-state cooperation in dealing with this growing problem. These cooperative efforts were expanded minimally by the Federal Water Pollution Control Act of 1956. By the early 60s, it was obvious that the legislation in effect at that time did not have enough "teeth" to effect very much progress in the control of pollution and the improvement in water quality. As a result, Congress passed the Water Quality Act of 1965. This Act gave the federal government a much stronger oversight role, and it directed states to develop water quality standards for all navigable, interstate waters. Amendments to the Act in 1972 extended the coverage of the 1965 Act to all in-state waters as well. These amendments also required that each state develop a permitting system (National Pollutant Discharge Elimination System or NPDES) that would apply to all 'end-of-pipe' discharges to public waters. Additional Amendments would be enacted in 1977, 1983 and 1987.

After the passage of the U.S. Water Improvement Act of 1948, the State of Alabama, with its amazing abundance of water, quickly became concerned about the status of its surface water quality. Shortly thereafter, the Legislature established the Alabama Water Improvement Commission (AWIC). Unfortunately, the new agency did not have the staff to undertake the much-needed field work. As a result, in 1949, they contracted with

Auburn to do a study of the fish population in a heavily polluted section of the Coosa River. So far as I can determine, this is the first extramural contract received by the Auburn Fisheries Program. This contract with AWIC and later contracts with its successor agency, the Alabama Department of Environmental Management (ADEM), resulted in many years of productive collaboration on solving water quality problems in the State.

Two other events, both generally related to the so-called 'Cold War' with Russia and international Communism, also contributed significantly to the 'widening-of-the-road-ahead' for Auburn's Fisheries Program. The Soviet Union launched a satellite into an elliptical, low-earth orbit, on October 4, 1957, resulting in the so-called "Sputnik crisis" in the U.S. – already deeply concerned with the world-wide spread of communism. The event was used by politicians and the scientific establishment to convince the American public that the nation was woefully behind Russia in all areas of science and technology. Later in the year and in early 1958, televised failures of two American attempts to launch satellites further fueled those fears. These events lead to the initiation of an unprecedented level of public investment in all areas of science and technology. Soon enormous amounts of money were being made available through federal grants and contracts. In the beginning, research funds were essentially available 'free-for-the-asking.' Seemingly, this growing flood of federal largesse was of little consequence to the Fisheries Program at Auburn, but to the 'Investigators' and especially to H. S. Swingle this was a golden opportunity that one might expect in the 'Kingdom of Serendip.'

The 'Cold-War' with communism also opened a second 'door' for the fisheries program. After the end of World War II, with the political developments in Eastern Europe and the establishment of the *People's Republic* of China, it quickly became a working hypothesis of the American government that communism would rapidly move to extend hegemony over as much of the world as possible. These events gave rise to the concept of the so-called 'Domino Theory' in American foreign policy. Out of this growing concern came the official understanding and policy that the best defense against the advancement of communism was enhanced economic stability and growth in less-developed countries. In support of this concept, the U.S. Congress created the highly successful Marshall Plan to encourage and stabilize the economic recovery in Europe. Afterwards, they also created one government agency after another in an effort to find the right 'mix' of policies and actions to improve the lot of people in developing countries throughout the world. The communist attempt to take control of the entire Korean peninsula in 1950, and the French defeat in Indochina in 1954, suggested that the U.S. had not yet found the right 'formula.'

American efforts to slow the advance of communism achieved a 'mixed-bag' of results throughout the 1950s. These 'shaky' efforts lead to a growing

world characterization of the nation's foreign assistance policies as the era of the 'Ugly American.' In 1961, the Kennedy administration moved decisively to improve the government's developmental assistance efforts by getting Congress to pass the 'Foreign Assistance Act of 1961.' The Act created the U.S. Agency for International Development, and gave it the mission of promoting "economic and democratic, political stability in the developing world to combat both the perceived spread of ideological threats, such as communism, and the threat of instability arising from poverty."

Obviously, the U.S. Government did not have the personnel or the expertise to undertake this mission, so they turned to the nation's Land Grant Universities for assistance. By mid-60s, a number of these Universities were under contract with the Agency for International Development to provide technical support for its mission in developing countries throughout the world. Most of these early contracts were for work in countries that were the best candidates for communist advances (India, Indonesia, Thailand, the Philippines, Northeast Brazil, etc.).

In many areas of the tropical world where the 'cold-war' was still largely undecided, warm water fish were an extremely important part of the diets of large segments of those populations, and at that time, Auburn was the only Land Grant University with substantial experience and expertise in warm-water fish production. Soon after the provisions of the Foreign Assistance Act began to be implemented, USAID Missions, established in many of the countries began to receive requests for assistance in this area. This situation led to the establishment of a long-term relationship between the University and its Fisheries Program, and the Agency (1967) that would quickly transform the 'body-and-soul' of the old 'pond-seining' program and its people.

All of the events described in the preceding paragraphs would, separately and through their interactions, change fisheries work at Auburn forever, and would lead it along paths that the early 'Investigators,' in their 'wildest dreams,' could have never imagined. Efforts to respond to changes in this 'new,' emerging world have resulted in far-reaching changes in programs, people and facilities. Some of these changes will be described in the following Sections.

GROWTH IN 'INVESTIGATOR' NUMBERS

One of the best indicators of the nature and extent of the response of the Fisheries Program at Auburn to the 'New-World' has been an increase in the number of individuals in its 'Investigators' group. As detailed in a preceding Section, at the beginning of the fisheries program at Auburn in the early 30s, it consisted primarily of Faculty (permanent personnel with advanced degrees and with professorial rank) and Field Crew employed by the Alabama

Agricultural Experiment Station. There were no Secretaries, Research Associates, Laboratory Technicians or Graduate Research Assistants (Table 67). This early group of ‘Investigators’ remained largely intact from the mid-30s until near the end of the 1950s, when with the ‘coming’ of extramural grants and contracts, and especially the International Program, it began to grow and within a decade, it would literally ‘explode.’

At this point, it is also important to reiterate the fact that fisheries ‘investigators’ at Auburn are now, and have always been, a complex but monolithic group of individuals; ‘joined-at-the-hip,’ in an effort to convert scarce ‘tax-payer’ and corporate dollars into useful information and procedures, to instruct students and to provide outreach to the public. In working to achieve these goals, hundreds of individuals (‘Investigators’) over the years have, in their own way, contributed to Auburn’s success and productivity.

In 1938, some 10 ‘Investigators’ (Swingle and Smith and eight Field Crew) were employed in the Fisheries Program at Auburn. They were actively involved in construction and research on the South Auburn Farm. A decade later (1949), the number had increased to 20. Then some four decades later, in FY ‘76, approximately 57 of them were involved in an unbelievable array of teaching, research and outreach activities in aquatic biology, fisheries and aquaculture in Auburn and abroad. Actually the number was much larger; it did not include approximately 35 Graduate Research Assistants (GRAs). Over the years, the number has continued to increase. The 1995 Fiscal Year (FY) Departmental Budget listed some 156 names in all categories, including GRAs. The 2015 Budget included the names of 68 individuals, not including GRAs. Table 68 includes data on the number of ‘Investigators’ in each of six different personnel categories, in 16 different years, during the period 1938-2015. Note that the Table does not include numbers of Laboratory Technicians, Field Operations Supervisors and Graduate Research Assistants. For several reasons, there are not enough comparable data available to include them.

TENURE CONSIDERATIONS

Once tenure is granted to an individual in a Tenure-Track position, it is expected that his/her salary will be paid as long as the University has the funds. As a result, granting tenure represents a long-term commitment by the University. This University policy was the source of considerable consternation for the Fisheries Program for many years. When I returned to Auburn in 1959, matters related to employment and Tenure were generally handled by the Deans of the various schools and the Dean of Faculties, with only limited input from the faculty. If I remember correctly, this situation began to change after Dr. Philpott became President. He arrived on campus with a mandate to expand Auburn’s traditional Land Grant Mission

(Agriculture and the Mechanic Arts) by placing more emphasis on the Humanities. Also, if I remember correctly, this change included increased involvement of the faculty in all aspects of University Governance, including the granting of Tenure. It also included giving more attention to the American Association of University Professors (AAU) positions on matters related to academic freedom and Tenure. By the mid-80s, at the beginning of the Martin Administration (1984-1992), it was expected that tenure would be granted within 5 years of the initial appointment to a Tenure-Track position. Further, if the individual continued to be employed by the University and tenure had not been granted within a seven-year period, the person was to be awarded *de facto* tenure.

In the beginning, my salary was paid with extramural funds ('soft-money'). Apparently, guaranteeing my future salary did not seem to pose a serious problem for the University. However, later, guaranteeing salaries for personnel on extramural funds became an extremely complicated problem; especially after 1967, when the University signed a contract with the U.S. Agency for International Development (AID/csd-1581) to provide direct support for Agency programs in warm water aquaculture on a world-wide basis. Under this contract, the first action required was to develop an adequate staff to provide the services requested. As a result, Moss and Smitherman were hired in 1967, Schmittou in 1968, Lovell, Jeffrey and Pardue in 1969 and Davies in 1970. By the time the new Department of Fisheries and Allied Aquacultures (FAA) and the International Center for Aquaculture (ICA) were established in July, 1970, seven new full-time positions had been added to the University Budget – all paid from extramural funds and all placed on Tenure-Track (Assistant and Associate Professors). All of these new hires were made while the fisheries program was still administratively 'housed' in the Zoology-Entomology Department, and F. S. Arant was still Department Head. I do not remember being involved in any way in the very serious and complicated discussions regarding whether or not to guarantee their salaries, if and when, Agency-funded contracts and grants were no longer available. These discussions must have involved Swingle, Arant, Smith and likely someone from Central Administration. Auburn had never been involved in any way in international development, and it had no experience in working with USAID. Similarly, there was no way to determine how long Congress would be willing to continue to fund such a large-scale program through contracts and grants. At the same time, several of the early hires (Moss, Smitherman, Schmittou, Bayne, Lovell) had left permanent positions at other Institutions to come to Auburn to work in the International Program. As a result, Swingle, Arant and Smith apparently decided that they needed to provide these new personnel with some degree of permanency.

Surprisingly, with all of these intangibles in mind, this highly conservative, insular, State University decided to take a gigantic 'leap-of-faith' by guaranteeing future salary support for all of them. In mid-1967, when the

decision had to be made on guaranteeing future salary support for Moss and Smitherman, it is highly likely that the University Administration did not fully realize how long that 'leap' would be. By the end of 1974, with the addition of Bayne, Grover, Johnson, Leary, Lovshin, Pamatmat and Snow, the number of new positions on USAID funds had increased to 13. The list also included Plumb and Gaines, who were paid from 'P and D' contracts.

I became Department Head in 1973. At that time, the U.S. had been involved in Vietnam for almost a decade, and in 1968 suffered through the 'Tet' Offensive. By 1973, the U.S. Congress was becoming disenchanted with the War, and as a result, enacted the Case-Church Amendment which essentially stopped American involvement in combat. Congressional disenchantment went far beyond Vietnam. They were ready to 'withdraw' from the world. Interest in international development declined sharply. There was real concern that they might stop funding USAID completely. This series of events led me to be deeply concerned about the future of our entire AID-funded program, and especially about the number of personnel in Tenure-Track positions being supported by its funding.

Actually, I had been concerned about Tenure-Track funding for personnel on the International Program from the beginning. Swingle had assigned me the responsibility for hiring Moss, Smitherman and Schmittou; consequently, it became my responsibility to talk with them about their future at Auburn. This uncertainty intensified with time, as we hired more-and-more people for international work. As a result, after I became Department Head, each year, I submitted an *Annual Tenure Status Report* to the Dean's office requesting guidance on whether or not to develop documentation recommending tenure for all of those Tenure-Track personnel who were nearing the five or seven-year deadline, or who were beyond it, and each year I was directed not to prepare or submit those names at that time.

Sometime during the Martin Administration (1984-1992), it was brought to his attention that FAA had a number of faculty in Tenure-Track positions that were beyond the seven-year time limit, which meant that they were immediately eligible for *de facto* tenure. He was really unhappy with this situation, and immediately began to try to determine who was responsible for allowing this matter to go unattended for so long. Fortunately, I had kept all of the correspondence with the Dean's office regarding tenure. The problem was in Central Administration. It had not been unattended; no one knew what to do about it. We had several valuable faculty members who were paid primarily from extramural sources, and all of them were immediately eligible for tenure. Further, all of them would likely have been granted tenure if the relevant documentation had been submitted. Finally, after much discussion, all were granted *de facto* tenure, with the general understanding that, over time, the University would provide enough additional money to cover their salaries if extramural funds were not available.

FACULTY

Table 69 includes data on the number of Faculty (Tenure and Tenure-Track, Research Fellows, Instructors and Research Associates) employed in the Fisheries Program at some time during the year, in 16 different years, in the period 1938-2015. These data are summed from data in Table 65. As indicated by these data, numbers remained relatively stable in the early years; however, by 1949, the increasing work-load resulting from the purchase and development of the Soughatchee and Story Farms made it necessary to employ additional faculty. Both Prather and Lawrence became 'Investigators' during this period.

Both Lawrence and Prather held Reserve Commissions in the military; consequently, they were called to 'active-duty' shortly after they were hired. Fortunately, both had returned by 1946. In 1944, Smith left the project to take a position in the Dean's Office. Then, in 1951, Prather was re-called to 'active-duty,' and in the same year, Lawrence left to begin graduate work at Iowa State University. While they were away, M. C. Johnson, J. R. Fielding and J. H. Padfield, Jr., who were completing requirements for M.S. Degrees, temporarily filled their positions.

By FY '58, the complement of permanent 'Faculty' (Swingle, Allison, Dendy, Lawrence and Prather) had largely been established for the Fisheries Program. These five positions were supported by University funds, and would be the only ones in the Program with permanent funding for many years. By the mid-60s, extramural research had increased sharply, and as a result, a number of additional personnel were employed. New positions (Instructors and Research Associates) were established to accommodate some of the additional people who were being employed. In the late 60s, the Faculty agreed to extend their work to Less Developed Countries throughout the world. The International Program required the hiring of still more personnel. There were some 29 Tenured and Tenure-Track personnel working with the Fisheries Program at some time in calendar year 1976. Eight of them were on long-term foreign assignments for at least part of the year.

By 1990, the 'Faculty' role in international development was declining rapidly. The Administration had removed the ICA from the Department in 1989. During that calendar year, only a single person was overseas on a long-term assignment, and in 1995, there was not one. Between 1976 and 1985, nine Tenure and Tenure-Track 'Faculty' who had been involved with international development activities had left Auburn; although Auburn was not directly involved in any of their decisions.

In 1990, the University created a new position – Research Fellow – to accommodate personnel with Terminal Degrees paid from extramural funds.

Prior to that time, they would have been included in the Research Associate group. By 1995, as a result of changes in the personnel policies of the Alabama Cooperative Extension Service, nine additional positions had been moved to the Department's 'Faculty. Afterwards, the total number of 'Faculty, has remained relatively stable.

SECRETARIES

I am not certain when the Zoology-Entomology Department first provided the fisheries 'Investigators' with permanent Secretarial Support. The Departmental Budgets for FY '34-'47 listed the name of only a single stenographer. The FY '48 Budget included the names of Jewell Jones and Sara Otto as Secretaries. When I was first employed as a Student Laborer in 1950, Mrs. Otto was the Secretary for the Fisheries Program. It is likely that she was employed for that position sometime in 1947 or 1948. She apparently resigned in 1951. Other Secretaries for the Program, in the several different years, are shown in Table 70. The dates are chosen to indicate when significant changes were made in either persons or number employed.

Mary Lou Smith has compiled a list of people who served as Secretaries for the program from 1947-2015, along with their dates of service. There are over 100 names on the list. It is surprising how many of them worked for only 1 or less years. For some reason, the 'turn-over' rate was unusually high. Out of the 100-plus names, I have identified only 23 who worked at least five years (Table 71). Seven of this group worked for 15 or more years: Adams (34), Butler (32), Smith (29) Barnette (25), Howard (21) and Markle and Pogue (16). Crouch and Jensen both worked 14 years. All of those individuals working for 14 years or longer provided an enormous amount of stability and continuity for the Program when it was changing so rapidly. Their long-term dedication contributed significantly to the growth of the program.

LABORATORY TECHNICIANS

Laboratory Technicians were budgeted personnel, usually with an appropriate B.S. Degree or with considerable experience in laboratory work. The 1965 Annual Report indicate that three persons in this personnel category were employed in the Fisheries Program. None had been listed in the 1964 Report.

The 1965 Lab Techs included:

1. Ethel MacArthur (Fish Health).
2. Freida Norris (Fish Health).

3. Margaret Phillips (Fish Physiology).

Both MacArthur and Norris were paid from funds received through the Cooperative Fish Parasite and Disease Project ('P and D) which was supported by contributions by several Southeastern States. They were part of the Southeastern Association of Game and Fish Commissioners. Margaret Phillips was paid from a grant from the U.S. Public Health Service (PHS-GM-11004-02 (FP). The work provided by MacArthur and Norris was extremely important to the 'P and D' Project because of the number of services being provided to the participating states. Phillips also played an essential role in the Fish Physiology Project. It required close daily attention to maintaining stocks of fish being held for experiments. Also, the research involved a substantial number of complicated chemical analysis that had to be conducted on a regular basis.

The 1971 Annual Report listed four people in the Laboratory Technician category (Bunkley, Gordon, Jones and Tillery). Della Gordon joined the Fisheries Program in 1969 to assist Tom Lovell with the large number of chemical analyses that had to be done in his fish nutrition research. The FY '77 FAA Budget listed only two Laboratory Technicians (Gordon and Vanis), and there were none listed in the FY '78 Budget. By that time, all the work that had been done by Laboratory Technicians was being done primarily by Research Associates. For example, in FY '74, there were 3 Laboratory Technicians and 2 Research Associates in the FAA Budget; however, by FY '78, there were no Lab Techs and 12 Research Associates listed.

RESEARCH ASSISTANTS

In the late 90s, the University began to classify a few budgeted positions as Research Assistants. This personnel category generally includes individuals who have been awarded a B.S. Degree. The FAA Budget for FY '94 included only a single individual in this category. There were 4 listed in the FY '01 Budget, and 6 in FY '15. Persons in this category listed in the FY '15 Budget are shown in Table 72.

There has always been considerable 'turn-over' in this Personnel Group. Very few remain longer than five years; however, Tammy Devries is an exception to this typical pattern. She first joined the Department as a part-time employee in 1992; then in 1996, she was employed as a full-time Research Assistant.

Tammy is an Indiana native. She was awarded a B.S. Degree in Biological Sciences by Indiana University/Purdue University in 1982. After graduation, she worked with the Museum of Biological Diversity (Ohio State Museum) at Ohio State University. At Auburn, she has provided technical support services (age and growth, food habits, bomb calorimetry, etc.) for a wide

variety of research projects being conducted by faculty and students at the Ireland Center. More recently she has accepted the added responsibility of maintaining records of the use of boats and vehicles at the Center.

FIELD OPERATIONS SUPERVISORS

The number of persons employed as Field Operations Supervisors has been relatively limited from the beginning (Table 73). In fact, there was not one between 1934 and 1944; then only one from 1944 until 1963. For a period, there were four, and currently there are three. Over the years, titles and job descriptions have been changed by the University numerous times. The list includes all persons who have had any supervisory responsibility; however only Webb, Ridgeway, Black, Goodman and Veverica were charged with the primary responsibility for Field Operations.

SHELLFISH LABORATORY MANAGER

The Alabama Legislature provided funding for oyster research by the Department in FY '91. These funds included money to construct a Shellfish Research Laboratory. The Auburn University Shellfish Laboratory was dedicated in 2003, but was partially operational in 2002. In that year, Scott Rikard was chosen as Manager for the new facility. Scott had been involved with the University's oyster research program since its inception.

FIELD CREW

From the establishment of the Fisheries Program in the early 30s, a central element in its evolution has been the continuing contribution of the 'Field Crew.' It was obvious to both Swingle and Smith that the only path to producing good fishing in 'terrace-water' ponds led through extensive experimentation in earthen ponds. From the beginning, they stocked ponds and drained ponds and stocked ponds and drained ponds, *ad infinitum*. Over time, they would repeat this process annually in over a hundred ponds on three farms. In this process the Field Crew spent endless hours in and around muddy ponds – spring, summer, fall and winter. The role of the Field Crew was made even more critical because of their efforts in construction and renovation of ponds and service buildings. These contributions were unique in the Alabama Agricultural Experiment Station, especially the continuous activities related to 'fish-handling.'

The Field Crew continuously performed 'miracles' under extremely poor working conditions, year after year, on behalf of Auburn's evolving Fisheries Program. Fortunately, there were also moments of high levity. One of these moments has been recounted many times, and in this process 'fact' and 'fable' have become thoroughly mixed.

It seems that sometime in the early 70s, the Crew was involved in some controlled burning in a sedge field on the Story Farm. As the fire burned across the field, a rabbit ran out of the grass and ran into a large diameter sewer pipe. The Crew was always hunting, fishing and looking for snapping turtles, and they considered the rabbit to be 'fair game.' They tried to extract the rabbit using long briars, shovel handles and sticks to no avail. Then 'Big Jr.' (Henry Fillmore, Jr.) said, "Boys, I'll show you how to get him out of there!" With this, he got a small container of gasoline from the work truck and poured some of it into one end of the pipe; then he got a burlap sack and covered the other end. When everyone was in position to capture the rabbit when it emerged, he yelled, "OK boys, light him up!" Using a burning stick, one of the Crew stuck the fire into the mouth of the pipe. Immediately, there was a huge explosion, and Big Jr. who was standing ready at the end of the pipe, ready to catch the quarry, went tumbling backwards in a cloud of smoke and came up all singed and covered with soot. At the same time, the rabbit ran out the pipe leaving a trail of smoke and into the woods. Everyone quickly lost interest in the rabbit. No one was left standing. They were all lying on the ground – laughing. Earnest Dowdell never missed an opportunity to tell and retell this story, and he always laughed so hard that tears ran freely down his cheeks.

Over the years, members of the Field Crew spent countless hours working together on construction and maintenance projects. Many of these individuals had worked together for years. Further, a large share of them were related. Banter was always a part of this tiresome, boring work. Most of the time it was conducted in a more-or-less friendly manner; however, on a few occasions, it turned nasty with really unfortunate consequences.

Numbers of persons in the Field Crew on each of 14 years are presented in Table 68. These numbers represent only those people involved in actual field work. Supervisors are not included. Generally, the numbers of persons involved have been relatively stable over the years. The slightly larger numbers in 1958 and 1966 are the result of the sharp increase in construction and renovation on the Soughahatchee Farm (Appendix Table 1), and the slightly higher numbers in 1990 and 1995 are the result of the extra labor required in the construction on the Mellon genetics project.

I am not certain when Swingle and Smith realized that they had to have some permanent field workers to help get the work done that they wanted to do. I can find no records on when the Field Crew was established by the hiring of permanent employees or of any of their names. However, Figure 17 is a copy of a photograph apparently taken in 1938 showing eight workers wearing waders, posed below the dam of Farm Pond 1. Names of six of these individuals are listed in the Figure. Names of the other three are not available. I have been unable to find any of the names working with the Field Crew during the period 1939-1948.

Fortunately, in December, 1949, Lamar Black began keeping pay roll records on the names of members of the Field Crew. They provide a generally continuous record of the names and rates of pay for all crew members through August, 1967. This list is available in the Media and Digital Resources Laboratory at the Ralph Brown Draughon Library.

Unfortunately, afterwards through the 70s and 80s, names of the Field Crew were not included in the Budgets. In 'digging through' old budget material in RBD Archives, Mary Lou Smith located a list of Departmental personnel for FY '95 which included names of the Field Crew, and beginning in FY '97, all Departmental budgets include their names. Table 74 contains names of persons working with the crew during the 30s, 50s, 90s and 2000s. These are not all inclusive lists. They are primarily people who worked for a number of years during these periods. For example, Earnest Dowdell began to work with the Crew as a 'Water-Boy' when construction was beginning on the Soughatchee Farm in the early 40s. He retired at the end of March, 1994. Over time, he became the primary 'heavy equipment' operator on the crew. He was a 'magician' on a bulldozer. He also became highly proficient in the maintenance and repair of this equipment. His employment on the Field Crew spanned almost a half century.

RESEARCH SUPPORT PERSONNEL

For many years, Graduate Research Assistants were the only Research Support Personnel employed by the Fisheries Program. Research Assistants, Instructors, Research Associates were not utilized until the extramural support program began to grow in the late 50s. As noted in a preceding Section, Jack Snow was employed as the first Graduate Research Assistant (GRA) in the Fisheries Program in 1944. There was still only one in 1953. Available data indicate that the number of persons employed in that category did not change very rapidly in the early years. The 1962 Annual Report lists only four (Brown, Beasley, Smitherman and Spencer). They were called Assistants in Fish Culture at that time. Afterwards, however, with the growth of extramural funding, the number increased rapidly. There were 15 listed in the FY '71 Budget, 24 in the FY '90 Budget and 70 in the FY '96 Budget. There is little comparable data available beyond that time that could be used to determine the numbers of personnel in that category.

One of the more important aspects of the of GRA positions, is that the Department was able to purchase their services at 'bargain-basement' prices. It had long been a basic premise in American higher education that full-time graduate students could rightfully considered as 'slave- labor.' Poverty was supposed to be part of the learning process. Fortunately, in most cases, they were able to utilize this research effort to collect data for their theses or dissertations.

In cases where GRAs, at the MS level, were taking less than a full-load of course work, they could be paid at a higher rate. Pay for GRAs in the Ph.D. Program was much more complicated. Most of them were less than full-time students, usually working on a research project supported by an extramural grant or contract. As a result, their pay was determined on an individual basis, usually with considerable input from the Principal Investigator.

'GOFERS'

When I returned to Auburn in the late 50s, virtually nothing 'moved' in the University unless accompanied by a 'piece' of paper with the appropriate signatures affixed. At that time, this was not a major problem because 'very little' was moving. Virtually all of its various programs had been 'fixed' for many years. Purchase Orders, when there was enough money to purchase anything, requests for Travel, and Requests for Personnel Action Forms slowly made their way upward via Campus Mail. Then, sooner-or-later, the necessary administrative decisions would make their way downward. With very little money to spend, there were few decisions that required immediate attention. However, with the coming of the 'age' of extramural funding, this 'snail's pace' process was no longer adequate. 'Approvals' were often needed 'yesterday.' Obviously, there was no good way to reduce the number of signatures needed, but Campus Mail could take Campus Mail out of the 'loop.' This change was accomplished by employing a number of 'Gofers.' They hand-delivered the various requests for approval to the different administrative offices, and often waited there until the necessary signature was obtained. This speeded up the process considerably. Obviously, the use of 'Gofers' was not widely appreciated by all administrators in the 'loop.' With a stack of requests already in front of them, they did not appreciate having a new one placed on top with a request for immediate attention and with a young lady or man standing outside, waiting.

Many of our 'Gofers' were local high school students – daughters or sons of University faculty or staff. They were well acquainted with Auburn, and often with the people in the various offices they visited. Further, they were usually available daily, 'after school' throughout the year. Many of them continued to help us after graduating from high school and even until they completed college.

The role of 'Gofers' expanded considerably as foreign travel increased, along with the growth of the International Program. In the 70s and 80s, it seems that someone was leaving or arriving at the Atlanta or Columbus Airports daily. The larger share of the required 'ferrying' of personnel was handled by Research Associates or Graduate Research Assistants. Fortunately, on weekends and between quarters, the 'Gofers' handled this responsibility.

In the mid-70s, a few of the 'Gofers' were pressed in service in the kudzu

control program on the Farms. Most of the early work was done by the Field Crew, but in succeeding years, we found several small areas that required re-treatment. Consequently, we would send a 'Gofer' out with a container of *Round-Up* and a hand-operated sprayer.

By the mid-90s, the need for 'Gofers' was diminishing. There was less international travel, and evolving administrative procedures and the use of computer networks reduced the need for 'walk-throughs.' Soon the 'Gofer' had gone the way of the 'horse-and-buggy.' However, for a time they were among the most important 'Investigators' on our payroll.

A partial list of persons who worked as 'Gofers' for the Department is shown in Table 75. There is no permanent record of their employment. As 'Temporary Student Labor,' their names were never included in a formal budget. Two of the persons (Gibson and Shinnick) were fisheries undergrads, however, the remainder were first employed while they were in High School. None of them later entered the fisheries curriculum.

GROWTH IN FUNDING FOR 'INVESTIGATORS'

The Alabama Agricultural Experiment Station (AES) was established by the Legislature in 1883. From that time, generally through the end of World War II, salaries of all categories of personnel in the organization were paid from funds appropriated either by the Alabama Legislature or the U.S. Congress. Funding for the salaries of the 'Investigators' in the Fisheries Programs followed this same general pattern; however, in the early 50s, it began to change, and by the mid-70s, considerably less than half of all salaries in the Program were being paid from appropriated funds. The salary funding situation in FY '51 is shown in Table 76. Note that in that year almost all salaries were paid from appropriated funds. The Alabama Legislature (Research and Teaching) provided the larger share; although the U.S. Congress provided a substantial amount through U.S.D.A.'s Bankhead-Jones Program. Note also that \$1,200 of salary money was provided from extramural sources. This was the stipend for I. B. Byrd, a Graduate Research Assistant. The money came from a grant from the Alabama Department of Conservation. It was to be used to support research in fisheries management. This allocation probably represents the first salary of an 'Investigator' in the Fisheries Program paid from non-appropriated funds.

Following changes in University funding for 'Investigator' salaries in the fisheries program over the past 70 years (1945-2015) is both interesting and instructive. It provides a good example of a traditional, 'hide-bound,' insular, State University being dragged into the rapidly changing 'New World,' and how it coped with the new demands involved.

TENURED AND TENURE-TRACK PERSONNEL

As noted in a preceding paragraph, until FY '59, all 'Tenured and Tenure-Track' positions in the Fisheries Program were supported by appropriated (Permanent) University funds. However, in 1957, F. Eugene Hester, a Graduate Research Assistant in the Ph.D. program, was given an appointment as Assistant Fish Culturist, and his entire salary was paid from a commercial grant from S. B. Pennick and Company to study the effect of their emulsifiable rotenone product on several species of warm water fish. I was away from Auburn at the time, so I knew nothing of the details of this appointment. However, I am virtually certain that it was not considered to be a Tenure-Track position.

In FY '59, I was recruited to come to Auburn to conduct research on the use of herbivorous fishes to control aquatic weeds in ponds; with the understanding that my entire salary would be paid with funds provided by a grant from the U.S. Public Health Service. At that time, I had completed all requirements for my Ph.D. at Cornell, but had not been awarded the degree. At that time Cornell awarded Terminal Degrees only once each year. I was so eager to get back to Auburn that I don't remember being concerned with what might happen when the prescribed research was completed. In fact, I have no recollection of any discussions about my future. I just assumed that the University would take care of it. I arrived so late that I could not be included in the FY '59 Zoology-Entomology Budget. In fact, I was not included in the FY '60 or FY '61 Budgets either. I was finally included in the FY '62 Budget as an Assistant Fish Culturist/Assistant Professor, after \$540 in permanent teaching funds were included in my salary. I never inquired about the matter, but assumed that this was a Tenure-Track position. Apparently, someone (likely Dean Smith) had made the decision that if, sometime in the future, I could not support myself with contract and grant funding, that AES and Teaching Division Funds would be used to pay me.

I remained the only person in a Tenured or Tenure-Track position, paid primarily from extramural funds, until 1964, when George Greene was employed as an Assistant Professor to conduct research on a National Science Foundation Grant. In 1965, George Krantz was employed to assist with the Fish Parasite and Disease Project. Virtually all of our salaries were paid with non-permanent funds. Then with the beginning of the International Program, the number of persons in these position increased rapidly.

FULL-TIME EQUIVALENTS (FTEs)

Data presented in Table 77 show the changes in University support for Tenured and Tenure-Track Positions in the fisheries program in 25 different years, during the period 1945-2015. Note that these changes in funding are best followed through time through the use of 'Full-Time Equivalents (FTEs),'

rather than through actual dollars. FTEs provide information on numbers of full-time positions, independent of the actual dollars involved, and as a result, are comparable from year to year. For example, in FY '35, 91.5 percent of Swingle's salary was paid from funds appropriated by the U.S. Congress (Adams Funds-USDA) and 8.5 percent from funds appropriated by the Alabama Legislature (Agricultural Experiment Station Funds). His entire salary was paid from appropriated or permanent funds, and in return, he provided the University with one (1.00) Full-Time Equivalent (FTE) of research. Note that the Adams Funds were considered to be part of the permanent base for AES. In contrast, in FY '62, 7.5 percent of my salary was paid from funds appropriated by the Alabama Legislature by the Teaching Division at Auburn, and 92.5 percent from grant funds provided by the U.S. Public Health Service (USPHS). These funds were considered to be non-permanent or extramural. In my situation, I only provided 0.075 FTE to the University and 0.925 to USPHS. Data in the Table show that the University purchased 3.00 FTEs of research time for the Fisheries Program in FY '46. This would have been based on the full-time salaries of Swingle, Lawrence and Prather.

Remember that the Department of Fisheries and Allied Aquacultures was established July 1, 1970; consequently, the first Budget prepared by the new Department was for the period July 1, 1970-June 30, 1971 (FY '71), and it included the names (Table 78) of 17 Tenured or Tenure-Track persons (17 FTEs total). Note that the names of Ramsey and Shelton are also listed; although they were paid directly by the U.S. Fish and Wildlife Service rather than the University. Unfortunately, the Department had appropriated funds to pay for only 4.87 of those 15.0 FTEs (Seventeen minus Ramsey and Shelton). This meant that the remaining FTEs (10.13) had to be supported by extramural funds.

Data in Table 77 show that the University had begun to increase Teaching FTEs for the Department before the Martin Administration had become involved in the FAA funding problem. This increase of 2.84 FTEs (0.98 to 3.82) in FY '74 was primarily the result of the establishment of the new Department. Remember that the University established the Department of Fisheries and Allied Aquacultures in July, 1970. There was no increase in University support for research funding at that time.

Once the Martin Administration was made aware of the severity of FAA salary funding problem, they began to work to solve it. In FY '86, a total of 0.65 FTE (5.60 to 6.25) was added to the Budget from the Teaching Division; along with almost 3 (3.06 to 5.98) new research FTEs from AES. In that same year, there were 20 personnel in the Departmental Budget (including Ramsey) who were in Tenure and Tenure-Track positions. Excluding Ramsey there were 19 FTEs, and permanent funding for only 12.23 (some 6.25 from the Teaching Division and 5.98 from AES). Approximately 6.77 had to be paid from

extramural funds.

Additional FTEs were added to the Budget over the years; until in FY '15, the Teaching Division was funding 6.91, and AES was funding almost 11 positions with appropriated (permanent) dollars. John Jensen was added to our Budget in FY '91, and his permanent Extension Service salary was transferred with him. Over time, additional Extension Service personnel were transferred. As a result, in FY '15, there were 21 Tenured and Tenure-Track positions in the Budget and there were 20.40 FTEs paid from appropriated funds to support them.

The data presented in Table 77 also indicate that the Teaching Division did not contribute very much permanent money to 'fix' the problem after FY '86. This is not really surprising. The assignment of teaching dollars is loosely related to the amount of teaching that a unit is doing. The teaching 'load' in FAA did not really change that much following the mid-80s.

As noted in a preceding Section, by FY '90, the University had developed a parallel personnel classification system that provided non-Tenure-Track positions for those individuals that would normally be eligible for Tenure, but who were paid entirely from extramural funds. These individuals were classified as Research Fellows. With this system, there was no requirement for consideration for Tenure. Of course, this system solved the Tenure problem for the University, but did nothing for individual faculty members in those positions. FY '05, FY '10 and FY '15 Budgets included 5, 5, and 4 personnel, respectively, in this classification.

SECRETARIAL PERSONNEL

Generally, from the beginning of the Fisheries Program, salaries for most Secretarial Personnel have been paid from University funds (Instruction, Agricultural Experiment Station and Extension Service); however, during the years when the Department was involved in so much USAID-funded work, parts of several positions were supported with money from the Agency. Table 79 includes information on the sources of funding for secretarial positions in the Fisheries Program in seven different years, beginning in the early 50s. By the early 70s, the number of secretarial positions was beginning to increase, along with non-University funding. In FY '71, almost half of all secretarial salaries were paid from extramural sources. Afterwards, however, although total FTEs continued to increase, the share paid from extramural funds began to decrease, and in FY '10, all of the salary funds for 6.00 FTEs came from University sources.

RESEARCH SUPPORT PERSONNEL

Most of the Research Fellows, Research Associates, Instructors, Research

Assistants and Graduate Research Assistants (Research Support Personnel) have been employed by the Fisheries Program to participate in research and development projects supported by extramural grants and contracts; consequently, virtually all of their salaries have been paid with funds from these sources. As a result of their non-university funded contributions, the Fisheries Program has been able to complete literally hundreds of projects that it could not have undertaken otherwise.

A substantial amount of funding required to pay these 'Support Personnel' during the 70s, 80s and 90s was derived from 'Indirect Costs.' Most of the grants and contracts, especially those from/with USAID carried a 'Line-Item' in the budget which allowed the University to recover costs (Administration, utilities, rents for building and laboratory space, etc.) that could not be recovered through 'Direct Costs.' In the beginning the University returned all of these funds ('Indirect Costs') to the Fisheries Program. Further, we were allowed considerable latitude as to how we utilized them. In some years, with millions of dollars in USAID contracts in effect, the Department received many thousands of dollars from this source. As a result, we were able to provide a substantial amount of Technical Support from this source for years. Later, the University decided that they would not return all of these funds to the Department. Instead, they decided instead to increase our annual maintenance budget by a 'fixed' amount.

Also funds obtained from the "Sale of Products" (fishing permits, fish bait and live catfish), provided considerable funding that could be used to pay this important group of 'Support Personnel.

FIELD CREW

Data on funding sources for the Field Crew have generally not been available for most of the eight decades of its history. A budget page prepared by Swingle and Smith, in FY '1951, indicates that the program was expected to spend \$18,500 on field labor that year (Table 76). Although most of that amount would have been spent on the Field Crew, some of it likely would have been used to pay student labor as well. In 1950, I would have been paid from this fund for my small amount of work on the project. Of the total labor budget, some \$8,000 was received from USDA as part of the Bankhead-Jones allocation to the Agricultural Experiment Station (AES). The remainder, \$10,500, was obtained from funds appropriated by the Alabama Legislature directly to AES.

I have been unable to locate any data on funding sources for the Field Crew during those years when the Department was doing so much work for USAID in the 70s and 80s; however, it is likely some of their wages might have been paid from that source during those years. Subsequently, the small amount of data available from the 90s and into the new century indicate that all Field

Crew were paid from University (appropriated) funds. Most of the money is derived from funds appropriated by the Alabama Legislature for support of the Alabama Agricultural Experiment Station; although, in most years, a substantial amount is derived from the Teaching Division which receives funds both from the Legislature and from student fees.

CHANGES IN 'INVESTIGATOR' CAPABILITIES

Over the years, there were also significant changes in the capability of the 'Investigators.' In 1942, Swingle, Smith and Lawrence were largely self-taught aquatic ecologists with considerable practical experience in the construction and management of 'terrace-water' ponds for the production of recreational fishing primarily for farm families. None of them had ever had a formal course in any field of aquatic ecology, aquaculture or fisheries. By 1976 the situation had changed markedly. The capability in farm pond management still remained, but capability in several other areas of aquaculture and fisheries had been added. These new areas included: Fish Nutrition, Fish Processing, Fish Parasites, Water Quality, Fish Population Dynamics, Aquacultural Economics, Aquatic Ecology, Ichthyology, Aquacultural Production Systems, Extension Methods, Fish Genetics, Fish Anatomy and Physiology and Fish Diseases.

Capabilities of all 'Investigators' in the fisheries program have changed significantly over the past 75 years. Secretaries now are capable of working with many different facets of Information Technology. Competence in a broad range of data handling and manipulation is required. Individuals on the Field Crew now have to work daily with a variety of motors, pumps and switches. The heavy equipment in use on the Farms is much more complicated. At the same time, it is capable of doing much more sophisticated work with increasingly skilled operators.

Now, much of the day-to-day research is much more complicated. One can compare the nature of the research conducted by Swingle and Smith on fertilizers for fish ponds in the greenhouse with that being done in John Liu's fish genetics lab or the facilities of other research faculty to be deeply impressed by the complexity of capabilities.

'INVESTIGATOR' ACTIVITIES

Obviously, it would be an impossible task to completely recount the vast array of activities undertaken by this unusually productive group of 'Investigators' over a period of over three-quarters of a century. It would also be truly unfortunate if they were denied some recognition of their accomplishments. In the earlier Sections, I made an effort to describe some of the events which led to the publication of Bulletin 254 *'Management of Farm Fish Ponds'* in 1942, and its revision in 1947. Unfortunately, those sections represent only a tiny portion of all of the 'Labors of Hermes' that this

talented group of people has undertaken over the years. In this Section, I have generally attempted to discuss a limited number of their activities – activities that hopefully represent the breadth and depth of their contributions.

Remember that throughout this book that I have utilized the term ‘Investigators’ in its broadest sense. I have generally utilized it to identify any person who is working now or has ever worked with the Fisheries Program in any capacity. The use of the term was more appropriate in the early days when virtually all of the activities involved were related to research. Although it is less appropriate now, given the breadth of activities involved, I will still use it in its original context.

ADMINISTRATION OF THE FISHERIES PROGRAM

The complexity of the Fisheries Program at Auburn has increased exponentially over the years. As a result, an inordinate amount of time and effort has been required to ‘keep-all-of-the-balls-in-the-air’ simultaneously. From the inception of the fisheries program in the early 30s through June 30, 1970, it was administratively ‘housed’ in the Department of Zoology and Entomology. However, for all practical purposes Swingle and Smith developed and administered their own ‘Department.’ They served as joint Project Leaders for the Purnell Project and later the Bankhead-Jones Project from the early 30s until 1944, when Smith moved to the Dean’s Office. Then from 1944 until 1970, Swingle remained Project Leader. In practical terms, this relationship meant that the Department Head made the budgets while Swingle ‘ran’ the program. This relationship remained unchanged until 1970 when the Department of Fisheries and Allied Aquacultures was established with Swingle as Department Head.

Administrative complexity of the fisheries program remained relatively limited from 1934 through 1941. Then, with the development and management of the Soughahatchee Farm (1940), it took a quantum ‘leap’ forward. A few years afterwards, it took another quantum ‘jump (1944) when the Story Farm was being developed and incorporated into the overall research effort of the Fisheries Program. The management of extramural funding from grants and contracts in the late 40s added another ‘layer’ of complexity; as did the initiation of the formal, degree-granting program in 1947. Administrative complexity expanded annually until the late 60s when the old, ‘pond-seining’ program went ‘global.’ Then in 1970, with the development of the new Department, and the management of the massive Title XII, Institution Building Grant, administrative complexity reached a state of ‘fusion.’ Then by the late 80s, much of the administrative ‘load’ related to the International Program was beginning to abate. In 1989, the Administration removed the ICA from the Department. By then much of the ICA’s international activity was being supported by the AID-funded,

Collaborative Research Support Program (CRSP) with Oregon State University (OSU) as the Management Entity. As a result, OSU was responsible for much of its administrative 'load' of what remained of Auburn's International Program.

Unfortunately, any reduction of administration complexity related to the 'down-sizing' of the International Program was more than off-set by an 'explosion' of new domestic activities. The Alabama Fish Farming Center was formally established in 1982. At that time there were a number of State, Federal and Auburn University administrative units involved in its governance; however, over time the Auburn Fisheries Program became increasingly involved in its day-to-day operations. Finally in 2005, Auburn assumed responsibility for its operation. In 1988, the Auburn University Marine Extension and Research Center (AUMERC), was established in Alabama's Coastal Zone and FAA was assigned the responsibility of administering its various extension and research activities. Also, in the late 80s, FAA was formally assigned responsibility for administering all Extension activities related to fisheries, aquaculture and aquatic sciences in the State. By the early 90s, some 16 Alabama Cooperative Extension Service positions had been moved into the Department's Budget. Finally, in the late 80s, primarily with the aid of a Mellon Foundation Grant, the Department expanded its program in fish breeding and genetics. The expansion involved the construction of new facilities (ponds and laboratories), the hiring of new faculty, and the initiation of new research projects. Some of the leadership challenges and accomplishments related to these administrative are discussed in the following Section.

HOMER S. SWINGLE

In several preceding Sections, some of Swingle's many contributions to the development of Auburn's Fisheries Program have been described, but no effort has been made to evaluate his over-all contribution. I first met Swingle in 1950 after Russ Fielding 'discovered' me in the old Agricultural Library in Comer Hall, and offered me a few hours of work each week at the Fish Culture Laboratory in the old Jones House, behind Comer Hall. Afterwards, except for the time that I spent in military service and at Cornell University (1954-1959), I had the good fortune of working around or with Swingle throughout the remainder of his career. For a time I shared an office with him. In this lengthy period, I began to understand that he was a 'Pioneer' rather than a 'Settler.' He left a safe and secure 'home' in insect toxicology, where he was well trained and experienced, for a 'wilderness' where he had neither. On arriving on this 'frontier,' he immediately began to clear away the 'under-brush' on pond fertilization; however, rather than 'settling-down' here, he quickly moved on to pond management. He could easily have spent much of his career in pond fertilization, but he chose to leave after developing only the barest outline of the science. Later, when Claude Boyd joined the faculty

on a permanent basis, Swingle commented that he had left lots of ‘loose-ends’ behind in pond fertilization, and he hoped that he (Boyd) would ‘tie-them-up.’

Before he had completed work on pond fertilization, he moved on to the new ‘wilderness’ of pond management for recreational fishing. Shortly, he (along with Smith) accumulated enough information to write *Bulletin 254 (Management of Farm Fish Ponds)*, but before he completed work there, he was off again to study river and reservoir populations. He left pond management research without any clear understanding of how to accommodate high levels of exploitation in pond management. He conducted literally dozens of experiments on the problem through the sale of fishing privileges to the public. Unfortunately, he did not remain there long enough to publish any of the results. By then he had moved on to a new ‘wilderness.’

While he was still conducting research on exploitation of fish populations in ‘terrace-water’ ponds, he moved into the new ‘wilderness’ of commercial fish production. He quickly cleared away much of the ‘underbrush’ there, and in 1958 published his classic – *Experiments on Growing Fingerling Channel Catfish to Marketable Size in Ponds*. Unfortunately, he did not remain there long enough to fully appreciate the complexity of producing, harvesting and marketing pond-raised fish in an increasingly globalized market, where customer choice and economics were controlling principles.

Before he could fully appreciate the complexities of catfish production in ‘terrace-water’ ponds, he moved on to still another ‘wilderness’ – tilapia production. From the early days of this research, it was difficult to understand why he was spending so much effort in a ‘wilderness’ where there was so little potential for Alabama farmers. The problem was that few of us working with him could appreciate that this work was part of what would be his final journey into a new ‘wilderness’ – warm water fish production in ponds in ‘Less-Developed Countries.’

Swingle made his first international trip late in 1953 when he attended the Pacific Science Congress held in Manila. Apparently on this visit he encountered his next ‘wilderness.’ In January, 1954, a shipment of *Tilapia mossambica* arrived on campus. In 1957, Swingle visited Thailand and Israel, and in 1961, he visited India. Then beginning in 1964, he served as Chairman of the Organizing Committee for the FAO-sponsored World Symposium on Warm-Water Pond Culture. Later, in May, 1966, he served as over-all Chairman of the Symposium (Figure 47). Finally, in 1967, Auburn was awarded its first contract for providing technical assistance, world-wide, in warm water aquaculture to the U.S. Agency for International Development (USAID). Swingle charged into his final ‘wilderness’ with almost super-human zeal. From late 1967 until 1973, he was seldom in Auburn for more

than a few weeks. He literally 'wore-out' several of his faculty who accompanied him on his travels, and in retrospect, it is likely that frenzied pace that he set for himself was detrimental to his health and probably played a role in his untimely death.

As a 'Pioneer,' Swingle's 'brush-clearing' work in all of those 'wildernesses' left a wealth of 'cleared,' fertile fields for the Auburn faculty who followed as 'Settlers'. Without a doubt, if he had been a 'Settler,' the Auburn Fisheries Program would have evolved along completely different lines – if it had ever evolved at all.

E. WAYNE SHELL

I became Department Head on May 21, 1973. I had first come to Auburn in the Fall Quarter, 1948, enrolled in the Forest Management Curriculum. Then in the Fall Quarter of 1949, I changed into the Fish Management Curriculum. I was awarded the B.S. Degree in 1952 and the M.S. in 1954. I had received my first exposure to administration in the fisheries program in June of 1952, shortly after I was awarded a Graduate Research Assistantship (GRA). In those days, a GRA was considered to be a regular faculty member. All Experiment Station personnel worked a five-day week, plus a half-day on Saturday. GRAs were expected to do the same. When I was not in class, I was expected to be at work along with Swingle, Lawrence and Prather, Lamar and all of the Field Crew.

I had not received my first monthly check as a GRA before I was assigned the responsibility of 'administering' Swingle's 'Check-Cashing' Service, along with his 'Pay-Day Loan' Program, for the Field Crew. The 'Check-Cashing' Service was extremely helpful to them. Checks were delivered to the Dean's Office at two-week intervals, early on Saturday morning. Unfortunately, the Field Crew worked until noon; along with all local banks. As a result, they could never get to the banks with their checks.

I don't remember who had this responsibility before I arrived, but it became my job to get the checks from the Dean's Office, carry them to the Farms to get them endorsed by individual Field Crew members, take them to the bank to get them cashed; then take the cash back to the Farms. This was a rather straight-forward responsibility, but it was really not that simple. Sometime in the past, Swingle had started making loans to members of the Crew who had unexpected needs for additional funds. Even after I became involved, from 'time-to-time,' he continued to make loans while on his frequent trips to the Farms. They were made from the large amounts of *cash* generated by the 'Fee-Fishing' Research in the 'S' Series, and it was expected that all or portions of the loans would be 'paid-off' on 'pay-day.' Obviously, there was no interest charge involved.

In this process, when on Saturday morning the *cash* was taken from the bank back to the Farms, a portion of it was expected to be 'set-aside' to 'settle' their loan obligations. This quickly became a 'gut-wrenching' proposition for me. In 1952, the Field Crew received \$3-5 per day for their work, depending primarily on seniority. With this pay rate, most bi-weekly checks were in the low \$40s range. This was the total amount of money that they had to 'live-on' for two weeks. It seemed a crime to take any of that meager amount of money to 'pay-off' a loan obligation. Further, they had all kinds of excuses as to why they should not pay anything that particular Saturday. The request to 'let-it-ride' for another two weeks was almost automatic. Still, 'sooner-or-later,' Swingle expected that each loan would be repaid, and it was my job to collect it. As a result, every 'pay-day' for me became a serious exercise in 'haggling.'

After leaving Auburn in June, 1954, I served for 2 years (1954-1956) in the U.S. Army (Army of German Occupation). After being separated, I entered Cornell University in the Fall Semester of 1956. I was awarded the Ph.D. Degree in 1959. While at Cornell, Dr. Arthur Phillips served as my Major Professor. He was internationally known for his research in trout nutrition. He also served as Director of the U.S. Fish and Wildlife Service (USFWS) Trout Nutrition Laboratory at Cortland, NY. While there I became acquainted with Dr. Paul Thompson, who was National Director of the Fish and Wildlife Research Laboratories. Dr. Thompson was also well acquainted with the work that Swingle was doing at Auburn. As a result, before I finished my work at Cornell, I was offered a job to work with Phillips at the Trout Nutrition Laboratory in Cortland. Later, Thompson offered me a position at the USFWS Research Laboratory at Marion. I was delighted at the prospect of being able to return to Alabama to begin my career in fish physiology and nutrition, so I readily accepted Thompson's offer, and he began the process of getting me hired. In the meantime, Swingle had received a Grant from the National Institutes of Health to study the use of herbivorous fishes in the control of aquatic weeds in warm water ponds. He contacted me and asked if I would be interested in returning to Auburn to work on that project. There was never any question about that. I would have returned to Auburn to 'sweep-floors,' if necessary. As a result, for a short time, I was in the process of being hired for two different jobs. I was really sorry to have to contact Dr. Thompson about my 'change-of-heart.' He was an especially nice person, and he had made me feel like my services at Marion would be a real benefit to USFWS. Later, Harry Dupree would accept that position after he completed his Ph.D. requirements at Auburn.

Dr. Swingle passed away the night of May 20, 1973. Jean and I had visited him in the hospital shortly before his death. At that time, he was in good spirits, and looking forward to leaving the hospital the next day. Mrs. Swingle accompanied us to the elevator as we were leaving. On returning to his room, she found him unresponsive. At that time, I already knew that I

would succeed him when he reached mandatory retirement age at the end of June, 1973. On May 21, I formally accepted the authority and responsibility for administering the affairs of the Department. Fortunately, there were few surprises. In September, 1967, I had unofficially accepted the responsibility for the administration of the old Bankhead-Jones Project; when Swingle began to travel extensively under the terms of the first USAID contract (AID/csd-1581).

In retrospect, it is somewhat difficult to remember how all of this happened. Much of it had to do with the fact that I was 'low-man-on-the-totem-pole' in the Fisheries Program. I was employed in 1959 to assist Project personnel with the rapidly increasing work-load resulting from the growing number of extramural grants and contracts. Everyone else on the Project (Swingle, Dendy, Lawrence, Prather and Allison) was already fully engaged with their own University-funded research and teaching responsibilities. As a result, it fell to me to 'pick-up' many of the administrative 'loose-ends' that came down from Central Administration. It was this situation, in 1961 that resulted in my receiving the assignment to prepare a draft of the status of the Fish Management Curriculum that would eventually become part of the University's 'Self-Study.'

No one else on the Project was even remotely interested in the 'Self-Study.' As a result, no one paid much attention to what I was doing. I used the assignment as an opportunity to recommend a complete reorganization of the curriculum; so as to make much of the existing course material in pond management available to undergraduate students. At that time, virtually all of the fish management material was available only to graduate students. This reorganization will be described in much greater detail in a following Section. Surprisingly, there was little or no objection to my recommendations for these sweeping changes. Subsequently, the new curriculum was included in the University Catalog for the 1962-1963 academic year. From that time, management of the Fish Management Curriculum was my responsibility.

The same, 'low-man-on-the-totem-pole' situation continued for me through the mid-60s. Then in 1967, the University signed the first contract with USAID (AID/csd-1581) to provide technical assistance to the Agency. Before the 'ink-was-dry' on the contract, Swingle 'packed-his-bags,' and they were never completely unpacked until his death in 1973. As before, everyone (Swingle, Lawrence, Prather, etc.) in the Fisheries Program was already fully employed, so there was no one else available to provide the administration required for the existing Fisheries Program and to begin the implementation of the new AID contract. In anticipation of the signing the contract, I was given the responsibility of contacting Moss and Smitherman, and making arrangements for them to join the faculty. Both began work on July 1, 1967. Unfortunately, they were of limited help in meeting the added administrative responsibilities. Both quickly became fully invested, along with Swingle, in

the 'Project Identification Phase' of the AID contract.

In 1969, AID/Washington officials notified us that we were eligible to receive funding through a Title XII Institutional Development Grant, and I was assigned the primary responsibility of preparing the proposal. This activity required a substantial amount of detailed attention. By the beginning of 1970, the Agency was satisfied with our proposal, and plans were made to begin its implementation on July 1. Implementation also required the establishment of the new Department and the International Center for Aquaculture. With Swingle away from campus much of the time, I had the primary responsibility of getting all of these activities 'on track.' The establishment of the new Department was especially challenging. I was given the responsibility to get it operational, but had no authority to do so. Negotiations with Dr. F. Arant, Head of the Department of Zoology/Entomology was especially troublesome. Beginning February 1, 1959, he was my real 'boss,' and then, in March and April, 1970, I had to negotiate with him over the share of his Department that would be moved to the new one. From my relatively 'weak' position, it is likely that I did not come away with our 'fair share.'

Of course, Swingle was appointed Head of the new Department. Every aspect of the Fisheries Program bore his 'fingerprints.' Appointing new Department Heads for the School of Agriculture and the Alabama Agricultural Experiment Station at Auburn in the late 60s and early 70s was a relatively simple matter. The Dean appointed a search committee that quickly submitted a name to him, usually from the existing faculty. Generally, he agreed with their recommendation, and the appointment was made. There was almost no faculty involvement. As Swingle approached his mandatory retirement date (June 30, 1970), Dean Smith began to be concerned with his replacement, and early in the year, he appointed a search committee. In 1970, I had never given much thought to becoming Head of the new Department. I felt strongly that because of his 'time-in-grade' and his solid record of accomplishments in teaching and research that John Lawrence was the obvious choice for replacing Swingle. I felt it unlikely that Dendy, Allison or Prather would be interested. Later, I talked with John at length about my opinion that he should accept the position. At that time, he had a steadily expanding research program that involved doing just exactly what he wanted to do. He informed me that he had no interest in giving it up for the administrative maelstrom that was developing around the Department Head position. I don't believe that I ever submitted an application, and I don't remember meeting with the committee. Finally, the Chairman (Don Davis from the Department of Botany and Pathology, if I remember correctly) asked me if I would accept the position, and I agreed to do so. I really hesitated taking it. I really loved teaching, and I felt that, given the growing complexity of the Program, I could not continue to give my students the attention they deserved. Further, I still wanted to continue my research in fish physiology.

At the same time, I felt a deep sense of devotion to what Swingle and his co-workers had built at Auburn over the preceding four decades. I was not confident that I could keep the program moving on the trajectory that they had established, but I was confident that I knew more about where it had been, where it was then and where it could potentially go than anyone else that they could find. It was on this basis that I agreed to accept it.

I became Department Head in May, 1973 and retired at the end of January, 1994. In that 20-plus year period, I had the privilege of participating in a truly unique undertaking with a truly unique group, involving thousands of people literally throughout the world. In several later Sections, I have attempted to summarize some of the unbelievable number of things that we did over this period. I will never cease to be amazed with what was accomplished and that I was privileged to be a part of it.

WILMER A. ROGERS

Bill Rogers became Department Head on February 1, 1994. He had been awarded a B.S. Degree in Biology by the University of Southern Mississippi in 1958. Afterwards for a year, he worked with the Mississippi Game and Fish Commission as a Fishery Biologist. Later, he came to Auburn to enter the M.S. program. He was awarded that degree in 1960. After graduation, he worked for two years as a District Fisheries Biologist with the Fisheries Section of the Alabama Department of Conservation. During that period, he established new Field Offices for the Section in both Tuscaloosa and Enterprise. In 1962, he left the Fisheries Section to accept a position with the National Fish Hatchery at Marion. In 1964, he decided that he wanted to continue his education, and began to prepare to move his family to Raleigh, North Carolina to enter the Ph.D. program at North Carolina State University. He had been promised a position there as Assistant Leader of the Cooperative Fisheries Research Unit while working on his degree.

Fortunately, he agreed to come to Auburn instead, to take charge of the new Southeastern Cooperative Parasite and Disease Project while working on his Ph.D. Degree here. He arrived in 1964. We were extremely fortunate to have him come here. We felt like he would work well with fisheries biologists and hatchery biologists in all of the participating states; as well as with the Commissioners. Further, we were getting, for 'free,' the acknowledged, all-time, national 'possum-cracking' champion.

When Bill became Department Head, he was nearing the end of a distinguished career of teaching, research and out-reach in the general area of fish health. Over the years, he had gained recognition as one of the world's leading authorities in fish parasitology. He was especially well known for his work on monogenetic trematodes. His research contributions are considered in greater detail in a following Section.

Rogers became Department Head at a very critical time. In the national election of 1994, the Republicans took control of the House for the first time in four decades. They had likely won as a result of proposing their so-called '*Contract with America*,' just before the election. One of the promises included in the '*Contract*' was to reduce the size of government. For a Department so dependent on federal grants and contracts, this was a scary promise. Beginning in early 1995 with Republicans controlling both House and Senate, literally every federal program became 'fair-game' for reduction in funding, if not elimination. Rogers had the responsibility of managing the 'down-sizing,' of several of those programs in the Department. He retired on August 31, 1995.

JOHN W. JENSEN

John Jensen became Interim Department Head in September, 1995; after Rogers retired. A native of Duluth, MN, he received the B.S. Degree in Fisheries and Wildlife Management from the University of Minnesota in 1969. At that time, the Fisheries Program at the University was under the direction of Dr. Lloyd L. Smith, Jr. It was considered to be one of the better fisheries programs in the country. Following graduation, in 1969, Jensen joined the Peace Corps. As a Volunteer he was assigned to work with fish marketing on the São Francisco River in central Brazil.

I had the opportunity to meet John while on a Project Review (AID/csd-2270-Task Order #4) visit that I made to Brazil while he was still on his Peace Corps assignment. Later, Task Order #8 of AID/csd-2270/BOA (March, 1972-June, 1974) included a request for technical assistance in fish culture extension there. Research conducted under Task Order #4 had demonstrated that the development of fish farming in Northeast Brazil would likely be an important rural development strategy and that future work should emphasize the extension of the new technology. The description of the proposed extension objectives in Task Order #8 was largely written with the expectation that we could employ Jensen to do the work. Fortunately, he agreed to accept the position, and after completing his Peace Corps assignment in 1972, he was employed by ICA to begin the first fish culture extension program ever undertaken in Brazil. A summary of his accomplishments there, during the three-year period May, 1972-May, 1975 has been presented in Jensen (1974).

John returned to campus in May, 1975, and entered the graduate program. He received the M.S. Degree in 1977 and the Ph.D. Degree in 1979. While working to meet the requirements for these degrees, he assisted with a number of ICA activities. After Earl Kennamer retired in 1974, there was no one with recreational fishing responsibility in the Alabama Cooperative Extension Service until John was appointed Extension Fisheries Specialist in 1979. At that time, he was assigned responsibilities in both aquaculture and

recreational fishing. He was the first person to serve as Extension Specialist in Fisheries in Alabama with a Terminal Degree in fisheries.

John is one of the few 'natural-born' extension agents that I have known. He has done lots of other things in his career, and has done them well, but without question, he is most effective working with groups of farmers. When John became Extension Specialist, catfish production in the U.S. was just entering its exponential growth phase. In 1979, the total production of 'food-size' catfish was around 50 million pounds. When he left his extension position in 1991, production had reached a level of around 450 million pounds. Production in Alabama followed a similar trend. John was 'right-in-the-middle' of this 'explosion.' He, along with ALFA's Jimmy Carlisle, virtually lived with the rapidly growing industry, constantly encouraging its orderly growth, providing it with a steady flow of technical information and serving as a conduit between farmer concerns and research work on campus. However, while attending to farmer needs, probably his most important contribution resulted from his pioneering work with processors, and his efforts to promote better producer-processor relations which had been a serious problem in the State for some time.

Later, with the 'sea-change' in the Cooperative Extension Service, associated with changes in University structure during the Martin Administration, John was given academic rank and made a tenured faculty member as a Professor in FAA. He also played a leading role in arranging for the incorporation of all Extension Specialists into their respective subject matter in Departments in the College of Agriculture, and determination of academic rank for each of them.

After Rogers retired in August, 1995, John was appointed Interim Department Head. He held that position until 1996 when he was appointed Department Head. Then in 2001, President Walker requested that he serve as Interim Dean of the College of Agriculture and Interim Director of the Alabama Agricultural Experiment Station until a new Dean and Director could be employed. In 2004, after a new Dean and Director had been appointed, President Richardson asked him to serve as his Special Assistant in Agriculture. He finally returned to regular faculty status in the Department in 2005. He retired March 30, 2007. However, when David Rouse retired in 2013, Dean Batchelor asked him to serve as Interim Director of the newly created School of Fisheries, Aquaculture and Aquatic Sciences until a replacement for Rouse could be hired. Jensen's contributions to our various 'outreach' programs will be discussed in greater detail in a following Section.

DAVID. B. ROUSE

David Rouse was employed as Interim Department Head in early 2002, after John Jensen had been asked to assume the position of Interim Dean and

Director. In 2005, he was appointed to the position on a permanent basis. He is an Auburn native. David was awarded a B.S. in Marine Biology, in 1971, by Auburn University, and the M.S. in Fisheries Management in 1973. From 1973-1978, he was employed as a Water Pollution Control Biologist with the Alabama Water Improvement Commission. In 1981, he was awarded the Ph.D. in Fisheries/Aquaculture by Texas A&M University. In the early 80s, the world 'boom' in shrimp aquaculture was just getting underway. We had no one on the ICA faculty with experience in this area; consequently, we invited David to come to Auburn to participate in our International Program and to conduct research and teach in the general area of crustacean and molluscan aquaculture. He joined the faculty in 1981. I had known David for many years. He taught my youngest son to swim.

When he returned to Auburn, he was initially employed on USAID funds; consequently, much of his early work here was related to agency-funded activities – especially non-degree training programs for internationals. We were soon able to find funds that allowed him to get involved in our research program, and somewhat later in the teaching program. In 1985, Muniruddin Mulla and Rouse published his first paper from Auburn on the culture of 'freshwater prawns' (Mulla and Rouse, 1985). Later, he would supervise student research on the biology and production of 'red claw' crayfish. Still later, he would become heavily involved in research on shrimp and oysters in Alabama's Coastal Zone. His contributions to our research program are considered in greater detail in a following section.

In the early 90s, the decision was made to enlist the help of ALFA and Representative Callahan to secure a 'Line-Item' for the Department's budget that could be used to construct a shellfish hatchery in south Mobile County and to conduct research on oyster production in coastal waters. We were ultimately successful in securing funding which allowed us to formally establish the program. David was involved in all aspects of this entire process including: meetings with Callahan, site selection, design and construction of the hatchery, and the development of work-plans for the facility. The hatchery was completed in 2003 – the year after David became Department Head.

In the mid-90s, Rouse played a major role in securing funding for the so-called CASH (Coastal Alabama Seafood Harvest) Project. CASH provided funding for the development and dissemination of brackishwater aquaculture technology. Rouse and Richard Wallace served as co-leaders for the Project.

In 2005, David became involved in the development and management of the largest construction project ever undertaken in the Department – construction of the Center for Aquatic Resources Management (Figure 78). The project was funded at a level of approximately \$8.6 million. Funds were secured, designs developed and construction completed during the period

between September 2006 and August 2011. Technically, this was a tremendously complicated project, requiring numerous design changes throughout the construction phase. Further, the funding pattern was also complicated; since appropriations were added over a four-year period. All-in-all, this was an extremely challenging project for Rouse as he attempted to translate departmental needs for modern research facilities into reality through a maze of over-lapping interests and responsibilities.

Also during Rouse's time as head, the Department went through a major wave of retirements. Faculty who had been hired in the late 1960s and 1970s began to retire. Rouse was able to obtain funds and approvals to hire 11 new 'Tenure-Track' faculty between 2003 and 2012. Faculty were added to replace much of the Aquatic Animal Health group, and to greatly expand capabilities in molecular genetics, shellfish biology, aquatic ecology and quantitative fisheries biology. The School's first economist was also hired.

Sometime around 2011-2012, the Central Administration made a decision to request permission from the Board of Trustees to change the status of the Fisheries Program from that of a Department to a School within the College of Agriculture. As a result, Rouse was assigned the responsibility of assembling the documentation supporting this request. Assembling the large amount of material required input from the entire faculty and staff; however, it was Rouse's ultimate responsibility to assemble the material that supported the request to the Board. The Board approved the request in early 2013.

David retired in the fall of 2013, after serving as Department Head and eventually as Director of the School of Fisheries, Aquaculture and Aquatic resources for a total of eleven years.

JOSEPH R. TOMASSO, JR.

Joe Tomasso became the permanent Director of the School of Fisheries, Aquaculture and Aquatic Sciences at Auburn in mid-August, 2015. He is a native of Tennessee. He was awarded the B.S. in Secondary Education by the University of Tennessee-Martin, in 1974; then the M.S. in Biology by Middle Tennessee State University in 1978. He received his Terminal Degree (Biology) from Memphis State University in 1981. From 1981-1987, he taught Biology at Texas State University; then during the period 1987-2006, he was involved (Teaching and Research) in the Aquaculture Program at Clemson University. In 2006, he returned to Texas State University as Professor of Biology and Chairman of the Department. He remained in that position until 2013 when he returned to full-time teaching.

When Tomasso arrived in 2015, his first order of business was to initiate several badly needed renovation projects in Swingle Hall and North Auburn.

When finished in 2019, Swingle will have two renovated classrooms and a new teaching lab, while North Auburn will have new or renovated space for challenges, hatchery operations, fishery management work, ichthyology, physiology, genetics, and production work.

The second order of business was to work with the faculty to plot the course for the future of the School. Two needs clearly came out of the discussions – first, the need in the School for expertise in aquatic toxicology, and second, a plan and facilities for an expanded role for the School on the Gulf Coast. Currently effort is being put into meeting both of these needs.

A part of the planning process was the development of a hiring plan for the future. As a part of this plan, Dr. Ian Butts and Dr. Luke Roy were hired to fill needs in reproductive biology and production. Over the next year, the faculty will refine the hiring plan and incorporate it into a strategic plan that will position the School to meet the needs of the State, nation and world over the next thirty years.

COVA ARIAS AND DENNIS DEVRIES

When the Department of Fisheries and Allied Aquacultures became the School of Fisheries, Aquaculture and Aquatic Sciences, the Dean of the College of Agriculture agreed to fund two Assistant Directors for the new School to assist the Director with administration. The decision was made to align the positions with the College's administrative structure, having one responsible for Academic Programs and the other for Research Programs, although in practice both individuals could assist with many overlapping projects (particularly given that much of the School's administration involves overlap of academics and research). The two positions were described and advertised in fall 2014, and after internal interviews were conducted, Cova Arias (Academic) and Dennis DeVries (Research) were selected to fill these positions in early 2015.

Since 1970 the Department Head and then the Director was responsible for the over-all management of all of the 'far-flung' activities of the Fisheries Program. It is 'safe-to-say' that with this arrangement, administration was chiefly confined to 'fighting-the-fire-of-the-day.' There was precious little time available to plan for the future of the Program, or to do those things required to 'pave-the-way' to bring those plans to fruition. With Cova and Dennis 'on-board,' the Director should have more time to provide the leadership required to make the Program even more productive than it has been in the past.

PROVIDING SECRETARIAL SUPPORT

Providing Secretarial Support has been a primary activity of one group of

'Investigators. This activity has been an essential element in the evolution of the Auburn Fisheries Program and the elaboration of its many noteworthy accomplishments. They have served as the central 'nervous system' of the entire Fisheries Program. They have been essential in holding together and supporting its teaching, research, and outreach activities. Further, they have served as the essential 'link' between the 'Investigators' and the greater University and the 'outside' world. Over time, they have typed examinations, research manuscripts, purchase orders, appointment papers, travel requests, grant proposals, reports, thousands of letters and memoranda, thousands of didactic epistles for Department Heads, filed hundreds of thousands of marginally important items, paid bills, kept records of expenditures, prepared budgets, placed and answered literally millions of phone calls. In performing this myriad of tasks for three-fourths of a century, they continuously maintained a stable, 'civilized' environment for a group of wet, muddy, often churlish, egocentric 'slave-drivers,' using smiles, kind words and an endless supply of home-baked cookies and cakes. 'God bless them, one and all.'

The responsibilities of secretarial personnel in the fisheries program remained generally unchanged from the late 40s until the mid-60s. Until that time, they were primarily typists or clerks. However, by the mid-60s, extramural funding for the program was increasing rapidly. For example, the Rockefeller Foundation Grant (\$500,000) was awarded in 1965. As a result, the preparation of grant and contract proposals and periodic and final reports were added to their regular duties. Further, the number of personnel employed was also increasing; requiring the preparation of a steady stream of personnel actions. Finally, with the increased level of extramural funding came a significant increase in the preparation and maintenance of financial records. The FY '65 Budget indicates that our first Clerk (Linda Lightfoot) was hired that year.

In the early days, 'tools-of-the-trade' for Secretarial Support had been typewriters (with carbons), adding machines and later, Marchant and Monroe rotary calculators. If I remember correctly, sometime in the late-50s, a 3M Thermofax copier was purchased. It was supposed to solve the problem of making copies without the use of carbons. It did make copies rapidly and cheaply, but they were unsuitable for most uses. A comment in the 1967 Annual Report indicates that a Xerox copier was rented in June of that year. It was not until the early 80s that many changes were made in the 'tools' available to Secretarial Support. The Apple II computer was first sold in June, 1977. If I remember correctly, we must have purchased one of these machines, probably for Bill Davies, in the late 70s. In August, 1980, Jim Buston enrolled in our graduate program, and almost immediately began to assist us with the improvement of Secretarial Support through the use of computers and computing.

Jim Buston is a native of Wyoming. He attended the University of Wyoming

for two years; then transferred to Oregon State, where he was awarded the B.S Degree in Fisheries Science (Concentration in Marine Biology) in 1974. After graduation, he joined the Peace Corps. He was assigned to the North Coast of Honduras, where he was involved in teaching artisanal fishermen how to construct modified New England Dorries. On completing his Peace Corps assignment, he was employed by USAID as a Technical Advisor to the Ministry of Natural Resources of the Government of Honduras. In this position, he worked on a fish farming project in the Comayagua Valley. He was in that position for three years. Several of the ICA faculty met him there while we were involved in our USAID-funded project (AID/DSN-2780/ADP) in Honduras. In 1980, he entered our graduate program. Later, he was awarded a Graduate Research Assistantship to work with Tom Lovell on the biotin requirements of channel catfish. He was awarded the M.S. Degree in 1983.

Jim arrived in Auburn with an abiding interest in computers and computing, and a well-used personal computer. Buston had become enamored with computers and computing while taking classes in statistics and data processing – ‘keypunch’ was all the rage then – at the University of Wyoming. About the same time, he discovered the hp-35. It was the first hand-held, programmable computer on the market. It had been introduced by Hewlett-Packard in 1972. He immediately broke his “piggy bank” and purchased one for around \$800. It accompanied him to Honduras, where he taught himself programming on his hp-35.

His long-held interest in Information Technology (IT) meshed well with our growing interest in the subject. Remember that in the early 80s, all aspects of the Fisheries Program were expanding rapidly. Administrative requirements were increasing exponentially. Sometime after his arrival, we enlisted him to ‘hard-wire’ several Apple II machines together to develop a “self-contained” computer network in Swingle Hall. It was likely the first ‘micro-computer’ network established on campus. Later, he added VisiCalc, a spreadsheet application, to the system. Jim ‘programmed’ it to perform several calculations, such as predicting yields of fish at harvest and feeding rates. Later, he incorporated Screen Writer II, a word processing application for the Apple II, into the system. It could be programmed to perform a variety of operations on several Epson 80 dot matrix printers that we had purchased. This combination could be programmed to produce a variety of documents in ‘letter quality’ mode, including theses and dissertations acceptable to the Graduate School. Jim graduated in 1983, but by the time he left, he had helped us establish a dynamic IT program. Eventually, we would have likely established an equally progressive one on our own, but as a result of his leadership, we were several years ahead of where we would have been otherwise.

Kelly Mosely also made a significant contribution to the development of Secretarial Services in the Department. He was a 1924 Auburn graduate in

Electrical Engineering. After graduation, he was employed by Southern Bell. After a distinguished career with the company, he was appointed Assistant to the Vice President in 1956, a position he held until he retired in 1963. After retirement he decided to up-grade the natural resources on a 930-acre tract of family land (Pineland) near Myrtlewood, along the Tombigbee River in Marengo County. Existing resources on the farm had been poorly used for decades. One of the up-upgrades consisted of harvesting water from a small permanent stream on the property to fill two 'terrace-water' ponds. Throughout most of his career with Southern Bell, he had maintained close contact with Auburn, generously supporting a wide range of its programs. In turn, the University was extremely happy to provide any technical assistance required in his efforts to improve the resource base at Pineland. The first University input involved the development of a management plan for a "Whole Farm Forestry Demonstration" on the tract. The initial work was done by Ivan (Ike) Martin, Extension Forester, in 1960. Later, Martin moved to Washington and was replaced by Larkin Wade. Larkin would complete the plan and oversee its application for many years.

Sometime later, Kelly became interested in the management of the two fishing ponds on the tract. After Bill Davies returned from Brazil in 1972, he assumed responsibility for teaching, research and outreach on the management of small impoundments. When Kelly became interested in the management of his two ponds, Davies provided information and at times technical assistance that was needed. Usually, Davies would make at least one trip each year to electro-fish the ponds. He would meet Kelly at Pineland on those visits where they would discuss the results of the sampling and what they meant in terms of management strategy. I believe that it was on one of these visits that Kelly indicated that he wished to begin making an annual contribution to the Fisheries Program. Initially, the contribution had few 'strings' attached to it; however, in the early 80s after we began to improve our computer technology, he requested that the contribution be used specifically for that purpose. Afterwards, we provided him with a report each year detailing how we had used his gift. Kelly continued this practice until he died in 2002.

PROVIDING TECHNICAL SUPPORT

Another important 'activity' of some of the 'Investigators' consisted of providing Technical Support for the research portion of the Auburn Fisheries Program. Generally, in presenting the material in this Section, I am separating Technical Support from Field Operations; although the line between the two is not sharply defined. Field Operations generally deals with facility development and maintenance, pond stocking, fertilization, feeding and pond draining and fish recovery, etc. Technical Support generally involves data collection and analysis. Most of the Technical Support has been supplied by a long succession of Research Support Personnel

(Research Assistants, Instructors, Research Associates, Research Fellows and Graduate Research Assistants).

Obviously, providing Technical Support for a research program is not always absolutely essential. For example, virtually all of the research that resulted in the publication of *Bulletin 254 (Management of Farm Fish Ponds)*, in 1942, was conducted with little, if any, Technical Support. Swingle and Smith were apparently responsible for all of the technical aspects of the experimentation involved; although they did employ a limited amount of student laborers on an hourly basis. Technical Support is not an absolute requirement, but it usually makes the process much more efficient. Providing a Principal Investigator with Technical Support is especially beneficial if the research requires the routine analysis of many samples in the laboratory, or if there is considerable repetition in the collection of field data, over time. With an adequate supply of Technical Support, a Principal Investigator can conduct several experiments at the same time. For example, at one point in the mid-80s, Tom Lovell was supervising some 15 graduate students. If I remember correctly, all of those students were receiving compensation (GRAs) to conduct their M.S. and Ph.D. research. At that point, with adequate Technical Support, primarily from Graduate Research Assistants, Lovell was conducting some 15 different research projects simultaneously.

It is difficult to over-emphasize the contribution that Technical Support has made to the success of the Auburn Fisheries Program over the years. We have been extremely fortunate in having the funds to purchase so much of it. All categories of personnel involved have made significant contributions. For several years Laboratory Technicians, although they were later replaced by other personnel categories, made significant contributions to our ability to provide the wide variety of services required in meeting the terms of numerous grants and contracts. Research Associates have also been essential in meeting contractual obligations in long-term research on water quality and recreational fishing in public waters. Further, they have played an absolutely essential role in their involvement in the wide-ranging activities undertaken by the International Center for Aquaculture, both on campus and overseas. Because of the large number involved, over many years, Graduate Research Assistants have been directly responsible for much of the mundane technical work supporting our highly productive program. For example, as detailed in a preceding Section, it was noted that in FY '96 that the FAA Budget included the names of some 70 individuals in the personnel category. It is simply 'mind-boggling' to imagine the amount of Technical Support for research that was provided by such a large number of gifted individuals. With this level of Technical Support, over the years, the large number of theses, dissertations and refereed publications produced in the Department and School is not surprising.

FIELD OPERATIONS ACTIVITIES

The term 'Field Operations Activities' is used here in the broadest possible sense. They generally include all of those activities taking place at the four farms. They include providing assistance (stocking, seining, draining, counting, weighing) for experiments being conducted in the various ponds on the farm, and the construction and maintenance of physical facilities. They are not a static entity; rather, they change as aspects of the mission(s) change.

In the early years (mid-30s through the mid-50s) the mission of the Program was generally related to efforts to develop technology for establishing good, sustainable fishing in 'terrace-water' ponds. Activities related to Field Operations were relatively limited in scope. Afterwards, the mission shifted somewhat to 'water farming' where the emphasis was on producing marketable crops (fishing privileges or bait minnows) in those ponds.

In the late 40s, Program Faculty began to offer formal courses in pond construction and management. Included in this effort was the need to provide graduate students with experience in conducting field research. Activities related to the various aspects of the new formal teaching program began to require assistance from the Field Operations group. Later, with the inception of the International Program, all aspects of the teaching program increased markedly, especially those related to providing informal training (short courses) for international trainees.

In the mid-50s, the research mission of the Program changed sharply. The channel catfish farming industry began to expand. Quickly, what had been a rather limited research project to learn to produce good recreational fishing in 'terrace-water' ponds, became much more complicated. Soon the 'Investigators' were conducting experiments in nutrition, fish health, genetics and breeding, processing and technology, and water quality maintenance in the field.

All of these new areas of research required additional assistance from Field Operations. Further, research in commercial fish farming 'moved' more rapidly. Ponds were stocked and drained more often. Also, the quantity of fish involved became much greater. Draining ponds in a typical bass-bluegill experiment might involve a few hundred pounds of fish. Draining a pond used in a commercial aquaculture experiment often involved several thousands of pounds.

Over time, as the nature of the Fisheries Program has changed, Field Operations has also changed. Activities related to construction and renovation have been replaced by an increased emphasis on maintenance. Further, technology employed by the Unit has changed significantly. The 'D'

Series (Figure 8) on the South Auburn Farm were all dug by-hand. The dam for Farm Pond 1 (Figures 6 and 7) was constructed using 'slip-scrapes' pulled by mules. Earth in the dams for the 'F' Ponds were 'pushed-up' with a bulldozer (Figure 31); while all of the dams on the large ponds on the Story Farm were constructed with the use of an earth-hauling, scraper-pan combination pulled by a large bulldozer (Figure 44). However, as maintenance has replaced construction as a primary Field Operations activity, the heavy equipment has also changed. Equipment such as the Schaeff 'Walking Excavator' and the Hitachi 'Mini-Excavator' are utilized more frequently than the bulldozers.

Records indicating the involvement of Field Operations in the construction and maintenance of facilities on all of the Farms have been maintained from the beginning of the program in 1934. Activities are listed by year in Appendix Table 1. Unfortunately, there is no similar documentation of the enormous amount of day-to-day effort (stocking, draining, fertilizing, feeding and treating ponds, cutting grass, road maintenance etc.) expended in support of the teaching, research and outreach programs of the Program for over a half century. Those contributions only appear as part of the overall, high level of productivity over the years.

As detailed in several preceding Sections, Swingle and Smith, with the help of the Field Crew and a few student laborers, were responsible for Field Operations from the beginning of the project. Then in 1941, Prather and Lawrence were employed to assist with the sharply increased work load resulting from the development and utilization of the Soughahatchee Farm. However, both of them were quickly called into military service. Then in 1944, the Story Farm was purchased. Also, in the same year E. V. Smith left the Project to move to the Dean's office. Sometime in that same year, J. W. Webb was employed as the first Superintendent of Field Operations (Table 73). He remained in the position until late 1946 or early 1947 when he went to South Carolina as the head of their Wildlife and Fisheries Agency. He was succeeded by Pate Ridgeway, who resigned in late 1947. Then on January 1, 1948, A. L. Black was employed to fill the position. He would remain in that position until he retired in 1985. During his tenure, Field Operations would experience some truly amazing changes – by far the greatest in its long history of service to the Program.

Lamar Black (Figure 48) was born in the Black Community in western Lee County in 1923. He graduated from Loachapoka High School, and soon joined the U.S. Navy. After his release from service, he began to take courses in surveying at Southern Union Community College in Wadley. When he joined the 'Investigators' on the Farm Ponds Project on January 1, 1948, much of the 'heavy-lifting' of pond construction on the Soughahatchee and Story Farms had been completed. All of the ponds in the 'E' and 'F' Series, and most of those in the 'H,' 'M' and 'T' Series were finished. Also,

most of the basic construction was complete on the major 'S' Ponds (S-1 to S-17) on the Story Farm (Appendix Table 1). Lamar arrived in time to help 'tie' them together and to make them function as an integrated research unit. He supervised the construction of the diversion 'ditches' around the ponds on the Story Farm and the installation of the miles of roads that connects the entire system.

In the late 50s, expanding extramural research placed an additional burden on the Field Operations Unit. There simply were not enough ponds available to meet the increasing research commitments. This problem was especially acute for specialized research, such as the evaluation of chemicals for weed control. As a result, Lamar and the Field Crew expanded the area available for new ponds on the Sougahatchee Farm. In 1959, they cleared a portion of the dense woods west of the Counting Shed, across Funchess Creek, and prepared the area for the construction of the 'K' Series. The construction of these ponds required the fabrication of elaborate, heavily reinforced wooden forms in preparation for pouring the concrete. Later, in 1960, 74 plastic pools of the 'L' Series were set-up in the same general area (Figure 49). This extensive construction effort was simply added to the on-going, 'day-to-day' Field Operations activities (stocking and draining ponds, counting fish, cutting grass, fertilizing ponds, maintaining dams and roads, etc.).

As noted in a preceding paragraph, in the early 60s, research interests of the Fisheries Program changed quickly from research on the production of recreational fishing to the production of commercial fish. This change created many new challenges for Field Operations. More ponds were being stocked with catfish or tilapia. With most of this research, ponds were stocked and drained annually. The use of feeds increased sharply. Ponds received feed at least 6 days per week, depending on the number and species involved. Feeding schedules had to be altered regularly. Feed handling and management required continuous attention. Counting and weighing of large quantities of harvested fish required an ever increasing amount of time and effort. Experiments with the commercial production of channel catfish resulted in the need to process and store thousands of pounds of fish each year. Tilapia production also required a considerable amount of attention. Fish needed for experiments the following year had to be held in warmed water throughout the winter.

As a result of the sharply increased work-load associated with research on commercial fish production, additional Field Crew had to be employed. By December, 1962, there were 16 of them on the payroll (Table 68). In December, 1958 there had been 10. However, even with the additional personnel, given the nature of our research facilities (large, deep ponds with uneven bottoms, inadequate processing facilities and freezer storage space, harvested rain water; etc.), Field Operations could never really effectively cope with the demands of a major research program in commercial fish

production.

The problem of removing thousands of pounds of food-sized fish from around the drain-pipe of a recently de-watered pond, over a short period of time, was particularly onerous. It was virtually impossible to remove fish from the pond until most of the water was removed. As a result, the large quantity of fish accumulated in a small volume of mud and water. In order to maintain carcass quality, the fish had to be moved to fresh water as quickly as possible. To do so required that fish be removed from the mud and water by seine and carried up the steep slope of the dam in large aluminum 'tubs' to a truck on the road above. Here, the 'tubs' were lifted onto the 'flat-bed' of a truck for transported to the Counting Shed. This process required almost 'super-human' effort on the part of the Field Crew.

After a few years of using this labor-intensive procedure, Lamar developed a small portable 'track' transportation system that was used to lift the 'tubs' of fish up the slope of the dam. It consisted of a small wooden platform mounted on a metal track installed on the slope (Figure 50). It was powered by a small gasoline engine. Later, Randell and Lamar collaborated in developing a system for lifting fish out of the drained pond directly into tanks on the truck-bed. It was based on attaching a heavy metal pipe to the 'bucket' on a 'back-hoe' (Figure 51). A large mesh container was attached to the end of the pipe. Fish collected around the drain-pipe with seines were transferred to the mesh container where they were power-lifted to the tanks. This system required very little 'heavy-lifting.' Also, getting the fish out of the mud into fresh water was accomplished much more rapidly. Randell had seen a prototype of this 'lift' system while he was working on the fish farm in Mississippi.

The back-hoe 'fish-lift' system solved one of the most onerous problems associated with our commercial catfish production research. Unfortunately, removing fish from the pond to fresh water quickly and efficiently was not the most intractable one. The Field Operations Unit simply was not prepared to process and store such large quantities of fish. Further, marketing was even more complicated. Later, Randell would solve the problems of processing and storage by selling live fish to 'fish-out' operations; however, by that time commercial production practices had moved ahead so rapidly in West Alabama and Mississippi that any research that we might do in this area would contribute very little to the continuing development of the industry.

Along with his other duties, Lamar was responsible for supervising the work of the entire Field Crew. On most work days, they were involved in various projects scattered over the Soughahatchee and Story Farms. Also, in the 50s, the 'Investigators' were still conducting research on the South Auburn Farm. It was his responsibility to see that they were transported to their work sites in a timely manner, with all of the required equipment and supplies so

as to keep all of their various tasks on schedule. He had to keep close contact with their progress, so that they could be shifted to different locations as needed.

By 1963, supervising the quantity and quality of work required of Field Operations was just too much of a chore for Lamar to handle alone. As a result, Claude S. Ellington was employed as Assistant Ponds Foreman. His name first appeared in the FY '65 Zoology-Entomology Budget. Claude was a native of Lee County. He graduated from Auburn High School in 1957. He attended Auburn University for several quarters. Adding Claude to the Field Operations Unit as an assistant to Lamar was an especially helpful move. It provided for much more effective functioning of the Field Crew. He was also especially helpful in maintaining levels of supplies required by the different groups of workers on specific projects. The need for supplies for the different jobs could never be fully anticipated. As a result, someone had to be constantly involved with their purchase and distribution.

Claude also provided considerable assistance to Ellis Prather in his research in the spawning of channel catfish. Over time, he became highly proficient in all aspects of the process. Claude retired in 1995.

Lamar also played a leading role in the second 'wave' of pond construction on the Soughahatchee Farm (Figure 52). It was largely funded by a grant from the Rockefeller Foundation and completed during the period 1967-1970. He was responsible for supervising the clearing of the remainder of the dense woodland west of Funchess Creek and making the area ready for constructing the 'R' Series. He and the Field Crew were also responsible for preparing the foundations in that area where literally hundreds of concrete ponds and plastic pools would be installed (Figure 49). Further, water supply and drains had to be provided for each one. They were also responsible for the complete renovation of the old 'E' Series of eight, 1.0-acre ponds, and the 'lay-out' and construction of the new 'E' Series of seventy-six, 0.10-acre ponds that replaced them.

In 1970, the Department of Fisheries and Allied Aquacultures and the International Center for Aquaculture were established. I became Department Head in 1973. Along with these changes, the Department was quickly involved in implementing the 'Institutional Development Grant' funded by USAID (AID/csd-2780). As a result of these changes, the Department's various programs (Instruction, Research and Outreach) were growing at a fevered pace, and much of the growth involved additional work for Field Operations. With all of these changes taking place, it seemed to me that the Field Crew was not adequately staffed or structured to meet these often specialized demands for assistance and support. We needed to add an individual with degree-training in aquaculture and with a farm background to assist Lamar and Claude. Consequently, I asked Swingle to let me hire

Randell Goodman for that position. In this period, he was spending much of his time traveling overseas in the 'implementation phase' of our AID-funded, outreach program in developing countries. He readily agreed. Randell agreed to accept the position, but before he could go to work, I received a telephone call from a catfish farmer in Minter City, MS asking if we had an individual who might be able to manage his 300-acre hatchery and production operation. While I really wanted Randell to join our Field Operations Unit, I felt that working for the private sector likely would be a better way for him to meet his long-term goals and those of his growing family.

Unfortunately, managing the Mississippi farm did not work out. The operation was inundated by floods in two successive years, and in late 1974, Randell without informing me, decided to return to Tennessee to resume a career in teaching in the public schools there. I called him again in November, 1974, after I became Department Head; again offering him the position, but by that time, he had already accepted the Tennessee teaching position; however, he did agree to return to Auburn after the school-year ended.

In June, 1975, Randell was employed as a Research Associate to assist Lamar and Claude; however, I really wanted him to spend most of his time working with the increasing number of graduate students who were using the facilities on the Farms, and providing support for the numerous non-degree training programs also utilizing those same facilities. Lamar had never been asked to work with large numbers of students, especially with and around large groups from various foreign countries. I had envisioned that Randell would be responsible for this rapidly growing area of the program.

Hiring Randell to work with Field Operations was a very complex matter. I expected that he would be directly responsible to me. At the same time, he was expected to work with Lamar as part of the larger Field Operations Unit.

In the mid-70s, Larmar had been supervising the Unit and its work for over 25 years, and in hiring Randell, it was difficult to convince him that I was not dissatisfied with his performance, and was hiring Randell to replace him. Of course nothing could have been further from the truth. Larmar had been and would continue to be an absolutely essential part of the 'Investigator' team.

In the early 80s, teaching, non-degree training, student research and outreach activities on the Sougahatchee and Story Farms were continuing to increase steadily. Scheduling and supervision was increasing to the point that Randell really needed some assistance in meeting the needs of all the programs and people that he had been working with. As a result, we decided that we needed to employ another Research Associate. We also felt that because so many women were involved in the program that we needed to

employ one in the position.

Later, we advertised the position, and in 1981, Karen Veverica was employed to assist Lamar, Randell and Claude. Karen, a Michigan native, was awarded the B.S. Degree in Biological Sciences by Michigan State University in 1976. Then during the period 1976-1978, she was a Peace Corps Volunteer in Cameroun. Later, in 1981, she was awarded the Master of Agriculture Degree (Fisheries/Aquaculture) by Oregon State University. She returned to Oregon State to work on her Ph.D. Degree during the period 1987-1988. We were especially happy that she agreed to come to Auburn. Her Peace Corps experience was especially helpful, given the nature of some of the training activities on the Farms. Further, her working knowledge of French was especially welcome.

The University Curriculum Committee had approved the establishment of the Master of Aquaculture (M.Aq.) Degree in 1978. The new program required that the M.Aq. students spend a significant amount of time, each week, involved in day-to-day activities on the Farms. This unique teaching activity required a major commitment to supervision, coordination and scheduling. Unfortunately, as a result of the 'press' of the world-wide ICA program, from its inception, we were not able to provide it with the faculty support and continuity that it needed. Randell had accepted a major role for the field-oriented activities of these students; however, he was already fully involved with other Field Operations commitments. As a result, when Karen arrived, we asked her to work with Randell on the field support of the M.Aq. Program. With her Peace Corps background, she was especially helpful in providing these students with a high level of 'hands-on' experience.

Unfortunately, Karen had hardly gotten her 'bags unpacked' before USAID requested that ICA undertake the development of a fish culture teaching, research and outreach facility in Rwanda. Of course, development of the facility required considerable experience in all phases of aquaculture, plus a working knowledge of French. Karen was the obvious candidate to serve as Chief of Party for the project. She had worked for two years (1976-1978) in aquaculture in Cameroun, so she had good working knowledge of aquaculture in Africa – plus a good working knowledge of the language. It was with considerable reluctance that we asked her to leave her M.Aq. responsibilities to go back to Africa. We let her make the decision, but assured her that her position on campus was secure. She could return to it once she had completed the Rwanda project. She moved from the campus to Rwanda in May, 1985. Then, for the next almost two decades, she would be involved in long-term, USAID assignments in Africa (Rwanda – 10 years; Kenya – 3.5 years and Uganda – 3.5 years)

Shortly after Karen's assignment to Rwanda in 1985 was finalized, we realized that we should replace her as soon as practical. Her reassignment

would leave a large 'hole' in our Field Operations efforts – especially in the field support for our M.Aq. Program. If I remember correctly, we felt that filling her position would be only a temporary matter. We expected her to return to it after Rwanda. Fortunately, we were able to quickly find the perfect replacement – Renee Beam.

Renee is an 'Army Brat.' She has no 'native' state, but was born in Texas. She attended Columbus College on two occasions, but was awarded the B.S. Degree in Marine Science/Biology by Southhampton College in 1983. Then in June, 1985, she was awarded the M.Aq. Degree by Auburn. She was the ideal person to replace Karen. In fulfilling the requirements for the M.Aq., she had become thoroughly familiar with all aspects of our Field Operations activities. She knew where every 'mud-hole' on both Farms was located, and how to navigate around or through each one. She also had a thorough knowledge of the principles and practices of warm-water aquaculture. She was offered the position for three years. We assumed that Karen would return in three years. Fortunately for the Fisheries Program, this three-year period has continued for almost 30 years. Renee's primary assignment was to provide the same support for the program as Karen.

In 1998, John Jensen requested that Renee devote less time to her regular Field Operations assignment in order to assist the Genetics Work Group with some of their record-keeping problems. She was also asked to assist with the supervision of some of the student research projects in genetics. For a time, she devoted most of her time to this assignment. She was finally relieved of any responsibility in this area in 2016. Currently, she also spends approximately 25 percent of her time on meeting the School's required reporting on its compliance with a myriad of Federal regulations

Lamar retired in 1985 – the last of the original 'Investigator' team (Swingle, Smith-Prather, Lawrence, Dendy, Allison and Black) to do so. Randell was immediately appointed as his replacement. His appointment, over time, resulted in some important changes in Field Operations. Lamar had been an extremely effective, 'no-nonsense' Foreman. You talked with him about what was needed on the Farms; then he quickly figured out the best way to get it done, and just as quickly – did it. When Randell replaced Lamar, I wanted to change the mission of the position somewhat. I wanted Randell to spend more time managing Field Operations and less time supervising the Field Crew.

In late 1974, Dean and Director Dennis Rouse had consolidated Field Operations of the various on-campus Departmental Research Units by establishing a Department of Research Operations. Its purview was later extended to the Substations. Laverne Brown was the first Department Head. Later the Department Head position was abolished, and Tom Cherry was appointed Superintendent. In 1989, Tom was later replaced by Peyton Kelly. Because our Field Operations activities were so unique, we were not officially

included within the new organization.

I wanted Randell to spend more time interacting with the new College of Agriculture Research Operations group. While I had no interest in that group taking the responsibility for our Field Operations, I hoped that over time they might help us with some of our most time-consuming activities. Specifically, it would have helped us a great deal to have some assistance in mowing the many acres of open grassland on the Farms during the summer. Swingle had started to deal with this problem many years earlier by planting pine trees on large open areas on both Farms. The stand of trees between Alabama Highway 147 and the new 'E' Series, was established for that purpose; as was the single row on the east side of 'Pond S-3. Further, we had to spend an inordinate amount of time working on the roads, especially on the Story Farm. Any assistance with road maintenance would have also helped us immensely.

The Field Operations role in the Fisheries Program sort of 'Grow'd-like-Topsy' over the years as the Departmental Research Center on the Farms grew. In the early years at South Auburn, Swingle and Smith decided what they wanted to do, and how to do it; then they along with the Field Crew just did what had to be done. The informal Field Operations procedure continued even after most of the research work was moved off-campus to the Sougahatchee and Story Farms. Even though both Farms were off-campus, they were never considered to be Substations of the Alabama Agricultural Experiment Station. The Department Head was still ultimately responsible for its 'day-to-day' operation. Even after Swingle retired and I became Department Head, I continued this same informal process for conducting operations on the Farms. With so many teaching, training and research activities going on simultaneously, it appeared to me that only an 'ad-hoc' approach would work effectively.

As noted in a preceding paragraph, in the early 60s, development of the area west of Funchess Creek began. Soon thereafter the 'K' Ponds and some of the plastic pools were installed. Then in mid-60s, the construction Phase of the Rockefeller Foundation Project began. Afterwards, several new buildings were constructed on the Sougahatchee Farm. All of them were constructed under contract with commercial builders. The primary input required of Field Operations was site preparation. However, as a result of increased activity on the Farms, there was a commensurate need for additional 'Field Storage.' Field Operations was responsible for the construction of all of these storage buildings. Their contribution in this area will be discussed in greater detail in a following Section.

As detailed in a preceding Section, most of the major basic construction projects on the Farms had been completed by the time that Lamar retired in 1985; however, in 1990, Randell and Field Operations became involved in

another major, grant-funded construction effort – the Mellon Foundation Genetics Research Complex. In many ways it was the most complex one ever undertaken by the Department. Most of the building construction was done under contract, but Randell and the Field Crew were responsible for all of the pond construction and site preparation. Pond construction was very complex on this project. There was a large amount of sand in the soil profile of the construction site just south of County Road 72, at the north end of the Soughahatchee Farm (Figures 18 and 18C). Construction of the complex was made even more complicated because of the concern for the possible escape of genetically-altered fish from these ponds. These special considerations will be discussed in greater detail in a following Section.

Because of the increasing complexity of the mission of Farm Operations, Mike Ward was hired in 1988. He had grown-up on a large farm south of Auburn. He was a ‘Jack-of-all-trades.’ He was a carpenter, plumber, electrician, and mechanic. There were few things that he could not do that needed to be done on the Farms. He remained with the Department until 2002.

After the completion of the Mellon Complex, Field Operations turned their attention to the much needed renovation of ponds and buildings. Renovation work tends to be more labor-intensive than the original construction. After Randell became Superintendent, he was always looking for ways to reduce ‘hand-labor.’ Even before he became Superintendent, he was instrumental in introducing the ‘back-hoe’ fish handling technology. This was one of the most important labor-saving technologies ever developed by the Fisheries Program. It was especially important when we were dedicating so much research effort to commercial fish production. Later, after he became Department Head, David Rouse received permission from AES to use funds obtained from timber sales to purchase new, labor-saving technology. These funds were utilized to purchase the side-cutting grass mowers, the mini-excavator, the motorized wheel barrow and the Schaeff “Walking Excavator.” These and other similar machines saved countless man-hours of hand labor.

When Renee was given the assignment to provide assistance to the genetics group, it was necessary to replace her contribution to Field Crew activities; consequently, in August, 1998, Esau Arana was employed as an Ag Tech I. Esau is a native of Guatemala. He had been awarded an Associate Degree (Aquacultural Technician) by the Universidad de San Carlos de Guatemala in 1980. Later, in August, 1991, he received the B.S. Degree in Fish Management from Auburn. After graduation, he worked as the Manager of the Westbrook Catfish farm in Albany, GA. Later, he returned to Field Operations as an Ag. Tech. At that time, he had not completed all requirements for the M.S. Degree. In July, 1999, he was awarded the degree. Afterwards, he was appointed to the position of Research Associate I. When

Mike Ward retired, he was assigned responsibility of supervising Field Crew activities; however, his title was not immediately changed to reflect those duties. Sometime later, his title was changed to Associate Director. In August, 2012, he was re-assigned to work full-time in support of the rapidly growing research effort to produce channel catfish in in-pond raceways.

After Karen left campus to begin the Uganda Project, Mark Peterman was employed (October, 2006) as a Research Assistant IV to assist Randell. Later, he requested permission to enroll in the Graduate Program while continuing to work with Field Operations. In 2011, he was awarded an M.S. Degree in Fish Management. He continued to work with Field Operations until February, 2014).

Karen returned to campus on a permanent basis in 2008, but for several reasons, she did not return to Field Operations until Randell retired in 2011. During that period she was classified as Administrator III, Academic Programs, and was involved in a number of ICAAE activities. She was named Interim Director of the Research and Extension Center in January, 2012. Later, after a nation-wide search, she was named Director. In that position she is responsible for the supervision of all Field Operation's activities.

EXPANDING FACILITIES

Continuous expansion of facilities had been a major activity of the Auburn 'Investigators' since the late 40s. Facility development began with the construction of ponds on the South Auburn Farm in 1933, and re-construction is almost complete on some of the 'E' Series of ponds on the Soughahatchee Farm in 2015. As a result of this long term effort, there likely is no other University Fisheries Program in the world that is equally provided with the quantity and quality of its facilities, both ponds and laboratories. Considering the breadth and depth of our programs in teaching, research and outreach, the facilities that have been developed to support these programs are truly phenomenal.

ADDITIONAL CAMPUS LABORATORIES

As detailed in a preceding Section, the 'Investigators' had been given the Miller House (Figure 10) for their offices and laboratories in the mid-1930s. The need for additional laboratory space did not increase very much in the following decade; however, once the graduate teaching program was initiated in 1947, it increased rapidly. By the early 50s, the 'investigators' and their graduate students were severely crowded in the limited space provided by the old dwelling. As a Graduate Research Assistant (1952-1954), I shared an office with Swingle. Fortunately, University administrators, when made aware of the rapidly worsening situation, began to search for space for the Fisheries Program.

GRAVES CENTER

In 1953, the University made the Graves Center Dining Hall, along with several of the cabins in the complex (Figure 53) available to the rapidly expanding Fisheries Program. This complex had been constructed with funds obtained from the State during the first Bibb Graves Administration (1927-1931), and named for Governor Graves. The dining hall was constructed to provide dining facilities for farm families from throughout the state, living in the small cabins while attending extension short courses related to agriculture. When I first came to Auburn in 1948, I ate all of my meals at the facility. At that time, students on the University meal plan took their meals in the eastern portion; while athletes on scholarship ate on the west side. The serving lines were closely adjacent to each other, but the food offered to each group was strikingly different.

Remodeling the dining facility into a research and teaching facility was a very complex and time-consuming task, and most of it was done by A. L. Black with the Field Crew. Lamar's father (Mr. 'Bud') supervised the day-to-day renovation work. All of the old dining hall equipment had to be removed, and a large number of partitions were constructed in order to create offices and laboratories within the building's cavernous interior (Figure 54). Surprisingly, only a single classroom was included in the renovation. The new space was occupied in December, 1953.

A number of the cabins in the Graves Complex were also renovated for laboratories. These renovations also required a considerable amount of work. Originally, each cabin contained two bedrooms and two bathrooms. Initially they were assigned to the Fisheries Program. In turn, two of the three were assigned to the Cooperative P & D Project for research on bacterial and viral diseases and fish parasites. A third one was assigned to the Cooperative Fisheries Research Project. Later, a fourth cabin was assigned for use by Bill Davies and his Work Group.

SWINGLE HALL

By the late 60s and early 70s, with the International Program attracting large numbers of foreign students to the fisheries program, it quickly became obvious that the Graves Center Complex was no longer adequate. Sometime in the early 70s, University officials approached Representative Pete Turnham regarding the need for a new facility. Turnham, Lee County's long-term representative (House District 79), was known as the 'Dean of the Alabama Legislature.' He had been awarded the B.S. and M.S. Degrees by Auburn University, and served as a Dairy Specialist with the Alabama Cooperative Extension Service during the period 1948-1954.

As a result of his efforts, the State provided the University with \$2.7 million

for the construction of new facilities at Auburn. Unfortunately, in the final disposition of the funds, only \$1 million was made available for the construction of a new fisheries building. The funds were generally sufficient for constructing the building, but there was very little remaining for equipping it. Fortunately, Dean Smith agreed to use Experiment Station funds for this purpose.

Swingle assigned me the responsibility of determining space needs that could be met with the expenditure of approximately \$1 million, and of allocating the space between offices, classrooms and laboratories in the three floors of the proposed structure. This information was submitted to the architects who converted it into the 21,000 square-foot floor plan. Construction began in May, 1971, and we moved into the building in late 1972 (Figure 55). It was dedicated as Swingle Hall on June 9, 1973. Unfortunately, Swingle had died less than a month earlier (May 20).

In assigning space for the new building, it seemed to me that a primary need was 'wet-labs;' consequently, a large portion of the west side of the First Floor was set aside for this purpose. Much of that space was divided into separate laboratories; each supplied with a number of stainless steel troughs. Unfortunately, throughout the year, Auburn's domestic water supply contained significant amounts of chlorine. Virtually all of the raw water is harvested from creeks east of the campus and stored in Lake Ogletree. The water cannot be used for drinking without the addition of this chemical. Chlorine, which is extremely toxic to fish, in the water supply made it necessary to install (1955) a large charcoal filter in the basement to remove it. The maintenance of the filter was a never-ending problem. Over time, 'channels' developed within the structure, allowing chlorine-laden water to pass into the troughs. As a result, the structure was almost always in need of "back-flushing" to disrupt the "channels." Further, even with the filter, the quality of the water was far removed from its natural state. For example, it was extremely difficult to conduct fish disease research in the troughs. Fish diseases could often be cured by just placing diseased fish in the supposedly chlorine-free water.

Then there was the problem with 'gas-bubble' disease, especially during the winter. Concentrations of gases such as oxygen, nitrogen and carbon dioxide occurring naturally in pipes of the city water system would quickly become super-saturated upon heating. As a result, 'bubbles' of gas would form in within the bodies of experimental fish, often resulting in their death or in a severe stress. Later, as a result of these problems, the 'wet-labs' were replaced with offices for graduate students.

U.S.D.A. ANIMAL DISEASE LABS

When the design of Swingle Hall was finalized, Dr. Claude Boyd had not yet

joined the faculty on a permanent basis; consequently, no provision was made for laboratory space for his use. Further, it was not anticipated that water quality research at Auburn would be divided into two major divisions: water quality related to aquaculture, and water quality in rivers and reservoirs. Fortunately, in the early 70s, the old USDA Animal Diseases Research facility on Wire Road was vacant. In 1972, the University assigned the four buildings there to the Department (Figure 56). Dr. Boyd, who had joined the faculty permanently in 1971, quickly began to develop his water quality labs in the main building. Later, Dr. Rouse would use one of the smaller buildings for 'red-claw' crawfish research and Dr. Yolanda Brady would use another to establish a fish pathology research lab.

In 1980, the Fisheries Department and the Soil Conservation Service established the National Aquaculture Activity Team. Office space for the Team was established in the USDA Labs. Ellis Prather was the Auburn representative on the Team. When the Team began its work, Prather moved his office from Swingle to the facility. He remained there until he retired.

FISH BIODIVERSITY LABORATORY

When Dr. Carol Johnston was employed in FY '01, she was assigned laboratory space at the Society Hill Road Farm. For several reasons, this was an unsatisfactory arrangement. When the Poultry Science Department moved into its new building, some of its old research space on South College Street was vacated. Later, Dr. Johnston moved into this vacated space (Figure 57). Later this laboratory was torn down to provide space for a new University Performing Arts Center. A new laboratory for the Johnston Work Group will be constructed west of the Ireland Center (Figure 18D) on the Soughahatchee Farm.

'WATER-WATCH' LABORATORY

In the early days of 'Water-Watch, 'Investigators' in the program utilized laboratory space in Swingle Hall. Then after Bayne's retirement in 2006, the group was provided with space for a laboratory in Room 329 in Upchurch Hall. That space had been assigned to the Department of Agronomy and Soils in 2004, after the new Poultry Science faculty was moved to the new Poultry Science Building on Lem Morrison Drive. Several other rooms in Upchurch were also assigned to the Program for use as offices. This laboratory space required extensive renovation before it could be used by 'Water-Watch' personnel. The laboratory remained in this space until the summer of 2013 when it was moved to the new Hubbard Center for Advanced Science, Innovation and Commerce (CASIC) on DeVall Drive (1).

CONTINUED POND DEVELOPMENT ON THE SOUGAHATCHEE FARM

Details related to the purchase and early development of the Sougahatchee Farm were presented in several preceding Sections. Much of the early development on this farm was completed by the end of 1942, but facility development would continue there for many years. Some of these projects are described in the following Sections.

THE MEVEL-CADENHEAD MAPS

Jean Yves Mevel received his M.S. (Plumb) and Ph.D. (Boyd) from Auburn in 1985 and 1990, respectively. He came to Auburn with considerable engineering experience, and in the mid-80s, we requested that he prepare a detailed map of the facilities on the Sougahatchee, Story and Farmville City Farms. It was finally published in 1984. It shows the location of all ponds, pools, water supply lines, wells and buildings on the farm at that time. It also includes some drawings of construction details. Then in 1992, he 'up-dated' the ponds and buildings map. Most of the details shown in his publication are still relevant today. A copy of the Map is available in the Special Collections and Archives Department of the Ralph Brown Draughn Library. In February, 2017, Carole Cadenhead of the University Utility Services (Mapping) Group 'up-dated' several of the Mevel 1984 maps and the 1992 version. Versions of these maps appear as Figures 18-18D in this text.

CONSTRUCTION OVERVIEW

As detailed in several preceding Sections, on the Sougahatchee Farm, ponds were completed on the most suitable sites by the mid-40s. As the Fisheries Program continued to expand, additional ponds were needed. Construction involved building new ponds in unutilized areas as well as renovating older ponds. Some of the most important ponds on the Farm in terms of relevance to the program were constructed or modified after the mid-40s.

CONTRACT AND GRANT POOLS

As detailed in a preceding Section, the rapidly expanding extramural contract and grant program made it essential that we develop new facilities. It was not only growing larger; it was also growing more specialized. As a result, the decision was made to begin to clear and develop part of the forested area west of the Counting Shed for the construction of additional ponds (Figure 49). In 1959, the ten concrete pools of the 'K' Series were installed on that site. In 1963, 12 additional pools were added to this Series. In 1960, to accommodate expanding research in chemical weed control, 74 plastic pools in the 'L' Series were installed near the 'K' Pools. In subsequent years, additional plastic pools were placed in the same area. By 1964, there were a total of 296 of these experimental units in place. Additional placement of

these experimental units continued on an annual basis through 1969. Unfortunately, experience through the years demonstrated that their utility in aquacultural research was severely limited (Shell, 1966). By the mid-90s, few of them were in use on the Farm.

ROCKEFELLER PONDS

As detailed in another Chapter, H. S. Swingle began to be active in the affairs of the Pacific Science Congress as early as 1951, and he attended both the 1957 and 1961 meetings. During these meetings, he apparently became associated with some members of the Rockefeller Foundation staff. In 1961, the Foundation provided funds to send him to India as the Rockefeller Fisheries Specialist. Four years later, in 1965, the Foundation awarded the University a sum of \$500,000 to be expended over a 5-year period to study 'Factors Limiting Fish Production in Ponds.' Although I was in Auburn in the mid-60s, I have no recollection of the preparation of a proposal to the Foundation, and I have been unable to locate one. Dr. Harry Philpott once commented that it was the first time in his experience as a university administrator that he had ever received that much money without asking for it. However, even if there was no formal proposal, Swingle must have had some general agreement with the Foundation about what he intended to do with the money. Apparently, there was some agreement that approximately one-fourth of the total would be used for the construction of new ponds and the renovation of old ones. Subsequently, in 1966, the remaining forested land west of the Counting Shed was cleared and made ready for the construction of a new series of experimental ponds. Later, construction began on the 33, 0.10-A ponds of the 'R' Series. They were completed in 1967 (Figure 52).

RE-CONSTRUCTION OF THE 'E' SERIES

As detailed in preceding Sections, the 'Investigators' had not been very successful in using the 1.0-acre 'E' Series of ponds in recreational fishing research. As a result, when funds from the Rockefeller Grant became available, the decision was made to divide those eight, 1.0-acre ponds into 66, 0.1-acre ponds of the 'E' Series (Figure 52). This work was completed in 1971.

FARM POND 11

By the early 70s, it was increasingly obvious that the unpredictable stream flow of Funchess Creek was not adequate for the new ponds and its increased use in the older ones. At that point, the obvious solution seemed to be construction of a large storage lake on Funchess Creek in the valley north of the low-head dam which had shunted water into the diversion ditch supplying water to the 'E' and 'F' Series since the early 40s. Unfortunately, a

lake constructed there would inundate property not owned by the Experiment Station; consequently, it was necessary to purchase the following tracts:

1. The Allen Hutchinson Tract (19 acres) (Figures 18A and 19), 1971.
2. The Jewell Walker Tract (42 acres) (Figures 18A and 19), 1971.

With the availability of this additional acreage the construction of Farm Pond 11 was initiated and completed in 1972. This 20-acre pond contains approximately 141-acre-feet of water storage. However, although the new pond provided much-needed additional storage, the distribution of its water still depended on the old diversion canal system. In 2001, the water level of the pond was raised 1 foot, which increased the storage volume at least 20 acre-feet. In order to increase the size of the pond, it was necessary to purchase an additional tract of land in its watershed:

1. The Robert Dowdell Tract (33.95 acres) (Figure 18A).

ADDITIONAL 'WASTE-SPACE' PONDS

The construction of the 'R' Series and the re-construction of the 'E' Series left a number of small 'waste' areas around them. A number of these areas were utilized to add ponds to the 'M' Series. When construction was completed utilizing the Rockefeller Grant funds, there were 24 ponds in the 'M' Series. Most of these ponds were constructed between the new 'E' Series and Soughahatchee Creek; although several were placed in 'waste-space' among ponds in the new 'R' Series (Figure 18D).

'ATP' PONDS

The initiation of the formal Aquaculture Training Program (ATP) in 1976 resulted in the demand for additional pond space. With this need in mind, construction began in 1969 to expand the number of ponds in the 'H' Series. By 1979, 20 ponds, 0.05-acre each, were in place southwest of the new 'E' Series, near Soughahatchee Creek (Figure 18D). They were generally dedicated to annual use by the ATP.

'B' PONDS (NEW SERIES)

By the early 80s, it was obvious that our on-going research in commercial catfish production and marketing was seriously limited because we did not have any large ponds for holding market-sized fish that could be drained and re-filled quickly. Because of topography, water supply problems and existing construction, we were unable to locate a suitable site on the Story Farm. Fortunately, there was suitable space east of the 'F' Series and adjacent to Highway 147 on the Soughahatchee Farm. However, it appeared that there

was not enough elevation change on that site to contain the volume of water required in holding ponds. As a result, we decided to consult Henry Miller, an engineer with the Natural Resource Conservation Service, regarding the topographic problems on the site. After surveying the site, he determined that it would be practical, by using a judicious combination of “cut-and-fill,” to construct four, 1.0-acre ponds on the site and that they could be filled by gravity-flow from Farm Pond 1. The four ponds of the new ‘B’ Series (B-1, B-2, B-3 and B-4) were completed in 1981 (Figure 18D). Remember that there was once a ‘B’ Series in use on the South Auburn Farm, but they were abandoned in the late 30s. The utility of the new ‘B’ Series was vastly increased by the sizing and placement of drain pipes installed by Lamar Black. These ponds have been extremely valuable in the catfish production and marketing program operated by our Master of Aquaculture students.

MELLON GENETICS PONDS

In 1986, Haywood Parrish, General Manager of Pineland Plantation and a graduate of Auburn’s Department of Agricultural Economics and Rural Sociology, visited the University to review its program in agricultural research. Pineland Plantation is located near Newton, GA and is owned by the Mellon Brothers and various business interests of the extended family. They operate a large, high technology, general farming enterprise on the plantation. Mr. Parrish informed the Dean of the College of Agriculture, Dr. James Marion, that the Richard King Mellon Foundation had funded a considerable amount of agricultural research at the University of Georgia and that it would be receptive of a research proposal in agriculture and natural resources from Auburn. After considerable discussion between University administrators and Mr. Parrish, it was decided that the Department of Fisheries and Allied Aquacultures would prepare a proposal for the Foundation’s review.

After considerable discussion among the faculty, it was deemed that our program in fish genetics and breeding would benefit the most from grant funds from the Foundation. That program was growing rapidly, and with seemingly almost limitless potential. At that time, the scientists in that area were sharing pond and laboratory facilities with other groups on the Sougahatchee Farm. With this in mind, it was decided to request Foundation funds to construct a world-class facility for research and teaching in fish breeding and genetics.

In April 1987, the Department submitted a proposal requesting \$1.27 million for the development of a Center for Genetics, Genetic Engineering and Breeding of Warm Water Fishes. As part of the proposal the University agreed to fund the continuing costs for personnel and operation of the Center. In 1988, the University received notification that the Foundation would provide it with a grant of approximately \$1.2 million for the

development of the facility. Included in the Plan of Work was a proposal to construct a series of about 30, 0.1-acre earthen ponds. Obviously, there was not suitable space for such a facility remaining in the valley below Farm Pond 11, and much of the Farm to the north was extremely hilly. Further, there were no suitable sites on the Story Farm. The only area large enough to accommodate a facility of that size was located immediately south of West Farmville Road (County Road 72), at the north end of the Sougahatchee Farm (Figure 18). Unfortunately, this area was extremely swampy and heavily forested, and the water-supply stream (Funchess Creek) for Farm Pond 11 passed through it.

Just south of the highway, Funchess Creek was formed from two smaller permanent streams, each draining hilly watersheds north of the highway. Over the years, top soil, sand and silt had eroded off of cultivated hills in those two watersheds, and had been deposited to form the 'swamp.' It was obvious from the beginning that land clearing and pond construction would be extremely difficult. Fortunately, we found that clearing was feasible during the dry fall months, and the swampy characteristics of the soil could be altered in the construction process by mixing it thoroughly with clay from the adjoining hills (Figures 18C and 59). These ponds were finally completed in 1990.

Because the Funchess Creek was the primary source of water for Farm Pond 11, special arrangements had to be made to maintain its flow as it passed through the Genetics and Breeding Unit. As a result, a wide, shallow ditch was constructed north to south across the unit to accommodate flood water, and a large diameter plastic pipe was buried beneath the ditch to carry the normal flow of the creek. As a result of this design, the ditch could be maintained by mowing.

THE TRANSGENIC FISH CONFINEMENT FACILITY

Also included in the proposed Plan of Work for the Mellon Grant was a provision for the construction of a facility for research on transgenic fish. Obviously, there was considerable concern regarding the possible escape of fish with an 'un-natural' complement of genes into the wild. Further, the proposed research would be the first in the nation to be undertaken outdoors in earthen ponds where water from the ponds could flow into a local stream. As a result of these concerns, this research was to be conducted under the purview of the United States Department of Agriculture, and they were deeply concerned about the design and construction of the facility. As a result, numerous features had to be included in its design, precluding the possible escape of experimental fish. Consultations continued for months. Finally, the construction of facility with all of its 'fail-safe' features began. Virtually all of the work on the construction of this facility was done by our Field Operations Unit. It consisted of ten, 0.25-acre ponds and was completed in

1989 (Figure 60).

NEW ELECTRICAL SYSTEM FOR THE RE-CONSTRUCTED 'E' SERIES

The re-construction of the 'E' Series of ponds was completed during the period 1967-1968. In this project, all of the ponds were provided with electrical service. Our Field Operations Unit was responsible for installing it, but I'm not certain who designed it. In retrospect, it was completely inadequate from a safety perspective. At that time, no one involved in the project was fully aware of the inherent danger to 'pond seiners' – the 'mix' of water and electricity. We are very fortunate that no one was electrocuted. I'm not certain when or who first became concerned with the danger involved.

The old system was replaced during the period 1993-1994. The new system was designed by Carl Gagliano from the University Facilities Division. Don Seay of AES was responsible for inspecting the system before it was fully activated. Mike Ward and Field Operations installed it. In the new system, virtually everything was put underground, but the most important addition was the installation of Ground Fault Circuit Interrupters (GFCI) with each outlet. This addition throughout the system significantly increased safety. We can find no records indicating the source of funding for the renovation, but it is likely that they were provided by Lowell Frobish, AES Director.

SECOND RE-CONSTRUCTION OF THE 'E' SERIES

The first re-construction of the 'E' Series was undertaken during the period 1967-1968 when Rockefeller Foundation funds were used to convert the eight, 1.0-A ponds into a series of 66 smaller ponds, each with an area of 0.1-Acre. Then in 2016, it was decided that larger ponds were needed to conduct research on the use of 'in-pond' raceways in the production of channel catfish; consequently, work was initiated to remove all of the concrete 'collars' from 'E' Ponds 1 through 36 (Figure 18C). Most of the 'cross' dams were eliminated. This soil was then used to construct several longer dams to create four larger ponds of approximately 0.9 Acre each (Figures 61, 61A and 61B). These new ponds will be part of the 'B' Series (5, 6, 7, and 8). In the process of re-constructing these 'ponds, 7 ponds of the 'H' Series (1 through 7) were eliminated (Figure 18D). Virtually all of the actual construction work was done by a Work Group of the Agricultural Experiment Station, supervised by Robert Hensarling.

DEVELOPMENT OF FIELD STORAGE

In the early days of the Fisheries Program, there was only a limited need for 'Field Storage.' The 'Investigators' had little to store. Their field equipment consisted primarily of a few seines, a few dip-nets and a variety of buckets

and cans of different sizes. They also needed space to store fertilizer. They had only a single truck, no tractors and never more than 2 boats. There was almost no storage on the South Auburn Farm and very little on the Soughahatchee Farm in the beginning. For many years, the only storage on that Farm was a small wooden building behind a dwelling just east of the eastern end of the Farm Pond 1 dam (Dwelling 8 on Figure 18B). The Counting Shed erected in 1947 on the Soughahatchee Farm (Figure 22) included limited space where seines, nets and containers could be stored.

FIELD STORAGE ON THE STORY FARM

Soon after the Story Farm was purchased in 1943, Field Operations erected several buildings west of the intersection of Lee Highways 90 and 46 (Figure 18 D). Several of these early buildings are shown in Figures 45 and 46. At this time, the 'Field Headquarters' was located at this site. With the limited inventory of field equipment, the storage space in these building was adequate; however, as the Program grew and changed directions, it slowly became inadequate. As a result, in the early 70s, 'Field Operations' constructed two long, open storage sheds on the western margin of the 'Field Headquarters' site (Figure 62). Several years later a fuel storage facility (Figure 63) was installed on this site.

FIELD STORAGE ON THE SOUGHAHATCHEE FARM

In 1960, construction began on the Soughahatchee Farm in the area west of the 'Counting Shed' (Figures 18D and 49). In the process a large number of concrete ponds and plastic pools were constructed/installed there. Then in the mid-60s, work was initiated on the construction of the 'R' Ponds and the re-construction of the 'E' Ponds. During this period, 'Field Operations' activities on the Farm increased rapidly. Soon, the 'Storage' erected at the 'Field Headquarters' site on the Story Farm was no longer adequate to support those activities. As a result, they constructed several storage buildings on the 'hill' ('hill-top' site) west of the 'Counting Shed' (Figures 18D) and north of the concrete pond/plastic pools site (Figures 18D, 49 and 62). Later, fuel storage and chemical storage facilities were constructed in the same area (Figure 65).

The choice of the 'hill-top' site for installing the much-needed 'Field Storage' was a poor one. Located on the top of the narrow hill, it was not readily accessible. The space available for construction was severely limited. Further, during this period, most of the 'Field Headquarters' activities on the Story Farm were being phased out. In the process, they were being moved to the Soughatchee Farm. This process added to the space problems there. Finally, near the end of the century, the inadequacies of the 'hill-top' site became increasingly troublesome. As a result, the decision was made to move all 'Storage' to a site in the southwestern portion of the Farm –

'Boundary Site' (Figure 18D). Following this decision, in 2009 construction of the following buildings began in 2009:

- 1. Tractor Sheds (Figure 66).**
- 2. Cooperative Fisheries Unit Storage (Figure 67).**
- 3. Shop Building (Figure 68).**
- 4. Chemical Storage Building (Figure 69).**

In developing these storage facilities, Field Operations did all of the site preparation work, including the installation of concrete slabs. In some cases, they were also responsible for 'roughing-in' the plumbing. Most of the work related to erecting the structures was done under contract.

FIELD STORAGE ON THE FARMVILLE CITY FARM

During the period 1973-1976, the University purchased the tracts of land that would comprise the Farmville Farm (Figures 18A and 18D). The Edgar Tract contained three abandoned 'Chicken Houses' (Figure 70). For several reasons these abandoned buildings were ideal for the Field Storage of larger items of equipment.

LABORATORY DEVELOPMENT ON THE SOUGHAHATCHEE FARM

As noted in a preceding Section, most of the early development of facilities on the Soughahatchee Farm involved pond building. The Counting Shed was the only permanent building on the Farm until the mid-70s. Around that time it became obvious that there was not enough space in the newly constructed Swingle Hall to contain all of the laboratories that our rapidly expanding program required. As a result, we began to search for sources of funding to establish them on the Soughahatchee Farm.

FURTHER DEVELOPMENT OF THE COUNTING SHED

Remember that the 'Counting Shed' was constructed in 1947, with five concrete fish holding tanks (Figure 22); however, by 1962, the fisheries program was growing so rapidly that those five tanks were no longer adequate. Consequently, in that year, the building was expanded eastward to accommodate eight new tanks. As noted previously, it would be renovated several more times in the coming years. Figure 71 provides a view of the building in 1987. At this point, it had essentially reached its final form.

THE FISH PROCESSING TECHNOLOGY LAB

In February, 1969, Dr. Richard T. Lovell joined the faculty ostensibly to teach and conduct research in the area of fish processing and technology. In the 1970-1971 Academic Year, ZY-620 *Fish Processing and Technology*, was added to the curriculum. In the planning for the construction of Swingle Hall, a considerable amount of laboratory space was set-aside for Dr. Lovell's work in both fish nutrition and in processing and technology, but there was not enough space for applied research in processing. When the funds from the 1974-1975 timber sale became available, providing field laboratory space for Lovell was a top priority. In 1975, some of those funds were used for the construction and equipping of the Fish Processing and Technology Lab. It was completed that year (Figure 72).

FISH REPRODUCTION AND NUTRITION LABS (THE KRESGE GRANT)

By the mid-70s, it was apparent that the 'wet-labs' in Swingle Hall were not really adequate for our growing research program in fish nutrition and fish reproduction. As detailed in the preceding Section, we had utilized some of the timber sale funds to construct the Fish Processing and Technology Laboratory, but felt that there was not enough of those funds remaining to build the other lab facilities that were needed. Consequently, I contacted Dr. John Pino of the Rockefeller Foundation. Remember that this Foundation had been extremely generous earlier, providing funds for the development of new 'R' Series and the re-construction of the 'E' Series. Dr. Pino replied that the Foundation did not have sufficient funds available to contribute further to the expansion of the Department's physical facilities, but he did suggest that I contact the Kresge Foundation as a possible source of funding.

The S. J. Kresge family accumulated a large fortune by owning and operating hundreds of variety ('5-and Dime') stores throughout the nation and in a number of foreign countries. They were also responsible for establishing the K-Mart Department Stores. A share of the family's vast wealth was used to establish and maintain the Kresge Foundation.

I contacted Kresge and they informed me that they had expended all grant funds available for 1975, but that they would accept proposals for 1976. They further informed me that they were usually able to fund only one of each five proposals. Early in 1976, I submitted our proposal, requesting \$148,000 for the development of a laboratory for Fish Reproduction Research and a Field Classroom. On July 12, 1976, the University received a letter indicating that our proposal had been accepted by the Foundation, but that it would be funded at only \$100,000.

At that time the Foundation required that all grant funds be 'matched' on a 50/50 basis. Fortunately, we were continuing to sell timber off the Farms, and

at that time we had accumulated a considerable amount of the 'timber-sale' funds, so that we could meet their matching requirement without difficulty. Once the Foundation funds were available, we began planning for the construction of the buildings in the space below the eastern end of Farm Pond 11 dam (Figures 18D and 73). This building was completed in 1977. Later, in 1979, Kresge/Timber Sales funds were used to add a fish nutrition laboratory to the southeast corner of the Fish Reproduction/Classroom Building. It was completed in 1978. These buildings were a "god-send" to our teaching and research programs in those areas.

In planning for the fish reproduction facility, we had hoped to defray some of the high cost of heating water in the flow-through system through the use of a solar water heater. Consequently, we incorporated a large capacity unit in the design. It was later constructed on the west side of the Fish Reproduction building. Unfortunately, as a result of several design problems, it never functioned very well. A principle problem resulted from the fact that the sun does not 'shine' at night, and we had neglected to consider the initial and continuing cost of installing a fossil fuel water heater. After about a year, the entire unit was removed.

FISH MARKETING FACILITY

As detailed in a preceding Section, research on the commercial production of channel catfish on the Farms had increased rapidly in the late 50s and early 60s. This research resulted in the production of large quantities of 'food-size' fish. Initially, the Field Crew butchered most of them and put them in freezer storage. Unfortunately, the 'Investigators' had no practical way of disposing of the rapidly accumulating quantity of frozen fish. Further, there are many health-related regulations related to the sale of such products. Obviously, the best solution was to sell as many live fish as possible. After experiments were terminated, usually in late fall, live fish could be returned to holding ponds until they could be sold during the following months. By the mid-60s, we were selling large quantities of live fish in the Counting Shed on Saturday mornings throughout most of the year.

The Counting Shed was not a very good place to sell anything. It was always wet and muddy. There was no suitable customer waiting area. Further, the various activities related to holding and selling live fish often interfered with on-going research and teaching programs. However, even with all of these problems, it was essential that disposing of live fish be continued. All of these animals were public property with value, and at least a portion of the cost of producing them had to be recovered.

In the early 80s, the Master of Aquaculture (M.Aq.) Degree Program was formally established in the Department. That program was designed to familiarize students in the program with all aspects of warm water fish

production from reproduction to marketing. The orderly marketing of fish that they had produced was an essential part of the program. This was the final component of the 'Cost-Benefit' relationship. Unfortunately, using the Counting Shed as a 'point-of-sale' was not very satisfactory. Only customers determined to purchase live catfish were likely to drive that far and 'wade' through the water and mud to do so. We desperately needed a modern building specifically designed for the storage and sale of live fish.

Dr. Gale Buchanan was appointed Director of the Alabama Agricultural Experiment Station in 1980. In that position, he also became Administrative Advisor for the Southern Cooperative Research Project: S-83 (Freshwater Food Animals). Dr. Dennis Rouse had served as Advisor before he resigned as Director of AES. Over the next few years, Dr. Buchanan became increasingly supportive of Experiment Station research on the commercial production of channel catfish in all of the States of the Southern Region.

Continuing discussions with the Director about the needs of the catfish research program at Auburn eventually led to the decision to construct a fish marketing building on the Sougahatchee Farm. He not only agreed that we needed a building specially designed for that purpose, but he also agreed to use Experiment Station funds to pay for it. Field Operations cleared the site on the east side of Pond E-18 and E-19 (Figures 18C and 18D). The contract for the construction of the building was 'let' either in late 1984 or early 1985. Construction was completed later that year – 1985 (Figure 18C). Later, the building was demolished when the 'Market' was incorporated in the design of the Center of Aquatic Resource Management.

THE IRELAND BUILDING

Departmental research on the dynamics of exploited fish populations in rivers and reservoirs had grown steadily since the early 70s when the faculty became involved in the West Point Project. At that time, this extremely active group was poorly supplied with space for the maintenance and storage of a large quantity of field equipment, and for the storage and analysis of samples taken in the field and transported back to the campus for further processing. In the early days, they worked out of several of the old Graves Center Cottages (Figure 33), which were poorly suited for this use. Unfortunately, this situation did not improve very much for a number of years. By the late 80s, we desperately needed space where their wide-ranging efforts could be consolidated.

In the late 80s, the late William R. Ireland, of Birmingham, was considering the purchase of a large tract of land near Chelsea, in west central Shelby County as a wildlife preserve. Ireland, now deceased, was a descendent of Charles Lincoln Ireland, an Ohio banker who purchased the Birmingham Slag Company in 1910 and developed it into the massive Vulcan Materials

Company. There was a large pond on the Chelsea property, and Ireland was interested in the condition of its population. He later contacted John Jensen, then Fisheries Extension Specialist, requesting his assistance.

In the late 80s, Mr. Ireland already had a well-established record as a philanthropist. He had been especially supportive of wildlife conservation causes. We were not aware of it, but at that time, he was considering a proposal to provide funds for a project in Wildlife Management at Auburn. Jensen made an appointment to visit the property. At the appointed time, he and Smitherman met Ireland at the well-known Lloyds Restaurant along U.S. 280 in North Shelby County. Mr. Ireland treated them to lunch there before going to the pond. At this first of many meetings with Mr. Ireland, somehow their discussion lead to the possibility that he would consider a proposal for a gift to Auburn for fisheries research.

During one of the several visits Departmental faculty made to the Chelsea pond, Mr. Ireland commented that he would be willing to consider a proposal to make a sizeable gift to the Department. Later, with the assistance of Mr. George Atkins of the University's Development Office, the Department submitted a proposal to him for funds to construct a building to house our research and graduate teaching programs in recreational fishing. The building was to include a large multi-purpose laboratory, student study spaces, space for equipment maintenance, and storage and covered parking space for vehicles and boats. Mr. Ireland accepted the proposal and the Ireland Center (Figure 74) was completed in 1989. Over the years, additional buildings have been constructed north of the original structure. The Ireland building was really an important addition to our basic inventory of facilities.

FIELD OPERATIONS HEADQUARTERS

The new Field Operations Headquarters Building was completed in 1990 (Figure 75). As detailed in a preceding Section, in retrospect, it is difficult to comprehend why the construction of this facility had been delayed for so many years. Remember that the Sougahatchee Farm had been occupied in 1940, so the research, teaching and outreach programs there had been developing for almost exactly a half-century before this new building was completed. Further, I had been Department Head for about one-third of that time. The world famous International Center for Aquaculture was two decades old. By the time the new building was finished, the Counting Shed had been expanded several times, and all of the construction related to the Rockefeller Foundation Grant had been completed. Also, all of the following new buildings were in use: Swingle Hall (on campus), the Fish Processing Technology Lab, the Kresge Labs (Reproduction and Nutrition), the Kresge Classroom, the Fish Sales Building, the Ireland Center and the Fish Disease Lab at S-6.

While the well-documented development of the world-class field facility had been hurrying along, our field staff and field crew were still housed under almost inhumane conditions in the west end of the fish counting room in the Counting Shed. In the beginning, it shared the space with the sorting tables. Finally, a cinder-block wall and a door were installed to provide some separation. There was no central heat. Field Crew Supervisors used electric heaters. In fact, it was almost impossible to heat the space; because one of the open drain channels for the holding tanks passed along the south wall of the space before it emptied water into Funchess Creek. During flood times, increased flow in Sougahatchee Creek would impede the flow of Funchess Creek to the point that flood waters would back-up to cover the floor the office space; sometimes to a depth of several feet. Because the out-flow of the drainage channel could not be closed, it provided great access for water snakes.

Further, there was no bathroom with running water anywhere on the Sougahatchee Farm until the Fish Processing Technology Laboratory was completed in 1975. Even when the first females were employed (Karen Veverica, 1981 and Renee Beam, 1985), and assigned office space in the Counting Shed, they had to go to the Fish Processing Building to find a modern bathroom.

As bad as the physical condition of the Field Office housing was, the conditions of the housing afforded the Field Crew were even more primitive. For years, they were housed in the open storage shed across the Funchess Creek from the Counting Shed. Their only source of heat was a free-standing, oil burning 'salamander' heater. One had to literally sit on top of it to get warm – on one side. They essentially took their noon lunch-break in the 'great outdoors.' And of course there was no suitable place to change in and out of their boots and waders.

The organizational status of the Sougahatchee and Story Farms certainly contributed to this unfortunate situation. Although the two Farms were located several miles from the main campus, they were never considered to be Substations of the Alabama Agricultural Experiment Station. They had always been considered to be Departmental Field Research Facilities. If they had been part of the AES Substation system, it is highly likely that the construction of a field office with suitable housing provisions for the Supervisors and the Field Crew would have been constructed much earlier.

The long-term 'festering' of this situation is even more difficult to understand, given the concern that both Swingle and I had for the importance of the well-being of Field Crew and their Supervisors. Unfortunately, we both just seemed to have too much to do to really appreciate their housing situation and take care of their needs. Obviously, given the unique organizational aspects of the program, no one in the University seemed ready to step

forward and make funds available for the much-needed facility. Further, the extremely turbulent environment for Agriculture at Auburn (teaching, research and extension) during the 80s likely also played some role. From the time Hanly Funderburke was appointed President in 1980 until William Muse arrived in 1992, it was difficult to get any administrator's attention about anything. However, in retrospect, it is likely that if Swingle and I had fully appreciated the deplorable situation, and had effectively articulated its immediate urgency, someone would have found the necessary money.

In 1970, President Nixon signed the legislation creating the Occupational Safety and Health Administration (OSHA). It was created to "assure safe and healthy working conditions for working men and women." Over the years, OSHA became increasingly active in promoting occupational safety and healthy working conditions. By the mid-80s, all U.S. Universities concerned with the stability of their federal funding, were actively supporting programs to more effectively address concerns for 'occupational safety and healthy working conditions' for their employees. Auburn was no exception. Administrators at every level were encouraged, even admonished to be especially vigilant in this matter. In this highly charged environment, the housing situation for the Field Staff and Field Crew finally received the attention that it should have almost a half-century earlier.

In 1986, Lowell Frobish was named Director of the Alabama Agricultural Experiment Station by President Martin, replacing David Teem who was serving as Acting Director. When Frobish was appointed, Teem returned to his original position as Assistant Director. In 1988, the Office of Director was moved to Samford Hall, and the Director began to work directly for the Vice President for Research (Paul Parks) rather than for the Dean of the College of Agriculture. This new administrative structure provided the Director with considerably more flexibility in dealing with a broader range of natural resource research problems in the University. This new administrative structure also seemed to result in a more cooperative relationship between the Experiment Station and the Department. Although the two Farms were still Departmental Research Facilities, AES under Frobish seemed to take a greater interest in our Field Operations problems.

From some of the old correspondence that I have located, I first began to ask the Dean and Director for funds to deal with the problem of suitable office space for Field Operations and improved housing for the Field Crew and Supervisors in a 1983 memorandum. Apparently, even earlier than that, I had included funds for a new field facility in a request that I had made to John Harbert, an alumnus and long-time Auburn supporter.

I do remember clearly how Randell and I finally decided to approach this situation. In early 1988, I asked him to write me a memo describing, in detail, the office and housing situation on the Farms. Then I attached a cover letter,

and sent them to the Dean and Director. Remember, it was at about this time that Frobish's office was moved to Samford.

Fortunately, the Shell-Goodman memos received a fairly quick response. Frobish, as Director, with the responsibility for the 'safety and well-being' of Experiment Station personnel, working on- and off-campus, was especially concerned about situations such as ours. The 'safety and well-being' of no other group of University employees was at greater risk than those working, directly or indirectly, under his leadership. Agricultural research, by its nature, is often nasty and extremely dangerous. I cannot remember when the discussions began, dealing with the office and housing situation, but soon David Teem, Tom Cherry, Peyton Kelly and Randell began to give it their undivided attention. Some of the discussions became quite intense. AES did not want to include as many offices as we did. They also wanted to use as many 'cost-cutting' options as practical. Finally, we agreed on the basic design and University approval must have been received in late 1988. The final design was completed in May, 1989.

The new building was constructed on the site of the abandoned Water Filtration and Sedimentation Plant on the low hill, east of the Counting Shed. This facility had been constructed to remove suspended soil from the raw water before it was piped to an oil-fired, water heater in the 'back-room' of the Counting Shed. Remember that this heater supplied water to the wooden troughs holding tilapia over-winter.

At that time, obtaining permission to construct new University buildings was an extremely complicated process. Fortunately, the process for receiving approval for renovating existing buildings was much simpler. If I remember correctly, David Teem suggested that we request approval for the renovation of the old Water Treatment Facility to create the new Field Operations Headquarters. The final plan of the building clearly includes the presence of an existing building – the old Filter Plant. This approach saved many months in getting the much-needed building in place. Using this approach, the Department of Research Operations in the Experiment Station was allowed to design the building and write construction specifications; consequently, the contracting process was much simpler than it might have been otherwise. The building (Figure 75) was completed in 1990. Many of the original functions of this facility have since been transferred to the new Teaching/Outreach Building of the Center for Aquatic Resource Management.

MELLON FISH BREEDING AND GENETICS FACILITY

Details related to the award of the grant by the Mellon Foundation to construct facilities for teaching and research on fish breeding and genetics were discussed in a preceding Section, along with details on the development of the pond facilities. Initially, the primary emphasis on the

project was on the construction of ponds, but after that work was underway, emphasis was shifted to the construction of laboratories. In 1990, the main laboratory building was completed (Figure 76). A year later the hatchery/culture (the 'greenhouse') facility was completed (Figure 77). It was first used in research in May, 1991. It was renovated and enlarged in 2009.

CENTER FOR AQUATIC RESOURCES MANAGEMENT (THE SHELL CENTER)

For many years, buildings associated with various Departmental teaching, research and extension functions have been 'scattered' across the landscape of the Sougahatchee and Story Farms. Further, most of those buildings were constructed three decades ago and were no longer adequate for the kinds of research work that needs to be done now. They were suitable when aquacultural research was extensive in nature, but are totally inadequate as it has become more intensive and specialized.

In 2005, as the political climate in Washington evolved, it seemed likely that our congressional delegation would be able to obtain a sizeable federal grant for facility construction on the campus. After several discussions on the matter, it was decided that the need for new facilities was more critical in the Department of Fisheries and Allied Aquacultures than in any other area; consequently, the University requested that the delegation work to secure funding for the construction of a new multi-purpose building to be located on the Sougahatchee Farm. This effort was led by Auburn's legislative liaison in Washington and Senator Richard Shelby. As a result of this intensive 'lobbying' effort, in 2006, the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce announced the award of \$8.6 million for the construction of the Center for Aquatic Resource Management. The funds were to be made available in three installments over a four-year period. After a nation-wide search HDR/FISHPRO based in Springfield, IL was awarded the contract to design the building and supervise construction.

Although the grant was a 'Godsend,' implementation quickly became a 'horror-story' of campus building requirements, environmental assessments, design squabbles, cost over-runs and a severely restricted 'time-window' of funding availability. Fortunately, all of these concerns and problems were finally resolved and the building was completed in 2011. Unfortunately, there was not enough funds in the grant for fully completing construction and none for equipping it. These additional funds were provided by the University.

The Center consists of two buildings (Figure 78). Building 1, near the highway, contains 17,000 square feet of floor space. It was constructed primarily for various kinds of limnological, aquaculture and fisheries research. It supplements facilities available in the Kresge nutrition and hatchery labs. It contains two analytical labs, a biology/necropsy lab, six

rooms containing aquaria allowing for temperature control (Figure 78A). There is also a large wet-lab, containing aquaria and tanks of varying sizes (78B).

Building 2 contains 20,000 square feet of space. It houses facilities originally contained in the Counting Shed and the Field Operations Headquarters. It contains a large number of fish holding tanks (78C). It also includes a large Visitor's Center (Figure 78D), a large, general purpose class room and two teaching labs. Building 2 also contains the 'Public Fish Marketing Facility' (Figure 78E).

POLE BARNS

Pole barns were not used in the early days of the development of the Soughahatchee Farm. The storage building (now demolished) across Funchess Creek near where the feed bins are located now had some characteristics of a pole barn, but its roof was supported by milled timbers rather than poles. The first regular pole barns were constructed in 2009 in the southwest "Boundary Area", north of the 'R' Ponds (Figures 18D and 66). They are used for the storage of boats and tractors.

Two pole barn were constructed on the Soughatchee Farm for use in the research program in 2017. One (Figure 66A) is located on the Genetics Unit for use by the Dunham Work Group. The second is located west of 'F' Ponds 17 and 18 (Figure 66B). It was constructed for used jointly by Field Operations and the Peatman Work Group.

FURTHER POND DEVELOPMENT ON THE STORY FARM

As detailed in a preceding Section, beginning in the late 50s, virtually all the activities related to the development of facilities was centered on the Saugahatchee Farm. In fact, most of the research, teaching and training activities of the fisheries program were being conducted there. Also, most of the planned pond development on the Story Farm had been completed. As a result, additional development was limited. Only three specific construction projects are worthy of mention.

CONSTRUCTION OF Pond S-29

Remember that ponds had been constructed on most of the suitable sites on the Story Farm within a few years after its purchase in 1943. By the mid-70s, the only remaining site for constructing a pond was near the eastern boundary of the Farm, northeast of Pond S-28 (Figure 18C). Pond S-29 (7.2-acres) was constructed on that small watershed in 1977. It was recognized at the time, that because of the watershed, the pond would seldom fill completely, but it would certainly capture water flowing off the area, and it

would provide additional 'seepage' to the small tributary flowing southeast from Pond S-28 and to Funchess Creek. The brush and small trees were never cleared from the pond site.

CONSTRUCTION OF Pond S-30

The Agricultural Experiment Station (AES) owns considerable acreage north and east of the Story Farm. A sizeable share of this property was included in the Beef Cattle Unit, and was operated by the Department of Animal and Dairy Sciences. Later, it was operated by the School of Veterinary Medicine. Swingle Creek originates in a large 'swampy' area adjacent to a hay field on the southern portion of that Unit (Figures 18 and 18C). In 1978, we requested permission from AES to construct a water storage lake in that open field that would impound the upper portion of the Creek. When the request was approved, we began construction on Pond S-30. It was completed in 1979, and covered an area of 13.2 acres.

The pond has a relatively large watershed, and the open land on the old Beef Cattle Unit yields a considerable amount of 'run-off,' at times considerably more than is required to maintain the water levels of Ponds S-8, S-14 and S-16 in the valley below. Remember that this excessive flow had already been dealt with by constructing a 'diversion ditch' on the north side of Pond S-8 and S-14.

The upper extremities of the watersheds of Swingle and Funchess Creeks are separated by a relatively narrow, low hill (Figure 18); consequently, it was possible to install a plastic pipe in a deep ditch connecting the two watersheds, so that up to 4-ft of water can be taken from Pond S-30 and transferred to the headwaters of Funchess. Connecting these watersheds in this manner provided a considerable amount of additional water supply and storage for the Soughahatchee Farm.

ACQUISITION OF THE AGRICULTURAL ENGINEERING PONDS

Land for the establishment of the E. V. Smith Agricultural Research Center at Milstead in Macon County was purchased in 1978. Sometime thereafter the Department of Agricultural Engineering moved its field research program to that new facility. In this process, it left behind three 'terrace-water' ponds (AE-1, AE-2 and AE-3) that had been used in their field research on Experiment Station land, north of the Story Farm (See Figure 18C). Soon after, in 1979, a memo from Stan Wilson to Emmett Thompson formally assigned those ponds to the Fisheries Program. We were asked to assume responsibility for their maintenance and management. Since then, we have used Ponds AE-1 and AE-2, in our research program. In the beginning, we did not use Pond AE-3, but in the late 90s, it too was included.

Later, the Experiment Station developed a Hospitality Center between Ponds AE-1 and AE-2. It serves as an 'outdoor' food preparation and serving facility for visiting groups associated with the Agricultural Experiment Station. Recently, the need for this facility has diminished with the development of the Red Barn complex at the Agriculture Heritage Park, on campus.

RENOVATION OF Pond S-6

In the mid-80s, it became apparent that our pond facilities for research on commercial-scale catfish production were woefully inadequate. Ponds in the 'Farm Pond' and 'S' Series were really not suitable. As detailed in a preceding Section, most of them could only be filled with winter rainwater. Also, it was difficult to remove the fish when they reached a marketable size. The generally uneven bottoms of the ponds made it difficult to remove many of the fish until most of the water had been drained away. As a result, most of the fish accumulated in a relatively small volume of extremely poor quality water. Further, because of the depth of the ponds, getting them from the muddy water around the drainpipe to tanks used to transport them to holding facilities was a time consuming and highly labor intensive operation.

As a result of these problems, we decided to develop a facility for catfish farming research within the S-6 basin. It was designed to include 22, one-acre, rectangular ponds, and there would have been a number of smaller ponds constructed in the 'waste-areas' around the rectangular ponds. With this design in mind, in 1985, Pond S-6 was drained, and Lamar and the Field Crew began to construct the center dam which would carry the water supply and drain lines for the individual ponds. When this dam was high enough to be used as a roadway, they began to install the cross-dams to form the individual ponds. In this scheme, Pond S-1 would have been used as the water supply. Further, the water supply and drain system were designed so that water being removed from a pond on draining could be pumped back to S-1. By 1986, virtually all of the drains had been installed and most of the cross-dams had been started. Unfortunately, before we could complete the project, the demand for Field Crew time and construction equipment requirements on the other Farms began to limit the time that we could spend on the S-6 project. At the same time, it was becoming apparent that the demand for funding on other projects had a higher priority. This was a classic case of beginning a project without fully 'counting-the-costs.' In 1999 with little likelihood that funds and manpower would ever be available to complete it, the decision was made to rebuild the main dam on S-6 and to inundate all of the drains and dams. As a result, a considerable amount of University funds lie at the bottom of S-6 because of poor planning.

DEVELOPMENT OF ADDITIONAL FACILITIES ON THE STORY FARM

For several reasons, from the beginning, all of the laboratories and related

facilities were developed on the Soughahatchee Farm, and most of the Program's Research activities were 'centered' there. As a result, there were only two buildings developed on the Story Farm worthy of note.

CONSTRUCTION AND OPERATION OF THE SAWMILL

In 1967, when planning for the construction of the 'Series', it was decided that creosoted boards would be installed in each pond to maintain their 'edges.' Further, it was decided that we would produce our own boards. Subsequently a used 'pecker-wood' sawmill was purchased and installed on the south side of the old Field Headquarters site on the Story Farm (See Figure 63). At the same time, creosote treating vats were installed at the same location. The mill with its large circular blade and cable-operated carriage, was powered by a large diesel engine. Mr. 'Bud' Black (Lamar's father) had some experience working with small mills. He was assigned the responsibility of supervising the entire operation. Logs were cut by the Field Crew from the near-by woodlands, cut into boards with the saw, and then 'soaked' in the creosote vats for several days. Afterwards, the treated boards were removed and stacked to 'fix' the creosote; before placing them in the edges of the ponds. As I remember, the mill was not operated very long after boards needed for the 'R' Series had been cut and treated. Later, the mill was sold.

DEVELOPMENT OF THE FISH HEALTH LABORATORY

The Cooperative Fish Parasite and Disease Project became operational in 1964. In the early days, the research and diagnostic work related to the new project was conducted in the main Graves Center Building and in the cabins associated with it (See Figure 53); however, there were no suitable 'Wet-Lab' facilities available. In 1968, it was decided that this situation should be dealt with by constructing a new 1,200 square-foot, Fish Health Laboratory below the dam at S-6 (Figures 18C and 79). For several reasons, it would have been more practical to locate the new facility on the Soughatchee Farm; however, concern with the possibility of contamination of the water supply there made it necessary to locate it at a more remote site.

Over the years, the Fish Health Program in the Department grew steadily. When Swingle Hall was being planned, one of the primary features included in the design was 'Wet-Lab' facilities for the program; however, as detailed in a preceding section, continuing problems with the water supply (chlorine and gas supersaturation) made the troughs and tanks there much less suitable than expected. As a result, in 1986, it was decided that the S-6 laboratory should be expanded by constructing a second building (Figure 79).

Further, it quickly became obvious that the raw pond water from Pond S-6 was poorly suited for research on fish diseases; consequently, we decided to

drill a well adjacent to the buildings. In preceding years, we had made numerous attempts to drill wells on the Soughahatchee and Story Farms. Unfortunately, most of them produced such a small amount of water that it was impractical to even put a pump in them. We were well aware that ground water is extremely difficult to locate in the Piedmont, but we felt that we had to try. Fortunately, the contractor apparently drilled into an area containing a quantity of partially decomposed granite that contained a small permanent stream of water. With a depth of approximately 50 feet, the well provided approximately 50 gallons of water per minute which is more than is generally required for the operation of the Lab. As a result, we purchased a large, used water tank in which to store excess water from the well. It is located on high ground northeast of the labs. This location provides water to the buildings by gravity flow.

DEVELOPMENT OF FLOATING EXPERIMENTAL UNITS

The Program has a long history of research on the use of floating units for producing catfish in ponds. Both Schmittou (1969) and Masser (1997a) did considerable work in this area several years ago, but their use as experimental units in other types of research is of more recent vintage. Currently there are three installations of these units in use on the Story Farm. The Peatman Work Group has installations in both Ponds S-1 (Figure 79A) and S-6 (Figure 79B) being used in genetics research. The Wilson Work Group also has an installation in Pond S-1. In this case, the floating units are being used as mesocosms.

ADDITIONAL POLE BARN

As detailed in a preceding Section, the first pole barn was constructed on the Farms in 2009. It was located north of the 'R' Series on the Soughahatchee Farm (Figures 18D and 66), and used for the storage of boats and tractors. In 2013, the first of these structures was erected on the Story Farm. It is located on the west side of Pond S-1 (Figure 66C). It was erected for the use of the Peatman Work Group. Later, a pole barn was erected on the east side of the pond (Figure 66C). It was also erected for use by the Peatman Work Group. With the exception of this structure, all of others used in research were erected to protect a number of plastic tanks. The S-1, east, structure protects a series of large plastic troughs (Figure 66C).

PURCHASE AND DEVELOPMENT OF THE FARMVILLE CITY FARM

The Farmville City Farm designation is used here to clearly differentiate this acreage from those of the Soughahatchee and Story Farms. The name is associated with a well-known local community from an earlier time which developed around the junction of the Oak Bowery Road (now Alabama 147) and the Farmville Road (County Road 072). Some maps continue to identify

the area around that intersection as 'Farmville City' (Figure 18)

Details of the construction of the large storage lake (Farm Pond 11) on the Sougahatchee Farm were provided in a preceding Section. Unfortunately, it was soon obvious that its construction did not solve the growing water supply problems on that Farm. There was no more water in the supply stream (Funchess Creek) than before. To really solve the problem, the flow of the stream needed to be both increased and stabilized. The only practical way to do this was to create more storage, and consequently, more 'seepage' upstream. Unfortunately, there were no sites for additional ponds on the Funchess Creek or from the S-28 watersheds, on land owned by the Experiment Station. Consequently, the decision was made to attempt to purchase as much of the remainder of the Funchess Creek watershed as possible

A substantial share of the water flowing in Funchess Creek comes from this area of the watershed, west of Alabama 147 (Figure 18); however, some of it comes from a small part of the watershed east of the highway. The small tributary draining this area passes under the highway just north of the junction of Alabama 147 and County Road 72 (Farmville Road). This small tributary is of increasing importance because of the construction of a large number of new homes on it.

DETAILS RELATED TO THE PURCHASE OF THE FARM

Fortunately, the Experiment Station recognized the growing severity of water supply problems on the Sougahatchee Farm; and provided funds for the purchase of three tracts which included a major share of the remaining portion of the Funchess Creek watershed that it did not own. As detailed in a preceding Section, three tracts were included in the purchase:

1. The Joe Davis Tract (44 acres) in 1973 (Figure 18A).
2. The Allen Edgar Tract (124 acres) in 1975 (Figure 18A).
3. The Bell Tract (5.5 acres) in 1975 (Figure 18A).

The purchase of the Allen Edgar Tract (Figures 18 and 18A) was essential for the development of additional water storage, because it contained the largest share of the watershed that we needed. There is an interesting story associated with the purchase of this tract. Dr. Edgar, Professor in the Poultry Science Department (world-renowned because of his pioneering work on 'coccidiosis' in poultry), had purchased the tract in the early 60s, but because of the relative positions of West Farmville Road and his property line, he had no direct access to the highway; consequently, he requested that the Experiment Station sell him a small strip of land between the highway and his

property line that would provide that access along his entire southern boundary (Figure 18A). This 'strip' was actually on the northern boundary of the Soughahatchee Farm. The Experiment Station with 'Investigator' approval agreed to Edgar's request, and the transfer was made in 1966. In making the request, Dr. Edgar promised Swingle that if the Experiment Station ever needed the entire tract that he would sell it to them for what he had paid for it. As detailed in a preceding paragraph, in 1975, the Experiment Station decided that its ownership was crucial in the further development of the Fisheries Program, and Dr. Edgar was contacted regarding its availability. He quickly agreed to sell it, and honored his promise to sell it for the price he paid for it; although it was much more valuable in 1975 than it had been in the early 60s.

The purchase of the Bell Tract also has an interesting history. This was a small, but extremely important Tract. The Funchess Creek tributaries from the S-28 watershed and from the large watershed to the east, passed through that Tract, to the "right-of-way" on the north side of Lee 72 (Figure 18). At the time of the purchase, the two small tributaries which formed Funchess Creek were still separate as they flowed across the Bell Property. They flowed together just south of the Highway. After the purchase of the Tract, a ditch connecting the two was dug north of the road.

The Bells had constructed a small wooden frame house on the property, and had lived there for several years. They were interested in selling, but needed to receive enough money from the sale to replace both the land and the living space that they had in the house. Negotiations with the family were very complex, because at the time, Mrs. Bell was experiencing some very serious health problems. I was given the responsibility of negotiating with the Bells for the purchase. They were very friendly and cooperative, but they were adamant regarding the amount of money that they wanted for the property. Very little progress was made until Dean and Director Rouse became personally involved in the matter. The final negotiations took place in his office in Comer Hall, and included the entire Bell family. In that meeting, the negotiations became quite intense, but it was obvious that they were not going to sell unless they received their 'price.' Finally, Dean Rouse realized that there was nothing else that he could do, and he agreed to their demand (Figure 18A).

PERMANENT BUILDINGS ON FARM

There were relatively few permanent buildings on the Farmville City Farm at the time of the purchase of the Tracts involved. There were the dwelling and a few out-buildings on the Bell Tract. There were also three abandoned broiler production houses located in the Southeastern 'corner' of the Allen Edgar Tract (Figures 18A and 18C). The buildings on the Bell Tract were demolished soon after it was purchased, but the broiler houses have been

used from the time of purchase as storage buildings (Figure 80). As a result of their design, they provide excellent storage space for large, unwieldy items. The over-sized doors located at both ends of each building provide vehicular access to the entire storage area.

POND CONSTRUCTION ON THE FARM

With this additional acreage available on the watersheds on the Farmville City Farm, we began to construct storage ponds there. Farm Pond 12 (7.9-A.) was completed in 1976 (Figure 18C). Farm Pond 13 was completed sometime after Farm Pond 12, and before Farm Pond 14 (1984) (Figure 18C), but I have been unable to find any details concerning its construction. It is a small pond located between 'Pond S-29 and Farm Pond 12, on a very small watershed (Figure 18C). Although it is small, it stores some water that eventually makes its way into Farm Pond 11. The completion of these ponds increased the harvest and storage of water on the Funchess Creek watershed significantly.

ACQUISITION AND UTILIZATION OF THE SOCIETY HILL ROAD FARM

As detailed in preceding Sections, over the years the Department and the organization preceding it, have done a considerable amount of research on new chemicals used for various purposes in aquatic habitats. However, no studies had been completed on the evaluation of chemicals that would be applied to land crops but that might gain access to aquatic habitats by 'drift' or 'run-off.' In the mid-80s, Wildlife International, Ltd., an international ecotoxicology contract research organization, contacted the Department about testing pesticides in aquatic mesocosms. This protocol for the testing of new chemicals was being encouraged by the Environmental Protection Agency prior to the release of the chemicals for use on private farms. This protocol allowed evaluation of the compounds under more 'real-world' conditions. Once the University agreed to provide the necessary technical support, the Corporation purchased land just off Society Hill Road (Lee County Highway 054), just southeast of its junction with County Road 862, in south Lee County, for development of the project. The site is located approximately 5 miles southeast of Auburn.

Mesocosms were designed by personnel of the Bayne Work Group, and constructed according to their specifications. Altogether, 12 of the 0.1-ha experimental units were constructed. Each one had a shallow, littoral (shoreline) zone and a deeper, limnetic zone to simulate a typical 'terrace-water' pond, found on farms throughout the country. A 13th mesocosm was constructed among the experimental units to be used as a reservoir for the circulation of water throughout the system (Figure 81). Initially the mesocosms were used to study the effects of a cotton pesticide, manufactured by DuPont on the aquatic ecosystems established in them.

In the early 90s, a second 'set' of mesocosms was constructed on the 'site' to evaluate the effects of a pesticide manufactured by Chevron. After meeting all contractual requirements related to the submission of data, we were allowed to publish results of this extremely complex study (Webber, et al. 1992). After the completion of the study, the facility remained largely unused for a time. Then in 1996, Wildlife International decided to give the facility to Auburn University. It was later used by several 'Investigators,' but the distance from campus was a problem, and it was quite costly to maintain.

RESOURCE MANAGEMENT ON THE FARMS

After the University purchased the 700-acre Story Farm for the Auburn Fisheries Program in January of 1944, Swingle wrote in the 1944 Annual Report, "on this area it is planned to work out various phases of land and water utilization." While the 'Investigators' generally kept this objective in mind, most of their efforts centered on a much more limited objective – producing marketable crops of fish. Years would pass before the broader objective would be re-visited.

WATER MANAGEMENT

Water management is a crucial element in conducting research on fish production. The ability to manage both quantity and quality of water being used in experiments is essential. As noted in several preceding Sections, the 'Investigators' encountered insurmountable problems in their efforts to conduct research on the South Auburn Farm because of their inability to effectively manage the water supply there. Both Farm Pond 1 and Farm Pond 2 were constructed on permanent streams, and both streams contained resident fish populations; consequently, it was virtually impossible to control the stocking of the experimental ponds.

When the 'Investigators' began to plan for the development of the Sougahatchee Farm, they included a number of features that would make the utilization of water from Funchess Creek more effective. However, as the research program increased in both size and complexity, it was necessary to make changes in the water management system almost continuously.

Water utilized for research on the three Farms was/is obtained from one of three sources: wells, city water and rainfall harvest. Of course, harvested rain water provides the much larger share, but in some situations such as the evaluation of the effect of chemicals on aquatic environments in plastic pools, well water was essential. Further, as more sophisticated research was initiated later, it became necessary to provide access to city water.

WELLS

Given the nature of the geology in the North Auburn area (Soughahatchee, Story and Farmville City Farms) there is relatively little sub-surface water present. On all three Farms north of Soughatchee Creek, various forms of hard igneous rocks (mostly Auburn Gneiss and 'Bottle' Granite) are near the surface. For example, on the south side of Pond S-14, a large area of 'Bottle' Granite is exposed. These rock formations may extend downward for thousands of feet. Very little rain water penetrates them; however, a considerable amount moves along and sometimes collects at the soil-rock interface. As a result, where there is a considerable accumulation of soil on the buried rocks, it was possible to develop shallow wells that provided sufficient water for intermittent household use, but that could not provide enough for continuous or high volume use.

Over the years, numerous attempts were made to drill deep into the rocks in an attempt to locate useable quantities of water on the Soughahatchee and Story Farms. Generally, yields from these efforts have been highly unpredictable. It was not uncommon to drill several hundred feet into the bed-rock and encounter almost no water. Apparently, what little water there is lies trapped in crevasses or cracks deep within the granite mass, or in zones where the hard rock is decomposing into feldspar and silicon dioxide.

SHALLOW WELLS

As detailed in a preceding Section, there were several dwellings located on land purchased to establish the three Farms north of Saugahatchee Creek (Figure 18B). Obviously, families living in those houses had to have access to clean drinking water, but there are few records available on where they obtained it. In at least one case, residents in one of the dwellings had to carry their water a considerable distance from one of the shallow wells fitted with a 'hand-pump.' Most of the more isolated dwellings must have had shallow wells located nearby, outfitted with windlasses, ropes and buckets. Unfortunately, there few records available concerning their specific locations.

There is a shallow well, fitted with a 'hand-pump,' located on the Soughatchee Farm, just behind the Feed House (Figure 82). Although the pump is still there, I am not sure that it still functions. This was the only known source of 'clean' water for the entire lower portion of the Farm. It was also the only source of drinking water for the large number of fishermen fishing in those early 'fishing quality' experiments in the original 'E' Series. I imagine that there must have been shallow wells near dwellings 8 and 10 (Figure 18B), but there is no information available regarding their location.

There were three known shallow wells fitted with 'hand pumps' on the Story

Farm. Their locations are shown in Figure 18E. Only one of these (S-3) can still be located (Figure 83). A second well fitted with a 'hand-pump,' was located just inside the gate at Pond S-6; however, the 'pump' has been removed and only the concrete 'slab' remains. There must have been shallow wells fitted with windlasses on the Farm, but there is no information on their location.

DEEP WELLS

In the late 50s, 'Investigators' began to increase research on the commercial production of channel catfish. This research resulted in the annual production of thousands of pounds of 'food-size' fish. With no local market for that quantity of live fish, the Field Crew began to 'hand-skin' and butcher large quantities of them. Of course this process required relatively large quantities of 'clean' water. To meet this critical need, in 1957, a deep well (Number 1) was drilled on the west bank of Funchess Creek, just north of the Counting Shed, and a pump installed (Figure 18D). Additional details regarding this and the other wells is presented in Appendix Table 4.

Approximate locations of other deep wells are also shown on Figure 18; with the exception that the well located just east of the Feed House and west of the 'old Field Operations Office, on the lower portion of the Soughahatchee Farm, is a shallow well with a 'hand-pump, rather than a deep well.'

In the early 60s, as a result of contract research on chemical weed control, a number of plastic pools were assembled west of the Counting Shed. Much of this research also required large quantities of 'clean' water. To meet these growing needs, in 1962, two deep wells (Numbers 2 and 3) were drilled north of the 'K' Pools (Figure 18D), and a large poured-concrete storage tank (30,000 gallons) was constructed on the south slope of the hill, to the north.

Later, as more plastic pools were installed to the south and west of the 'K' Pools, additional water was needed, and in 1967, two additional wells (Numbers 4 and 5) were drilled south of the 'K' Pools, along the road north of Pond R-26 (Figure 18D). These wells were integrated with the storage and supply system established in 1962.

In 1969, it was decided that a source of 'clean' water was needed at the 'Field Headquarters' site on the Story Farm. As result a contract was let to drill a deep well just south of the S-5 Dam (Figure 18C). After drilling to a depth of 380 feet, and finding little water, it was decided to abandon the effort. The water yield was so limited that it did not justify the expense of installing a pump.

As detailed in a preceding Section, in 1977, the Kresge Foundation Grant provided some funding for the construction of the Fish Reproduction

Laboratory, the Field Classroom, below the Farm Pond 11 dam. It was intended that water taken from Farm Pond 11, would meet most of the regular needs for the Labs; however, we had already realized that a source of “clean” water would also be essential for the operation of these facilities. Soon after the Grant was approved, we let a contract for the drilling of a deep well (Number 6) near the old stream-bed below the Farm Pond 11 dam (Figure 18D). Fortunately, at a depth of approximately 50 feet, the drill encountered a zone of decomposing granite. The water yield from this natural water storage zone was approximately 50 gpm. We decided not to drill any deeper, but to establish an ‘inlet for the pump at that depth. At the same time, we purchased two used steel tanks for storage. These were placed east of the end of the Farm Pond 11 dam Figure 18D).

As detailed in a preceding Section, in 1985, a new Fish Sales Building was constructed on the Sougahatchee Farm just east of Pond M-2 (Figure 18D). This new facility also required a source of ‘clean’ water; consequently, a well (Number 7) was drilled nearby. This well was abandoned with the construction of Building 2 of the Shell Center.

As detailed in a preceding Section, it was decided in 1986 to expand the fish Health ‘Wet-Lab’ below the S-6 dam (Figure 79) and to drill a deep well there to provide the expanded facility with a source of ‘clean’ water. The well (Number 8) proved to be relatively productive. As a result, a pump was installed, and a metal storage tank was placed on the low hill just to the west of the laboratory.

CITY WATER

In the early years, there was no source of city water available near the North Auburn Farms; however, with the development (dwellings and businesses) moving westward out of Opelika, along U.S. Highway 280, it soon became necessary for that city to provide water for the area. The Mellon Genetics Labs were constructed in 1990, and a substantial supply of ‘clean’ water was needed for the complex research that would be conducted at that site. Fortunately, by that time the City of Opelika had extended a water line west to the junction of U.S. 280 and State Road 147, and southward along 147, beyond its junction with County Road 72. While construction of the Labs was in progress, the ‘Field Operations’ installed a plastic pipe westward, ‘cross-country’ from the Opelika ‘city-water line’ on Highway 147 to the new buildings.

All of the buildings in the new buildings associated with Center for Aquatic Research Center receive water from Opelika; however, sewerage from the buildings flows into the Auburn Waste-Water Treatment System.

WATER HARVEST

In its most basic form, Water Harvesting is a matter interrupting, for a time, the normal hydrological cycle; whereby rainfall, after reaching the earth's surface, flows down-hill to the ocean. There it evaporates and is later deposited again on the land as rainfall. With Water Harvesting, the cycle is interrupted by collecting the falling and flowing rainwater behind dams before it can leave the watershed where it fell. In its stored form, it may have a variety of uses. One of them is the production of fish. As early as 1902 Stanahan (1902) writing on the justification for building fish ponds and harvesting water commented, "there are vast areas in all the states which now produce virtually nothing and much of which might be made to furnish abundance of fish, with comparatively little expense. Not only would the conversion of this waste land into water areas increase and equalize the rainfall to some extent, but it would measurably decrease the liability to disastrous floods and equalize the flow of streams."

In the mid-30s, harvesting water in man-made ponds was not very common in Alabama. Swingle (1936) commented that there were approximately 1,000 small ponds and lakes in the State at that time and that about three-fourths of them were less than 10 acres. Although farm ponds containing harvested water were not very common (an average of less than 20 per county), the establishment and evolution of the Auburn Fisheries Program was predicated on the harvest of rainwater and its storage in earthen ponds for use in research on various aspects of aquatic ecology. As detailed in a preceding Section, Lake Auburn was constructed to collect and store water harvested from a small, un-named tributary of Chewacla Creek where it would be utilized for the production of recreational fishing. Once the pond was filled, only subsequent rainfall was required to maintain its water level.

RESEARCH ON WATER HARVEST

The first formal research on Water Harvesting at Auburn was conducted by D. A. Parsons, a Soil Conservation Service Hydraulic Engineer (Parsons, 1949). His study was based on data collected from Farm Pond 4 and its watershed, on the South Auburn Farm. In his study, he estimated ground-water flow to the pond, soil moisture and evapo-transpiration, surface run-off, watershed intake rates and infiltration rates. Unfortunately, this research was conducted after most of the construction of ponds on the South Auburn, Sougahatchee and Story Farms had been completed. Further, the data were collected from a pond (Farm Pond 4) constructed on a watershed consisting of soil derived primarily from marine and fluvial sediments in the East Gulf Coastal Plain Physiographic Section; while all of the ponds constructed on the Sougahatchee and Story Farms are in watersheds with soils derived from the igneous rocks of the Piedmont Physiographic Section. As might be expected, the hydrological

characteristics – especially seepage – of the two areas are quite different. Hydrological studies on the ponds constructed on the Story Farm in the Piedmont would not be published until the early 80s (Boyd and Shelton, 1984).

TYPES OF PONDS

In the early years, ‘Investigators’ at Auburn constructed two different types on ponds on the South Auburn Farm:

1. ‘Flow-Through’ Ponds.
2. ‘Terrace-Water’ Ponds.

Farm Pond 1 and Farm Pond 2 were of the ‘Flow-Through’ type. They were both constructed on permanent streams where the annual flow was considerably in excess of their storage capacity. In contrast Farm Pond 3 and Farm Pond 4 were of the ‘Terrace-Water’ type. They were both constructed on intermittent streams where the annual availability of water for harvest and storage was not greatly in excess of the capacity of the ponds. In Farm Pond 3, annual availability was generally much less than the storage capacity.

Because of the differences in the annual availability of water for harvest and storage for these four ponds, it is a simple matter to divide them into those two distinct groups. Unfortunately, the matter is not really so simple. The availability of water for harvest and storage at different locations on a watershed is dependent of several factors.

On the Soughahatchee Farm, ponds of the ‘E’, ‘F’, ‘H’, ‘M’, and ‘R’ Series were of the ‘Flow-Through’ type (Figure 18D). Water available annually for harvest is far in excess of storage capacity. Farm Pond 1 is also of this type. It was constructed on a permanent stream (Funchess Creek). When it was constructed annual water availability was far in excess of storage capacity. In contrast, Farm Ponds 5, 6, 7, 8, 9 and 10 also on that Farm are of the ‘Terrace-Water’ type. Annual water availability for Farm Ponds 6 and 10 is about equal to storage capacity, but for the remainder, it is far below. Farm Ponds 5 and 7 were abandoned ‘early-on’ because availability was so low relative to storage capacity. Both ponds lost all of their water during the year.

On the Story Farm, Ponds S-1, S-6 and S-7 on the Smith Creek Watershed are of the ‘Flow-through Type (Figure 18D). Availability relative to storage capacity was so great in these ponds that it was necessary to construct diversion canals to allow the excess water to by-pass them. In contrast Ponds S-2, S-4, S-23 and S-25 are examples of the ‘Terrace-Water’ type. On

the Swingle Creek Watershed, S-8, S-14 and S-16 are 'Flow-Through.' A diversion canal was also constructed around them. On the same Watershed, Ponds S-13, S-15 and S-17 are examples of 'Terrace-Water Ponds.'

On the Farmville City Farm, Farm Ponds 12 and 14 are 'Flow-Through;' while Farm Pond 13 is 'Terrace Water' (Figure 18D).

Remember that assigning each of these ponds to either of these two types is not always a simple matter. For example, Pond S-3 should probably be included in the 'Terrace-Water' Group; however, the presence of more-or-less permanent springs in its watershed helps to maintain a stable water level in the pond in most years. Although assigning a 'type' designation to a specific pond is a rather 'loose' matter, 'water availability-storage capacity' characteristics for most of them are generally predictable enough that they were of considerable value in developing Water Management Plans for the Farms.

SPECIFIC WATER MANAGEMENT INITIATIVES

Initially, there seemed to be enough water in the Funchess Creek watershed to meet all the needs for research on the Soughahatchee Farm. In much of that early research, the ponds were filled and drained only once per year – usually in the fall and winter; however, as the program increased in size and complexity, they were often drained more frequently.

THE 'CLOSED' SYSTEM

As detailed in a preceding paragraph, Water Harvesting has been an important part of the Auburn Fisheries Program from the beginning, and in later years improving the efficiency of the use of harvested water (Water Management) has also become increasingly important. As detailed in a preceding Section, the earliest development in Water Management on the Soughahatchee Farm involved installing the low-head dam in Funchess Creek so that water could be lifted into the diversion canal ('ditch') where it could be distributed, by gravity, to all of the ponds in the lower valley. In this system, water in the canal flowed continuously. When it was not being used in the ponds, it eventually passed through Pond J-1 (Figure 18D) near the 'Counting Shed,' and flowed back into Funchess Creek and on to the Saugahatchee. It seemed that if we could eliminate the open canal and replace it with a 'closed system' that we could reduce, at least to a degree, this continuous loss of stored water; consequently, in 1978, Lamar and the Field Crew placed two large PVC pipes through the dam of Farm Pond 11, one at the 4-ft level and one at the 12-ft level; then joined them to a large diameter PVC pipe below the dam, which ultimately provided water to all of the ponds in the valley below.

WATER RE-CYCLING

With the water supply for the 'E' and 'F' Ponds contained within a 'closed system,' it was finally possible to develop a procedure to recover some of the seepage water from all ponds north of the Counting Shed, flowing southward in Funchess Creek. To effect this recovery, a low-head, concrete dam was placed across the Creek at the 'Counting Shed' (Figure 84). Then an electric pump was placed in the pool behind the dam. This pump transferred seepage water from the stream into the closed system.

THE SMITH CREEK AND SWINGLE CREEK 'CONNECTION'

In 1968, a pipe was installed connecting the Diversion 'Ditch' on Smith Creek with Pond S-8 on Swingle Creek. A low dam was installed on the 'Ditch' near the eastern end of the S-6 dam in order to create a small water reservoir (Figure 84D). A PVC pipe routed water from the reservoir over the 'hill' to Pond S-8, where it was discharged near the northern end of the dam on that pond.

THE SWINGLE CREEK AND FUNCHESS CREEK 'CONNECTION'

Another of the developments in Water Management involved transferring water from the Swingle Creek Watershed to the Funchess Creek Watershed (Figure 18). In this system, also installed in 1968, water is pumped (Figure 85) from the eastern end of Pond S-8, southeastward, over the 'hill' into S-28 on the Funchess Creek Watershed (Figure 18C). Later (2006), the system was altered to also route water from S-8 to S-9, S-10, S-11, S-12 and S-13 (See Appendix Table 2).

THE S-30 POND AND FUNCHESS CREEK CONNECTION

Also described in a preceding Section, was another important improvement in Water Management on the Soughahatchee and Story Farms. It was a result of the installation of the PVC pipe through the low hill separating Pond S-30 and the upper reaches of the Watershed of the northern-most tributary of Funchess Creek (Figure 18C). This connection also allowed for the transfer of excess water harvested from the Swingle Creek Watershed to the Funchess Creek Watershed.

WATER MANAGEMENT AT THE SHELL CENTER

Figure 78 provides an aerial view of the Center for Aquatic Resource Management. The building on the left, adjacent to Highway 147,

was designed primarily for research. It contains analytical labs, environmentally controlled labs containing aquaria and a large wet lab with rows of aquaria and tanks. The building on the right, adjacent to the 'F' Ponds, contains a large classroom and two teaching labs. It also is designed to replace the Counting Shed as the School's primary fish-handling facility. It also contains the Fish Marketing Facility, several faculty offices and a large multi-media display area. Pond 4 of the 'B' Series is shown at the bottom of the Figure.

Water management in the two buildings is quite different. There are 10 different groups of tanks (Systems) in the wet-lab portion of the Research Building. They are operated primarily as flow-through systems. There are two sources of water available:

1. City water.
2. Water pumped from a group of four connected reservoir ponds (Ponds F-15 – F-18) which are part of a re-cycling system for waste water from the fish holding facility in the adjacent building.

Although there are two sources of water available for the tanks, most of the 'Investigators' utilizing them choose to use city water. These two sources of water are also available for use in the aquaria in the environmentally controlled rooms of this building.

While it is possible to dispose of the waste water from this building by piping it to the F-15 – F-18 re-cycling reservoir, virtually all of it is currently directed to the Sanitary Sewerage Collection System of the City of Auburn.

Figure 78 includes a view of the Administration Building (Adjacent to the 'F' Series) of the Shell Center. It was designed to replace the fish holding facilities of the now demolished Counting Shed (Figure 71). It contains 36 tanks of 1 cubic meter and 3 tanks of about 10 cubic meters capacity. Water for these tanks can come from Farm Pond 11, or from the 'F' Ponds 15-18, re-cycling reservoir.

Water from the Farm Pond 11 source can be taken from the 8-foot outlet, but the primary source is the 4-foot outlet – the 'B'-1- 4 outlet (Figures 58 and 73). The outflow from the tanks in the building can only flow into the Pond F-17, which has a pipe connecting it with Pond F-18. The water from Pond F-18 can only be returned to Pond F-17; through the use of a variable-speed pump. The original plan was to allow the variable speed pump to return water to Farm Pond 11 if it wasn't needed in the fish holding tanks. This did not work as planned; Pond F-17 and F-18 were frequently almost completely de-watered; risking leaving the holding tanks without a water source. Later, in

2014, two additional ponds were added to the series to increase the biological filtration and re-cycling capacity. With this change, the water re-cycling system for the holding tanks included 'F' Ponds 15, 16, 17 and 18.

Although Farm Pond 11 water was clear most of the year, its chemistry was poor, primarily as a result of very low alkalinity. Further, often large quantities of bryozoans would clog even the 2-inch pipes delivering water to the holding tanks. In 2013, Karen decided to heavily lime and salt the water in 'F' Ponds 17/18 and to operate the fish holding facility counting shed as a purely recirculating system. Her intention was to maintain water at 60 mg/L or more total alkalinity and hardness, and above 2 ppt salinity. As a result of these changes, fish survival in the fish holding tanks has greatly improved, and it is now possible to maintain fish in them for several months with regular feeding, providing the tanks are washed-down periodically to prevent a biofilm from building up. The fear of parasites and disease transmission from infected fish being held in the facility has proven to be unfounded.

TIMBER MANAGEMENT ON THE FARMS

After the purchase of the Story Farm, 'Investigators' made considerable progress in developing uses for the water on the tract, but little was accomplished on the management of the other primary resource there – the timber. Years of wasteful agricultural practices on both the Sougahatchee, Story, Farmville City Farms had left their timber stocks in disarray. Over the years after I returned to Auburn in 1959, I had discussed the lack of management of the timber with Swingle and others on many occasions, but no one seemed to have time to worry about it. Consequently, when I became Department Head, timber management on the Farms was one of my priorities.

Later, I requested permission from the Director of the Experiment Station to cut most of the timber off both the Sougahatchee and Story tracts and to replant them with loblolly pines. He approved my request early in 1974, and agreed that we could retain the proceeds for planting replacement trees and for the construction of facilities. Shortly thereafter, we contracted with Sizemore and Sizemore, a local consulting forestry company, to inspect the timber and make recommendations for its disposal. In its report, the Company commented that much of the marketable pine timber was infected with *Cronartium*, and was in danger of dying within the next five years. They further noted that much of the entire area was heavily infested with kudzu. Shortly thereafter, the University contracted with the company to mark the timber for sale, to estimate its value and to supervise its sale. We did stipulate that they try to save at least 50 square-feet of basal tree area of standing timber per acre; unless the stand was in such poor condition that none of it should be saved.

Unfortunately, before the timber could be marked, a powerful storm felled

between 300 and 400 trees, primarily on the Story Farm. Sizemore and Sizemore felt that they could not adequately mark the remaining timber until the downed trees were removed, so we hired them to mark the damaged trees and to try to sell them. After some effort, they were able to sell them to Alabama Wood Products for \$2,811. After that wood was removed, the company marked the remaining trees and estimated its value at \$268,500. Bids were received for the timber in September, 1974, and soon thereafter the University signed a contract with G & B Log Company, who agreed to pay \$211,000 for it. The first cutting began soon thereafter, and all harvesting was completed in August 1975.

From the beginning of the timber marketing process, we had set aside enough money to pay for the elimination of the kudzu and for planting the entire area where the remaining stand was less than optimum. Of course, the first priority was elimination of the kudzu. Sizemore and Sizemore recommended that we thoroughly burn the areas infested with the pest during the late winter and then graze the areas with cattle. They further commented that any chemical that could be used to control the pest would likely cause problems in the adjacent ponds. Of course, we could burn the areas with our Field Crew, but there was no practical way to get those areas grazed, so we decided to gamble on the use of the herbicide *Torodon*, both as a spray and as pellets to eliminate the pest.

We began the process of kudzu elimination shortly after the timber cutting began. In the late summer, some 88 acres of the area were sprayed with *Torodon*. Virtually all of this area required two sprayings, and some of it required three. Later that year, fire lanes were cut around the hill north of Pond S-13 and south of Pond S-14 (Figure 18C). This was one of the largest areas of infestation on the Story Farm. The burn was completed in late winter, and when young kudzu plants began to emerge from the largely undamaged root stocks, in the early spring, *Tordon* pellets were applied around each emerging plant. Although the labor costs were extremely high, we finally virtually eliminated the plant from the larger open fields on the Soughahatchee and Story Farms. Unfortunately, even after all of the effort expended by the crew, there were small 'patches' of the pest located in 'out-of-the-way' places around the Story Farm. As a result, student labor and *Round-Up* were used to eliminate those patches each summer for several years.

There was little kudzu on the Soughahatchee Farm; consequently, as soon as the 'old' timber stand was removed, we began to replant part of the area with loblolly pines. One of the first areas re-planted (1975-1976) was along Lee 72, between Farm Pond 8 and Farm Pond 9. Part of the stand established by this re-planting is shown in Figure 86. It has been thinned at least one time since it was planted.

In 1974, there were a number of partially open areas throughout the Story Farm that were entirely free of kudzu. One of these was the old field south of the road going into Pond S-6 from County Road 46. There was another larger open area south of the old Field Headquarters storage buildings and Pond S-4 and Pond S-5. The Field Crew began planting these areas during the late fall in 1974. Planting continued into 1976 when 22,000 loblolly pine seedlings were planted between Pond S-1 and Pond S-3 and around Pond S-15. Figure 87 shows the stand established on the open field adjacent to the road between Lee 46 and Pond S-6. This field had been part of a radar testing site established by the University during World War II.

From the beginning, we had decided that we would manage the timber on a 'saw-log' rotation basis. In other words, we would manage it for the production of high-quality saw logs rather than for pulpwood. This seemed the best way to produce timber on the Farms, and at the same time, maximize water harvesting. Unfortunately, this created a timber management problem for us. Hand-planting of seedlings by our Field Crew had resulted in extremely good survival, and by the early 90s, those old 'worn-out' cotton fields had produced an extremely large quantity of pulpwood. Most of those stands were 20 years old at that time. However, in order to produce saw-logs in the shortest time, those stands had to be thinned.

Bill Rogers became Department Head after I retired at the end of January in 1994. In April of that year, someone noticed that some thinning was taking place on the Story Farm; although there was no agreement with anyone to do it. Later, it was learned that a Professor in the School of Forestry was doing some thinning as a teaching exercise. Rogers agreed that the exercise could proceed. Unfortunately, it did not result in very much thinning.

In September, 1995, remnants of Hurricane Opal passed through the Auburn area, downing many trees in the severely crowded stand of timber on the North Auburn Farms. By that time, John Jensen had become Department Head. Later that year, he requested permission to remove the downed timber. He also used the occasion to begin to thin all of the stands. This process was completed in 1997.

Sometime later, as a result of the success of the timber management program on our Farms, the Board of Trustees established a policy on the management of Experiment Station forestland, and Richard Martin of the School of Forestry and Wildlife Sciences was given the responsibility of establishing management plans for Experiment Station timberland all over the State. In 2000, he decided that additional thinning was needed at North Auburn. Bids were solicited with a closing date of October 6, 2000. Later, Mead Coated Board agreed to pay \$8.50 per ton for the wood. For this particular sale, approximately 60 total acres, on different areas at North Auburn, were to be clear-cut. In addition, thinning was to be continued on an

additional 55 acres. The contract also required that in the thinning-cut, every fifth row could be removed to provide access for efficient harvesting. It also required a minimum of 70 square-feet of basal area per acre would be left. The clearing and thinning operation was completed in June, 2001.

After 2001, timber management efforts at North Auburn became somewhat complex, and records of sales are confusing; consequently, I have not attempted to describe any of them. Dick Martin maintained good records on all of his activities on the Farms, and summarized them in a December 17, 2009 memo to David Rouse. In 2009, Martin developed a timber management plan for the North Auburn Farms for the period 2010-2015. He divided the entire area into 93 sub-areas and provided suggestions for managing the timber on each. Noting the long-term efforts on the part of the Department to manage this valuable resource, he recommended a combination of continued clear-cutting, planting, release spraying, thinning, and kudzu control to maintain the size class distribution on the area.

In late 2013, bids were requested for 'clear-cutting' two areas on the Sougahatchee Farm, and one area each on the Story and the Farmville City Farms. More specifically the 'cuts' were to be made on a tract north of Farm Pond 11, west of Farm Pond 8, east of Farm Pond 14 and north of 'S'- 29 (Figure 18C). All cutting was to be completed by December, 2014. Later, a bid of \$155,435 was accepted. Then in August, 2014, a Purchase Order was issued to Green South Land and Timber, Inc. of Auburn to replant the 'cut' areas with 450 loblolly pine seedlings per acre and for the spraying of 94 acres with *herbicide* to control hardwood sprouting.

'INVESTIGATOR' RESEARCH ACTIVITIES

In the following Sections some of the accomplishments of Auburn's extraordinary research and development program are discussed. Over the long period between the mid-50s and the end of the first decade of the 21st century, 'Investigators' have completed literally hundreds of research projects. Many of them are listed and described in a comprehensive list of Fisheries Program Publications that has been kept since its beginning. A copy of this list is maintained in the Special Collections and Archives Department of the Ralph Brown Draughon Library. Unfortunately, detailed consideration of this mass of information is far beyond the scope of this book. Instead, I have attempted to summarize it by listing some of the publications resulting from research in the several areas, along with their authors. In this way it is possible to follow the trends of research in the different areas along with contributions of the 'investigators.' It is unfortunate that there is not time or space available to fully recognize and describe all of the contributions of this highly talented and productive group of individuals.

As detailed in several preceding Sections, as late as 1950, the scope of Auburn's Fisheries Research Program (Fisheries, Aquaculture and Aquatic Sciences) was still relatively limited. Virtually all of its research funding still came from the Experiment Station (State and Federal); consequently, most of the research generally was related in some way to the improved management of 'terrace-water' ponds for recreational fishing. In that year, virtually all of the 'S' Ponds were still in research related to the sale of fishing permits. Most of those ponds were stocked with largemouth bass, bluegills and shellcrackers. In the 'E' Ponds, serious commitment to research on commercial fish production in ponds was just beginning. Experiments there were in progress on the production of speckled bullheads, carp and smallmouth buffalo. The first experiments involving the production of *Tilapia* were underway.

FUNDING FOR RESEARCH

Funding for the salaries for Auburn 'Investigators' involved in the research in the Fisheries Program was discussed in detail in a preceding Section, but little attention has been given to funding the 'Maintenance' (equipment, supplies, services, travel, etc.) share of expenditures.

Changes in the source of funding for Research Maintenance over the years are indicative of the growing complexity of the Fisheries Program. Data presented in Table 76 indicates that as early as FY '51, more money was received from non-appropriated sources for funding 'Research Maintenance' than from appropriated sources. Over the years, this imbalance increased. The first budget (FY '71) prepared for the newly created Department of Fisheries and Allied Aquacultures included the following sources of funds from non-appropriated sources:

- 1. Alabama Power Company**
- 2. Eli Lilly and Company**
- 3. Goldkist**
- 4. Alabama Department of Conservation – Fisheries Section**
- 5. Alabama Department of Conservation – Seafoods Division**
- 6. Southeastern Association of Game and Fish Commissioners**
- 7. National Marine Fisheries Service**
- 8. U.S. Fish and Wildlife Service**

9. U.S. Army Corps of Engineers

10. U.S. Agency for International Development.

All of the grants or contracts received from these groups included allocations for 'Maintenance.' For example, the Institutional Building Grant (AID/csd-2780), funded by the U.S. Agency for International Development, provided \$63,385 in research maintenance in FY '71. In the same year, the contract with Alabama Power Company provided \$24,000.

As detailed in a preceding Section, a substantial amount of funding required to pay 'Maintenance' costs during the 70s, 80s and 90s was derived from 'Indirect Costs.' In some years, with millions of dollars in USAID contracts in effect, the Department received many thousands of dollars from this source.

The 'Sale of Products' (fishing permits, fish bait, live and processed fish) was also a major source of funding for maintenance in the early years; however, by the time that the new Department was created (1970), they were much less important.

A PLETHORA OF RESEARCH PROJECTS

As the post-war world slowly evolved in the nation, science and technology lead the way. This phenomenon in the Fisheries Program at Auburn is shown by data presented in Figure 88. These data show the number of students receiving advanced degrees from Auburn, requiring the completion of a research project (Thesis or Dissertation) in 7 different years (1950, 1960, 1970, 1980, 1990, 2000 and 2010). The data indicate that the number of research projects completed per year by graduate students increased rather slowly (0 to 14) in the two decades from 1950 to 1970, but in the following decade, it doubled to almost 30. Not only did the amount of research increase, but the variety also increased. In the early days, pond management, fertilization, fish biology, limnology were most common, but by the early 80s, research was being conducted on fish nutrition, water quality, genetics and breeding, viral fish diseases and immunology, fish ecology, population dynamics, oyster biology, shrimp farming, etc.

In the following Section, research conducted in several of the areas will be described. Generally, specific research publications prepared by individual faculty and their graduate students in each of the areas will be identified. Publications listed were chosen to highlight the changes in research conducted by individual scientists throughout their careers and by their graduate students. Each publication is listed in abbreviated form. The complete citation is listed in 'LITERATURE CITED.'

RESEARCH ON NON-AQUATIC ANIMAL CROPS

It may seem strange that the 'Investigators' of the early Auburn Fisheries Program would spend valuable time on research on crickets, worms and bamboo pole production; however, from the beginning they had understood that the ready availability of these 'crops' could be a limiting factor in recreational fishing. This concern became even more important when they began their research on selling 'fishing privileges' as a means of marketing largemouth bass and bream from 'terrace-water' ponds. In some years, while the research on the marketing of recreational fishing was being conducted, worms, crickets and poles produced on the farms were sold to fishermen.

PRODUCTION OF FISH WORMS

The first publication on the production of fish worms was released by the Agricultural Experiment Station in mimeographed form in 1938. It was later revised and in 1961 issued as a Progress Report (Series Number 62, Swingle, 1961b). There was very little research conducted. The 'Investigators' simply described the procedures already in use locally for producing worms.

In personal correspondence addressed to H. S. Swingle, Earl Kennamer, Extension Fish and Wildlife Specialist, estimated that approximately 690 persons in the state produced earthworms for sale in 1949, and that the value of these sales totaled approximately \$200,000.

PRODUCTION OF CRICKETS

The 'Investigators' began research on the production of crickets in the late 30s, but the first publication, Agricultural Experiment Station Leaflet (Number 22), *Raising Crickets for Bait* was not released until August, 1945. It was later reprinted in June, 1946 and May, 1961 (Swingle, 1961c). Again there was very little research done (Figure 89). In fact, it was common knowledge that Dean Funchess criticized Swingle for writing an Experiment Station publication based on so little research.

In personal correspondence addressed to H. S. Swingle, Earl Kennamer, Extension Fish and Wildlife Specialist, estimated that approximately 228 persons in the state produced crickets for sale in 1949, and that the value of these sales totaled approximately \$10,000.

PRODUCTION OF BAMBOO FISHING POLES

Soon after the purchase of the Soughahatchee Farm, Dr. D. G. Sturkie of the Department of Agronomy and Soils, initiated an Agricultural Experiment Station Project on the production of bamboo as a source of fiber

for paper production. His research plots are visible in the lower left-hand portion of Figure 52. They were immediately south of the Ireland Building. These plots persisted for years after Sturkie terminated the project. In fact, it was extremely difficult to eliminate them. The 'Investigators' harvested some of these plants for use as fishing poles. Later, a stand was established on the west side of Pond S-1. Unfortunately, none of these plants made very good poles. The distance between the nodes was too great, which resulted in a pole that was much too limber. There was little market for these inferior poles when those made with another species of bamboo were already available. The primary use of plants from the Pond S-1 stand was for making decorations for fraternity parties. There is no indication that any information on bamboo production was ever released by the 'Investigators.'

Although the "Investigators" apparently did not publish information on the production of bamboo for fishing poles, Earl Kennamer, Fish and Wildlife Extension Specialist, reported (personal correspondence) that in 1949, 87 persons in the state produced bamboo fishing poles for sale and that the value of the sales was \$16,225.

RESEARCH IN BASIC AQUATIC ECOLOGY

As detailed in several preceding Sections, the early Fisheries Program was soundly grounded in basic aquatic ecology. Studies on raising the trophic levels of the artificially established ecosystems in 'terrace-water' ponds, through the addition of inorganic fertilizer, required considerable research in the field. Further, studies on the biology of fish and their interactions (predator-prey relationships, density-dependent growth and reproduction) in the ecosystems required sophisticated ecological research. Finally, managing these primary effects and their varied interactions to produce a specific outcome (good fishing on a sustained basis) represented a major exercise in applied ecology.

The publication of *Bulletin 254 (Management of Farm Fish Ponds)* in 1942, and its revision in 1947, brought to an end this early broadly-based basic research effort in aquatic ecology by the 'Investigators.' Basic research would continue in the "New World," but it would be more narrowly focused.

RESEARCH BY THE DENDY WORK GROUP

In the mid-50s, Dr. J. S. Dendy began a series of studies on the dynamics of fish food organisms in ponds with primary emphasis on Chironomidae. Dendy (Figure 90), a native of South Carolina, had received the B. S. Degree from Presbyterian College in 1930 and the M.A. Degree from the University of North Carolina in 1932; then in 1943, he was awarded the Ph.D. Degree by the University of Michigan. During this period, he was employed as a high school biology teacher in Washington, NC (1933-1934);

Instructor in Zoology at the University of North Carolina (summers, 1934-1936); Professor of Biology, Brevard College (1934-1938) and Limnologist with the Tennessee Valley Authority (1942-1947). In 1947, he joined the Zoology-Entomology Department at Auburn to help develop a new curriculum in Fish Management and to teach some of the new courses developed for it. At the same time, he was also involved in teaching several of the established zoology courses.

For several years after coming to Auburn, he was mostly ‘swamped’ with teaching and teaching-related activities, but in the mid-50s, he was provided with some Agricultural Experiment Station Funds to work on fish food organisms in fertilized ponds. Some of the publications developed from this research included:

- 1. Bottom fauna in ponds with largemouth bass only and with a combination of largemouth bass plus bluegill (Dendy, 1956).**
- 2. The Chironomidae (=Tendipedidae; Diptera) of Alabama with descriptions of six new species (Dendy and Sublette, 1959).**
- 3. A multiple-plate sampler for aquatic macroinvertebrates (Hester and Dendy, 1962).**
- 4. Observations on bryozoan ecology in farm ponds (Dendy, 1963).**
- 5. Phenology of midges in experimental ponds (Dendy, 1971).**

RESEARCH BY THE PAMATMAT WORK GROUP

As detailed in a preceding Section, the Department of Fisheries and Allied Aquacultures was created in 1970. Prior to that time, our teaching curriculum and research program were developed within the Department of Zoology and Entomology. Once we were separated, we had to begin to think about developing a teaching and research program of our own. It was quickly apparent that one of the glaring deficiencies of the existing program was in the area of basic aquatic ecology. Of course, as noted in a preceding paragraph, the program had been established on a base of applied aquatic ecology, but we never had an ‘Investigator’ on the faculty that was trained in basic aquatic ecology or that had worked in that general area. In order to remedy this situation, in the early 70s, we contacted Dr. Mario Pamatmat concerning the possibility of his coming to Auburn to teach and conduct research in this subject matter area.

Mario Pamatmat was one of the first of many Philippine students to come to Auburn to study fish culture (1949-1950). Later, he returned to Auburn to study and in 1958 was awarded the B.S. Degree in Fish Management. Then in

1960 with H. S. Swingle serving as his Major Professor, the University awarded him the M.S. Degree in Fish Management. Later, in 1966, he took his Ph.D. Degree in Biological Oceanography from the University of Washington, and when we contacted him he was already employed as a Research Associate by that University. He was pleased to return to Auburn as a faculty member; arriving here in late January, 1973. He immediately began research in basic aquatic ecology with the assistance of several excellent graduate students. One of these studies is especially noteworthy. In 1977, Valdis (Val) E. Mezainis submitted his thesis "*Metabolic Rate of Pond Ecosystems under Intensive Catfish Cultivation.*" He was awarded the M.S. Degree the same year.

Mario had done research for the Terminal Degree in the marine ecosystems on the west coast. After working for several years in marine ecology, he never seemed comfortable working with the ecology of small earthen ponds. He resigned in 1979 to accept a position with San Francisco State University to conduct research at the Tiburon Center for Environmental Studies.

BASIC STUDIES IN ICHTHYOLOGY

Over the years, Auburn 'Investigators' have made a number of important contributions to Ichthyology. Leaders in this effort have been F. E. Guyton, J. S. Dendy, Billy Smith-Vaniz, J. S. Ramsey and Carole Johnston. Some details on their contributions are noted in the following paragraphs:

THE GUYTON COLLECTION

Guyton's contribution in this area was discussed in some detail in a preceding Section; consequently, it will not be repeated here.

CONTRIBUTIONS OF THE DENDY WORK GROUP IN ICHTHYOLOGY

As noted in a preceding Section, J. S. Dendy came to Auburn in 1947 to assist with the establishment of the Fish Management Curriculum. He had received excellent training in ichthyology while a graduate student at the University of Michigan. Although his primary responsibility here was teaching, he did find time to devote some effort to the research in ichthyology. Publications resulting from the work of his Group his work include:

1. Distribution, life history, and morphological variations of the Southern Brook Lamprey, *Ichthyomyzon gagei* (Dendy and Scott, 1953).
2. How large do redeye bass grow (Dendy, 1954).

THE SMITH-VANIZ BOOK

Likely, Dendy's most important accomplishment in ichthyology at Auburn was guiding the efforts of one of his M.S. graduate students, William F. Smith-Vaniz, in his thesis research on the fishes of Alabama. In 1968, the thesis was published by the Alabama Agricultural Experiment Station as *Freshwater Fishes of Alabama*. It would be one of the first comprehensive books ever published on the fishes of the State and their taxonomy.

ESTABLISHMENT OF THE RAMSEY WORK GROUP

As will be detailed in a subsequent Section, major changes were made in the Fish Management Curriculum in the 1962-1963 academic year, but when all the changes were 'in-place,' it was apparent that one of its most glaring deficiencies was the lack of a course in ichthyology. Further, at that time, it was unlikely that the University was going to employ a new faculty member to teach the course. At Cornell, I had the opportunity to work with personnel of the New York Cooperative Fisheries Research Unit. With that background, when I returned to Auburn, it seemed possible that we might get a similar Unit established at Auburn that would emphasize research and teaching in ichthyology. Auburn had a Cooperative Wildlife Research Unit for many years. Later with considerable assistance from Congressman George Andrews, USFWS agreed to establish a Unit at Auburn. It was officially established in June, 1967. Additional information on the establishment of the Unit is presented in a following Section.

In 1968, Dr. John Ramsey was chosen as the Leader of the new Cooperative Fisheries Research Unit. I had worked with him on the summer lake trout sampling program in Cayuga Lake when he an undergraduate in fisheries at Cornell. I was impressed by his work ethic, so I was delighted when the Fish and Wildlife Service recommended that he become Unit Leader. He had taken his Ph.D. under Dr. Royal D. Suttkus, a nationally-known ichthyologist at Tulane University. Ramsey's dissertation research was based on the distribution of fishes in river drainages of the Southern Appalachians. At the time he was chosen as Unit Leader, he was employed by the University of Puerto Rico. He began work at Auburn in 1968

In the mid-80s, Carole E. Johnston was one of Ramsey's M.S. students. She had been awarded the B. S. Degree by Columbus State. Under Ramsey's direction, she did a study involving the re-description of the Dixie Chub (*Semotilus thoreauianus*). They later published the results in an article in *Copeia*. Ramsey left the Cooperative Unit in 1986 to accept another position with USFWS. As a result, the Department was without an ichthyologist from 1986 until Dr. Johnston returned to the University in 1998. Prior to returning, she was awarded the Ph.D. Degree in Ecology and Ethology (1993) by the University of Illinois, and had also served as a fisheries biologist with the

U.S. Forest Service. Johnston and Ramsey continued to publish together in the 90s. After returning to Auburn, she continued an active research program in ichthyology and in the early 2000s she and her graduate students began a far-ranging program on sound production in fishes.

CONTRIBUTIONS OF THE RAMSEY-JOHNSTON WORK GROUP IN ICHTHYOLOGY

Some of the publications developed by Ramsey and Johnston over the years include:

1. Development of color pattern in pond-reared young of five *Micropterus* species of the Southeastern U.S. (Ramsey and Smitherman, 1971).
2. Redescription of *Semotilus thoreauianus* Jordan, 1877, a cyprinid fish of the Southeastern United States (Johnston and Ramsey, 1990).
3. Reproduction of the Greenbreast Darter, *Etheostoma jordani* (Teleostei: Percidae) (Orr and Ramsey, 1990).
4. The relationship of spawning mode to conservation of North American minnows (Cyprinidae) (Johnston, 1999).
5. Movement patterns of imperiled blue shiners (Pisces: Cyprinidae) among habitat patches (Johnston, 2000).
6. Nest site selection and aspects of the reproductive biology the pygmy sculpin (*Cottus paulus*) in Coldwater Spring, Calhoun County, Alabama (Johnston, 2001).
7. Seasonal, diel and spawning habitat of the rare muscadine shiner (Johnston, et al., 2002).
8. Habitat use of the shoal bass, *Micropterus cataractae*, in an Alabama stream (Johnston and Kennon, 2007).
9. Learned or innate production of acoustic signals in fishes: a test using a cyprinid (Johnston and Buchanan, 2007).
10. The Alabama bass, *Micropterus henshall* (Teleostei: Centrarchidae), from the Mobile River Basin (Baker, et al., 2008).
11. Ontogenetic habitat shifts and habitat use in an endangered minnow, *Notropis mekistocholas* (Henderson and Johnston, 2010).

12. Sound production in *Etheostoma oophylax* (Percidae) and all characteristics correlated to body size (Speares and Johnston, 2011).

BASIC RESEARCH IN FISH PHYSIOLOGY

In 1963, I applied for and received a Research Grant to study *Metabolic Cycles in Fish* from the National Institutes of Health. This research represented the continuation of the work that I had done at Cornell for my dissertation. With funds provided by NIH, we remodeled a large room on the southwestern corner of Graves Dining Hall which was serving as the 'home' for the Fisheries Program at that time, and equipped it as a physiology laboratory. In the basement, we installed eight large feeding troughs, which with the attachment of plastic covers, could be converted into large respiration chambers. Mr. 'Bud' Black (Lamar's father) and the Field Crew constructed these troughs. Using the white catfish as the test animal, I began a periodic sampling program, measuring several physiological characteristics of the species.

In the fall of 1967 when the Fisheries Program began the foreign country 'surveys' requested in our first AID/Washington contract (AID/csd-1518), I was making good progress on my study of *metabolic cycles*. However, when Swingle left on his long-term trip to Southeast Asia, my research quickly began to suffer. He left me with all of my regular teaching, research and graduate program responsibilities; plus all of his program administration responsibilities. It was quickly obvious that I could not do all of these things, so I requested that NIH terminate the grant. Not only did I have to relinquish the grant, but I also never had the time to publish any of the information that I had accumulated to that time.

Only a single publication was developed from this area of research before I terminated it:

1. Lactate dehydrogenase isoenzymes of Nile tilapia (*Tilapia nilotica*), Java tilapia (*Tilapia mossambica*) and their reciprocal crosses. (Lankford, 1966).

RESEARCH ON THE MANAGEMENT OF SMALL IMPOUNDMENTS

As noted in a preceding Section, Swingle published his last paper on fish populations in small impoundments in 1955 (*Determination of Balance in Farm Fish Ponds*, Swingle, 1955). It was further noted that this was one of his most important, if not the most important publication, because it essentially summarized all of the research that he had done on the establishment and management of fish populations in farm fish ponds since 1934. Further, it encapsulated the depth of his understanding concerning the biology of and relationships between forage and picivorous fishes. It was

and still is a masterpiece of insight into the predator-prey relationship. Unfortunately, it never received much attention from traditional fishery scientists, probably because it concerned only farm fish ponds. Afterwards, virtually all of his publications dealt with various subjects related to commercial aquaculture. He continued to teach his course, *Management of Impounded Waters*, for a number of years.

Although, Swingle was generally not directly involved in research on recreational fishing in small impoundments after the mid-fifties, other faculty continued to conduct research in this area. Research related to the sale of fishing permits in the 'S' Ponds continued for another 30 years. Some of the publications developed from this research included:

1. The estimation of channel catfish (*Ictalurus punctatus*, Rafinesque) populations in farm ponds from catch statistics (Hatcher, 1962).
2. Estimation of bass numbers in a farm pond prior to draining with electro-shocking and angling (Swingle, et al., 1965).
3. Investigation in the use of electricity for thinning overcrowded populations of bluegills (Spencer, et al., 1966).
4. Some effects of a sanctuary on an exploited fish population (Hill and Shell, 1975).
5. Estimating rate of exploitation from tag returns and fishing effort (Reed and Davies, 1980).
6. Competitive influences of gizzard shad on largemouth bass and bluegill in small impoundments (Kirk and Davies, 1985).
7. Effects of a selectively reduced gizzard shad population on trophic interactions and age-0 fishes in Walker County Lake, Alabama (Kim and DeVries, 2000).
8. Response to gizzard shad recovery following selective treatment in Walker County Lake, Alabama, 1996-1999. (Irwin, et al., 2003a).
9. Response to gizzard shad recovery following selective treatment in Walker County Lake, Alabama, 1996-1999 (Irwin and DeVries, 2003).
10. Population size, survival and growth of largemouth bass one year after stocking in four ponds (Sammons and Maceina, 2005).

RESEARCH ON COMMERCIAL AQUACULTURE

The National State Experimentation Station System was established to conduct research on various aspects of the commercialization of food and fiber production in the country, in order to improve its effectiveness and efficiency. Virtually all programs of the Alabama Agricultural Experiment Station at Auburn shared this mission. However, there is no indication that in the early days of Auburn's Fisheries Program that the 'Investigators' ever considered using 'terrace-water' ponds on farms for any purposes other than to harvest and store rainwater in order and to produce good, sustainable recreational fishing for farm families and to produce fish for the family table; although there was limited early interest in the production of fish for 'bait' in 'terrace-water' ponds, which apparently grew out of the difficulty they experienced in obtaining minnows for their frequent fishing trips to Lake Martin. Recall that one of their first experiments on the South Auburn Farm involved the production of goldfish in the Swingle Pool in 1936.

MARKETING OF FISHING PRIVILEGES

The first organized research effort to commercialize fish production in farm ponds involved the marketing of fishing privileges. Although one cannot be certain, it is likely that this research was initiated after the 'Investigators' systematically fished Farm Pond 4 (The 'Eureka' Experiment) in 1940. Fishing quality was really, really good. None of them had ever experienced fishing of that quality. One can imagine that during this period, they began to discuss the possibility that farmers might find a ready 'cash' market for such good fishing.

The 'Investigators' first experience with the sale of fishing privileges came with their research on maintaining fishing quality of bass-bluegill populations in the 'E' Series in the early 40s. They sold fishing permits to the public as a means of applying exploitation to those populations. As detailed in a preceding Section, the results of that research were not very encouraging. Fishing quality was excellent for 2-3 days, but began to deteriorate rapidly afterwards.

About the same time, the 'Investigators' began a series of similar experiments in the larger 'S' Ponds on the Story Farm. Although fishing quality was also of interest in those experiments, they were more interested in the practical aspects of selling fishing permits in ponds that were similar to those that farmers might utilize. Soon thereafter, most of the large 'S' Ponds (Figure 18C) on that Farm were being used in this research. This research resulted in the accumulation of an extremely large amount of data in the next two decades. Unfortunately, there is simply too much of it to include in this book. Instead, I have chosen to discuss only that research conducted in Pond S-6. It is the largest pond in the 'S' Series. It was dedicated to

research on the commercialization of recreational fishing for almost three decades. The data collected in this long-term research effort comprises the largest data set that is available anywhere on the subject. Unfortunately, very little of it has been published.

BASS AND BLUEGILL FISHING IN POND S-6

You will remember that the 6th pond in the 'S' Series (S-6) on the Story Farm was completed in 1946 (Figure 18C); although some additional work 'filling-the-edges' was required in 1947. When the original survey was made, it was assumed that the pond area would be 26.0 acres; however, when 'filling-the-edges' was completed, it was discovered that the actual acreage was 25.5.

EXPERIMENT 1 (1947-1955)

Pond S-6 was stocked with 1,450 bluegill fingerlings and 50 shellcracker fingerlings, per acre in February and March, 1947. Approximately 50 fathead minnows, per acre, were also added in February; then 100 largemouth bass fry, per acre, were added in early May. It was fertilized following *Bulletin 254* recommendations. In 1947, public 'fee-fishing' experiments were already in progress in the 'E' Series on the Sougahatchee Farm and in several other ponds on the Story Farm.

FISHING IN 1948

Pond S-6 was opened to public fishing at noon on Tuesday, July 6, 1948. It was later opened Wednesday, Thursday and Friday afternoons of that week, but beginning with Monday of the following week, it was opened for half-days, six days per week through mid-October. During the entire period, the pond was open for 84 'half-days' of fishing. Prior to July 6, it had been fished lightly by the 'Investigators.' Permits were priced at 50 cents each. Catch limits were 10 bream (bluegills and/or shellcrackers) and 2 bass. In contrast to the previously described 1944 fee fishing experiment in the 'E' Ponds, 'beginning' and 'ending' times were recorded for each fisherman. With this data, a much more accurate estimate of 'fishing effort' was available. Boats were made available to fishermen late in the 1948 fishing season. They were rented at a rate of \$1.00 per one-half day, with a limit of three fishermen per boat.

On the first 'Half-Day' (Wednesday, July 6) a total of 354 persons (13.88 per acre) registered for fishing (Figure 91). Some 322, 145 and 40 paid to fish on Wednesday (July 7), Thursday (July 8) and Friday (July 9), respectively. Afterwards, 'numbers' remained around 75, per 'Half-Day' through Friday, July 16, but then on Saturday, July 17 – the first Saturday of the 1948 fishing season – it increased sharply to 213; however, on Monday, July 19, it had

fallen back to less than 25. Note that on 'Half-Day' 1, the number of persons fishing per acre in Pond S-6 in 1948 and the 'E' Ponds in 1944 were similar – 13.88 versus 12.75, respectively (Figure 92). However, afterwards participation was much higher in the 'E' Ponds in the following 8 'Half-Days).

Some 354 fishermen harvested 683.1 pounds of all species from Pond S-6 on 'Half-Day' 1. Average weight harvested per fisherman was 1.93 pounds. In the first five days of fishing ("Half-Day Period 1- 4), 951 fishermen harvested 1,503.1 pounds, with an average weight per fisherman of 1.58 pounds. Data on the catch in other 'Half-Days' are shown in Table 80.

Bluegills comprised the largest share (approximately 80 percent) of the total catch of sunfish during the 84 'Half-Day' season, ranging from 70 to 86 percent of the total. Green sunfish were the second most common – 14 percent. Shellcrackers was the third most common – 5 percent. On 'Half-Day' 1 (July 6), 354 fishermen caught 2,770 bluegills (7.8 per person). Remember that the limit was 10 sunfish per permit. The average catch per fisherman was 7.0 fish for the first five 'Half-Days' of fishing, but generally the number caught per 'Half-Day' declined during the remainder of the season.

On 'Half-Day' 1, the 2,770 bluegills caught weighed 396.7 pounds – 0.14 pound each. On 'Half-Days' 2 and 3, the average weight of bluegills harvested weighed 0.06-pound and 0.05-pound, respectively. With average weights this low, fishermen must have harvested a substantial number of 'Intermediate' fish (inch-groups 3-5), especially on 'Half-Days' 2 and 3. For some reason, the creel clerks did not record daily weights of bluegills harvested beyond 'Half-Day 3. With bluegills this small, the quality of fishing was extremely poor. Both fishermen and 'Investigators' must have been badly disappointed.

On 'Half-Day' 1, 354 fishermen harvested 146 largemouth bass weighing 91.3 pounds. The average weight per fish was 0.62 pound. During the first 5 days of fishing ('Half-Day, period 1-4), 282 bass averaging 0.65 pound each were caught (Table 81). Over the entire fishing season, the average weight of each fish caught declined sharply. With this decline in average weights, it is likely that in the latter part of the fishing season that fishermen must have been really unhappy with their catch.

The 'Investigators' must have been disappointed with the fishing in Pond S-6 in 1948. Except for the first few days, fishing quality was extremely poor. Further, it became increasingly poor as the season progressed. To begin with, they had to be deeply disappointed with the size of bluegills (0.14-pound) and bass (0.6-pound) harvested. With these low average weights, after a 'Half-Day' of fishing, fishermen were 'carrying-home' 1.5 pounds, or less, of 'scales and eye-balls' – a 'far cry' from the results of the 'Eureka'

Experiment in Farm Pond 4 in 1939 and 1940. It is surprising that anyone would pay to fish there; however, they came and continued to come (“If you build it they will come”). For example, some 22 people purchased fishing permits on Saturday, October 15. For their efforts, they caught 147 bluegills, 2 shellcrackers, 17 green sunfish, 3 largemouth bass, and 2 red-eye bass. The total catch weighed 28.15 pounds, or 1.28 pounds of fish of all species per permit. Data collected that day indicated that they spent approximately 75.4 hours fishing – an average of 3.4 hours per fisherman. For their effort and costs, they took 1.28 pounds of fish home. These data strongly suggest that fishing quality had very little to do with their fishing at Pond S-6 that day. They apparently just wanted to fish, regardless of what they caught. Experiment 1 (1947-1955) in Pond S-6 was continued through 1955. The ‘Investigators’ commented in the 1953 Annual Report that the population in S-6 had been ‘thrown-out-of-balance’ in 1951; probably as a result of a feeding experiment conducted in the pond. A portion of the population was removed with partial poisoning in October, 1951, and ‘balance’ was restored. In 1952, an infestation of the branched alga *Pithophora* developed in the pond. It was so extensive that fishing was extremely difficult. This problem persisted for several years, and efforts to control it with chemicals likely affected the production of single-celled algae and insects in the pond and, in turn, the fishing.

For all practical purposes, the pond was ‘out-of-balance’ again in the summer of 1953. There was no evidence of bass reproduction and bluegills reproduced sparingly in the spring, but heavily in the early fall. However, in terms of ‘pounds-removed,’ fishing was good that year. The recorded catch totaled 212 pounds per acre, and included 189.9 pounds of bluegills, 8.2 pounds of shellcrackers, 2.2 pounds of speckled bullheads and 19.8 pounds of largemouth bass. Swingle, in the 1953 Annual Report, suggested that this high level of production was likely the result of the use of feeding.

In 1954, bluegill growth in the pond was extremely poor. A July 12, rotenone sample indicated that the ‘F/C’ value was well above 10.0, which demonstrated that the population was badly crowded with this species; subsequently, portions of the population were again removed by ‘partial poisoning’ – three times that summer. But even with ‘bluegill-thinning’ with rotenone, catch per acre was only 97 pounds. Apparently the heavy infestation with *Pithophora* also contributed to the low catch. By 1955, the *Pithophora* problem had been solved with the use of sodium arsenite and *Delrad*. Later, an infestation with the blue-green alga *Microcystis*, required the addition of copper sulfate.

FISHING AND DRAINING IN 1955

The quality of fishing was relatively poor in Pond S-6 in 1955. Total catch per month during the ‘season’ is shown in Table 82. Because of

all of the problems encountered, Experiment 1 in Pond S-6 was terminated by draining in October, 1955. On draining, some 4,262.8 pounds of fish of all species (167.3 pounds per acre) of fish per acre were recovered (Table 83). Note that 5 of 8 of the species recovered had gained entrance to the pond through the water supply. They were not stocked. The 'F/C' ratio of the recovered population was 5.0, and the A_T was 60.9. While an 'F/C' value of this magnitude is in the so-called 'balanced' range, it indicates that some serious problems were developing that would probably lead to a seriously 'unbalanced' condition in the following year.

On draining some 2,200 'Intermediate' (3-5 inch-groups) bluegills and shellcrackers combined, and 244 large fish (inch-groups 6-9), per acre, were recovered. It is not likely that this number of 'Intermediate' fish could have found enough food to grow much before the 1956 fishing season; consequently, while it would have been possible to catch a limit of large fish in March of the following year, doing so would have required catching and discarding a substantial number of 3-5-inch, 'bait-stealers.' Further, after the large fish were removed, there would have been nothing left to catch.

EXPERIMENT 2 (1955-1960)

Another 'fee' fishing experiment was initiated in Pond S-6 in November, 1955 with the stocking of fingerling bluegills, shellcrackers and adult fathead minnows. Bass fingerlings were added in May, 1956, and later that year, a small number of Israeli carp were added to control weeds. In June, 1958, 7 adult bass (30.0 pounds) were stocked. Speckled bullheads, warmouth, green sunfish, golden shiners and goldfish were not stocked, but were present later at draining.

The pond was 'opened' to public fishing in 1957. It was also 'fished' in 1958. Later, in the 1959 'season,' 2,173 fishermen removed 6,594 'large' bluegills weighing a total of 1,203.6 pounds (average weight – 0.18 pound), and a total of 1,390 largemouth bass weighing 550.4 pounds (average weight – 0.40 pound). It was drained in January, 1960, with the population badly 'out-of-balance.' Total pounds per-acre recovered on draining was 370.7, and the 'F/C' ratio was 13.8 (Table 84). This value is somewhat misleading. It is extremely high only as the result of the weight of speckled bullheads and Israeli carp included in the 'F' group. If only largemouth bass and sunfish are included, the value is reduced to 7.8. The average weight of all bluegills in inch-groups 6-9 (large fish) was only 0.15 pound. The draining data indicated that Pond S-6 was badly 'over-crowded' with bluegills. On draining, a total of 192,548 (7,551 per acre) bluegills were recovered. Only 7.7 percent of that number was in the 6 through 9-inch groups.

Concerning the problems of maintaining quality fishing in 'fee' fishing ponds, the 'Investigators' wrote in the 1957 Annual Report:

“The problem of maintaining balance in public fishing lakes is made more difficult in newly-operated ponds because of ease with which fish can be caught. In Pond S-1, a newly-opened pond, fishermen caught 115 pounds per acre in the first 2 days of fishing... The effects of these heavy catches are being studied.”

From our perspective, it is likely that they were dealing with a ‘density-dependent’ reproductive situation in which the sudden and massive reduction of adult bluegills ‘triggered’ a massive production of bluegill ‘fry.’ However, even if that hypothesis is correct, it is not readily apparent whether the ‘active’ factor was related to the sudden increase in the amount of ‘space’ available for each adult female, or if there was suddenly a massive increase in the amount of food available for each of them. This question would later prod Swingle to apply for a research grant from the National Science Foundation to look for a chemical ‘factor’ excreted by ‘crowded’ adult fish that inhibited reproduction.

EXPERIMENT 3 (1960-1961)

This experiment was initiated in early 1960 by stocking Pond S-6 with 471 bluegill, 212 shellcrackers), 1,000 fathead minnows, 100 largemouth bass fingerlings and 200 channel catfish, per acre. Note that the stocking rate for bluegill and red-ears was reduced by about half to accommodate the stocking of the catfish. This experiment was part of a state-wide experiment to determine the effect of channel catfish on traditional bass-sunfish populations.

Brad Brown used the data obtained from this experiment as a basis for his thesis (Brown, 1962). From the beginning, it was apparent that the rapidly increasing weight of catfish was reducing the rate of growth and reproduction of the bluegills. At the end of their first year of growth, most of the ‘large’ bluegills were still in the 6-inch group. A severe flood occurred in February, 1961, resulting in the loss of a large share of the population. After the flood, the population became severely overcrowded with bluegills. The pond was open to public fishing during the period June 19 through July 4, 1961. Altogether, fishermen removed 74 pounds of fish (all species) per acre. The pond was drained in the late fall of that year. On draining approximately 200 pounds per acre were recovered. In the population recovered, the ‘F/C’ Ratio, considering only the bass in the ‘C’ group, was 15.9.

EXPERIMENT 4 (1961-1966)

For this Experiment, Pond S-6 was stocked in late 1961 and early 1962. Joe Elrod used the data obtained in the experiment as a basis for the preparation of his thesis (Elrod, 1966). In this Experiment, the pond was

open for public fishing from 7:00 A.M. - 5:00 P.M. as follows:

Year Pond Open for Fishing

- 1963, May 25-September 4
- 1964, May 09-August 22
- 1965, May 29-September 6

Permits were priced at \$1.00.

In his Thesis Abstract, Elrod commented:

1. A heavy withdrawal of fish in the first season of fishing a new largemouth bass-sunfish-catfish population was followed by an overcrowding of small bluegills.
2. The unbalanced condition persisted through the next two years with a low yield to fishermen in both years.
3. Restocking 10 largemouth bass per acre, 6.0 and larger, was not sufficient to correct crowding of small bluegills in 16 months.

The pond was drained in mid-October, 1965. The final recovery of all fish was completed on October, 19.

EXPERIMENT 5 (1966-1970)

Pond S-6 was restocked in 1966 with the express purpose of determining the effect of the black crappie on the dynamics of a 'classical' bass-bluegill population. It was stocked with the usual combination of bluegills, red-ears, largemouth bass and fathead minnows, but in this experiment 100 black crappie fingerlings, per acre, were also added. The stocking of bass was not adjusted to accommodate this additional predatory fish. Grass carp were later stocked at a rate of 20 per acre to control weeds in the pond. The pond was fished by the public in 1967, 1968 and 1969. In 1969, a 'sanctuary was established in the pond in an attempt to reduce the rate of exploitation. Data on the catch of fish from the pond in 1967, 1968 and 1969 are presented in Table 81. Note that the catch declined as overcrowding intensified.

The pond was drained in 1970. Tom Hill used the data obtained from this experiment as a basis for writing his dissertation (Hill, 1970). His primary conclusion was that, even with the sanctuary, the population became

overcrowded with intermediate bluegills during the summer of 1969.

EXPERIMENT 6 (1971-1973)

For Experiment 6, Pond S-6 was stocked during the period March 3- June 9, 1971. It was planned that the population would be allowed to 'mature' for 2 years. At the end of that period, public fishing would be allowed. Unfortunately, the experiment was seriously compromised in the summer of 1971. Earlier, it had been decided to superimpose a catfish and tilapia production experiment in pens on the 'fee' fishing experiment. As a result, 38 pens constructed with plastic mesh had been placed along the margin of the east side of the pond. This addition to the experiment indicates the growing interest among the 'Investigators' in the production of channel catfish and tilapia as 'food' fish. Unfortunately, later that summer, approximately 2,500 tilapia and 1,200 channel escaped from the pens to become part of the 'fee' fishing experiment.

The pond was opened to 'fee' fishing in 1972 from July 6-October 8, 1972. Because of the presence of the pens on the east side, fishing was only allowed on the dam and the west side. During the season, 1,007 fishermen fishing a total of 4,710 hours caught 2,695 pounds of fish, or approximately 0.6-pound per hour.

The pond was again opened for 'fee' fishing in 1973, for a total of 32 days in the period May-September. That year, some 1,342 fishermen removed 2,858 pounds of fish in 6,312 hours of fishing, or 0.45-pound per hour. Bluegills caught averaged 0.16 pound each.

The pond was drained November 2, 1973. A total of 14,991.3 pounds of fish were recovered. Some 53 percent of the total weight was threadfin shad and 15.2 percent were catfish that had escaped from the pens in 1972. No bass less than 9 inches in length were recovered. Apparently bass did spawn in 1973. A total of 1,947 pounds of bluegills were recovered on draining. Unfortunately, 1,534 pounds (78.8 percent) were in inch-groups 1-5.

MARKETING BASS AND BLUEGILL FISHING – A SUMMARY

The termination of Experiment 6 in Pond S-6, 1973, effectively ended the research on the commercialization of aquaculture through marketing bass and bluegill fishing in 'terrace-water' ponds at Auburn. Bill Davies returned from his Brazil assignment in August, 1972, and was assigned the responsibility of continuing research on pond management. He and his Work Group remained active in this area until he retired, but he never conducted any research on 'fee' fishing. By that time, the University had become concerned with liability of its staff involved in research that required public participation.

Unfortunately, the results obtained in Pond S-6 in Experiment 6 were no more promising than they had been in the 'E' Series Experiments in 1944 and 1945. Either the populations were out of balance when fishing began or they soon became unbalanced. The 'Investigators' commented in a mid-60s Annual Report that populations in 'fee' fishing experiments in Ponds S-1, S-6, S-7, S-8 and S-14 were all unbalanced by mid-summer. By that time, it was obvious that the 'Investigators' did not know how to provide good, sustainable fishing in fertilized, 'terrace-water' ponds. As a result, with the information available in the early 70s, it was apparent that 'selling' recreational fishing directly to the 'public' was not an economically viable way to use the resources on the Story Farm.

Research on the marketing of fishing in the 'E' Ponds and in Pond S-6 had continued for some 30 years. It accumulated a tremendous amount of extremely interesting data. It is likely that there is no similar data base anywhere that details the interaction between exploitation and fish population structure to an equal extent. Unfortunately, in the final analysis, very little came from this extensive research effort. When the time came to begin to analyze and publish the data, the 'Investigators' had 'moved-on.' This long-term research effort died without a 'whimper,' in the early 70s, without the production of a single extension publication. The final realization that there was little need to continue research on 'fee' fishing forced the 'Investigators' to face a dilemma that they had never anticipated – what meaningful, cost effective research could be conducted in the large ponds on the Story Farm – a dilemma that succeeding 'Investigators' have yet to completely resolve.

Although the 'investigators' made no recommendations in published form on the management of 'fee' fishing in bass and bluegill ponds, a relatively large number of pond owners throughout the State decided to try to sell fishing privileges in their ponds. In 1949, Earl Kennamer, Extension Fish and Wildlife Specialist, reported (personal correspondence) that permits were being sold for approximately 536 ponds or about 8 percent of the total number of ponds (6,640) in the state at that time.

Although there is little specific data on the matter, over the years, the number of pond owners selling fishing privileges diminished. Likely, the money they received did not adequately compensate them for the costs of pond maintenance, providing access, providing parking, collecting registration fees, policing creel limits, controlling poaching, trash removal and liability insurance. Later, some pond owners were able to market recreational fishing by leasing their ponds to fishing clubs. In this manner, they were able to transfer the responsibility for producing good, sustainable fishing to the clubs.

MARKETING CHANNEL CATFISH FISHING IN Pond S-14

Research in the early 50s indicated that the channel catfish was an excellent sport fish. They readily accepted a number of baits, and they provided a really powerful, although not showy, 'fight,' once hooked. Further, because they would not readily spawn in ponds, it was expected that stock management would be much easier. A large number of fingerlings could be stocked and fed with a commercial feed. Once they reached harvestable size, the pond could be opened to the public. Fishing would be continued as long as enough fish were being caught to attract fishermen. (1959) reported the results of one of the first of these experiments. He stocked Pond S-14 (12.4-acres) with 2,000, 3-inch fingerlings, per acre, on February 27, 1958. Adult fathead minnows (1,000 per acre) were added on April 28. When it was discovered that green sunfish had entered the pond from the water supply, fingerling largemouth bass (66 per acre) were stocked on June 7. Later it was determined that *Gambusia*, bluegills, golden shiners, goldfish and speckled bullheads had also entered the pond from the water supply stream. The catfish were fed a mixed feed, April through October in 1958, and March through October in 1959.

The pond was opened for 'fee' fishing daily, except Sundays on September 24, 1958 (Figure 93). Permits were \$1 each, and fishermen were allowed to catch three catfish and three largemouth bass on each permit. The pond was closed for the year on December 8, and once again opened on March 14, 1959. Fishing was continued until October 6, 1959.

Some data related to fishing effort and catch are presented in Table 86. Data presented in the Table show that some 579 fishermen, per acre, fished Pond S-14 during 4 months in 1958 and 8 months in 1959 (twelve months total), and they caught 1,241 fish weighing 1,292 pounds. Data shown in Figure 94 that more than one-half of the total number fished during the months of May and June, 1959. The number of fish caught per month is shown in Figure 95. In sum, they harvested 1,241 fish, per acre, weighing 1,292.5 pounds. 'Accumulated Catch' reached around 50 percent of the number originally stocked (2,000 per acre) in June, 1959, and at that point 'Catch per Fisherman' began to decline precipitously (Figure 96). As a result, the number of persons fishing also declined sharply. Prather commented:

"Fishing continued to be good during the first half of June, but the catch declined during the latter part of the month and continued poor until the pond was closed October 6."

The pond was drained on November 17, 1959, and 180 channel catfish weighing 391.2 pounds were recovered, per acre (Table 87). All of these data indicate that during the 12 months of fishing that fishermen removed 1,241 of the 2,000 per acre stocked, and 180 remained in the pond when it was

drained. Some 579 (29 percent) could not be accounted for. Catfish recovered at draining were cleaned and sold to the public for 60 cents per pound.

Some financial data associated with the experiment are presented in Table 88. The author concluded that, when costs and returns were considered, there would have been some \$253 per acre to cover the cost of labor and capital. It was difficult to accurately 'count' all the costs associated with this research, and the estimate of \$481.46, per acre, was certainly only a fraction of the 'real' costs. Farmers selling channel catfish fishing would have number of additional costs. For example, there would be costs associated with the construction and maintenance of the facility, with the use of labor and equipment in stocking, daily feeding, draining and fish recovery, storage of fish awaiting processing, hand-processing and holding and selling the processed fish. Finally, there were the considerable costs related to the sale of permits. Also, there would have been some cost for determining that fishermen did not exceed the limit. It is likely that when all costs were considered, that the 'return' would have been considerably less than \$253 per acre.

The author commented:

“Research now in progress ... should provide needed data on the most desirable stocking and feeding rates, understocking or restocking, the use of other combinations of species, and related problems.”

Unfortunately, this was the last publication on the marketing of channel catfish through the sale of fishing permits. The 'Investigators' would continue to conduct 'fee-fishing' experiments with channel catfish in various 'S' Ponds for several years; however, the publication reviewed above would be the only one resulting from this considerable amount of research.

MARKETING OF TILAPIA FISHING

Swingle (1960) reported the results of experiments on 'fee' fishing for the Java tilapia (*Tilapia mossambica*) and the Nile tilapia (*Tilapia nilotica*) in several of the 'S' Series in 1957 and 1958. Ponds were stocked during the period April 20-30 with 80 brood fish per acre. Fish in all ponds received feed 6 days per week until October. Ponds were opened for public fishing, beginning in August. In approximately 3 months of fishing (August-October), fishermen removed 594 and 591 pounds per acre in 1957 and 1958, respectively. Swingle commented that this catch was considerably higher than could be expected from a bass-bluegill pond in the second year of fishing. The Nile tilapia were much more difficult to catch. Under similar conditions, the catch for the pond stocked with the Nile tilapia was only 128 pounds; although it contained some 1,600 pounds per acre of harvestable-

sized fish, during the period.

Swingle commented that management of tilapias for public fishing was complicated by the fact that they could not survive through the winter in Alabama. As a result, good fishing could not be provided until the late summer. Unfortunately, public interest in fishing usually 'peaked' in late spring and early summer. In fact, the problems related to 'fee' fishing for tilapias in Alabama were even more complicated. It is likely that the cost of 'over-wintering' of brood fish would make this fish marketing scheme cost-prohibitive.

PRODUCTION OF FISH FOR 'BAIT'

The commercial production of 'bait' fish nationally began to expand sharply after World War II; along with the increased interest in and demand for recreational fishing. The first really serious efforts to intensify the production of fish for this purpose began in Arkansas in the mid-40s when rice farmers sought ways to better utilize their ponds. Experimentation had begun on the production of bait fish species at Auburn as early as 1936. These early experiments included the following:

1. Goldfish production in the Swingle pool in 1936.
2. Golden shiner production in Pond D-3 in 1939.
3. Golden shiner production in Pond C-1 in 1940.

Auburn research on bait fish (minnow) production was first specifically identified and described in Section III of the 1943 Annual Report – *Production of Goldfish for Bait*. The research was conducted in the 'B' Ponds and Pond C-2 on the South Auburn Farm and in Ponds H-6 and M-3 on the Sougahatchee Farm.

The 1946 Annual Report included a section entitled *Minnow Production*. It included descriptions of research on the production of golden shiners in Pond F-9, and fathead minnows in Ponds F-10 and F-11. The Section also describes the production in Pond T-1 of the so-called 'Redfin,' a minnow obtained from a farm in Paulette, MS. Research on minnow production at Auburn intensified during the late 40s, and in his 1949 publication, *Some Recent Developments in Pond Management*, Swingle commented:

"Production in ponds of minnows for bait is one of the very few commercial developments in the fresh-water fishery field."

After returning from service in 1945, E. E. Prather took over responsibility for research on the production of minnows for fish bait. In his research, he

conducted a number of experiments on minnow production, but none of it was published at that time. None of Prather's research on minnow production, during the period 1945-1952, was published until after he was recalled to active duty in 1951. While he was in service, Russ Fielding and Malcolm Johnson compiled the data from those early experiments and published it as an Alabama Agricultural Experiment Station Circular (112). Unfortunately, the publication had only limited influence on the minnow production industry. By 1953, rice farmers in Arkansas had already developed production procedures that allowed them to capture the market for bait minnows throughout the lower South.

Published Auburn research on bait minnow production includes:

1. Production of bait minnows in the Southeast (Prather, et al., 1953).
2. Experiments on the commercial production of golden shiners (Prather, 1957).
3. Preliminary experiments on winter feeding of small fathead minnows (Prather, 1958).
4. Further experiments on feeds for fathead minnows (Prather, 1959).

Fish and Wildlife Extension Specialist Earl Kennamer reported (personal correspondence) that, in 1949, some 112 individuals and farmers produced and sold minnows in Alabama. He estimated that the total value of minnow sales was approximately \$250,000

PRODUCTION OF AQUATIC FOOD ANIMALS

Recall that in the early stages of the research on the marketing of recreational fishing in the 'E' Ponds and in Pond S-6, Swingle had written:

"Fishery managers now had the 'tools' to produce all of the recreational fishing that fishermen were willing to purchase and that emphasis should be shifted to the identification of aquatic animals that could be produced in ponds for human food."

Unfortunately, when that research was terminated in the early 70s, he would not have been so confident in making that statement. Then in his 1949 publication, *Some Recent Developments in Pond Management*, he commented:

"The whole field of commercial production in ponds of fish and other aquatic animals awaits development. It would appear, however, that this will be a slow process, because in the entire United States, there are

inadequate numbers of experimental ponds and other research facilities to enable rapid solutions to the problems involved.”

THE CASON CALLAWAY CONTRIBUTION

Cason J. Callaway (1894-1961) amassed a large fortune while serving as President of Callaway Mills in Lagrange, GA. His large estate included a 40,000-acre tract of land primarily in Harris County, south of Pine Mountain – now Callaway Gardens. In the late 20s and 30s, Callaway became a close friend of Franklin D. Roosevelt, a part-time resident of Warm Springs, GA. Through this period, Callaway and Roosevelt became increasingly concerned about the continuing deterioration of the farm economy in the South. Callaway retired as President of Callaway Mills in 1937, and began to give his full attention to improving Georgia’s farm economy. He worked with the Agricultural Extension Service of the University of Georgia to develop his farm as a model for the application of modern methods of agriculture. With their assistance, he applied the most advanced technology available in the production of timber, beef, wool, vegetables and fruit. His farm became a ‘show-place’ for improved farming practices.

In his efforts to develop a model farm, sometime around the mid-40s, he apparently enlisted the assistance of H. S. Swingle and E. V. Smith in helping him develop the water resources on his farm. By that time, Swingle and Smith had developed technology for the construction of ‘terrace-water’ ponds to harvest and store rainwater, for enhancing the biological productivity of the stored water through the use of inorganic fertilizers, and for the establishment of fish populations in those ponds which could provide sustainable annual crops of fish that could be harvested by farm families by recreational fishing. The several beautiful ponds at Callaway Gardens today, and the good fishing that they provide, are obviously the ‘handi-work’ of Swingle and Smith. Further, it is likely that the ‘fee’ fishing program still utilized in the Gardens are the direct result of experiments on public fishing conducted in the ‘E Series at Auburn in 1944 and 1945.

While one cannot be certain, it appears that in this interaction with Callaway, Swingle became preoccupied with his concern for the use of more effective agricultural technology for improving the lot of farm families. It is highly likely that they discussed the possibility of growing marketable crops of aquatic animals in harvested rain water. In his 1949 publication entitled: *Some Recent Developments in Pond Management*, Swingle described some of the early research at Auburn on commercial fish production. In the publication he provided the rationale for beginning research on the production of fish principally for food.

The nature and intensity of the interaction between Callaway and Swingle regarding commercial aquaculture in ‘terrace-water’ ponds, is further

suggested by Callaway's decision to fund a trip for Swingle and his family to Utah in 1953 to study the commercial rainbow trout industry. In September, 1953, Swingle submitted a report to the Ida Cason Callaway Foundation in which he recorded his observations. In his report, Swingle seemed to be anticipating the future development of the commercial channel catfish industry when he commented:

“Techniques used for hatching trout eggs appear directly applicable to the hatching of channel catfish eggs. Feeding procedures also should apply to both species with minor changes to be determined by research.”

By the mid-50s, an increasing amount of the pond space on the Sougahatchee Farm was being devoted to research on food fish production. Later, a substantial amount of pond space on the Story Farm would also be utilized for this purpose. However, it did not take long for the ‘Investigators’ to realize that they had few ponds on either Farm suitable for experiments on the practical aspects of food fish production on a commercial scale. Water availability for filling the larger ponds was seasonal. Further, most of the ponds were so deep and the bottoms so uneven that it was impractical to remove the fish without completely draining them. This situation meant that all of the fish had to be removed in a very short period of time from an oxygen-limited, mud-water ‘slurry.’ As a result of these problems, they were soon forced to concentrate their research efforts on other crucial areas in support of commercial production, such as species selection, nutrition, fish health, water quality, breeding and genetics. Some of the research conducted in these supporting areas will be discussed in the following Sections.

SPECIES EVALUATIONS

The first ‘real’ research on commercial aquaculture at Auburn involved the production of carp and big-mouth buffalo in the ‘F’ Series. These early experiments were described in Section V of the 1946 Annual Report entitled, *Carp and Buffalo*. Actually, some very limited research had been done on species that might be used for commercial production somewhat earlier:

1. Yellow bullhead production in Ponds D-5 and D-11 in 1941.
2. Channel catfish production in 1943.
3. Channel catfish production in 1944.
4. Channel catfish production in 1945.

5. Production of speckled bullheads in Pond F-24 in 1944.

In all of these early experiments, the primary interest in these species was for their use in stocking in ponds containing largemouth bass and bream (bluegills and shellcrackers). For example, Swingle (1949a) commented that experiments on the production of channel catfish in fertilized ponds had begun at Auburn as early as 1943 and that

“Their principle purpose would be to enable the pond owner to catch an occasional large fish.”

In 1954, Swingle published, *Experiments on Commercial Fish Production in Ponds* which summarized all of the research work that had been completed on this subject at Auburn until that time. In a footnote, he commented that the paper also included research on the production of minnows that had been conducted by E. E. Prather, J. R. Fielding, M. C. Johnson and J. H. Padfield. He summarized the results of this research as follows:

- 1. Round fliers (*Centrarchus macropterus*) and bluegills appear to have little or no possibilities for commercial production.**
- 2. Speckled bullheads offer some promise as a commercial species.**
- 3. Channel catfish may prove to be of value as a commercial species.**
- 4. The common carp sells at such a low price that its commercial possibilities as a pond fish appear limited.**
- 5. The bigmouth buffalo and smallmouth buffalo appear to be promising commercial pond fishes.**
- 6. Flathead cats grew well in ponds, but failure to induce spawning in ponds or in running water has prevented extensive tests with this species.**

This publication suggests that as late as the early 50s, the ‘Investigators’ were still somewhat confused regarding the required characteristics of a suitable commercial species; however, someone should have been aware that the ‘bloody’ carcasses of butchered speckled bullheads would not be acceptable in many fish markets. Further, the American public had never accepted the common carp as a food fish because of the extreme boniness of the dressed carcass. There were too many marine fish available in markets without that characteristic. This same characteristic severely limited the marketing potential for the bigmouth and smallmouth buffalo. Research had demonstrated that it would be a relatively easy matter to produce them, but it was highly unlikely that anyone would purchase them with all of those bones.

BUFFALO

In the 1954 publication, Swingle commented that the bigmouth and smallmouth buffalo appear to be promising commercial pond fishes, but that the ‘bigmouth’ species seemed to have more promise because of the relative ease of producing the young. He also described the results of experiments conducted at Auburn, and detailed instructions on production of food-size fish in ponds. Later, his 1957 publication would describe revised procedures for their production. After the publication of the 1957 research report, there was little interest in the buffalos at Auburn.

SPECKLED BULLHEADS

Swingle’s 1954 publication reported the results of several early experiments of the commercial production of this fish. Later, (Swingle, 1957a), he would summarize all the work that the ‘Investigators’ had completed on the fish. He concluded that the fish had considerable commercial potential, but that its reproduction in grow-out ponds was a problem. He failed to comment on the ‘blood-red’ color of the skinned carcass. After the publication of this research report, there was little continued interest in this species at Auburn.

CHANNEL CATFISH

By the late 40s, the channel catfish was already highly acceptable as a commercial species. Tons of them were being harvested from streams throughout the South, and sold to local restaurants. Further, they were already being spawned in state and federal hatcheries in Kansas, Oklahoma and Arkansas, where they were being stocked in grow-out in ponds primarily for use as a sport fish. Results reported in Swingle’s 1949 publication, plus a growing interest in the fish throughout the South, encouraged the Auburn ‘Investigators’ to increase their efforts to develop procedures for commercial production. Unfortunately, early efforts were limited as a result of Auburn’s inability to spawn them. Prather had begun efforts to spawn them in 1951, but despite the commitment of considerable effort, he was not successful until 1958. In the meantime, all the fingerlings used in production research had to be obtained from hatcheries, both private and public, in Arkansas and Missouri.

In 1956, Swingle reported on the status of the research on channel catfish at Auburn by publishing, *Preliminary Results on the Commercial Production of Channel Catfish in Ponds*. Then in 1957, still using imported fingerlings, he committed a number of ponds to production trials. After evaluating those data, he commented in the 1957 Annual Report that commercial production of channel catfish will be a profitable business. Two years later, in 1959, he published what would become the first definitive guide for the commercial

production of the species in ponds. The publication, *Experiments on Growing Fingerling Channel Catfish to Marketable Size in Ponds*, also included information on processing and production economics.

After the early 60s, relatively little research was conducted at Auburn on the practical aspects of commercial channel catfish production. None of the ponds on either the Saugahatchee or Story Farms were really suitable for production research. Very few of the ponds available had the necessary characteristics. The ponds on the Soughahatchee Farm were too small, and those on the Story Farm were unsuitable for several reasons. To begin with, because of the depth of the ponds, fish could only be removed at the end of the production cycle by completely draining them. This situation resulted in the accumulation of thousands of pounds of fish around the drain pipe in a 'slurry' of mud and water. Further, there was no fresh water available to maintain any semblance of adequate water quality for this mass of rapidly dying fish. Obviously, under these conditions, all of the fish needed to be removed and iced-down at once.

Finally, the problems encountered in conducting a single production experiment in Pond S-1 convinced everyone that it should never be repeated. Harvesting, transporting, butchering, storage and disposal of 40,000 pounds of channel catfish by the 'Investigators' and the Field Crew was a 'once-in-a-lifetime experience – an experience never to be duplicated.' Afterwards, our catfish research was directed toward solving problems related to the efficiency of production (feeds and feeding, diseases, breeding and genetics, etc.) rather than to production itself. As detailed in a preceding Section, on November 14, 1966, the STRAL Plant in Greensboro processed its first 'batch,' of catfish. Then some 46 years later, in 2012, some 208 Alabama catfish farms sold fish valued at approximately \$112. 2 million. During this period, the change in the technology base of the industry has been 'mind-bending.' The contributions of research and extension to this change has been phenomenal. However, the uncertainty at the 'cutting-edge' of this change is still somewhat greater than expected. In 2015, Bott et al. published the results of a study in which they compared the effectiveness of catfish farm management based on highly regimented recommendations promoted by Extension Agents with 'seat-of-the-pants' management employed by pond owners. They concluded that in over three production cycles, 'seat-of-the-pants' management outperformed management based on Extension Agent recommendations. Obviously, in the management of commercial catfish production, there is still 'work-to-be-done' at the 'cutting-edge' of technology and its application.

TILAPIAS

In 1953, Swingle attended the 8th meeting of the Pacific Science Congress held in Manila, the Philippines, as the U.S. representative in Pond

Culture. By that time the so-called Java tilapia (*Tilapia mossambica*) was being widely cultured throughout much of Asia. Apparently, Swingle was impressed with their potential as a candidate for culture in 'terrace-water' ponds in Alabama. Later that year, he requested specimens of the species from Steinhart Aquarium in San Francisco, CA. The fish were delivered on January 4, 1954. Then in 1957, he received a shipment of the so-called Nile tilapia (*T. nilotica* – now *Oreochromis niloticus*) from Israel.

In 1954, Dave Kelly conducted the first field experiment on the pond culture of *T. mossambica* at Auburn (Kelly, 1956). His work on the temperature tolerance of the species should have dissuaded the 'Investigators' from spending much effort on it. He reported that it quit feeding at 60°F and died at 48°F. With these limitations, it is not likely that the species could have survived winters in Alabama.

McBay (1960) conducted a similar study on *T. nilotica*. He found that this species was somewhat more temperature tolerant, but they could not be expected to survive winters, even in south Alabama, in most years. Even with the temperature limitations, the 'Investigators' were not dissuaded from committing large amounts of research effort to the culture of several species of the genus. Research protocols required that large numbers of fish had to be over-wintered in warmed water. To meet these requirements, a special over-wintering room, containing a large number of plywood troughs, was added to a room constructed to the south side of the Counting Shed. To meet the requirement for the large quantity of heated water, a high capacity, oil-fired, water heater had to be installed. Unfortunately, maintaining its proper function became a continuing problem that was never completely solved. It was not practical, at the time, to clean the water in the troughs of wastes and to re-circulate it. Further, because the water in the stream and diversion ditch was often extremely muddy, a large water filtration plant was installed. The maintenance of this entire heated-water supply system was an ever-present nightmare, during the cold months.

Swingle (1960) summarized the results obtained from experiments on *T. mossambica* and *T. nilotica* in 18 ponds in 1957 and 1958 in a publication entitled: *Comparative Evaluation of Two Tilapias as Pond Fishes in Alabama*. This would be his last publication on any of the exotic cichlid species.

Although commercial tilapia production had little potential in either Alabama or the U.S., basic research conducted here, especially on the Nile tilapia, provided some of the information required for the development of world-wide commerce of the species. Auburn research on the control of unwanted reproduction was especially important in the development of this important world-wide industry. It has been estimated that world-wide production of tilapias reached 3.5 million metric tons in 2008 and that, in the period January through June of 2010, the U.S. imported 97,000 metric tons of the fish

(Josupeit, 2010).

Tilapias were maintained at Auburn long after it was obvious that they had little potential as either a food fish or sport fish in the U.S.; however, basic research on their biology continued. They were useful in a teaching program which included many foreign students from tropical countries where they had much greater commercial potential. It is also likely that long-term research with these species was one of the determining factors that lead to the decision by the U.S. Agency for International Development to request that Auburn lead the Agency's world-wide efforts to promote aquaculture in less-developed countries. Further, tilapias still had considerable appeal to local consumers purchasing fish at the Department's Saturday Morning Fish Market.

A review of Auburn publication titles showed that there were some 150 which included the key-word Tilapia. The last one on the list was published in 2011 (Phelps and Okoko, 2011). A number of these publications will be listed in following Sections.

RED SNAPPER

The Auburn Fisheries Program began its first formal research on the red snapper in Alabama's Coastal Zone when Szedlmayer's work began on aspects of the population dynamics of the species. Later, in the early 2000s, the Phelps Work Group group began a series of experiments at the Claude Petet Mariculture Center (Figure 97) on artificial spawning, hatching of the eggs and early rearing of larvae of the species. Details on both of these projects will be presented in two following Sections. Later, the Auburn University Marine Extension and Research Center (AUMERC) would accept the responsibility for this research. The primary emphasis of that research was on pond-production of brood fish. A special aspect of the project is the involvement of students at Alma Bryant High School in feeding research.

RED SWAMP CRAYFISH

Red swamp crawfish (*Procambarus clarkii* (Girad)) have likely always been an important food in the diets of various groups of people in the lower Mississippi Valley. As the population of the region steadily increased after the arrival of the French near the end of the 17th century, demand for the species has steadily increased. Fortunately, with the coming of rice production, the supply increased rapidly, but by the 1950s, demand was beginning to exceed supply, and research efforts began to increase production using aquacultural techniques. Although, there was little, if any, commercial production of the species in Alabama at that time, Auburn began to 'dabble' in research on the production of the species in the early 1960s (Figure 90).

Jerry Broom, a native of Louisiana, entered Graduate School at Auburn in 1960. He was interested in doing his M.S. Thesis on production of the red swamp crawfish. I believe that his thesis is the first published work in this area. Later, in the late 70s, Dr. J. S. Dendy began a Hatch-funded project on the culture of the species. Still later, Dr. Michael Masser, Gregory N. Whitis and Dr. Jerry Crews wrote an extension publication in which they summarized all aspects of its culture, and in 2003, Boyd, Queiroz, Whitis and Hemstreet developed a publication detailing “*Best Management Practices (No. 21)*” for its culture. Details on these publications are:

1. Production of the Louisiana Red Crawfish, *Procambarus clarkii* (Girard), in ponds (Broom, 1961).
2. Preliminary experiment with photoperiod to influence crawfish spawning (Dendy, 1978).
3. Conditions for holding and propagating brood stock *Procambarus clarkii* (Nelson and Dendy, 1979).
4. Production of crawfish in Alabama (Masser, et al., 1997b).
5. Managing crawfish ponds (Boyd, et al., 2003b).

FRESHWATER SHRIMP

As detailed in a preceding Section, David Rouse returned to Auburn in April of 1981 to assist with work of the ICA in projects involving shrimp and mollusk production. Later, we were able to locate funds which allowed him to teach a course on their production and to conduct research in this area. In the early 80s, there was considerable interest throughout the tropical world on the culture of the so-called freshwater shrimp (*Macrobrachium rosenbergii*). Several Universities in the southern U.S. were conducting preliminary work on the culture of this large crustacean. By the mid-80s, we had so many students interested in the culture of the species that Rouse decided to begin a preliminary research effort on the animal.

Preliminary work indicated that spawning and the early rearing of *Macrobrachium* could be accomplished without undue difficulty at Auburn, and that stocked juveniles survived well under pond grow-out conditions. Unfortunately, the limiting factor was the length of the growing season – May to October. Growth declines sharply when the water temperature falls below 70°F. With a short growing season, the maximum size attainable in production ponds is limited. With this critical limitation, Rouse and his graduate students did not continue research on this species very long. Publications resulting from the research include:

1. Comparison of four techniques for prawn (*Macrobrachium rosenbergii*) nursery rearing (Mulla and Rouse, 1985).
2. Producing freshwater shrimp in ponds may be an option on Alabama farms (Rouse, 1987).
3. Growth response of *Macrobrachium rosenbergii* to different levels of hardness (Vasquez, et al., 1989).

RED-CLAW CRAYFISH

While conducting research on the production of *Macrobrachium*, Rouse's review of crustacean literature suggested that the culture of one or more Australian crayfish might have some potential for Alabama, as well as for many developing countries. Rouse's early (1986) research evaluated the potential of three species of large Australian crayfish for culture at Auburn. Results of these studies suggested that the red claw, *Cherax quadricarinatus*, had the most desirable characteristics for culture in ponds in the State. Dr. James Hicks was a world-renowned surgeon in Otolaryngology at University Hospital at the University of Alabama-Birmingham. He had a large farm near Union Springs in Barbour County. He had a long-term relationship with Swingle and Smith and the Auburn fisheries program as a result of the development and management of a number of ponds on his farm. Rouse's early work on the red claw drew considerable media attention, and sometime in the mid-80s, Hicks heard of it and immediately wanted to stock one of his ponds with the species. Rouse was able to get a number of the animals shipped to Auburn, and he stocked them in a small pond on Hick's farm. The first crop was harvested in the fall of 1989, and if I remember correctly, he produced a second crop in 1990. In both years, he harvested a good number of large crawfish. Hicks was ecstatic, and encouraged us to re-double our research efforts on the culture of the species.

Sometime within this sequence of events, the question of obtaining State funding for the research came up, and it was agreed that we should approach Representative Jimmy Clarke about the possibility of having a line-item inserted in the State Education Budget for this purpose. At that time, Mr. Clarke was the Speaker of the Alabama House of Representatives, and had been for many years. He was also a long-time friend of Dr. Hicks and of Mr. W. B. Easterling, a good fish-farming friend of the Auburn Fisheries Program from Clio, AL. With assistance from our friends in ALFA, we made an appointment to visit Speaker Clarke at his office in Eufaula to discuss the matter. Consequently, Mr. Easterling and I met with him in November, 1989. He very graciously received us, and quickly became interested in the potential of the red claw. He also agreed to help us secure the funding that we needed.

Several months later, Mr. Clarke became seriously ill, and because of the nature of the problem, he was rushed to the hospital at UAB. Dr. Hicks found out that Clarke was there, and near the end of his recovery, he confronted him about the line-item funding. Hicks commented that he was aware that Clarke was a powerful man in the Legislature, and that he (Hicks) was an equally powerful man at UAB, and that if Clarke ever expected to get out of the hospital with his life that he had better sign an oath that Auburn would get its money. The line-item funding (\$100,000) for crayfish research was in Auburn's 1990/1991 budget.

Rouse, his graduate students and other faculty, conducted research on various aspects of the biology and culture of Australian crayfish for several years. Publications resulting from these efforts include:

1. Australian crayfish promising for Alabama aquaculture (Rouse, 1991).
2. Influence of salinity and temperature on molting and survival of the Australian freshwater crayfish (*Cherax tenuimanus*) (Rouse and Kartamulia, 1992).
3. Economic feasibility and risk analysis of Australian red claw crayfish *Cherax quadricarinatus* aquaculture in the Southeastern United States (Medley, et al., 1994).
4. Australian crayfish culture in the Americas (Rouse, 1995).
5. *Cherax destructor*, *C. tenuimanus* and *C. quadricarinatus* (Decapoda:Parastacidae): a comparative review of biological traits relating to aquaculture potential (Semple, et al.,1995).
6. Growth and survival of the Australian red claw crayfish *Cherax quadricarinatus* at three densities in earthen ponds (Pinto and Rouse, 1996).
7. Growth characteristics of the Australian red claw crayfish, *Cherax quadricarinatus*, culture in an outdoor recirculating system (Rodriguez-Canto, et al., 2002).
8. Growth, processing, measurements, tail meat yield, and tail meat proximate comparison of male and female red claw crayfish, *Cherax quadricarinatus*, stocked in earthen ponds (Thompson, et al., 2004).
9. The effects of monosex culture and stocking density on survival, growth and yield on redclaw crayfish (*Cherax quadricarinatus*) in earthen ponds (Rogers, et al., 2005).

10. Effects of stargrass supplementation on growth and survival of juvenile red claw crayfish *Cherax quadricarinatus* (Garzade Yta, et al., 2011).

MARINE SHRIMP

Historically, 'Investigators' with the Auburn Fisheries Program had little interest in marine or brackish-water aquaculture. This general attitude did not change materially until the University became involved in a USAID-funded project on shrimp aquaculture in Panama in the mid-80s. Later, the ICA would be involved in a similar project in Honduras. A few years later, 'Investigators' would initiate some cooperative marine shrimp research at the Claude Petet Mariculture Center in Gulf Shores, AL, and then in the early 2000s, they began some collaborative research with personnel of Greene Prairie Aquafarms in Greene County, AL. Some of the accomplishments at these four locations are summarized in the following paragraphs.

MARINE SHRIMP RESEARCH IN PANAMA

Auburn 'Investigators' conducted their first research on marine shrimp aquaculture in the mid-80s as part of an USAID-funded Collaborative Research Project Research project (DAN 4023-G-00-0031-00) in Panama. David Teichert-Coddington ('T.C.') was assigned to the project in January, 1985. Initially, the project was designed to obtain information on the production of tilapia in ponds using fertilization. Later, it was terminated as a result of budgetary problems; however, project funding was taken over by the Government of Panama, but the research emphasis was shifted from tilapia to marine shrimp. Research work plans were coordinated with the commercial shrimp farming industry. The Project was terminated in 1987 because of political unrest.

MARINE SHRIMP RESEARCH IN HONDURAS

Bart Green had established a CRSP-funded aquaculture research project in Honduras in 1983; then 'T.C.' had joined him in 1988 when the Panama Project was terminated. The primary emphasis of the Project was tilapia production, but they conducted two experiments on marine shrimp production in excavated ponds on a portion of Grandjas Marinas San Bernado, S. A. Ralph Parkman, manager of the shrimp production company, and a 1976 Auburn graduate, provided the ponds and assisted with the research. 'T.C.' continued to be involved in research on various aspects of marine shrimp production there until 1994. Some of the publications resulting from this research include:

1. Substitution of chicken litter for feed in production of Penaeid shrimp in Honduras (Teichert-Coddington, et al., 1991).
2. Cause of cyclic variation in Honduran shrimp production (Teichert-Coddington and Rodriguez, 1994).
3. Semi-intensive commercial grow-out of *Penaeus vannamei* fed diets containing different levels of crude protein during wet and dry seasons in Honduras (Teichert-Coddington and Rodriguez, 1995).
4. Partial nutrient budgets for semi-intensive shrimp farms in Honduras (Teichert-Coddington, et al., 2000).

**MARINE SHRIMP RESEARCH AT THE CLAUDE PETEET
MARICULTURE CENTER**

In 1996, an agreement between FAA and Vern Minton, Director of the Marine Resources Division of the Alabama Department of Conservation and Natural Resources, made a series of brackish ponds on a portion of the Claude Peteet Mariculture Center in Gulf Shores, available to Auburn 'Investigators' for research on the culture of marine shrimp. David Rouse and his graduate students, along with several other faculty members, established the initial Work Group for marine shrimp research at the Center. One of the first research projects was undertaken by Wade Scardino, one of Rouse's graduate students. It was supported by funds from Sea Grant for the so-called 'CASH' Project. Several other projects were completed there using funds from this Project. Details about it are presented in a following Section describing the establishment and operation of the Auburn University Marine Extension and Research Center (AUMERC). In 1999 when Allen Davis joined the Department, he and his graduate students joined this continuing research effort at Claude Peteet. Some of the publications resulting from this long-term effort include the following:

1. Characteristics of water quality and a partial nutrient budget for experimental shrimp ponds in Alabama (Couch, 1998).
2. Influence of nursery period on the growth and survival of *Litopenaeus vannamei* under pond production conditions (Garzade Yta, et al., 2004)
3. Nursery protocols for the rearing of brown shrimp, *Farfantepenaeus aztecus*: effects of stocking density and salinity (Mays, et al., 2006).
4. Grow out of Pacific white shrimp, *Litopenaeus vannamei*, stocked into production ponds at three different ages (Zelaya, et al., 2007).

5. Use of commercial fermentation products as a highly unsaturated fatty acid source in practical diets for the Pacific white shrimp *Litopenaeus vannamei* (Samocha, et al., 2009).
6. Pond production of Pacific white shrimp (*Litopenaeus vannamei*) fed high levels of soybean meal in various combinations (Sookying and Davis, 2011).

MARINE SHRIMP RESEARCH AT GREENE PRAIRIE AQUAFARMS

In 2000, David Teichert-Coddington and Rudy Schmittou began the development of Greene Prairie Aquafarms in Greene County, AL for the purpose of producing marine shrimp in ponds filled with low-salinity ground water. The farm is located approximately 6 miles north of Forkland. It lies just west of U.S. Highway 43, and consists of 23 ponds ranging in size from 0.49 to 2.02 ha. Early problems with water quality in production ponds led to Auburn involvement in a number of research projects on the farm. Initially, most of the research effort was on water quality, but later they initiated additional research in several other areas of production. The following publications are indicative of the kinds of research that Auburn 'Investigators' conducted at the facility:

1. Supplementation of potassium, magnesium and sodium chloride in practical diets for Pacific white shrimp, *Litopenaeus vannamei*, reared in low salinity waters (Roy, 2009).
2. Pond-to-pond variability in post-larval shrimp, *Litopenaeus vannamei*, survival and growth in inland low-salinity waters of west Alabama (Roy, et al., 2009a).
3. Shrimp culture in inland low salinity waters (Roy, et al., 2010).
4. Survival of postlarval *Litopenaeus vannamei* following acclimation to low salinity waters at different temperatures (Paz, et al., 2011).
5. Effect of feeding rate and pond primary productivity on growth of *Litopenaeus vannamei* reared in inland waters of west Alabama (Roy, et al., 2012a).

The research on water quality problems related to the production of marine shrimp in low salinity water is described in a following Section on Water Quality in Aquaculture.

OYSTERS

Alabama oysters likely have been an important item in the diets of humans living along the Gulf coast of the State since the first Native Americans reached the area thousands of years ago. The State first began to intervene in the production of this important seafood in the early 20th century when they began to return discarded oyster shell ('cultch') to suitable sites in its coastal zone (Figure 98). This so-called 'cultch' served as 'setting-sites' for naturally-produced oyster larvae. After 18 to 36 months of growth on the refurbished reefs, market-sized oysters were harvested by oystermen ('tongers'). Wallace (1993) and Perkins (1997) have described aspects of the State's involvement in this 'low-input' oyster-farming system.

When we were holding discussions with the Auburn Administration regarding the establishment of the Auburn University Marine Extension and Research Center, we had not given much thought to the possibility of conducting research on 'high-input' oyster aquaculture; however, before the Center was formally established, we were faced with the decision as to whether or not to get involved in this area.

In early 1989, Lt. Col. Don Frierson (Ret.) of Bayou LaBatre contacted Bill Hosking and Rick Wallace regarding the potential for marine shrimp farming in ponds that might be constructed on family-owned land located adjacent to Portersville Bay, south of Coden in Mobile County. In turn, they requested that Rouse and I come to Mobile to meet with them to discuss Frierson's proposal. At that time, the general consensus was that there was only limited potential for shrimp farming anywhere in the southern tier of states. Growth rates were too low to allow for the production of shrimp of marketable size in the water temperature-limited growing season. Instead, we suggested that he might consider producing oysters in ponds. We based our recommendation on the results being obtained by west coast oyster farmers, oyster farming progress in Chesapeake Bay and some experimental work being conducted by the State of Florida in Apalachicola Bay. In our discussion, we proposed that Frierson initially construct an earthen pond on his property for the production of oysters instead of shrimp, and we agreed that AUMERC and other FAA personnel would provide technical assistance for this venture.

In later discussions, we agreed that the Frierson Food Group would provide the land for the experimental pond, and pay for the construction. Frierson also agreed to provide the cost of installing pumping equipment and a water line to secure water from Portersville Bay for the pond. Still later, we requested funds from the Alabama Department of Economic and Community Affairs (ADECA) to help defray research and development costs related to the project.

In August and early September, 1985, Hurricane Elena devastated the oyster

producing reefs in Apalachicola Bay. In its efforts to re-establish the oyster industry in the area, the State of Florida began research on 'increased-input' oyster farming. Before we finalized the protocol for the Frierson oyster pond production research, several of us visited Apalachicola in the summer of 1989 to see what they had learned about oyster farming. Leslie Sturmer, a Smitherman graduate student, was working with that project and she reviewed the status of their efforts for us. They were growing oysters in bags attached to ropes on the bottom of the Bay. As I remember, they were achieving satisfactory growth rates; although high mortality rates were a problem. Further, fouling of the bags was a continuing problem which made it necessary to raise them fairly often to clean the accumulated sediment from them. She suggested that, if practical, we should suspend the bags in the water column in our research, which should increase water flow around and through them. Consequently, suspending the bags should increase the amount of food available to the oysters; while at the same time reducing the fouling and high mortality rates.

The Frierson pond was completed in late 1989, but for several reasons, it was not ready to receive oysters until April, 1990 (Hosking and Wallace, 1992). In that month 50,000 juveniles were received from the Harbor Branch Oceanographic Institute in Fort Pierce, FL. They were placed in sacks which were placed on wooden racks in the pond. This arrangement suspended the young oysters off the bottom. Growth of the oysters was much greater than expected through June, 1992. In fact, it was so good that a 'media-day' was held on June 15, 1990. Unfortunately, measurements made on June 18 indicated that the oysters had stopped growing. Further, by the end of September, approximately 20 percent of them had died. Research on this project continued through December, 1991, but despite all kinds of interventions, we finally had to conclude that we simply did not know enough to produce marketable oysters in earthen ponds. But while we were disappointed with these results, we had learned that young oysters quickly deplete the quantity of organisms in the water column that serve as their food. We also learned that with our water supply equipment, we could not change the water in the ponds often enough to maintain an adequate supply of food as the oysters grew. We also learned that the application of inorganic fertilizer to the pond water helped very little. We did increase phytoplankton production, but apparently not right the type.

Although the Frierson oyster pond project did not provide us with the positive results that we had anticipated, it did indicate that with further research, 'increased-input' oyster farming did have considerable potential in Alabama. Consequently, with strong support and assistance from personnel of the Alabama Farmers Federation (ALFA), we met with Representative Taylor Harper at his office in Montgomery to request his support for obtaining a 'Line-Item' appropriation for the University from the Legislature for oyster farming research. Representative Harper is a long-term resident

and pecan farmer from Grand Bay in western Mobile County. At that time, he was serving as Chairman of the House Ways and Means Committee, and was extremely interested in doing anything he could that might increase the value of the oyster harvesting industry in the state. As a result of his interest, the 1991 Alabama Legislature included funds in the Education Budget for oyster farming research. These funds allowed us to significantly increase our research effort in oyster aquaculture.

In the oyster pond research project, we learned several things that would not work, but we did learn how to produce oysters with the limited use of cultch. During the course of the research, we obtained a large number of eyed-larvae from a commercial oyster hatchery in Louisiana. This life-history stage of the oyster is free-living. It has not attached itself to any substrate (cultch) to become a spat. We learned through experimentation that individual eyed-larvae will attach themselves to tiny pieces of cultch to become an individual oyster. Further, this tiny spat attached to this tiny piece of substrate could grow to market size as a 'cultch-less' oyster.

Probably as a result of his interest in the Frierson oyster pond project, in 1990, Chris Nelson of Bon Secour Fisheries began an oyster farming endeavor in Bon Secour Bay. He suspended bags containing 'cultch-less' oysters from ropes attached to pilings driven into the bottom of the Bay. Growth and condition of the oysters were exceptional. Results were so impressive it was decided to hold an oyster-farming 'Field-Day' to inform the public concerning the potential for commercial, off-bottom, cultch-less' oyster production. The event was held at a small church in Bon Secour in September, 1992. The event featured oysters harvested from Nelson's production bags, served on the half-shell. They were really beautiful and delicious, deep-bodied, juicy, 'singles' – the perfect raw oyster.

Unfortunately, the price that could be obtained from the sale of these excellent individual oysters was not sufficient to cover the cost of establishing and maintaining the farm. For best growth, it was necessary periodically to transfer them into bags with a larger mesh size. Also, even suspended above the bottom, fouling by other marine organisms and sediments was so severe that the bags had to be cleaned on a regular basis. After losing a substantial amount of money on the operation, it was eventually abandoned.

While the Frierson oyster pond project resulted in the conclusion that with the information available at that time, oysters could not be grown to marketable-size in earthen ponds; it did demonstrate that survival and growth of young oysters held in ponds for a short period of time before transferring them to a suitable location on a reef was substantially better than for oysters naturally established on the same reef.

I never fully understood all of the factors involved, but in the late 80s, Paul Parks and Lowell Frobish became involved in an effort to establish an Auburn fisheries research presence in Alabama's Coastal Zone. On several occasions, Parks and Frobish visited with business leaders in the Mobile area to discuss their vision of Auburn's Involvement there and to solicit their support. The Agricultural Experiment Station had been involved in the Coastal Zone for many years. The Gulf Coast Substation of the Alabama Agricultural Experiment Station (AES) was established at Fairhope in 1930, and the Ornamental Horticulture Field Station was established in Mobile in 1951; however, there had never been any AES-supported fisheries research down there. The first Auburn fisheries-related work there was begun in 1974 when the Cooperative Extension Service (CES) began to provide technical assistance to the Seafood Industry in Baldwin and Mobile Counties by appointing Dr. Billy Powell, Marine Advisory Specialist.

Following the initial contacts by Parks and Frobish in Mobile, I was directed to develop a proposal to establish the program. Not surprisingly, I proposed a much more ambitious program than Parks and Frobish were willing to fund, but after considerable discussion regarding the matter, they agreed to establish a Marine Fisheries 'Line' in the FY '89 AES budget with an initial funding level of \$125,000. None of these funds were utilized for tenured or tenure-track personnel until FY'90 when some of Hosking's Cooperative Extension Service 'time' was purchased. In making this change, some of the Cooperative Extension Service (CES) funds in his salary were released. Then in FY '91, some of Wallace's salary was 'purchased' with 'Marine Fisheries' money, and in the same year the Szedlmayer position was created.

In the three decades that the Department has been involved in research and outreach on oyster production, a substantial number of individuals have been involved in the effort. Initially Rick Wallace and Scott Rikard led the efforts of the Work Group. Later, David Rouse, Yolanda Brady, Cova Arias, LaDon Swann, Bill Walton and P. J. Waters became involved. Names of other important contributors are included in the various bibliographic references related to the work.

Over the years, Departmental research on oysters has been channeled into six general areas:

1. Oyster reef biology.
2. Oyster reef restoration.
3. Oyster hatchery management.
4. Off-bottom culture.

5. Diseases and parasites of oysters.
6. Public health aspects of oyster production.

Research in these general areas over the past three decades has resulted in the development of a wealth of reports, outreach bulletins, published abstracts and scientific publications. Only a limited number are listed here. Those listed were chosen to provide an overall perspective of the on-going research.

OYSTER REEF BIOLOGY

Old data show that oyster production Alabama's coastal zone was once much greater than it is currently. Over the years, some significant negative changes must have taken place in the biology of the State's oyster reefs. These changes have generally been attributed to man-made alterations (construction of dams, dredging, etc.) of the rivers supplying water to Mobile Bay. As a result, a substantial amount of research has been conducted on the current status of reef biology with an emphasis on how relic reefs might be re-established and how productivity on producing reefs might be increased. Some of the research and outreach efforts have been summarized in the following publications:

1. Comparative assessment of three unproductive oyster reefs and a productive oyster reef in Mobile Bay (Smith, 1999).
2. Solving the mystery of unproductive oyster reefs in Mobile Bay (Wallace, et al., 2000).
3. An *in situ* study on survival and growth of *Crassostrea virginica* in Bon Secour Bay, Alabama (Saoud, et al., 2000a).
4. Evaluating sediment accretion on a relic oyster reef in Mobile Bay, Alabama (Saoud and Rouse, 2000).
5. Oyster reef assessment and *Perkinsus marinus* disease analysis on a recently restored reef in Mobile, Alabama (Dunne, et al., 2001).

OYSTER REEF RESTORATION

A considerable amount of research has involved searching for methods of reef restoration and rejuvenation. Research has consistently demonstrated that the variable and sometimes non-existent natural 'set' of spat is a major cause of variable production of oysters. Consequently, considerable attention has been directed at this problem. Over the years it has been shown that the best solution is to 'set' hatchery-produced larval

oysters on 'cultch' off-site, and when they have reached an appropriate size, to be moved to a suitable reef. AUMERC staff have devoted considerable effort in support of this solution.

Efforts at oyster reef restoration received a helpful boost in 2001 with the establishment of the Mobile Bay Oyster Gardening Program. It is modeled after a successful program established earlier on Chesapeake Bay. In the Program, juvenile oysters (spat) used in the oyster gardening project are produced by the Auburn University Shellfish Laboratory. Once they reach the right stage of growth, they are given to local volunteers who grow them to a larger size in privately owned and managed 'gardens.' The 'gardens' generally consist of rectangular, wire-mesh baskets which are suspended off-bottom in 'conditionally open waters,' as classified by the Alabama Department of Public Health (Figure 99). Generally, spat from the Laboratory are stocked in the gardens in late June. Each week, the containers are raised so that mud, algae and other fouling can be rinsed away. Usually in late November when the oysters have reached a length of around two inches, they are removed from the gardens by AUMERC personnel and moved to previously-identified natural reefs chosen for restoration and enhancement.

P. J. Waters, Extension Aquaculture Specialist with AUMERC, has the primary responsibility for the operation of the Program. Also, students from Alma Bryant High School help with stocking the gardens, harvesting the oysters and planting them on designated reefs.

A recent article in the Birmingham News (December, 29, 2017, Page A4) indicates that Oyster 'Gardening' has gone commercial. Andy DePayola comments that thousands of edible oysters produced in private gardens around Mobile Bay are being sold in 'high-end' restaurants in several distant cities. Apparently there are so many individuals involved that they have formed a local Pier Growers Co-Op. He further notes that triploid 'seed' oysters are now commercially available from local producers. Probably the most important thing is that local producers are now actively involved in developing practical solutions to problems limiting the growth of the industry.

Some publications developed from this research include the following:

1. Oyster farming in Alabama (Wallace, 1993).
2. Environmental parameters affecting the restoration of an oyster reef in Mobile Bay, Alabama (Saoud, 2000).
3. Experiments in determining optimum size for planting hatchery produced oysters (*Crassostrea virginica*) (Wallace, et al., 2001).

4. Evaluation of two off-bottom oyster, *Crassostrea virginica*, culture methods for use in oyster gardening in Alabama (Hamilton, 2004).

OYSTER HATCHERY MANAGEMENT

In Auburn's cooperative oyster farming project with Don Frierson, it quickly became apparent that we needed a hatchery so that we could produce larvae from adults taken from the Alabama Coastal Zone. With funds available from the 1991, 'Line-Item' appropriation, the Wallace Work Group developed a very primitive one in the wet lab of the AUMERC facility at Brookly Field. There, they spawned Alabama oysters for the first time in the spring/summer of 1992 and 1993. While they were successful with the spawning, attempts to grow-out the larvae were not. They had no ready access to natural seawater, and the artificial mixture did not seem to work very well. Afterwards, spawning efforts were moved to the Claude Peteet Mariculture Center, operated by the Alabama Marine Resources Division of the Alabama Department of Conservation and Natural Resources. The Work Group continued to use that facility for oyster spawning research until the completion of the Auburn University Shellfish Laboratory (AUSL) facility in 2002 (Figure 100).

The Work Group began work on the production of triploid oysters around 1994. In this work, the genetic alteration was accomplished using nitrogen oxide under increased pressure. Later, triploids were produced in Alabama oyster larvae, by a member of the Work Group utilizing hatchery facilities at Rutgers University. The larvae were later returned to AUMERC for grow-out studies.

As noted in a preceding paragraph, in the early 90s with assistance from ALFA, we had approached Representative Taylor Harper from Mobile County regarding the possibility of securing legislative funding for oyster research. In the original proposal, we requested that a permanent 'Line-Item' for oyster research be established in the FAA budget and that it contain sufficient funds to locate a suitable site and to construct a modern oyster hatchery and grow-out facility. These funds (\$250,000) first appeared in Auburn's budget in the 1991/1992 academic year. Further details related to the development of the facility will be provided in a following Section.

Published works related to research on hatching, rearing and setting larval oysters by AUMERC staff under hatchery conditions include the following:

1. Oyster farming in Alabama (Wallace, 1993).
2. Induction of triploidy in unconditioned eastern oysters, *Crassostrea virginica*, using nitrous oxide under increased pressure (Anderson, 1995).

3. Oyster hatchery techniques (Wallace, et al., 2008)
4. Use of microalgae concentrates for rearing oyster larvae, *Crassostrea virginica* (Rikard and Walton, 2012).

'OFF-BOTTOM' OYSTER FARMING

From the early experiences with producing oysters in the Frierson pond, the visit with Leslie Sturmer in Apalachicola, and the production, both quantity and quality, obtained by Chris Nelson; the Department has been determined to pursue the goal of producing oysters 'off-bottom' with economically acceptable returns (Figure 101). Research in this general area has involved two distinct phases:

1. Early phase (Wallace Work Group).
2. Later phase (Walton Work Group).

In the Early phase, the research staff at AUMERC was poorly prepared for the complex problems involved. Everyone involved was on an extremely 'steep' learning curve. In the later phase, the facilities of the Shellfish Laboratory were available to support the research and the staff had been expanded to include a scientist with considerable experience in 'off-bottom' oyster production.

Publications related to the early research by the Wallace Work Group include the following:

1. Oyster culture in Bon Secour Bay, Alabama (Nelson and Wallace, 1991).
2. Growth and survival of the eastern oyster cultured in an earthen pond (Wallace and Rouse, 1993).
3. Management strategies for fouling control in Alabama oyster culture (Rikard, et al., 1996).
4. Cultivating the eastern oyster, *Crassostrea virginica* (Wallace, 2001).
5. Evaluation of two off-bottom oyster, *Crassostrea virginica*, culture methods for use in oyster gardening in Alabama (Hamilton, et al., 2004).

Dr. Bill Walton joined the faculty in early 2009. He was employed specifically to participate in the oyster aquaculture program of the Auburn University Marine Extension and Research Center (AUMERC). He had been awarded the

B.S. Degree (Biology) by Tufts University in 1991. He received the M.S. Degree (Ecology and Evolution) from Rutgers University in 1993 and the Ph.D. (Fisheries Science) from the University of Maryland-College Park in 2003. Before coming to Auburn, he had worked as an Aquaculture Specialist with the Woods Hole Sea Grant/Cape Cod Cooperative Service. Research conducted by Walton's Work Group resulted in the development of the following publications:

- 1. Off-bottom oyster farming in the Gulf of Mexico: evaluation of start-up costs and labor requirements of different aquaculture gear in side-by-side comparison (Chaplin, et al., 2011).**
- 2. Evaluation of a mechanical grader for the improvement of the aquaculture production of eastern oyster, *Crassostrea virginica*, in the Northern Gulf of Mexico (Coddington-Ring, 2012).**
- 3. Gulf Coast off-bottom oyster farming gear types: adjustable long-line system (Davis, et al., 2012a).**
- 4. Effects of basket arrangement and stocking density when using the adjustable long-line system for oyster grow-out (Davis, 2012).**
- 5. Gulf Coast off-bottom oyster farming gear types: floating cage system (Davis, et al., 2012b).**
- 6. Gulf Coast off-bottom oyster farming gear types: bottom cages (Walton, et al., 2012).**
- 7. Off-bottom culture of oysters in the Gulf of Mexico (Walton, et al., 2013a).**
- 8. Effects of ploidy and gear on the performance of cultured oysters, *Crassostrea virginica*: survival, growth, shape, condition index and *Vibrio* abundances (Walton, et al., 2013b).**
- 9. Template for Alabama Public Health Oyster Farm Operational Plan (Walton and Rikard, 2013).**

Walton and his Work Group have done an outstanding job of taking their research to the private sector. As a result, several private 'off-bottom' farms have been established in the Mobile Bay area; however, they have encountered some problems with leasing sites for their research, teaching and extension activities. Fortunately, they are in the process of obtaining permits for their work in Portersville and Grand Bay. According to Bill, these requests for permits are moving forward and they expect to be installing equipment in early 2017.

Walton comments (personal communication) that at the beginning of 2018 there are 15 commercial producers in Alabama, and that their combined sales are expected to be around \$3 million.

PARASITES AND DISEASES OF OYSTERS

Problems, some of them quite severe, with parasites and diseases are expected with virtually all efforts in the 'high-input' culture of any plant or animal. For this reason, research in this area began soon after oyster culture efforts in Alabama's Coastal Zone began. Some of the publications developed from this effort include:

1. Effects of *Perkinsus marinus* on cultured Mobile Bay oysters (Bruni, 1996).
2. The effectiveness of N-halamine disinfectant compounds on *Perkinsus marinus*, a parasite of the eastern oyster *Crassostrea virginia* (Delaney, 2003).
3. *The effect of Perkinsus marinus* infection on the population structure of harvested and unharvested oyster reefs in Mobile Bay, Alabama (Brady, et al., 2009).

OYSTER FARMING AND HUMAN HEALTH

Because of our long-term interest in developing technology for the production of oysters for the 'raw' market, human health has been a special concern in Auburn's research. Consumption of un-cooked oysters by immuno-compromised individuals has long been a concern for public health agencies and consequently for producers as well. Because of the interest in producing a high quality product that would command a premium price, the Work Group working on this complex problem has expended a considerable amount of research effort in producing a product with a reduced potential for causing serious health problems in consumers of un-cooked oysters. Results of some of the research has been summarized in the following publications:

1. The use on N-halamine disinfectants on depuration of the Eastern Oyster, *Crassostrea virginica* (Gmelin) (Delaney, 2000).
2. Evaluation of a flow-through depuration system to eliminate the human pathogen *Vibrio vulnificus* from the eastern oyster *Crassostrea virginica* (Lewis, et al., 2010).
3. Distribution and survival of *Vibrio vulnificus* genotypes in postharvest Gulf Coast (USA) oysters under refrigeration (Wood and

Arias, 2012).

4. Effective reduction of *Vibrio vulnificus* in the eastern oyster (*Crassostrea virginica*) using high salinity water (Larsen, et al., 2012).

HATCHERY MANAGEMENT RESEARCH

As detailed in several preceding Sections, research on the production of fry and fingerlings of various species for stocking in experimental ponds began in the earliest days of the Auburn Fisheries Program. Although fingerlings were generally available from Federal Fish Hatcheries at that time, the 'Investigators' chose to produce their own; especially in the early days in order to meet specific research requirements. Experiments on the production of minnows provided additional opportunities for research and development in hatchery management.

In the late 40s, the 'Investigators' accepted the responsibility for managing the two state Hatcheries – one at Springhill, near Mobile and the other at Estaboga, southeast of Anniston. They continued to manage these facilities until the Fisheries Section was organized within the Alabama Department of Conservation in 1951.

Ellis Prather assumed responsibility for teaching in the general area of hatchery management when he returned from military service in 1945. Later, he was recalled to active duty during the period 1951-1954. He was actively involved in research on catfish spawning for several years. When Jack Snow joined the faculty in 1974, he assumed most of Prather's responsibilities in this area. Later after Snow retired (1984), Len Lovshin worked for a short time in the area. Ron Phelps was assigned responsibility for it after Prather retired in 1983.

SPAWNING THE CHANNEL CATFISH

Early in his career, Ellis Prather had accepted the responsibility for research and development and for teaching in the area of hatchery management. He played a leading role in developing hatchery procedures for producing bait minnows. His research on their production was described in a preceding Section. He first attempted to spawn the channel catfish in 1951, but failed – probably as a result of using brood fish that had not reached sexual maturity (Figure 102). In the following years, he re-doubled his efforts, but was not successful until 1958, when he harvested several small egg masses. Afterwards, he encountered few problems in spawning the species; especially after he was able to use brood fish that had been grown from eggs and fry produced at Auburn. By the early 60s, he had plenty of egg masses for his research on hatching and the early care of fry. Unfortunately, very little of the information obtained from his research was ever published.

Fortunately, most of it was described in considerable detail in the Annual Reports. These are available for review in the files of the Department of Special Collections and Archives in RBD Library (Accession 97-029).

PRODUCTION OF STRIPED BASS FINGERLINGS

Sampling with the use of emulsifiable rotenone on the Coosa River impoundments in the early 50s demonstrated that a major share of the population consisted of large gizzard shad. Further, many of these fish were so large that there were few predators to utilize them. Except for large catfish, they were poorly utilized. Certainly, few of the 'black' bass were large enough.

Prior to the construction of impoundments on the Coosa, the Gulf 'strain' of the striped bass (*Morone saxatilis*) ascended the river annually to spawn. Some of these fish were quite large; however, after the dams were completed, these large predators no longer had access to the newly created impoundments, and there was never any indication that a 'land-locked' 'strain' had developed.

In the early 60s, personnel with the South Carolina Game and Fish Commission began to utilize hormone-spawning to produce millions of striped bass larvae annually. Soon, most of the coastal states (Virginia to Georgia) bordering the Atlantic were using the same procedure. By the mid-60s, these States were making these fish readily available to other states for research. Then in 1966, Congress approved the *Anadromous Fish Act* (Public Law 89-304). Under its provisions, States were given money to conduct research on fish that utilized both marine and freshwater environments. Fortunately, some of these funds were made available to Auburn's Fisheries Program. Details related to the availability of the funds will be discussed in a following Section.

Because of our long-term interest in the potential use of striped bass in the management of large impoundments and the availability of both large numbers of larvae and research funds, we decided to begin a series of experiments on fingerling production. I served as Project Leader. Most of the research was conducted by graduate students, both at the M.S. and P.D. levels. An overview of the decade-long research effort is provided by the following Thesis and Dissertation titles:

1. Investigations on the propagation of the striped bass *Morone saxatilis* (Walbaum) (Kelley, 1969).
2. The effects of water hardness and age at stocking on the survival of striped bass, *Morone saxatilis* (Walbaum), fry (Powell, 1971).

3. The effects of increased water hardness, salinity, and source of fry on the survival and growth of striped bass fry, *Morone saxatilis* (Walbaum), in hatching jars (Germann, 1972).
4. The effects of increased salinity and of feeding treatments on survival and growth of striped bass, *Morone saxatilis* (Walbaum), fry in hatching jars, and fingerling striped bass in troughs (Catchings, 1973).
5. The effects of increased sodium chloride and continuous organic fertilization on the survival and growth of striped bass, *Morone saxatilis* (Walbaum), fry and the effects of antibiotic feeds and increased sodium chloride on the ponds (Mike, 1974).
6. The effects of two levels of sodium chloride and increased alkalinity on growth and survival of striped bass, *Morone saxatilis* (Walbaum), fry and the effects of two feeding methods on production and survival of advanced fingerling striped bass in earthen ponds (Kirby, 1975).
7. The effects of increased salinity, feeding treatments, and ultraviolet radiation on the survival and growth of striped bass, *Morone saxatilis* (Walbaum), fry in hatching jars (Braid, 1977).
8. Studies on the culture of larval striped bass *Morone saxatilis* (Walbaum) in closed recirculating systems (Carreon, 1978).
9. Nutritional value of brine shrimp nauphli for striped bass larvae (Webster, 1989).

HATCHERY MANAGEMENT STUDIES BY THE PHELPS WORK GROUP

As noted above, Dr. Ron Phelps accepted responsibilities in the general area of hatchery management for the Department in 1985. Ron is a native of Alabama. He was awarded the B.S. Degree by Auburn University in 1969. Afterwards, he chose to by-pass the M.S. Degree and work for the Ph.D. instead. He was awarded this degree in 1975. He joined the faculty as an Assistant Professor in July of that year. He was employed specifically to work with the ICA. In 1976, he was assigned to work as Chief-of-Party in the USAID-funded Project (AID/la-C-176) in Colombia. He returned to campus in 1980, where he continued to provide support for the International Program on a number of assignments.

Phelps and his Work Group in hatchery management produced their first publication in this area in 1992. Afterwards, their work was generally divided

into three primary areas:

1. Procedures for the hatchery production of catfish fingerlings.
2. Spawning of red snapper.
3. Management of reproduction.

CONTRIBUTIONS TO CHANNEL CATFISH REPRODUCTION

1. Factors influencing the enumeration of channel catfish eggs (Walser and Phelps, 1993)
2. The use of formalin and iodine to control *Saprolegnia sp.* infections in channel catfish eggs (Walser and Phelps, 1994)
3. Effects of temperature on the induced spawning of channel catfish and the production of channel X blue catfish fry (Phelps, et al., 2007).
4. Broodstock selection criteria for induced spawning of channel catfish for the production of channel X blue catfish hybrid fry and the influence of temperature (Phelps, et al., 2011).

CONTRIBUTIONS TO RED SNAPPER REPRODUCTION TECHNOLOGY

The Phelps's hatchery management Work Group also worked extensively on the spawning of the red snapper. They developed a sequence of techniques which allowed them to be among the first to complete the life-cycle (eggs through sexual maturity) under controlled conditions. Several publications were developed from this research including:

1. Egg and larval quality of natural and induced spawning of red snapper (Papanikos, et al., 2003).
2. Induced spawning and egg quality of red snapper (Bourque and Phelps, 2007).
3. Spontaneous spawning of captive red snapper and dietary lipid effect on reproductive performance (Papanikos, et al., 2008).
4. Spawning of red snapper in response to hormonal injection or environmental control in a hatchery setting (Phelps, et al., 2009).

RESEARCH ON THE MANAGEMENT OF REPRODUCTION

Uncontrolled reproduction has always been a serious problem in the commercialization of aquaculture. For example, efforts to produce and market recreational fishing in the 'E' and 'S' Ponds was largely stymied by the inability to limit the reproduction and recruitment of bluegills. The production of marketable crops of speckled bullheads was affected by uncontrolled reproduction during the pond production cycle, and un-wanted reproduction was an extremely serious problem in the production of marketable tilapias in ponds.

Unfortunately, in the early 60s, the only practical way to obtain monosex populations of tilapia was 'hand-sexing,' which were both labor intensive and inaccurate. The first research at Auburn to find an alternative was begun in 1959 when Yoel Pruginin and I began an experiment on the use of mechanical graders for the separation of the sexes of *Tilapia nilotica* (Pruginin and Shell, 1962). At that time, Yoel was on study leave from the Division of Fisheries of the Ministry of Agriculture in Israel. Then in the late 60s, I directed the Ph.D. research of Najim Al-Daham (Al-Daham, 1970), graduate student from Iraq, in which he evaluated the use of chemosterilants, sex hormones, radiation and hybridization for controlling reproduction in *Tilapia*.

STUDIES BY THE SHELTON WORK GROUP

In the early 70s, Dr. William (Bill) Shelton established a Work Group to study the use of sex hormones to convert female tilapia into males in order to achieve a monosex population. Shelton was appointed Assistant Leader of the Alabama Cooperative Fisheries Research Unit in August of 1971. He is a native of Oklahoma. He received his B.S. Degree (Zoology Wildlife Management) from Oklahoma State University in 1961. After graduation, he served a 2-year tour with the U.S. Air Force. In 1964, he received the M.S. Degree (Zoology-Fishery Biology) from Oklahoma State. Later, in 1972, he was awarded the Ph.D. Degree (Zoology-Fishery Biology) by the University of Oklahoma. Shelton's first research at Auburn involved a collaborative effort with Dr. Bill Davies in a long-term, highly productive study of the fish population in West Point Reservoir as it transitioned from a riverine to a lacustrine environment. This work will be described in some detail in a following Section.

Shelton first became involved with Auburn's sex reversal research in 1976. In the following decade, he and his Work Group completed a number of field studies in this area. From these studies they developed several publications which included the following:

1. Use of androgens for the production of all-male *Tilapia aurea* (Guerrero, 1975).

2. Inducement of sex reversal in *Sarotherodon niloticus* (Linnaeus) (Tayamen and Shelton, 1978).
3. Effects of estrogens on *Tilapia aurea*: implications for production of monosex genetic male tilapia (Jensen and Shelton, 1979).
4. Sex ratios of progeny from mass spawnings of sex-reversed broodstock of *Tilapia nilotica* (Calhoun and Shelton, 1983).
5. Sex reversal and breeding of grass carp (Boney, et al., 1984).
6. Tissue distribution and elimination of radiolabelled methyltestosterone fed to adult blue tilapia (Goudie, et al., 1986).

STUDIES BY THE PHELPS WORK GROUP

Ron Phelps and his Work Group also completed a number of important studies on the sex reversal of the Nile tilapia. Several publications were developed from these studies, including:

1. Effects of initial age and size on sex reversal of Nile tilapia using methyltestosterone (Hiott and Phelps, 1993).
2. Use of diethylstilbestrol and ethynylestradiol to feminize Nile tilapia in an outdoor environment (Potts and Phelps, 1995).
3. Sex reversal in tilapia (Phelps and Popma, 2000).
4. Hormone manipulation of sex (Phelps, 2006).
5. A non-paradoxical dose response to 17 β -methyltestosterone by Nile tilapia *Oreochromis niloticus* (L.): effects on sex ratio, growth and gonadal development (Phelps and Okoko, 2011).

ESTABLISHMENT OF THE BUTTS WORK GROUP

Dr. Ian A. E. Butts was employed in January, 2017 to fill the position in Hatchery Management Instruction and Research vacated by the retirement of Ron Phelps. Ian is a native of New Brunswick, Canada. He was awarded the B. S. Degree in Marine Biology by the University of New Brunswick in 2002. Later he was awarded the Master of Science (2006) and Ph.D. (2010) Degrees in Biology by the same institution. Prior to coming to Auburn, he was employed as a Senior Research Scientist at the Technical University of Denmark.

His Work Group will conduct studies in the following areas:

- 1. Applied reproductive physiology: understand and control gametogenesis, gamete physiology, fertilization, and embryonic development for species of commercial importance, and identify factors regulating these processes.**
- 2. Gamete cryopreservation: develop cutting-edge techniques to cryopreserve genetic resources (i.e. create a 'germplasm repository') for conservation breeding efforts that may be needed in the future for commercially important or endangered species.**
- 3. Sexual selection and the evolution of gamete interactions: gamete interactions in shaping fertilization dynamics and the evolution of sexual characteristics.**

GENETICS AND BREEDING RESEARCH

Research on genetics and breeding of warm-water fish has a long history at Auburn. The first work in this area was conducted in the late 40s. Afterwards it received relatively little attention until the early 70s when research on channel catfish and tilapia began.

EARLY WORK

As detailed in a preceding Section, experimentation on selection and breeding at Auburn had its beginning when the 'Investigators' selected and bred an improved strain of largemouth bass that was both more food efficient and faster growing for stocking farm fish ponds (Prather, 1951). Experiments were conducted in the circular, concrete 'A' Ponds which were located on the South Auburn Farm. Today that site is mostly underneath East University Drive, just north of the Bull Testing Facility.

This research was continued through 1948; although it was suspended in 1944 and 1945 because of a shortage of labor. Some individuals of a so-called 'improved strain' were saved from this research, and subsequently used to produce fingerlings for stocking. In some following research, it was noted that bass fingerlings of the 'improved strain' were being used to stock the ponds, but there was no further mention of this matter. Later, growth and survival of the 'improved' strain were compared to those of the so-called 'Marion' strain. Both growth and survival of the 'Marion' strain seemed superior to those of the Auburn 'improved' strain; however, the 'Investigators' concluded that, as a result of the small number of replications and of the variation between treatments, there appeared to be no significant difference between the two.

STUDIES BY THE SMITHERMAN WORK GROUP

Classical research in fish breeding and genetics received little attention at Auburn until Dr. R. O. Smitherman returned from his assignment on an Auburn/USAID Project in Panama in 1973. Smitherman, a native of Bibb County, had received a B.S. Degree in Fish Management from Auburn in 1959. He was awarded the M.S. Degree by North Carolina State University in 1961. At N.C. State he had worked under the direction of Dr. F. Eugene Hester, an Auburn fisheries alumnus. His M.S. Thesis involved meristic comparisons of three species of *Lepomis* and five of their hybrids. Smitherman returned to Auburn afterwards and received his Ph.D. in 1964. After graduation, he accepted the position of Unit Leader of the Louisiana Cooperative Fisheries Research Unit at Louisiana State University. He remained in that position from 1964-1967; before returning to Auburn in July, 1967. He was recruited to assist the 'Investigators' with the work of the International Center of Aquaculture. In February, 1972, Smitherman was assigned to the Panama Project (AID/la-684) as Chief-of-Party.

While Smitherman was in Panama, USDA's Southern States Cooperative Regional Research Project 'Freshwater Food Animals (S-83)' was initiated (1972). The Project had three primary objectives:

1. Production
2. Economics
3. Product Development and Quality Assurance.

Within the "Production" Objective there were five sub-objectives:

- a. Nutrition
- b. Breeding and genetics
- c. Water quality
- d. Fish health
- e. Culture systems.

Upon returning to campus in 1973, he became an active contributor to this cooperative effort. His first research in this area involved several experiments on the production of channel X blue catfish hybrids and their evaluation in ponds (Yant, et, al., 1976). Later, the Technical Committee of the 'S-83' Project requested that he prepare a summary of the state of knowledge on the genetics and breeding of channel catfish. This report prepared by Smitherman and two of his graduate students, H. M. El Ibiary and R. E. Reagan, was published in October, 1978 as Southern Cooperative Series Bulletin 223, *Genetics and Breeding of Channel Catfish*.

Arguably, Smitherman's first really important study on the genetics of channel catfish was concerned with methodology. The publication resulting from this study, *Communal Stocking and Multiple Rearing Technique for Channel Catfish Research*, was the result of a significant collaborative study by Smitherman and several of his graduate students (Dunham, et al., 1982). Afterwards, his genetics Work Group would become more sharply focused on the genetics and selection of the species. Publications resulting from these studies, included:

1. Effects of selecting for growth rate on reproductive performance in channel catfish (Dunham and Smitherman, 1982).
2. Response to selection and realized heritability for body weight in three strains of channel catfish grown in earthen ponds (Dunham and Smitherman, 1983).
3. Selection or drift-isozyme allele frequency changes among channel catfish selected for rapid growth (Hallerman, et al., 1986).
4. Comparison of mass selection, crossbreeding, and hybridization for improving growth of channel catfish (Dunham, et al., 1987a).
5. Response to three generations of selection for increased body weight in channel catfish grown in earthen ponds (Rezk, et al., 2003).

In the mid-70s, interest in commercial tilapia production intensified at Auburn, and Smitherman and his Work Group began to conduct studies on the genetics and breeding of several of these species. Publications produced by the group, over time, are indicative of growing sophistication of their research in genetics; although there is little indication at this point of any interest in molecular genetics. Publications included the following:

1. Production of normal male and androgen sex-reversed *Tilapia aurea* and *T. nilotica* fed a commercial catfish in ponds (Anderson and Smitherman, 1978).
2. Predicted response to selection for early growth in *Tilapia nilotica* (Tave and Smitherman, 1980).
3. Development of a cold-tolerant population of red tilapia through introgressive hybridization (Behrends and Smitherman, 1984).
4. Maintenance of genetic quality in cultured tilapia (Smitherman, 1987).
5. Estimates of additive genetic effects, maternal genetic effects, individual heterosis, maternal heterosis and egg cytoplasmic effects

for growth in *Tilapia nilotica* (Tave, et al., 1990).

STUDIES BY THE DUNHAM WORK GROUP

Smitherman and his Work Group in the fish genetics and breeding program attracted a number of excellent graduate students, whose thesis or dissertation research contributed significantly to its productivity. One of these students was Rex A. Dunham. He is a native of Illinois, and was awarded a B.S. Degree in Ecology, Ethology and Evolution by the University of Illinois in 1978. Shortly thereafter, he entered the graduate program at Auburn. Smitherman served as his major professor for both the M.S. (1979) and Ph.D. (1981) Degrees. After completing all requirements of the Terminal Degree, he was appointed as a Research Associate in the Department, and later in the same year, he was appointed to the position of Assistant Professor. After receiving the Terminal Degree, Dunham collaborated with Smitherman on a number of studies, and co-authored several publications. Several of these collaborative efforts were listed in a preceding paragraph.

As detailed in a preceding Chapter in the planning stage for the Mellon Foundation project, one of the primary goals was to construct a facility that would make it possible to conduct research on gene transfers in warm-water fish (See Figure 60). Dunham played a leading role in the beginning stages of the research in this area which lead to the development of several publications:

1. Transfer of the metallothionein-human growth hormone fusion gene into channel catfish (Dunham, et al., 1987b).
2. Transfer, expression, and inheritance of salmonid growth gene into channel catfish, *Ictalurus punctatus*, and effects on performance trials (Dunham, et al., 1992).
3. Enhanced bacterial disease resistance of transgenic channel catfish *Ictalurus punctatus* possessing cecropin genes (Dunham, et al., 2002).
4. Effect of rainbow trout growth hormone complementary DNA on body shape, carcass yield, and carcass composition of F₁ and F₂ transgenic common carp *Cyprinus carpio* (Dunham, et al., 2002).

In the late 90s, Dunham and his group began to conduct studies on the production and performance of channel and blue catfish hybrids. Several of these studies were developed into publications:

1. Seiniability of channel catfish, blue catfish and their F₁, F₂, F₃ and backcross hybrids in earthen ponds (Dunham and Argue, 1998).

2. **The effect of the absence or presence of channel catfish males on induced ovulation of channel catfish females for artificial fertilization with blue catfish sperm (Dunham, et al., 1998).**
3. **Effects of fertilization method on selection for body weight and species on fertilization efficiency of channel c. c catfish eggs with blue or channel catfish sperm (Dunham, et al., 1999).**
4. **Comparison of manual stripping and pen spawning for production of channel catfish x blue catfish hybrids and aquarium spawning of channel catfish (Dunham, et al., 2000).**

Dunham also provided important leadership in the development and implementation of the Southeastern Cooperative Fish Genetics and Breeding Project. By 1984, the Southeastern Fish Parasite and Disease Project had been so successful that it seemed that Auburn should look for other ways to serve fishery managers in the Region. At the same time, our program in genetics and breeding was making outstanding progress. Consequently, it seemed likely that the state fisheries agencies in the region would be interested in a cooperative project in this area, utilizing the genetics and breeding resources being developed at Auburn.

In 1984, I presented a proposal for a cooperative project to the Annual Meeting of the Game and Fish Commissioners in Greenville, MS. As a result, in 1985, Auburn University and several states in the Southeast Region established the Southeastern Cooperative Fish Genetics and Breeding Project. It was funded with grant funds available to the states from the Dingell-Johnson Act of 1950 and the Wallop-Breaux Amendment to that Act in 1984. Auburn University contributed the "indirect costs" required by the project. Objectives of the project included:

1. **Genetic relationships between selected populations of fish in the Region. Inventory strains of fish in state hatcheries.**
2. **Evaluate breeding procedures for their impact on quality of stocks.**
3. **Develop procedures for preservation of natural gene pools**
4. **Monitor and evaluate the impact of introduced fish on existing gene pools.**

From its beginning, Dr. Dunham accepted a major responsibility for the ongoing operation of this cooperative project. Over the years, he and his Work Group completed a number of studies that had been requested by the cooperating states. Publications developed from several of these studies included:

1. Biochemical genetics of largemouth bass populations in Alabama (Norgren, et al., 1986)
2. Hybridization and biochemical genetics of black and white crappies in the Southeastern USA (Dunham, et al., 1994).
3. Distribution of largemouth bass genotypes in South Carolina: initial implications (Bulak, et al., 1995).
4. Biochemical genetics of brook trout in Georgia: management implications (Dunham, et al., 2001).
5. Genetic analysis of Ozark Hellbenders utilizing RAPD markers (Kucuktas, et al., 2001).

When Zhanjang (John) Liu joined the Genetics and Breeding Program in 1995, the types of research conducted by Dunham and his Work Group changed markedly. This change is evident in the group's publications:

1. Transcriptional activities in the pituitaries of channel catfish before and after induced ovulation by injection of carp pituitary extract as revealed by expressed sequence tag analysis (Karsi, et al., 2002).
2. Differential gene expression in the brain of channel catfish (*Ictalurus punctatus*) in response to cold acclimation (Ju, et al., 2002).
3. Gene mapping, isolation and genetic improvement in catfish (Dunham and Liu, 2003).
4. Alterations in gene expression in brain of white catfish (*Ameiurus catus*) in response to cold acclimation (Kocabas, et al., 2004).

As suggested in a preceding paragraph, Dunham had become interested in the commercial possibilities of the use of the blue catfish X channel catfish hybrid in the catfish farming industry early in his career at Auburn. In the latter part of the first decade of the new century, he spent a considerable amount of time helping farmers adopt this new technology.

TAVE CONTRIBUTIONS

Douglas Tave was another of Smitherman's outstanding graduate students in genetics and breeding. After he was awarded the Ph.D. Degree in 1979, he remained with the program as a Research Associate for several years. In this capacity, he and Smitherman collaborated on a number of studies. Some of the publications resulting from those studies were identified in a preceding paragraph. In the mid- to late 80s, Tave developed

several publications on fish genetics of his own, and in 1987 and 1988, he was asked by *Aquaculture Magazine* to develop a series of articles for aquaculturists with limited understanding of genetics. These various publications included:

1. Predicted response to selection for early growth in *Tilapia nilotica* (Tave and Smitherman, 1980).
2. A quantitative genetic analysis of 19 phenotypes in *Tilapia niotica* (Tave, 1986).
3. Effective breeding number and brood stock management (Tave, 1988.)
4. Estimates of additive genetic effects, maternal genetic effects, individual heterosis, maternal heterosis and egg cytoplasmic effects for growth in *Tilapia nilotica* (Tave, et al., 1990).

STUDIES BY THE KUCUKTAS WORK GROUP

Dr. Huseyin Kucuktas, currently a Research Fellow IV, has been a productive member of the research team of the Fish Molecular Genetics and Biotechnology Laboratory at Auburn since the late 90s. He is a native of Turkey. He took a B. S. Degree from Selcuk University in Konya in 1983 and an M.S. Degree from Akdeniz University in Antalya in 1988. At Auburn, Dr. Yolanda Brady served as his Major Professor while he was fulfilling requirements for the Ph.D. Degree (1997). In 1997, he was appointed a Postdoctoral Fellow. In 2000, he was appointed to the position of Research Fellow I. In the intervening period, he has contributed to many of the studies conducted by the molecular genetics, biotechnology and genomics research team. More recently, he has provided leadership for the studies that have resulted in the development of a large number of publications. On five of these publications, he was listed either first or second author:

1. Molecular biology of channel catfish virus (Kucuktas and Brady, 1998.)
2. Cloning and expression of a putative glycoprotein of channel catfish virus using baculovirus expression system (Kucuktas, et al., 1998).
3. Genetic analysis of Ozark Hellbenders utilizing RAPD Markers (Kucuktas, et al., 2001)
4. Molecular characterization and differential expression of the myostatin gene in channel catfish (*Ictalurus punctatus*) (Kocabas, et al., 2002).

5. Bioinformatic mining of type 1 microsatellites from expressed sequence tags of channel catfish (*Ictalurus punctatus*) (Serapion, et al., 2004).

STUDIES BY THE LIU WORK GROUP

Dr. Zhanjiang (John) Liu joined the Department as part of its genetics and breeding program in 1995. Specifically, he was employed to fill Smitherman's position which had been vacated on his retirement in 1994. John Liu had taken a B. S. Degree in Microbiology at the Northwestern Agricultural University, Shaanxi Province, China, in 1982. Later, he would take both the M.S. (1986) (Plant Pathology) and Ph.D. (1990), (Molecular and Cellular Biology) Degrees at the University of Minnesota.

In 2007, John was appointed Assistant Director of the Alabama Agricultural Experiment Station. Fortunately, he was able to continue to provide leadership for his Work Group. Later, in 2013, he was appointed Associate Provost and Associate Vice President for Research. John retired in 2017.

Liu was employed to add a new dimension to Auburn's fish breeding and genetics program. Smitherman's primary research effort had been in the area of fish breeding. Liu was expected to develop research in the areas of molecular genetics and biotechnology as they applied to cultured fishes. When he began his tenure at Auburn, he immediately began to contribute to the University's participation in the USDA-sponsored Southeastern Cooperative Regional Project on Fish Genetics and Breeding of Fish (S - 168). The following publications are indicative of the nature of his early contributions:

1. Review of progress in catfish gene mapping (Waldbeiser, et al., 1997)
2. Inheritance and usefulness of AFLP markers in channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), and their F1, F2 and backcross hybrids (Liu et al., 1998).
3. Microsatellite-containing genes from the channel catfish brain: evidence of trinucleotide repeat expansion in the coding region of nucleotide excision repair gene RAD23B. A review of catfish genomics: progress and perspectives (Liu et al., 2001).
4. A review of catfish genomics: progress and perspectives (Liu, 2003).
5. An AFLP-based genetic linkage map of channel catfish (*Ictalurus punctatus*) constructed by using an interspecific hybrid resource family (Liu, et al., 2003)

6. Transcriptome characterization through the generation and analysis of expressed sequence tags: factors to consider for a successful EST project (Liu, 2006).
7. Expression analysis of the acute phase response in channel catfish (*Ictalurus punctatus*) after infection with a Gram-negative bacterium (Peatman, et al., 2007).
8. Microarray analysis of gene expression in blue catfish liver reveals early activation of the MHC class I pathway after infection with *Edwardsiella ictaluri* (Peatman, et al., 2008)

STUDIES BY THE PEATMAN WORK GROUP

In 2009, Eric Peatman returned to Auburn and established his own Work Group. He had been part of Liu's Work Group during the period 2002-2007. He first became a part of it in 2002, shortly after receiving the B.S. Degree from Auburn. John served as his Major Professor for both his M.S. (2004) and Ph.D. (2007) Degrees. Afterwards, he served as a Research Associate with the School of Medicine at Emory University. In May, 2009, he joined the fish genetics and breeding group as a Research Fellow. Then in August, 2009, he was appointed Assistant Professor. With this appointment, he was given the position vacated by John Liu who had moved to the Dean's Office. In this position, he also joined John in providing direction for Auburn's Fish Molecular Genetics and Biotechnology Laboratory.

On his return, Eric again became a major contributor to the research program of the Liu Work Group. The Group has continued to produce a large number of publications each year. Some of them include:

1. Gene expression profiling of a fish parasite *Ichthyophthirius multifiliis*: insights into development and senescence-associated avirulence (Abernathy, et al., 2011).
2. Development of genomic resources in support of sequencing, assembly and annotation of the catfish genome (Liu, 2011).
3. Susceptibility of channel catfish, blue catfish and channel X blue catfish hybrid to *Ichthyophthirius multifiliis* (Xu, et al., 2011).
4. Molecular responses of ceruloplasmin to *Edwardsiella ictaluri* infection and iron overload in channel catfish (*Ictalurus punctatus*) (Liu, et al., 2011).
5. Characterization of mannose-binding lectin from channel catfish (*Ictalurus punctatus*) (Zhang, et al., 2011)

6. Molecular characterization of three L-type genes from channel catfish, *Ictalurus punctatus* (Zhang, et al., 2012).
7. Early mucosal responses in blue catfish (*Ictalurus furcatus*) skin to *Aeromonas hydrophilia* infection (Li, et al., 2013).
8. Basal polarization of the mucosal compartment in *Flavobacterium columnare* susceptible and resistant channel catfish (*Ictalurus punctatus*) (Peatman, et al., 2013).
9. Physiology and immunology of mucosal barriers in catfish (*Ictalurus spp.*) (Peatman, et al, 2015).

FISH HEALTH RESEARCH

There is little indication that the ‘Investigators’ were concerned with fish health prior to 1953; although several of the Annual Reports prior to that time mentioned the deaths of large numbers of fish held in experimental ponds. I have been unable to find any records indicating that any studies were conducted in the area prior to 1953. It is amazing to compare the status of fish health teaching, research and extension, at Auburn, in the early 50s and at the beginning of the 21st century.

EARLY WORK

In the spring of 1953, there was a serious outbreak of ‘Columnaris’ disease in many of the ponds on the Sougahatchee and Story Farms. Similar outbreaks of the disease were also recorded in ponds and reservoirs across the Southeast (Shell, 1953). This was the first record of the presence of that disease in the region. Further, this is the first case where there was a widespread outbreak of any disease in ponds and reservoirs in the same time period, over such a large area. By mid-summer, however, there were very few fish deaths from the disease. At that time, none of the States in the region were prepared to identify or treat diseases of warm-water fishes, and there was certainly no one at Auburn with any expertise in this area.

Although I had no training in bacteriology at the time, I decided to conduct research on ‘Columnaris’ disease for my M.S. Thesis. In the same year, I presented a paper on the ‘out-break’ at the Annual Meeting of the Southeastern Association of Game and Fish Commissioners meeting in Chattanooga, TN (Shell, 1953). Early in 1954, Swingle asked me to attend a week-long short-course in fish diseases offered at the Eastern Fish Disease Laboratory operated by the U.S. Fish and Wildlife Service at Kearneysville, WV. Unfortunately, I completed all requirements for the M.S. in May, 1954, so what I learned in the short-course did not provide much help to Auburn.

Fortunately, there was no widespread out-break of 'columnaris' that year. In fact, nothing like the 1953 'out-break' has happened since.

In 1961, Swingle received a grant from the National Institutes of Health entitled '*Biological Control of a Trematode Disease.*' The project was designed to determine whether shellcrackers could control snail populations in ponds well enough to affect the level of trematode infestation in the fish population. The potential use of shellcrackers for this purpose could have had important public health implications. Ray Allison, a parasitologist with the Department of Zoology-Entomology, was enlisted to help with this project (Figure 103). In 1962, his name was included for the first time on the list of 'Investigators' in the fisheries research group. Then early in 1964, NIH provided funds for another research project: '*Parasitocidal Activity of Organic Compounds.*' If I remember correctly Allison was the Principal Investigator on this Project, as well.

EARLY STUDIES BY THE ALLISON WORK GROUP

Ray Allison (Figure 103) a native of North Carolina joined the faculty of the Department of Zoology-Entomology at Auburn in 1950. He attended Carolina College from 1939-1943, but before he could complete requirements for the B. S. Degree, he was called into military service (1943-1945). After the war, he returned to Carolina and was awarded the degree (Biology) in 1946. He was awarded the M.S. Degree (Zoology) by North Carolina State University in 1950. He joined the faculty in Auburn in 1950 to work in the area of wildlife parasites. In 1956, he took a leave-of-absence from Auburn and entered a Ph.D. program at Louisiana State University. He remained at LSU until 1958 when he returned to Auburn. He was awarded the Ph.D. by LSU in 1961.

Allison spent most of his research career working in the area of fish parasites; however, near the end, he developed an interest in aquaculture. He was especially interested in high-density, re-circulating production systems. The following list of publications are indicative of the types of research that he and his Work-Group did over the years:

1. A preliminary note on the use of Di-n-Butyl Tin Oxide to remove tapeworms from fish (Allison, 1957).
2. Observations on the infestation of a fresh water fish by a marine copepod (Kelly and Allison, 1962).
3. An epizootic of *Ichthyophtherius multifiliis* in a river fish population (Allison and Kelly, 1963).

4. **Some host responses of white catfish to *Ichthyophirius multifiliis*, Fouquet (Beckert and Allison, 1964).**
5. **Experimental biological control of a trematode parasite of bluegill (Avault and Allison, 1965).**
6. **Monogenetic trematodes of some Alabama freshwater fishes with description of four new species and redescription of two species (Allison and Rogers, 1970).**
7. **Evaluation of a closed recirculating system for tilapia culture (Rakocy, 1980).**
8. **Maximizing tilapia production in re-circulating systems by sequential rearing (Paessun and Allison, 1984).**

THE SOUTHEASTERN COOPERATIVE FISH PARASITE AND DISEASE PROJECT

The Dingell-Johnson Sport Fish Restoration Act of 1950 encouraged States receiving federal funds to use a portion to establish cooperative projects involving several states to work on problems of common interest. The 1964 Annual Report described the establishment of the Southeastern Cooperative Fish Parasite and Disease Project at Auburn, utilizing some of these funds. Also, John Grizzle (Grizzle, 2004) has written an informative history on the establishment of the Project and its accomplishments. Additional details regarding its establishment are presented in a following Section.

Grizzle (2004) commented that Swingle and Allison prepared a proposal for the Project in 1963. It was submitted to the Southeastern Association of Game and Fish Commissioners. It was quickly approved, and Swingle asked Ray Allison to get the new Cooperative Project started. He immediately called Bill Rogers, who was serving as the Assistant Director of the Warm-Water, In-Service, Fish Hatchery Training School of the U.S. Fish and Wildlife Service at the Marion, Alabama National Fish Hatchery, to enquire about his interest in returning to Auburn to manage the new project. Remember that Rogers had received the M.S. Degree from Auburn in 1960. Although he had recently agreed to go to North Carolina State as Assistant Leader of their Cooperative Fisheries Research Unit, he agreed to accept the Auburn offer instead. Later, George Krantz (1965) and Nikola Fijan (1966) were employed to assist Rogers in making the Project operational.

THE KRANTZ CONTRIBUTION

It was obvious from the beginning that Rogers could handle the parasitic diseases portion of the new fish health program, but we needed to hire someone to take charge of the bacterial and viral diseases portion; consequently, in 1965, Dr. George Krantz was employed. Unfortunately, he resigned April 1, 1966. Although he did not remain with the Project very long, he did help to establish a laboratory for diagnosis and research in this area.

THE WELLBORN CONTRIBUTION

Sometime in 1964, the Fish and Wildlife Service moved the Office of the 'Regional Hatchery Biologist' to Auburn. At the same time, Tom Wellborn, who was serving in that capacity, entered the Ph.D. program, and began his dissertation research on the taxonomy of protozoan fish parasites. Although he was not directly responsible for any part of the 'P and D' Project or for the new Fish Health Program, his presence contributed to the over-all capability of Auburn in building a viable teaching, research and outreach program in this area.

STUDIES BY THE FIJAN WORK GROUP

In November 1966, Dr. Nikola Fijan joined the faculty as a Visiting Assistant Professor in Fish Diseases. He had worked in the area of fish diseases for a number of years at the University of Zagreb in Yugoslavia. Swingle had met him while working with FAO in Rome. His presence further strengthened Auburn's capacity to serve the needs of the States in the Cooperative Project. He remained with the Project until November 13, 1968.

Soon after Fijan arrived, the Southeast experienced another 'outbreak' of 'columnaris' disease. In the spring of 1967, the Cooperative Fish Parasite and Disease Laboratory received 69 samples of fish thought to have been killed by the disease. *Chondrococcus columnaris* was identified as the likely causative agent in 19 of the cases. Afterwards, he evaluated the sensitivity of the organism to 78 antimicrobial compounds in the laboratory, but there is no indication that any of them were evaluated under field conditions.

Early in 1968, 'P and D' laboratory personnel were confronted with several cases of unusual mortality of fingerling channel catfish from different locations within the region. After a considerable amount of study, it was concluded that the deaths were the result of a viral infection. Later, Fijan and his Group isolated the virus, and in laboratory studies, demonstrated that it resulted in the elaboration of the same abnormal cell characteristics that were observed in fish killed in the field. He described the result of these studies in the publication, *An Acute Viral Disease of Channel Catfish* (Fijan, et al., 1970).

Fijan would return to Auburn in the early 90s as a Visiting Professor. He remained here until taking a position in the Fish Health Program at the University of Arkansas at Pine Bluff.

STUDIES BY THE ROGERS WORK GROUP

As detailed in the preceding paragraph, Bill Rogers came to Auburn in 1964 to administer the new Southeastern Cooperative Parasite and Disease Project, while working on his Ph.D. Degree. He published his first paper based on original research on monogenean fish parasites in 1965 (Rogers and Wellborn, 1965). In the next two decades, he and his Work Group published some 20 papers on the taxonomy and biology of this Class of ectoparasites:

1. Eight new species of *Gyrodactylus* from the southeastern U.S. with rediscussions of *G. fairporti* Van Cleave, 1921 and *G. cyprini* Diarova, 1964 (Rogers, 1968a).
2. Seasonal abundance of *Gyrodactylus macrochirus* on bluegill and largemouth bass (Rawson and Rogers, 1973).
3. Gill lesions in bluegill infested with *Cleidodiscus robustus* (Thune and Rogers, 1981).

Much of the early research conducted by Rogers and his group involved Monogenean fish parasites, but they conducted considerable research on other groups as well. Some of the publications developed from those studies include:

1. Fish mortalities associated with *Goezia spp.* (Nematoda: Ascaroidea) in central Florida (Gaines and Rogers, 1971).
2. The parasitic copepod *Ergasilus* from the skin of the gizzard shad (Rogers and Hawke, 1978).
3. *Pomphorhynchus lucyi sp. N.* (Acanthocephala) from fresh and brackish water fishes of the southeastern Gulf Coast (Williams and Rogers, 1984).
4. Interaction of bass tapeworm and *Neoechinorhynchus spp.* (Acanthocephala) in largemouth bass (Durborow, et al., 1988).
5. *Neoergasilus japonicus* (Poecilostomatoida: Ergasilidae), a parasitic copepod new to North America (Hayden and Rogers, 1998).

During his long career, Rogers and his Work Group also published the

results of several studies on the control of specific parasites, including:

1. The biology and control of the anchor worm, *Lernaea cyprinacea* (Rogers, 1968b).
2. Control of the bass tapeworm, *Proteocephalus ambloplites* (Leidy), with mebendazole (Boonyaratpalin and Rogers, 1984).
3. Effect of Droncit (Praziquantel) on yellow grubs (*Clinostomum marginatum*) and eye flukes (*Diplostomum spathaceum*) in channel catfish (Plumb and Rogers, 1990).

STUDIES BY THE PLUMB WORK GROUP

After Fijan left Auburn's Fish Health Program in 1968, we were again without the services of a specialist in fish diseases; consequently, we contacted Dr. Ken Wolf at the Eastern Fish Health Laboratory for a recommendation regarding a specialist in this area that we might employ. He suggested that we contact John Plumb, who was working at the Federal Fish Hatchery in Genoa, WI, at that time. In early 1968, we were in the beginning stages of the International Program, and Swingle was away from the campus for much of the time. As a result, he asked me to interview John for the position. John agreed to join the 'P and D' Project with the stipulation that he be allowed to work on his Ph.D. Degree. He was the ideal person for the job. He had spent time at Leetown, so he was well acquainted with all aspects of the field of bacterial fish diseases. In addition, he was acquainted with the rapidly emerging field of viral fish diseases, and the use of tissue culture in studying them. John agreed to come, and joined the faculty as an Instructor in Fish Diseases in April, 1969.

John Plumb, a native of Virginia, received the B.S. Degree in General Biological Sciences from Bridgewater College in 1960. In 1963, he was awarded the M.S. Degree in Zoology by Southern Illinois University. In 1962, he joined the U.S. Fish and Wildlife Service and served as both a Fish Hatchery Manager and a Fish Hatchery Biologist until 1964. Between 1964 and 1965, he attended 10-month course in Warm-Water Fish Hatchery Management at Marion, AL. Then between 1966 and 1967, he attended a course in fish diseases at Leetown, W.V.

Plumb arrived in the midst of the furor over the channel catfish virus disease, and immediately began work to expand on Fijan's earlier studies. In 1971, he published a progress report on the status of research at Auburn (Plumb, 1971). In the following decade Plumb and his Work Group would publish nine papers on the disease, including:

1. Histopathology and electron microscopy of channel catfish in

infected channel catfish (Plumb, et al., 1974).

2. Channel catfish virus experiments with different strains of channel catfish (Plumb, et al., 1975).
3. Epizootiology of channel catfish virus disease (Plumb, 1978).

The importance of 'Enteric Septicemia' (ESC) as a disease of cultured channel catfish was first recognized around 1976. In 1979, John Hawke, an Auburn alumnus working at LSU, published a paper reporting the isolation of a bacterium associated with the disease (Hawke, 1971). Then in 1981, Hawke, et al., proposed the name *Edwardsiella ictaluri* for the causative organism.

Plumb and his Work Group published their first paper on 'Enteric Septicemia' in 1983. It was based on studies of the pathogenicity of the causative organism, under laboratory conditions when injected into the catfish (Areechon and Plumb, 1981). Over the next decade, they published the results of several studies on 'ESC' including:

1. Modular effects of temperature on immune response (Plumb, et al., 1986).
2. Kinetics of the immune response of channel catfish to *Edwardsiella ictaluri* (Vinitnantharat and Plumb, 1992).
3. Optimum concentration of *Edwardsiella ictaluri* vaccine in feed for oral vaccination of channel catfish (Plumb and Vinitnantharat, 1994).

In 1995, Plumb and his Work Group isolated a virus from moribund largemouth bass taken from Santee-Cooper Reservoir in South Carolina, during a sizeable 'kill' of the species there. They reported the results of this study in a 1996 publication (Plumb, et al., 1996). Over the following 5-year period, the Work Group published several additional papers on the so-called 'largemouth bass virus.'

As detailed in the preceding paragraphs, from the late 60s to early in the new century, Plumb and his Work Group spent most of their time on the channel catfish virus, 'Enteric Septicemia' in channel catfish and the 'largemouth bass virus.' However, during the period they also worked on a number of other important disease problems including:

1. *Streptococcus spp.* from marine fishes along the Alabama and northwest Florida coast of the Gulf of Mexico (Plumb, et al, 1974).
2. Virulence of different isolates of *Aeromonas hydrophila* in channel

catfish (De Figueiredo and Plumb, 1977).

3. Effect of stocking density on the mortality of golden shiners resulting from infections with the golden shiner virus (Schwedler and Plumb, 1982).
4. Effects of salinity on Streptococcal infections in the Nile tilapia (Chang and Plumb, 1996).
5. Morphological, biochemical and physiological characterization of four species of fish (Samsudin and Plumb, 1996).
6. Histopathology and pathogenesis of experimental infection with *Edwardsiella tarda* in channel catfish (Darwish, et al., 2000).

Plumb's Work Group also conducted research on a rather unique aspect of fish health – increasing survival of largemouth bass caught in fishing tournaments. Bass fishing tournaments had grown rapidly in popularity since the late 60s, but early in their history, there was also growing public concern about the destruction of large numbers of fish in these contests. As a result, the Bass Anglers Sportsman's Society under the leadership of Ray Scott began to require that only live fish would be considered at weigh-ins in their tournaments, but there was still concern for the fate of the live fish when they were returned to the 'wild.' Plumb's Work Group published the results of their first study on this problem in 1974, and the results of a more definitive study in 1988:

1. Experimental use of antibiotics in preventing delayed mortality in a bass tournament on Lake Seminole, Georgia (Plumb, et al., 1974).
2. Survival of caught and released largemouth bass after containment in live wells (Plumb, et al., 1988).

STUDIES BY THE GRIZZLE WORK GROUP

John Grizzle was appointed Assistant Professor in the Department July 1, 1976. A native of Oklahoma, he had received the B.S. Degree in Zoology from Oklahoma State University in 1971 and the M.S. also in Zoology from the same institution in 1972. He came to Auburn the same year as an NSF Graduate Fellow. He was awarded the Ph.D. Degree in 1976, and he joined the faculty on July 1 of that year. Rogers served as chairman of his graduate committee.

Grizzle brought a unique perspective to the Fish Health Group – pathology. He was designated as a "Certified Fish Pathologist" by the American Fisheries Society for most of his career. He contributed to the Department's

Fish Health Program in many ways. One of his most important contributions was in area of the pathological effects of diseases on cultured fishes. He and his Work Group published the results of numerous studies in this area including:

1. Pathology of cyprinid fishes caused by *Bothriocephalus gowkongensis* (Scott and Grizzle, 1979).
2. Hematology and histopathology of an idiopathic anemia of channel catfish (Noyes, et al., 1991).
3. Histopathology of gill, liver, and pancreas, and serum enzyme levels of channel catfish infected with *Aeromonas hydrophilia* complex (Grizzle and Kiryu, 1993).
4. White grub *Posthodiplostomum minimum centrarchi metacercarie* in the liver of largemouth bass: quantification and effects on health (Grizzle and Goldsby, 1996).
5. Early changes in pigmented macrophages in head kidney of channel catfish infected with *Aeromonas hydrophilia* (Matsche and Grizzle, 1999).

Throughout most of his career, Grizzle's Work Group also studied the toxicological effects on fish of various chemicals and environmental conditions. Publications resulting from these studies included:

1. Hematological changes in fingerling channel catfish to malachite green (Grizzle, 1977).
2. Nitrite-induced predisposition of channel catfish to bacterial diseases (Hanson and Grizzle, 1985).
3. Acute toxicity of aflatoxin B₁ to channel catfish (Jantrarotai, et al., 1990).
4. Oral toxicity of rotenone for common carp (Fait and Grizzle 1993).
5. Acute toxicity of an acid mine drainage mixing zone to juvenile bluegill and largemouth bass (Henry, et al., 1999).

In the later stages of his career, Grizzle and his Work Group were involved in a number of important studies on the effect of "electro-fishing" on the health of fish taken with this new technology. Several publications were developed from these studies including:

1. **Electroshocking-induced injuries in newly transformed fish (Henry and Grizzle, 2003).**
2. **Electroshocking-induced mortality of four fish species during post-hatching development (Henry, et al., 2003).**
3. **Survival of largemouth bass, bluegill and channel catfish embryos after electroshocking (Henry and Grizzle, 2004).**
4. **Susceptibility of ten fish species to electro-shock mortality (Henry, et al., 2004)**

CONTRIBUTIONS OF THE BRADY WORK GROUP

joined the Fish Health Group in a professorial capacity in 1985. A native of Mississippi, she had been awarded the B. S. Degree in Marine Biology by the University of Mississippi in 1978. Later, in 1982, she received an M.S. Degree in Microbiology from the University of Southern Mississippi. She entered the Ph.D. Program at Auburn in 1982, and was awarded the degree in 1985. John Plumb served as chair of her graduate committee. Much of Yolanda's early work at Auburn involved studies on several viruses which affect cultured fish. She and her Work Group were especially interested in characteristics of these viruses at the molecular level. Publications developed from some of these studies included the following:

1. **Serological comparison of golden shiner virus, chum salmon virus, reovirus 13P2 and catfish reovirus (Plumb, 1988).**
2. **Replication of four aquatic reoviruses in experimentally infected golden shiners (Brady and Plumb, 1991).**
3. **Survival in pond water of four reoviruses isolated from aquatic animals (Brady, et al., 1993).**
4. **Cloning and expression of a putative glycoprotein gene of channel catfish virus using baculovirus expression system (Kucuktas, et al., 1998).**
5. **Molecular biology of channel catfish virus (Kucuktas and Brady, 1999).**

Later in her career, Brady and her Work Group became involved in the safety of seafood. They were especially interested in suppressing numbers of *Vibrio vulnificus* in raw oysters. Publications resulting from this research were listed in the preceding Section on 'oyster diseases.'

STUDIES BY THE ARIAS WORK GROUP

Covadonga (Cova) Arias, a native of Spain, joined the Fish Health Group at Auburn in 2002. She was awarded both the B.S. (Biochemistry - 1993) and Ph.D. Degrees (Microbiology-1998) by the University of Valencia in Spain. Before joining the faculty here, Dr. Arias served as a Post-doctoral Research Associate at the Citrus Research and Education Center at the University of Florida. Cova and her Work Group have also been extremely active in the broad area of the molecular biology of microorganisms causing diseases in fish. The following publications are indicative of their contributions in this field.

1. A comparative study of *Edwardsiella ictaluri* (EILO) and *E. ictaluri* rifampicin-mutant (RE-33) isolates using lipopolysaccharides, outer membrane proteins, facids, Biolog, API 20E and genomic analysis (Arias, et al., 2003).
2. Genetic fingerprinting of *Flavobacterium columnare* isolates from cultured fish (Arias, et al., 2004).
3. Comparison of lipopolysaccharide and protein profile between *Flavobacterium columnare* strains from different genovars (Zhang, et al., 2006).
4. Combined use of 16S ribosomal DNA and automated ribosomal intergeneric spacer analysis to study the bacterial community in catfish ponds (Arias, et al., 2006).
5. Identification and characterization of an intervening sequence within the 23S ribosomal RNA genes of *Edwardsiella ictaluri* (Zhang and Arias, 2007).
6. First report of *Yersinia ruckeri* Biotype 2 in the USA (Arias, et al., 2007).
7. Catfish hybrid *Ictalurus punctatus* X *I. furcatus* exhibits higher resistance to columnaris disease than the parental species (Arias, et al., 2012).

STUDIES BY THE TERHUNE WORK GROUP

John Plumb retired in September, 1998, and Dr. Jeffrey Terhune was employed to replace him in the general area of bacterial fish diseases. Dr. Terhune brought a different philosophy to the Department's Fish Health Program. He was more interested in the molecular biology of the disease process. The implementation of this philosophy required the involvement of

a much larger group of researchers. For example, in a 2007 publication (Peatman, et al., 2007) reporting the results of research describing the response of channel catfish to infection by a gram-negative bacterium, listed the names of 11 different scientists, including Terhune, who had cooperated on the project.

Jeff received his B.S. Degree (Aquaculture, Fisheries and Wildlife Biology) in 1990 from Clemson University. Later, he received the M.S. Degree (Aquaculture, Fisheries and Wildlife Biology) from Clemson in 1993, and the Ph.D. Degree (Microbiology) from the same institution in 1999. After graduation, he accepted a position as Assistant Research Professor with the Thad Cochran National Warmwater Aquaculture Center in Stoneville, MS. He remained in that position until coming to Auburn.

Representative research conducted by Terhune and his fish health Work Group resulted in the development of the following publications:

1. Expression analysis of the acute phase response in channel catfish (*Ictalurus punctatus*) after infection with a Gram-negative bacterium (Peatman, et al., 2007).
2. The two channel catfish intelectin genes exhibit highly differential patterns of tissue expression and regulation after infection with *Edwardsiella ictaluri* (Tomokasu, et al., 2007).
3. Effects of an extended hatchery phase and vaccination against enteric septicemia of catfish on the production of channel catfish, *Ictalurus punctatus*, fingerlings (Carrias, et al., 2008).
4. Cloning, expression, and immunogenicity of *Flavobacterium columnare* heat shock protein DnaJ (Olivares-Fuster, et al., 2010)

STUDIES BY THE BULLARD WORK GROUP

Bill Rogers retired in 1994. Consequently, until 2008 Auburn's Fish Health Program was without the services of a fish parasite specialist. Then in 2008, Dr. Stanley "Ash" Bullard was employed in that capacity. "Ash" is a native of Tennessee. He was awarded the B.S. Degree in Marine Biology by the University of South Carolina (Columbia) in 1997. Then in 2002, he was awarded the M.S. Degree (Coastal Sciences) by the University of Southern Mississippi, and in 2007, the same institution awarded him the Ph.D. Degree (Coastal Sciences). After graduation, he remained with the Gulf Coast Research Laboratory at Ocean Springs as Post-doctoral Fellow. He left that position to come to Auburn in 2008. After joining the fish health group here, he immediately established an extremely active Work Group. They have been involved in a wide range of research projects, generally related to fish

parasitology. Some of the publications relating to their work include:

1. Historical account of the two family-group names in use for flukes (Bullard, et al., 2009).
2. A new species of *Cardicola Short*, 1953 (Digenea: Aporoctylidae) from the heart and branchial vessels of two surfperches (Embiotocidae) in the eastern Pacific Ocean off California (Bullard, 2010).
3. Scanning electron microscopy of “saddleback lesions associated with experimental infections of *Flavobacterium columnare* in channel catfish, *Ictalurus punctatus* (Siluriformes: Ictaluridae) and zebrafish *Danio rerio* (Cypriniformes: Cyprinidae) (Bullard, et al., 2011a).
4. Adhesion dynamics of *Flavobacterium columnare* to channel catfish *Ictalurus punctatus* and zebrafish *Danio rerio* after immersion challenge (Olivares-Fuster, et al., 2011).
5. Molecules infer origins of ectoparasite infrapopulations on tuna (Bullard, et al., 2011b).
6. A new aporocotylid (Digenea) species from blood vascular system of gag grouper, *Mycteroperca microlepis* (Perciformes: Serranidae), off Alabama, with an emendation of *Pearsonellum* Overstreet and Køie, 1989 (Bullard, 2012).
7. *Cardicola langeli* sp. n. (Digenea: Aporcotylidae) from heart of sheepshead, *Archosargus probatocephalus* (Actinopterygii: Sparidae) in the Gulf of Mexico, with an updated list of hosts, infection sites and localities for *Caricola* spp. (Bullard, 2013a).
8. Skin lesions on yellowfin tuna, *Thunnus albacares* from the Gulf of Mexico’s outer continental shelf: morphological, molecular, and histological diagnosis (Bullard, et al., 2017).

FISH NUTRITION AND FEEDING RESEARCH

As detailed in several preceding Chapters, the primary emphasis in the Fish Culture Project, in the early years, was on the use of fertilizers to increase the production of natural foods for fish in ponds. There was little or no interest in feeding fish at that time. In a pond fertilization experiment conducted in 1935 and 1936, Pond D-15 received 1 pound of poultry laying mash per week. Both the production of plankton and fish in this pond were poorer than in ponds receiving inorganic fertilizers. In comments regarding the results, the ‘Investigators’ questioned whether the feed was serving as a fertilizer or whether the fish might have consumed the feed itself. With the

schedule of application, it is more likely that the results were related to a “fertilizer” effect rather than a “feeding” effect.

EARLY WORK

One of the earliest experiments involving the feeding of fish at Auburn was conducted in 1947 when Pond F-10 was stocked with 1,500 bluegill fingerlings and 100 largemouth bass fingerlings per acre. The pond was fertilized, and in addition, the fish were fed daily with pelleted turkey growing ‘mash.’ At the beginning of the experiment, 4 pounds of the feed was fed each day, and at the end, 20 pounds were being applied.

Later, in 1950, it was decided to begin a winter feeding program in the Fishing Quality experiments in several of the ‘E’ Ponds in an attempt to increase the growth of bluegills. Consequently, Ponds E-6, E-7 and E-8 were fed with 10 pounds of soybean cake, per day. Similarly, Ponds E-1, E-2, E-3 and E-4 were fed 20 pounds per day. During the following spring, fish kills resulting from low oxygen levels occurred in all of the ponds except Ponds E-4 and E-8. Apparently, the fish consumed very little of the soybean cake, leaving large quantities covering the bottoms of the ponds. This Experiment was discussed in detail in the 1950 and 1951 Annual Reports.

Zobari (1956) conducted the first formal research in fish nutrition at Auburn when he experimented with feeds and rate of feeding for the common carp. He began this research in 1953. Later he would publish a paper derived from this study on the incidence of avitaminosis in fish fed some of the feeds (Zobari, 1956).

In 1956, E. E. Prather (1957) conducted an experiment on the winter feeding of fathead minnows in which he fed the fish with the so-called Auburn No. 1 fish feed. It consisted of soybean oil meal (35 percent), peanut oil meal (35 percent), fish meal (15 percent) and distillers dried solubles (15 percent). This feed was formulated by Prather, and this is the first published record of its use.

In 1958, Prather (1958) conducted another experiment on the winter feeding of fatheads. By this time he had changed the formulation of Auburn No. 1 fish feed, by replacing the peanut oil meal with ground peanut cake. This substitution reduced the fiber content of the feed. The new formulation was given the name: Auburn No. 2 fish feed. This particular formulation, in pelleted form, would be used as the feed of choice for experiments at Auburn involving feeding, for a number of years.

While at Cornell, I had received a good exposure to the field of fish physiology and nutrition. I took several courses in biochemistry, physiology and animal nutrition. My Major Professor was Dr. Art Phillips, who was a

world leader in the field of trout feeds and feeding. He had been in charge of the Cortland National Fish Hatchery and Trout Nutrition Laboratory for many years. I was a student in his course 'Fish Culture' which was primarily devoted to the practical aspects of feeds and feeding of trout.

I began work at Auburn on February 1, 1959; however, I was not at first employed to work in nutrition. Rather, I was employed to work on a project on the use of herbivorous fishes to control aquatic weeds, funded by the U.S. National Institutes of Health. Fortunately, while my primary responsibility was with the NIH Project, I was given the opportunity to begin nutrition research, primarily through the supervision of graduate students. The following publications resulted from these early efforts:

1. The protein requirement of channel catfish, *Ictalurus punctatus* (Raff.) (Nail, 1962).
2. Utilization of casein and soybean protein by channel catfish, *Ictalurus punctatus* (Raff.) (Krishnandhi and Shell, 1965).

By the mid-60s, all aspects of the Fisheries Program at Auburn were growing rapidly. This was especially true with the teaching program. Also, the number of foreign students coming to campus was growing almost exponentially. Then in 1965, the program received the large Rockefeller Foundation Grant, and in 1967, we received the first contract with USAID. As a result of these rapid changes, I was asked to take a larger role in program administration. At this point, my research career in nutrition ended.

STUDIES OF THE LOVELL WORK GROUP

During the period (1964-1967) when Dr. Smitherman was serving as Unit Leader of the Louisiana Cooperative Fisheries Research Unit at L.S.U., he became acquainted with Dr. Richard T. Lovell, who was on the faculty at the University. Lovell was a native of northwestern (Lockesburg) Arkansas. He had attended Southern State College during the period 1952-1954. Then in 1956, he was awarded the B. S. Degree in Dairy Science by Oklahoma State University. Late, in 1958, the same institution awarded him the M.S. Degree in Animal Nutrition. In 1963, he was awarded the Ph.D. Degree in Animal Nutrition and Biochemistry by Louisiana State University.

Dr. Smitherman returned to Auburn in 1967 to assist with the activities of the International Program. The decision was made sometime in 1969 to add a faculty member in the area of fish processing and technology and nutrition. With Dr. Smitherman's recommendation, Dr. Lovell was contacted concerning his interest in moving to Auburn. On February 1, 1969, he was appointed to the position of Associate Professor (Fish Technology). It was assumed at that point that I would continue to conduct some research in fish

nutrition and that Dr. Lovell would work in processing and technology; however, with my becoming increasingly involved with administration, Lovell was asked to also work in nutrition. This was a very fortuitous development. He was much better prepared to work in this area, given his strong background in animal nutrition. For the next 30 years, Lovell's Work Group would conduct research on a broad array of studies, primarily related to the nutritional requirements and feeds and feeding of channel catfish. Over the years, he attracted an amazing number of excellent graduate students, and throughout his career, he was ably assisted by several outstanding Laboratory Technicians. At the end of his career, he would have trained a large share of all of the fish nutritionists in the world working in the field of warm-water aquaculture.

Dr. Lovell's first published paper at Auburn dealing with the nutritional requirements of channel catfish was a cooperative effort with Ellis Prather. It described an experiment to evaluate the effect on the growth of channel catfish fingerlings of fortifying the Auburn No. 2 fish feed with a vitamin 'package' (Prather and Lovell, 1971). A considerable amount of Lovell's early work dealt with the requirement of channel catfish for certain specific nutrients (fiber, protein, phosphorus, etc.). Results of some of that research was developed into the following publications:

1. Protein requirements of cage-cultured channel catfish (Lovell, 1972).
2. Response of intensively fed channel catfish to diets containing various protein-energy ratios (Prather and Lovell, 1973).
3. Value of fiber in production-type diets for channel catfish (Leary and Lovell, 1975).
4. Energy (Lovell, 1976).
5. Dietary phosphorus requirement of channel catfish (Lovell, 1978).
6. Essentiality of vitamin D in diets of channel of channel catfish (Lovell and Li, 1979).

In 1971, Lovell published his first paper on the preparation of feeds for channel catfish. It summarized a large amount of literature on the subject. Through the years, he and his Work Group continued to conduct research on 'least-cost,' but effective rations, for commercial production of the species. Results of some of these studies were used in the preparation of the following publications:

1. Significant aspects of feed preparation for feeding catfish (Lovell, 1971).

2. Effects of addition of fish meal to all-plant feeds on the dietary protein needs of channel catfish in ponds (Lovell, et al., 1974).
3. The use of heat-treated soybean meal in rations (Lovell, 1980a).
4. Comparison of extruded and pelleted feeds (Mgbenka and Lovell, 1984).
5. Protein-to-energy ratios in production diets (Reis, et al., 1989).

Lovell's first research on the feeding of channel catfish involved the evaluation of winter feeding. His Work Group continued to conduct research on practical feeding practices for channel catfish in commercial production throughout the remainder of his career. Publications of these studies included the following:

1. Winter feeding of channel catfish (Lovell and Sirikul, 1974).
2. Effect of fish size on feeding response (Lovell, 1984).
3. Comparison of satiate and restricted feeding with diets of varying protein quality (Munsiri and Lovell, 1993).
4. Variable feed allowance with constant protein input for channel catfish cultured in ponds (Cho and Lovell, 2003).

Lovell and his Work Group conducted numerous studies on nutrition and fish health over the course of his career. He encountered the first problem in this general area shortly after beginning his research career at Auburn – the so-called 'broke-back' syndrome. This problem had been identified by personnel of Auburn's Fish Health Group. In their investigations, they identified the pathological effect, but no apparent cause. Lovell surmised that the lack of vitamin 'C' in commercially prepared feeds was the likely culprit. Publications related to these and similar types of problems included:

1. Essentiality of vitamin C in feeds for intensively fed caged channel catfish (Lovell, 1973).
2. Elevated levels of ascorbic acid an immune response in channel catfish (Li and Lovell, 1985).
3. Acute toxicity of Aflatoxin B to channel catfish (Jantrarotai, 1990).
4. Dietary lipid sources influence responses of channel catfish (*Ictalurus punctatus*) to challenge with *Edwardsiella ictaluri* (Fracalossi and Lovell, 1994).

5. Response to *Ewardsiella ictaluri* challenge by channel catfish fed organic and inorganic sources of selenium (Wang and Lovell, 1997).

As detailed in a preceding paragraph, most of the research conducted by Lovell and his Work Group concerned the various aspects of the nutrition of the channel catfish, but they also did some important work on the nutrition of other species as well. Publications developed from these studies included the following:

1. Value of menhaden oil in the diet of Florida pompano (Williams, et al., 1985).
2. Digestive enzyme activities in striped bass from first feeding through larva development (Baragi and Lovell, 1986).
3. Intensive feeding of grass carp in ponds (Mgbenka and Lovell, 1986).
4. Identification of feed enhancers for juvenile largemouth bass *Micropterus salmoides* (Kubitza, et al., 1997).
5. Effect of protein to energy ratio in purified diets on growth performance, feed utilization and body composition of Mozambica tilapia, *Oreochromis mossambicus* (Peters) (El-Dahhar and Lovell, 1995).
6. Diet preparation for aquarium fishes (Boonyaratpalin and Lovell, 1977).

STUDIES BY THE DAVIS WORK GROUP

Dr. Lovell retired in 1998. Dr. Allen Davis was employed to replace him in December, 1999. Davis brought a significantly broadened perspective to the Auburn Aquatic Animal Nutrition Program. Between 1999 and 2012, he conducted nutrition and feeding research on at least 10 different species of aquatic animals, including: 'sunshine' bass, bluegills, channel catfish, yellow perch, Florida pompano, white seabass, brown- and Pacific white shrimp, red- snapper and Nile tilapia. Note that most of these are marine species.

Dr. Davis came to Auburn from the Marine Science Institute of the University of Texas (Port Aransas) where he was employed as a Research Associate. He had received the B.S. Degree in Biology and Chemistry from Northern Arizona University in 1983. Later, he was awarded the M.S. (1986) and Ph.D. (1990) Degrees in Wildlife and Fisheries Sciences from Texas A&M University.

The major thrust of Davis' research at Auburn has been the formulation of practical feeds for cultured aquatic animals without the use of fishmeal. He and his nutrition research Work Group have also conducted considerable research on the dietary lipid and amino acid requirements of these animals. Following is a list of research publications produced by Davis' Work Group. They are indicative of the breadth and depth of their research during his tenure at Auburn:

1. Evaluation of practical bluegill diets with varying protein and energy (Hoagland et al., 2003).
2. Replacement of fish meal with soybean meal in the production diets of juvenile red snapper, *Lutjanus campechanus* (Davis, et al., 2005a).
3. Interrelationship among methionine, choline and betaine in channel catfish *Ictalurus punctatus* (Wu and Davis, 2005).
4. Chelated potassium and arginine supplementation in diets of Pacific white shrimp reared in low-salinity waters in West Alabama (Saoud, et al., 2007).
5. Replacement of fish meal with poultry byproduct meal as a source of protein in pond-raised sunshine bass, *Morone chrysops* X *M. saxatilis*, diets (Pine, et al., 2008).
6. Methionine requirement in practical diets of juvenile Nile tilapia, *Oreochromis niloticus* (Nguyen and Davis, 2009).
7. Evaluation of apparent digestibility coefficient of energy of various vegetable feed ingredients in Florida pompano, *Trachinotus carolinus* (González-Felix, et al., 2010).
8. Pond demonstration of production diets using high levels of distiller's grains with solubles with or without lysine supplementation for channel catfish (Zhou, et al., 2011).
9. Use of soy protein concentrate in practical diets for Pacific white shrimp (*Litopenaeus vannamei*) reared under field conditions (Sookying and Davis, 2012).

FISH PROCESSING AND TECHNOLOGY RESEARCH

As detailed in a preceding paragraph, Tom Lovell was initially employed to conduct research and teach in the area of fish processing and technology. Fortunately, instead, he quickly focused his career on fish nutrition. However, he did publish the results of several studies in

processing and technology.

EARLY WORK

Swingle was involved in the first research and development work done in fish processing and technology at Auburn, in his research on the commercial production of red cats (speckled bullheads), channel catfish and bigmouth buffalo (Swingle, 1957a, 1957b and 1957c). He also studied the best procedures for cleaning and processing each species. Included in these studies were estimates of 'dress-out' percentages and estimates of time and costs of hand labor required, for 'butchering,' cleaning and packaging.

STUDIES OF THE LOVELL WORK GROUP

Lovell did not spend very much time working in the area of Fish Processing and Technology. Almost from the beginning, catfish processing was developed as a commercial enterprise (Perez, 2006). Those entrepreneurs quickly accepted the responsibility for the development of the necessary technology in this area. Lovell's Work Group did publish the following reports on their work:

1. Report from the processing and marketing subcommittee of Project S-83 (Lovell and Ammerman, 1974).
2. Utilization of catfish processing waste (Lovell, 1980b).
3. Design of small scale catfish processing plants in Alabama (Lovell, et al., 1981).

Lovell and his Work Group were also active in another area generally related to processing and technology – 'off-flavor.' Shortly after arriving in Auburn, he became involved with the rapidly growing problem of objectionable flavors in commercially produced and processed channel catfish. 'Off-flavor' is and always will be a water quality problem in commercial catfish production. Fortunately, the production of geosmin varies with time. Under some circumstances, there is very little of it present in pond water, or in the fish. Because virtually all of the fish in a pond are either 'off-flavor' or 'on-flavor,' at any one time, by 'taste-testing' a small sample of fish just before the scheduled harvest, a large share of severely 'off-flavored' fish can be kept off the market.

Early in the history of the channel catfish production industry, 'off-flavor' quickly became an extremely serious problem. In 'worse-case' situations 'off-flavored' fish were almost inedible. The problem quickly threatened the future of the entire industry. Unfortunately, we had little money to begin the necessary research required in this area. For a number of years, Senator

Hinton Mitchem (D) represented the 9th District, and served as Chairman of the Finance Committee in the Alabama Senate. He had a fish pond at his home in Union Grove in northwest Marshall County, several miles northeast of Arab. Late one fall he called John Jensen, requesting that he check his pond for 'balance.' When John was next in the area, he went to Mitchem's pond. On the trip to the pond, the air temperature fell to 38 degrees. John was by himself, so he put one end of a 15-foot seine on the bank and made several 'quadrant' hauls in different parts of the pond. Unfortunately, Hinton had forgotten to tell his wife that John was coming. While John was seining, Mrs. Mitchem called her husband out of a Committee Meeting in Montgomery to tell him that "someone was swimming in the pond." John later called the Senator to give him the results of his extremely cold 'pond-check.'

Later, Milton Parsons with ALFA talked with the Senator about the 'off-flavor' problem in catfish in west Alabama. Soon thereafter, Mitchem called the President to tell him that if he would provide the Fisheries Program with \$50,000 for 'off-flavor' research immediately, he would insert a 'Line-Item' for \$50,000 in the forthcoming State Education budget for 'off-flavor' research at Auburn.

Off-and-on, for over 30 years Lovell and his Work Group conducted research on the 'off-flavor' problem. Once processors developed a rapid 'smell' test for the presence of the compound causing 'off-flavor,' research on the problem became somewhat less critical. Using this method, a sample of fish was removed from the pond and 'tested.' If the sample of fish indicated a high level of the compound, fish were not harvested from that pond at that time. Results of research conducted periodically over this long period of time were used to develop the following publications:

1. Environment-related off-flavors in intensively cultured fish (Lovell, 1973).
2. Absorption by channel catfish of earthy-musty flavor compound synthesized by blue-green algae (Lovell and Sackey, 1973).
3. Geosmin and musty-muddy flavors in pond-raised channel catfish (Lovell, et al., 1986).
4. Sampling channel catfish ponds for pre-harvest off-flavor detection (Gautier, et al., 2002).

OTHER CONTRIBUTIONS

After Lovell's retirement, there was little Faculty interest in Fish Processing and Technology; however, in the past few years several studies have been completed in this area. Publications resulting from these studies

include:

1. Evaluation of textural properties of channel catfish (*Ictalurus punctatus*) fillets with the natural contour method (Jiang, et al., 2008a).
2. Production and processing trait comparisons of channel catfish, blue catfish and their hybrids, grown in earthen ponds (Jiang, et al., 2008b).
3. Correlations of xanthophylls in catfish fillets, plankton, shad and snails in catfish production ponds in west Alabama (Hu, et al., 2013).
4. Coloration characteristics of mechanically processed channel catfish (*Ictalurus punctatus*) held in refrigerated storage for seven days (Peterman and Cline, 2013).

RESEARCH ON WATER QUALITY IN AQUACULTURE

As detailed in a preceding Section, very early in the evolution of the Auburn Fisheries Program, the 'Investigators' had determined that by altering the water quality of farm fish ponds by adding inorganic chemical compounds (fertilization), they could enlarge of the base of the 'Food Pyramid.' In the succeeding years, much of their research on the water quality in ponds centered around improving the effectiveness and efficiency of fertilization. In those early years, there were few water quality related problems that resulted in the death of fish. According to the Annual Reports, there were a few fish 'kills' that seemed to be related to water quality, but they were more-or less dismissed as an annoyance.

The subject of water quality problems in fertilized ponds was not mentioned in either *Bulletin 254* or its revision. Still, there was at least one situation in which poor water quality could have a devastating effect on the entire population. For example, a sudden, unusually cold, 'down-pour,' associated with an especially violent thunderstorm during the summer, could quickly and thoroughly 'mix' the contents of the entire pond. In this situation, water from near the bottom of the pond, containing little or no oxygen, would be quickly mixed with surface water which was likely to be near saturation. If the volume of the low-oxygen water was sufficiently large, the resulting 'mixed-water' volume would not contain enough oxygen to support the requirements of the fish. Under this unusual condition, within a very few minutes, virtually all the large fish in the pond would be killed. Usually, most of the algae and invertebrates were also killed. In most cases, the losses were so severe that the pond had to be drained and restocked.

EARLY WORK

One persistent water quality problem encountered in the ‘D’ Series research resulted from seepage of water from beneath the base of the Farm Pond 1 dam. Water continuously seeped through the soil into one of the ponds near the base of the dam. As a result, the acidity of the water in that pond was always much lower than those around it.

As noted in a preceding Section, the ‘Investigators’ encountered the first water quality problems related to feeding fish in ponds in the mid-40s. Remember that they experienced considerable difficulty in maintaining good quality fishing in the ‘E’ Ponds in the Fishing Quality experiments. Once the public was allowed to fish the ponds, they quickly removed most of the large bluegills. The ‘Investigators’ decided that if they could increase the growth rate of ‘replacement’ fish through the addition of soybean ‘cake’ to the ponds, they might maintain good fishing for a longer period of time. Unfortunately, severe ‘fish-kills’ occurred in most of the ponds receiving the feed.

Systematic experimentation on the use of feeding in commercial fish production at Auburn had its beginning with Prather’s (1957) early experiments on the winter feeding of fatheads and with Swingle’s (1957d) early work on the production of channel catfish. These early experiments on the use of feeding of fish in earthen ponds required the consideration of a new variable – water quality and its management. This new problem in the process that would challenge scientists and catfish producers in perpetuity.

STUDIES OF THE BOYD WORK GROUP

Claude Boyd returned to the Auburn Faculty permanently in 1971. He is a native Mississippian. He received a B.S. Degree in Entomology and Chemistry from Mississippi State University in 1962. While he was a junior at MSU, he came under the influence of Dr. Denzel Ferguson, a well-known biologist and a nationally recognized Environmental Toxicologist. Ferguson steered him away from a career in medicine – the career of his paternal grandfather. Boyd did his M.S. research under Ferguson in Environmental Toxicology. He was awarded the M.S. Degree by MSU in 1963. Following Ferguson’s advice, he entered Auburn University in 1964 to work on the requirements for the Ph.D. Degree. In addition to taking all of the regular fisheries management courses, he took several courses in Soil Chemistry. His Ph.D. research on mineral composition of several freshwater algae was supervised by Dr. J.M. Lawrence (Boyd and Lawrence, 1966). Boyd was awarded the Ph.D. Degree by Auburn University in 1966.

After graduation, he was employed for a short time (1966) as an Aquatic Biologist with the Federal Water Pollution Control Administration. He

returned to Auburn in December, 1966 as an Assistant Professor on the fisheries faculty. He resigned in August, 1968, to accept a position as Ecologist with the Savannah River Ecology Laboratory, which was operated by the University of Georgia. While there he had the opportunity to work with the world-renowned ecologist – Eugene Odum. He rejoined the Auburn faculty in May 1971 as an Associate Professor in the recently established Department of Fisheries and Allied Aquacultures. Upon Boyd's return in 1971, Swingle told him that his pond fertilization work needed further refinement. Boyd accepted this comment as a suggestion that he begin work in this area.

POND FERTILIZATION RESEARCH

One of the most significant contributions of Boyd and his Work Group, to the field of farm pond fertilization was his research on the use of lime. As detailed in a preceding Section, the 'Investigators' included calcium carbonate in some the fertilizer mixtures which they evaluated in the 1930s in the 'D' Series on the South Auburn Farm. Under those experimental conditions, they were unable to show a need for it. Remember that the soils on the South Auburn farm were derived from marine sediments.

In Swingle's final summary of all of Auburn's work on pond fertilization (Swingle, 1947), he commented that the use of lime tended to reduce fish production because it 'tied-up' the free carbon dioxide as the bicarbonate; thus making it unavailable to the planktonic algae. As a result of this early research, concern for liming farm fish ponds lay dormant for some 25 years.

Wayne Thomaston received a B.S. Degree in Fish Management in 1955. Afterwards, he was employed by Georgia as a Fisheries Biologist. He was assigned a District that generally ran eastward from Columbus. Being relatively close to the campus, he would visit several times a year to talk with the faculty about the problems that he was encountering in his District. In several years of visits, he would complain about the difficulty of obtaining plankton 'blooms' in ponds constructed on the extremely sandy soils found there. He was particularly concerned with the results he was getting in attempting to fertilize the Sid Dykes Pond near the city. After discussions with Thomaston and visits to some of the ponds in west central Georgia, Boyd decided to begin research on the problem.

Boyd conducted his first experiments on the use of lime in 1973. Later that year, he surveyed ponds for total hardness in several areas of Alabama. In this research, he was provided with invaluable assistance by Dr. Fred Adams of Auburn's Department of Agronomy and Soils, who helped him adapt regular soil testing procedures to pond soils. In 1974, Boyd published the results of this research (Boyd, 1974). In that publication, he suggested that in ponds with a 'natural' total hardness of above 20 parts per million, or in

cases where that level is obtained with the application of lime, plankton production responded well to inorganic fertilization.

Over the next 40 years Boyd and his Work-Group would conduct numerous studies in pond fertilization. The following publications are indicative of their research:

1. Phosphorus dynamics in ponds (Boyd, 1971).
2. Lime requirements of Alabama fish ponds (Boyd, 1974).
3. Phosphorus fertilization of sunfish ponds (Lichtkoppler and Boyd, 1977).
4. Experiments on fertilization of sport-fish ponds (Murad and Boyd, 1987).
5. Reassessment of nitrogen fertilization for sunfish ponds (Tepe and Boyd, 2003).
6. Re-evaluation of potassium fertilization of bluegill, *Lepomis macrochirus*, ponds (Viriyatum and Boyd, 2011).
7. A bicarbonate titration method for lime requirement to neutralize exchangeable acidity of pond bottom soils (Han, et al., 2014).

WATER QUALITY IN COMMERCIAL FISH PRODUCTION

Catfish farmers in west Alabama were already having problems in water quality management in their production ponds when Boyd returned to Auburn in 1971. Although, as noted in the preceding paragraphs, most of his early work concerned pond fertilization, he was interested in this ever worsening problem in catfish production. In 1973, he conducted basic research on the chemical oxygen demand of waters and biological materials from ponds. In the same year, he studied daily changes in water quality in a feeding experiment with channel catfish conducted by Prather and Lovell (1973); however, it was likely the detailed study of a fish kill in Ponds S-1, in 1974, following a massive plankton 'die-off,' that resulted in a long-term commitment to studying this problem. As a result, Boyd and his Work Group conducted many studies on water quality problems and management in aquaculture production ponds. Some of their work has been summarized in the following publications:

1. Chemical oxygen demand of waters and biological materials from ponds (Boyd, 1973d).

2. **Sudden mortality of a massive phytoplankton bloom (Boyd, et al., 1975.)**
3. **Predicting early morning dissolved oxygen concentrations in channel catfish ponds (Boyd, et al., 1978).**
4. **Predicting nighttime dissolved oxygen decline in ponds used for tilapia culture (Romaine, et al., 1978).**
5. **Water quality management in pond fish culture (Boyd and Lichtkoppler, 1979).**
6. **Water quality in ponds for aquaculture (Boyd, 1990).**
7. **Gas supersaturation in surface water of aquaculture ponds (Boyd, et al., 1994).**
8. **Biochemical oxygen demand in channel catfish *Ictalurus punctatus* pond waters (Boyd and Gross, 1999).**
9. **Water and sediment quality, phytoplankton communities, and channel catfish production in sodium nitrate-treated ponds (Chainark and Boyd, 2010).**

The 1990 publication (Boyd, 1990) is particularly noteworthy. This book, published by the Alabama Agricultural Experiment Station, summarized an enormous amount of information on all aspects of water quality in aquaculture ponds, and included a summary of much of the research that Boyd and his Work Group had conducted following his return to Auburn in 1971.

AERATION OF PRODUCTION UNITS

Auburn research on mechanical pond aeration has had a world-wide effect on aquaculture. As early as the late 60s, 'Investigators' became interested in aeration to increase production of catfish in ponds. In 1969, Norris Jeffrey submitted a dissertation on this subject. A year later (1970), Harold A. Loyacano submitted a dissertation describing a follow-up study. I served as Chairman of both Graduate Committees. However, most of the research in this area was conducted by Boyd and his Work Group after he returned to Auburn in 1971. Initially, he had only limited interest in pond aerators; however, the rapidly developing water quality crisis in the catfish farming industry forced him into a role that he did not relish.

It has always been true that 'need-is-the-mother-of-invention,' and this old axiom was certainly appropriate in the 'crisis-ridden' catfish farming

environment of the mid-70s (Perez, 2006). Everyone seemed to agree that the only solution when a water quality crisis was developing, was to effect a rapid increase in dissolved oxygen concentrations by mechanical means. The first machine built specifically for emergency aeration of commercial catfish ponds was designed and constructed by Livingston's Machine Shop in Greensboro, AL. This machine consisted of steel 'paddles' welded to a steel drum which was mounted on the axle of an old automobile differential and powered by a farm tractor through its power take-off (PTO) (Figure 104). At that time, there were a number of commercially available pumps and aerator devices designed for other purposes that could have possibly been used for emergency aeration. In 1978, Boyd and graduate student, Craig Tucker, evaluated several of these devices in their capacity to raise dissolved oxygen concentrations in ponds. In this research, they determined that effectiveness differed significantly. Soon 'everybody-and-his brother' was building and attempting to sell 'machines' for putting oxygen into water.

Later, Thed Spree, a catfish farmer near Boligee, AL designed and constructed a 'paddle-wheel' aerator where a circular array of paddles, mounted on floats, was powered by an electric motor. Boyd had steadily insisted on staying out of the 'paddle-wheel' design field, but Spree's persistent insistence for his cooperation finally forced him to become involved. He studied the various requirements for a functional aeration device for a time, but he knew nothing about the engineering required to design or construct one. Finally, Dr. Priester, a retired Professor of Electrical Engineering, and some of his friends provided him with much of the information that he needed to design a prototype aerator. In the spring of 1985, Lamar Black and the Field Crew constructed a "paddle-wheel" testing tank southeast of the Farm Pond 11 dam. The tank was constructed so that various designs (paddle shapes and arrangements, speeds, depths, etc.) could be evaluated. With the testing tank in place, Precision Prototypes in Opelika, AL, fabricated all of the parts required for constructing the adjustable device. Boyd and one of his graduate students Taufik Ahmad (Indonesia), ran hundreds of tests with various combinations of components and component arrangements over a 3-year period. Finally, he thought that he could design an effective, efficient, floating, electrically operated 'paddle-wheel' aerator; but, he had no idea how to make the engineering drawings required for its construction, or how it might be fabricated.

Later, Boyd attended the annual meeting of the Catfish Farmers of America in Reno, NV, where he verbally described the paddlewheel that he had designed (Figure 105). He returned to Auburn on Tuesday, and on Thursday afternoon, Barry House from Lake Village, AR, arrived at Boyd's Wire Road Office with one of Boyd's aerators on his truck. He had left the meeting after the presentation, returned home and from memory, fabricated the machine. Field tests on House's machine showed that it was far superior to anything commercially available at that time. Soon, a number of other people

fabricated similar machines, and brought them to Auburn for testing.

With the publication of *Design and Performance of Paddle Wheel Aerators*, in 1988, Boyd and his Work Group were essentially finished with the design of these devices. From that time onward, commercial firms assumed this responsibility; however, this did not end his involvement with pond aeration. He continued to be active in the area of the use of aeration in the catfish industry, and with the growth of intensive shrimp farming in Asia and South America, he became deeply involved in the use of aeration in aquaculture on a much broader scale.

Over the years, Auburn 'Investigators' have conducted a large number of experiments on the various aspects of pond aeration. The following list is indicative of the wide range of the research:

1. The use of mechanical aeration in white catfish production ponds (Jeffrey, 1969).
2. Effects of various rates of aeration on water quality and production of white catfish in ponds (Loyacano, 1970).
3. Aeration, water quality and catfish production (Busch, et al., 1973).
4. Emergency aeration of fish ponds (Boyd and Tucker, 1979)
5. Nightly aeration to increase production of channel catfish (Hollerman and Boyd, 1980).
6. Evaluation of aerators for channel catfish farming (Boyd and Ahmad, 1987).
7. *Design and performance of paddle wheel aerators* (Ahmad and Boyd, 1988).
8. Performance of surface aerators in saline pond waters (Boyd and Daniels, 1987).
9. Aeration systems in aquaculture (Boyd and Watten, 1989).
10. Effect of salinity on oxygen transfer by propeller-aspirator-pump and paddle-wheel aerators used in shrimp farming (Ruttanagosrigit, et al., 1991).

INTENSIVE AERATION OF PRODUCTION PONDS

There is currently considerable interest in commercial catfish

production on the use of intensive aeration of production ponds. According to Whitis (personal communication), there are currently several hundred acres of ponds in Mississippi utilizing intensive aeration. In this system, aeration rates as high as 6-8 horsepower per acre are used in production ponds; as compared to the customary rate of 4-6 horsepower.

Auburn researchers have been only minimally involved in this area. Most of their effort has been to verify productions achieved utilizing intensive aeration on private farms in west Alabama. Gregory has been involved in this verification effort for several years. Then in 2015, Lisa Bott (2015) published the results of her Auburn thesis research summarizing a significant amount of the verification data.

POND WATER QUALITY AND THE ENVIRONMENT

The Federal Water Quality Control Act of 1965 significantly increased the role of the Federal Government in all aspects of the control of water pollution in the nation. In 1972, amendments to the Act (known as the Clean Water Act) established the statutory basis for the development of the National Pollutant Discharge Elimination System (NPDES), which required that discharge of pollutants into natural waterways be permitted. The Act required that the Environmental Protection Agency establish “effluent guidelines” on an industry-by-industry basis (Boyd, 2000). Boyd further commented that in 1977, that the EPA had developed a draft report on proposed effluent limitation guidelines for fish hatcheries and ponds; however, the preparation of the report did not result in a proposal for the establishment of national rules. Then in 1992, environmental groups won a court decree that required that the Agency develop effluent guidelines for several additional industries. With the decree ‘in-hand,’ the Environmental Defense Fund sought to convince the Agency that aquaculture should be included in the list of additional industries. In 1998, the Agency announced that indeed aquaculture would be included. Later, it announced that its national rules on the release of effluents from aquacultural operations would be finalized in June, 2004 (Boyd, 2003a).

In the late 70s, Boyd and his Work Group had become concerned about the potential impact of federal rules and permitting on the catfish industry. As a result, they began research on the quantity and characteristics of effluents released when the fish were being harvested. By the end of the 90s, they had completed a number of studies on the subject.

It was not apparent in the beginning that the less than yearly, periodic draining of catfish production ponds would be covered by EPA policy. At that point, most of the catfish were being produced in systems that did not require draining for harvest. Discharges were generally restricted to overflows associated with heavy rain events. As expected, EPA did not initially

prepare national effluent guidelines for aquaculture in ponds (Boyd, 2000).

When it was announced in 1998 that the EPA would indeed write national rules on the discharge of effluents from aquaculture operations, several States decided to take a proactive approach and rushed to develop rules and permitting procedures on their own. Central to these developments were the preparation of Best Management Practices (BMP) for aquacultural operations. In a 2000 publication, Boyd commented that the Alabama Catfish Producers also planned the development of a BMP program. Boyd and his Work Group took the lead in developing them. In 2003, they joined the Alabama USDA-Natural Resources Conservation Service in publishing some 21 BMPs. The resulting publication, entitled *Alabama Aquaculture Best Management Practices*, was published as Special Report 1 of the Alabama Agricultural Experiment Station (Boyd, et al., 2003a). These BMPs dealt with a wide range of aquacultural enterprises and specific aquacultural practices in the State, including: general operations and worker safety, production of bait minnows, cage culture, flow-through systems, feed management and therapeutic agents. In the same year, Boyd and another Work Group published, *Best Management Practices for Catfish Farmers in Alabama* as Special Report 1 of the Alabama Catfish Producers.

It was fairly obvious from the beginning that provisions of The Clean Water Act were never going to provide the level of 'oversight' of the U.S. aquaculture industry that environmental groups desired. As a result, they changed their focus from the use of provisions of the Act to one encouraging the development of so-called certification programs, in which some entity would certify that an aquatic animal had, in fact, been produced under a rigorous set of environmental and social conditions. In advancing the concept of certification, environmental groups assumed that consumers desire seafood produced by environmentally and socially acceptable methods (Boyd, et al., 2005). Boyd and his Work Group expended a considerable amount of effort in developing this concept, and working with International Environmental Groups to establish criteria required for certification and means of implementing systems of evaluation required.

Publications developed in these long-term, wide-ranging efforts to allay environmentalist's concerns include the following:

1. Effluents from catfish ponds during fish harvest (Boyd, 1978).
2. Shrimp aquaculture and the environment (Boyd and Clay, 1998).
3. Formulating standards for effluent management (Boyd, 2000).
4. Environmental assessment of channel catfish *Ictalurus punctatus* farming in Alabama (Boyd, et al., 2000).

5. EPA rule-making for aquaculture effluents in the United States (Boyd and Tucker, 2000).
6. Guidelines for aquaculture effluent management at the farm level (Boyd, 2003a).
7. EPA drafts effluent guidelines for U.S. aquaculture (Boyd, 2003b).
8. Best management practices for channel catfish farmers in Alabama (Boyd, et al., 2003c).
9. Certification issues for some common aquaculture species (Boyd, et al., 2005).

Boyd's pro-active approach seemed to have satisfied everyone, and soon the furor disappeared. By 2004, the environmental effects of their operations were the least of the concerns faced by Alabama catfish farmers, and by Boyd's Work Group as well. A paper written by Boyd, Queriroz and McNevin, *Perspectives on the Responsible Aquaculture Movement* (Boyd, et al., 2013), summarizes much of the history of efforts to encourage and even force producers of aquacultural crops to be better stewards of the ecosystem. An important summary statement stated:

“The broader effects of responsible aquaculture programs will be even more problematic to verify at the regional, country or global levels. Facilities that participate in sourcing policy and eco-liaible certification programs are usually producing products for export to developed countries or they are located in developed countries. The greater majority of aquaculture production is in developing countries, and it is sold to markets in the same or other developing countries where there is no demand for eco-friendly products. The proportion of the total negative impacts of aquaculture that are avoided through better performance by facilities participating in sourcing policy and eco-liaible certification is no doubt quite small and likely un-measurable on a broad scale.”

WATER QUALITY IN MARINE SHRIMP PRODUCTION PONDS

As detailed in a preceding Section, the Greene Prairie Aquafarm was established in 2001. Early problems with post-larval survival led to Auburn 'Investigators' (Boyd and Allen Davis) involvement in research on water quality problems in ponds on that unique aquaculture facility. The following publications are indicative of the kinds of research conducted there:

1. Acclimation of *Litopenaeus vannamei* post larvae to low salinity:

influence of age, salinity endpoint, and rate of salinity reduction (McGraw, et al., 2002).

2. Suitability studies of inland well waters for *Litopenaeus vannamei* culture (Saoud, et al., 2003).
3. Ionic supplementation of pond waters for inland culture of marine shrimp (McNevin, et al., 2004).
4. Effects of potassium, magnesium and age on growth and survival of *Litopenaeus vannamei* in inland low salinity well waters in west Alabama (Davis, et al., 2005b).
5. Potassium budget for inland, saline water shrimp ponds in Alabama (Boyd, 2007).
6. Distribution of ground water suitable for use in saline-water aquaculture in central and west-central Alabama (Boyd, et al., 2010).
7. Effects of water temperature and Na:K ratio on physiological and production parameters of *Litopenaeus vannamei* reared in low salinity water (Perez-Velazquez, et al., 2012).
8. Magnesium budget for inland low-salinity water shrimp ponds in Alabama (Pine and Boyd, 2011).
9. Effects of major water quality variables on shrimp production in inland, low salinity ponds in Alabama (Prapaiwong and Boyd, 2012).

RESEARCH ON ALTERNATIVE FISH PRODUCTION SYSTEMS

As detailed in a preceding Section, it became quickly obvious in early research at Auburn that characteristics of ponds constructed in 'hilly' areas were really not suitable for the commercial production of any species. This is the primary reason why the development of the commercial catfish industry has proceeded more rapidly on the less "hilly" topography on the Black Prairie Physiographic District in west central Alabama. Over time, this basic problem led to efforts to develop alternative systems of production that might be more suitable for use in the 'hills.' Several of these systems are described in the following Section.

PRODUCTION IN SUSPENDED 'CAGES'

One of the first Alternative Production Systems evaluated was the production of fish in suspended cages. Apparently the impetus leading

to the beginning of research on cage culture came out of a late-night 1965 graduate student 'beer party' at the War Eagle Supper Club. Those freely imbibing included: Norris Jeffrey, Rudy Schmittou, Hugh Swingle and Tom Scott. As beer consumption and the noise level increased exponentially, Scott bet the others that he could produce more catfish in a barrel than any of them could produce in an equal volume of water in a pond. In the same noisy session, support for production in wire cages also emerged (Perez, 2006). The 1966 Annual Report indicated that research was being conducted on barrel culture and suspended cage culture. There was no mention of research of this type in the 1965 Annual Report. Afterwards, there were few, if any, years when there was no research conducted in this area.

Schmittou and his Work Group conducted research on the production of channel catfish in suspended cages (Figure 106) for several years, and in the mid-80s, they led an extensive evaluation of the technology in the Piedmont (Perez, 2006). Additional information on these 'field-trials' will be presented in a following Section.

Research on the culture of fish in Suspended Cages has resulted in the development of several publications, including:

1. The culture of channel catfish, *Ictalurus punctatus* (Rafinesque), in cages suspended in ponds (Schmittou, 1969).
2. Cage culture – cage construction, placement, and aeration (Masser, 1997).

PRODUCTION IN 'IN-POND' PENS

In the early 70s, the 'Investigators' conducted other research on a different system for utilizing 'terrace-water' ponds for food-fish production. In 1971, 38 pens (0.025- acre each) made of plastic mesh were installed in the margin of the east side of Pond S-6. Later, the pens were stocked with tilapia and channel catfish. Unfortunately, holes developed at the mud-mesh interface in 13 of the pens, allowing an unknown number of fish to escape into the pond. In 1972, 23 of the pens were again stocked with tilapia and channel catfish. Pond S-6 was drained in November, 1972. At that time the pens were removed from the pond.

PRODUCTION IN RECIRCULATING SYSTEMS

For several reasons, by the late 70s, Ray Allison was only minimally involved in Auburn's Fish Health Program, but he had developed an interest in producing fish in recirculating systems. In his research in this area he used aquatic plants to remove nutrients from the water. He and Jim Rakocy collaborated on a project to evaluate the production of tilapia in

recirculating systems constructed in a series of concrete pools located west of Funchess Creek (See Figures 18B, 18C and 49). Later Jim would use information obtained in this study to write his dissertation (Rakocy, 1980).

Later, Allison and Mike Paessun would use the same system to evaluate the production of tilapia. In addition, they enclosed it in a 'greenhouse' in order to continue the research through the winter. Later, additional research was conducted in this area by other Auburn "Investigators." Publications from all of this research include the following:

1. Evaluation of a closed recirculating system for tilapia culture (Rakocy, 1980).
2. Maximizing tilapia production in recirculating systems by sequential rearing (Paessun and Allison, 1984).
3. Economic feasibility of utilizing West Alabama saline ground water to produce Florida pompano and hybrid striped bass in a recirculating system (Gorman, et al., 2009).
4. The effect of stocking density on size dispersal and growth performance of largemouth bass fingerlings in a recirculating system (Park, et al., 2015)
5. Evaluation of a biofloc system for intensive culture of fathead minnows, *Pimephales promelas* (Park, et al., 2016).

HYDROPONICS

Allison retired in 1983, and there was no additional research conducted on hydroponics at Auburn until after Jesse Chappell was employed in 2002. Sometime thereafter, he established a Work Group to conduct research in this area. Later, a really nice facility was developed for this work (Figure 107).

Allison's research used aquatic plants only as a means to remove nutrients from the production system. Chappell and his Work Group decided to use the 'waste' nutrients in the system to produce plants with an economic value. Consequently, most of their research has involved the production of 'greenhouse' tomatoes for the fresh vegetable market. In 2008, the Alabama Agricultural Experiment Station published the results of a portion of this work:

Integration of hydroponic tomato and indoor recirculating aquacultural production systems: an economic analysis (Holliman, et al., 2008).

'IN-POND' RACEWAYS

Mike Masser and Andy Lazur published a report on the status of in-pond raceways in 1997. They commented that research on this Alternative Production System began at Auburn in 1991, but that a search of the literature revealed that research had actually begun at other institutions around the turn of the 20th century. Over the years, Auburn 'Investigators' have conducted research on two types of in-pond raceways:

1. 'Fixed' systems
2. 'Floating' systems

'FIXED' SYSTEMS

With fixed 'system' 'in-pond raceways', the production container is permanently attached to the pond substrate (Figure 108). Relatively little research has been conducted at Auburn on this system; however, in 2007, six commercial-scale units were constructed on a catfish farm in Dallas County. They were constructed so that two of the units shared a common wall. Travis Brown, one of Boyd's Ph.D. students, collected data on production of hybrid catfish in the units, along with related data on water quality. Brown published several papers from the data he collected. Recently, Gregory Whitis (personal communication), noted that not a single one of the units was still being used for the production of catfish. The owner abandoned them as production units as a result of disease problems and high maintenance and operation costs.

'FLOATING' SYSTEMS

With 'floating' systems, each unit includes floats as part of its structure, so that it is suspended at the surface of the water column (Figure 108A). While the units float at the surface, they usually must be permanently attached so that equipment required for aeration and water circulation can be accommodated.

Although Auburn 'Investigators' have used these units extensively as research containers (Figure 79A); relatively little work has been conducted at the Farms on their use for production. Recently, 'Investigators' have decided to place special emphasis on their evaluation for this purpose. As detailed in another Section, in 2017, 36 of the 0.1-acre 'E' Series were torn down to construct a new series of larger ponds. These new ponds (B-5 – B-8) were designed expressly for research on the evaluation of 'floating' raceways on a commercial scale (Figure 61B).

Publications developed by the 'Investigators' related to the use of 'in-pond'

raceways include:

1. In-pond raceways (Masser and Lazur, 1997).
2. Development and evaluation of an in-pond raceway and waste removal system (Hawcroft, 1994).
3. An in-pond raceway system incorporating removal of fish wastes (Yoo, et al., 1995).
4. Evaluation of an in-pond raceway system and its economic feasibility for fish production (Bernardez, 1995).
5. Effluent control of an in-pond raceway system (Martin, 1997).
6. In-pond raceway system demonstrates economic benefit for commercial catfish production (Brown, et al., 2010)
7. A commercial-scale in-pond raceway system for *Ictalurid* catfish production (Brown, et al., 2011).
8. Approximate water and chemical budgets for an experimental in-pond raceway system (Brown, et al., 2012).
9. Economic feasibility of an in-pond raceway system for commercial catfish production in west Alabama (Brown, et al., 2014).

PRODUCTION IN 'SPLIT-PONDS'

Gregory Whitis (personal communication) comments that there are over one thousand acres of Split-Pond Production Systems now in use in commercial catfish production in Mississippi. In this system, an existing pond is divided into two 'cells' with an earthen levee dividing them. Sluiceways between the 'cells' provide for water circulation between the two. Only one of them is used for fish production. It generally accounts for only 20-25 percent of the total volume of the two combined. The larger 'cell' is used for water 'treatment.' Auburn researchers have been only minimally involved in the development of this system of production. According to Whitis, there are only about ten of the split-pond systems in use in Alabama. He has been involving in verification of production of the units and in collecting data on the economics of their operation.

STUDIES IN AQUACULTURAL ECONOMICS

'Investigators' with the Auburn Fisheries Program were aware of the importance of 'Costs-Versus>Returns' in fish production from the very

beginning. In the discussion of the 'fee-fishing' research in the 'E' Series in the 1944 Annual Report, some data on the cost of fertilizer and feed and the income from the sale of fishing permits were included. Swingle included a section entitled 'Returns Per Acre' in his 1959 publication on channel catfish production in ponds (Swingle, 1959). Later, in his 1959 publication on 'fee' fishing for channel catfish, Prather included information on the cost of feed and fertilizer and the income from the sale of permits.

EARLY WORK

From the early days of the development of the International Program at Auburn, USAID was concerned about the lack of expertise in economics among the 'Investigators.' As a result, after the approval of the 211-d, Institutional Development Grant (AID/csd-2780), in 1970, some of those funds were utilized to purchase faculty-release time for Drs. Gregg Sullivan, Ed McCoy, and others, in the Department of Agricultural Economics and Rural Sociology to assist the newly created ICA in this area. This early collaboration would pay handsome dividends in the future when several faculty members in that Department would become involved in various aspects of our aquaculture and fisheries program. Over the years, Ed McCoy would be especially helpful. Later, we would secure the services of Dr. Don Street of the Department of Economics and Dr. Paul Starr of the Department of Sociology in conducting some of the work required. The services provided by Dr. Street were especially helpful because of his command of Spanish and also some capability in French.

Dr. Jerry R. Crews of the Department of Agricultural Economics and Rural Sociology was also an important contributor to the early work on aquacultural economics. He produced some of the first budgets on the production of catfish in west Alabama ponds (Crews, et al., 2001).

The publications included in the following list are indicative of the contributions of these individuals to our program:

1. Fish culture survey report for West Central Africa (Moss, et al., 1969).
2. Costs and returns of commercial catfish production in Alabama (Adrian and McCoy, 1971).
3. Fish management plan for Jones Bluff Lake (Bayne, et al., 1973).
4. Economic analysis of the catfish processing industry (McCoy and Sherling, 1973).
5. Economic analysis of the Inland Fisheries Project in El Salvadore (McCoy, 1974).

6. **An economic assessment of fisheries development in Colombia (Street, 1978).**
7. **Fish marketing in Central Luzon, Philippines (Sevilleja and McCoy, 1979).**
8. ***Review of aquacultural development activities in Central and West Africa* (Grover, et al., 1980).**
9. **Effect of production and credit management factors on catfish investment and profitability (Flynn, et al., 1983).**
10. **Effects of selected tax policies on management and growth of a catfish enterprise (Kinnucan, et al., 1986).**
11. **The political economy of fisheries development in the third world (Bailey, 1988).**
12. **Socioeconomic factors affecting the transfer and sustainability of aquacultural technology in Rwanda (Molnar, et al., 1993).**
13. **Impacts of integrated fish culture on resource limited farms in Guatemala and Panama (Lovshin, et al., 2000).**

STUDIES BY THE HANSON WORK GROUP

In 2008, the University made the decision to establish a new position in the Department for an Agricultural Economist. Later, the Selection Committee recommended Dr. Terrill (Terry) Hanson (a Georgia native) for this position. He received the B.S. Degree in Biology and Studio Arts from Allegheny College in 1977. After receiving the M.S. Degree in Aquaculture and Fisheries from Auburn in 1984, in 1985, he was awarded the Master of Agriculture Degree (Agricultural Economics). Later, he entered the Peace Corps where he served as Associate Director for Agricultural Programs in Tunisia during the period 1986-1989. Later, he returned to Auburn to take a Ph.D. Degree in Agricultural Economics. While working to meet the requirements for this degree, he participated in the economic evaluation of several of the Department's international development projects. From 1998 until 2008, he served on the faculty at Mississippi State University. In this period, he conducted research almost exclusively on the economics of the catfish industry in Mississippi. Since returning to Auburn, he has broadened his field of research to include the economics of recreational fishing. Also, he has used his expertise to help several faculty members with the economic aspects of their research projects. The following list of publications are indicative of the contributions of his Work Group:

1. Development of plant-based diet and the evaluation of dietary attractants for juvenile Florida pompano *Trachinotus carolinus* L. (Rhodes, et al., 2016).
2. Chemical treatments to reduce off flavor in farm-raised channel catfish (*Ictalurus punctatus*) fillet (Liu, et al., 2016).
3. Tomato seedling growth response to different water sources and a substrate partially replaced with dewatered aquaculture effluent (Danaher, et al., 2016).
4. Research verification of production practices using intensive aeration at a hybrid catfish operation (Bott, et al., 2015).
5. Farm size, seining practices, and salt use: risk factors for *Aeromonas hydrophilia* outbreaks in farm-raised catfish, Alabama, USA (Bebak, et al., 2015).
6. Angling effort on an embayment of Lake Guntersville, Alabama, before and after herbicide application (Maceina, et al., 2015).
7. Economic impact of a recreational striped bass fishery (Lothrop, et al., 2014).
8. Economic feasibility of an in-pond raceway system for commercial catfish production in west Alabama (Brown, et al., 2014).
9. Supermarket sales of crawfish and competing crustacean products (Hanson and Nguyen, 2013).
10. A demand analysis for crustaceans at the retail level (Nguyen, et al., 2013).
11. Off-bottom oyster farming (Walton, et al., 2012).
12. College student opinions of U.S. farm-raised catfish (Hanson and Rose, 2011).
13. Effects of stocking density on the performance of Pacific white shrimp *Litopenaeus vannamei* cultured under pond and outdoor tank conditions using a high soybean meal diet (Sookying, et al., 2011).

**GENERAL STUDIES – CONTRIBUTIONS OF THE DANIELS
WORK GROUP**

Bill Daniels and his Work Group have published the results of

several studies on different aspects of food-fish production, and one important study on the production of a non-food species (The Gulf Killifish – *Fundulus grandis* Baird). Publications resulting from these studies include the following:

1. Behavioral responses to ‘Alarm Odors’ in potentially invasive and non-invasive crayfish from aquaculture ponds (Daniels and Gherardi, 2004)
2. Tilapia: a fish with a global reach (Molnar and Daniels, 2007).
3. Production and processing trait comparisons of channel, blue catfish and their hybrids grown in earthen ponds (Jiang, et al., 2008b)
4. Replacement of fish meal with poultry by-product meal as a source of protein in pond-raised sunshine bass, *Morone chrysops* X *M. saxatilis*, diets (Pine, et al., 2008).
5. Manual for the commercial pond production of the African catfish in Uganda (Isyagi, et al., 2009).
6. Production of Gulf Killifish in the Black Belt Region of Alabama using saline groundwater (Phelps, et al., 2010).

Bill joined the Faculty of the Department of Fisheries and Allied Aquacultures in 2003. He was awarded the B.S. Degree (Biology/Chemistry) in 1978, by the University of South Alabama. In 1984, he received the M.S. Degree in Wildlife and Fisheries Science (Nutrition of Aquatic Animals) from Texas A&M University. Then in 1993, he was awarded the Ph.D. Degree in Wildlife and Fisheries Science (Physiology) from Mississippi State University.

After receiving his B.S. Degree in 1978, he joined the Peace Corps where he served as a Fish Culture Extension Agent in Zaïre, which is located in central Sub-Saharan Africa. Zaïre is now known as the Democratic Republic of the Congo. He served in that position during the period 1978-1982. After receiving his M.S. Degree in 1984, he worked for a year (1984-1985) as an Aquaculture Research Specialist with Texas Southmost College. During the period 1994-2002, he was a Research Assistant/Associate Professor/Extension Specialist-Aquaculture in the Department of Agriculture and Natural Resources at Delaware State University.

RESEARCH ON AQUATIC PLANTS

As emphasized in several preceding Sections, manipulation of the biology of aquatic plants (phytoplankton) through the addition of inorganic elements (nitrogen, phosphorus and potassium) to their

environment, provided the essential foundation of pond management for the production of recreational fishing in 'terrace-water' ponds. Early on, 'Investigators' conducted numerous experiments on this aspect of the biology of aquatic plants. Later, they conducted additional research on aquatic plant biology in their efforts to control rooted aquatic weeds in ponds through the manipulation of phytoplankton populations.

BIOLOGY

In the early 60s, as weed control problems mounted in public waters, Auburn 'Investigators' began to re-visit research on different aspects of the biology of aquatic plants. John Lawrence established an active Work Group in this area. Later, two of his former graduate students Claude Boyd and David Bayne would lead their own Work Groups. When David Bayne retired in 2006, Dr. Alan E. Wilson was invited to Auburn to fill that position. Dr. Wilson earned the B.S. Degree in Biology (1995) at Young Harris College. Later, he earned a B.A. in Biology (1997) from the University of North Carolina. In 2001, he received the M.S. Degree in Fisheries and Wildlife from Michigan State University. Then in 2006, he was awarded the Ph.D. Degree in Applied Biology with a Minor in Chemical Ecology from the Georgia Institute of Technology. Alan joined the faculty in 2007, and has continued the Department's long-term research program in the biology of aquatic plants, specializing in the blue-green algae.

The following publications are indicative of the wide range of research conducted by Auburn 'Investigators,' over the last half-century on the biology of aquatic plants:

1. Effects of light intensity and quality on the growth of *Elodea densa* and *Heteranthera dubia* (Blackburn, et al., 1961).
2. Identification of aquatic weeds (Lawrence and Weldon, 1965).
3. The mineral composition of several freshwater algae (Boyd and Lawrence, 1966).
4. The competition pattern existing in a community of common aquatic weeds and effects of herbicide treatment on the competition pattern (Breedlove, 1966).
5. Relationship between the chemical composition of aquatic weeds and water quality (Denton, 1966).
6. Some aspects of aquatic plant ecology (Boyd, 1967).
7. Separating constituents of natural phytoplankton populations by

- continuous particle electrophoresis (Bayne and Lawrence, 1972).
8. Biotic interactions between different species of algae (Boyd, 1973a).
 9. Summer algal communities and primary productivity in fish ponds (Boyd, 1973b).
 10. Amino acid composition of freshwater algae (Boyd, 1973c).
 11. Primary productivity studies during early years of West Point Reservoir, Alabama-Georgia (Bayne, et al., 1983).
 12. Growth rate consequences of coloniality in a harmful phytoplankter (Wilson, et al., 2010).
 13. Large variation in vulnerability to grazing within a population of the colonial phytoplankter, *Microcystis aeruginosa* (White, et al., 2011).
 14. Bioaccumulation of microcystins by fish associated with a persistent cyanobacterial bloom in Lago de Patzcuaro (Michoacan, Mexico) (Berry, et al., 2011).

RESEARCH ON CONTROL OF AQUATIC WEEDS IN PONDS

Comments on the importance of planting aquatic plants in newly established ponds were detailed in a preceding Section. Recall that the Lake Auburn 'managers' had encouraged the establishment of weeds when they were stocking that newly-constructed pond. Unfortunately, they quickly realized that un-managed populations of aquatic weeds were a major problem, especially in older ponds.

CONTROL WITH FERTILIZATION

Fortunately, as a result of the early work on pond fertilization, the 'Investigators' realized that, under some conditions, 'blooms' of phytoplankton often developed after the application of inorganic fertilizer, and that these 'blooms' tended to suppress the growth, and even cause the death of rooted aquatic weeds by limiting their access to sunlight. Results of research in this area has been discussed in several preceding Sections and was summarized by Smith and Swingle (1940b) and Smith and Swingle (1941).

CONTROL WITH CHEMICALS

Later, realizing the limitations of the use of pond fertilization to control weeds in ponds, the 'Investigators' began to investigate other means

of eradicating them. First, they experimented with the use of a few widely available inorganic chemicals known to have phytotoxic characteristics. Later, they would begin the evaluation of a number of new organic chemicals, products of the highly proactive U.S. chemical industry which emerged during World War II.

The first reference on the use of chemicals to control pond weeds at Auburn was included in the 1939 Annual Report. In that year, the 'Investigators' had conducted a few experiments on the use of sodium arsenite, sodium thiocyanate and sodium chlorate to control *Najas sp.*, planted in soil-filled boxes in Pond D-14.

The 1947 Annual Report stated that the 'Investigators' used several formulations of 2,4-D (butyl ester form) to control arrowhead, cattail, needle rush and knotgrass. In 1950, a field trial was conducted in Pond F-16 on the use of Rosin Amine D Acetate (dehydroabietylamine acetate-Hercules Algicide D) for the control of the alga *Cladophora sp.* This chemical was manufactured by the Naval Stores Division of the Hercules Powder Company of Wilmington, Delaware. These field trials marked the beginning of long-term collaboration between Auburn and several chemical companies to evaluate phyto-toxic compounds.

In the early 1950s, infestations with the branched alga, *Pithophora sp.*, became an extremely serious problem in literally thousands of farm ponds across the South. The problem is especially serious in ponds located in Alabama's Black Prairie District. The alga was also present, to a lesser or greater degree, in all the ponds on the Story Farm. In the most extreme situations, fishing in ponds with these infestations was virtually impossible. In 1954, Lawrence published a comprehensive paper on the use of Hercules Algicide D for its control. Then, in 1955, he published a paper summarizing the results of Auburn's research on weed control in farm ponds.

As an aside, region-wide infestations of *Pithophora spp.* disappeared about as rapidly as they had appeared. By the mid-1960s, relatively little of the algae could be found anywhere in the South; however, infestations with this plant were quickly replaced by equally wide-spread infestations of the blue-green algae, *Microcystis spp.* In Alabama, this alga was observed most commonly in its brownish-yellow form. From a low-flying airplane, it appeared that most of the ponds in the State were 'muddy.' Although it is known to excrete toxic chemicals under certain conditions, there were no verified reports of fish kills associated with its presence. Surprisingly, infestations of this species also disappeared over a relatively short period of time. Soon it was difficult to find it in appreciable quantities anywhere.

In 1958, Lawrence and Dr. Don Davis (Professor in the Department of Botany and Plant Pathology) were awarded a contract by the Weed Control Division

of the United States Department of Agriculture, for the 'screening' of potential aquatic herbicides. This was the first of a number of contracts that would involve collaboration with Dr. Davis, who had recently become involved with the chemical control of weeds in farm crops. Many of you will remember Dr. Davis as the long-time instructor for the course '*Aquatic Plants*.' This contract required the development of new experimental protocols for the rapid screening of large numbers of compounds. Lawrence, et al. (1961) described these procedures in a 1961 publication (see Figure 54). Later, the U.S. Corps of Engineers and several private companies would provide funds for the research. Throughout its 'life,' some 1,485 chemicals were 'screened' for herbicidal activity on several species of submerged and emergent plants and filamentous algae.

This extensive effort to screen chemicals for potential herbicidal activity also provided Lawrence with the opportunity for a considerable amount of collaborative research with Dr. Hanley Funderburk, an Associate Professor in the Department of Botany and Plant Pathology. With the use of radio-isotopes, Dr. Funderburk was able to trace the translocation of herbicides within the stems and leaves of aquatic plants. At that time, this was real 'cutting-edge' technology. As a result of these and other similar accomplishments, Funderburk was later appointed to an Alumni Professorship. Still later, he became Assistant Dean of the Graduate School; then Chief Administrative Officer for the newly established Auburn University at Montgomery. From 1980-1983, he was President of Auburn University. Afterwards, he served as President (1984-1998) of Eastern Kentucky State University.

After screening hundreds of chemical compounds for herbicidal effects on aquatic plants, in vitro, Lawrence and Davis began testing some of the more promising compounds in progressively larger and more natural settings. In the early 1960's, he tested diquat and paraquat in plastic swimming pools containing bottom soil and aquatic plants. He examined the effects of herbicide combinations on the physiology, ecology and life cycle of the target plants. Within a couple of years, he was testing 30 chemical compounds in plastic pools that contained fish and was measuring chemical residues, fish toxicity and reproduction as well as effects on the target plants. Weeds being used in these trials were some of the more troublesome plants of the day, such as, cattail, Eurasian water milfoil, water hyacinth, alligator weed and the algae, *Pithophora* and *Hydrodictyon*. All of the plastic pool work was done on the Soughahatchee Farm (see Figure 49).

Some of the most promising herbicides were applied to small earthen ponds with serious weed problems that were not responding to other control efforts. These ponds were mostly located on the Soughahatchee Farm. The performance of the herbicides was evaluated at intervals during the growing season.

Screening of the large number of chemicals for herbicidal activity did identify two promising ones – diquat and paraquat. In a publication describing their research, (Lawrence, et al., 1962), the authors commented:

“The herbicidal activity exhibited under these conditions has been spectacular.”

By 1964, financial support available for the continued screening of chemicals had virtually disappeared. Research by Lawrence and his Work Group was largely confined to applied work funded by the U.S. Army Corps of Engineers on the control of alligator weed in Lake George on the Chattahoochee River. Fortunately, this research led Lawrence into an entirely different realm of aquatic ecology – water quality in rivers and reservoirs.

Some of the publications resulting from the research efforts of Lawrence’s Work Group on the chemical control of weeds include:

1. Control of a branched alga, *Pithophora*, in farm fish ponds (Lawrence, 1954).
2. Weed control in farm ponds (Lawrence, 1955).
3. Methods of controlling aquatic weeds in fish ponds with emphasis on the use of chemicals (Lawrence, 1955).
4. Aquatic weed herbicides evaluated (Lawrence, et al., 1961).
5. A sensitive bio-assay for two bipyridyl quaternary salts (Funderburk and Lawrence, 1962).
6. The status of diquat and paraquat as aquatic herbicides (Lawrence, et al., 1962).

MESOCOSM RESEARCH

In the late 80s, the chemical weed control Work Group became involved in a rather unique area of aquatic toxicology. It involved evaluating the effects of a synthetic pyrethroid insecticide on various elements of aquatic ecosystems. The evaluation was conducted in twelve, 0.1-ha earthen mesocosms constructed in south Lee County, AL. This research presented the group with some unique challenges in experimental design, sampling and data analysis. The research has been described in considerable detail by Webber, et al., 1991.

WEED CONTROL WITH HERBIVOROUS FISHES

You will recall that I returned to Auburn in 1959, after completing work for the Ph.D, specifically to conduct research on a National Institutes of Health Project – *Control of Aquatic Weeds with Herbivorous Fishes*. Swingle, after discussions with biologists in several foreign countries, felt that several species of *Tilapia* and the mirror (Israeli) carp, cultured in Israel, might be able to control weeds in ponds. Over the next 40 years, a considerable amount of research would be conducted on this subject by various staff members at Auburn.

Some of the publications resulting from this research include:

1. Control of pond weeds by the use of herbivorous fishes (Swingle, 1957d).
2. Herbivorous fish to control *Pithophora* sp. and other aquatic weeds in ponds (Shell, 1962).
3. Biological weed control with herbivorous fish (Avault, 1965a).
4. Preliminary studies with grass carp for aquatic weed control (Avault, 1965b).
5. Evaluation of eight species of fish for aquatic weed control (Avault, et al., 1968).
6. Spawning the grass carp (Jeffrey, 1970).
7. An evaluation of two methods for inhibiting reproduction in the White Amur, *Ctenopharyngodon idella* (Johnson, 1972).
8. Food habits of white amur, largemouth bass, bluegill and red-ear sunfish receiving supplemental feed (Kilgen, 1973).
8. Effects of white amur, *Ctenopharyngodon idella*, and common carp, *Cyprinus carpio*, on populations of pond fishes (Forrester, 1975).
9. Assessing impacts of introduced aquatic species: grass carp in large systems (Bain, 1993).

WEED CONTROL IN PUBLIC WATERS²

The 1963 Fisheries Annual Report includes a Section on weed

²I am indebted to David Bayne for preparing most of the material presented in this Section.

control research being conducted by John Lawrence and his Work Group on the Chattahoochee River and in Lake Walter F. George (Lake Eufaula). Later, the work would be extended down-river to Lake Seminole. Funding for the work was provided by the U.S. Army Corps of Engineers. Annual Reports prepared each year, through 1978, included similar Sections.

This Lawrence Work Group was likely the first ever established in the Fisheries Program. It was necessary because of the nature of the work involved. They often worked several hours from campus, and often on protocols that required hours of concentrated effort. The work required transporting large quantities of equipment to these remote sites. If I remember correctly, David Rouse, Malcom Johnson III, Opal Dakin and Carolyn Carr were members of the Group.

In the early 60s, two exotic weeds, hydrilla (*Hydrilla verticillata*) and Eurasian watermilfoil (*Myriophyllum spicatum*), began spreading rapidly into the southeastern states and were presenting a major challenge in managing large multi-purpose impoundments. This 'invasion' resulted in a Corps of Engineers contract with Auburn University for the involvement of the Lawrence Work Group to assist in the control of these weeds. These plants root in the bottom soil and grow up through the water column to the surface where they form thick floating mats. Depending on water clarity, the plants may 'top-out' in 15 to 20 feet of water.

Throughout the mid-1960's, Lawrence established research plots on various weed species using herbicides that proved most efficacious in his earlier trials. Large plots were staked-out in stands of weeds in Lake George, extending from the shoreline out as far (15-20 yards) as the plants grew. Plots were numbered and later treated with herbicide. Each plot was graded numerous times during the growing season, and again the following spring to determine re-growth. Divers were used to grade herbicide effectiveness on some of the plots. Along with watermilfoil and hydrilla, other weeds treated included water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera philoxeroides*) and giant cutgrass (*Zizaniopsis miliacea*). Some of the herbicides evaluated were diquat, paraquat and various formulations of 2,4-D.

When Eurasian watermilfoil was discovered in Lake Seminole in 1966, Lawrence led a concerted effort to halt the spread of the plant. It was first found in the Spring Creek 'arm,' a very fertile, spring-fed tributary. The location of the plant was mapped, and a dye study conducted to determine water flow patterns that would indicate where the plant propagules might drift. The herbicide 2,4-D was applied, but did not halt its spread; as it quickly became established throughout that portion of the impoundment. Fortunately, water quality conditions in the main portion of the lake were different enough that the plant did not thrive there. While herbicides failed to

control the spread of the plant in Spring Creek, *hydrilla*, which appeared in Lake Seminole in 1968, gradually displaced it. These two plants are still the dominant submersed weeds in the lake.

In the early 1970's, increased regulation by federal agencies on the use of pesticides in public waters, spurred renewed interest in biological approaches to controlling aquatic weeds. Lawrence began to shift his efforts to evaluating two exotic bio-agents, grass carp (white amur) and the alligator weed flea beetles, for weed control.

Remember, as detailed in a preceding Section, research on the use of grass carp for weed control in ponds began at Auburn in the mid-60s. This early work demonstrated its effectiveness in controlling a variety of weeds in ponds. Unfortunately, grass carp were not native to North America, and there was widespread concern that stocking male and female fish in rivers and lakes could negatively impact the ecology of these systems, especially if they reproduced. To address this problem, Lawrence and his graduate students conducted studies to develop procedures to produce monosex populations (see Johnson, 1972). They had limited success with this approach, but ultimately others were able to produce all-male grass carp for stocking public waters (see Stanley, 1976 and Cassani and Caton, 1985). After the mid-80s, sterile, triploids became available in large quantities. As a result, many states began to use them to deal with weed problems in their public waters. Lawrence had been correct, grass carp were an effective means of dealing with weed problems in large lakes and reservoirs. Unfortunately, he retired in 1981, and was not active in research when their evaluation in these large bodies of water began.

The alligator weed flea beetle (*Agasicles hygrophilia*, Selman and Vogt) was approved for introduction into the USA by the U.S. Department of Agriculture after extensive study and research revealed that the insect fed and completed their life cycle on only one plant species – alligator weed. Lawrence established his first field plot with the beetle in Lake Seminole in 1967. After several years of observation of the beetle, in both Lakes Eufaula and Seminole, it was concluded that the beetle was a success. It would eat the floating mat of weed down to the water level and then fly off to the next floating mat nearby. The only problem was the void left by the absence of the alligator weed was quickly filled by several more aggressive weeds, like water hyacinth and giant cutgrass.

As noted previously, the Lawrence and Bayne Work Group were responsible for most of the field work in the weed control research on Lake George and Lake Seminole; however, the assistance of Corps personnel was invaluable. Angus Gholson, the Reservoir Manager at Lake Seminole, was especially helpful. He was always ready to provide assistance with any work to be done.

The research on weed control conducted by the Lawrence Bayne Work Group in Lake George and Lake Seminole resulted in the preparation of a large number of reports to the Corps. Most of the material included is available in the Fisheries Annual Reports from 1963-1975. Copies of most of these are available in collections maintained by the Archives and Special Collections Department of the Ralph B. Draughon Library (see Table 103).

Since the mid-60s, the world of aquatic weed control in public waters has been 'turned-on-its-head.' In those early years, the threat of 'invasion' was a widespread concern; however, for fishermen in the following half-century that concern has generally abated. Now the presence of aquatic weeds is a major factor in the management and exploitation of largemouth bass populations. On the other hand, public resource managers are still caught in the crossfire between fishermen and other resource users, e.g. lake front home owners, boaters, swimmers etc., who have interests beyond largemouth bass. The challenge now is how to fairly manage aquatic weeds in multi-use public waters with the limited budgets available.

RESEARCH ON AQUATIC ECOSYSTEMS IN PUBLIC WATERS

From the beginning, U.S.D.A.'s Agricultural Experiment Station System was expected to conduct research related to the production of food and fiber on private farms in the nation. While the System had reluctantly agreed that its funds could be used for Auburn to conduct research applicable to fish production for recreation in ponds on private farms, the use of any of the funds to support research in public waters was never a serious consideration. There were other publicly funded agencies with this responsibility.

As noted in a preceding Section, after the end of World War II, the 'whirl-pool' of events in the 'New World' quickly pulled the old 'terrace-water' pond seiners into the vortex of a new world of complex aquatic ecosystems in public waters and of contracts and grants. Unfortunately, they were poorly prepared for it. The 'Investigators' had virtually no experience in this 'World,' and the fact that it was also changing rapidly, further increased the challenge. They had no experience with water pollution, water quality standards, hydropower production, flood control, complex multi-species populations, and with un-regulated fishing pressure. But Swingle, with his pioneer's inclination, quickly rushed into the maelstrom. In the beginning, they were primarily involved in collecting basic data on the fish populations in Alabama's rivers and reservoirs, and in some specific situations, research of the effect of pollution on the populations. Later, the 'Investigators' would study various aspects of water quality in public waters under contract with several corporations and government agencies over a number of years.

RESEARCH ON FISH POPULATIONS

Experiment Station-funded research on fish populations by Auburn 'Investigators' was initiated on the South Auburn Farm in May, 1934 with the stocking of Farm Pond 1. A period of some 15 years would pass before they would 'take their show on the road' into a larger 'World.' Even then, they kept looking over their shoulders at the old 'terrace-water' ponds that they were leaving behind.

EARLY RESEARCH ON THE COOSA RIVER

As detailed in a preceding Section, as a result of growing concerns about water pollution in the State, the Alabama Water Improvement Commission (AWIC) was established by the Legislature in 1947. In 1949, AWIC contracted with Auburn to survey the fish population of a section of the heavily polluted Coosa River. Auburn had virtually no experience in this area. As a result, the actual work was sub-contracted to Dr. Don Scott (Scott, 1951) of the University of Georgia. Although Scott did the actual field work, the 'Investigators' were actively involved in the process. The sampling was conducted on two, quarter-mile sections of the River near Childersburg (Shelby and Tallapoosa Counties) in July and August, 1949. Early samples were collected with hoop nets, wire baskets and a permanent fish trap; however, none of these methods captured very many fish. As a result, the decision was made to utilize rotenone. This is likely one of the first examples of the use of this fish toxicant in public waters in Alabama.

With the Coosa River experience behind them, in 1950, the 'Investigators' conducted additional surveys on impoundments on the Coosa and one on the Tombigbee River, utilizing rotenone. Then 1951, in cooperation with the newly established Fisheries Section of the Alabama Department of Conservation, they conducted fish population surveys on the Tallapoosa River, Lake Martin, the Alabama River, the Tensaw River, and the Tombigbee (Figure 109). Swingle (1953) summarized the results of this work. Fish were collected in these surveys with the use of emulsifiable rotenone. This sampling represents the first large-scale use of this fish toxicant in the State. The author discusses in detail the factors affecting the accuracy of the results. He concluded that although the chemical killed large quantities of fish in all of the surveys, that it was difficult to know whether or not the fish actually came from the sample area. This problem was especially acute in sampling taken in flowing waters. Even though the results obtained were often suspect, the surveys resulted in the collection of some useful qualitative data.

Rotenone sampling in public waters was continued under the direction of the 'Investigators,' in cooperation with biologists of the Fisheries Section of the Alabama Department of Conservation, through 1966. Swingle analyzed the

data in the samples using the same procedures described in his 1950 publication, *Relationships and Dynamics of Balanced and Unbalanced Fish Populations*. Later, Swingle and his son Wayne conducted a thorough analysis of the problems in utilizing the 1950 pond population analysis methodology on data obtained with rotenone in rivers and reservoirs. The results of their study was published in 1968. Afterwards, Fisheries Section personnel assumed responsibility for the sampling.

THE WEST POINT RESERVOIR FISH POPULATION STUDY

This research was conducted under a long-term contract with the U.S. Army Corps of Engineers. The awarding of this contract had an extremely interesting history, and will be discussed in a later Section. The study was specifically designed to document changes in the fish population in a section of the Chattahoochee River near West Point, GA, as it transitioned from a riverine to a lacustrine aquatic ecosystem.

This extremely important fisheries research project was initiated with a pre-impoundment survey on the Chattahoochee River at West Point in January, 1972, under the direction of Dr. William L. Shelton. Dr. William D. Davies joined the West Point Work Group later in 1972 when he returned from his assignment with the ICA's fisheries project in northeast Brazil. At that time, Dr. Davies also became the leader in the Department's Work Group on fish populations in public waters. The employment of Davies in this capacity reflected a new commitment by the Department to add expertise in classical fisheries science to its traditional program in fish culture.

Dr. Davies had been awarded a B.S. Degree by Purdue University in 1962 and an M.S. Degree by Ohio State University in 1964. During the period 1964-1966, he served in the U.S. Army in Alaska; then in the period 1966-1967, he served as a Fisheries Biologist with the U.S. Bureau of Commercial Fisheries. In 1970, he was awarded the Ph.D. Degree by North Carolina State University. At N. C. State, Dr. F. Eugene Hester, an Auburn Fisheries Alumnus, served as his major professor. Dr. Davies joined the Auburn faculty in July 1970, and was immediately re-located to Fortaleza, Brazil.

The pre-impoundment 'phase' of the West Point Project was completed in May, 1974. The reservoir reached full-pool early in 1975. Post-impoundment surveys began in the summer of 1975, and were continued through the fall of 1984. Initially surveys involved sampling with rotenone and electro-fishing; then in 1978, a roving creel survey was initiated. These studies resulted in the development of the following publications by the Davies-Shelton Work Group:

1. Pre-impoundment survey of fishes in the West Point area (Chattahoochee River, Alabama and Georgia) (Shelton and Davies,

1977).

2. Initial fish population changes following impoundment of West Point Reservoir, Alabama-Georgia (Timmons, et al., 1978a).
3. Sampling of reservoir fish populations with rotenone in littoral areas (Timmons, et al., 1978b).
4. Fishing and natural mortality: effects on the initial class of largemouth bass in West Point Reservoir, Alabama-Georgia (King, et al., 1979).
5. Variation in the growth of the initial year class of largemouth bass in West Point Reservoir, Alabama-Georgia (Shelton, et al., 1979).
6. Fixed versus random sampling of fishes in a large reservoir (King, et al., 1981).
7. Prey-dependent recruitment of largemouth bass: a conceptual model (Davies, et al., 1982).
8. Fisheries and limnological studies on West Point Reservoir Final Report (Bayne, et al., 1986).

This long-term study and the publications developed from it helped advance the Department's reputation as a leading institution in practical fisheries science.

The West Point study attracted a large number of outstanding graduate students. One of these, Stephen P. Malvestuto, joined the Work Group in 1975, and did his dissertation research on one phase of the study. In October, 1978, he joined the faculty as an Assistant Professor and continued to participate in Work Group activities through the end of the study in 1984. Steve had received the B.A. Degree in Zoology from the University of California, Santa Barbara in 1970, and the M.S. Degree in Zoology from the University of Nairobi in Kenya in 1975 and the Ph.D. Degree in Fisheries Biology from Auburn in 1978.

As a result of his graduate research, Malvestuto added a new perspective to the Department's program in the study of fish populations in public waters. Historically, 'Investigators' with the fisheries program had obtained most of their data from draining experimental ponds. Obviously this method was no longer available to them when working in rivers and reservoirs. Instead, they began to utilize fish toxicants to collect samples from populations, and even later they would begin to use electro-fishing for that purpose. When the filling of West Point Reservoir was completed in May 1975, the Work Group

decided to utilize the creel census as an additional way of collecting data about the fish population. Steve became the leader for the application of this methodology. The three following publications provide a good indication of his contribution to the Study through the use of creel censuses:

1. An evaluation of the roving creel survey with non-uniform probability sampling (Malvestuto, et al., 1978).
2. Predicting the precision of creel survey estimates of fishing efforts by use of climatic variables (Malvestuto, et al., 1979).
3. Relationships between economic benefit and sport-fishing effort on West Point Reservoir, Alabama-Georgia (Palm and Malvestuto, 1983).

The first publication (Malvestuto, et al., 1978) firmly established Steve as a national leader in the design of creel censuses and of the evaluation of the data obtained from them.

OTHER STUDIES BY THE DAVIES WORK GROUP

As detailed in a preceding paragraph, field work on studies of the evolution of the fish population of West Point Reservoir was terminated in 1984. At that point, Davies and his Work Group turned their attention to studies of fish populations in other rivers and reservoirs in the State. Some of those studies were described in the following publications:

1. The influence of differing flow regimes on the tail-water fishery below Jordan Dam, Alabama (Jackson and Davies, 1986).
2. Characteristics of the freshwater drum fishery below Jordan Dam (Benton, et al., 1988).
3. Environmental factors influencing summer angler effort on the Jordan Dam tailwater, Alabama (Jackson and Davies, 1988).
4. Population dynamics of the black crappies and white crappies in Weiss Reservoir, Alabama: implications for the implementation of harvest restrictions (Reed and Davies, 1991).

These 'other' studies by the Davies Work Group, begun in the mid-80s, represent the beginning of increased emphasis in the Department on applied fishery science that is continuing into the 21st century.

STUDIES BY THE BAIN WORK GROUP

As detailed in another Section, in 1966, the U.S. Fish and Wildlife

Service, in cooperation with Auburn University and the Alabama Department of Conservation and Natural Resources, established a Cooperative Fisheries Research Unit at Auburn. The establishment of this Unit also has an interesting history that will be discussed in a following Section. In our early contacts with the Agency, we requested that they assign an ichthyologist to the Unit. In 1967, Dr. John Ramsey became Unit Leader. He served in that capacity until 1984 when the Agency decided to combine the older Wildlife Research Unit with the Fisheries Research Unit. Under this administrative arrangement, Ramsey became Assistant Leader. In 1986, he left Auburn to relocate to another position within the Agency.

In November, 1986, Dr. Mark B. Bain came to Auburn as Assistant Leader. He had received his B.S. Degree in Wildlife Resources from West Virginia University in 1977, the M.S. Degree in Fisheries Science from Virginia Polytechnic Institute in 1980 and the Ph.D. Degree in Fisheries Biology from the University of Massachusetts in 1985. Before coming to Auburn, he had been employed by Ball State University (1984-1985) and Argonne National Laboratory (1985-1986). Mark remained at Auburn until 1991. While here he established a very active research program in stream and riverine fish ecology with emphasis on flow modifications in rivers resulting from dams and hydropower generation. The following publications are indicative of the kinds of projects his Work Group completed. Note that results of several of the studies were published after he left Auburn.

1. A new approach in measuring cover in fish habitat studies (Kinsolving and Bain, 1990).
2. Effect of aquatic plant control on the microdistribution and population characteristics of largemouth bass (Bain and Boltz, 1992).
3. Smallmouth bass in the shoals reach of the Tennessee River: population characteristics and sport fishery (Weathers and Bain, 1992).
4. Assessing impacts of introduced aquatic species: grass carp in large systems (Bain, 1993).
5. Fish assemblage recovery along a riverine disturbance gradient (Kinsolving and Bain, 1993).
6. Larval fish distribution and microhabitat use in free-flowing and regulated rivers (Scheidegger and Bain, 1995).

STUDIES BY THE CRANCE-FISHER-FREEMAN WORK GROUP

For several years, 'Investigators' in Auburn's Fisheries Program

had been interested in the fishery resources associated with the many large creeks in the State. Fortunately, in the late 80s, we were able to convince Congressman Bill Nichols, an Auburn University Trustee at the time, of the potential value of this resource. Consequently, with considerable support from his office, in 1989, the In-stream Flow Group of the National Ecology Research Center of the U.S. Fish and Wildlife Service in Fort Collins, CO., agreed to establish the Southeastern Stream Ecology Field Station at Auburn. Later, administration of the Station would come under the purview of the National Biological Survey. Johnie Crance, an Auburn alumnus, was selected as Leader. Initially, Bill Fisher was chosen as Assistant Leader. Later, when Fisher left the program, Mary Freeman was chosen for the position.

Johnie Crance, a native of Coal City (St. Clair County) was awarded the B. S. Degree (Fish Management) by Auburn University in 1956 and the M.S. Degree (Fish Management) in 1958. Before accepting the position as Leader of the Field Station, he was employed (1982-1989) as a Fishery Biologist with the In-stream Flow Group of the National Ecology Research Center. Prior to that assignment, in the period 1979-1982, he had served as Senior Fisheries Advisor to USAID/Philippines. Earlier (1976-1979), he had served as Aquaculture Extension Advisor and Chief of Party for Auburn's contract team in the Philippines.

Bill Fisher was awarded the B.A. Degree in Biology by the University of Louisville in 1976. He was awarded the M.A. Degree in Zoology from DePauw University in 1979, and then returned to the University of Louisville, where he was awarded the Ph.D. Degree (Biology) in 1987. He served as Assistant Leader at Auburn from 1989-1991. Afterwards, he became Assistant Leader of the Cooperative Fisheries Research Unit in Oklahoma.

Mary Freeman, a Georgia native, was awarded the B.S. Degree in Biology by the University of Georgia in 1979. Later the same institution awarded her the M.S. Degree (Entomology) in 1982 and the Ph.D. Degree (Forest Resources) in 1990.

The Field Station Work Group conducted numerous studies in warm water streams in Alabama, Arkansas, Tennessee and Virginia; but most of their work involved obtaining base-line data on streams in the Chattahoochee, Coosa and Tallapoosa River Basins. They also conducted short courses for state biologists on Physical Habitat Suitability Indices and In-stream Flow Methodology. The Field Station was closed as a result of the political "sea-change" which followed the congressional election of 1993.

The Crance-Freeman Work Group developed several publications from their studies:

1. Relationship between palustrine wetlands of forested riparian

floodplains and fishery resources: a review (Crance, 1988).

- 2. Fishery functions and values of forested riparian wetlands (Crance and Ischinger, 1989).**
- 3. Evaluation of the mussel fishery in Wheeler Reservoir, Tennessee River (Bowen, et al., 1994).**
- 4. Streams: a national heritage worth preserving (Crance and Masser, 1996).**
- 5. Transferability of habitat suitability criteria for fishes in warm water streams (Freeman, et al., 1997).**

STUDIES BY THE DEVRIES-WRIGHT WORK GROUP

In the late 70s, The Department was beginning its first 'halting' efforts to bring its Fisheries Program into the 'world' of classical fisheries science. We began the fish population phase of the West Point Project in 1975. That phase of the project was completed in 1984. Afterwards, it broadened its efforts in this area primarily with funding provided by the Alabama Department of Conservation and Natural Resources. Over time, it became obvious that the Department needed to further strengthen its research capability base in this area by acquiring expertise in the field of basic fish ecology. Further, while strengthening the base, we also wanted to become more competitive for extramural funding at the national level.

I discussed this matter with Dean James Marion, Director Lowell Frobish, and Vice President for Research Paul Parks. All of these administrators were well aware of our long-term productivity in applied fish ecology, and were quite sympathetic with our interest in building a stronger, permanent base of basic research in this area. From the beginning of his tenure (1986) as Director of the Agricultural Experiment Station, Frobish had been vitally interested in increasing the amount of basic research being conducted throughout the Experiment Station. He was especially interested in making Station personnel more competitive for grants and contracts at the national level. After considerable discussion to clearly define the goals of the position, funding was approved, and in early 1989, it was advertised. Dr. Dennis R. Devries accepted the position, and joined the faculty in January, 1990.

Dennis R. Devries is a native of Illinois and Indiana. He was awarded the B.S. Degree in Biological Sciences (Mathematics Minor) by Purdue University in 1982. Later, he received his M.S. (1985) and Ph.D. (1989) Degrees in Zoology from The Ohio State University. Over the years, the DeVries Work Group research program in basic fish ecology has received considerable funding from both the U.S. Fish and Wildlife Service and the Experiment Station. In

addition, it has received considerable support from the Alabama Department of Conservation and Natural Resources, the National Science Foundation and the Environmental Protection Agency.

As detailed in a preceding section, Mark Bain and his research attracted a large number of excellent graduate students. As a result, he was able to put together a highly effective fish ecology Work Group. On his arrival, Dr. DeVries quickly greatly expanded its program and the 'reach' of its activities. In 1997 Dr. Russell Wright joined the Group.

In 1997, Dr. Russell (Rusty) A. Wright accepted a position with the Department. Wright was awarded the B.A. Degree in Biology by the University of North Carolina-Ashville in 1983. Later, in 1985, he was awarded the Master of Science Degree in Zoology (Statistics Minor) by North Carolina State University. Then in 1993, he was awarded the Ph.D. Degree in Zoology (Statistics Minor) by the University of Wisconsin-Madison. Before coming to Auburn, he was employed by The Ohio State University as a Post-Doctoral Research Fellow. A sizeable share of his salary at Auburn has been supported by the Alabama Cooperative Service Extension System. It was anticipated that he would assist County Agents in promoting recreational fishing in their counties as a means of increasing income through tourism.

The DeVries-Wright Work Group has been involved in a wide range of studies in fish ecology, some of it quite basic, but most of it is applied. The following list of publications is indicative of the kinds of studies that they have completed:

1. Spatial and temporal heterogeneity of larval shad in a large impoundment (Allen and DeVries, 1993).
2. Interactions between larval white crappie and gizzard shad: quantifying mechanisms in small ponds (Pope and DeVries, 1994).
3. Habitat use, diet, and population structure of adult and juvenile paddlefish in the lower Alabama River (Hoxmeier and DeVries, 1997).
4. Regulation of growth and mortality in larval bluegills: implications for juvenile recruitment (Partridge and DeVries, 1999).
5. Relative weight: an easy-to-measure Index of fish condition (Wright, 2000).
6. Is density-dependent growth in young-of-the-year fishes a question of critical weight (Cowan, et al., 2000).
7. An exploration of factors influencing crappie early life history in three

- Alabama impoundments (Dubic and DeVries, 2002).
8. Energetic adaptations along a broad latitudinal gradient: implications for widely distributed assemblages (Garvey, et al., 2003).
 9. Evaluating the potential for predatory control of gizzard shad by largemouth bass in small impoundments: a bioenergetics approach (Irwin, et al., 2003b).
 10. 2002 Alabama Freshwater Anglers Survey (Wright, et al., 2003).
 11. Movement patterns of coastal largemouth bass in the Mobile-Tensaw River Delta, Alabama: a multi-approach study (Norris, et al., 2005).
 12. First year growth and recruitment of coastal largemouth bass (*Micropterus salmoides*): spatial patterns unresolved by critical periods along a salinity gradient (Peer, et al., 2006).
 13. Searching for threshold shifts in spawner-recruit data (Garvey, 2009).
 14. Mercury concentration in two estuarine fish populations across a seasonal salinity gradient (Farmer, et al., 2010).
 15. Otolith microchemistry reveals substantial use of freshwater by southern flounder in the northern Gulf of Mexico (Lowe, et al., 2011).
 16. Freshwater Mussels and Clams (Wright and Reeves, 2014).
 17. Migratory characteristics and passage of paddlefish at two Southeastern U.S. lock-dam systems (Simcox, et al., 2015).

STUDIES BY THE MACEINA WORK GROUP

As detailed in a preceding Section, Bill Davies and his Work Group had been instrumental in helping the Department enter the 'main-stream' of modern fisheries science through the studies on West Point Reservoir; however, his primary interest was in the management of small impoundments. As a result, in the late 80s, we requested Experiment Station funds for establishing a tenure-track position for a scientist to work generally in the area of fish populations and fisheries of rivers and large reservoirs. In defining this new position, we were especially interested in identifying candidates with strong backgrounds in both basic fisheries science and statistical methods. The Search Committee decided that Dr. Michael J. Maceina met both criteria. He joined the faculty in June, 1990.

Mike Maceina had been awarded the B.S. Degree in Wildlife Ecology and the M.S. Degree in Forest Resources and Conservation by the University of Florida in 1977 and 1979, respectively. Then in 1987, he was awarded the Ph.D. in Fisheries Science by Texas A&M University. Before coming to Auburn in June, 1990, he was employed by the University of Florida as a Biologist II from March, 1979 through November, 1983; and as Senior Environmental Scientist by the South Florida Water Management District from August, 1987 through June, 1990.

In employing Maceina, the Department envisioned that he would continue the strong research program in fish management in public waters established by Bill Davies. Further, it was expected that he would continue the strong collaborative relationship between the Department and with the Fisheries Section of the Alabama Department of Conservation and Natural Resources.

Maceina and his Work Group conducted a large number of studies on fish populations in the public waters of Alabama, but in addition, they contributed significantly to the Department's reputation in the field of fisheries science through the application of statistical methods. In addition, Jerry Slipke and Maceina created a Windows software package – *Fishery Analysis and Simulation Tools (Fast)*. The name of the package was later changed to FAMS. It modeled fish population dynamics and generated assessment statistics. This software received a patent and was commercially marketed.

A partial list of publications by the Maceina Work Group includes:

1. A simple regression model to assess environmental effects in fish growth (Maceina, 1992).
2. Use of a split-plot analysis of variance design for repeated-measures fishery data (Maceina, et al., 1994).
3. Recovery of a warm water fish assemblage after the initiation of a minimum-flow release downstream from a hydroelectric dam (Travnichek, et al., 1995).
4. Relations between reservoir trophic state and gizzard shad population characteristics in Alabama reservoirs (DiCenzo, et al., 1996).
5. Simple application of using residuals from catch-curve regressions to assess year-class strength in fish (Maceina, 1997).
6. Use of equilibrium yields models to evaluate length limits for crappies in Weiss Lake, Alabama (Maceina, et al., 1998).

7. Influence of trophic state on spotted bass and largemouth bass spawning time and age-0 population characteristics in Alabama reservoirs (Greene and Maceina, 2000).
8. Exploitation of largemouth bass in Wheeler Reservoir, Alabama and simulated effects of minimum length limit regulations (Slipke, et al., 2003).
9. Population characteristics of largemouth bass associated with changes in abundance of submerged aquatic vegetation in Lake Seminole, Georgia (Sammons, et al., 2005).
10. Effects of striped bass stocking on largemouth bass and spotted bass in Lake Lewis Smith, Alabama (Shepherd and Maceina, 2009).
11. Fishery and population characteristics of blue catfish and channel catfish and potential impacts of minimum length limits on the fishery in Lake Wilson, Alabama (Holley, et al., 2009).
12. Stocking threadfin shad to enhance largemouth bass production in two Alabama ponds (Maceina and Sammons, 2015).

Mike Maceina retired in February, 2010. Because of funding problems, the College decided not to fill his position immediately. Fortunately, an agreement with ADCNR allowed the Department to fill that position with Dr. Catalano.

STUDIES BY THE IRWIN WORK GROUP

In 1995, Dr. Elise R. Irwin came to Auburn as an Assistant Leader of the Alabama Cooperative Fish and Wildlife Research Unit. She replaced Mark Bain, who left to become the Leader of the New York Unit at Cornell University. Elise received the B. S. Degree (Wildlife and Fisheries – Dual Major) from Delaware State College in 1987. Then she was awarded the M.S. Degree in Biology by Tennessee Tech University in 1989, and the Ph.D. Degree in Zoology by North Carolina State University in 1994.

Dr. Irwin assumed the leadership role for the Work Group in aquatic ecology established by Mark Bain. Under her leadership, it has been actively involved in a wide range of studies. Publications developed by the Group include the following:

1. Acute toxicity of an acid mine drainage mixing zone to juvenile bluegill and largemouth bass (Henry and Irwin, 1999).
2. An evaluation of soft visual implant tag retention compared with

anchor tag retention in channel catfish (Ferrara and Irwin, 2001).

3. Food habits of catfishes in tailwater and reservoir habitats (Jolley and Irwin, 2003).
4. Comparison of native and introduced flathead catfish populations in Alabama and Georgia: growth, mortality and management (Sakaris, et al., 2006).
5. Influence of gravel mining and other factors on detection probabilities of Coastal Plain fishes in the Mobile River Basin, Alabama (Hayer and Irwin, 2008).
6. A fish health assessment and liver lipid content examination of catfish populations in the Coosa River, Alabama (Jolley and Irwin, 2008).
7. A digital underwater video camera system for aquatic research in regulated rivers (Martin and Irwin, 2010).

STUDIES BY THE SZEDLMAYER WORK GROUP

The University established the Auburn University Marine Extension and Research Center (AUMERC) in 1989, but did not immediately increase funding for its research program. Then in 1990, the decision was made by the Agricultural Experiment Station to add funding for the establishment of a research position in marine recreational fishing. Later the Search Committee identified Dr. Stephen Szedlmayer, a Pennsylvania native, as the best candidate for that new position. He joined the faculty later in October, 1990.

Steve had been awarded the B.S. Degree in Biology by Millersville University in 1977, the M.S. Degree in Fisheries Ecology by the University of South Florida in 1982, and the Ph.D. Degree from the Virginia Institute of Marine Science, College of William and Mary in 1988. After receiving the Terminal Degree he worked with Dr. Ken Able as a Postdoctoral Fellow at the Rutgers University Marine Station from 1988, until he accepted the position at Auburn. Steve was initially assigned office and laboratory space at the AUMERC facility in Mobile County, but for several reasons, it was decided in 1998 that he would move into excess space available on the Fairhope Substation of the Alabama Agricultural Experiment Station.

Steve's Work Group has varied considerably in size over the years. At one point, during the period when British Petroleum (BP) was funding research related to the oil-spill, he had 14 people working with him. Presently, he has four graduate students and only one Research Associate – Peter Mudrak.

Peter has been part of the Work Group for several years. A native of Ohio, he was awarded the B. S. Degree by the University of Wyoming. Later, in 2011, he was awarded the M.S. Degree by Auburn.

When Steve began work in the coastal zone, 'boat-time' immediately became a critical problem. We had acquired the *Silver Eagle* in 1989. Unfortunately, a single vessel did not meet their needs. Then in the 1991-1992 period, AUMERC acquired two surplus vessels, on loan, from the Coast Guard. Although they were a 'god-send' for Steve's research, they really were not designed for fisheries work in the open Gulf. Finally, in 2003, the Department received permission to acquire a vessel specifically designed for that research. The financial arrangements for acquiring the vessel were really weird. The University loaned the Department funds to purchase it, but they were to be 'paid-back' over time from extramural grants and Departmental and Experiment Station Funds. The new boat was designed and fabricated by Jeff Gillman in Panama City, FL. It is 44 feet in length, with a width of 14 feet and a draft of 4 feet. It has an effective range of about 350 nautical miles. Later, in 2005, The *Mary Lou* (Figure 110) was added to the boat inventory. It was named for the Department's long-time Administrative Assistant, Mary Lou (Edwards) Smith. She had the responsibility of seeing that the University got its money back for the purchase of the boat. Later, the two Coast Guard vessels were "retired" (2007 and 2012).

As a result of the *Deepwater Horizon* oil spill, grant-funded research conducted by Szedlmayer's Work Group, increased substantially. Finally, the *Mary Lou* alone could not meet their needs for 'boat-time.' In July, 2012, a new 38-foot research vessel was acquired from Henrique Yacht, Inc., in Bayville, NJ. It has the same general characteristics as the *Mary Lou*. It was named the *R/V John Jensen*, after a long-term Extension Specialist and former Department Head.

The primary thrust of Steve's Work Group has evolved around the biology and management of fish associated with natural and artificial reef habitats of the northern Gulf of Mexico. This emphasis is consistent with the fact that the largest concentration of publicly- and privately-constructed reefs in the nation are located off coastal Alabama. The Work Group has also been responsible for important advances in the use of SCUBA diving and ultrasonic transmitter tagging methods in securing data on fish populations associated with the reefs. In recent years, the Work Group has extended its research efforts into much deeper water in order to collect data in habitats near the site of the *Deepwater Horizon* oil spill.

The importance of the Alabama reef fish resources to the economy and the importance of the data being collected by the Work Group is indicated by amount of extramural funds provided for their research over the years. In the last 20 years, it has been awarded grants and contracts totaling

approximately \$4.5 million from just three agencies. The primary source of funding has been the Alabama Department of Conservation and Natural Resources (ADCNR) with some 43 percent of the total, British Petroleum (BP) with 43 percent, and the National Oceanic and Atmospheric Administration (NOAA) with 16 percent.

Historically, the red snapper has been the most important fish in Alabama's coastal zone, both as a recreational and commercial species. As a result, Steve and his Work Group worked primarily with it; although they have conducted research on other important species. Their publications include the following:

1. Nursery habitats, growth rates, and seasonality of age-0 red snapper *Lutjanus campechanus*, in the northeast Gulf of Mexico (Szedlmayer and Conti, 1999).
2. Diel feeding patterns of red snapper on artificial reefs in the northcentral Gulf of Mexico (Ouzts and Szedlmayer, 2003).
3. Vertical distribution, size structure, and habitat associations of four Blenniidae species on gas platforms in the northcentral Gulf of Mexico (Topolski and Szedlmayer, 2004).
4. Estimates of residence and site fidelity for red snapper on artificial reefs in the northeastern Gulf of Mexico (Schroepfer and Szedlmayer, 2006).
5. Effects of habitat complexity and predator exclusion on the abundance of juvenile red snapper (Piko and Szedlmayer, 2007).
6. The effects of epibenthic communities on reef fishes in the northern Gulf of Mexico (Redman and Szedlmayer, 2009).
7. The use of otolith shape analysis for ageing juvenile red snapper, *Lutjanus campechanus* (Beyer and Szedlmayer, 2010).
8. Site fidelity, residence time and movements of red snapper *Lutjanus campechanus* estimated with long-term acoustic monitoring (Topping and Szedlmayer, 2011).
9. Territoriality, reproductive behavior and parental care in gray triggerfish, *Balistes capriscus*, from the northern Gulf of Mexico (Simmons and Szedlmayer, 2012).
10. Proximity effects of larger resident fishes on recruitment of age-0 red snapper in the northern Gulf of Mexico (Mudrak and Szedlmayer,

2012).

11. A comparison of size and age of red snapper (*Lutjanus campechanus*) with the age of artificial reefs in the northern Gulf of Mexico (Syc and Szedlmayer, 2012).
12. Fine-scale movements and home ranges of red snapper *Lutjanus campechanus* around artificial reefs in the northern Gulf of Mexico (Piraino and Szedlmayer, 2014).

Szedlmayer has introduced a novel new technique to the Department's arsenal of methods of obtaining data on fish populations – SCUBA diving. In the relatively shallow, clear waters of the Northern Gulf, he and his Work Group were able to establish experiments on the bottom using SCUBA and then directly observe and enumerate fish responses to the treatments.

STUDIES BY THE JOHNSTON WORK GROUP

A large share of Carol Johnston's research has been in the area of basic ichthyology. I have listed several publications, some of them developed with John Ramsey, in a preceding Section. Her Work Group also completed a number of studies in the much broader area of fish biology. I am listing below some of the publications developed in that area. Later in her career, she became interested in sound production in fishes, and her Work Group published the results of a number of studies in that area. Several of those are also included in the list:

1. Introduced species of fishes in the Southern Appalachians: consequences for conservation (Johnston, et al., 1995).
2. Sound production in *Pimephales notatus* (Rafinesque) Cyprinidae (Johnston and Johnson, 2000).
3. Fish assemblage recovery and persistence (Phillips and Johnston, 2004).
4. Habitat use of the shoal bass, *Micropterus cataractae*, in an Alabama stream (Johnston and Kennon, 2007).
5. Fish assemblages and species declines in Alabama, USA streams (Johnston and Maceina, 2008).
6. Life-history plasticity among stream sites in the Chattahoochee River Drainage, Alabama (Casten and Johnston, 2008).
7. Sound production in *Etheostoma oophylax* (Percidae) and call

characteristics correlated to body size (Speares and Johnston, 2011).

STUDIES BY THE CATALANO WORK GROUP

As noted in a preceding paragraph, when Maceina retired in 2010, the College of Agriculture was not replacing positions immediately, but anticipated that there would be a several-year gap between retirements and when those positions might be funded and re-established. Discussions between Dr. Rouse and Stan Cook (Chief of the Alabama Department of Conservation and Natural Resources Wildlife and Freshwater Fisheries Division) led to the conclusion that there was a need to refill the position sooner. ADCNR then agreed to provide funding for 75 percent of a tenure-track Assistant Professor position for 3 years, with the College of Agriculture providing the other 25 percent for those 3 years, after which the College would pick up the funding for the entire position. This allowed the Department to search for a replacement for the Maceina position shortly after he retired, which led to the employment of Dr. Matt Catalano in 2012. It was agreed that the Search Committee should seek a candidate with strong quantitative credentials. In September, 2012, Dr. Matthew J. Catalano agreed to accept the position.

Matt was employed specifically to conduct research and teach in the general area of fish population dynamics. He is a native of Ohio. He was awarded the B. S. Degree in Zoology by Miami University in 1997. In 2002, he was awarded the M.S. Degree in Fisheries by the University of Wisconsin-Stephens Point; then in 2009, he received the Ph.D. Degree in Fisheries and Aquatic Sciences from the University of Florida. At Florida, he had worked under the direction of Dr. Mike Allen, who had been one of Maceina's early graduate students. Before coming to Auburn, he was employed as a Post-Doctoral Research Fellow at the Quantitative Fisheries Center at Michigan State University.

Matt's Work Group has been involved in a number of wide-ranging research efforts, and they have developed several publications from them:

1. An age-structured state-space stock recruit model for Pacific salmon *Oncorhynchus* spp. (Fleischman and Catalano, 2013).
2. Prospects for fishery-induced collapse of invasive Asian carp in the Illinois River (Tsehaye, et al., 2013).
3. A simulation-based evaluation of in-season management tactics for anadromous fisheries: accounting for risk in the Yukon River fall chum salmon fishery (Catalano and Jones, 2014).
4. Influence of environmental variables on catostomid spawning

chronology in a warm water river (Catalano and Bozek, 2015).

5. Field and model-based evaluation of a low-cost sampling protocol for a coordinated, crayfish life-history sampling effort (Stoeckel, et al., 2015).
6. Harvest-induced size structure shifts alter nutrient release by a population of omnivorous fish (Catalano and Schaus, 2016).
7. Stakeholder-centered development of a harvest control rule for Lake Erie walleye *Sander vitreus* (Jones, et al., 2016).
8. From sequential to integrated Bayesian analyses: exploring the continuum with a Pacific salmon spawner-recruit model (Staton, et al., 2017a).
9. Spatial heterogeneity, variable rewards, tag loss, and tagging mortality affect the performance of mark-recapture designs to estimate exploitation: an example using red snapper in the Northern Gulf of Mexico (Sackett and Catalano, 2017).
10. Statistical catch-free age-structured assessment to estimate year-class strength for inland recreational fisheries: a largemouth bass example (Feltz and Catalano, 2017).
11. Development and evaluation of a migration timing forecast model for Kuskokwim River Chinook salmon (Staton, et al., 2017b).

STUDIES BY THE SAMMONS WORK GROUP

Steve Sammons is a native of New Jersey. He was awarded the B.S. Degree (Fisheries Science) by Virginia Polytechnic Institute and State University in 1991. Then in 1993, he received the M.S. Degree (Fisheries Science) from South Dakota State University. He was awarded the Terminal Degree (Fisheries Science) by Auburn University in 2004.

In 1994 and 1995, Steve was employed as a Research Associate by the Department of Fisheries and Wildlife Sciences at Virginia Polytechnic Institute. Then during the period 1995-2000, he worked as a Research Associate with the Tennessee Cooperative Fishery Research Unit at the Tennessee Technological University. In 2000, he entered the Ph.D. program at Auburn.

After receiving the Ph.D. in 2004, he was appointed as a Research Fellow. In that position, he continued to assist Maceina with some of his contract projects. He also was awarded a number of contracts from adjoining states

to conduct research on various species of bass and sunfish in their waters. He also works closely with Terry Hanson on research to quantify the economic benefits of population management efforts

The following publications are indicative of the kinds of research that this Work Group has completed:

1. Changes in behavior, movement and home range of largemouth bass following large-scale hydrilla removal in Lake Seminole, Georgia (Sammons, et al., 2003).
2. Population size, survival and growth of largemouth bass one year after stocking in four ponds (Sammons and Maceina, 2006).
3. Population characteristics of largemouth bass associated with changes in abundance of submerged aquatic vegetation in Lake Seminole, Georgia (Sammons, et al., 2006).
4. An evaluation of different structures to age freshwater fish from a northeastern river (Maceina and Sammons, 2006).
5. Evaluating the potential effectiveness of harvest restrictions on riverine sunfish populations in Georgia (Sammons and Maceina, 2008).
6. Effects of river flows on growth of redbreast sunfish (Centrarchidae) in Georgia Rivers (Sammons and Maceina, 2009).
8. Pond renovation (Slipke and Sammons, 2012).
9. Summer habitat use of large adult striped bass and habitat availability in Lake Martin, Alabama (Sammons and Glover, 2013).
10. Economic impact of a striped bass fishery (Lothrop, et al., 2014).
11. Movement and habitat use of shoal bass, *Micropterus cataractae*, in a regulated portion of the Chattahoochee River, Alabama/Georgia, USA (Sammons and Earley, 2015).

RESEARCH ON FRESHWATER CLAMS AND MUSSELS

Historically there has been little interest among the 'Investigators' in freshwater clams and mussels. As detailed in a preceding Section, J. S. Dendy had worked for TVA before coming to Auburn in the mid-40s. Mussel biology had been of considerable interest in that organization. Exploitation of mussel resources in some of the TVA reservoirs was an

important commercial enterprise. However, I do not remember him pursuing this matter once he joined the Auburn faculty.

For several years, each summer, Swingle took his 'Management of Impounded Waters' class to observe some of the work of TVA Biologists on the Tennessee River and its impoundments. A thorough exposure to mussel biology and exploitation was always included in the trip.

For many years, there was a resident population of 'paper pondshell' mussels (*Uitterbackie imbecilis*) in Smith Creek (Figure 18). When Pond S-6 was drained there was always a few of the animals present; along with a larger number of 'empty' shells. I do not remember anyone attempting to conduct research on them.

If I remember correctly, the first research conducted on freshwater clams and mussels at Auburn was conducted by Martin (Marty) Hable. In 1970, he wrote his M.S. thesis (Hable, 1970) on some aspects of the biology of *Corbicula manilensis*. *Corbicula*, a non-native species had been introduced to the U.S. previously, and in the 70s, it was spreading rapidly across the eastern half of the nation. From the beginning, it was obvious that the presence of this exotic had the potential to cause all kinds of problems in the utilization and management of our aquatic resources. When the zebra mussel first appeared in Alabama's public waters, there was widespread concern over its possible adverse effects on power generation.

As part of his study, Habel conducted several experiments on the possible use of the species in controlling phytoplankton populations in ponds. Later, other students would conduct research on the use of *Corbicula* to control excessive phytoplankton production in ponds. Unfortunately, I have been unable to recover any of the details on any of this work.

In 1993, Zachery Bowen, a Bill Davies graduate student, conducted a study on the commercial value of the mussel fishery in Wheeler Reservoir on the Tennessee River. This study was later published as Bowen, et al., (1994).

In 2014, Russel Wright and Claude Reeves produced an excellent Extension Publication on the role of freshwater clams and mussels in recreational pond management (Wright and Reeves, 2014). They concluded that these animals impact pond management by weakening the 'food chain' that connects inorganic compounds with fish production. This is accomplished by 'shunting' phytoplankton biomass into clam and mussel tissue rather than allowing it to 'flow' into aquatic insect tissue.

STUDIES BY THE STOECKEL WORK GROUP

Dr. James A. Stoeckel joined the Departmental Faculty in

August, 2007. His employment represented a new facet of work for the Department. In recent years, concern for the well-being of populations of non-vertebrate aquatic animals has increased substantially. Stoeckel's employment represented the University's and Department's commitment to be more actively involved with aquatic invertebrates.

Stoeckel, a native of Ohio, received the B.S. Degree in Biology from Northern Kentucky University in May, 1988. Then in June, 1994, he was awarded the M.S. Degree in Zoology (Aquatic Ecology) by The Ohio State University, and in August, 2007, he was awarded the Ph.D. Degree in Zoology (Aquatic Ecology) by Miami University. He was employed as Teaching/Research Assistant at Miami University before coming to Auburn.

Since his employment, Stoeckel and his Work Group have been involved in a number of studies on the biology of non-vertebrate aquatic animals in public waters of the State. Results of some of these studies were utilized in the preparation of the following publications:

1. Differing effects of suspended sediments on the performance of native and exotic *Daphnia* (Soeken-Gittenger, et al., 2009).
2. Evaluation of a crayfish burrowing chamber design with simulated water flow (Stoeckel, et al., 2011).
3. Effects of temperature and photoperiod on lure display and glochidal release in freshwater mussel (Landis, et al., 2012).
4. Behaviour and physiology are linked in responses of freshwater mussels to drought (Gough, et al., 2012).
5. Rapid development of molecular resources for freshwater mussel, *Villosa lienosa* (Bivalvia:Unionidae), using an RNA-seq-based approach (Wang, et al., 2012).

STUDIES ON WATER QUALITY IN PUBLIC WATERS³

It was noted at the beginning of this Section that the 'Investigators' became involved in two basic areas of research on aquatic ecosystems (Fish Populations and Water Quality) in public waters the late 40s. In the beginning, most of the research was conducted on Fish Populations. After the passage of federal legislation related to water quality in the mid-60s and early 70s, they were quickly overwhelmed with requests for assistance in meeting the State's requirements established by the Legislature.

³ David Bayne prepared a substantial share of the material in this Section

As a result of this action at the federal level, the Alabama Water Improvement Commission, established in September, 1947, contracted with the Farm Ponds Project of the Department of Zoology and Entomology to assist the State in collecting data on the status of water quality in Alabama's public waters. Dr. J. M. Lawrence was chosen to head the Auburn Work Group assembled to carry out the contract requirement.

EARLY WORK

In a preceding Section, it was noted that Dr. John Lawrence and his Work Group had conducted research on weed control in Lake Walter F. George (Lake Eufaula) and in Jim Woodruff Reservoir (Lake Seminole) for a number of years in the mid-60s, through contracts with the U.S. Army Corps of Engineers. The 1963 Fisheries Annual Report contains the first description on this research on the Chattahoochee River and Lake Walter F. George.

In this early weed control research, Lawrence realized the need for a better understanding of the reservoir's limnology; consequently, they requested funding from the Auburn University Water Resources Research Institute for the study. Later, he described characteristics of the reservoir and sampling techniques utilized in a paper presented to the Reservoir Fishery Resources Symposium, in Athens, GA in 1967. Sampling of the first phase of the study began in July, 1965, and continued through November of 1966. Apparently, they received additional funding to complete a second phase of the study. Sampling for this phase was concluded in December, 1967.

STUDIES BY THE LAWRENCE-BAYNE WORK GROUP

In 1974, the Lawrence Work Group became involved in a completely different kind of research. David Bayne had joined the group on returning from El Salvador in 1973. He had received a B.S. Degree from Tulane University in 1963. He attended the University of Alabama for a time in 1964, but in 1965, he enrolled in the graduate program at Auburn and was awarded the M.S. in Fisheries Management in 1967. Later (1970), Auburn awarded him a Ph.D. Degree in Aquatic Ecology. During the period 1970-1972, he served as an Assistant Professor in the Biology Department of Georgia College at Milledgeville.

Bayne returned to Auburn in 1972 to become 'Chief-of-Party' in the Department's USAID-funded Aquaculture Project in El Salvador. He returned to campus in 1973. He summarized his work there in Publication Number 7 of the School's Research and Development Series. Lawrence retired in 1981, and Bayne became the permanent Director of the Work Group. Over the years, it benefitted significantly from the presence of four other long-term participants: Wendy Seesock, Sergio Ruiz-Cordova, Eric Reutebuch and Dr. E. Cliff Webber.

Eric Reutebuch, a native of Indiana, received the B.S. Degree in Biology from Purdue University in 1981. After graduation he served as a Fisheries Extensionist with the Peace Corps in Nepal. In 1986, he was awarded the M.S. Degree in Fisheries Management by Auburn. For two years, 1988-1989, he was employed at the University of Georgia Coastal Plain Experiment Station in Tifton, GA as an Aquaculture Specialist. In 1989, he returned to Auburn to become part of the Bayne Water Quality Work Group. He continued in this position until Bayne retired (2006); at which time he joined the 'Water Watch' Work Group, under the direction of Dr. Bill Deutsch.

Wendy Seesock, a native of Jacksonville in Calhoun County, received the B.S. Degree in Marine Biology from Auburn in 1974 and the M.S. Degree from the same institution in 1979. She began work as a Graduate Research Assistant with the Lawrence-Bayne Work Group while in Graduate School, and joined them on a full-time basis after graduation. After Bayne retired in 2006, she worked with Alan Wilson until 2008, when she joined the Alabama 'Water Watch' Program.

Sergio Ruiz-Cordova, a native of Mexico, received the B.S. Degree (Marine Biology) from the Autonomous University of Baja California Sur (Mexico) in 1989. In 1993, he entered the Master of Science program at Auburn. In 1994, he began work as a Graduate Research Assistant in Bayne's Work Group. In 1994, he was employed as a Research Assistant to assist with the Department's participation in the USAID-funded Collaborative Research Support Program (CRSP) – Sustainable Agriculture and Natural Resources Management (SANREM). On the completion of that program, he assisted with the Deutsch Work Group in the 'Alabama Water Watch and Global Water Watch Programs'. He was awarded the M.S. Degree in Aquatic Ecology by Auburn in 2007.

Cliff Webber received the B.S. Degree in Biology from the University of Mississippi in 1965 and the M.C.S. in Biology from the same institution in 1967. Then in 1979, he was awarded the Ph.D. Degree in Aquatic Ecology by Auburn University. He had worked with the Lawrence-Bayne Work Group while he was in Graduate School. Then, in 1981, he became a permanent member as a Research Associate.

Publications and reports generated from the research effort of the Lawrence-Bayne Work Group included:

- 1. A study of dye flow in heated effluents released by Monsanto Textile Company, Decatur, Alabama into Wheeler Reservoir (Lawrence and Bayne, 1974).**
- 2. Effects of heated effluent released by the Greene County Electric Generating Plant upon the aquatic biota of the Black Warrior River.**

Report to Alabama Power Company (Lawrence and Bayne, 1976).

- 3. The effects of heated water on warm water fish in earthen raceways (Turner, et al., 1976).**
- 4. Effects of thermal alteration on macroinvertebrate fauna in three artificial channels (Alston, et al., 1978).**
- 5. Final report on evaluation of any impact caused by Monsanto's waste effluent upon the aquatic community in the Tennessee River in the environment of the Decatur, Alabama plant – Report to Monsanto (Lawrence and Bayne, 1978).**
- 6. A biological study of the Conecuh-Escambia Rivers in the vicinity of Brewton, Alabama (Lawrence, 1979).**
- 7. Water quality and plankton communities of the Chattahoochee River in the vicinity of the Farley Nuclear Plant (Lawrence and Bayne, 1980).**
- 8. Microinvertebrate communities in Wheeler Reservoir (Alabama) tributaries after prolonged exposure to DDT contamination (Webber, et al., 1989).**
- 9. Zooplankton, fish and sport fishing quality among four Alabama and Georgia reservoirs of varying trophic status (Bayne, et al., 1994).**
- 10. Zooplankton trophic state relationships in four Alabama-Georgia Reservoirs (Hartman, et al., 1995).**
- 11. Urban influence on phosphorus and sediment loading of West Point Lake, Georgia (Emmerth and Bayne, 1996).**
- 12. Relative mobility of fishes in a southeastern reservoir based on tissue PCB residues (Bayne, et al., 2000).**
- 13. Nutrient and sediment loading in Soughahatchee Creek and impacts on aquatic biota (Bayne, et al., 2004).**
- 14. Physical-chemical and biological characterization of small streams following intensive forest management in the Coastal Plain of Alabama (Ruiz-Cordova, 2007).**
- 15. Biological study of the Conecuh-Escambia River in the vicinity of Brewton, Alabama (Seesock, et al., 2007).**

16. Hydrologic habitat preferences of select southeastern USA fishes resilient to river ecosystem fragmentation (Rypel and Bayne, 2009).
17. Water quality in a non-traditional off-stream polyethylene-lined reservoir (Dougherty and Bayne, 2006).

Over the years, a large number of Technical Reports were prepared by this Work Group for submission to various companies and agencies funding their research projects. Many of these are included in the Annual Reports prepared by the Fisheries Department. Copies of most of these are maintained by the Department of Special Collections and Archives of the Ralph B. Draughon Library (See Table 103).

THE WEST POINT RESERVOIR WATER QUALITY STUDY

The Fish Population portion of the *Work Plan* for the U.S. Army Corps of Engineers contract for research on West Point Reservoir was described in some detail in a preceding Section. This Section describes some of the accomplishments of the 10-year study of changes in the water quality characteristics of the reservoir. When the actual field work began on this project (1976), the Lawrence-Bayne Work Group was already involved in a number of contracts with several companies for technical assistance in meeting the requirements of the Clean Water Act. As a result, Bayne accepted the responsibility of directing the research on West Point. Sampling began in 1976, and was concluded in 1985. The methodology employed and the results obtained were described by Bayne, et al. (1990). Publications developed from these long-term research efforts include the following:

1. Effects of water level fluctuations on the littoral macroinvertebrates of West Point Reservoir (Hale and Bayne, 1980).
2. The relationship of primary productivity to sport fish production in a new southeastern reservoir (Bayne, 1981).
3. Primary productivity studies during the early years of West Point Reservoir (Bayne, et al., 1983).
4. Cultural eutrophication of West Point Lake – a 10-year study (Bayne, et al., 1990).
5. Urban influence on phosphorus and sediment loading of West Point Reservoir, Georgia (Emmerth and Bayne, 1996).
6. Changes in Blackbass Community and Fishery with oligotrophication in West Point Reservoir (Maceina and Bayne, 2001).

The West Point Study could not have come at a better time; because the U.S. Environmental Protection Agency (EPA) was urging states to adopt water quality standards to assure that all public waters were “swimable, fishable and drinkable.” EPA worked closely with the Alabama Department of Environmental Management (ADEM) in evaluating lake water quality data and attempting to identify problem areas. The 10-year study of West Point Reservoir (WPR) revealed the accelerated cultural eutrophication caused by excessive nutrient enrichment. West Point Reservoir is the first impoundment of the Chattahoochee River downstream of Atlanta, GA. Rarely do you find such a large city dependent on and located in the head waters of a relatively small river. At the time, Atlanta had point-source wastewater treatment at the secondary level, but secondary treatment only removes a relatively small portion of the plant nutrients – nitrogen and phosphorus. Therefore, these nutrients were discharged into the river and were available to stimulate growth of algae, and thus add to the organic loading of the receiving waters. In addition, combined sewer overflow occurred during rainfall in Atlanta resulting in raw sewage flowing into the Chattahoochee River. To make matters worse, neither Alabama nor Georgia considered nitrogen or phosphorus to be pollutants; therefore, there was no attempt to regulate these harmful elements. Point and non-point source dischargers were free to release unlimited quantities of these pollutants. Without intervention, the fate of West Point Reservoir appeared grim.

To address this problem, Auburn University, EPA, ADEM and the Georgia Department of Natural Resources (DNR) compiled all relevant water quality data to develop the first comprehensive water quality standards for a large lake in the southeastern USA dealing with nutrient pollution. It was clear from this experience that other Alabama waters would suffer the same fate as West Point, but at a slower pace, if nutrient standards were not imposed on all lakes in the State. While the U.S. Army Corps of Engineers, Mobile District (COE) financed the West Point study for all 10 years (almost unheard of), it was not clear where funding for the other 35 large public lakes (only one natural lake) would come from. But over the next decade or so, funding was obtained from a combination of contracts and grants from Alabama Power Company (ALPOW), EPA, ADEM, COE, and various industrial clients. The results of intensive water quality studies of these 35 lakes were added to the information that ADEM was collecting as they proceeded to set nutrient and chlorophyll a standards for each individual Alabama lake, following the West Point model. Now all Alabama lakes are monitored by ADEM in a rotation that assures compliance with these standards.

A number of graduate students who studied under Lawrence or Bayne and participated in water quality research in public waters as part of their thesis or graduate assistantships, moved on to careers in water quality or water management: John Grogan (1973), Malcome Pierson (1982), Bill Garrett (1983) and Justin Mitchell with ALPOW; Bob Cooner (1981), Tim Forrester

(1975), Fred Leslie (1989), Gina LoGiudice (2002), and Chris Harman (1993) with ADEM. Bob Conner and Fred Leslie both assumed leadership roles as Chief of Field Operations-Montgomery Branch ADEM, and were very active supporting and developing these advanced water quality standards for Alabama waters.

Other important participants in these efforts to manage and preserve aquatic resources were: Howard Marshall, EPA Atlanta, GA; David Camp, Georgia DNR, Atlanta; Mike Eubanks, CORPS, Mobile District, Mobile, AL; James McIndoe and Lynn Sisk, ADEM, Montgomery, AL.

INSTRUCTION IN FISHERIES, AQUACULTURE AND AQUATIC SCIENCES⁴

It is difficult to determine when Auburn's instructional program in fish management began. Swingle seemed to be 'born to teach.' He never engaged in 'small talk.' Every moment seemed to be a 'teaching opportunity.' In one of his less serious moments, he related how he and his siblings were encouraged to debate each other after the family meal in the evenings. One has only to read one of the early Annual Reports that he and Smith prepared to appreciate his 'drive' to inform others of what he had done and what he thought it meant. The 1930s Annual Reports are syllabi rather than research reports. In this sense, the instructional program in fisheries management are as old as the program itself.

While Swingle never missed an opportunity 'to teach,' there is no record of him being involved in an organized 'teaching' effort until the late 40s. The 1947 Annual Report provides a description of a week-long Short Course (non-credit) in pond construction and management offered to U.S. Fish and Wildlife Service Biologists in the Southern Region. In the same year (1946-1947), the first description of the curriculum in Fish Management appeared in the University *Bulletin*. Listing in that publication provided official approval for its establishment. It also indicated approval for awarding University credit for students who successfully completed Swingle's two courses on the *Management of Impounded Waters* (ZY 619 and 620). With this timing, Swingle could have first taught the new courses as early as the Spring and Summer Quarters of 1947.

The establishment of the formal teaching program also required a new emphasis on faculty development. In 1946, when the establishment of the first curriculum was being developed, the available faculty consisted of Swingle, Prather and Lawrence – all Agricultural Experiment Station 'Investigators.' At that point, Swingle and Lawrence never had a formal

⁴ I am especially indebted to John Grover for his contribution to this Section.

course in any subject matter related to fisheries. Prather had taken applicable courses while working on his M.S. Degree at the University of Michigan. Obviously, there was not enough expertise available at that time to offer an M.S. in Fish Management. As a result, the Department of Zoology-Entomology began to search for an individual with a Terminal Degree and with specialization in some area of aquatic biology, closely related to fisheries management. It is not known how widespread the search was, but soon Dr. J. S. Dendy was chosen for the position of helping to plan the establishment of the new curriculum and to remain as a permanent faculty member to help implement it. Earlier (1943), Dendy had been awarded the Ph.D. Degree by the University of Michigan. In 1947, he was employed as a Fisheries Biologist (Limnologist) by the Tennessee Valley Authority. It is likely that Swingle knew him from his early contacts with the TVA fisheries program and was instrumental in getting him to come here to help establish the new academic program.

With only Prather and Dendy with any academic background in any aspect of fisheries, faculty development was still important for the new program. The importance of faculty development to support the new teaching program doubtlessly was likely a major factor in Lawrence's decision to leave the Fisheries Program temporarily, in 1950, to go to Iowa State University to work on requirements for the Ph.D. Degree. There, he worked under the direction of Dr. Kenneth Carlander, one of the pre-eminent fisheries scientists of that period. Lawrence returned to campus permanently in 1952.

As detailed in the preceding Section, the research productivity of the Auburn Fisheries Program has been truly amazing, but the accomplishments of its instructional program has been even more exceptional, and likely more far-reaching. The quality of fishing obtained in the 'Eureka' Experiment in Farm Pond 4 in 1940 and 1941 attracted widespread national attention. Soon Soil Conservation Biologists, hatchery managers and state biologists were making, informal visits to Auburn regularly to follow the progress of the research in pond management. Consequently, it was inevitable that sooner or later the 'Investigators' would be asked to offer 'organized' instruction on their methods and results to a wider audience.

The establishment of a formal teaching program forced the 'Investigators' into the new, larger world of academics. As employees of the Agricultural Experiment Station, they had lived and worked within a relatively confined world. Oversight of their work and productivity was relatively limited. The academic world was much larger, and in many ways, much more complex. For the first time, they had to develop course descriptions, and syllabi. Further, they had to meet classes according to pre-arranged schedules. Meeting these classes took precedence over their research plans. They were required to give examinations and to report grades to the Registrar's Office.

INFORMAL INSTRUCTION

As noted above, the formal teaching program in fish management was initiated in the late 40s; however, the 'Investigators' were involved in teaching (informal instruction) at least a decade earlier.

Informal instruction is a quick, efficient way to get information into the 'hands' of those who will usually apply it on a 'day-to-day' basis. Unfortunately, because of time limitations, informal courses must be rather sharply focused. There is little time for the presentation of broader aspects of the information, and even less time for an exposure to the basic sciences which provide the basis for the information. These deficiencies can only be dealt with over an extended period of time through more formalized instruction. Auburn has used informal instruction to present information in support of its many programs on campus, throughout the Region and around the world for over seventy-five years. Some of these efforts will be described in the following material.

SHORT COURSES IN POND MANAGEMENT

These courses were provided at Auburn for groups of biologists from various government agencies. They generally consisted of several days of instruction in pond construction and management around the ponds on the South Auburn, Soughahatchee and Story Farms. Initially, most of the emphasis was on the management of ponds for recreational fishing; however, later, instruction also included limited information on commercial fish production. There is no information in the Annual Reports of Short Courses having been given earlier than 1942. The 1947 Report indicated that a two-week short-course was presented to a group of U.S. Fish and Wildlife Service Hatchery Biologists during the period August 4-15, 1947. Later the same year (August 26-27), a two-day Short-Course on pond analysis was presented to group of Soil Conservation Service employees from south-west Georgia.

The 1948 Annual Report noted that during the period June 7-11, 1948, that Swingle, Dendy, Lawrence and Prather provided a 1-week training program for a total of 16 biologists from Florida, Mississippi, North Carolina, South Carolina, Tennessee and West Virginia (Figure 111). Names of those attending are listed in Appendix Table 5.

Note that Vern Davidson, Regional Biologist, SCS, attended this 1948 course. Recall that he was instrumental in publicizing Auburn's Pond Management Program among SCS personnel across the country. The number of states participating in that Short Course is indicative of the level of recognition that Swingle and his pond management program had received by 1948.

During the period July 25-August 7, 1948, Auburn personnel were involved in providing instruction on the management of largemouth bass and bream in farm ponds to Soil Conservation Technicians and state fish culturists in California, Idaho, Oregon and Washington. This training exercise also provided the Auburn personnel with the opportunity to become familiar with pond characteristics in other regions.

Information in the Annual Reports indicate that other Short Courses were held later in 1948 and in 1950 and 1958. Additional information on the names of the participants in most of these (1947-1958) is available in the Annual Reports for those years which are maintained in the permanent files of the Department of Special Collections at RDB Library (Accession 97-029).

STATE LAKES TOURS

The Alabama Department of Conservation initiated its State Lakes Construction Program in 1945. In this Program, State funds were utilized to construct small lakes in areas of the State where the availability of sport fishing for the public was severely limited. The first such lake (55 acres) was constructed in Crenshaw County in the south-central portion of the State. By the mid-50s, a number of these lakes had been completed and were available for public fishing. This was the first such program in the nation, and it attracted considerable attention among fish managers everywhere. The Department received numerous requests for tours. In response, the Fisheries Section of the Alabama Department of Conservation began to schedule them each summer for several years. Biologists from throughout the nation were invited to attend. Usually, the tours involved visiting a number of the lakes over a 5-day period. In the early days, Swingle joined the tour, and guided the group through the process of determining population balance at each of the sites. Alabama biologists discussed the history of each lake and efforts undertaken to manage it. With all of this information presented, Swingle led a group discussion on management procedures that should be followed in the future. Generally, the first day of each tour was spent visiting the ponds at North Auburn. These tours were extremely popular. Over the years, the tours provided a useful exposure of Swingle's approach to pond management, and an introduction to the entire Auburn Fisheries Program.

FISH PARASITE AND DISEASE SHORT COURSES

Annual Short Courses have been one of the primary services provided by the Auburn faculty to biologists in the participating states of the Southeastern Cooperative Fish Parasite and Disease Project. Grizzle (2004) has provided a good summary of this continuing education activity over the 40-year life of the Project. He commented:

“The Project has provided two types of continuing education opportunities for biologists in the participating states. More than 60 Short Courses, usually one to two days in duration, have been presented within the states to provide basic information about fish diseases or about new information resulting from Project research. Also, five-day courses, which allowed for a more comprehensive coverage of current information and of new laboratory procedures and practices, were taught on the Auburn campus, 19 times over the years.”

THE COOPERATIVE CONTINUING EDUCATION PROJECT⁵

In 1976, we presented a proposal to the Southeastern Association of Fish and Wildlife Agencies to establish a Cooperative Continuing Education Program in Fisheries and Wildlife Management, to be administered by the Department. Its purpose was to provide professional continuing growth opportunities for biologists in the cooperating states. Initially five states (Alabama, Arkansas, Florida, Georgia, and Mississippi) participated in the Program. Later, Tennessee and West Virginia joined. From the beginning, it was well received by the participants. John Grover, Bill Davies and Paul Krause from the Wildlife Group were instrumental in getting the project ‘off-the-ground.’ Later, Kraus left the University and with his departure, the Wildlife Group quickly lost interest.

Information presented in the *ICA 1979 Communique* (January-March, 2(1):2-3), noted that the Steering Committee of the Southeastern Cooperative Fishery Continuing Education Project met in Auburn in March, 1979. During the meeting it was agreed to establish an Associate Member classification to allow agencies such as the U.S. Army Corps of Engineers, the Tennessee Valley Authority, the Soil Conservation Service and the U.S. Fish and Wildlife Service to participate in the project. The Committee also agreed to meet again in December, 1979, and to offer a Short Course on ‘Funding of State Fisheries Programs’ to interested administrators from the participating states.

In the administration of this Project, the Steering Committee with input from the participating states, proposed a short list of subjects for Short Courses. When there was final agreement on the courses, the Department identified presenters for each one, and scheduled time and locations for the presentations. This arrangement was well received by the participating states, and they cooperated fully by funding employee travel.

In 1979, it was agreed that Short Courses offered would be limited to either ‘Length Limits’ or ‘Professional Communications.’ Accordingly, Robert Kendall and John Grover offered a Short Course in ‘Professional

⁵ Dr. John Grover provided much of the information for this Section. He was active on this Project from its inception.

Communications' to biologists in Georgia (February 27-28) and West Virginia (March 20-21). Similarly, a Course on 'Length Limits' was offered to biologists in Alabama, Florida, Mississippi and Tennessee. Richard Anderson and Steve Malvestuto were the presenters for most of the States; although Gary Novinger assisted with the Alabama Course. Arkansas made a special request for a Course in Water Quality. Claude Boyd and Robert Romaine presented it in Little Rock during the period March 6-8.

As an Auburn graduate student, Steve Malvestuto had participated in a number of the Short Courses presented in the different states as part of the Cooperative Continuing Education Project. Then in March, 1979, he was employed as an Assistant Professor with the Department. One of his primary responsibilities was to help provide leadership to the Continuing Education Project. In this capacity, he spent much of his time working with State Biologists in the Project on the use and design of creel censuses. In fact, his presentations were in such great demand that he decided to create his own company (Fishery Information Management Systems) to provide this information 'for profit.' At first, he only served as a consultant to the company; while continuing to lead the Continuing Education Program. However, he soon began to encounter serious 'conflict-of-interest' problems, and in April, 1989, he resigned from the University to manage his company 'full-time.' At the same time, we decided that Steve's Company should be able to meet the continuing education needs of the Southeastern Region without any direct involvement of the Department. When Steve resigned, there were 12 state and federal agencies involved in the project.

Involving Malvestuto in the Continuing Education Project was one of the wisest things that we ever did. By the time that he had to give up his teaching activities as a result of poor health, he had almost single-handedly revolutionized fisheries management in the Southeast. His presentations encouraged the widespread use of creel censuses in collecting data about the exploitation of fish populations and the use of that data in making management decisions.

SHORT COURSES IN LESS DEVELOPED COUNTRIES (LDCs)

Short Courses in Less-Developed Countries (LDC's) were largely 'creatures' of International Center for Aquaculture (ICA) efforts to implement Caton's 'Model' for the development of aquaculture in the 'third world.' The initial contractual agreement between the U.S. Agency for International Development and Auburn University (Aid/csd-1581, signed on June 30, 1967), resulted in a formal request from USAID that Auburn provide them with seven different types of services. One of these was to conduct Short Courses in subjects related to aquaculture and fisheries in LDC's. Later, requests for informal training would be included in several additional contracts with USAID. As a result, in the following half-century, Auburn faculty and faculty

from other Universities, employed on short-term contracts, provided dozens of Short Courses in a wide variety of subjects for aquaculture and fisheries workers in LDC's around the world. In the early years, much of this effort was centered on Thailand.

SHORT COURSES IN THAILAND

In the late 60s, Thailand already had a well-established aquaculture and fisheries program. As a result, USOM/Thailand decided that there was no need for a long-term project involving permanent Auburn personnel. Rather, it was decided that the best approach was to up-grade the capability of their personnel through additional training – both in-country and by sending some of them abroad for formal training. Several of the Short Courses conducted in-country are described in the following paragraphs.

SWINGLE AND SMITHERMAN (1969)

The first of these in-country training sessions in Thailand was conducted by Swingle and Smitherman during the period April 15-May 15, 1969. While in-country, they gave lectures on research methods and fish population dynamics to biologists from most of the Government Fishery Stations.

SWINGLE, PARDUE AND SCHMITTOU (1969)

Later in 1969 (August 20-September 19, 1969), Swingle, Pardue and Schmittou visited Thailand. During this visit, they gave lectures and demonstrations to Thai biologists on the following subjects:

1. Water chemistry
2. Hatchery management
3. Management of village ponds and small reservoirs
4. Management of large reservoirs
5. Intensive cage culture of fishes
6. Methods in fish health
7. Effective extension.

SWINGLE AND SHELL (1971)

In the fall of 1971, Swingle and Shell visited Thailand and

provided lectures and demonstrations at several of the Fisheries Stations on the following subjects:

1. Sampling methods in reservoirs
2. Fish population dynamics in reservoirs
3. Statistical treatment of research data
4. Fish nutrition
5. Fish feeds
6. Anatomy and physiology of fishes
7. Design of experiments on cultural methods.

SHELL AND LOVELL (1972)

Shell and Lovell traveled to Thailand on October 1, 1972, to review progress on research projects planned jointly by Auburn and the Department of Fisheries in a previous visit, and to deliver lectures to Thai biologists and administrators. This visit was quite different from the previous ones. For the first time, Swingle was no longer a 'team' member. His absence changed the relationship between Auburn advisors and biologists to a considerable degree. Lovell and I were both 'teachers.' In fact, both of us had taught courses at Auburn which included several current Thai biologists. However, there was a considerable difference between being a 'teacher' and a 'Teacher.' Swingle had been a 'Teacher' and would always be in the 'eyes' of all Thai biologists. In retrospect, I feel that this changed relationship was really a positive factor in all of our contacts with the biologists. With Swingle present, presentations by biologists tended to be recitations rather than frameworks for discussion. This is not meant to be a derogatory comment. Rather it is a 'fact-of-life' and an extremely important cultural artifact in Thailand. There, 'Teachers' are revered.

Lovell and I visited a total of 11 stations in the Northeast, North and Central Plain Regions. We presented lectures and led discussions with biologists at several locations. Most of the presentations dealt with two subjects:

1. Planning and administering research, the design of analyzing and reporting results.
2. Fish nutrition, meeting nutritional needs with feeds, feed formulation and manufacture and feeding practices.

SHORT COURSE IN JAMAICA

Mike Cremer taught a 3-week (October 28-November 24, 1982) Short Course on pond construction to six Inland Fisheries Project Personnel in Jamaica. Most of the emphasis in the course was on the construction of 'dug' ponds. Cremer noted that additional training should also be provided on the construction of 'terrace-water' ponds. Jim Bowman, ICA Resident Advisor, assisted with site-selection field exercises in the West.

SHORT COURSE IN COLOMBIA

Len Lovshin and Gary Jensen taught a course for INDERENA biologists in Colombia on hatchery management and induced spawning, during the period April 30-May 4, 1979. During the same year (September 1-8), John Jensen and Carole Engle taught a Short Course on extension methodology and on the economics of aquaculture.

SHORT COURSE IN TUNISIA

During the period January 22-February 3, 1987, John Jensen conducted a four-day work shop on extension philosophy, planning and methodology for Tunisian Peace Corps volunteers.

SHORT COURSE IN INDONESIA

Ron Phelps and Tom Popma taught a Short Course on 'seed' production of tilapia, common carp, Chinese carps, *Pangasius*, *Clarias* and *Leptobarbus* at the BBAT Station at Sukabumi, West Java, Indonesia, in November, 1991. The course involved approximately 50 percent lecture and 50 percent demonstration.

SHORT COURSES IN VIETNAM

In April, 2015, an agreement was approved by the Dean of the College of Agriculture at Auburn and the Dean of the College of Agriculture and Fisheries at Can Tho University in Vietnam for the exchange of teaching and research personnel. Under the agreement, two to four faculty members from the School of Fisheries, Aquaculture and Aquatic Sciences would visit Can Tho each year to teach undergraduate and graduate courses. The courses included materials used at Auburn, condensed into a 2-3 week period. Auburn course materials will be shared with Can Tho faculty during these interchanges. Bill Daniels has served as Auburn Coordinator for this program. Boyd, Davis, Dunham, Brady, Phelps, Bullard, Terhune, and Stoeckel have also participated.

SHORT COURSE IN AQUACULTURAL ENGINEERING

Malcom Johnson taught a 6-month course at Auburn in Aquacultural Engineering to a group of biologists from Egypt, during the period January-July, 1984. The course was sponsored by the World Bank–Maryut Project. The course involved a combination of lectures and field exercises. Record keeping and the preparation of reports received considerable attention. The course also involved trips to farms, hatcheries and processing plants in nearby states.

THE AQUACULTURE TRAINING PROGRAM (ATP)

Providing non-degree training in aquaculture for foreign nationals was an important activity of the Auburn Fisheries Program from the early 40s onward; however, by the late 1960s, the haphazard scheduling associated with this important program was becoming a serious problem. As a result, it was decided to combine all of these individual training activities into a single program – the Aquaculture Training Program (ATP). Under this program, training was to be offered only one time each year, generally from May to September. It was designed as a 15-week ‘hands-on’ program emphasizing the pond culture of warm-water species: African tilapias, Asiatic carps and channel catfish. It consisted of approximately 400 hours of classroom and field exercises. The program also included supervised tours of fish farms, processing plants, government hatcheries, research stations and other aquaculture-related facilities in the Southeast. The first of these annual programs was offered in 1976. The demand was so great that year that two different sessions were offered. The program quickly became so popular that available pond facilities were badly over-subscribed; consequently, in 1979, 20 new ‘H’ Ponds were constructed on the Soughahatchee Farm specifically for the use of ATP students (Figure 18D).

FISHERIES SUMMER CAMP

In 2009, David Cline offered the Fisheries and Aquaculture Summer Camp for the first time. He is an Extension Specialist in Aquaculture Aquatic Resources with the Alabama Cooperative Extension System. A native of New York, he received the B.A. Degree (Biology) from Colgate University in 1986 and the Master of Aquaculture Degree from Auburn in 1991. Afterwards, during the period April, 1991-October, 1992, he served as manager for Eastwood Aquaculture, Inc. Later, in 1993 and 1994, he worked with the University of Arkansas as Extension Fisheries Specialist. He joined the Auburn Extension Faculty in 1994. His first assignment for Auburn involved providing technical assistance to caged fish producers in the Piedmont Region of east-central Alabama. He was re-assigned to the campus in 2002. In 2011, he was awarded the Ph.D. Degree in Aquaculture by Auburn University.

The summer camp is sponsored jointly by the Alabama Cooperative Extension System and the School of Fisheries, Aquaculture and Aquatic Sciences. Over a 5-day period, high school students participate in a wide variety of fisheries, aquaculture and aquatic biology activities, including lure-making, fishing, kayaking on the Coosa River, and seining fish ponds. These activities are designed to provide the students with the broadest possible exposure to careers in the aquatic sciences. Students live in Auburn's resident dormitories, and take their meals in campus dining facilities. Enrollment is limited to 25 students.

CERTIFICATION FOR AQUACULTURE PROFESSIONALS (CAP)

Responding to the growing need world-wide for better trained aquaculture professionals, in 2008, the Department began the development of a program for the certification of aquacultural professionals. The program utilizes web-based technology to offer instruction in either English or Spanish, any place in the world that has access to the internet. Instruction involves the use of videos featuring various departmental faculty teaching in their specialty areas. Troy Hahn and his Work Group in Information Technology were responsible for developing the program into a fully online accessible package. In 2008, the program utilized the Blackboard Learning System (LMS), but in 2011 this system was discarded in favor of CANVAS Learning Management System produced by *Instructure*. With its intuitive features, CANVAS was much easier to use.

In the beginning, the complete curriculum involved ten areas of instruction. In turn, each area was divided into a number of segments (Table 89).

Under the procedures adopted for the program, students were to be evaluated at the completion of each module. They were expected to achieve grades of at least 70 percent in order to proceed to the next module. Those not able to reach this level of response were allowed to review the lectures again and retake the exam.

Although this program apparently is still functional, it is no longer under the purview of the School Fisheries, Aquaculture and Aquatic Sciences. I believe that it is now administered by the Office of Technology Transfer.

FORMAL INSTRUCTION – REGULARLY SCHEDULED UNIVERSITY COURSES

As detailed in a preceding Section, formal instruction (regular University courses) in Fish Management was initiated by Auburn at about the same time that the first informal Short Courses were first offered. According to comments made by H. S. Swingle, the request that regular university courses in pond management and related subjects be offered at Auburn came from James Silver, Southeast Regional Director of the U.S. Fish and Wildlife

Service. Silver recognized the growing need for university-trained fishery biologists in the Region, and apparently felt that Auburn, with its active research program in pond management, was the place to do it.

In the mid-40s, the University of Washington, the University of Michigan, the University of Minnesota, Cornell University and Iowa State University offered curricula in fisheries biology and management; but there were none in the South, although there were a few universities offering courses in fish taxonomy. In other unpublished comments by Swingle on the beginning of the teaching program at Auburn, he included the name of Dr. C. M. Mottley of Cornell University. Mottley was a Professor of Limnology and Fisheries at that institution at that time. Although Swingle offered no further comment, it seems likely that Mottley was consulted regarding the establishment of the new curriculum.

ESTABLISHMENT OF THE FISH MANAGEMENT CURRICULUM

There is no record of the discussions that connected the comment by Silver on the need for formal training in Fish Management in the Region and Auburn's decision to do so. It is obvious that it would be organized around the primary elements of the research and development program here at that time – pond construction and management. As noted previously, with the exception of Ellis Prather who had earned an M.S. at the University of Michigan, none of the 'Investigators' had ever had a course in any area of aquatic biology. There simply was not sufficient academic experience to offer a University Degree. As detailed in a preceding Section, Dr. J. S. Dendy joined the Zoology-Entomology Department to help with the implementation of the new curriculum and to teach some of the courses that would be required. Remember that the first formal description of the new curriculum first appeared in the 1946-1947 *Bulletin*. Obviously, Dendy was not on campus when the final decisions were made to establish the curriculum, or what would be included. I assume that he had already been identified to help with its implementation, and was involved informally with advanced planning. Unfortunately, there is no record of any of these events.

In the following material, some aspects of the evolution of the formal teaching program in Fish Management will be reviewed. Generally, these comments are based on information obtained from the official API/Auburn University Bulletins. Note that the academic year began in the middle of one year and ended in the middle of the following year.

THE 1945-1946 ACADEMIC YEAR

Although the curriculum for an undergraduate major in Fish Management and requirements for the Master of Science in Fish Management would not appear in the College *Bulletin* until the 1946-1947 academic year,

two courses in the general area of fish management were listed in the 1945-1946 publication:

- ZY 312 – Fish Culture (3 Credit Hours).
- ZY 616 – Systematic Ichthyology (5).

The course in *Fish Culture* included information on construction, stocking, fertilization and management of fishponds; bait production, angling, and identification of the principle game and forage fishes. ZY 312 was the first formal course listed in the Auburn *Bulletin* that included information generated by the ‘Investigators.’ I am not certain that the course was taught before the formal curriculum was established. In the following year (1946-1947), it was listed as a General Elective, and not included in the list of courses required for the B.S. Degree.

The M.S. Degree in Fish Management was not formally available until the 1946-1947 academic year; however, the 1945-1946 catalog included the following statement:

“Students who wish graduate training in Fish Culture and Wildlife Management should have a Degree from a recognized college with fundamental training in agriculture, botany, chemistry, physics and zoology.”

THE 1946-1947 ACADEMIC YEAR

As noted previously, the first undergraduate curriculum offered in Fish Management was listed in the University *Bulletin* for 1946-1947. It listed the following courses designed primarily for undergraduate majors:

- BY 415 – Aquatic Plants (5 credit-hours)
- ZY 413 – Ecology and Identification of Fishes (5).
- ZY 414 – Aquatic Insects (5).
- ZY 415 – Limnology (5).

Except for Aquatic Plants (BY 415), all of these courses were part of the larger curriculum of the Zoology-Entomology Department. Also listed was a General Elective: ZY 412 - Fish Management (3). This course could be taken for credit by any student in the University, and it was the only course available to undergraduates in Fish Management that included any information on pond management. The courses, ZY 412, ZY 413, and ZY 415, were offered in the Department of Zoology and Entomology, and were taught by J. S. Dendy.

The same University *Bulletin* (1946-1947) also indicated, for the first time, that

the Master of Science in Fish Management was an option of graduate study within the Department of Zoology and Entomology. Specific graduate credit courses for that option included:

- ZY 610 – Aquatic Zoology (5) (Dendy).
- ZY 615 – Fisheries Biology (5) (Dendy).
- ZY 616 – Systematic Ichthyology (5) (Dendy).
- ZY 617 – Systematic Ichthyology (5) (Dendy).
- ZY 618 – Pond Construction (5) (Lawrence).
- ZY 619 – Management of Impounded Waters (5) (Swingle).
- ZY 620 – Management of Impounded Waters (5) (Swingle).
- ZY 621 – Practical Fish Culture (5).

I have listed instructors for these courses; although the *Bulletin* listed only 'Staff' for all of them. Three of these courses (ZY 618, ZY 619 and ZY 620) are especially noteworthy, because they included material obtained primarily from the field research conducted by the 'Investigators' on the South Auburn, Sougahatchee and Story Farms. The catalog description for these courses were as follows:

Aquatic Zoology (ZY 610): Biology, ecology, and classification of fresh water animals, with special emphasis on the plankton and other organisms important to the production of food for fishes.

Fisheries Biology (ZY 615): General survey of U.S. Fisheries resources, biology of commercial species, and a study of the management methods employed.

Systematic Ichthyology (ZY 616): Principles of classification and the construction and utilization of keys for the identification of fishes. The student will be required to collect and identify 50 species.

Systematic Ichthyology (ZY 617): Principles of classification and the construction and utilization of keys for the identification of fishes.

Pond Construction (ZY 618): Principles and practices in the selection of pond sites, survey pond areas, use of dynamite in dam construction, installation of drain pipes and valves, construction of dams with tractor equipment, and the construction of spillways and diversion ditches.

Management of Impounded Waters (ZY 619 and ZY 620): Basic principles of fish production and methods of stocking, fertilization, sampling techniques, renovation of old ponds and harvesting the fish crop. Obviously the title of this course was somewhat misleading. It was primarily concerned with recreational fish production in 'terrace-water' ponds. The catalog

description of *Management of Impounded Waters* (ZY 620) in the 1946-1947 catalog was identical to ZY 619.

Both of Swingle's '*Management*' courses were taught in the so-called 'fig-tree' house – a small wooden frame building just west of the Miller home. It was unbelievably hot in the summer. Fortunately, however, there were double doors that could be opened, and large fans to keep the air moving.

Practical Fish Culture (ZY 621): Designed to provide credit for students working for at least 3 months in state, federal or private hatcheries. It was never practical for graduate students to use this course. The scheduling of regular courses was such that there was no 'free' quarter to go off campus to work in a hatchery.

Table 90 includes data on the courses in the sciences and mathematics required by all undergraduate students in the 1946-1947 Fish Management Curriculum. Table 91 lists the number of regularly scheduled courses in different categories offered by the Fisheries Program in several different Academic Years.

THE 1947-1948 ACADEMIC YEAR

The only major changes in the *Bulletin* for the 1947-1948 year, were revisions in the descriptions for *Management of Impounded Waters*, both ZY 619 and ZY 620. In the catalog, the description of ZY 619 was changed to read:

“Basic principles of water conservation, geochemical cycles and principles underlying fish production. Methods of stocking impounded waters, the use of fertilizers in pond management, and principles underlying plankton production. Field work at the experimental ponds at Auburn and in impoundments in various parts of the State.”

The description of ZY 620 was changed to read:

“A consideration of the species of fish in impounded waters, factors affecting their reproduction and growth, species combinations, species balance, pond analysis, renovation of old ponds, fishing experiments, weed and mosquito control and related problems of water management. Field work will be conducted in the experimental ponds at Auburn, and in impounded waters located in various parts of Alabama and neighboring states.”

THE 1948-1951 ACADEMIC YEARS

In the 1948-1949 academic year, ZY 428 - *Hatchery Management*

(5), (Prather) and ZY429 - *Pond Construction* (5), (Lawrence), were added to the undergraduate curriculum. Remember that, in the preceding year, *Pond Construction* had been offered only for graduate credit. This was a wise move on the part of the Fisheries Program. The 'how-to-do' material in the courses was really not suitable for graduate credit. With these changes, the undergraduate curriculum was complete. There were now five graduate-level courses with a total of 25 credit-hours available. After this, there would be no major changes for number of years.

SUBSEQUENT CURRICULUM CHANGES

By the early 50s, changes in the characteristics of the original Fisheries Program, plus the availability of additional faculty in the Department of Zoology-Entomology, resulted in several changes in the curriculum:

THE 1952-1953 ACADEMIC YEAR

In the 1952-1953 Academic Year, three new graduate courses related to the Fish Management Curriculum were added to the *Bulletin*:

- ZY 621 – Fish Management in Rivers and Large Impoundments (5) (Swingle).
- ZY 623 – Morphology and Physiology of Fishes (5) (Otis).
- ZY 633 – Parasites of Fish and Game (5) (Allison).

The new course, *Management of Rivers and Large Impoundments*, is of special interest. Remember that in 1949, the Alabama Water Improvement Commission (AWIC) contracted with Auburn to survey the fish population of the Coosa River. In 1950, the 'Investigators' conducted additional surveys on impoundments on the Coosa River and one on the Tombigbee River. Then in 1951, they cooperated with the Fisheries Section of the Alabama Department of Conservation, in surveys on the Tallapoosa River, Lake Martin, the Alabama River, the Tensaw River, and an additional one on the Tombigbee. By the end of 1951, the 'Investigators' had accumulated a large amount of data on the fish killed with rotenone at these sites. The new course, ZY 621 was designed to present this data to students in an organized form, and not because any of the 'Investigators' knew how to manage rivers and reservoirs. The course also recognized the fact that interest in the management of rivers and reservoirs was growing rapidly across the nation. I am not certain that this course was ever taught. If so, it was not taught very long.

The addition of the new courses: *Morphology and Physiology of Fishes* and *Parasites of Fish and Game* are indicative of efforts by the Department of Zoology and Entomology to provide more supporting courses for the rapidly expanding graduate training program in aquaculture and fisheries.

THE 1955-1956 ACADEMIC YEAR

In this year, ZY 619 – *Systematic Ichthyology* and ZY 633 – *Parasites of Fish and Game*, were removed from the catalog. These were cosmetic changes. Neither of the courses had ever been taught.

THE 1962-1963 ACADEMIC YEAR

I returned to Auburn from Cornell in February, 1959. Then In 1961-1962, I was assigned the responsibility for teaching ZY 615 – *Fisheries Biology*. At the same time, the content of the course was changed to emphasize the study of the vital statistics of fish populations. This change represented the first time that course material in traditional fisheries science was offered to students at Auburn.

Also in 1961, as part of a University Self-Study exercise, the fisheries group was required to do a 'self-study' of its curriculum. As 'low-man-on-the totem pole,' I was asked to prepare a draft and get it reviewed and approved by other members of the fisheries faculty. In my B.S. work at Auburn and in my exposure to the fisheries curriculum at Cornell, I had become convinced that neither institution offered enough subject matter in the field to award undergraduate Degrees. With this basic premise as a starting point, and using the ancient fable "*The Emperor's New Clothes*," I made the strongest possible case for making available to undergraduates much of the material then being taught at the graduate level at that time and to create a number of new graduate-level courses.

Surprisingly, the fisheries faculty and the Department of Zoology and Entomology agreed with my proposals, and as a result several changes were made in the curriculum:

1. The pond management material in Swingle's two *Management of Impounded Waters* courses (ZY 619 and ZY 620) was moved to a new undergraduate course, ZY 436 – *Management of Small Impoundments*.
2. Much of the material in ZY 615 – *Fisheries Biology*, was moved to the new undergraduate course, ZY 437 – *Fisheries Biology*.

Generally, these changes went into effect in the 1962-1963 Academic Year. I taught ZY 437 for the first time in the Winter Quarter of 1963.

These changes also made it necessary to alter courses in the graduate curriculum:

1. Course ZY 615 was changed from *Fisheries Biology* to *Advanced Fisheries Biology*. The number remained the same.

2. The comparative fish culture material that had been a part of ZY 619 and ZY 620, *Management of Impounded Waters*, was moved to a new graduate-level course, ZY 618 – *Fish Culture*.
3. A new course, ZY 617 – *Advanced Limnology*, was established; although I am not certain that it was ever taught.
4. Also in that year, I assumed responsibility for teaching ZY 621 – *Management of Streams and Large Impoundments*.

Table 91 presents data on the distribution of regularly scheduled courses by categories in the Fish Management Curriculum in this academic year.

SUBSEQUENT CHANGES IN THE 'REVISED' CURRICULUM

The changes made in the curriculum in the 1962-1963 Academic Year represented the most significant ones since the beginning of the teaching program in the late 40s. Still, as the Fisheries Program grew in complexity, other changes were deemed necessary. Program development associated with the beginning of the International Program and the growth of the catfish farming industry resulted in the need to make several additional changes.

THE 1964-1965 ACADEMIC YEAR

In the 1964-1965 Academic Year, the title of ZY 618 – *Fish Culture* was changed to *Aquaculture*. Generally speaking, for many years, the term *Fish Culture* had been associated with the production of fish in hatcheries for stocking public waters. The change of the course title to *Aquaculture* resulted from the need to better describe its emphasis on the production of aquatic animals and plants for human consumption.

When the changes were made in *Management of Impounded Waters* (ZY 619 and ZY 620), in the 1962-1963 Academic Year, the material on water quality was 'lost.' It was not included in any of the new courses. As a result, a new course, ZY 416 – *Biological Productivity and Water Quality*, was added to the curriculum in the 1965-1966 Academic Year. This course was developed and taught by Dr. George N. Greene, who had received his Ph.D. Degree from Auburn in 1964. He resigned in 1970, and Dr. Lawrence taught the course until Dr. Boyd assumed responsibility for it after he returned to campus on a permanent basis in 1971.

With the addition of ZY 416, the restructuring of the original 1940s curriculum and course offerings was complete. With these changes, the B.S. curriculum provided the undergraduate student with a broad exposure to most aspects of fishery science. The one glaring exception was the lack of instruction in the area of ichthyology. This need would be dealt with later when Dr. John

Ramsey came to Auburn, in 1967, as the Leader of the newly established Cooperative Fisheries Research Unit. ZY 438 – *General Ichthyology*, was added to curriculum in the 1968-1969 Academic Year.

THE FISH MANAGEMENT CURRICULUM IN THE 'NEW' DEPARTMENT

The first contract (AID/csd-1581) between the University and the Agency for International Development became effective on July 1, 1967. Later (June 25, 1970), the Institutional Development Grant (AID/csd-2780) became effective. Under its requirements, it was necessary to create a new Department within the School of Agriculture to administer it. On July 1, 1970, the Department of Fisheries and Allied Aquacultures became a functional unit within the University. At the same time, the International Center for Aquaculture (ICA) was established. The creation of a new Department meant that all of the aquaculture and fisheries courses within the Department of Zoology-Entomology would become its responsibility. This change had been anticipated earlier. As a result, the Department's curriculum was included in the 1970-1971 catalog, and included the following courses:

- FAA 210 – Fish Culture (3).
- FAA 312 – Practical Fish Culture (5).
- FAA 415 – Limnology (5).
- FAA 416 – Biological Productivity and Water Quality (5).
- FAA 428 – Hatchery Management (5).
- FAA 430 – Pond Construction (5).
- FAA 436 – Management of Small Impoundments (5).
- FAA 437 – Fisheries Biology (3).
- FAA 438 – General Ichthyology (5).
- FAA 445 – Fish Parasitology (3).
- FAA 446 – Fish Diseases (3).
- FAA 447 – Management of Streams and Large Impoundments (5).
- FAA 498 – Special Problems in Fisheries and Aquacultures (1-3).
- FAA 615 – Advanced Fisheries Biology (5).
- FAA 616 – Systematic Ichthyology (3).
- FAA 617 – Nutrient Cycles in Aquaculture (3).
- FAA 618 – Aquaculture (5).
- FAA 620 – Fish Processing Technology (5).
- FAA 621 – Fish Nutrition (5).
- FAA 645 – Advanced Fish Parasitology (3).
- FAA 693 – Seminar (TBA).
- FAA 698 – Special Problems in Fisheries and Aquacultures (TBA).
- FAA 699 – Research and Thesis (TBA).
- FAA 799 – Doctoral Research and Dissertation (TBA).

This curriculum was one of the most comprehensive offered by any

institution in the country at that time. It owed much of its strength and diversity to the presence of a number of faculty who had been employed to work with the ICA, with the Southeastern Cooperative Fish Diseases Project, with the Cooperative Fisheries Research Unit or with other extramural programs. As a result of its strengths, students, especially graduate students throughout the world, came here to study in increasing numbers

Note that the curriculum in 1970-1971 included nine more courses (10 versus 19) than the one in effect in 1962-1963 (Table 91). By 1970-1971, Boyd, Lovell, Ramsey and Rogers had joined the faculty, and they were all teaching courses that were not listed in 1962-1963.

SUBSEQUENT CHANGES IN THE CURRICULUM

As noted above, the curriculum of the 'new' Department was not much changed from the one offered in the Department of Zoology-Entomology in the 1965-1966 Academic Year, and there would be few additional changes made until the early 80s

THE 1980-1981 ACADEMIC YEAR

In 1980-1981, FAA 520, FAA 521 and FAA 522 had been added to the curriculum. The courses were titled: *Aquaculture Production I*, *Aquaculture Production II* and *Aquaculture Production III*. All three provided credit (5 quarter-hours) for students working with all aspects fish production at North Auburn throughout the year. It was offered primarily for advanced undergraduates and graduate students. These new courses constituted the 'heart' of the Master of Aquaculture Curriculum. Later, FAA 523 was added. It was designed to summarize, primarily in economic terms, all of the field work completed annually in the other three courses. Initially Lovshin was primarily responsible for this course.

THE 1985-1986 ACADEMIC YEAR

Remember that the number of courses in the curriculum increased sharply (35 versus 19) between 1970-1971 and 1985-1986 (Table 91). This increase is largely the result of the addition of new courses in aquaculture and in fish health. These were added primarily to provide students with information related to the rapidly growing catfish production industry. Courses were also added in breeding and genetics, extension methods, and aquatic plant management.

THE 1998-1999 ACADEMIC YEAR

Data presented in Table 91 indicate that the number of scheduled courses taught by the Department was continuing to increase. Some 35 were

included in the 1985-1986 Curriculum; however, by 1998-1999, that number had increased to 44. This increase was primarily the result of adding more courses in aquaculture and in water quality.

The 1998-1999 Curriculum also listed a number of courses in marine science, marine fisheries and marine aquaculture. These were taught at the Dauphin Island Sea Laboratory. Our students were free to register in them; however, not many chose to do so. As a result, I have not included them in these considerations.

THE 2000-2001 ACADEMIC YEAR

After a 3-year study, The Auburn Board of Trustees decided that the University should return to the Semester System in August, 2000. This decision resulted in major restructuring in all curricula. As might be expected, in terms of subject matter made available to the students, there were not many changes. The primary changes were related to the problem of 'fitting' all of it into two Semesters rather than into four Quarters. There were so many changes made in the course descriptions in the '00-'01 *Bulletin* that I will not attempt to summarize them here.

With the course restructuring, the number offered in the curriculum was reduced from 44 in '98-'99 to 36 in '00-'01 (Table 91). The primary losses were in the 'Limnology and Related' (6 to 3) and the 'Aquaculture and Related' (15 to 6) categories. At the same time, there was an increase in the 'Fish Biology and Management' (8 to 12) category.

THE 2012-2013 ACADEMIC YEAR

Data presented in Table 91, indicate that the curriculum was continuing to change in the '12-'13 Academic Year. There were reductions in courses offered in the 'Fish Biology and Management' (12 to 8) and 'Fish Health' (8 to 5) categories. However, the number taught in 'Aquaculture and Related' increased from 6 to 8.

Many of the changes in the curriculum between '00-'01 and '12-'13 (Table 86), were likely the result of in changes in the Faculty. Of the 16 primary faculty teaching courses in '00-'01, there were only 8 remaining in '12-'13.

THE UNDERGRADUATE CURRICULUM IN FISH MANAGEMENT

Generally undergraduate curricula are established to meet one of two primary objectives:

1. Prepare graduates for full-time employment in the field.

2. Prepare graduates with the academic foundation for further study.

Most curricula at American Universities are planned to meet the first objective; however, in some fields, advanced study is a pre-requisite to finding employment.

In the mid-40s, there were few opportunities for employment in the field of fisheries anywhere. Federal funds from the Dingell-Johnson Act (Federal Aid in Fish Restoration) would not be available until after August, 1950. Fish management efforts in most states in the South were limited to producing game fish in hatcheries and stocking them in public waters. The primary goal of most of the positions in the field was related to hatchery management and production. Fish management efforts in the northern tier of states were still also primarily related to the stocking of fish, but they were slowly moving beyond this stage by beginning studies on life history characteristics of game fish in public waters.

An evaluation of Auburn's Undergraduate Fish Management Curriculum in the 1946-1947 Academic Year strongly suggests that it was designed primarily to prepare its graduates for advanced study. None of the required courses had very much 'market value.' Swingle's courses were available only to graduate students and *Hatchery Management* would not be taught until the Spring Quarter of 1949. Further, the Curriculum was strongly biased toward the sciences and mathematics (Table 90). Information presented in the Table show that these courses were distributed as follows:

- Basic Biology – 14 courses.**
- General Soils – 1 course.**
- Chemistry – 4 courses.**
- Physics – 2 courses.**
- Mathematics and Statistics – 4 courses.**

Obviously, completion of these courses would have provided the graduates with a solid foundation for advanced study in Fish Management; however, it was somewhat rigorous, and there was always the problem of making good enough grades in the courses to qualify for admission to the Graduate School. In this respect, curricula that are designed to prepare graduates only for advanced study do the 'average' student a disservice.

The 'revision' of the Curriculum in Academic Year 1962-1963 described in a preceding paragraph was designed to improve the 'marketability' of our graduates with only the B.S. Degree. Swingle's *Management of Impounded Waters* (ZY 619 and 620) and my *Fisheries Biology* (ZY 615) were made available to undergraduate students for the first time. Without question, after these changes were made, our undergraduates were better educated for working careers in Fish Management. Unfortunately, no effort was ever made

to determine their effectiveness in meeting this objective.

ADVISORS FOR UNDERGRADUATE STUDENTS

Long before the establishment of the Fish Management Curriculum, Auburn had a well-established system of undergraduate student advisors. In this system, the ‘advisors’ had to approve all student course schedules each quarter. It provided the only mechanism for maintaining contact with individual students, and their progress toward graduation. It also provided a mechanism whereby the University could be continuously aware of its effectiveness in meeting overall student career goals.

J. S. Dendy served as Undergraduate Advisor (UA) for the few undergraduates in the Fish Management Curriculum from 1947 until around 1963. When the ‘revised’ curriculum was activated in the 1962-1962 Academic Year, I became UA. If I remember correctly, I continued to function in this capacity until Bill Davies returned from Brazil in August, 1972. Soon after his return, he assumed responsibility for advising undergraduates, and if I remember correctly, he continued to do so until he retired in 1996.

Len Vining served as UA during the period 1996 through 1999, when Bart Green assumed the responsibility. Bart left the Department in 2001. Tracy Collier Cline is the first full-time Undergraduate Advisor. She was appointed to the position in 2006. Tracy is a native of Georgia. She was awarded the B.S Degree in Marine Biology from Auburn in 1990, and the M.Aq. from the same institution in 1992. In 2002, she received the M.S. in Education from Jacksonville State University. In the Undergraduate Advisor position, Tracy advises students on all academic matters, and maintains records on their progress toward graduation. She is the primary instructor for the course FISH 1100 – Fisheries Orientation. She also serves as the primary contact for individuals interested in entering the undergraduate fisheries program.

GRADUATES

In the early years, the Undergraduate Curriculum in Fish Management received relatively little attention. Virgie L. Barnes of Castleberry was awarded the first B.S. Degree (August 27, 1949). From the Winter Quarter, 1948, through Fall Quarter, 1957 (10 years), a total of only 29 B.S. Degrees were awarded (three-four per year) in each year. The number awarded each year in several different years, during the period 1950-2016, is shown in Figure 112. These data show that the number generally has not exceeded 15 per year, and usually been considerably less. It has been consistently higher from 1995 through 2010. Relatively few international students have been enrolled in the program over the years (Figure 112); consequently, they have had only limited effect on the total number of graduates.

A list of all Graduates of the Auburn Fisheries Program from 1948 through the Summer Semester of 2015 is available from the Media and Digital Resources Lab of Ralph Brown Draughon Library. Names of more recent graduates are available in the Official List of Auburn University Graduates.

THE GRADUATE PROGRAM IN FISH MANAGEMENT

As noted in a preceding Section, the requirements for the Master of Science in Fish Management were formally established when the first Curriculum in Fish Management was published in the 1946-1947 University *Bulletin*. Later, in the 1952-1953 Academic Year, requirements for the Ph.D. Degree in Fish Management were published in the University *Bulletin*, and finally in the 1979-1980 *Bulletin*, requirements for the Master of Aquaculture (M.Aq.) were formally established. Following, some characteristics of these three Degree options are described.

Enrollment in the Graduate Program increased slowly in the early years. When the new Department was established in 1970, it was at a level of around 20 students; however, with the initiation of the International Program and the creation of FAA, it began to increase steadily. By the end of the 70s, it had reached around 90 students. It continued to grow through the 80s and early 90s, reaching a level of well above 100. Afterwards, however, with the reduction in the 'reach' of the International Program, enrollment began to decline, and by the end of the 90s, it had returned to around 75 students. It remained near that level through the early 21st century. In 2010, it was still at a level of 76 students; however, in the last few years it has begun to increase again; reaching a level of 93 in 2015.

GRADUATE PROGRAM OFFICERS

Once a Graduate Advisory Committee was formally appointed for a student by the School of Graduate Studies, it was primarily responsible for assisting her/him with the 'management' of their graduate programs; however, prior to that time, there were several other steps that had to be completed. Over time, it has become the responsibility of the Departmental Graduate Program Officers to provide guidance in dealing with these matters:

1. Responding to requests for information about the graduate program.
2. Processing applications, notifying students regarding Graduate School decisions.
3. Holding discussions with individual students regarding their program objectives.
4. Assisting with the establishment of Graduate Advisory Committees.

5. Assisting with the quarterly registration of students.

Over the years, supplying these 'non-teaching' inputs required literally thousands of hours of patient, dedicated work on the part of various Auburn faculty.

As noted in a preceding paragraph, with the 'revision' of the Fish Management Curriculum that became effective in the 1962-1963 Academic Year, I was assigned the responsibility of advising undergraduate students. Although my memory is 'hazy' on the matter, I believe that I was given the responsibility of advising graduate students as well. I am certain that I had that responsibility when the Fisheries Program was made a separate Department in July, 1970. I continued to function in this capacity until I was made Department Head in 1973. Bill Davies returned from his long-time assignment in Brazil in August, 1972. He became the Graduate Program Officer for the Department about the time that I became Department Head

When I became involved with assisting fisheries graduate students within the Department of Zoology-Entomology, it did not require much of my time. We were receiving relatively few enquiries about the program, and not many applications. We were graduating only 4 to 5 students per year in our M.S. and Ph.D. Programs combined; however, after the formal initiation of the International Program in 1967 (AID/csd-1581), and the formal establishment of the Department, the work-load increased rapidly. Figure 113 contains information on the average number of total and foreign graduate students in both the M.S. and Ph.D. Programs enrolled each quarter in nine years from Academic Year '71 through '79. The increase in the average number of foreign students enrolled is especially noteworthy. Students from Less-Developed-Countries (LDCs) generally required much more Graduate Program Officer attention. In the period covered by the Figure, average number of LDC students enrolled each quarter increased from 6 to 33.

By the mid-70s, responsibilities of the Graduate Program Officer in the Department had reached the point where it was almost a 'full-time' position. Unfortunately, Bill Davies, with both major teaching and research responsibilities, did not have the time to devote to it. Fortunately, John Grover returned from his long-term assignment in the Philippines in July, 1976, and he was willing to replace Davies.

John H. Grover is a native of Utah. He was awarded the B.S. in Zoology by the University of Utah in 1964. Then he attended Iowa State University where he was awarded the M.S. (Zoology) and Ph.D. (Zoology) Degrees in 1966 and 1969, respectively. He completed those two graduate degrees working under the direction of Dr. Kenneth Carlander, one of the leading educators in fisheries science in the nation at that time. After leaving Iowa State, he served as a Lecturer in Biology at the University of Libya for a short time.

John joined the Department in August, 1971. He was employed specifically to serve as one of the Resident Advisors on the Philippines Inland Development Project (AID/ea-180). He moved to the Philippines in early January, 1972. His primary responsibility was providing technical assistance to the Philippine Government in the establishment of the Freshwater Aquaculture Center at Central Luzon State University, and the establishment of formal fish culture education program there. Many of his contributions to this project were described by Crance and Leary (1979)

When John became Graduate Program Officer in mid-1976, the Department's total educational program (informal and formal) was literally 'exploding.' Fortunately, he was willing to assist with a wide range of the growing responsibilities. He served as coordinator for the development and maintenance of the formal teaching program of the Department, and for many of its informal teaching activities as well. He prepared and submitted the class schedules quarterly, along with course text book orders. He prepared material required by the University Curriculum Committee for the development of new courses. He was also responsible for up-dating and maintaining curriculum material in the University Bulletin. In the early 80s, he was responsible for developing much of the material required to receive approval for the new Master of Aquaculture Degree.

John was also associated with the formal aspects of the Graduate Program as Major Professor for several foreign M.S. students, who intended to complete their coursework at Auburn, but had to return to their home-country to complete their research. He also served on virtually all of the committees of students in the M.Aq. Program. Along the way, he was responsible for teaching several courses. He developed and taught *Research Methods* which was designed to introduce new students to research in aquatic sciences. After John Ramsey left the Department, he taught *General Ichthyology* for three years, until Carole Johnston joined the faculty. Over the years, *Principles of Aquaculture* was taught by several different faculty members. John taught this course on several occasions.

John was active in the establishment of Southeastern Cooperative Continuing Education Project, and provided continuing support for it until it was terminated. He was active in determining the courses that would be offered in each state, and for arranging for presenters for each course. He was also helpful in arranging for paying them and for the reimbursement for travel. In addition, he taught courses in various participating states on scientific writing.

Yolanda Brady, who had worked with the Department's Fish Health Program for a number of years, was appointed Graduate Program Officer in 2002. She served until 2009.

Bill Daniels joined the faculty in January, 2003, and quickly assumed responsibility for many of the support functions for the Graduate Program that had been handled by John Grover for many years before he retired in 2003. However, Bill's situation was somewhat different than John's, in that only around one-third of his salary was paid from teaching funds. John was generally paid primarily from teaching funds only from the time he returned to campus from the Philippines in 1976.

Bill also teaches two courses in aquaculture. One of these courses (FISH 5250/6250) is taught both on campus and at Can Tho University in the Central Mekong Delta of Vietnam. The material presented is essentially the same in both locations; however, at Can Tho it is condensed into a two-week period.

THE MASTER OF SCIENCE PROGRAM AND ITS GRADUATES

As suggested earlier, the primary emphasis in the establishment of the formal instruction program in Fish Management at Auburn was on training of students at the Master of Science level. Initially, both of Swingle's courses in *Management of Impounded Waters* (ZY 619 and 620), Lawrence's course in *Pond Construction* (ZY 618) and Dendy's courses in *Systematic Ichthyology* (ZY 616 and 617) and *Fisheries Biology* (ZY 615), required graduate status for admission. Further, *Research and Thesis* (ZY 699) provided candidates with invaluable 'one-on-one' instruction and field experience that was not available to undergraduate students.

Some of the effects of teaching formal courses on the research faculty ('Investigators') in the Fisheries Program were discussed in a preceding Section; however, the research and thesis requirement likely had an even more far-reaching effect. The formal review and approval of theses by Graduate Committees added a new level of scrutiny to all aspects of the research program. The formalized process of conducting research (Literature Review, Methods and Materials, Results and Conclusions) began to receive much more attention. With the growing number of graduate students enrolled, larger and larger shares of the total research program came under the purview of Graduate Committees. This process brought increasing amounts of information from other fields into the Fisheries Program. Experimental design became much more rigorous. Remember that experimental design had been of concern from the beginning of the program in the late 30s. For example, in 1941, research on pond stocking in 14 of the 'F' Series, involved 14 different experiments. There were no replications (Table 42). With the enrollment of increasing numbers of graduate students, this 'broad-brush' approach was replaced by statistical designs whereby specific hypotheses could be evaluated.

The development of the graduate program also expanded the amount of

research that individual ‘Investigators’ could do. From the beginning, graduate students in fisheries were expected to participate in all aspects of the program’s over-all research program; while at the same time conducting research that would serve as the basis for the preparation of a thesis. Over time, as the graduate program grew, more and more of the day-to-day aspects of the research program was done by graduate students. Ultimately, a major share of the publications resulting from original research carried the name of a graduate student as first author.

Jack R. Snow from Jasper, AL was the first recipient of a degree in the new Graduate Program in Fish Management. He was awarded the M.S. Degree in June, 1948. His thesis – *A Preliminary Study of the Toxicity 2,4-D to Pond Fishes and Its Effectiveness in the Control of Emergent Species of Pond Weeds* – was directed by Swingle.

Figure 114 presents data on the number of graduates receiving the Master of Science Degree in Fish Management at five-year intervals during the period 1950 through 2014. These data indicate that the number of graduates remained relatively constant at around five per year from 1950 through 1970. Then, when the new Department was created in 1970, and the implementation of the International Program was rapidly gaining momentum, the number of graduates literally ‘exploded.’ In Academic Year ’75, 20 students received M.S. Degrees. The number remained near the same level through Academic Year ’95. From ’95 through ’10, the number was around 10 per year. Later, however, in ’14 and ’16, it began to increase.

Data presented in Figure 114 show that international students played an important role in the Master of Science Program; however, their contribution was especially auspicious. During the period ’75 through ’95, over one-third of all M.S. graduates were internationals. The sharp reduction in their numbers after ’00 was the primary reason why the ‘total’ declined sharply.

A list of all Graduates of the Auburn Fisheries Program from 1948 through the Summer Semester of 2015 is available from the Media and Digital Resources Lab of Ralph Broun Draughon Library. Names of more recent graduates are available in the Official List of Auburn University Graduates.

THE MASTER OF AQUACULTURE PROGRAM

The first Degree in the Master of Aquaculture Program was awarded to Nik Ab.Wahab Bin Mat Diah, in the Fall Quarter of the 1979-1980 Academic Year. Between 1976 and 1980, catfish processed in the U.S. increased from 18.7 to 46.5 million pounds. By 1982, pounds processed would reach 99.4 million (Harvey, 1988). Production and processing in Alabama provided a large share of the total. It seemed likely that the rapidly growing industry would benefit from the availability of graduates who had

received a significant amount of 'hands-on' training in all aspects of catfish production. With all of the basic science and mathematics requirements for the B.S. Degree in Fish Management, it was not practical to provide these with all of the 'hands-on' experience at the undergraduate level required to prepare them to manage large catfish farms; consequently, we requested that the University approve the Master of Aquaculture Curriculum. In this Curriculum, the Research and Thesis requirement would be replaced by a series of 'fish farming-oriented' courses.

The establishment of this new graduate program was a result of the rapid growth of the catfish farming industry taking place at that time, and the decision that the Fisheries Program should provide the education base for its continued development. In arriving at this decision we assumed that the industry in Alabama would continue to expand rapidly and that it would require a continuous 'flow' of post-B.S.-trained graduates to meet its operational needs. Unfortunately, this assumption has proven to be erroneous. Fairly early in its history, the number of individual catfish production operations in the State reached a level of about 250. As a result of consolidation, the number is closer to 100 currently.

Further, from the beginning, the production portion of the industry has been based on an 'owner-operator' business model, where the owner and his family operated the enterprise. Most of the operations have been relatively small. For years, the size has averaged around 100 acres each. In most cases, an M.Aq. from Auburn could not be expected to increase production on an operation of this size enough to pay his/her salary and associated costs.

Historically, although the catfish farming industry in Mississippi is not quite as old as Alabama's, it has grown much faster, and is considerably larger. The individual operations are also substantially larger. We likely assumed that we might place a considerable number of M.Aq. graduates there. However, the Department of Wildlife, Fisheries and Aquaculture at Mississippi State University responded to perceived industry needs by developing a large, active teaching, research and extension in aquaculture. With that investment, they fully expected to meet the needs of their farmers. Unfortunately, I understand that MSU has recently begun to 'phase-out' the 'practical farming' experience of their program.

INITIATION OF THE PROGRAM

I have been unable to find any records on discussions that took place that preceded our final decision to propose the creation of the new Degree option, but John Grover returned from his long-term assignment in the Philippines in July, 1976, and I requested that he prepare the documentation required for submitting the formal proposal to the University

Curriculum Committee. The material was duly submitted and the description and requirements for the new program were published in the 1977-1978 University Bulletin. Grover was further assigned the responsibility of managing it on a day-to-day basis. He continued to provide leadership for it until he left campus to accept a long-term assignment in Bangladesh in March, 1999.

Len Lovshin was on campus during the period 1978-1981, between long-term assignments in Brazil (1972-1978) and Panama (1981-1984). He was interested in the development of the new program, and was instrumental in the development of the FAA 520-522 course series described previously. Later, FAA 523 was added to the series. If I remember correctly, he taught the courses until he left campus to take the long-term assignment in Panama in 1981.

From the time that the Master of Aquaculture Program was approved, I had encouraged the Administration to provide additional money to help fund it. At that time some of Grover's annual salary was being supported by Teaching funds, but there was no additional University money specifically designated to support its operation. Finally, the Administration agreed that \$20,000 would be added to our Budget beginning in the 1983-1984 Academic Year. If I remember correctly, we decided to use all of these additional funds to pay Salaries for faculty involved, and to support its 'Maintenance' from non-University sources.

PROGRAM ADVISORS

Because of the emphasis on 'field training,' the role of Program Advisors is extremely important for M.Aq. students. The scheduling of their work on the Farms is extremely time consuming, and supervising their participation and progress added significantly to the burden. For this reason, the permanent teaching and research faculty in the Fisheries Department was reluctant to get involved in the Program. Also, in the beginning, the University did not provide funds to purchase long-term faculty participation. Fortunately, several members of the ICA faculty supported it whole-heartedly; however, while their participation has been welcome, their contributions have been limited by the need to have them available for assignment in the long-term project support activities of the ICA.

The early roles of Grover and Lovshin in providing leadership for the M.Aq. Program were described in a preceding paragraph; however, Len went to Panama in 1981. With his departure, only Grover, among the senior faculty, was available to help with the program, and he was involved in a number of other Departmental activities. Fortunately, Schmittou had returned from the Philippines in July 1976, and by 1983, he was in a position to help. Consequently, in an August, 1983 memo to the faculty, I presented a plan to

solidify the administration of the Program. I requested that Grover continue to handle the administrative responsibilities and that Randell continue to supervise student field-experience activities.

Further, I requested that Schmittou serve as Chairman of the Graduate Committees for all of the students in the Program. I also requested that he serve as Chairman of a Committee (Schmittou, Grover and Goodman) to look at all aspects of the Program, and to make recommendations on any changes that should be made. In addition, I assigned the Dodge van and the Field Classroom on the Soughahatchee Farm to the Program for their use. Schmittou provided significant leadership for the Program until he went to Indonesia in July, 1988.

Remember that Karen Veverica had joined the faculty to work with the Field Operations Group in 1981. More specifically, we wanted her to assist Randell in supporting the 'field experience' activities of students in the M.Aq. Program. Unfortunately, in May, 1983, she left for Rwanda to assume responsibility for the USOM-funded project

Lovshin returned from Panama in 1984, and resumed his involvement with the M.Aq. Program. He worked closely with Schmittou, and under their combined leadership, the Program expanded rapidly. He continued to help with it until he retired in 2003.

Fortunately, Renee Beam had joined Field Operations prior to the 1985-1986 Academic Year, and she was able to assist Randell in supervising the field activities of M.Aq. students. In 1998, she was relieved of some of her M.Aq. responsibilities in order to provide technical assistance to the Genetics and Breeding Research Program.

Randell had helped to supervise the 'field experience' activities of the M.Aq. students from the inception of the program in the early 80s; however, when Lamar retired in 1985, he was assigned the responsibility of supervising all of the activities of the Field Operations Group. Afterwards, he was able to spend less-and-less time with the M.Aq.

Throughout the 80s, Grover continued to provide administrative support for the program, and assisted with the formal teaching of the Fish Production Series from time to time. He continued to work with it until he went to Bangladesh in March, 1999. He returned to campus in November of 2001. He retired the following April.

Apparently, sometime during this period, Tom Popma helped with the M.Aq. Program by teaching the Fish Production Courses (FAA 520-523). He retired in October 2001. In the meantime, Karen had returned to campus in 2000, and soon resumed her support for student activities at North Auburn.

However, in 2005, she left the campus again to accept an assignment for management for a USAID-funded project in Uganda.

Bill Daniels joined the faculty in January, 2003. Soon thereafter, he was asked to take charge of the administration of the M.Aq. Program; however, I do not believe that he was involved in the supervision of student 'field experience' activities.

Apparently in 2005 when Karen left campus to begin the Uganda Project, Mark Peterman was employed as a Research Assistant IV to assist Randell at North Auburn. I am not certain how much contact he had with M.Aq. students. He resigned in 2014. Unfortunately, enrollment in the M.Aq. Program had dwindled to only a single student. As a result, organized supervision of 'student field activities' was suspended.

Karen returned to campus permanently in September, 2008; however, she participated in a variety of International Center activities. Bill Daniels continued to administer the M.Aq. Program, and Mark Peterman continued to work with the Field Operations Group; however, there were still few students in it.

In November, 2011 Randell retired, and soon afterwards, Karen was assigned the responsibility of supervising all Field Operations activities. At that point, she also began to work closely, once again, with the 'field experiences' part of the M.Aq. Program. She has recently 'up-dated' the list of 'skills' that the students are expected to 'master' while participating in the 'field experience' activities of the Program. This list is shown as Appendix Table 6.

FINANCIAL SUPPORT FOR M.Aq. STUDENTS

From the beginning of the M.Aq. Program, finding financial support for the students was a major problem. Support for Master of Science students was much less troublesome. Usually, their research was funded by extramural grants, and enough money was included in it to pay their stipends. These funds were generally not available for use with M.Aq. students.

Fairly early in the Program, we decided to commit funds obtained from the 'sale-of-fish' to pay the M.Aq. In the early 80s, the Department was 'flush' with money obtained from the 'Indirect Costs' from our many extramural contracts. We decided that we could use these funds to pay for the 'direct' costs of producing the fish for sale, and use 'fish sale' money for the support of students. Further, we felt justified in doing this because producing and marketing fish were at the 'heart' of the M.Aq. training program. Unfortunately, over time, for several reasons 'fish-sales' began to decline, and funding available for supporting M.Aq. students followed. Then in 2012,

as a result of Karen's recommendation, Jensen decided to develop a new funding model for supporting these students.

Currently, Cooperative Extension provides funds for approximately one Assistantship. Salary savings from the Peterman position and other School funds provides enough money for three more. In addition, under some circumstances, money from extramural research grants is used to provide short-term support.

FIELD EXPERIENCE REQUIREMENTS

From the beginning of the M.Aq. Program, advisors have generally agreed that there is a 'body' of knowledge and experience that a graduate should have in order to manage the production of aquatic animals for profit. As professionals they should be prepared to operate safely and efficiently a wide range of equipment normally encountered in the industry. Similarly, there are a number of procedures and decisions that must be dealt with repeatedly. Over the years, a list of these experiences has been developed as a guideline for the field training of all of the students in the Program. As noted in a preceding paragraph, recently Karen, Renee and Randell have developed a revised list. It is shown in Appendix Table 6.

GRADUATES

Data assembled by the Department show that during the period 1980 through 2016, the University granted M.Aq. Degrees to 143 individual students (98 U.S. and 44 internationals). These data are presented in Figure 115. Generally speaking, the number of graduates remained about the same from 1981 through 1995. The lack of a trend was the result of a decline in the number of internationals receiving Degrees and an increase in the number awarded to U.S. students (Figure 116). USAID contracts, which funded the matriculation of international students, was near its maximum level in the early 80s; however by 2000, there was virtually no funding for this purpose.

U.S. student participation in the Program generally increased slowly from 1981 through the mid-90s, and remained about the same until around 2000. It was generally lower afterwards; although there did seem to be an indication of increased interest in 2016.

A list of all M.Aq. Graduates of the Auburn Fisheries Program from 1948 through the Summer Semester of 2015 is available from the Media and Digital Resources Lab of Ralph Broun Draughon Library. Names of more recent graduates are available in the Official List of Auburn University Graduates.

THE Ph.D. PROGRAM AND ITS GRADUATES

As noted previously, the requirements for the Ph.D. Degree in Fish Management were first published in the 1952-1953 University *Bulletin*. It was the first such Degree offered by the University. I was in Auburn, in the M.S. Program, during the period that the proposal for the requirements for the Ph.D. Program was being developed, but I do not remember any of the details.

In retrospect, I am surprised that it was approved. Dendy was the only faculty member with the Terminal Degree in the Fisheries Program at that time. E. V. Smith had been awarded the Ph.D. in Plant Physiology in the early 30s by Iowa State University, but he had left the Program in 1944. Lawrence would not be awarded the Degree from Iowa State until 1956, and I would not return to campus until 1959. It is likely that the primary factor leading to the approval of the Program was Swingle's amazing record of accomplishments. By the beginning of the 50s, they were recognized throughout the nation. He and Smith had published *Bulletin 254 (Management of Farm Fish Ponds)* in 1942 and revised it in 1947. With assistance from U.S.D.A.'s Soil Conservation Service, it had been widely distributed throughout the country. From 1938 onward, Swingle and Smith had regularly published results of their research in all of the major journals. They also had written several publications for the Agricultural Experiment Station, and numerous articles for the popular press. After Smith left the Program, Swingle continued to produce a continuous flow of written material about his work. Few, if any, scientists at Auburn were better known. Further, his early 'Outreach' efforts with local pond owners brought him in contact with many influential farmers and industrialists in the State. His 'fish-fries' for legislators also made that group aware of his accomplishments in pond management.

Abdul Rahman Khan Zobari, a Pakistani, was awarded the first Ph.D. Degree in the Fisheries Program 1955. This was also the first Terminal Degree awarded by Auburn University, in any field. Data on the total number of Ph.D. Degrees in Fish Management awarded to all students, and the number awarded to international students, in several years of the period 1955 through 2016 are shown in Figure 117.

After 1955 and until the late 60s, the new Ph.D. Program in Fish Management did not attract many students. In several of the years there were no graduates, and in years when there were graduates, there were never more than 3; however, in the mid-60s this situation began to change. Remember, as detailed in a preceding Section, funding from extramural grants and contracts began to increase rapidly at about this time. This increase in funding provided more opportunities for advanced study for the Terminal Degree.

After the establishment of the new Department and the creation of the International Center for Aquaculture (ICA) in 1970, the number of graduates began to increase sharply. Much of it was fueled by the enrollment of growing numbers of international students funded by various ICA contracts and grants. The total number of graduates continued to increase as long as the enrollment of international students continued to grow. Finally, as noted previously, in the early 90s, support for ICA activities began to decline, and by 2000 there was only a single graduate – an international student.

After 2005, the number of graduates began to increase again. Much of the growth again came as a result of the growing enrollment of international students (Figure 117). A large share of this increase came as a result of growing international interest in the pioneering work in fish genetics and breeding being conducted by John Liu, Rex Dunham and Eric Peatman and their Work Groups.

The apparent declining interest in the Terminal Degree among American students is surprising. There was only a single American graduate in 2016. The decline is likely the result of a concern for job opportunities, a decline in funding for this level of advance study, or a combination of the two.

A list of all Ph.D. graduates of the Auburn Fisheries Program from 1948 through the Summer Semester of 2015 is available from the Media and Digital Resources Lab of Ralph Broun Draughon Library. Names of more recent graduates are available in the Official List of Auburn University Graduates.

INTERNATIONAL STUDENTS IN THE TEACHING PROGRAM

One of the most important aspects of the relationship between Auburn's teaching program in fisheries and aquaculture and its International Program was the number of international students that it brought to campus. Internationals had been visiting Auburn to observe the work of Swingle and Smith since the early 40s, but the first to earn a Degree was Surenda Sharma from Bihar India. He was awarded the M.S. in Fish Management in 1949. Later, in 1955, Abdul Rahman Khan Zobari from East Pakistan would be awarded the first Ph.D. granted by Auburn. As shown in Figures 112,114, 115 and 117, the number of international students in our graduate program grew slowly during the 50s and 60s, but began to increase more rapidly afterwards. In 1971, after the first contract with the U.S. Agency for International Development had been initiated in 1967, 6 of the 35 graduate students enrolled were internationals. Then just 7 years later, in 1978, 30 of 90 of our graduate students were from other countries. An Annual Report submitted to USAID/Washington in 1987, indicated that there were over 100 students in our graduate program, and 54 of them were from 23 different foreign countries.

Obviously, international students were an important part of our graduate

program, but they contributed even more than their numbers indicate. Although there were usually some language problems, working with them in the classroom and in the field on their research was a pleasure. Almost without exception, they all deeply appreciated the opportunity to study at Auburn. All of them established special 'bonds' with other students, their teachers, and especially their Major Professors. They were all deeply dedicated to their studies. In a study that we did in the mid-80s, we found that international students enrolled in the Ph.D. program earned slightly better grades in courses taken outside the Department than their American counterparts.

'International Night' was a special event that celebrated our working together to increase food production through improved aquaculture in their countries. Each year, usually near the end of the Winter Quarter, the international students and their families invited all of the faculty and other graduate students to an evening of sharing foods from their homelands. It was a special time of sharing our lives together, away from the academic world. My records are incomplete, but I believe that we began to share this time together as early as 1987, and I'm certain that it was continued through 1993; but I retired early in 1994, and I have no record of it continuing beyond that time.

There were often problems related to getting international students enrolled and helping them meet all the numerous rules and regulations related to graduate study. Fortunately, Paul Parks was Dean of the Graduate School around the time that our international student enrollment reached its highest point. Throughout that period, he was especially helpful in assisting us in this often complicated task. He is a native of Lee County, AL. He was awarded the B.S. Degree in Animal Husbandry by Auburn in 1953. Later, he was awarded the M.S. Degree in Biochemistry in 1956. He was employed by the Department of Animal Husbandry from 1956-1959. Later, he enrolled in the Graduate Program at Texas A&M University. After receiving the Ph.D. Degree, he accepted a position there. He returned to Auburn as a faculty member in the Department of Animal and Dairy Sciences in 1965. In 1972, he became Dean of the Graduate School. In this position, he became a strong supporter of the rapidly growing graduate program in the newly established Department of Fisheries and Allied Aquacultures. He was especially supportive of our efforts to provide a graduate education to a sharply increasing number of international graduate students. This was a difficult task for him and for us. Dealing with foreign transcripts and low GRE and TOEFL scores were an ever-present problem that required a great deal of sympathy on the part of the Graduate Dean. The onslaught of graduate students in the 70s placed an enormous burden on the Graduate Faculty in the Department. Many of them simply had too many students – often far beyond the number that the Graduate School was comfortable with. Parks provided as much support in this matter as his position allowed. He became

Vice President for Research in 1981.

Our efforts to provide a quality educational experience for graduate students from other countries was enhanced considerably by the presence of a large number of 'Returned' Peace Corps Volunteers ('RPCVs') in our program. Fortunately, the number of international students and the number of 'RPCVs' began to increase at about the same time. Having recently returned from overseas assignments, they were highly supportive of the internationals – always looking for ways to help them.

OVERVIEW OF THE ACCOMPLISHMENTS OF THE INSTRUCTIONAL PROGRAM

The material presented in the preceding Sections suggests that the overall program of instruction provided by the Auburn Fisheries Program through its parent Department (Zoology and Entomology), by the Department of Fisheries and Allied Aquacultures, and by the International Center for Aquaculture (ICA), in fisheries, aquaculture and aquatic sciences is likely the most complex, far-reaching and productive program ever developed by any University: four formal Degree Programs (Bachelor of Science, Master of Science, Master of Aquaculture and Doctor of Philosophy); an extremely large number of informal, non-degree, programs (Short Courses) for aquatic biologists in adjoining states; short-term training exercises on-campus for individuals and small groups of individuals from other countries; scheduled, long-term Short Courses for larger groups of persons both at Auburn and in countries throughout the developing world. Untold numbers of people throughout the world have benefitted both directly and indirectly from Swingle's 'love' for teaching. Although he was directly involved in only a small amount of the combined teaching effort over the years, it was his decision, immediately after the end of the War, to take his highly productive career and that of the Fisheries Program in research, into pedagogy that provided the foundation for all of the contributions that were to follow.

Finally, one of the most important accomplishments of the Program has been the recognition of our students by the profession. Students in the Fisheries program have been recognized at all levels for many years. This includes internal awards such as the Swingle Award and the David Partridge Scholarship, as well as Auburn University awards, and awards from state (e.g., Alabama Fisheries Association), regional, and national organizations such as the World Aquaculture Society and the American Fisheries Society (AFS). A number of Auburn Fisheries students have been awarded Auburn University Outstanding Graduate Student awards, 3-Minute Thesis Best Presentation Awards, Alabama Fisheries Association Student Scholarships, and AFS Skinner Awards.

Dennis DeVries joined the Department in 1990. Almost from the time he

arrived on campus, promoting the recognition of our students has been a passion. He has spent countless hours in this effort with only limited recognition.

Auburn University was home to a formal Chapter of the AFS for many years, but just recently, when the Alabama Chapter of the AFS was officially re-established, the Auburn University Chapter of the AFS became a student-subunit of the Alabama Chapter. Students served as officers in the former AU Chapter of AFS, which allowed them to compete very effectively for Skinner Awards for travel to the national AFS meeting.

THE EDUCATION OF AYODELE OLAIYA – A TRAGEDY

Nigerian Grad Student Ayodele Olaiya drowned in the early afternoon of Sunday, May 8, 1988, in Pond S-12 on the Story Farm. At the time, he was involved in the daily feeding of catfish in cages suspended in the open pond. He was thoroughly familiar with all aspects of this activity; having repeated it numerous times before. He was alone when the tragic event occurred. As a result, there are no details available as to what led to the accident. This was a situation in which a series of events unexpectedly converged with tragic impact. While Ayodele was a mature young adult, he was one of *our* students. This makes the tragedy even more personal to all of us who were his *'teachers.'*

OUTREACH IN THE 'NEW' WORLD

Remember that the initial impetus for the Fisheries Program at Auburn came as a result of an 'outreach' effort when Agricultural Experiment Station faculty became involved with the Auburn Outing Club in an effort to construct and manage a pond for Club fishing. Swingle was involved with that effort from the beginning, and would continue to work with the fish and fishing in Lake Auburn for many years. As detailed in the following Sections, that early, highly localized, 'outreach' effort would later be extended into the 'far-corners' of the world. Some of these efforts will be described in the following Sections.

EARLY OUTREACH EFFORTS

Administratively, workers in agricultural research and extension (outreach) at Auburn existed in different worlds for many years. Research Faculty were employed by the Alabama Agricultural Experiment Station (AES) and Extension Faculty were employed by the Alabama Cooperative Extension Service (ACES). There were few joint-appointments. While there was generally close unofficial cooperation between the two groups, only extension personnel were specifically responsible for 'outreach.' In the early 30s, no one in extension had any official responsibility for fish and wildlife

work. As a result, Swingle and Smith handled 'outreach' responsibilities for the early Fisheries Program. Almost from the beginning, they worked with a number of owners of local private ponds principally on pond fertilization, weed control and fish management problems in their ponds. This practice provided them with an excellent opportunity to test their recommendations on a variety of 'real-life' situations. It also enabled them to earn an ever increasing amount of credibility for the ongoing work at Auburn.

As noted in a preceding Section, Swingle and Smith continued to provide technical assistance to the Auburn Outing Club on the management of Lake Auburn for many years. In 1943 they published a paper (Swingle and Smith, 1943) summarizing their 10 years of 'outreach' efforts with this pond. Further, as late as 1949, the Annual Report listed the names of 14 off-campus locations receiving technical assistance on pond management. The list included Lake Auburn. Unfortunately, over time, requests for technical assistance by local pond owners became overwhelming, and the 'Investigators' had to request help from the Alabama Cooperative Agricultural Extension Service. It would be the early 50s before the Alabama Department of Conservation would employ a pond management biologist to provide assistance to pond owners.

One really unique early 'outreach' effort of the Fisheries Program involved providing fish fries for out-of-town guests of the Agricultural Experiment Station. Sometime after the end of World War II, the AES Director began to invite the State's Congressional delegation and selected State officials to Auburn for a half-day of fishing and a fish fry. I do not know when this practice began, but I was involved with two of them as a Graduate Research Assistant (1952-1954). For many years these events took place at Pond S-3 on the Story Farm. Over time, it became known as the 'Senator's Pond.' During this period, the fish population was heavily over-crowded with bass, and the bluegill fishing was phenomenal. People who fished it once would literally 'kill' for another opportunity.

On the day of the event, long, 2 X 12 pine planks were laid on permanent supports to make tables and seats. The tables were located alongside two large brick furnaces. The cooking surfaces were thick steel plates with circular holes cut in them to hold large cast iron pots. A shallow well, fitted with a hand-operated pump, was located nearby. It furnished clean water for the operation (Figure 83).

The visitors had to catch the fish for their meal using cane poles, mostly baited with red worms; although in some years, crickets were available. The Field Crew cleaned the fish. The menu was always the same: deep-fried, cornmeal-dipped bluegills and bass, tossed green salad and 'hush-puppies.' In later years, after Ray Allison became involved, he prepared a large pot of really great baked beans, and over time they became part of the menu. The

menu and recipes were sacrosanct. In all these years since, I have eaten thousands of 'hush-puppies,' but I have never eaten one that was as good as those cheese and onion laden 'masterpieces' that Swingle mixed and cooked. He did not hand-form them into balls; rather he distributed his batter evenly across a cookie sheet. Then he used a spatula to push small portions of the 'mix' into the hot oil. Because the individual rectangles were relatively thin, they cooked 'through-and-through' almost instantly.

Most fish were never filleted. Heads, scales, gills and intestines were removed, and the remaining carcass was fried whole. However, the largest bluegills were generally split or 'butterflied'; while larger bass were cut into 'cross-sections.' In the early days, heating the large volume of oil was accomplished using primarily oak wood. Keeping the heat right was an art. Swingle and Lamar Black did virtually all of the cooking. The meal always ended with ice cream sandwiches.

These events were labor intensive. They required the efforts of the full Field Crew, all the 'investigators' and all the students available. A single event required about two full days to get ready, a day to put it on, and two days to clean up. Ellis Prather usually spent two full days assembling all of the 'groceries' that would be needed. He was the only one that Swingle trusted with that chore. These annual events were designed to 'make friends and influence people.' I am sure that no one ever considered the 'cost-benefit' ratio. However, I am equally certain that they earned Swingle and his co-workers literally 'tons' of good will that paid large and small dividends for years. Few people who attended one of those early events ever forgot it.

By the early 60s, Congress began to remain in session throughout the summer, and it was extremely difficult to find a time when the delegation could attend. As a result, the Director quit trying to schedule the event; however, the use of fish fries as an 'outreach' activity continued for many years. Fortunately, we became much more efficient in the process; especially after we began to cook purchased catfish fillets instead of fisherman-caught bass and bluegills. Unfortunately, these events became too popular. Soon we were spending entirely too much time cooking fish and 'hush-puppies' for visiting dignitaries.

THE ALABAMA COOPERATIVE EXTENSION SERVICE 'WEIGHS-IN'

Yeager and Stevenson (2000) provided a considerable amount of information on extension work in fisheries. ACES hired L. K. Sanford as its first Extension Wildlife Specialist in the 1941 Academic Year. At that time, there was little fish pond technology to extend to the public. Later in 1945, Dr. A. M. Pearson, who was working with ACES in Wildlife Management, was also assigned the responsibility of technology transfer to pond owners. Notes made by Swingle indicate that this appointment might have come as early as

1942. I am not certain when Pearson was relieved of this responsibility, but in the late 40s, Earl Kennamer joined ACES, working in the area of fish and wildlife marketing, but he was primarily a Wildlife Specialist; although he had taken both of Swingle's courses on the *Management of Impounded Waters*.

Kennamer was an extremely effective Specialist. He was an indefatigable worker, traveling widely throughout the state to work with pond owners, either individually or in groups. Although Kennamer had been a student in Swingle's courses, and attended as many Short Courses on pond management as he could, he and Swingle did not always agree on some of the particulars of pond problems and their solution. He retired in 1978. John Weeks, who had a long history of extension work in poultry marketing, was assigned the responsibility of fisheries extension work in 1978. He was expected to work primarily in the area of catfish marketing.

After Kennamer retired in 1978 there was no Extension Specialist with recreational fishing or fish farming responsibilities until John W. Jensen became Extension Fisheries Specialist in 1979 with responsibilities in both aquaculture and recreational fishing. He was the first person to provide extension support for the Fisheries Program who had a Degree in the field. His appointment came at a critical time. The catfish industry was growing rapidly in west central Alabama, with large numbers of new fish farmers coming into the business. Few of them knew anything about it.

In the beginning, Jensen spent virtually all of his time with catfish producers. During this early period, most producers felt that the processors were getting 'rich' at their expense. Over time, this relationship deteriorated, and it certainly did little to promote the overall health of the industry. Finally, Jensen decided that it might be helpful if he began to spend more time with processors, to learn more about their side of the industry. This move proved to be extremely beneficial to both groups.

A 'SEA-CHANGE' IN EXTENSION

Dr. James E. Martin, an Auburn alumnus (B.S. in Agricultural Management, 1954) became President of Auburn University on February 15, 1984. Soon after his arrival, Dr. Ann E. Thompson, another Auburn alumnus (B.S., Home Economics, 1954), joined his administration as Director of the Alabama Cooperative Extension Service. Later, she would become Vice President for Extension. Dr. Martin quickly began to make sweeping changes in the organization of the University, especially in agriculture (Yeager and Stevenson, 2000).

In this re-organization process, the University initiated a major change in the administration and supervision of the work of Subject Matter Specialists in Extension. Sometime in the 1985-1986 Academic Year, the University began

the process of giving many of its Specialists academic rank and of moving their ACES salaries into the appropriate Departmental budgets. Under this new arrangement, supervision and evaluation of their performance was shifted to the 'subject-matter' Department Heads. It was also expected that as soon as practical, they would be housed in Departmental offices. In all cases, Specialists were given the choice of joining a Department or remaining in their positions as Extension Specialists.

As detailed in a preceding Section, Jensen had been awarded the Ph.D. Degree by Auburn University in 1979. In the same year, he was appointed Extension Specialist in Aquaculture and Fisheries. From the beginning, he was given an office in Swingle Hall, and although he was not a departmental employee, his extension activities were integrated within the teaching and research program of the Department. For all practical purposes, he was a departmental faculty member. When the University began the process of awarding academic rank to Specialists, Jensen was asked to provide leadership for the Committee preparing recommendations on this matter. His ACES-funded position first appeared in the 1990-1991 FAA Budget.

SPECIFIC OUTREACH ACTIVITIES

As detailed in a preceding Section, in the early days of the Fisheries Program, its 'Investigators' worked with a number of pond owners in east central Alabama on problems related to the management of their fish ponds. Later, campus-based personnel would work closely with catfish farmers throughout the State as that industry began to grow. In the late 60s, Fisheries Program personnel began to travel widely throughout the tropical world in a USAID-funded Outreach Program to encourage the use of pond fish culture to increase food production and reduce poverty. In all of these outreach efforts, personnel responsible for their 'day-to-day' management were permanently based on-campus; even though some of them were often on long-term assignments overseas. However, over time, highly specialized, permanent, local Outreach Programs were developed off-campus. As a result, it became necessary to establish concentrations of specialized personnel and services permanently in other areas of the State. For purposes of discussion, these are considered to be 'Off-Campus Projects.'

ON-CAMPUS BASED ACTIVITIES

Included in this 'group' of outreach projects are the following:

1. Providing technical assistance to owners of farm ponds.
2. Assisting ACES in its efforts to increase income from recreational fishing.

3. Participating in collaborative research on fisheries management in public waters.
4. Providing technical assistance to the catfish farming industry
5. Providing technical support for the 'Water Watch' Program.
6. Implementation of the Caton 'Model' for the development of warm water fish culture in Less Developed Countries (LDCs).

OUTREACH TO RECREATIONAL POND OWNERS

As described in a preceding Section, Swingle and Smith began to help local pond owners with their management problems, especially fertilization and weed control in the mid-30s. Later, after the completion of early work on the 'Eureka' Experiment in Farm Pond 4 and the publication of *Bulletin 254 (Management of Farm Ponds)*, they were able to provide owners with valuable information on all aspects of pond management. Over time, requests for technical assistance quickly increased until they were spending an unusually large amount of time working with private pond owners in east central Alabama, and using Experiment Station funds to pay for it.

Normally, the Alabama Cooperative Extension Service would be expected to accept the responsibility for technology transfer for this new farm 'crop.' Unfortunately, this did not happen. ACES did not hire a trained Fisheries Specialist until over 30 years (1979) later, and the Fisheries Program did not become formally involved in the process for another decade (1989). There are several reasons for this lack of response. To begin with in the mid-30s, ACES like most of the University, was 'broke.' In the 'wake' of the *Great Depression*, they hardly had enough money to do anything. Certainly, they were not able to undertake any new programs.

Further, while growing fish for recreation in 'terrace-water' ponds was a new and exciting idea, pond numbers in the State increased slowly throughout the late 30s and early 40s. Construction did not really begin to increase rapidly until the end of World War II, after farmers had accumulated some 'war-time' savings and after mechanized, earth-moving equipment became widely available.

Also, in the early 40s, pond construction and management was the 'new-kid-in-town' and the need for technology transfer would soon begin to increase sharply; however, the need for extension in farm game management had been languishing for decades with very little attention. In 1940, there were an estimated 232,000 farms in Alabama. Virtually all of them had farm game populations, but very, very few of them had a farm pond. Consequently, it is not surprising that early ACES employees in the area of wildlife and fisheries

management were wildlife oriented.

Finally, in 1950, the Alabama Department of Conservation created the Fisheries Section within its Game and Fish Division. The new Section made providing technical assistance to private pond owners throughout the State their first priority. Data presented in the 1959-1960 Annual Report of the Department (now Alabama Department of Conservation and Natural Resources – ADCNR) indicates that in that year, Section Biologists ‘checked’ 690 individual ponds for ‘balance.’ With this new source of technical assistance readily available, most requests related to pond management problems were directed to State Biologists. In passing, I should note that this process for providing management technology for pond owners was unique. Alabama was likely the only state in the nation where assisting private pond owners was a major priority. Few states allowed their biologists to work on private property. Fortunately or unfortunately, depending on how you view the situation, the technology services provided to pond owners by State Biologists relieved ACES of the pressing need to develop a pond management extension program of their own.

As noted in a preceding paragraph, ACES employed its first Fisheries Extension Specialist (Jensen) in 1978, but not in response to a need for providing technical assistance to owners of recreational fish ponds. Rather, they were responding to the growing interest in commercial catfish production. The 1978 Alabama Agricultural Census reported that in that year that there were commercial catfish production ponds totaling some 3,300 acres on 247 farms in the State, and that total sales were slightly in excess of \$3.0 million. Jensen was employed the following year.

The 1987 Alabama Census of Agriculture reported that farms involved in the commercial production of channel catfish had increased to 399 and that total sales had increased to a near \$15.8 million. As the industry grew, fish farmers had to deal with an increasing number of critical problems. As a result, Jensen was able to spend less-and-less time on recreational pond management problems. Fortunately, as noted previously in 1989, we were able to hire Michael Masser as a Fisheries Extension Specialist to share the work-load. I can’t remember if we divided his projected work-load evenly between commercial and recreational fishing,

Before accepting the Auburn position, Masser had served as State Specialist in Aquaculture while employed by Kentucky State University. He is a native Texan. He received the B.A. Degree in Geography and Zoology from the University of Texas in 1970. After graduation, he was a teacher with the San Antonio Independent School District. While in that position, he also served as part-time instructor at San Antonio College. Later, he was awarded the M.A. in Biology by Incarnate Word College (1973), and in 1987, he received the Ph.D. Degree in Wildlife and Fisheries from Texas A&M University. He

joined the Auburn Faculty in August, 1989.

In the late 80s, the County ACES Offices continued to receive requests for assistance with pond management problems. They continued to respond to these requests usually by arranging for 'pond-bank' demonstrations by Masser in which a number of individual pond owners were involved. The Offices discouraged, to the extent possible, working with individual pond owners. They considered that responding to these individual requests were largely the responsibility of the State Biologists.

As noted in a preceding paragraph, Masser was employed in 1989. As indicated by data presented in Figure 118, interest in pond management in Alabama, as indicated by the number of 'pond-checks' provided by State Biologists, had likely reached its maximum level at about the time that he was employed. Unfortunately, there are no comparable data available for the 70s or early 80s. During the 90s, State Biologists conducted pond balance determinations on 1,200 to 1,400 private ponds annually; however, beginning in the new century, the number began to decline rapidly, and by 2011 it had fallen to less than 400. The data for 2010 and 2012 are somewhat misleading. At that point in order to save money, State Biologists attempted to solve as many problems as practical over the telephone rather than through visits to individual ponds.

While requests for technical assistance in pond management provided by State Biologists seemed to be declining after the beginning of the new century, requests for assistance from 'private' consultants began to increase. More-and-more pond owners were willing to pay for advice and services which could be provided by several 'service-for-fee' companies, such as Southeastern Pond Management and American Sportfish, operating in the State. Most of the requested services involved increasing the quality of fishing for largemouth bass.

The apparent declining interest in the management of 'terrace-water' ponds on private land in Alabama seemed to be associated with declining interest in recreational fishing in the State. Data collected in the National Survey of Fishing, Hunting and Wildlife Associated Recreation indicated that the total number of fishing trips completed by State residents, in the period 1991 through 2011, was at its highest level in 1996 (14.5 million) (Figure 119). Afterwards, the total declined significantly, and in 2011, reached its lowest level (9.9 million).

Even with all of the changes that have taken place, University extension personnel continue to support County ACES' efforts to provide technical assistance to pond owners. Currently this support is provided by David Cline and 'Rusty' Wright based on the Auburn Campus, P. J. Waters with AUMERC in Mobile, and Gregory N. Whitis at the Fish Farming Center in Greensboro.

ASSISTING ACES IN ITS EFFORTS TO INCREASE INCOME FROM RECREATIONAL FISHING

The 1996 National Survey of Fishing, Hunting and Wildlife Associated Recreation (FHWAR) reported that total fishing-related expenditures of all fishermen fishing in Alabama (16 years of age or older) was \$835.6 million. Of this total, \$363.2 million was trip-related (fuel, lodging, transportation, etc.) and some \$472.5 million was spent on equipment or related 'other' items. Although there are no specific data to support it, we suspected that most of these expenditures were related to fishing in 'public' waters (rivers and reservoirs). As a 'point-of-reference,' the 1992 Agricultural Census reported that 'net-cash-returns' for all agricultural sales in Alabama totaled approximately \$381.8 million.

Throughout the 80s and into the early 90s, interest in recreational fishing in public waters in the State, primarily large reservoirs, increased rapidly. At the same time, its contribution to the economy also increased sharply. Consequently, for a number of years in the early to mid-90s, we had encouraged the Extension Service to employ a person to work directly with District and County Agents to encourage the continued growth of this industry. Finally, in 1997, they agreed to purchase a portion of a person's time for this purpose. In 1997, Dr. Russell (Rusty) Wright was employed to fill that position. His presence on the faculty added significantly to the Department's support for recreational fishing extension.

From the beginning, Wright was on a joint extension/research appointment. As detailed in a preceding Section, shortly after joining the FAA faculty, he joined the DeVries Work Group. As indicated by the publications produced by the group, it has been highly productive in a broad range of studies in aquatic ecology.

PARTICIPATING IN COLLABORATIVE RESEARCH ON FISHERIES MANAGEMENT IN PUBLIC WATERS

In a preceding Section, it was noted that the Alabama Department of Conservation created the Fisheries Section within its Game and Fish Division in 1950. The Seafoods Division was created a year later. In 1950, the Auburn Fisheries Faculty collaborated with personnel in the Section in collecting fish population data, using emulsifiable rotenone, from sites on the Coosa River, Lay Lake, Mitchell Lake, Soughahatchee Creek and the Tombigbee River (Figure 109). These early collaborative population surveys marked the beginning of a long series of collaborative projects involving personnel of the Auburn Fisheries Program and personnel in the Alabama Department of Conservation. These collaborative efforts have involved projects both in freshwater and in Alabama's Coastal Zone. From 1950 to the

present, there has seldom been a time when there was no ongoing collaborative projects in place. Most of these projects have been supported by Federal Funds appropriated by Congress through several different Acts. Auburn has generally supported them by paying the Administrative Costs required. Through the years, results of these studies have been used to prepare literally hundreds of reports, many of which were published in peer-reviewed journals. Many of these publications were listed in the preceding Section summarizing the research accomplishments of the Auburn Fisheries Program over three-fourths of a century.

These collaborative efforts have paid 'handsome dividends' to the State of Alabama in its efforts to utilize its aquatic resources wisely. All of the personnel involved also benefitted. The many graduate students involved probably benefitted most of all. Working as part of a group of professional fisheries scientists, in the field, on practical problems, has been an extremely useful part of their training. Further, converting the data they helped collect into formal reports, theses and dissertations, and refereed publications added materially to their appreciation for the practical value of fishery science.

CAMPUS-BASED OUTREACH TO THE CATFISH FARMING INDUSTRY

State-wide interest in channel catfish production followed the publication of Swingle's *Experiments on Growing Fingerling Channel Catfish to Marketable Size in Ponds* in 1958; however, it would be several years later before the 'fad' would develop to the point where it would require technical assistance (outreach). After several years of experimentation, Ellis Prather finally spawned the channel catfish at Auburn in 1958 (Perez, 2006). Afterwards, a number of farmers across the State began to produce fingerlings for sale locally. Once fingerlings were commercially available in different areas of the State, farmers purchased them for stocking. Most of the ponds had been constructed for producing recreational fishing. Few of these 'early adopters' were concerned with what they would do with the fish once they reached harvestable size.

The 'official' beginning of the development of the commercial catfish industry in Alabama can be dated to the spring of 1968 when the STRAL Company constructed a processing plant in Greensboro. The company had previously (1961) established a commercial hatchery, and had begun to sell fingerlings throughout the State (Perez, 2006). The company had been established earlier by 'Check' Stevens, Richard True and Bryant Allen. Unfortunately, hatching catfish eggs and growing and selling fingerlings did not constitute a commercial industry. Fortunately, the Company recognized this fact, but it took them several years to do so. As a result, a new company was formed – the STRAL Processing Company. It included a new partner – Joe Glover, Sr.,

a local butcher and meat market owner. Earlier, on November 15, 1966, Stevens, True and Glover with some local help, 'hand-skinned' and butchered 3,000 pounds of fish from one of Glover's small ponds. Unfortunately, the partners had not given much thought to the most important factor in the entire farming enterprise – marketing. They had expected that if they produced and processed the fish, someone would certainly purchase them. Further, they expected that purchases would keep pace with processing so there would be no accumulation of dressed fish. Sadly, it did not work that way. Demand for that first 'batch' was so limited that most of them had to be frozen. Some of them were still in the freezer a month later. The development of the new processing plant with its Townsend Model 600A skinning machines provided the essential base for the establishment of the industry.

EARLY COLLABORATORS IN COMMERCIAL CATFISH FARMING

Details of early Fisheries Program research on the commercial production of channel catfish were presented in preceding Sections. While this early research clearly demonstrated the potential for the commercial production of the species, the industry would not have moved very far beyond this stage without the 'arrival' of several 'early adopters.' History has repeatedly acknowledged the important contributions of a small number of people who were willing to commit scarce, personal resources to adopt new technology. In the following paragraphs, I have listed some of this unique group of collaborators.

Marvin Pope, a local farmer, was probably the first 'early adopter' of the channel catfish spawning technology developed by Ellis Prather at Auburn in the early 60s. Soon after Prather learned to spawn the fish, hatch the eggs, and produce fry and fingerlings, Marvin Pope was doing the same on his tiny operation east of Auburn. He was soon marketing small lots of fingerlings throughout the area to pond owners who stocked them for recreational fishing. At about the same time (1963), William Easterling, from Clio in Barbour County, visited Prather's catfish spawning enterprise. Once Ellis showed him a mass of catfish eggs, he also became an 'early adopter.'

Without question, the most important 'early adopters' were Bryant Allen, Richard True and Chester ('Chek') Stevens – the STRAL partners. Later, Joe Glover, Sr. would join them. After producing their first crop of fingerlings in 1961, over time, these individuals literally 'birthed' the commercial channel catfish industry in the South. Perez (2006) describes their many contributions in considerable detail. What happened later had a great deal to do with the personalities and backgrounds of the individuals. Bryant Allen was a successful cotton and dairy farmer. He understood crop production. Richard True also operated a cotton and cattle and dairy farm. Further, he owned a few small ponds. Joe Glover owned a grocery store, which included

a meat market. Joe knew a good bit about meat processing. Finally, 'Chek' Stevens was the perfect 'front' man. He had an agriculture degree from Auburn, operated a large farm of his own and sold Ralston-Purina feeds throughout west Alabama. He had useful 'contacts' everywhere.

In the spring of 1964, W. B. Easterling hatched the first channel catfish eggs on a commercial scale in southeast Alabama. Perez (2006) provides an interesting story about how the Easterling Fish Hatchery was established. His facility, located near Ariton, later became the focal point for efforts to establish a commercial catfish farming industry in that area. Once Easterling's fingerlings were available, he began to sell small 'lots' of the fish to pond owners in several adjacent counties. Many of these fish were stocked in ponds already containing populations of bass and bluegills, and in some cases, they were used to establish small 'fish-out' operations. There seemed to be little real interest in establishing a commercial food fish industry.

Sometime later, the Sutton family (Freddie) in Ariton began to serve farm-raised catfish at their restaurant. They produced, harvested and processed their own fish. This family-owned operation became one of the first, vertically-integrated catfish farming enterprise in the State.

In the mid-60s, Lester and Milton Taylor established a small catfish 'fish-out,' operation near Town Creek (Lawrence County, AL). As part of the operation, they provided a fish-cleaning service (Perez, 2006). Soon, they were receiving requests for processed catfish; so in 1970 they constructed a small market building with a processing facility attached. Later, the demand for processed fish became so great that they were unable to supply the demand from fish produced in their ponds. As a result, they began to harvest fish from local fish farmers who were without marketing outlets. After a few years, demand had grown so much that they were purchasing fish from some 20 local producers. At this stage of the development of their operation, they were signing contracts for their fish. In this contractual relationship, the Taylors were using the vertically integrated business model that had been established in the broiler industry in the area. They stocked the ponds, provided the feed and harvested the fish. Producers fed the fish and maintained the ponds. On harvest, they were paid for their inputs on a 'per-pound' basis.

The second 'wave' of 'early adopters' began to arrive in west Alabama in the mid-60s. They would be the ones who would invest really large sums of money to establish commercial farms. In 1965, Joe Kyser, Sr. established the first commercial scale fish farm in Alabama. He had mortgaged his dairy farm to purchase the necessary land near Greensboro. In an interesting aside, I served as faculty advisor for Joe's son Bill, who was awarded the B.S. Degree in Fish Management by Auburn in 1973. Around 1967, J. V. Friday and Clint Wilkinson joined forces to become catfish farmers. Lenson

Montz became a commercial producer at about the same time. Later, David Pearce, also become a commercial producer on the cattle and row-crop farm of his father-in-law, veterinarian Bill Weissinger.

When I returned to Auburn in 1959 to conduct research on the NIH-funded project on controlling aquatic weeds with herbivorous fishes, Dr. Bill Weissinger was one of my local cooperators. At the time, he was operating several bluegill and bass ‘fish-out’ ponds on his farm near Browns in Dallas County, and he was having a serious problem with infestations of *Pithophora*. He allowed Auburn to stock his ponds with *Tilapia aurea* in an effort to control the pest. In the early 70s, David would stock these same ponds with catfish. Later, in 1972, the Spree family in Boligee mortgaged everything they owned, including the chairs in the kitchen, to get in the catfish business. Perez (2006) describes many of the problems encountered by each of these ‘early adopters’ and their families in making fish farming a ‘paying’ proposition. Fortunately, most of them never lost their kitchen chairs, but all of them doubtlessly experienced some really scary moments.

Echoing Perez, because of space constraints, I have chosen to list only a few of the larger group of ‘early adopters’ who helped to build the ‘base’ of the large industry that we have today. I deeply regret that I do not have the space to list more of them.

THE INDUSTRY EVOLVES AND OUTREACH NEEDS CHANGE

Even with the solution of many of the initial problems, catfish farming in Alabama grew slowly, with virtually all of it in around Hale County. It would be over a decade (1978) before the industry would be large enough to warrant the collection and publication of data on the number of farms and acreage involved. The 1978, *U.S. Census of Agriculture* reported that there were 247 fish farmers in Alabama, producing catfish commercially in 3,024 acres of ponds. A decade later, the 1990 *Census* reported that there were a total of 17,550 acres of ponds in catfish production. ‘Acres-in-ponds’ continued to increase at a rate of about 200 per year until 2000, when it reached 22,100, and in 2002, the area in ponds reached 25,900 acres. In the early years, the Fisheries Program at Auburn provided only limited technical assistance to the developing catfish farming industry in west-central Alabama. Throughout the 60s, Prather was the only ‘Investigator’ at Auburn continuing work with catfish production, and his primary interest was in research on spawning, hatching and fingerling production. After 1957, Swingle had begun to devote much of his time to the production of tilapias. Then in June, 1967, Auburn University signed its first contract with the U.S. Agency for International Development to assist the Agency with the development of aquaculture in ponds in Less Developed Countries (LDCs). For the next several years the Fisheries Program would be focused on International Development.

As noted previously, Jensen was the first Extension Specialist employed with graduate training in fish management and aquaculture, but he was not on the FAA Faculty at that time. The Jensen position with its ACES funding was not added to the FAA Budget until Fiscal Year 1990-1991. With his strong background in extension work, Jensen quickly established an active outreach program that reached into all areas of the State. By the late 80s, the program that he had established had grown too large for him to manage alone, and it was still growing.

As detailed in a preceding paragraph, ACES agreed to help with the increasing Jensen work-load by providing funds to employ Mike Masser. Although Mike provided some assistance to John in his outreach efforts to catfish farmers, he spent most of his time working with owners of recreational fish ponds.

While at Auburn, he was quite active in developing extension publications in various areas of pond management and aquaculture. For example, in May, 1992, he published *Management of Recreational Fish Ponds* in Alabama (ANR 577). It was the first comprehensive publication on the subject written at Auburn since *Bulletin 254* was published in 1942. In fact, it was much more comprehensive.

Masser resigned his Auburn position in May, 1998, to return to Texas A&M as an Extension Specialist in Fisheries. Later, he became Department Head of their Fisheries and Wildlife Program.

After Masser resigned in 1998, the Department requested and obtained permission to recruit a replacement. David Teichert-Coddington, a Post-Doctoral Fellow in the Department, was appointed to the position in 1999. David received the B.S. Degree (Biology/Chemistry) from Houghton College in 1976. He had spent the first 12 years of his life in Liberia. He was awarded the M.S. Degree (Aquaculture/Genetics) by Auburn in 1983. In 1984, he was a Research Associate with the ICA, assigned to work with the Pond Dynamics/ Aquaculture Collaborative Research Support Program (PD/A, CRSP) in Panama. In 1993, he moved to a similar position in Honduras. He remained there until he returned to campus in 1995. He had been awarded the Ph.D. Degree by Auburn in 1986. At that time, he was promoted to the position of Post-Doctoral Fellow. After returning to campus, he was involved in a number of ICA activities until he accepted the tenure-track, ACES-funded position. He resigned that position in 2000 to establish Greene Prairie Aquafarm in Greene County.

Jesse Chappell was awarded the B.S. Degree in Zoology by Clemson University in 1973; then the M.S. Degree in Wildlife Biology in 1974. After receiving the Ph.D. Degree from Auburn in 1979, he returned to his native South Carolina where he served as Director of SCAMPI (1981-1985) at the

University of South Carolina. Later, he established two companies which were involved in various activities related to aquaculture. In August, 2002, he returned to Auburn as an Assistant Professor in the Department, replacing David Teichert-Coddington with primary responsibility in aquacultural extension and research.

Jesse was on a joint Extension/Research appointment (25%/75%). He has used his research support to conduct experiments in hydroponics (Figure 107) and in the development of 'in-pond' raceways (Figure 108) for the production of channel catfish. Some of the publications produced by his Work Group were listed in a preceding Section.

SUPPORT FOR THE 'WATER-WATCH' PROGRAM⁶

The Alabama Water Watch Program (AWW) has been one of the Department's most successful outreach efforts. It was initiated in the early 90s when Tim Forester, an Auburn alumnus working with the Alabama Department of Environmental Management (ADEM), contacted FAA regarding the establishment of a Citizens Volunteer Water Monitoring Program. Apparently the U.S. Environmental Protection Agency had provided states with funds to establish these programs, and at that time, ADEM did not feel that it was in a position to utilize the funds within the organization. Instead, they requested that Auburn establish the program on their behalf. The Department agreed to establish the program, and assigned the task of supervising it to Dr. Bill Davies. Soon Dr. William G. Deutch joined him in implementing the program. Deutch had been awarded a B.S. Degree in Zoology by Houghton College in 1972, and another in Anthropology by Bloomsburg University in 1983. In 1975, he had received a Master of Arts Degree in Biology from the State University of New York at Binghamton. Later, in 1988, he was awarded the Ph.D. Degree in Fisheries/Aquatic Ecology by Auburn. After graduating, he did Post-Doctoral work with the Bayne Work Group. Later, he was employed as a Research Fellow to assist with the International Program. During this period, he also served as one of the coordinators of the Aquacultural Training Program.

Among AWWs first tasks were to develop protocols for contacting and organizing interested groups within the State, to develop appropriate teaching materials, and to procure water sampling and water analysis equipment for use by the participating groups. Once interested groups were identified, Auburn personnel provided intensive 'hands-on' training on the chemistry and biology of natural waters, characteristics to be monitored and methods used for their determination. They also placed strong emphasis on

⁶ I am indebted to Bill Deutsch and Eric Reutebuch for assembling much of the information used in the Water Watch Section.

the essential requirement for data accuracy, keeping good records, and on the timely submission of their data to the University team.

Davies retired in 1996, and Deutsch assumed responsibility for the program. Afterwards, AWW's Quality Assurance Plan was recognized by the Environmental Protection Agency (EPA). This recognition meant that data collected by water quality monitors in Alabama could be entered directly into the Agency's national database.

When volunteer groups were adequately prepared for monitoring, they were encouraged to establish their own schedules and collect their own data. At this stage, the Auburn role with the groups was relegated to one of data management, preparing water-body reports and 'trouble-shooting' support. While Auburn continued to support these on-going monitoring efforts, AWW was also actively seeking and training additional groups.

'Lake Watch of Lake Martin' was the first volunteer group established. In 1993, they were certified as Water Monitors for the Lake. Since that time, they have collected and analyzed hundreds of water samples from six sampling stations.

After almost 20 years, 'Water Watch' is still active. In that period, about 200 volunteer groups have sampled 1,500 sites on 500 water bodies in Alabama watersheds, and in shared watersheds with adjoining states. Cumulatively, data on more than 20,000 water chemistry and 4,000 bacteriological tests have been placed in the University, ADEM and EPA databases. Further, as a result of these two decades of effort, some 40 long-term participants have been certified as Alabama 'Water Watch Trainers.' These certified participants now conduct approximately 90 percent of the annual workshops. In 1999, ADEM support was terminated. Fortunately, the University (The Alabama Agricultural Experiment Station and the Alabama Cooperative Extension System) was in a position to continue financial support for the program, on a temporary basis. Finally, in 2002, the Alabama Cooperative Extension System began to provide permanent support when they established an Extension Team Project to encourage the participation of County Extension Agents in Alabama Water Watch activities.

Personnel working with the Water Watch Program in 2017 include the following:

- Eric Reutebuch: Director, Alabama Waterwatch (AWW)
- Bill Deutch: Director, Global Water Watch (GWW)
- Sergio Ruiz-Cordova: Associate Director, Global Eater Watch
- Mona Scrugs Dominguez: AWW Monitor Coordinator/4-H AWW Program Coordinator
- Sidney Smith: Student Intern

- **Samantha Daniell: Student Intern.**

From the beginning, a primary mission of AWW has been the publication of citizen-friendly information concerning Alabama's water resources. Over the years, this information has been included in one of the following Series:

1. **AWW Infographic**
2. **Citizen Guides to Alabama Rivers**
3. **Waterbody Reports: Lakes, Rivers and Bays**
4. **AWWareness**
5. **AWW's Online Newsletter**

Most of the publications in each Series can be down-loaded from AWW's website – 'Alabama Water Watch.'

As detailed in a preceding paragraph, Deutsch had also participated in the Department's ICA program after graduation. Much of his effort was assigned to the USAID-funded Collaborative Research Support Program (CRSP) in *Sustainable Agriculture and Natural Resource Management (SANREM)*. From 1993-2002, he served as Project Site Leader for Auburn's SANREM/CRSP work in the Philippines. Out of this work, the idea emerged for extending the lessons learned in managing AWW, throughout the world. As a result, the Global Water Watch (GWW) program was established. By 2012, GWW partnerships, primarily supported by USAD, had been established in Argentina, Brazil, The Philippines, Ecuador, Mexico, Peru and Thailand. On July 1, 2013, administration of the Alabama Water Watch and Global Water Watch Programs were removed from the Department and placed with the Auburn University Water Resources Center.

THE INTERNATIONAL OUTREACH PROGRAM

Participation of Auburn's Fisheries Program in international development was essentially non-existent until the early 50s, and after a 'halting' start, it remained extremely limited until the mid-60s. At that point, it literally exploded – carrying the old structure of the Program along in a growing 'flood.' Some of the events related to its amazing evolution will be discussed in the following Section.

Note that this activity is being included with the 'On-Campus' group of outreach projects because it was administratively supported from the campus.

EARLY SWINGLE TRAVELS

This long and fascinating story of Auburn's international outreach efforts to promote the use of warm water, pond aquaculture likely began with H. S. Swingle attending the Eighth Pacific Science Congress, held in the Philippines during the period November 16-28, 1953. He was there to represent the United States on a working group on fish production in ponds.

Later, he attended the Ninth Congress, held in Bangkok, Thailand in 1957. After that meeting, he remained in-country to review the Thai Government's Program in freshwater fisheries research and extension. It is likely that the invitation to assist the Government was a result of the efforts of Thai officials who had attended Swingle's classes in Auburn in the late 40s.

Further, it is likely that Swingle met Shimon Tal for the first time in the Philippines, and visited with him later in Bangkok. Tal was the Director of Fish Culture in Israel. In 1957, Swingle visited the country to review its rapidly growing pond fish production program. It is also likely that his participation in the '53 and '57 Congresses led to the request from the Rockefeller Foundation that he review India's Inland Fisheries Program in 1961.

THE DENDY ASSIGNMENT IN THE PHILIPPINES

J. S. Dendy was the first 'Investigator' in the Fisheries Program to accept a long-term assignment for international work. From March, 1959 until August, 1960, he served as Fisheries Officer (Limnologist) for the Food and Agricultural Organization of the United Nations (FAO) in the Philippines. He was there as part of an international working group to study the limnological characteristics of Laguna de Bay – a large freshwater lake east of Manila.

INTERNATIONAL SYMPOSIUM ON WARM-WATER POND FISH CULTURE

The Auburn Fisheries Program received international recognition when Swingle and other faculty and students participated in the *World Symposium on Warm-Water Pond Fish Culture*, held in Rome, May 18-25, 1966. Sometime in the early 60s, the leadership of the FAO Fisheries Program had decided to sponsor the Symposium, and in May, 1964, they invited Marcel Huet (Belgium), Gerald Prowse (Malaysia), Shimon Tal (Israel) and Swingle to Rome to begin planning for it. The same group returned to Rome in December, 1965, to finalize the arrangements. Swingle was chosen as Chairman. He also served as Discussion Leader for one of the nine primary Sessions (Session VI – *Standardization of Research Techniques*). I was asked to serve as Discussion Leader for Session III (*Feeds and Feeding*). I also prepared and presented a report on the world-wide use of feeds in fish

farming. Bob Blackburn (a Lawrence Graduate Student) was asked to serve as Discussion Leader for Session VII (*Weed Control*). Burwell Gooch (a Swingle Graduate Student) served as Presenter for a Review Paper on *Pond Fertilization Research and Development in North America in Session II (Pond Fertilization)*. In addition to these contributions, Fisheries Faculty and Graduate Students prepared some 15-20 Experience Papers on various aspects of aquaculture, which became a part of the Final Report of the *Symposium*. Swingle and I also prepared a comprehensive report entitled: *Techniques for the Development of Systems of Aquaculture*.

We were not aware of it at the time, but our participation in the *Symposium* was really important to the future of our involvement in international aquacultural development. As a result of our participation, we became well acquainted with many of the FAO fisheries scientists and their work, and others working in warm-water aquaculture throughout the world.

THE LONG-TERM RELATIONSHIP WITH THE ISRAELIS

Our long-term, close relationship with the Israelis and appreciation for their outstanding experimental work in fish culture was certainly strengthened by Swingle and Tal working together to plan the *Symposium*. Remember that they had likely first met at the *Session on Pond Fish Culture* at the 8th Pacific Science Congress in the Philippines in 1953. Later, the Israelis would provide us with our first fingerlings of the Israeli strain of the common carp, and in 1957, they provided us with our first 'Nile' Tilapia fingerlings. Later, in the early 70s, Rom Moav would come to Auburn as a Visiting Professor in Fish Genetics. The Short Course that he taught probably played an important role in the development of our own program in fish genetics. Still later (1976), W. G. Wohlfarth came to Auburn as a Visiting Professor to assist us in the further development of our genetics program. Then in the late 70s, the U.S.-Israeli Bi-National Science Foundation (BSF) provided funding to promote closer collaboration in fish breeding between scientists at Auburn and in Israel. Smitherman and Gideon Hulata provided the leadership of this effort.

THE FIJAN CONNECTION

In late 1966, Nikola Fijan joined our faculty as a Visiting Professor (Fish Diseases). He was extremely helpful in our efforts to provide services in disease diagnostics requested by the participating states of our new Cooperative Fish Parasites and Disease Project. We first met him at the 1966 *Symposium*.

DENDY, PRATHER AND SHELL IN NORTHEAST BRAZIL

At the beginning of 1966, the Auburn Fisheries Program was preparing for its forthcoming participation in the FAO Symposium on *Warm-Water Pond Fish Culture* to be held later in Rome. At about the same time, the University received a request from the U.S. Bureau of Commercial Fisheries (BCF) for the services of three faculty members to provide technical assistance in limnology, reservoir management and hatchery management, on a short-term basis, to the Brazilian Government. The assignment would involve working with scientific personnel from DNOCS (Departamento Nacional Obras Contra Seca). This organization had been established by the Government of Brazil early in the 20th century to deal with the broad range of problems related to the periodic drouths in the 'drouth-polygon' of the Northeast. Field work would be conducted on reservoirs and in local fish hatcheries in the Region. The rationale for the assignment and details regarding the negotiations are described in a following Section, but by early spring, it had been decided that Dendy, Prather and I would go to Brazil in early summer.

THE 1966 TEAM VISIT

Dendy, Prather and I arrived in Recife, the capital of Pernambuco State, on June 27, 1966. We remained in-country until September 3. Discussions with USOM/Brazil and with Bill Stevenson, who was serving as BCF Fisheries Advisor to the Mission, indicated that our field activities would be concentrated on Pereira de Miranda, a large reservoir approximately 85 km (53 miles) west of Fortaleza, the capital of Ceara State, and at government fish hatcheries located in that State. The reservoir (5,486 ha) was constructed under the supervision of DNOCS in the period 1950-1957, by building a dam near the confluence of the Canindé and Curu Rivers. In our discussions we learned that, at that time, the entire region was in the midst of a severe drought. The entire drought "polygon" had received little rain during the year.

In further discussions we learned that DNOCS had established a number of regulations governing exploitation of the fish population and that they maintained an active and extensive catch census on the reservoir. As required by law, each fish removed from the reservoir had to be weighed at one of the guard stations. Ostensibly, DNOCS had relatively good records of fish being removed from the reservoir, but they had little or no information concerning the population being exploited, and the effects of their regulations on it. We quickly decided that we could obtain some of that important data that we needed through the use of 'cove' rotenone sampling. All three of us were quite familiar with this procedure. Although there was plenty of powdered rotenone available, most of the other elements required for the surveys (block nets, dip nets, counting tables, measuring boards, etc.)

had to be constructed locally. Fortunately, the deployment of hanging gill nets was one of the primary fishing methods used on Pereira de Miranda; consequently, there was ample expertise available for building all of the block' nets required.

Once the block nets were completed, we spent several weeks collecting samples of fish from ten (10) cove locations on the reservoir. During that period much of the *team's* time was spent helping our counterparts learn as much as possible about the use of this method of sampling fish populations. At the same time, Dendy worked with his counterparts doing limnological sampling. Prather worked with hatchery management personnel and I visited several of the guard stations and worked with several of my counterparts on the analysis of catch data. Once the cove sampling was completed, a considerable amount of time was spent working with counterparts on the handling, summarizing and analysis of large amounts of fish population data. Near the end of the tour, in anticipation of a follow-on visit, we spent a considerable amount of time developing plans and schedules with our counterparts for continuing the studies and activities that we had begun during the initial visit.

At the end of the first tour, the *team* generally concluded that there were limited opportunities to increase fish production in the reservoir, except possibly by establishing non-native species, through stocking, that would take advantage of the resources in currently un-utilized or under-utilized niches in the aquatic ecosystem. Further, it was noted that some increase in catch might be realized somewhat by changing fishing regulations. The team also suggested that it was likely that the only way that fish production could be increased significantly in the region was through the use of commercial aquaculture, and that the first step in this process would be to develop an aquaculture research and demonstration facility there.

In 1967, USOM/Brazil contracted for a short-term marketing study in the Northeast. The study generally supported the position of the 1966 Auburn *team* that intensive fish culture could contribute to the reduction of the protein deficiency in the region; while also increasing the over-all food supply (Davies, 1972). A report prepared by the *team* describing its accomplishments on the initial visit was later prepared and submitted to Stevenson and BCF (Dendy, et al., 1966).

THE 1967 TEAM VISIT

In mid-August, 1967, Dendy, Prather and I returned to Brazil for the second of our three scheduled annual trips. On this visit, we were in-country during the period August 19-September 21, 1967. This year (1967) was a wet year. The entire 'drought polygon' had received a considerable amount of rainfall. As result, we found conditions and characteristics of the

reservoir changed to a considerable extent. A summary of the activities completed during the 1967 team visit was described in Dendy, et al. (1967).

Remember that beginning in June, 1967, the Auburn Fisheries Program was involved in implementing *Phase 1* of the first contract with USAID (AID/csd-1581) – *Increased Fish Production through Improved Fish Cultures in Less Developed Countries*.

Also remember that we had agreed with our Brazilian counterparts on an extensive and intensive plan of work that was to be undertaken in the period between our first two visits. On our return in 1967, we found that they had completed virtually all of the planned activities. They had collected the limnological and fish catch data as scheduled. Also, beginning in March, they had completed nine additional 'cove' rotenone samples. Consequently, Dendy and I spent much of our time analyzing the data that they had collected. During the period he also worked with his counterparts in the evaluation of several new limnological sampling devices, and I helped my counterparts begin to collect data on economic aspects of the capture fishery in the reservoir.

Recall that at the end of the 1966 tour, we suggested that USOM/Brazil and DNOCS consider the use of commercial aquaculture as a means of increasing the quantity of fish available to the people living in the region, and that the first step in developing such an industry would be establishing a modern research and extension center. In the period between our 1966 and 1967 visits, the two agencies decided to begin the implementation of this strategy. After our arrival in 1967, Prather began the task of locating a site for the development of the facility.

The most logical location for the Center was on a level plot of land below the Pereira de Miranda dam, north of the Canindé River and adjacent to it. This site would have been very near the town of Pentecoste. Later it was decided to move the location of the facility to the south side of the river; although it was somewhat less suitable. Once that decision was finalized, Prather began to develop plans for the lay-out and construction of ponds and buildings. By the completion of the 1967 tour, he had developed a complete set of plans.

THE 1968 TEAM VISIT

The third visit by the Auburn team to Northeast Brazil took place during the period August 19-September 21, 1968. Dendy did not participate. He was replaced on the *team* by Norris Jeffrey. Jeffrey assumed the responsibility of working with the limnology group.

By the time we arrived, the Northeast was in the midst of another wet year; consequently, it was possible to study the limnological characteristics of a

reservoir becoming more stable following the 1966 dry year. After the end of our 1967 visit, the counterparts had also begun to survey the limnological characteristics of Araras Reservoir in the far western portion of Ceara State. The limnology team spent most of their time during our visit developing summaries of all data (1966, 1967 and 1968) collected to that time, and evaluating the effects of these physical and chemical characteristics on fish distribution and ecology, and how they affected the fish population and the fishery.

The fishery biology and management Work Group also spent a considerable amount of time evaluating the field data obtained by cove rotenone sampling, fishermen's catches and experimental fishing data obtained previously. Using these combined data, a number of possible management techniques were discussed. Each technique was discussed with respect to fish production in the reservoir, yield of fish to the fishermen and any possible deleterious effects to fish populations or fishing communities. Finally, the team discussed in detail the sampling that would be needed in the future.

Recall that during the 1967 *team* visit, a site below the Pereira De Miranda Reservoir Dam had been chosen as the site of the new Aquaculture Research and Training Center. Also during that visit, Prather had completed a set of plans for all ponds and buildings to be constructed there. Unfortunately, when the *team* returned to Brazil in 1968, additional study of the Canindé River site indicated that it was really not suitable for the development of the Center; subsequently an alternate site was chosen near the Agricultural Training School, several miles to the north of Pentecoste. Water at this site was to be provided by an irrigation canal flowing from General Sampaio-Serrota Reservoir. This site was chosen so late that Prather did not have time to prepare plans for its development during our visit; however, he completed them shortly after his return to campus and forwarded them to USOM/Brazil. Activities of the 1968 Team are described in Shell, et al., 1968.

THE SMITH INITIATIVE⁷

The so-called 'Smith Initiative played an important role in the evolution of Auburn's International Aquaculture Outreach Program; although when it was initiated, we were expecting a quite different outcome. During World War II, several foreign students from tropical countries began to find their way to Auburn to study the warm-water aquacultural research facilities and methodology being developed here (Moss, 1990). The first to arrive were

⁷ In preparing this introductory section, I am deeply indebted for the wealth of information, especially pertinent correspondence, assembled by Don Moss while he was serving as Associate Director of the International Center for Aquaculture. A copy of this material is available in the holdings of the Special Collections and Archives Department of the Ralph B. Draughon Library.

George Caranza and Jose Alvares del Villar from Mexico. Then shortly after the end of the war, students began to arrive from Southeast Asia when USAID/Missions sharply increased their efforts to provide training opportunities in the U.S. for foreign scientists in those areas. As a result, the flow of foreign students to Auburn from tropical countries to study warm-water fish culture began to increase.

While the Missions sending those students willingly paid direct costs (tuition, fees, books, costs of living, etc.) associated with their training, there was no easy way to recover costs associated with the increased demand for study spaces and instructional and research facilities. By the mid-60s, this growing problem lead Dean and Director E. V. Smith to contact USAID for assistance. Remember that Smith, along with Swingle, had worked together beginning in the mid-30s to establish the Fisheries Program, and that he had left it in 1944 to move to the Office of the Dean and Director of the School of Agriculture and the Agricultural Experiment Station.

In 1966, Congress enacted the Foreign Assistance Act of 1966. Section 211-d of the Act provided for the expenditure of federal funds to increase the capability of U.S Institutions of Higher Learning to assist the U.S. Agency for International Development (USAID) in the implementation of its programs in Less Developed Countries (LDCs). An 'Institution Building Grant,' funded by the Agency, was exactly what the Fisheries Program needed. Unfortunately, no one in USAID seemed to feel that the Agency would benefit from the availability of added capability for training foreign graduates in aquaculture at Auburn.

Smith received very little encouragement in his efforts until early in 1966, when he contacted Dr. A. H. Moseman who was then serving as Assistant Administrator of the Office of Technical Cooperation and Research with USAID. Dr. Moseman had worked with USDA for many years before leaving to join the Rockefeller Foundation in 1956. Dean Smith had worked with him on several occasions while he was with USDA, and he had maintained contact with him after he joined the Foundation. Moseman joined USAID in early 1966. Soon afterwards, Smith met with him in Washington, while there on Experiment Station business, to discuss our needs for additional classroom and research space and financial support required in the training of USAID-supported international students. Later, Smith wrote to him in April, inviting him to visit Auburn in early May. For some reason, Moseman was unable to make the visit, but suggested that Dr. Douglas Caton come instead. At that point Dr. Caton was Director, Agricultural and Rural Development Service, Office of Technical Cooperation and Research with the Agency.

Later in December, 1966, Moseman did visit the campus to participate in the Annual Conference of the School of Agriculture and the Agricultural

Experiment Station, and at the same time, to review the training and research programs of the Fisheries Group. Mosman apparently was extremely impressed with what he saw and learned on his visit. He left the impression that the 211-d program was ideally suited to meet Auburn's needs for additional facilities, and that he would ask Dr. Caton to come to the campus to assist in the development of a proposal.

THE CATON 'MODEL' AND ITS IMPLEMENTATION⁸

In the meantime, as a result of the Moseman-Smith correspondence in early April, Dr. Caton called Dean Smith on April 18, 1966, requesting a meeting on campus. We were somewhat surprised, but extremely pleased with this rapid USAID response. It appeared that we might get a quick response to our request for funds for expanding our teaching and research facilities. We held our first meeting with him on Saturday, April 2. He quickly informed us that there was little hope that USAID could provide funds for facilities, but that he would like to explore the possibility of enlisting Auburn to assist the Agency in improving warm water fisheries and aquaculture in less-developed countries throughout the world. His request was completely unexpected. We had never indicated to anyone in Washington that we had any interest in direct involvement in international development beyond the training of foreign students. Up to that time, no one at Auburn had any experience in planning and implementing an international development program at any level. None of us could imagine what might have prompted Caton to make such a proposal. We could not understand how he knew enough about our program to think that we might be capable of mounting such an effort. We still do not know the answer. At this point Alexander Pope's (1688-1744) famous line "for fools rush in even where angels fear to tread" was entirely appropriate.

The USAID interest in aquaculture was a complete surprise to us. In April of 1966, the beginning of the Dendy, Prather, Shell development work in Northeast Brazil was still months away. USAID and agencies that preceded it had actively supported the development of traditional agriculture in LDCs for a number of years, but there was little indication of any interest in fish farming. It had taken them a long time to realize that fish generally provided the largest share of animal protein in the diets of people in the tropical world. When Caton first arrived in Auburn, he was already convinced that aquaculture had an important role to play in international development, that USAID/Washington was ready to commit a considerable amount of funding to

⁸ I am indebted to Rudy Schmittou for assembling a significant amount of the information available on the evolution of Auburn's International Program. Unfortunately, there is not enough space available in the book to include all of it. Copies of all of the material that he has assembled is available in the International Publication Section on the website of the Auburn School of Fisheries, Aquaculture and Aquatic Sciences and in the Special Collections and Archives Department of the Ralph Brown Draughon Library.

support the effort, and that Auburn was the chosen 'vehicle' to implement the Agency effort.

Caton generally proposed that the University would utilize USAID funds to develop a worldwide 'outreach' program in warm water fisheries and aquaculture, in three Phases (Table 92). This Caton proposal would become the 'Model' for the development of Auburn's international development program; although there was really little that was new about it. The nation's Land Grant Universities had been utilizing this general approach to agricultural development for many years. However, the so-called Caton 'Model' clearly helped us better understand what was expected of us as we entered this 'new world'.

Obviously, Caton expected that the Auburn Faculty would have to 'bear-the-brunt' of implementing the 'Model.' Surprisingly, there was only limited appreciation regarding the effect that its implementation would have on ongoing, campus teaching and research programs. Fortunately, USAID would address this problem at a later date, but when the Caton 'Model' was first being discussed, there appeared to be little concern about it.

In retrospect, I am sure that Swingle and Smith considered Caton's proposal from a different perspective than the rest of us. They had almost singlehandedly 'wrestled' the Auburn Fisheries Program to national prominence, working in 20 'mud-holes' ('D' Series) on the South Auburn Farm, and now Caton was asking them to take it onto a 'world-wide stage.' However, most of us were excited with the prospects, and at that point, there was little concern regarding any negative aspects. Apparently, one of us did ask about the use of contract funds for on-campus research. Caton commented that this was not a research contract, but that some of the funds could be used for that purpose if its relevance to LDC development could be established. At the end of the meeting, Caton was assured that we would prepare a proposal, consistent with his stated guidelines as soon as practical. On July 6, 1966, following the end of the *Warm Water Pond Fish Culture Symposium* in Rome, a proposal was forwarded to Smith for his review and approval. Later, he forwarded it to the University Administration for their review and approval. On July 8, Smith submitted the proposal to Caton, who quickly (August 18) acknowledged its receipt.

Rudy Schmittou, then a graduate student, was responsible for providing transportation for Caton to and from the Columbus Airport, and while he was on campus. He remembers Caton's return trip to the airport. Caton apparently commented to him that he was well pleased with his 'whirlwind' visit to the campus, but that he was concerned that he and Auburn had been on different 'wavelengths' for much of the time. He felt that Auburn had spent too much time 'pushing' its facilities and related programs and not enough time on how the philosophy and processes that led to their

development could be reproduced in a much larger and more complicated venue. What USAID wanted to purchase was not more research ponds at north Auburn, but rather the intuitive 'drive' that led Swingle and Smith to take the failed effort at Lake Auburn in the early 30s to the highly respected and highly productive aquaculture and fisheries program of the mid-60s.

In Caton's letter acknowledging the receipt of the proposal, he commented that we should not expect an immediate response. Apparently, the Agency was in the process of significantly expanding its technical assistance program, and there were a number of proposals ahead of ours requiring approval and contracting. Also, our proposal was somewhat different in that it was 'world- wide' in scope, and this required additional consideration. As noted in a preceding paragraph, in mid-October, Dr. Moseman came to Auburn to participate in the Annual School of Agriculture/Agricultural Experiment Station Conference. He discussed the status of the contract, and suggested steps that we might take to secure its early approval.

Little of significance happened until early February, 1967, when Dr. Nels Konnerup from Caton's office came to Auburn to discuss some specific aspects of the proposed contract. In his meeting with President Philpott, he commented that funding for the implementation of Caton's *Phase I* (Table 92) would total approximately \$150,000, and would cover a period of 18 months. Near the end of that period, funding would be provided for the implementation of *Phase II*.

Although there seemed to be no question that the contract would finally be approved, there was considerable uncertainty as to the exact date that work on *Phase I* could begin. Finally, on April 20, 1967, Swingle was called to Washington to discuss the final details. In the same meeting, he was encouraged to conduct a survey in the Philippines, as quickly as possible after the contract was signed. Finally, in the latter part of June, all approvals had been secured and the first contract, AID/csd1581, was scheduled to begin July 1, 1967.

In retrospect, we were hopelessly naïve when Caton presented his proposal to us in early May, 1966. As detailed in a preceding paragraph, international experience, of any sort, in our faculty was extremely limited. International experience was a problem, but of greater importance was that we had no personnel to implement his proposed scope of work. When Caton presented his proposal, the personnel responsible for teaching and research for the entire Fisheries Program consisted of only five permanent positions (Swingle, Dendy, Lawrence, Allison and Prather). I had finally been placed in a tenure-track position, but virtually all of my salary was paid from extramural funds. All of these people were already fully involved in teaching and research. In addition, virtually everyone was involved in fulfilling the obligations for a number of grants and contracts. No one had 'free-time'

available for international work.

Fortunately or unfortunately, depending on how you view the situation, Auburn was essentially the only University in the country with a program in teaching and research in warm-water aquaculture. It is truly amazing that USAID was about to request that a single University program, with only five permanently funded positions, begin a world-wide program. Further, we did not even have Departmental status at that time.

Auburn's half-century cooperation with USAID in seeking to make the lives of people in LCDs better through improved aquacultures generally revolved around the implementation of the different *Phases* of Caton's 'Model.' However, in the early stages of this effort, USAID/Washington introduced a new element into the 'mix' – *Institution Building*. Subsequently, contracts and grants received by the University often included elements of both primary objectives.

THE FIRST IMPLEMENTATION CONTRACT (AID/CSD-1581)

AID/csd-1581 (Increased Fish Production through Improved Fish Culture in Less Developed Countries) became effective on July 1, 1967, and was continued until June 30, 1969. It was funded by USAID/Washington (centrally funded). The contract was initially designed to fund the implementation of *Phase I* of Caton's Model (Table 120); however, before the requested work was completed, some effort was directed to the other Phases as well.

Implementation of the Caton 'Model' began soon after the first Contract (AID/csd-1581) became operational, and it would continue for some four decades. Initially, most of the implementation effort involved 'short-term' assignments; however, as early as November, 1969, with Jeffrey's assignment to Brazil, we began a period of about 10 years when 'long-term' assignments were widely used. After the early 80s, however, these assignments became much less common, and after around 2000, they were seldom utilized.

DEVELOPING A FACULTY FOR IMPLEMENTATION

Once we had a clear understanding of what USAID wanted Auburn to provide them (Caton's 'Model'), we had to quickly begin to decide who was going to do the required work. It was immediately apparent that, except for Swingle, none of the other current permanent faculty (Dendy, Lawrence, Prather and Allison) could contribute very much time to the venture. I had played an active role in the early response of the University to Caton's proposal, but had no time to become more involved in the early stages of its implementation. We had no choice but to look elsewhere for the

personnel required. In the process, we identified four possible sources:

1. Students in our Graduate Program, especially Returned Peace Corps Volunteers, who were in the final stages of meeting degree requirements.
2. Faculty from other University Departments.
3. Calling our alumni 'home.'
4. Faculty from other universities.

Some details on our effort to utilize personnel from these sources are described below.

Utilizing Advanced Students from Our Graduate Program⁹

Fortunately, we had a number of well-qualified, advanced graduate students in our Graduate Program in 1968. Norris Jeffrey, John Kelley, Ron Kilgen, Garland Pardue and Rudy Schmittou had completed the research phase of their Ph.D. work, and were in the final stage of completing all requirements for their degrees. At the time, all of them were employed as Graduate Research Assistants. Of this group, only Jeffrey, Pardue and Schmittou were interested in international development work. Subsequently, Pardue was appointed as an Instructor on September 1, 1968. Jeffrey and Schmittou were appointed as Instructors on October 1 of the same year.

Garland Pardue is a native of North Carolina. He attended Mars Hill Junior College, but later transferred to North Carolina State University, where he received the B.S. Degree in Zoology in 1963. He received the M.S. Degree (Animal Ecology) from the same institution in 1965. After receiving the M.S. Degree, he entered graduate school at Auburn. He was appointed to the position of Instructor in September, 1968, to provide support for the rapidly growing International Program. In August, 1969, he was awarded the Ph.D. Degree in Fisheries Management. In the early years of implementation, he was involved in a number of support activities; however, he decided to leave Auburn in June, 1971, for a position with the U.S Fish and Wildlife Service.

Norris Jeffrey is also a native of North Carolina. He received the B.S. Degree (Fisheries Option) from North Carolina State University in June, 1962. Later, he enrolled in graduate school at that institution. However, he did not complete requirements for the M.S. Degree. Instead, he entered the graduate

⁹ I am indebted to Len Lovshin for assembling much of this material on returned Peace Corps Volunteers.

program at Auburn to work on requirements for the Ph.D. Degree. He was appointed as an Instructor in the Department of Zoology-Entomology in October, 1968. He was awarded the Terminal Degree in June, 1969. He first became involved in international development work when, in 1968, he replaced Dendy on the Brazil 'Team.' Later, the same year, he was employed as an Instructor to serve as Chief-of-Party for the 'long-term' project in Brazil. Other details on his contribution to that Project are presented in a following Section. After returning from the Brazil assignment, he resigned to accept a position with the National Marine Fisheries Service.

Rudy Schmittou is a native of Tennessee. He received the B.S. in Biology from Tennessee Technological University in 1962 and the M.S. (Fish Management) from Auburn in 1965. During the period 1964-1966, he served as a District Fisheries Biologist with the Fisheries Section of the Alabama Department of Conservation and Natural Resources. He returned to Auburn to enter the Ph.D. program in 1966, and was awarded the degree in 1969. On October 1, 1969, he was appointed as an Instructor to assist with the development of the International Program. On November 15, 1969, he resigned to accept the position as Extension Aquaculture Specialist with Texas A&M University. Later, on February 1, 1971, he returned to Auburn as an Assistant Professor in order to accept a 'long-term' assignment as Chief-of-Party for the USAID-funded aquacultural development project (1971-1976) in the Philippines.

Schmittou returned to campus in July, 1976 to assist with various ICA activities. In 1978, he served as the first National Coordinator for Aquaculture for the U.S. Department of Agriculture. During this assignment, he played a leading role in the development of the Department's National Aquaculture Plan. Following the Washington assignment, he returned to campus. Then in the early 80s, he and Mike Cremer did a study for Kentucky State University on the feasibility of establishing an aquaculture research station there. In the mid-80s, he developed and taught a formal course – *Organization, Programming and Implementation of Aquaculture Extension (FAA 510)*. It was first listed in the University Bulletin for the 1985-1986 Academic Year. It was likely among the first formal courses in aquacultural extension taught in the U.S.

There had been no Returned Peace Corps Volunteers (RPCVs) in our Graduate Program when we began to seek new faculty to assist in the implementation of Caton's 'Model.' Len Lovshin was the first of these individuals to earn an advanced degree. He enrolled in the Auburn Ph.D. Program in 1969, after completing his overseas Peace Corps assignment. He had been a member of the first Peace Corps Team in Togo (1966-1968). Over the years, he would be followed by a large number of other Returned Peace Corps Volunteers (RPCVs) (See Appendix Table 7).

Lovshin is a native of Minnesota. He was awarded the B.S. Degree in Zoology by Miami University (OH) in 1964, and the M.S. Degree in Zoology by the University of Wisconsin in 1966. He entered Graduate School at Auburn in 1969, and was awarded the Ph.D. Degree in Fisheries Management in 1972, and was immediately given a 'long-term' assignment to the Brazil Aquaculture Development Project (AID/csd-2270, T0 8). He replaced Norris Jeffrey who had been there under AID/csd-2270, T0 3), from November, 1969 through October, 1971. We felt that Lovshin was the ideal person for that assignment. He had demonstrated a real interest and commitment to international service as a Peace Corps Volunteer in Togo. He had considerable experience living and working with people in another culture. He also had the benefit of the wealth of academic training in fisheries and aquaculture on campus. Finally, we also saw it as an opportunity to help him find a wife. After his assignment in Brazil was completed, Len worked with a similar long-term project in Panama, from June 1981 through June of 1984.

Fortunately, after Lovshin, enrollment of 'RPCVs' steadily increased (Appendix Table 7), and we, in turn, began to utilize them in our International Program. By the mid- to late 70s, they were serving as the primary Technical Advisors for virtually all of our long-term, AID-funded, LDC projects. Those who served in this capacity included: Tom Popma (Jamaica, Columbia and Ecuador); John Jensen (Brazil); Dick Scully (Colombia); Bryan Duncan (Indonesia); Bart Green (Honduras and Egypt); Mike Cremer (Indonesia); Gary Jensen (Egypt); Brian Nerrie (Jamaica); Jim Bowman (Jamaica); Karen Veverica (Rwanda, Kenya and Uganda); J. J. Newman (Rwanda), David Hughes (El Salvador and Panama) and John Moehl (Rwanda).

Five RPCVs who completed Ph.D. Degrees at Auburn and three earning Ph.D. Degrees at other universities, became faculty members within the Department of Fisheries and Allied Aquacultures. Four faculty members, Leonard Lovshin, Tomas Popma, John Jensen and Bryan Duncan completed 25 or more years of service on the faculty and are retired. Stephen Malvestuto, a former faculty member, is deceased. Three, Terry Hanson, William Daniels and LaDon Swann who received their Terminal Degrees from other Universities, are presently employed by the School of Fisheries, Aquaculture and Aquatic Sciences.

Finally, as detailed in a preceding Section, Karen Veverica had served as a Peace Corps Volunteer in Cameroun before earning her M.S. Degree at Oregon State University (1981), and joining the Auburn Faculty.

Without question, all of these individuals, with their unique backgrounds, played an essential role in the implementation of the Caton 'Model' and, in turn, the success of our International Program. Further, several of them with their shared background in international service, also played an essential role in the over-all development of the unique programs in fisheries,

aquaculture and aquatic environments that was evolving at Auburn, both on- and off-campus. In retrospect, it is difficult to imagine how we could have responded to USAID requests for the various services for over 40 years without their help.

Because the RPCVs listed above played such important roles in the evolution and function of Auburn's Fisheries Program, I have chosen to include additional information about each of them in Appendix Table 8.

Utilizing Faculty from Other Auburn Departments

Early in the implementation of Caton's *Phase I*, we began to utilize faculty of the Department of Agricultural Economics (AEC) on our surveys. For example, during the period March 30 through May 24, 1969, Maurice Danner of AEC joined Moss and Pardue in visits to Senegal, Cameroon, Central African Republic, Nigeria, Togo, Ghana, Ivory Coast, Thailand and Rome (FAO). Later, with the implementation of *Phase II* and *Phase III*, personnel from that Department began to play a much more substantial role. They provided significant input in the evaluation of production economics, marketing and the economics of development for several 'long-term' projects. Data presented in Table 93 provides examples of their cooperative efforts. In the early 70s, the ICA developed a series of publications – The Research and Development Series – where we maintained records in publication form for most of our 'long-term' projects. Reports developed from those projects were assigned a number in the Series. For example, data in the Table list the AEC faculty involved, the countries where they worked and the number of the publications containing their input to the project.

Ed McCoy only visited two projects (El Salvador and the Philippines), but he contributed to six publications (6, 11, 12, 13, 21 and 24), in the Series. Upton Hatch worked on the projects in Panama and Guatemala, and helped develop three of the publications (33, 37 and 46).

Don Street from the Department of Economics also helped us with several of the projects (Jamaica, Colombia and Central and West Africa). He was involved in preparing three of the R & D publications (19, 20 and 28). Paul Starr in Sociology accompanied Don on the work in Central and West Africa. He was also involved in preparing R & D Publication Number 28.

Calling Our Alumni Home

In early 1967, when we began to consider where we might find the additional people to help us with the implementation of Caton's 'Model,' an obvious choice was to contact some of our alumni, then working with other institutions, to determine whether or not they would be willing to return to

Auburn to assist us in this international venture. Don Moss (Tennessee Tech) and Neal Smitherman (LSU) returned in July, 1967. Later (1971), Smitherman began his 'long-term' assignment to Panama. Schmittou returned from Texas A&M in 1971, and in September, began his assignment in the Philippines. Bayne returned from Georgia College and State University in 1972, and soon began his tour in El Salvador.

The alumni, except for Moss, had little if any foreign experience, or any competence with a foreign language. Further, we had no experience with 'long-term' overseas assignments. We knew virtually nothing about how to get them and their families abroad, how to support them once they were there and how to get them home. Further, at that point, no one at Auburn seemed to have much concern for what would happen to them once they completed their overseas assignments. There were no vacant tenure-track positions available. Mostly, we were concerned with meeting the immediate AID contractual requirements. We would worry about the future later. Fortunately, by the time the early 'long-term' assignments were completed, the on-campus teaching and research programs resulting from the further implementation (Phases II and III) of Caton's 'Model' were growing so rapidly that all of them were quickly 'fitted into' regular faculty positions.

Early in 1967, in anticipation of the approval of the initial agreement with USAID, we had already contacted Don Moss at Tennessee Tech regarding his interest in joining us in the development of the International Program. He quickly agreed to come back to Auburn. He officially joined the faculty on July 1, 1967. His return was especially significant. He was the ideal person for helping to build an International Program from the 'ground up.' He knew Auburn, and was generally familiar with USAID procedures. He had served two consecutive 'long-term' tours at the University of Bogor in Indonesia under a contract with the University of Kentucky. Don had received a B.S. Degree in Fish Management from Auburn in 1949. Then in 1950, he completed work for the M.S. Degree. Afterwards, in January, 1951, he joined I. B. Byrd to establish the Fisheries Section of the Alabama Department of Conservation. In November, 1957, he left his position with the State to begin work for his Ph.D. at the University of Georgia. In January 1962, he joined the University of Kentucky as the Fisheries Specialist on their USAID-funded project in Indonesia. His primary responsibility there was helping establish a graduate program in fisheries at Bogor University. On completion of his responsibilities on that project (September, 1965), he accepted a position on the faculty of the Department of Biology at the Tennessee Technological University. 'Bad-knee-and-all,' he was the 'stack-pole' around which Auburn's International Program grew. Throughout much of his career with the ICA and ICAE, it was his responsibility to maintain 'day-to-day' liaison with USAID/Washington, and to keep Auburn's response to their needs continuously 'on-track.' He was extremely effective, because he had the ideal personality (a good sense of humor and infinite patience) to deal with the AID/Washington 'bureaucracy.' In the early years of the program, Moss

accompanied Swingle on almost all of the 'short-term' assignments – primarily surveys; however, after the establishment of the Department in 1970, he became the Associate Director of ICA. In that position, he was largely responsible for the 'day-to-day' management of Auburn's International Program.

Jack R. Snow, a native of Jasper, AL received the B.S. Degree in Agriculture from Auburn in 1942. Shortly thereafter, he entered the U.S. Army where he served as a paratrooper in Europe through the end of hostilities. Afterwards, he returned to Auburn where he was awarded the M.S. Degree in Fish Management in 1948. His Degree was the first earned in the new (1947-1948) curriculum. After graduation, he joined the U.S. Fish and Wildlife Service, and served as Superintendent of the National Fish Hatchery in Marion, AL. Later, he also served as Supervisor of the USFWS, in-service training program in Warm-Water Fish Hatchery Management. In 1974, he retired from USFWS and soon returned to Auburn to provide much-needed support for ICA activities. While assisting with those activities, he was involved in a number of 'short-term' assignments in LDCs. However, his most important contribution was likely helping with the supervision of thesis research for the large number of graduate students enrolled at that time. During the period 1978-1985, he served as Major Professor on the Graduate Committees of 20 M.S. students. A total of 14 of them were from LDCs. Jack retired in 1983.

Malcolm C. Johnson was born in Georgia, but spent most of his early life in Florida. In the late 30s, he attended the University of Tampa for a short period. He was called into the Army in July, 1941. After basic training, he was assigned to the European Theatre of Operations where he spent one year as a paratrooper, before becoming a pilot. During his service with the Army Air Corps, he flew 35 combat missions. He was placed on the 'inactive' Reserve list in November, 1945.

He was awarded the B.S. Degree in Fish Management by Auburn in 1949 and the M.S. Degree in 1950. On graduation he was employed to assist Swingle in the operation of the Fisheries Program. John Lawrence had taken a leave-of-absence in September, 1950 to attend Iowa State University. Ellis Prather would return to active duty with the U.S. Air Force shortly thereafter. Johnson worked with Swingle until July, 1952.

After leaving Auburn, Johnson and Russ Fielding established a private venture in Florida to culture marine fish for local markets. Fielding (M.S. '50) had also worked with Swingle during the period 1950-1952. Unfortunately, the business did not go as planned. Later, Johnson would serve as a Biologist for the Soil Conservation Service in Arkansas. Sometime later, Johnson left SCS to enter the commercial minnow production business. Over time, he became the manager of a large plantation in Tillar, AR.

In early 1974, we were approached by a consulting company in Columbus, GA, who represented a large multi-national development corporation (Tiffany Industries American Corporation) with headquarters in St. Louis. Tiffany had a contract to manage the development of a large fish farm (Avaria Fish Farm) in Bendel State, Nigeria, and they wanted the ICA to manage the on-site development, including site selection, construction of ponds and supporting infrastructure, fish production and marketing. From the beginning, it was obvious that of our entire array of alumni, Malcolm Johnson was likely the only one with the experience to manage the development of such a large complex project, and fortunately he was in a position to accept the assignment; subsequently, he was employed by the Department in April, 1974.

Malcom first visited Nigeria in June, 1974 to participate in the preliminary site selection process. Later, he returned to Auburn to finalize the plans for the fish production enterprise. He moved to Nigeria permanently in June, 1965 to begin the construction phase of the project. He returned to Auburn in December, 1978. A report summarizing ICAs contribution to the Nigerian project was finalized in 1983 in Research and Development Series Publication Number 30 – *Commercial Fish Farming Project in Nigeria*.

After returning from Nigeria, Johnson assisted with a number of ICA activities before accepting a 'long-term' assignment with the JMM/KNBS fish culture project in Egypt. He was there from May, 1982 until July of 1983. After returning from that assignment he resigned from his position with the University.

Utilizing Faculty from Other Universities

Soon after we began to search for additional faculty to assist with the implementation of the Caton 'Model,' we contacted Gene Hester, who was serving on the faculty at North Carolina State University, regarding students who were in the final stages of work on their Terminal Degrees and who might be interested in working with Auburn in the development of its International Program. Remember that Hester was awarded the Ph.D. Degree by Auburn in the Spring Quarter of 1959. Hester commented that Bill Davies had just been awarded the Terminal Degree there, and was actively seeking employment. Davies began his 'long-term' assignment in Brazil in November, 1970.

John Grover's biodata was detailed in a preceding Section. Recall that he was awarded the Terminal Degree by Iowa State in 1969. He joined the FAA Faculty on August 1, 1971 to help with the 'Model' implementation process. In January, 1972, he was assigned to the long-term project at Central Luzon State University.

Ken Randolph was working as a Fisheries Consultant in Oklahoma when he joined the Auburn Faculty as an Assistant Professor in October, 1976. He is a native of Mississippi. He was awarded the B.S. Degree in Biology by Delta State in August, 1960. Later he received the M.S. (Zoology) from Memphis State, and in May, 1975, the University of Oklahoma awarded him the Terminal Degree in Zoology.

In January he became the Chief of Party for Auburn's USAID/GOJ Fisheries Development Project in Jamaica (Table 102). At the termination of his assignment, he along with K. Ellis, P. Peterson and J. Grover prepared a report summarizing the accomplishment of the project. It is published as part of the ICAs R and D Series.

He returned to Campus in May, 1980. He joined the staff of the Marion National Fish Hatchery in June, 1980. In 1981, returned to international development work and participated in several USAID projects in Indonesia, Somalia, Oman, and Sudan.

THE FIRST SURVEYS

Although the contracting process to procure services from Auburn to provide support for USAID's mission was a fairly lengthy one (June, 1966-June, 1967), Caton seemed to want us to begin the initial country surveys in as many LDCs and to visit as many Missions (USOMs) as possible, as quickly as possible, once it was approved. Of course, he was primarily interested in the implementation of *Phases II and III*, but realized that those portions of his 'Model' could only be addressed after considerable progress had been made in the implementation of *Phase I*. Swingle seemed to agree with Caton's sense of urgency. As a result, the 'ink was hardly dry' on the first contract before he and Moss arrived in the Philippines (September 2, 1967).

Using funding provided by '1581,' Auburn faculty on short-term assignments, visited 17 different countries during the two-year contract period to determine whether improved technology in warm-water pond fish culture might result in increased fish production when transferred to LDCs (Table 94). Several of the countries were visited more than once. A total of nine of those countries, beginning with the Philippines, was visited in the last half of 1967. All of these early surveys were conducted in Asia by Swingle and Moss. Remember that Caton had requested that the first survey be made in the Philippines. This is where they began. Later, on the same trip, they also visited Taiwan, Japan, Vietnam, Thailand, Malaysia, Nepal, India and Rome. The results of this first survey in the Philippines was published in 1967 however, the results of additional surveys were later added to a revision; published in 1969 (Swingle and Moss, 1969). Each survey resulted in the development of a formal report which was submitted to the local AID Mission.

Only two additional surveys were completed in 1968 under '1581' (West Pakistan and Hong Kong). The remaining six were conducted in 1969, prior to the termination of the contract on June 30. All of these were conducted in Africa by the AU team of Moss, Pardue and Danner (Table 94).

The quick completion of these surveys was the direct result of the almost super-human effort by a few Auburn Faculty. For example, from early September, 1967 through early December of that year, Swingle and Moss literally traveled all over Asia conducting surveys in nine countries (Table 94). Several of the countries (Thailand, the Philippines, East Pakistan and Cameroon) received second visits during this period, and Thailand received a third. These additional visits were scheduled to collect data not obtained on the first one.

The Swingle-Moss Survey in Thailand during the period October 29-November 12, 1967 was quite different than most of the other '1581' surveys. It included much more detail and included some elements of *Phases II and III*. Swingle was already quite familiar with inland fisheries work in the country. Remember that he had conducted a comprehensive survey of aquaculture and fisheries work in that country in December, 1957 (Swingle, 1957e). He conducted the survey after attending the 9th *Pacific Science Congress* meeting in Bangkok during the period 18 November-9 December, 1957. In the report that he submitted to the Department of Fisheries, he described facilities available for research and extension and reviewed the programs in progress. He also recommended that research should be initiated at all of the fish hatcheries in all of the Regions. He also noted that there were sufficient ponds already available for this new emphasis on research; however, he did note that additional trained personnel would be needed.

In that early Thailand visit, he was accompanied in-country by Mr. Prida Karnasut, Chief of the Division of Inland Fisheries. Prida had spent a number of months at Auburn in the 40s working with Swingle. He was familiar with most aspects of the Auburn program and was probably responsible for getting Swingle invited to Thailand initially. Chertchai Amatayakul, Chief of the Invertebrate Section of the Division, also accompanied him. Both were fluent in English. Chertchai was destined to become Chief of the Division later when Prida became Secretary of Agriculture. Chertchai was a classmate of mine in both of Swingle's courses in the spring and summer of 1953. He did not take a degree at Auburn. On their visit to the Northeast Region, they were also accompanied by Ariya Sidthmunka, who had been awarded the B.S. Degree in Fish Management in 1955.

Swingle and Moss completed the first report on the Thailand survey in January, 1968; however, it was revised (Swingle and Moss, 1969) in August, 1969, after a second visit (Swingle and Smitherman, 1969a,b). During the 1967 visit, they reviewed the organization and function of the Department of

Fisheries of the Ministry of Agriculture. They suggested that it was likely the most effective in Asia. The team visited virtually all of the sites in the country where the Department was conducting its various activities. They also reviewed the academic program of the School of Fisheries at Kasetsart University, and visited the Khon Kaen Agricultural Research Center, operated by the Ministry of Agriculture with long-term, AID-funded consultants from the University of Kentucky.

In April, 1969, Auburn began the implementation of *Phases II and III* in Thailand when Swingle and Smitherman arrived to conduct the first Short Course. This first Short Course, and all of those conducted subsequently, were described in detail in a preceding Section.

THE SECOND IMPLEMENTATION CONTRACT (AID/CSD- 2270)

On July 1, 1969, AID/csd-1581 was replaced with AID/csd-2270. The new contract had the same title, but the emphasis was changed to a considerable degree. Some work on Caton's *Phase I* (Surveys) was continued, but much of the emphasis centered on beginning the implementation of *Phase II*, which included facility development, beginning adaptive research and on-campus training for domestic fisheries scientists from selected countries, and *Phase III* which primarily involved the development of functional extension programs and information exchange systems (Table 92).

The new contract also was structured as a Basic Ordering Agreement (BOA) which allowed AID/Washington to add specific Task Orders as needed. These Task Orders included specific objectives for specific countries. Altogether from its inception through June 30, 1974 when it was terminated, a total of nine Task Orders had been added (Table 95). Task Order 1 (world-wide) provided the funding to continue the implementation of *Phase I* of the Caton 'Model' and beginning the implementation of *Phase II*. The use of this and the other Task Orders are shown in Table 95. Three of the Task Orders were funded by AID/Washington; while others were funded by the U.S. Overseas Missions (USOMs) requesting the technical assistance.

ADDITIONAL SURVEYS AND VISITS

As detailed in the preceding paragraph, most of the surveys in Asia and Africa of primary interest to USAID were completed under contract AID/csd-1581 (July 1, 1969-June 30, 1969); however, none had been completed in Central or South America. Then during the period October 6-October 18, 1969, Swingle and Pagan began surveys in those Regions with their visit to Colombia. In the following two years, Auburn faculty would conduct surveys in eleven additional countries – most of them in Latin America with '2270' funding (Table 96).

Remember that under Contract AID/csd-1518, AID/W funds were used for the implementation of *Phases II and III* in only one country – Thailand (April 14-May 17, 1969). However, with the approval of AID/csd-2270, initial implementation of those *Phases* in other countries began to proceed rapidly. In the following four years, return visits were made to 12 countries where ‘1581’ surveys had been completed earlier – some more than once (Colombia, East Pakistan, Ecuador, Malaysia, Nicaragua, Panama and Peru – 2; Peru, Brazil, Puerto Rico and Thailand – 3 and The Philippines – 6)

TASK ORDERS FOR IMPLEMENTATION OF *PHASES II AND III*

As noted in the preceding paragraph some ‘2270’ funds were used for the continuation of surveys (*Phase I*); however, in cases where plans for implementation of *Phases II and III* had been completed, specific Task Orders were developed to begin the work. Table 95 lists the nine Task Orders written under the Basic Ordering Agreement (BOA) of AID/csd-2270. Some of the services requested in the different Task Orders are described in the following paragraphs.

TASK ORDER 1 – WORLD-WIDE: T.O. 1, essentially provided the funding for on-campus activities required in support of the world-wide implementation of *Phases II and III* from July 1, 1969 through June 30, 1971.

TASK ORDERS 2, 7 AND 9 – THAILAND: Remember that the first *Phase II and III* implementation projects for Thailand were funded from contract AID/csd-1581. Then effective August 1, 1969, Task Order 2 was added to the AID/csd-2270 (Basic Ordering Agreement – BOA). The funding provided by this Task Order allowed for continued periodic visits to Thailand by Auburn personnel for the purpose of providing training (Short Courses) to enhance the capabilities of Departmental personnel and for providing assistance in planning and evaluating the Department’s research program. Later Task Orders 7 and 9 were added to the BOA for continuing those visits. Material presented in these Short Courses were described in a preceding Section.

Downloads of Reports resulting from these various visits are available in a database – *Historical Reports* – from the Media and Digital Resources Lab in Ralph B. Draughon Library.

TASK ORDER 3 – THE JEFFREY IMPLEMENTATION PROJECT IN BRAZIL: Technical support activities in limnology, reservoir Management, and hatchery management in the implementation of Caton’s *Phase II and III* in Northeast Brazil were partly supported by this Task Order. Remember that Norris Jeffrey had replaced Dendy on the 1968 Auburn Team visit in Northeast Brazil, and he was subsequently chosen to provide the long-term consultancy required by T.O. 3. Jeffrey arrived in Forteleza with

his family in November 1969, for a one-year assignment. He was the first of our faculty to begin a 'long-term', overseas implementation project. Later, an amendment to T.O. 3 extended his assignment through October, 1971. When Jeffrey arrived in Brazil, only 20 of the new ponds that had been planned in the 1968 Team visit had been completed, and the system to provide water to them had not been installed. When he completed his tour in October of 1971, 48 ponds were available for research and extension. Further, a laboratory building and four fish holding tanks had been completed. With the limited time available, preliminary production trials were completed on only two species, one native and one exotic. In addition, a number of brood stock of both native and exotic species were secured and spawned. Offspring from these fish were being accumulated and evaluated for future production experiments.

Throughout his assignment at the Center, Jeffrey worked closely with Brazilian biologists who would have the responsibility of operating and maintaining the facility after the advisory services contract was completed. Near the end of his tour, he led a team of counterparts on a 10-week tour of a number of warm-water research centers in the U.S.

The description of the work completed under this contract was published as the first report (Number 1) issued in the Research and Development Series (Jeffrey, 1972). It is available in the Ralph B. Draughon Library (SH 236.P7) or on the School 'website.' Norris returned to campus in October, 1971, and later (1972) accepted a position with the National Marine Fisheries Service.

TASK ORDER 4 – THE DAVIES RESERVOIR MANAGEMENT IMPLEMENTATION PROJECT IN BRAZIL:

As detailed in a preceding Section, during the three visits (1966, 1967 and 1968) to Brazil under the PASA agreement with the Bureau of Commercial Fisheries, the Auburn Team, with strong support from its Brazilian counterparts, had accumulated a large amount of field data on the biology of the fishes in Pereira De Miranda Reservoir and on their exploitation. Further, the combined team had made considerable progress in organizing and analyzing it. They had also used the analyses to make a few preliminary recommendations on management; however, there had not been time to adequately place these limited results within the larger framework of fisheries management in the reservoirs of the Northeast. As a result, the Team suggested that USOM/Brazil fund a Task Order to provide the services of a full-time advisor to deal with these larger reservoir management issues. Subsequently, Task Order 4, attached to AID/csd-2270, went into effect in November, 1970, and Bill Davies was assigned to the project as Resident Advisor.

During Davies' tour, he assembled and organized a large amount of information on the *Drought Polygon* in Northeast Brazil and on the historical

role of DNOCS in developing reservoirs and managing the fish populations that had developed in them. He also assembled a large amount of data on the total fish catch, gear used and the economics of fish harvest, marketing and utilization. Information on the past and current strategies adopted by USOM/Brazil and DNOCS to increase the contribution of reservoir fishing to the well-being of the people in the drought-stricken region was also assembled. Davies also outlined a series of additional studies that should be conducted in order to make more informed management decisions.

The Davies assignment was completed in August, 1972. After the completion of his tour, USOM/Brazil decided that they would no longer provide the services of a permanent advisor in fisheries biology and management to DNOCS. Later, after returning to campus, he prepared a detailed summary of his work there (Davies, 1972). This report is also included in School's Research and Development Series (Number 2).

TASK ORDER 6 – WORLD-WIDE: Task Order 6 was developed to extend the provisions of Task Order 1 through September, 1973.

TASK ORDER 8 – THE JENSEN AND LOVSHIN AQUACULTURE IMPLEMENTATION PROJECTS IN BRAZIL: The Jeffrey Project in Brazil under Task Order 3 had been terminated in October, 1971, and Task Order 4 (The Davies Project) was terminated in August, 1972. Sometime later, DNOCS requested that USOM/Brazil provide it with advisory services in intensive fish culture. As a result of this request, the Mission began the process of adding Task Order 8 to AID/csd-2270. It became effective in March, 1972.

The Jensen Outreach Project

John Jensen was the first full-time advisor in outreach (extension) employed by Auburn for an LDC project, and was also the first person given a 'long-term' assignment who was a Returned Peace Corps Volunteer. He began his assignment in Brazil in May, 1972. He was employed specifically to help DNOCS develop an outreach capability to extend the results of the research and development work being done in intensive fish culture, to the private sector.

The early part of Jensen's tour involved the determination of the potential for intensive fish culture on 25 private farms in Maranguape County (Ceara State) and in Tutoia County (Maranhao State). Each of these sites were evaluated with respect to:

1. Suitability of soils.
2. Availability of water.

3. Proximity of markets.
4. Farmer interest.

By mid-1973, experiments conducted at the research and development facility at the Training Center had demonstrated that the hybrid resulting from crossing the female *Tilapia nilotica* with the male *T. hornorum* produced an all-male population, and that the use of this hybrid in intensive fish culture was extremely promising. The extension of this technology for producing the hybrid on private farms in the Region became the 'center-piece' of Jensen's work.

While the primary emphasis of his work was designed to encourage fish production in intensively managed ponds on private farms, he also investigated the potential for fish production in ponds and lakes on public lands:

1. Land areas associated with DNOCS irrigation projects.
2. Small natural reservoirs (permanent and temporary) in the Region.

During his tour, Jensen also produced a manual of fish culture, written especially for farmers with limited knowledge of the biology of fish and their culture. With the use of many drawings, photographs and simple tables, the manual was a useful tool for farmers who were interested in fish culture. It contained information on pond site selection and construction, the production and stocking of hybrid fingerlings, feeding, fertilization, marketing and economics.

At the end of his tour in June, 1974, Jensen summarized his project activities in Jensen (1974). This report is part of the School's Research and Development Series (Number 8). It is also available in the Ralph B. Draughon Library (SH 11.A6 A65 no.8).

The Lovshin Fish Culture Research Project

Len Lovshin was the second of the Returned Peace Corps Volunteers employed for a 'long-term' LDC implementation assignment. He arrived in Brazil in June, 1972 as Jeffrey's replacement as Technical Advisor in fish culture. Jeffrey had returned to campus in October, 1971. Much of his work had been dedicated to the completion of the new research and extension facility at the Training Center near Pentecoste. As a result, much of his time was given to supervising the completion of the facility, installing equipment and establishing protocols for conducting fish culture research. During his tour he was able to make the facility fully functional, but there was little time left before the end of his tour to complete very much research.

Lovshin's responsibility was to fully invest the facility in research. The primary emphasis of research at the facility was to be:

1. Continuation of studies on the production of the two species of tilapia (*T. nilotica* and *T. hornorum*) and their hybrid in ponds.
2. Evaluate the role of the Israeli strain of the common carp in polyculture with the tilapia with feeding and/or fertilization.
3. Begin the evaluation of indigenous species for culture potential.

Lovshin (1975) summarized his accomplishments on these objectives as part of the Research and Development Series (Number 9). It can also be found in the RBD Library (SH 11.A6 A65 no.9).

THE THIRD IMPLEMENTATION CONTRACT (AID/TA-BOA-1152)

Contract AID/csd-2270 (The Second Implementation Contract) was terminated on June 30, 1974, and AID/ta-BOA-1152 was initiated to replace it. It would be the last contract established with AID/Technical Assistance (AID/ta) funding. Henceforth, all of the USOM requests would be serviced through funding authorized by the so-called Title XII legislation. Contract '1152' was essentially an extension of AID/csd-2270, except that it did not include funding for campus-based activities. The *Institutional Development Grant* (AID/csd-2780) would become operational on July 1, 1970; consequently, there was no longer any need to include campus support funds in the Implementation Contracts. AID/csd/ta-BOA-1152 became effective July 1, 1974 and was scheduled to remain in effect until June 30, 1979. During its operational period, a total of ten Task Orders for short-term technical assistance was added. These are listed in Table 97. All of these Task Orders except '2' provided short-time technical assistance to Missions (USOMs) in various LDCs. Task Order 2 provided funds for the continued support of Jensen's and Lovshin's long-term projects in Northeast Brazil. They had been initiated as Task Order 8 under AID/csd-2270. Several of these '1152' short-term assignments (T.O. 3, 4, 6 and 8) were used to begin the development of 'long-term' implementation projects that would be funded by the various USOM's. Trip Reports prepared related to these '1152' Task Orders are generally available in 'Historical Records' database maintained by the Media and Digital Resources Lab in RBD Library.

The most substantive of these ten Task Orders was Number 2, which funded the continuation of the Jensen and Lovshin Projects in Northeast Brazil. As detailed in a preceding paragraph, both the Jensen and Lovshin implementation projects were initiated under Task Order 8 of AID/csd-2270; however, the contract was terminated earlier than anticipated on June 30, 1974. Both prepared final reports on work completed on that contract;

however, under AID/ta-BOA-1152, they continued the work that they had initiated under '2270.'

CONTINUATION OF THE JENSEN OUTREACH PROJECT IN BRAZIL

This portion of the long-term Jensen Outreach Project began with the effective date of the new Contract ('1152') (July 1, 1974) and was terminated in May, 1975. Because Jensen remained in-country for less than a year, under the new Contract, most of his accomplishments had already been initiated. Subsequently, he prepared a report summarizing the results of all of his work in Brazil, but with emphasis on accomplishments in the 1974-1975 period. Some of his reported activities included:

1. Began to extend the technology associated with the use of hybrid tilapia in ponds of local farmers.
2. Production of a simple but comprehensive fish culture manual for use by local farmers.
3. Participation in the organization and presentation of an aquacultural extension workshop at the International Training Program in Fish Culture, sponsored by DNOCS, during the period March-April, 1975.

Jensen's report is part of the Research and Development Series (Number 10), and is available on the School's website. It is also available in the RBD Library (SH 11.A6 A65 no.10).

CONTINUATION OF THE LOVSHIN FISH CULTURE RESEARCH PROJECT

The Lovshin Fish Culture Research Project in Brazil was also continued under this new Contract ('1152') as Task Order 2. It had a termination date of February 15, 1979. With the first Progress Report (Lovshin, 1975), Lovshin described his activities in the Northeast that generally covered the period from June, 1972 through the end of 1974. This report was published as part of the Research and Development Series (Number 14). It is also available in the RBD Library (SH 11.A A65 no.14). The report summarized his accomplishments in five areas:

1. Training and Technical Assistance.
2. Installations and Facilities.
3. Aquaculture Research Program.

4. Fish Culture Extension.

5. Reservoir Management.

The section on research primarily emphasized the experiments on the use of native fishes in fish culture. The extension section described his work with local farmers in fish culture that John Jensen had initiated (Research and Development Series Number 10). He also commented that the shortage of tilapia hybrid fingerlings was a severe problem in the expansion of fish culture.

Later, Lovshin prepared a final report which described his activities during the period January 1, 1977-December 31, 1978 (Lovshin, 1980). This second report is also published as part of the Research and Development Series (Number 26). It can also be found in the RBD Library (SH 11.A6 A65 no.26).

AID/TA-BOA-1152 would be the last funding that Auburn would receive from USAID's Technical Assistance Bureau. Henceforth, virtually all the collaborative funding would be passed through the so-called Title XII mechanism.

MISSION-FUNDED, 'LONG-TERM' CONTRACTS

During the period that AID/csd-2270 was in effect, the University received 'long-term' contracts from USAID Missions in the Philippines, Panama and El Salvador. These contracts primarily called for the implementation of Caton's *Phase II* in those countries. These Mission-funded projects involved the development of an 'Auburn-style' production research facility, complete with all related equipment. Effective utilization of these facilities was encouraged by the permanent assignment of Auburn faculty to each facility, until indigenous scientists could be trained and returned to their countries to operate them. Specific details related to these long-term contracts will be discussed later.

THE INSTITUTION BUILDING GRANT

Title II of the Foreign Assistance Act of 1961 contained a provision (Section 211-d) for providing Grants to U.S. Institutions of Higher Learning to increase their capability to assist the U.S. Agency for International Development in meeting its goals. The Act was amended several times in the 60s. In the process, the language authorizing 'Institution Building Grants' was added to Title XII (*Famine Prevention and Freedom from Hunger*) of the Act. During this period, grants were awarded to a substantial number of Institutions. Auburn was awarded one in 1970. Its specific purpose was to increase the University's effectiveness for the implementation of the Caton 'Model.'

As detailed in a preceding Section, neither the fisheries faculty nor Auburn's Central Administration really fully appreciated the long-term effects that implementation of Caton's 'Model' would have on our traditional, campus-based teaching, research and outreach programs. In 1967, no one could possibly have imagined how rapidly campus involvement in the implementation process would grow. I am sure that the rate of increase surprised even Caton himself. We could not imagine the quantity of on-campus resources (personnel, pond and laboratory space, supplies, equipment, transportation, etc.) that would be required. Further, we had no idea how much it would cost to provide these resources on a continuing basis, or where the funding to purchase them might come from.

You will remember that in the discussion between Moseman and Smith in Washington early in 1966, regarding the repercussions of the increasing enrollment of foreign students in the Graduate Program in Fish Management at Auburn, Moseman suggested that a 211-d, *Institution Building Grant* as authorized under Title XII of the Foreign Assistance Act of 1961, should solve those problems. Unfortunately, at that time, USAID and Auburn were soon involved with working through the details of Caton's 'Model,' and Moseman's suggestion was forgotten.

In early 1969, Swingle, Moss and I met with Caton in Washington to discuss the termination of the first of the implementation contracts (AID/csd-1581) and its replacement. At this meeting, Caton also discussed the possibility of USAID funding the development of a 'World Center for Freshwater Fisheries Development and Research' through the use of a 211-d – *Institution Building Grant*. This was the second Caton 'Bombshell.' The first was his description of the Caton 'Model' and Auburn's role in implementing it on a world-wide basis. He also commented that he would notify us later regarding the proper time to make such a proposal to the Agency.

Later, in an early July, 1969 meeting with Caton to discuss the survey work that we had been doing in Africa, he again surprised us by indicating that we should begin immediately to seek a 211-d Grant and that we should utilize all of the political 'capital' that we had to secure its approval. In a July 22-24 meeting, Caton, Vice President Ben Lanham, Smith and Swingle discussed the preparation and submission of the proposal. Soon thereafter, one was submitted requesting funds from the Agency to 'Strengthen the Specialized Competency in Aquaculture.' Shortly after the proposal was submitted, Dean Smith wrote a personal letter to all members of our Congressional Delegation requesting their support. Later, following an intensive, comprehensive on-campus review, our proposal was accepted and the agreement (AID/csd-2780) was signed on July 25, 1970 by Dr. John Hannah for the Agency and by Dr. Harry Philpott for the University. The Grant was initially scheduled for termination after 5 years; however, it was later extended for an additional 3 years (1978). Objective of the Grant are presented in Table 98.

Auburn's *Institution Building Grant* did not contain provisions for providing the Agency with technical assistance in LDCs. As originally drafted, it did contain those provisions; however, it was decided that there was already a contract (AID/csd-2270) 'in-place' for providing those services, and that including them in '2780' would needlessly complicate the process.

For several reasons, our Institution Building Grant was joined informally with a similar grant awarded to the International Center for Marine Resources and Development at the University of Rhode Island. Rhode Island had established their International Center earlier. In 1965 and 1966, both Senators Claiborne Pell (D/RI) and John Sparkman (D/AL) were members of the Senate Committee on Foreign Relations. President Johnson's Gulf of Tonkin Resolution had been passed by the Senate in 1964, but by late 1965, support for international development in the Committee was declining rapidly. Sparkman would support the President on the Vietnam War to 'the-bitter-end.' Pell had supported him in the beginning, but was beginning to waver. It is likely that Sparkman's long-term support for the Administration in this matter played a positive role in our efforts to secure the Grant. Further, it is likely that a Sparkman-Pell relationship helps explain why Auburn and the University of Rhode Island were informally linked in AID's administration of the Grant. However, the scopes of activities for the two Grants were so different that we did not work on any projects with the University of Rhode Island; however, we did hold regular meetings with them to discuss our ongoing activities.

The most 'far-reaching' product of the Grant for the Auburn Fisheries Program had little to do with the stated objectives (Table 98). When we began to work on the Grant application, we were not aware that Agency requirements related to the approval of AID/csd-2780 would require substantive changes in the administrative structure of the Program. From its beginning in 1933, it had been 'housed' within the Department of Zoology and Entomology. The Grant required that the University entity responsible for administering it must have at least departmental status so that its administrator would have direct access to the Dean's office; consequently, on July 1, 1970, the Department of Fisheries and Allied Aquacultures was created with Dr. H. S. Swingle as its Head. The signing of the agreement between USAID and Auburn University also resulted in the creation of the International Center of Aquaculture (ICA), with Swingle as its Director. The establishment of the ICA was an administrative anomaly. The ICA never had any administrative status. There was never a line-item in the University's budget for it. It simply identified one of the Department's activities.

From a Departmental perspective, the most important of the Grant's objectives was to "*add faculty with specific professional expertise in selected fields*" (Table 98). Remember that in 1965, before we became involved with USAID, the tenure-track faculty of the Fisheries Program consisted of Swingle, Dendy, Lawrence, Prather, Allison, Shell and Greene. By 1976, with

the exception of Greene, the faculty included the same people, plus Moss, Lovell, Bayne, Boyd, Davies, Grover, Johnson, McCoy, Pamatmat, Schmittou, Smitherman, Snow and Wohlfarth. All of these additional people were active in providing campus-based support for the implementation of Caton's 'Model,' and most of them were being paid, at least partly, from other funds; however at some time in their careers at Auburn, '2780' funds were critical in recruiting them or in retaining their services. While the availability of the '2780' funds was a 'God-send' for Auburn's traditional Fisheries Program which had been placed under severe duress in its efforts to implement Caton's 'Model, in the long-term, the University response to the situation was of considerably greater importance. In Fiscal Year (FY) 1964-1965, it provided permanent funding for 5.00 full-time-equivalents (FTEs) of faculty time for the program (Table 77). Fortunately, by FY 1974-1975, it had increased the level to 8.53. Then by FY 1979-1980, it had increased the level even further to 9.89. These additional permanent FTEs guaranteed that most of the people (Bayne, Davies, Smitherman, etc.) who returned from 'long-term' assignments in LDCs had permanent positions with the Program.

Reports of progress in meeting Grant objectives were submitted to the Agency annually. Copies are available in the School's 'Historical Records' file. Copies of four of them (FY '71, FY '72, FY '74 and FY '77) are available in RBD Library (SH 11.A6 A64).

In August, 1976, an intra-agency team conducted a comprehensive review of Auburn's progress in meeting the objectives of its 211-d Grant. The team report included the following comments:

"The sustained effort at AU in fresh water tropical aquaculture has resulted in a highly competent, experienced and practical staff that has enabled the ICA to transfer successfully knowledge to a wide range of situations throughout the less developed world..... There is manifested throughout the entire staff an impressive sense of service to the world community"

Copies of the entire text of the report are available on the 'web' at: pdf.usaid.gov_docs/PDAAC670A1.pdf.

The 'Institution Building Grant' provided the first support that we would receive through so-called Title XII funding mechanism. It had been developed specifically to facilitate USAID/University collaboration. As noted previously, virtually all of our implementation funding in the past had passed through the Agency's Technical Assistance Bureau.

SUBSEQUENT TITLE XII-FUNDED CONTRACTS

As noted previously, after the termination of the *Third Implementation Contract* (USAID/TA-BOA-1152) on June 30, 1979, all

subsequent University Building/Implementation contracts were funded through the so-called Title XII mechanism. They are listed in chronological order in Table 99. Some details on each of them are provided in the following paragraphs:

AID-DSAN-C-0053 (The University Services Contract) (April 1, 1977-March 31, 1982)

As noted in a preceding Section, AID/csd-2780 (211-d, *Institutional Building Grant*) became operational on July 1, 1970. Originally it was intended that the Grant would include a provision for providing 'short-term' overseas advisory services for USOMs. Before it was finalized, it was decided that adding this provision would result in unnecessary complications. As a result, the provision for providing 'short-term' advisory services was never included. Instead, this activity was made a part of a new contract. The Title XII-University Services Contract (AID-DSAN-C-0053) was approved April 1, 1977, and was to continue in effect until March 31, 1982. It provided a contractual mechanism for the ICA to respond rapidly to requests from USOMs for 'short-term' training programs in specific areas, including economics and extension.

ICA personnel completed some 25 specific short term implementation projects, requiring 995 person-days of service, under 'C-0053.' However, only one of them – the Schmittou and Cavender Short Course in extension – presented in Thailand during a five-week period in January and February, 1980 will be discussed here.

I have chosen this particular project for discussion because it more-or-less 'closes-the-book' on our long-term, USAID-funded aquaculture and fisheries development efforts in Thailand. By that time, we had provided advanced degrees to a number of Thai biologists, and they needed little additional 'baby-sitting' from ICA. Also, it represented a clear departure from the heavily research-oriented projects that we had completed there in the past. It also was one of the few projects where we utilized a high-level Auburn University administrator to provide special emphasis to what we considered to be a serious limitation to the development of aquaculture in the country.

Much of our earlier work in Thailand involved efforts to improve their capability in the development and management of research facilities, planning, experimentation, data analysis and reporting and publishing. However, on most of our Project Reports, some mention was made on our concern for problems outreach, but few recommendations were made about what should be done about it. Finally, in the October-November visit in 1971, Swingle and I took the time to seriously evaluate the aquaculture and fisheries extension situation (Task Order 7, funded by AID/csd-2270). In our report, we clearly expressed our concern for the lack of coordination of

extension (outreach) efforts, and recommended that the Extension Section of the Thai Department of Fisheries should be more centralized with more clearly defined responsibilities and duties for the Subsections and that all national extension work (inland and brackish water) should be coordinated out of a single office in Bangkok.

When Lovell and I visited Thailand in October, 1972 (AID/csd-2270 – Task Order 9), we again reviewed progress in extension since the 1971 visit, and generally concluded that not much had been made. Subsequently, in our report (Shell and Lovell, 1972), we recommended that an in-depth review and evaluation should be made of inland fisheries extension and its relationship to research and to fishermen and fish farmers. If I remember correctly, Lovell and I pressed this point in our pre-departure meetings with the Undersecretary of Agriculture, USOM officials, and with Rockefeller Foundation personnel.

Details concerning progress in improving aquaculture and fisheries extension in Thailand following the 1971 and 1972 visits are unclear, but apparently little, if any, change was effected. If I remember correctly, in a subsequent 'pass-through' visit with USOM/Thailand in late 1979, Mission personnel voiced their concern with the lack of progress in bringing about the much-needed changes. During the visit it was decided that we might break the 'log-jam' if we conducted an in-country short-course, using AID-DSAN-C-0053 funds, specifically on extension principles, organization and methods. It was further decided that we might receive a better response if we utilized an extension specialist, with considerable administrative experience, in making the presentations. We felt that recommendations made by such a person might be more favorably received by officials with higher levels of responsibility in the Thai Ministry of Agriculture and the Department of Fisheries. With this goal in mind, we approached Dr. Ray Cavender, then Associate Director of the Alabama Cooperative Extension Service, concerning the possibility of assisting us with this Short Course. Fortunately, he was in a position where he could spend time away from campus, and he agreed to go to Thailand.

I had known Ray for many years. In the late 50s, my father was involved in the production of Red Duroc breeding stock. Ray was one of the Extension Service Specialists in Swine Production at that time, and he spent a considerable amount of time on our farm and in Butler County helping to organize a County Swine Association. Because of Rudy Schmittou's background in aquacultural extension, he was chosen as the ICA representative on the extension Short-Course assignment.

Schmittou and Cavender spent five weeks in Thailand in January and February, 1980. During the period, they conducted training sessions in extension philosophy, organization and methods at various Inland Fisheries

Division sites throughout the country. At the end of the period, they discussed their activities and recommendations for improving extension for fishermen and fish farmers in meetings with officials of the Ministry of Agriculture, the Department of Fisheries and USOM/Thailand. In these meetings, the team emphasized two of the most pressing problems in improving fisheries and aquaculture extension in the country:

1. A poorly organized extension system.
2. Poorly trained extension personnel.

Schmittou and Cavender prepared a report on their visit, which included schedules, observations and recommendations. Copies are available from "Historical Reports" of the School of Fisheries, Aquaculture and Aquatic Sciences.

ICA has no record of what, if any, immediate efforts were made by Thai officials to respond to the recommendations made by Schmittou and Cavender, however, in the fall of 1980, Schmittou and Cremer went to the country to conduct a pre-appraisal study of the Village Fisheries Project in Northeast Thailand. They found that few, if any, changes had been made; consequently, in their final report (Schmittou and Cremer, 1980) they strongly suggested that the success of the Village Fish Pond Project depended on a much more effective extension effort. Consequently, they used a considerable portion of their report making the case for an improved extension effort and making detailed recommendations on what changes should be made. Copies of the Schmittou-Cremer report are also available in the "Historical Reports" file of the School.

AID/DSAN-G-0039 (Aquaculture Technology Development and Technology Transfer Grant) (May, 1978-April, 1982)

Fortunately, with the termination of AID/csd-2780 in April of 1978, the Agency did not abandon the Department and its then massive campus-based program. On May 1, we were awarded the *Aquaculture Technology Development and Technology Transfer Grant* (AID/DSAN-G-0039). Its objectives included:

1. To maintain a quality graduate program in aquaculture.
2. To provide support special training for students from the international community.
3. To provide support to graduate students interested in aquaculture sciences.
4. To carry out an intensive aquaculture training program designed

primarily for students from Less Developed Countries.

5. To prepare a set of working manuals with detailed technical information on selected aquaculture topics.
6. To publish a newsletter, on a quarterly basis as an aid to communication among aquaculturists working in developing countries.

This Grant finally acknowledged the most important characteristics of the on-campus-based International Program and the cost of maintaining it. Graduate and specialized training, the way we did it, was extremely expensive.

Grant '0039' also initially included funds for providing short-term advisory services for USOMs. During its 'life,' 13 ICA-funded personnel expended 134 person-days during 24 visits to 13 countries. In the implementation of '0039,' it soon became obvious that combining '*Institution Building*' and '*Advisory Services*' was not working well from a contractual perspective. Consequently, '*Advisory Services*' was terminated in '0039,' and placed in a new contract – the aforementioned AID-DSAN-C-0053, which had been approved in April, 1977.

Reports detailing progress in meeting Grant objectives were submitted to the Agency annually. Copies of these reports are available in the School's 'Historical Records' file.

AID/DSAN-G-0150 (Matching Formula Strengthening Grant) (July, 1979-June, 1984)

The purpose of this Grant was to develop and expand the ICA's competence in the social sciences to complement its already considerable competence in the biological sciences. It funded the participation of personnel from The School of Agriculture's Department of Agricultural Economics and Rural Sociology in ICA's development activities. With funds obtained through this Grant, FAA also added three new positions – two in aquaculture and one in extension.

Reports detailing progress in meeting Grant objectives were submitted to the Agency annually. Copies of these reports are available in the School's 'Historical Records' file.

AID/DSAN-G-1314 (Title XII AID/AU Cooperative Agreement/Program Support Grant) (January, 1982-December, 1987)

The Aquaculture Technology and Technology Transfer Grant

(‘0039’) and the University Services Contract (‘0053’) were terminated December 31, 1981 and March 31, 1982, respectively. Later, elements of these two separate contracts were combined in the Cooperative Agreement/Program Support Grant (‘1314’) which became effective January 1, 1982, and was to continue for a 5-year period. It was scheduled for termination in 1986, but was extended for a year (December, 1987).

Reports detailing progress in meeting Grant objectives were submitted to the Agency annually. Copies of these reports are available in the School’s ‘Historical Records’ file.

AID/DAN-5058-G-55-6073-00 (Title XII Program Support Grant/Aquaculture and Managed Fish Production) (September, 1986-September, 1988)

The primary purpose of this Program Support Grant was to provide funding for mobilization of campus resources for the support of on-going Title XII projects, on campus and in several LDCs. Some of the funds were utilized to support international development activities on-campus which had been initiated under Cooperative Agreement/Program Support Grant AID/DAN-1314-A00200500. Within the Mobilization of Campus Resources Objective of ‘5058,’ some of the funds were utilized to purchase ‘release time’ in the Department of Agricultural Economics and Rural Sociology to allow its faculty to participate more effectively in the ICA’s development activities. Conner Bailey, Howard Clonts, Upton Hatch and Joe Molnar were involved in this effort. Other funds were utilized to establish a Joint Memorandum of Understanding (JMOU) with the University of Arkansas at Pine Bluff for collaboration in the development of aquacultural technology and for mobilization of campus resources for international development service. In addition, some of the funds were utilized in support of ongoing development projects in Ecuador, Honduras, Panama, Indonesia and Rwanda.

Reports detailing progress in meeting Grant objectives were submitted to the Agency annually. Copies of these reports are available in the School’s ‘Historical Records’ file.

AID/DAN-4180-A-00-8008-00 (Title XII AID/AU Cooperative Agreement/Aquaculture Technology Development Program) (January 1, 1988-December, 1992)

The first Cooperative Agreement between Auburn University and USAID (AID/DSAN-G-1314) became effective January 1, 1982, and terminated December 31, 1987. Later, AID/Washington wished to continue the Cooperative Agreement, but they wanted to develop a more formal planning process for the next period (1988-1992). To develop this process, they suggested that we employ Mr. Ray Kitchell, a long-time employee of the

Agency and a specialist in program planning, who had recently retired. Kitchell suggested that we do the following:

1. Identify a small number of problems impeding the development of aquaculture and fisheries in LDCs.
2. Identify solutions to those problems within our range capabilities.
3. Develop annual work plans for solving those problems.

Within this basic framework, the ICA identified four primary areas that should be addressed:

1. Inadequate research data on aquacultural production systems appropriate for developing countries.
2. Information on development in aquaculture and technical information of a practical nature is not generally appropriate or available in LDCs, and is, thus, a constraint for technology transfer.
3. Lack of personnel with specialized skills, knowledge and advanced training in aquacultural sciences.
4. Systematic, complete and current information on aquacultural specialists working worldwide is generally inaccessible.
5. Administration of ICA.

Within these primary areas, ICA developed work plans for ten specific problems:

1. To improve the efficiency of monosex seed production of tilapia.
2. Assess economic performance of aquacultural development projects in LDCs.
3. Publish the *ICA COMMUNICAE*.
4. Publish technical guides for producers.
5. Publish and distribute *AQUACULTURE NEWS*.
6. Initiate a program of information exchange in Africa.
7. Supervise foreign student study programs.
8. Conduct non-degree aquacultural training for international participants.

9. Model, develop program and manual to make the IAN database more user friendly
10. Plan, manage and report Cooperative Agreement activities.

Of course, we just proposed to continue what we had been doing for a number of years. However, USAID wanted ICA to use a new planning process for the Cooperative Agreement. This was fine with us; however, we were not in a position to begin any major new initiatives.

Soon after the approval of this contract, the International Center for Aquaculture was administratively removed from the Department of Fisheries and Allied Aquacultures and re-established in the Dean's Office. The FAA Department Head was no longer responsible for the direction of the program.

The Final Report was submitted to USAID in 1992. Copies may be downloaded from:

www.aq.auburn.edu/fish/wpcontent/uploads/formidable/aquaculture-technical-development-report-1992.pdf. It is also available in the School's 'Historical Records' file.

Cooperative Agreement 617-A-00-05-00003-00

This Cooperative Agreement was funded by USOM/Uganda. It was the first contract funded after the ICA was removed from the Department. It was developed specifically to fund Auburn's participation in a unique aquaculture development project there – Fisheries Investment for Sustainable Harvest (FISH). Its primary objective was to use a holistic approach to encourage the development of a private sector-driven commercial aquaculture industry in the country. It was designed to encourage the private sector to provide and organize all of the inputs required to 'jump-start' the industry. The contract also provided funding for campus 'back-stopping.'

Karen Veverica served as Chief-of-Party for FISH. Bill Daniels served as Campus Coordinator. The Final Report on the five-year project (2005-2008) is available on the web: www.aq.auburn.edu/international/uganda/docs/final-report.pdf.

CONTINUED USE OF 'SHORT-TERM' ASSIGNMENTS

From the beginning of the formal relationship between Auburn and USAID in 1967 (AD/csd-1581), the use of 'short-term' assignments has played a pivotal role in the implementation of Caton's 'Model' for increased fish production through improved fish cultures. A number of examples of their successful use were discussed in several preceding paragraphs. It was not surprising that so many of these assignments were required in the

implementation of Caton's *Phase I*, and the early stages of *Phase II*; however, it was that the demand for them has persisted long after AID-funding for Auburn's International Aquaculture Program began to decline. Table 100 shows that in just six months of 1979, visits were made to 9 different countries. Obviously, some countries were visited multiple times. It is even more surprising that 'visit-days' have actually increased with time. The total was greater in 2008 and 2010 than in 1986 (Table 101).

IMPLEMENTATION WITH 'LONG-TERM' CONTRACTS

Recall that by the end of 1973, Auburn Faculty had conducted preliminary surveys (*Phase I*) on the potential for the use of intensive aquaculture to increase fish production in some 33 countries in Africa, Asia and Central and South America (Tables 94 and 96). These surveys generally indicated some potential for aquacultural development in virtually every country visited; however, it quickly became obvious that it would not be practical to provide the technical assistance to the USOMs, described in *Phase II*, with 'short-term' assignments. Supervision of construction of facilities and the initiation and development of a structured research program would require that Auburn faculty be on-site continuously.

Phases II and III of Caton's 'Model' were implemented in a total of 12 LDCs through the use of long-term assignments (Table 102). Nigeria is listed, although funding for that project was provided through a privately-owned company. Brazil is also included; although it was initiated before the Caton 'Model' implementation contract was formally accepted by the University. Note that in several cases, long-term assignments were funded by more than one contract. For example, the long-term implementation project in Panama continued 'off-and-on' from February, 1972 through December, 1987. Four persons were on long-term assignments at some time during the 15-year period, and over the years, three different contracts were used to fund their work.

Also note that USAID funded few long-term implementation projects in LDCs after the early 80s. The reason for this change is discussed in a following Section. Data presented in Table 102 showed that between 1969 and 2005, Auburn was involved in implementation projects in 13 countries requiring long-term assignments. Nine of these projects were initiated prior to 1980. In the next 35 years (1980-2015), similar projects would be initiated in only five LDCs.

In most cases, details regarding the accomplishments related to each long-term assignment are reported in 'End-of-Tour' reports. Many of these are published in the Research and Development Series. Table 102 also includes data on the 'R and D' Numbers assigned to the report(s) for each country. These reports are available on the "web-site" of the School of Fisheries,

Aquaculture and Aquatic Sciences. Copies are also maintained in the RBD Library (SH 11.A A65 nos.1-46).

Final reports for the Kenya and Uganda Projects were not published in the Research and Development Series. The Kenya Project was part of the PD/A CRSP Program. As a result, Oregon State University was responsible for publishing the accomplishments of Auburn's faculty on the long-term assignments there. Those accomplishments are described in the 16th (1997-1998) through the 21st (2002-2003) Annual Reports of the CRSP Program. Auburn faculty were there on long-term assignment for only part of that period. Karen Veverica served as Senior Research Associate and Resident Researcher at Sagana Fish Farm from 1997-2000. Except for that period, Auburn participation was handled with short-term assignments.

The Auburn Project in Uganda was funded through a USOM/Uganda contract with the University (Cooperative Agreement 617-A-00-05-00003-00). It was initiated May 16, 2005, and terminated November 16, 2008. This contract included most of the elements of Caton's *Phase II* and *Phase III*. Karen was also responsible for much of the implementation of the field work for that project through a long-term assignment there in the period 2005-2008. The Final Report for the Project is available from:
<http://www.aq.auburn.edu/fish/international/uganda/>

THE WATER HARVESTING/AQUACULTURE ('WHAP') PROJECT

This project was apparently funded by AID/Washington to encourage the collaboration between Private Volunteer Organizations and U.S Universities receiving Title XII funding. It was not a part of the Caton 'Model' Program. The Project involved a collaborative effort between the Joint PVO/University Center for Rural Development located at Western Carolina University, ICA and six Private Volunteer Organizations (PVOs). It was funded by USAID Grant PDC-024-G-SS-4085-00. The Grant was given to the Joint Center. The ICA served as a sub-contractor. It was initiated July 1, 1984, and was to be continued for five years.

The cooperating PVO groups included:

1. The Cooperative League of the United States (CARE).
2. Catholic Relief Services
3. Church World Services
4. Heifer Project International
5. Lutheran World Relief
6. Save the Children Foundation.

The primary purpose of the Grant was to enlist the assistance of the PVO community in seeking ways to improve the quality of life of people in LDCs through the use of water harvesting and aquaculture. More specifically, it was designed to develop procedures whereby PVOs could readily obtain technical assistance for their field projects. Bryan Duncan served as Technical Coordinator for ICA. Other ICA faculty involved included: Alex Bocek, Randy Brummet, John Grover, Upton Hatch, David Hughes, Len Lovshin, Jean Yves Mevel, Ron Phelps, Tom Popma, Rudy Schmittou, Neal Smitherman and Kyung Yoo.

ICA's responsibility involved providing training for PVOs on water harvesting and aquaculture, and to provide them with technical assistance by accompanying them as they developed field contacts and projects. This was an extremely effective project. The PVOs with direct and indirect technical assistance from ICA, made 114 visits to 56 different Field Projects in 29 different LDCs.

Two of the Field Projects are of special interest. Both were established by Catholic Relief Services (CRS) in Panama, during the same period that ICA (Lovshin) was completing the implementation of AID/la-0216 there and Teichert-Coddington was beginning the implementation of the ICA CRSP Project. One of the Projects was established at the Tole Mission Center in the Tole District of Chiriqui Province. With the support of CRS and ICA, 225 family ponds were constructed in that District. Altogether, 240 families in 20 communities became involved in water harvesting and aquaculture.

In the second Field Project, CRS was involved in building 24 ponds in ten communities in Veraguas Province. Altogether, approximately 150 families became involved in the production of tilapia, pigs and ducks in integrated farming systems. Details related to the implementation of the Project can be found in the Final Report presented to USAID/W. It is available on the 'web': AID/PDC-0204-G-SS-4085-00.

The 'WHAP' was very successful. It introduced the concept of water harvesting to a large number of families throughout much of the developing world. It provided USAID with an extremely large 'bang-for-the-buck.' From a practical perspective, it suffered from the perennial PVO problem of "small is beautiful but often irrelevant," but with long-term ICA inputs, production economics could have been improved considerably.

Both the PVOs and ICA learned a great deal from implementing 'WHAP.' With the knowledge gained, the partnership could have been much more productive over time. Unfortunately, while Congress in its post-Vietnam mood, wanted to put more emphasis on the poorest-of the-poor, USAID saw its future in supporting large numbers of U.S. Universities conducting research at LDC institutions.

THE PD/A/CRSP PROGRAM

In 1982, Auburn University and its Department of Fisheries and Allied Aquacultures (ICA) became involved in a radically different kind of international development strategy, when the Collaborative Research Support Program (PD/A CRSP) went into effect. This change effectively transformed the University's long-term relationship with USAID, which had been based on the world-wide implementation of Caton's 'Model.' The reason for this basic change in the Agency's development strategy and the effect that it had on the ICA are discussed in a following Section.

In the late 70s, the Board for International Food and Agricultural Development (BIFAD) directed that one of its committees – The Joint Committee on Agricultural Research and Development (JCARD) – develop a new strategy for involving the larger University community in international development. From this mandate, JCARD recommended the establishment of the Collaborative Research Support Program (CRSP). Later, it decided that one of the new CRSPs would emphasize research in aquaculture and fisheries. Subsequently, the Pond Dynamics/Aquaculture CRSP was approved by BIFAD and USAID, and Auburn was chosen as one of the participants.

THE ICA AND THE PD/A CRSP

In an early meeting of the participating Universities, Oregon State University was chosen as the Management Entity of the PD/A CRSP. It was also decided that with so much planning and coordination required, it was impractical to begin field implementation immediately. Instead, AID/W decided to fund these preliminary activities with a Title XII Planning Grant (AID/DSAN-G-0264). In this meeting, it was also suggested that Universities in Honduras, Panama, Philippines, Rwanda and Thailand serve as counterpart institutions and that pairings between U.S. and LDC Universities be as follows:

AUBURN UNIVERSITY

- Honduras
- Panama

UNIVERSITY OF HAWAII

- The Philippines

OREGON STATE UNIVERSITY

- Rwanda

UNIVERSITY OF MICHIGAN

- Thailand

MICHIGAN STATE UNIVERSITY

- **Indonesia**

Under the Plan developed by the participating Universities and accepted by USAID, it was proposed that all funds for the operation of the Project would be given to Oregon State, which would disburse them according to a Plan of Work which had been approved by a Board of Directors. The Board consisted of one representative of each participating University. Obviously, this mode of operation was very different from the one that had been established in 1967, when Auburn and the Agency had agreed on the protocols for implementing Caton's 'Model' on a world-wide basis.

In 1982, the Agency approved a second grant (DAN-4023-G-SS-2074-00) which provided funding for the actual initiation of PD/A CRSP research activities. Its effective date was September 1, 1982. Auburn initiated its CRSP responsibility in Honduras in early April, 1983, with the long-term assignment of Bart Green to the country. He would remain there until August, 1989. In the meantime, he was joined by David Teichert-Coddington in June, 1988. CRSP work would continue there until late December, 1998. We began our CRSP work in Panama in late May, 1983, with the assignment of David Hughes to the project. He remained there until February, 1987. Afterwards, we had no permanent faculty there until David Teichert-Coddington arrived in January, 1985. He remained there until December, 1987.

Auburn had earlier established programs in aquacultural development in both countries (Honduras and Panama) before the beginning of the CRSP programs. David Hughes had been in Honduras (AID DSN-2780/ADP) from February, 1977 until December, 1979. Smitherman was in Panama (AID/Ia-684) from February, 1972 until September, 1973. Later, Lovshin would work there (AID/Ia-0216) from June, 1981 until June, 1984. In fact, before the initiation of the CRSP, Auburn had completed 'long-term,' Caton 'Model' implementation projects in all of the LDCs involved.

Remember that Karen Veverica and John Moehl had initiated the Auburn-USOM/Rwanda project (AID/afr-0112) in early May, 1983. Both had returned to the campus by mid-December, 1987. However, after that initial project had been completed, it was decided to initiate a PD/A CRSP (4023) project there. Consequently, Karen was assigned to the country again in mid-January, 1988. She remained in-country until the end of January, 1992. Then in June, 1993, J. J. Newman was assigned to the Project. She remained in-country until April, 1994.

Initially, the USOM/Egypt Project encountered so many prime contractor problems in implementation that Malcom Johnson had to be recalled in 1983. He had been assigned to the Project in May of 1982. Remember that Auburn was participating in the Project as a sub-contractor. The prime contractor

was James M. Montgomery and KNBS Consulting and Civil Engineering – a joint venture. Finally, the Mission was able to solve most of those problems and Auburn was asked to return. As a result, Bart Green arrived in-country in March 1993. This time Auburn's participation was funded by PD/A CRSP (4023). He remained in country until the end of December, 1994.

The 13th PD/A CRSP Annual Report (September, 1994-August, 1995) prepared by Oregon State University comments that the East Africa CRSP project in Rwanda was terminated as a result of political unrest. Later, it was decided to shift the project to Sagana Fish Farm in Kenya. Karen Veverica was assigned (March, 1997) to the country as Resident Research Scientist. Collaborators on the project included three U.S. Universities and four from Kenya. This was an extremely broad-based project. It involved the renovation of the old Sagana Fish Hatchery and the construction of 70 new ponds, the collection of baseline data on the modernized facility, a wide range of experiments on fish production, and an extremely active outreach program for local extension agents and fish farmers. Karen returned to Auburn at the end of March, 2000. She was not replaced with a long-term assignment.

Each year after the initiation of CRSP grant activities in 1982, Oregon State University – the Managing Entity – has submitted an Annual Report to USAID. These reports include a wealth of information regarding the administration of the program and technical accomplishments of its participants. In the early years, administrative and technical information were included in the same Report; however, in recent years (after 1993-1994), separate Reports have been prepared. All of these Reports can be down-loaded from the 'net' by searching for 'PD/A CRSP Annual Reports.'

The PD/A CRSP was scheduled for termination at the end of July, 2006, after 24 years (1982-2006) of operation. During this unusually long period of time, many changes were made in the program. For example, sometime in the period 2001-2002, the decision was made to change the name of the program from PD/A CRSP to Aquaculture CRSP. Further, in the 24 years, the program had 'grown-like-topsy.' When field work was initiated in 1982, there were five American Universities involved in collaborative research in six countries. The final Annual Report for 2006-2007 included the names of 13 Lead U.S. Institutions, 8 Subcontractor U.S. Institutions and 4 Collaborating Institutions; however, as will be discussed later, the International Center for Aquaculture had been removed from the Department in 1989 and moved to the Dean's Office.

Along with the Twenty-Fifth Annual Administrative Report, Oregon State published the Twenty Fifth Annual Technical Report (2005-2006), in two volumes. These publications listed some 29 reports on research projects completed in LDCs. There were 15 American Universities involved in these various projects. The University of Michigan was involved in 18. The

Department of Fisheries and Allied Aquacultures was hardly involved at all. Boyd was involved in a project in a Short Course on Best Management Practices in Aquaculture. Joe Molnar, a Rural Sociologist in the Department of Agricultural Economics and Rural Sociology, was more involved than any FAA faculty. He was involved in two research projects on tilapia fingerling production in Central America.

THE AQUAFISH CRSP

After the termination of the PD/A CRSP (4023) in 2006, USAID/Washington agreed to continue funding collaborative research in LDCs, but they wanted to expand the program to include more emphasis on fisheries, more development-related projects, to involve more American Universities, and to limit the number of LDC Universities. The new program was given the name *AquaFish CRSP*. It was formally initiated in September, 2006. Oregon State University continued to serve as Managing Entity. The First Annual Report (2006-2007) listed North Carolina State University, Purdue University, University of Arizona, University of Connecticut (Avery Point), University of Hawaii at Hilo and the University of Michigan as Lead Institutions. Auburn was not included; however, as noted in the Third Annual Report (2008-2009), it had been added to the list, but as part of a Research Group. The Auburn University Research Group also included Alabama A&M University and the University of Georgia.

The Third Annual Report also indicated that the Auburn Research Group would be responsible for research in the following core areas:

1. Hydrology, water harvesting and watershed management for food security, income and health.
2. Small impoundments for aquaculture and other community uses.

THE AQUAFISH INNOVATION LAB

In 2013, Oregon State University was notified that USAID/W intended to extend funding support for collaborative research in aquaculture and fisheries in LDCs for an additional five years, but that they wished to change the name to AquaFish Innovation Lab and to change other aspects of the Project. It was funded as a Cooperative Agreement (USAID/CA/LWA No. EPP-A-00-06-00012-00) between USAID and U.S. and Host Country Universities.

The 2013-2015 Implementation Plan indicated that Auburn University, North Carolina State University, Purdue University, the University of Connecticut at Avery Point and the University of Michigan would serve as Lead Universities. Several other Universities were listed as collaborators. The document also indicated that Auburn and two collaborating Universities (Alabama A&M University and the University of Arizona) would be responsible for a major

research effort on *Aquaculture Development in Kenya and Uganda: Advancing Cost-Effective Technology, Market Assessment and End User Engagement*. The Implementation Plan also identified six specific problems that Auburn and its partners would be investigating initially. The Plan did not indicate who the Principal Investigators were for the various problem areas, but it appears that the School of Fisheries, Aquaculture and Aquatic Sciences would be only minimally involved.

THE SANREM CRSP

In the beginning, the projects supported by USAID's Collaborative Research Support Program (CRSP) were primarily commodity or discipline oriented (Sorghum/Millet, Beans/Cowpeas, Small Ruminants, Aquaculture/Fisheries, etc.). Later, however, in the early 90s, the Agency added another category of multidisciplinary projects to the program. These were included within a group generally related to *Sustainable Agriculture and Natural Resource Management* (SANREM). The Agency also established a Management Entity (ME) to administer the program. The University of Georgia served as the first ME for the program, but later Virginia Tech assumed this responsibility. Auburn participated in this program from November, 1990 until June, 2003 – primarily contributing short-term technical assistance for projects related to water quality and management in the Philippines and in Ecuador. Bryan Duncan, Bill Deutch and Sergio S. Ruiz-Córdova were responsible for most of the ICA input. Details of Auburn's contribution to this Project are available online in Annual Reports of the SANREM CRSP. Auburn's Global Water Watch Program evolved out of its participation in this Project.

OVERVIEW OF THE AUBURN/USAID WORLD-WIDE 'OUTREACH' PROGRAM IN AQUACULTURE

FAO data (FAO, 2010) indicate that World Aquaculture Production (finfish, crustaceans, molluscs and other aquatic animals) increased from approximately 2.6 million to 59.0 million metric tons during the period 1970-2010 (Figure 120). By 2010, aquaculture contributed almost one-half of total world fish consumption (45.6 percent). It had contributed 33.8 percent in 2000. Without question, the implementation of the Caton 'Model' for increasing aquacultural production by the Fisheries Program at Auburn contributed to this increase.

Auburn, with funding provided primarily by USAID/W, visited with fisheries personnel in dozens of LDCs in the late 60s and early 70s, to make them aware of the potential for the production of fish and other aquatic animals in ponds in their countries, and in the following two decades, we provided many of them with 'hands-on' practical training at Auburn in all aspects of the new science. We also provided practical training in specific areas to hundreds of them in their home countries. In several of the countries, we supervised the

development of modern aquaculture research facilities, and remained long enough to help them learn how to use them. Further, we provided advanced degrees for large numbers of their personnel. Finally, our research faculty developed practical information in three 'key' areas of aquacultural science that would contribute significantly to the dramatic increase in world-wide aquaculture production:

1. Practical management of tilapia.
2. Feeds and feeding for warm-water fish and crustaceans.
3. The management of water quality in production units.

As noted in a preceding Section, Swingle set the 'pace' for our work to implement the Caton 'Model' with his 'super-human' efforts in 1967 and 1968. While in his absence we could not possibly maintain that pace, our contributions always met the approval of USAID at all levels. In February, 1973, Dr. Omer Kelly, Director, Office of Agriculture, Bureau of Technical Assistance, USAID/W wrote:

"We appreciate very much the effort and good work which you have done for us in the past, along with what has always been excellent cooperation on your part and a ready willingness to assist our field missions."

A large share of the increase in world aquacultural production is a result of the dramatic increase of production in China (Figure 120). In 2010, production in that country constituted approximately 89.1 percent of the world total. Data presented in the Figure show that production there increased sharply between 1990 and 2000 (approximately 236 percent – 6.4 to 21.5 million metric tons). In 1991, the American Soybean Association requested that Rudy Schmittou go to China to assist them in developing a feed-based fish farming system there. His efforts were so successful that the Chinese Ministry of Agriculture decreed that the system, (LVHD, 80:20) developed with Schmittou's efforts, would be the only one supported by the Ministry. He remained in-country until 1995, when he was replaced by Mike Cremer who remained there until 2001. This effort was not funded by USAID. It was not an Auburn program, but both Schmittou and Cremer were *products* of Auburn's implementation of Caton's 'Model.'

This recounting of the contributions of the Auburn program to the development of aquaculture is in no way intended to diminish the contributions of literally thousands of other dedicated people who have worked and who are currently working in this area around the world. Their combined effort has also contributed significantly to the dramatic increase in

aquaculture production. I have simply recounted our efforts to underline the fact that Auburn has been there literally 'from the beginning.' Recall that Swingle and the Auburn Faculty played a leading role in the *Symposium on Warm-Water Pond Fish Culture* held in Rome in 1966. It was the first such effort to acquaint the entire world with the potential of aquaculture.

The State of Alabama has also benefitted directly from Auburn's International Program to encourage the increase in aquacultural production in LDCs. From the beginning, certain aspects of its International Program have been used to advance the development of the domestic aquaculture industry in Alabama. Technical capability established in economics, fish breeding, feeds and feeding, stock management, fish diseases and water quality management to implement Caton's 'Model' has been equally useful in meeting needs of our domestic aquaculture program.

The work of the International Center for Aquaculture has also benefitted the larger University community. A number of senior officials of the U.S. Government visited Auburn that would have had no reason to come here otherwise. Literally hundreds of international students and officials have visited the *University on the Plains*. As a result, there are groups of these individuals scattered throughout the largely tropical world who have 'orange-and-blue-eyeballs.' Further, the Program showed the University community that Auburn could play an important role on the 'world' stage by implementing Caton's 'Model,' and resulted in permanent changes in the Auburn Fisheries Program. It was accorded considerable recognition in the University when it was placed in a separate Department. Without question, the rapidly growing International Program played a major role in the decision to request funds to construct Swingle Hall. Also, as a result of funding from various aspects of the program, numerous improvements were made in the facilities on the Soughahatchee, Story and Farmville City Farms.

The University's decision to increase the size of the faculty of the Department was a result of the success of the program. Remember that many of the people that were employed to work on the program were initially paid from 'soft' money. Fortunately, over time, the University kept adding 'tenure-track' positions to the FAA Budget until virtually all of those people became permanent faculty members. In 1988, the last USAID contract (AID/DAN-4180-A-00-8008-00) providing funds for '*Institution Building*' on campus was signed. The Department's Budget that year (1988-1989) included the names of 19 persons in tenure or tenure-track positions related to its research and teaching mission. Remember that there were seven in 1966. Seven of them (Bayne, Davies, Grover, Jensen, Lovshin, Phelps, Popma and Smitherman) had completed at least one long-term ICA assignment in an LDC. Remember that each of these seven individuals were employed specifically to accept a 'long-term' assignment in an LDC. We were extremely fortunate to be able to retain them once they completed those assignments. Each of them has

contributed significantly to the function of the program over the years.

Auburn's efforts to implement Caton's 'Model' attracted large numbers of graduate students from throughout the country and the world. This bounty of young, energetic, deeply motivated people allowed the Department to establish and maintain a large, high quality, highly productive graduate teaching program. At one point in the early 90s, the Auburn program in fisheries and aquaculture education was judged to be best in the nation.

Because of the large number of Graduate Research Assistants involved in the Auburn Fisheries Program, for a number of years they have been primarily responsible for much of the 'day-to-day' work required in our on-going research program. As a result, they have written literally hundreds of theses and dissertations, and a large share of these have been developed into refereed journal papers. For years, the Department has been among the most prolific University programs in the nation in the publication of scientific information in aquatic biology, fisheries and aquaculture.

THE SPARKMAN FACTOR

As will be detailed in a following Section, for a time in mid-70s, international development efforts by the United States faced great political difficulty. As a result, it appeared for a time that Auburn's rapidly growing program in extending improved fish culture to developing countries might be quickly terminated. With increasing casualties and a 'bogged-down' peace process in Vietnam, anti-foreign aid forces in the nation and in Congress expanded rapidly. Fortunately, at that time one of our Senators, John Sparkman, was ranking majority member on the Senate Committee on Foreign Relations. He would later become its Chairman (1975-1979). He was also one of the strongest supporters of President Johnson's Vietnam Policy, and a strong proponent of foreign assistance. He was also well aware of Auburn's contracts with USAID. Partly as a result of his involvement, our program 'weathered that storm,' and became even stronger afterwards. Until Sparkman retired in 1979, USAID was well aware of our International Center for Aquaculture and of his presence on the Senate Foreign Affairs Committee.

If I remember correctly, sometime in 1975 after Sparkman became Chairman of the Senate Foreign Relations Committee, Don Moss and I decided that we should visit with the Senator at his office and inform him of the progress that the International Center for Aquaculture was making in improving fish culture in developing countries. We contacted his staff, and of course, they were pleased that we would take the time to come to Washington to visit with him. At that time, we could fly out of Columbus early in the morning, conduct business in Washington, and fly back in the late afternoon. We duly appeared at his office at the appointed time, carrying our projector, a full slide tray and a portable screen. The Senator was delighted to see us. He sat

down in his large, comfortable office chair while we explained what we wanted to do. We turned off the lights and began our very good, well designed, lengthy presentation, and the Senator promptly went to sleep. He woke up just as we finished, and thanked us for coming. His staff had scheduled our presentation for his nap time. The Senator was approximately 75 years of age, and I am certain that he needed that short nap much more than he needed our presentation. Both Moss and I learned an important lesson that day – not everyone, everywhere was as enamored with our lengthy ‘dog-and-pony-show,’ as we were. I think that was the last time we ‘lugged’ our slide projector and portable screen to Washington.

THE ADMINISTRATION RELOCATES THE ICA

Sometime in 1988, Auburn’s Central Administration made the decision that ‘Centers’ could not be administratively housed within Departments. As a result, it was decided that the International Center of Aquaculture would be removed from the Department’s Budget and included in the recently established Budget of the Office of International Agriculture within the College of Agriculture. This development resulted in an important change in the Fisheries Program. When the Department of Fisheries and Allied Aquacultures was created in 1970, it was determined that the Department Head would also serve as the Director of the International Center for Aquaculture (ICA), and that the Director would select an Associate Director to assist him/her with the administration of the day-to-day activities of the Center. Sometime in late 1988, I was informed that the administration of the ICA would be removed from the Department, and that a new Director of the ICA would be named. Dean James Marion noted that I had the option of remaining Head of the Department, or becoming the new Director of the re-located ICA.

By the time the ICA was removed from the Department, there had been a ‘sweeping’ change in USAID’s development philosophy. Emphasis on long-term Mission-funded projects was largely in the past. In the late 70s, Auburn agreed to participate in the implementation of the AID-funded PD/A/CRSP. With this development, Auburn would end its predominate role in promoting international warm-water aquaculture development for the Agency. Henceforth, this role would be increasingly shared with an ever increasing number of other American institutions.

I do not remember any significant problems developing from this new administrative arrangement. Dr. Bryan Duncan was chosen as the new Director, effective February, 1989. Of course, he was well aware of all aspects of the Department’s Domestic and International Programs, having served as Associate Director after Don Moss retired. Further, he had been actively involved in ICA activities since 1975, when he came to Auburn to assist with some of our international training programs.

In 1991, the International Center for Aquaculture became the International Center for Aquaculture and Aquatic Environments (ICAE). The change was apparently made to better represent a broader perspective of the International Program in its new location in the College of Agriculture.

In 1998, the decision was made to employ someone with a background in Contracts and Grants to assist the Director of ICAE. Billy Earle, an employee of the University Office of Contracts and Grants (1992-1998), was chosen for the position. Billy, a native Alabamian, had been awarded a B.S. Degree in Industrial Relations by the University of Alabama in 1973. His initial responsibilities in the new position was to provide Contract and Grant support for the Director related to work that the Center was doing as part of the PD/A/CRSP, to meet the training needs of the American Soybean Association in aquaculture, and to administer the Tankersly Endowment.

Billy was assigned Room 221 in Swingle as an office. The Room also contained records of Contracts and Grants related to ICA's International Development activities. This collection had been established in 1973 by Don Moss.

When Bryan Duncan retired in 2005, Joe Molnar, Professor in the Department of Agricultural Economics and Rural Sociology, was appointed as Director of ICAE. At that point Earle was relocated to Comer Hall, along with all of the Contract and Grant Records. Fortunately, he maintained them until Schmittou began his work to document the evolution of Auburn's program in international aquaculture. Much of the information recorded and discussed in this entire Section is the result of their collaboration.

OFF-CAMPUS-BASED 'OUTREACH' PROGRAMS

As noted in a preceding Section most of the early outreach efforts were supported by personnel based on the Auburn campus; however, for a number of reasons it later became necessary to permanently locate personnel in other parts of the State in order to accomplish the objectives of the projects. These efforts were directed into two primary areas:

1. Outreach in Alabama's Coastal Zone
2. Outreach to the commercial catfish farming industry
 - a. Development of the Alabama Fish Farming Center
 - b. Initiation of local development projects

Auburn's first formal off-campus outreach effort related to the Fisheries Program began in 1974 when the Alabama Cooperative Extension Service appointed Dr. Billy Powell as Marine Advisory Agent and established an office for him on the coast in south Mobile County. Later, in 1988, the

University increased its commitment to outreach in the Coastal Zone by establishing the Alabama Marine Extension and Research Center (AUMERC).

Also as noted in a preceding Section, the commercialization of the catfish farming industry reached its final stage in Alabama in 1982, with the establishment of the STRAL Company processing in plant in Greensboro. Prior to that time, the involvement of the Auburn Fisheries Program in outreach to the industry was limited. Then in 1982, the Agricultural Experiment Station joined with several other governmental agencies to establish the Alabama Fish Farming Center in Greensboro. In 1988, the Cooperative Extension Service attempted to expand the industry to other parts of the State by establishing several local fish farming development projects.

OUTREACH IN THE COASTAL ZONE

As noted in the preceding paragraph, Auburn outreach in Alabama's Coastal Zone began formally in 1974. Some details related to the evolution of this prolonged effort follow.

DEVELOPMENT OF THE AUBURN UNIVERSITY MARINE EXTENSION AND RESEARCH CENTER (AUMERC)¹⁰

In 1974, ACES had assigned its first Marine Advisory Agent (Dr. Billy Powell) to work in Alabama's Coastal Zone. Over the years, as the Marine Advisory Program grew, additional personnel were employed to work in the Alabama Coastal Zone. Bill Hosking, Rick Wallace and Brian Perkins were extension employees with that program. Later, all three chose to accept academic rank and to become members of FAA. They were added to the FAA faculty in the 1989-1990 Academic Year. Their salaries and part of the salary for a secretarial position (Marianne Forrester) represented the first ACES funding in the FAA Budget. Since then, AUMERC has become an important element of Auburn's Fisheries Program. Some details of its early history and later development follow.

AUMERC – ITS EARLY HISTORY

Auburn's teaching, research and extension activities in fisheries, aquaculture and aquatic sciences in Alabama's Coastal Zone is now an important part of its on-going program. This has not always been true. For

¹⁰ Much of the information in these introductory paragraphs was obtained from personal comments by Dr. Powell and from material published in the November, 1974 and July, 1975 issues of *Sea Grant Newsletter*, published by the Cooperative Extension Service at Mississippi State University, Starkville, Mississippi.

several very practical reasons, the ‘Investigators’ of the early Fisheries Program were not involved in any way in marine fisheries; although Swingle took his class in ‘*Management of Impounded Waters*’ (ZY 620) to the Alabama Gulf Coast each summer, for several years, to observe oyster ‘tongers’ at work, to visit shrimp and blue crab processing plants, to learn something of shrimp boat characteristics and operation, and to visit the University of Alabama Marine Laboratory. There was no direct involvement in any phase of marine fisheries until well after the Department was created in 1970.

THE MISSISSIPPI INITIATIVE

In 1969, the Mississippi Legislature reorganized the administration of the various activities of the Gulf Coast Research Laboratory (GCRL) at Ocean Springs as a means of optimizing utilization of ocean related research and education resources of participating institutions of higher learning, by establishing the Universities Marine Center. GCRL had been established by the Mississippi Academy of Sciences in 1947 to provide courses of instruction in marine sciences to students from the institutions of higher learning in the State. Over time, institutions in other states requested permission to send their students for instruction, and in turn, agreed to accept credit for coursework completed there. By the early 70s, under the leadership of Dr. Gordon Gunter, GCRL was affiliated with well over 50 institutions throughout the country (Skupien and Shaw, 1997). The formal establishment of the Universities Marine Center was the first step ultimately leading to the creation of the Mississippi Sea Grant Consortium, as provided for under the National Sea Grant and Program Act of 1966.

ALABAMA COMES ‘ABOARD’

In 1971 the Alabama Legislature (Code of Alabama Title 16: Education-Chapter 45-Sections 1-4) established the Marine Sciences Environmental Consortium, with the purpose of providing “educational programs in marine sciences on both the graduate and undergraduate levels, to promote and encourage pure and applied research in marine sciences and related areas, to promote and encourage communication and dialogue among those interested in marine sciences.” Initial membership in the Consortium included Auburn University and 16 other institutions of higher learning in the State. The Legislature later ‘institutionalized’ the Consortium by providing funds for the establishment and operation of the Dauphin Island Sea Lab (DISL) as Alabama’s marine science education and research center. The Lab is housed in a surplus Air Force radar station facility on the eastern end of Dauphin Island; one of the State’s barrier islands in the Gulf of Mexico (Crozier and Dardeau, 2012).

THE MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM IS 'BORN'

Shortly after the creation of the Alabama Marine Environmental Sciences Consortium in 1971, discussions were begun between this group and the Mississippi Sea Grant Consortium regarding the establishment of a two-state Sea Grant Consortium (Crozier and Dardeau, 2010). The two groups quickly agreed to merge elements of their programs, and in June 1972, the National Sea Grant office accepted their petition to officially establish the Mississippi-Alabama Sea Grant Consortium. It would be the first bi-state program in the nation.

Initially the bi-state Consortium consisted of eight institutions of higher learning in the two states: Auburn University, the Gulf Coast Research Laboratory, Mississippi State University, Tuskegee University, the University of Alabama, the University of Alabama-Birmingham, University of Mississippi, University of South Alabama and University of Southern Mississippi. Note that neither the Alabama's Marine Environmental Sciences Consortium nor its Dauphin Island Sea Lab were included. Dr. Sidney D. Upham, a marine pharmacologist, was chosen as its first Director.

Shortly after I became Department Head in 1973, I was asked to serve as Auburn's representative on the Board of Directors of the Bi-State Consortium. It was quickly obvious that this was not a wise decision. All of the other universities were represented by Vice Presidents, who were in a position to discuss the commitment of university resources. Obviously I was not in a similar position. As a result, I requested that I be replaced, and soon Dr. Gene Bramlett, Vice President for General Extension at Auburn, became the University's representative.

When Mississippi established its Sea Grant Consortium, it provided substantial funding for its operation. Unfortunately, Alabama never had a Sea Grant Consortium; consequently, there were no funds available for the operation of its share of the bi-state program. Further, the cooperating institutions in the State, at least initially, did not appear interested in directly supporting its operation, and since they had just secured funding for the establishment of the Marine Environmental Sciences Consortium and the development of the Dauphin Island Sea Lab, they apparently were not interested in going to the Legislature again for funds for yet another marine institution. Consequently, for several years there were no funds available from Alabama for the direct support of the activities of the bi-state program.

THE 'RED' BAMBERG AND BILLY POWELL 'EPISODE'¹¹

In 1972, Robert C. "Red" Bamberg was serving as the Director of the Alabama Development Office. He was also a member of the Auburn University Board of Trustees, and had been since 1956. Early in 1972, Bamberg called Dr. Ralph Jones, Director of the Alabama Cooperative Extension Service in Auburn, with a plea that he quickly find someone to establish an Alabama Sea Grant Advisory Service Office on the coast; otherwise, the State was going to lose a \$250,000 grant.

In 1974 Billy Powell, a native of Washington County with a Ph.D. Degree in Meat Science from Auburn University, was serving as State Extension Specialist in Food Science. Shortly after receiving Bamberg's call, Director Jones called Dr. Powell to his office to tell him that he was about to move to Mobile to become a Marine Advisory Specialist, working with the seafood industry. Powell commented that he didn't know much about seafood. Jones reminded him that he was a food scientist and that seafood was indeed food. By July, Powell and his family were in Mobile.

Dr. Powell soon learned that as a "govement" man, quickly establishing good working relationships with the insular seafood industry in Bayou La Batre, was a difficult task. Fortunately, Laverne Deakle, a native of that area, was serving as Assistant County Agent at that time in Mobile County, and he knew everyone. With Deakle 'running interference,' Powell was able to begin to work effectively with the other private and public 'players' in Alabama's coastal zone economy. Within a short period of time, he was appearing on food shows on local television stations, sharing great seafood recipes and talking about the Sea Grant Program. Later, working through the Small Business Administration, he was able to help secure approximately \$315,000 in emergency loans for fourteen shrimp boat operators, suffering from excessively high fuel prices. Still later, he published the *Alabama Charter Boat Directory*, which included information on forty charter boats operating in Baldwin and Mobile Counties. In the fall of 1974, he began to work with the Bayou La Batre Chamber of Commerce and the local Catholic Church to plan the details for the first Alabama Seafood Festival to be held in Bayou La Batre, in June, the following year. Powell vacated the Marine Advisory Service Position in 1975 to enter private business, but in this relatively short period of time, he established a strong, clear, and effective Auburn presence in the Mississippi-Alabama Sea Grant Program and in Alabama's costal economy. Later, in 1984, he would become Executive Vice President of the Alabama Cattlemen's Association.

¹¹ Much of the information in these introductory paragraphs was obtained from personal comments by Dr. Powell and from material published in the November, 1974 and July, 1975 issues of *Sea Grant Newsletter* published by the Cooperative Extension Service at Mississippi State University, Starkville, Mississippi.

EARLY 'CONSORTIUM' STAFF CHANGES¹²

As detailed in a preceding paragraph, Dr. Billy Powell vacated the position of Alabama Marine Advisory Specialist in 1974, and it was not filled until the fall of 1977 when Dr. Mac V. Rawson was appointed to the position. Dr. Rawson had received the B.S. Degree in Fisheries Management from Auburn in 1967 and an M.S. Degree in 1969. He did his thesis research on fish parasites under the direction of Bill Rogers. Later, he was awarded the Ph.D. Degree by the University of Georgia. Rawson was considered to be the Alabama Sea Grant Advisory Leader. In 1981, he vacated the position to take a similar one with the University of Georgia Sea Grant Program. Later, he became Director there. In 1981, Wallace Calhoun was appointed to the position of Marine Advisory Specialist (Fisheries) to replace Rawson. Wallace had received a B.S. Degree in Fish Management from Auburn in 1979, and in 1981, he had received a M.S. Degree. His thesis work on the biology of sex-reversed tilapia was supervised by Bill Shelton. He did not remain in the position very long. He quickly became frustrated trying to work in the 'no-man's-land' between the Coastal Conservation Association and the commercial 'gill-netting' industry.

In June, 1983, Dr. Richard Wallace was employed to replace Calhoun. Wallace had received a B.S. Degree in Zoology from Ohio Wesleyan University in 1968 and a M.S. Degree in Fish Ecology and Ichthyology from the University of Puerto Rico in 1975. Then in 1982, he was awarded the Ph.D. by Auburn University. At Auburn, he had worked under the direction of John Ramsey, who was serving as Leader of the Cooperative Fisheries Research Unit at that time.

In 1976, Dr. James I. Jones became Director of the Mississippi-Alabama Sea Grant Consortium. Under Jones' leadership, the Consortium made rapid progress in achieving its goals, and in 1982, it was awarded the status of a National Sea Grant College. Jones was also able to convince the Washington Office that the Consortium needed more funds to meet its obligations. As a result, in October, 1977, funds were made available for Auburn to employ Dr. William Hosking as a Marine Resource Economist. The National Sea Grant Office provided 75 percent of the funds for his salary and the Alabama Cooperative Extension Service provided 25 percent. Bill Hosking had been awarded the B.S. Degree in Forest Resources and the M.S. Degree in Agricultural Economics by the University of Georgia in 1972 and 1975, respectively. Later, in 1977, he received the Ph.D. Degree in Agricultural Economics from the same institution.

In the early 80s, funds were made available for the Alabama Cooperative Extension Service to employ a sea food technologist. Bob Collette, from

¹² Much of the information in this Section was developed by 'Rick' Wallace before he retired. Some of the more recent information was supplied by LaDon Swann.

Rhode Island, was employed in this position in 1984. He vacated the position in 1985, and Brian Perkins was employed to replace him. Brian had been awarded the B.S. Degree in Biology, in 1975, by Georgia State University and the M.S. Degree in Food Science by Louisiana State University in 1977. Brian remained in the seafood technology position until his untimely death in 2002.

AUBURN GETS SERIOUS ABOUT THE COASTAL ZONE

In December, 1987, I met with Drs. Parks, Thompson and Frobish to discuss the status of Auburn's Marine Program. Later, Dr. Paul Parks contacted me regarding the possibility of establishing a research presence in marine recreational fishing in Alabama's coastal zone. Remember that there had been an Extension Service presence there since 1974. Subsequently, in February, 1988, Dr. Parks and I flew to Mobile to meet with local business leaders concerning the establishment of the program. That group was very supportive of Parks' proposal.

As detailed in a preceding Section, during the period 1988-1989, the University made the decision to merge Extension Specialists with their counterparts in the various subject matter Departments, and it gave them considerable freedom in deciding which Department to join. Hosking, Wallace and Perkins made the decision to join FAA. With this decision, it was decided that, for administrative purposes, a new administrative 'unit' should be created within the Department to 'contain' these 'new' employees and their activities. Consequently, the Auburn University Marine Extension and Research Center (AUMERC) was established in 1988. Its primary mission was to "apply scientific discovery through a responsive Extension program to address the long-term needs of the coastal economy, environment and society."

The Center focuses its outreach into four primary areas:

1. Safe and sustainable seafood supply.
2. Healthy coastal ecosystems.
3. Hazard resilient coastal communities.
4. Sustainable coastal development.

THE AUMERC OFFICE

In the early days, Auburn's Sea Grant Program had an office some place in Mobile. Unfortunately, no one seems to remember where. After Bill Hosking was employed, those quarters were no longer suitable. Apparently, he was assigned the responsibility of finding new office space.

There is no indication of how long or hard he searched before locating space in the rear portion of a private club/lounge on Government Street. Regarding this location, Rick Wallace commented:

“He seemed to know the owner of the building, and I think the price was right.’

After the establishment of AUMERC with its research responsibilities, the Government Street location was no longer adequate, so in 1989, the Center moved to a location on Commander’s Drive on the abandoned air base from the University of South Alabama, who had acquired the buildings sometime after Brookley Air Force Base was closed. Later the office was moved into downtown Mobile. It is currently located in Suite 800 of an office building at 118 North Royal Street. The location is approximately two blocks north of the Battle House and about the same distance north of Bienville Square.

AUMERC FACULTY AND ASSOCIATES

As noted in a preceding Section, the Department of Fisheries and Allied Aquacultures did not have a formal responsibility in Alabama’s Coastal Zone until the Auburn University Marine Extension and Research Center was established in 1989. Hosking and Wallace first appeared in the FAA Budget in FY ’90 (1989-1990). Brian Perkins was added in 1990-1991. Then in 1990, we hired the first Research Associate for the AUMERC research team – Lance Robinson. Unfortunately, he did not remain with the program very long. Then on January 1, 1991, Scott Rikard joined the group. The current members of the Staff and Associates are listed below, along with additional information regarding their responsibilities.

LaDon Swann

Bill Hosking retired in 1999. At that point he was serving as Extension Marine Economist. In addition, he served as coordinator of AUMERC’s day-to-day activities. His position was not immediately re-filled. Then, in 2000, the University hired Dr. David LaDon Swan as an Assistant Research Professor. LaDon had been awarded the B.S. Degree in Wildlife and Fisheries and the M.S. Degree in Biology by Tennessee Technological University in 1982 and 1985, respectively. In 1989, he went to work as the Aquaculture Extension Specialist for the Illinois-Indiana Sea Grant College Program. While in that position, he completed all requirements for the PhD. in Adult Education. The Degree was awarded in 1999. Soon after joining AUMERC, LaDon was appointed Associate Director of the Mississippi-Alabama Sea Grant Consortium. Later, he served as Interim Director for 10 months, and in 2002, was appointed Director. In his present capacity, he coordinates the day-to-day activities of AUMERC and also serves as the Director of the Mississippi-Alabama Sea Grant Consortium.

Glen Chaplin

Glen (Research Associate III) assists with the Oyster Hatchery Research Program.

Lisa Pogue

Lisa serves as Administrative Support Assistant II, ACES/AAES.

Scott Rikard

Scott (Manager, Agriculture and Natural Resources Programs) received the B.S. Degree in Marine Biology from Auburn in March, 1988. Afterwards, he worked for a short period on various tasks in the coastal zone before returning to Graduate School in Auburn. He currently is involved in the research program of the Auburn University Shellfish Laboratory and manages its 'day-to-day' operations.

Jody (Scanlan) Thompson

Jody (Administrator II, Outreach Programs) joined AUMERC in 1999 as an Ag Program Assistant I. She was awarded the B.S. Degree (Biology and Marine Sciences) by the University of Alabama in 1997 and the M.S. Degree (Instructional Design and Development) by the University of South Alabama in 2005. She has been involved in a number of activities in Coastal Community Development, Land Use and Coastal Hazards. She has played a leading role in developing management plans for several bodies of water in the coastal zone. These include Bon Secour River, Little Lagoon, Dog River and Threemile Creek.

Bill Walton

In January, 2009, the University employed Dr. William C. Walton to serve as Marine Extension Specialist with AUMERC. The Center had not had a person in that position since Rick Wallace retired in 2008. Dr. Walton was awarded the B.S. Degree in Biology by Tufts University in 1991, the M.S. Degree in Ecology and Evolution by Rutgers University in 1993 and the Ph.D. Degree in Fisheries Science by the University of Maryland in 2003. An extensive description of the activities of his Work Group is presented on his 'Walton Lab' web-site.

P. J. Waters

P. J. joined AUMERC in February, 2002, on AAES funding. He had received both the B.S. (1999) and M.S. (2001) Degrees at Auburn. He had previously worked with Ron Phelps at Claude Petet on the Red Snapper

Spawning Project before joining AUMERC. Then in July, 2007, he joined the Outreach Group in AUMERC as an Extension Specialist. He works with the Center's K-12 Aquaculture/Aquascience Programs, and with oyster restoration (Oyster Gardening and the Oyster Trail). He is also responsible for the School's outreach efforts in support of owners of recreational fish ponds in Southwest Alabama.

Chandra Wright

Chandra Joined AUMERC in 2013 as an Administrator III, Outreach Program. She is a native Alabamian. She was awarded the B.A. in Political Science by the University of Alabama (1992), and the J.D. from the University of Alabama School of Law in 1995.

With AUMERC, she serves as an Outreach Administrator in SFAAS with the specific job title of Nature Tourism Specialist. She works with various nature-based businesses in coastal Alabama in an effort to help them enhance their 'bottom-lines.' In this effort, she works with a broad range of enterprises including: the 'charter-for-hire' fishing fleet, nature cruise operators, outfitters who provide support services for fishermen, 'bikers,' 'birders,' SCUBA divers and 'paddling' enthusiasts. She also provides technical assistance to several non-profit groups, such as the Alabama Gulf Coast Reef & Restoration Foundation and the NUISANCE Foundation.

BOATS

Through the years the Mississippi-Alabama Sea Grant Consortium had received little, if any, research funding from Auburn, but with the establishment of AUMERC, that situation quickly changed, and one of the first things that had to be done was to deal with the group's boat situation. For all practical purposes, when it was created, AUMERC had no boats that could be used in research. As a result, we requested funds for the construction of a boat with the capacity, power and range to work throughout the in-shore waters of Mobile and Baldwin Counties. Late in 1988, we received permission to purchase one. Later, we contracted with Mike McCarty of Silver Ships in Theodore to design and build it. In May 1989, the *Silver Eagle* was delivered, and it was a 'beauty' – 25 feet in length, including the fantails, 8 feet wide at the gunwales, 7 feet on the deck with a draft of 15 inches. It would literally float on 'wet-grass.' It was ideal for a wide range of research activities in the relatively shallow waters of Alabama's Coastal Zone. Then almost a decade later, in May, 1998, the *Dr. Bill* was added to the Center's 'fleet.' It was similar in size to the *Silver Eagle*. Although it was generally similar, it soon became the vessel of choice for most of the field work.

As detailed in a preceding Section in 2005, another work boat – the *Mary Lou*

– (*Figure 110*) was added to Auburn’s fleet of vessels for working in the Coastal Zone; however, it was acquired primarily for the use of the Szedlmayer Work Group. Finally, the *RV John Jensen* was purchased in 2012 from Henriques Boats in New Jersey. It is 38 feet in length with a full cabin. It is fitted with all the facilities for lengthy trips away from port. It is powered with a 3028 Caterpillar diesel engine and contains all of the equipment needed for virtually any marine-related ecological research in the Northern Gulf. It is also used primarily by the Szedlmayer Work Group

AUMERC also operates a variety of other ‘working’ boats, but those listed above are used for most of their activities that require travel in the larger bays and the open Gulf.

DEVELOPMENT OF THE OYSTER HATCHERY

In a preceding Section, I described some of the Department’s early interest and efforts in oyster farming research in Alabama’s Coastal Zone. Although we encountered numerous problems in that early work, it appeared that oyster farming still had considerable potential. Recall that in the early 90s, Representative Taylor Harper from Grand Bay, who was serving as the Chairman of the Ways and Means Committee in the Alabama House, with considerable encouragement and assistance from ALFA, began to assist the Department with some minor funding needs through Line Item appropriations in the Education Budget. Sometime during this period we visited with him at his home in Grand Bay to discuss the possibility of obtaining a Line Item for the purpose of establishing an Oyster Aquaculture Laboratory in Mobile County. He readily agreed that he would be happy to support any effort that might increase oyster production in Alabama’s Coastal Zone. Subsequently, in 1991, a Line Item appropriation specifically designated for the construction of a Shellfish Laboratory was included in Auburn’s budget.

Early in 1992, I notified the Administration of our intention to begin to pursue this matter. By September, 1993, we had identified what we thought was a suitable site on property owned by the Mobile Diocese of the Catholic Church, adjacent to Portersville Bay, southeast of Coden. We were especially interested in that area because of good water quality in the Bay and the fact that there was some natural oyster production there. By the time that I retired in 1994, we were actively involved in the details related to the purchase of the property. Fortunately, after I retired, Bill Rogers, David Rouse and John Jensen took a closer look at this site and identified several potential problems that we had not fully considered earlier. As a result, it was decided to look for another site. This change in plans resulted in considerable consternation among local officials who had become deeply interested in the development of the project.

Later, it was determined that land was available for long-term lease adjacent to the physical plant of the Dauphin Island Sea Lab on the south side of the island. This site is closely adjacent to a water source of exceptional quality. It is also near the Estuarium. Location of the hatchery there provides numerous opportunities for cooperative efforts among a number of scientists involved in research and education in the Coastal Zone. The oyster hatchery, with its associated laboratories, was dedicated as the Auburn University Shellfish Laboratory (Figure 100) in April, 2003.

The Laboratory has an active, on-going research program on all phases of oyster spawning, hatching and rearing. Details on their activities and accomplishments were described in a preceding Section.

AUMERC OUTREACH PROJECTS

As detailed in a preceding Section, the relationship between AUMERC and the Mississippi-Alabama Sea Grant Consortium (MASGC) is somewhat complex. LaDon Swann serves as Director of both. AUMERC is an integral part of the Auburn University School of Fisheries, Aquaculture and Aquatic Sciences, and at the same time, it is part of a Consortium of Mississippi and Alabama Institutions of Higher Learning. Other than LaDon, several other AUMERC Staff are also listed as MASGC Staff. Further, the goals of both are essentially the same. Both have research and extension programs. The primary efforts of MASGC Outreach are focused on the following general areas:

1. Sustainable fisheries and aquacultures.
2. Healthy coastal ecosystems.
3. Resilient communities and economies.
4. Environmental literacy and workforce development.

Other AUMERC outreach projects include the Northern Gulf Sentinel Site Cooperative and the National Water Center Extension Program. These specific projects are included within the larger MASGC programs. Still others more specifically targeted Alabama concerns.

COMMERCIAL OFF-BOTTOM OYSTER PRODUCTION

Research conducted by AUMERC Faculty on oyster production was described in a previous Section, but the project effort also has a significant outreach component. In working to develop off-bottom commercial oyster farming in Alabama and across the Gulf of Mexico region, Bill Walton's extension Work Group has assisted a variety of stakeholders,

including established, new and potential oyster farmers; commercial fishermen; state and federal agency representatives; scientists; chefs; writers and consumers in understanding the potential and problems of the growing industry.

They have worked with oyster farmers on how they can protect public health, improve product quality, and other related issues. Additionally, the Group has worked with chefs and writers to broadly promote recognition of the availability and quality of 'farmed' oysters, and encouraging oyster farmers to pursue individual 'brands' or appellations for their crop. This effort has generated interest across the U.S. in premium, farm-raised oysters.

In addition, the technology transfer program has worked with a range of regulatory agencies, including the U.S. Army Corps of Engineers, U.S. Coast Guard, Alabama State Lands, Alabama Marine Resources Division, and Alabama Department of Public Health, to streamline the permitting process. The Governor's Shellfish Aquaculture Review Board (Bill is a member of this Board), was tasked with making the permitting process clear and affordable to applicants. The Board has agreed on a process that did appear to lead to an increase in permitted farms. However, as questions and concerns arose, these will be addressed, and is likely an ongoing task.

THE OYSTER TRAIL

As detailed in a preceding Section, the Oyster 'Gardening' Project is a primary activity of the current AUMERC Outreach Program. Originally developed in the Chesapeake Bay, it provides an opportunity for a large number of local volunteers to get involved in oyster restoration in Alabama's Coastal Zone. The Program has been in operation since around 2001. Specific details on its operation were discussed in a preceding Section (Oyster Reef Restoration).

The 'Oyster Trail' is a special activity associated with the Oyster Gardening Program, and is co-ordinated by volunteer Marie Dyson. The 'Trail' is a scavenger hunt marked with 26 stops in Mobile and Baldwin Counties (Gulf Shores/Orange Beach to Dauphin Island). Each stop is marked by a large 'Oyster Shell,' painted on plywood by a local artist. Each 'Shell' is sponsored by a local business, and carries a '*fact plaque.*' Maps of the 'Trail' are available 'on-line,' and carry questions about the importance of the oyster industry. Answers to those questions are to be found on the '*fact plaques.*' Visitors from across the country and from Europe and South America have followed the 'Trail.' After answering as many questions as possible, they can return their completed forms for 'prizes.' Funds obtained from the giant 'Oyster Shell' sponsors are used to help fund the Oyster Gardening Project.

COASTAL NATURE-BASED TOURISM

As detailed in a preceding Section, activities related to this Project are supervised by Chandra Wright.

RECREATIONAL POND MANAGEMENT OUTREACH

The Alabama Cooperative Extension System (ACES) has assigned AUMERC the responsibility of assisting recreational pond owners in southwest Alabama with their management problems. P. J. Waters has been assigned the responsibility for coordinating this activity. He is part of a team that includes 'Rusty' Wright and David Cline on campus. Together, they provide the response of the ACES to this group of stakeholders in the State. All three are members of the faculty and staff of the School of Fisheries, Aquaculture and Aquatic Sciences; however, all or part of their positions are supported by ACES funds. P. J. regularly responds to requests for information from individual pond owners; however, he responds to most of his requests through participation in ACES-sponsored Pond Management Workshops in the different counties in the southwest corner of the State.

THE ALMA BRYANT HIGH SCHOOL AQUACULTURE PROJECT

As noted in a preceding paragraph, the decision to seek a new location for the Shellfish Laboratory resulted in considerable excitement and concern among the elected officials in South Mobile County. After a year of discussion, as we looked for a suitable site in that area, they were really looking forward to the establishment of the facility near Bayou LaBatre. The South Mobile County Educational Foundation (SMCEF) was especially disappointed when they learned that we had tentatively selected a site on Dauphin Island. They had expected that the proposed research facility would be especially beneficial to the teaching program in the new high school (Alma Bryant) being developed at Irvington, between Grand Bay and Bayou La Batre. Alma Bryant opened in September, 1998. John Jensen was Department Head at that time. He, David Rouse and Rick Wallace suggested that students from the new school would still be welcome at the Dauphin Island facility, and that in addition to having them come to Dauphin Island, Auburn would take the 'laboratory' to them as well.

This proposal was extremely appealing to Alan Horne and SMCEF. Immediately they began to solicit funds to establish an aquaculture teaching facility at the new school. Shortly after it opened, the aquaculture teaching program was ready to accept its first students. The Department of Fisheries and Allied Aquacultures played a leading role in developing the curriculum and working closely with school personnel as the facilities and program developed. Lisa Walsh, a science teacher at the school, was chosen as the first Director of the program. Later (2000), Julian Stewart would assume that

responsibility.

The goals of the new program were:

1. Keep students in school.
2. Stimulate interest in science/technology.
3. Hands-on learning by doing the 'real thing.'
4. Demonstrate to students practical applications of biology, math, physics and chemistry.
5. Help develop aquaculture opportunities by using commercially important species.

The Alma Bryant Project was wildly successful. Students literally swarmed to it. Soon, additional facilities had to be added to handle the 'over-flow.' It was so successful that it soon attracted state-wide and nation-wide attention, and was quickly being duplicated throughout the state and the country. Within a short time, similar programs were being installed in high schools in Mobile and Baldwin Counties (Fairhope, Citronelle, Daphne, Gulf Shores, Robertsdale, etc.) and throughout the State (Cedar Bluff, Fyffe, Demopolis, Greensboro, Billingsly, Wetumpka, Florala, etc.).

Through the years, students have been exposed to various aspects of the biology and culture of a number of species of aquatic animals, including:

- Cobia
- Red claw crawfish
- Koi carp
- Redfish
- Oysters
- Red snapper
- Rainbow trout
- Tilapia
- Red swamp crawfish
- Marine shrimp

In 2008, the Alma Bryant Program received its first funding from the U.S. Department of Agriculture for conducting research in applied aquaculture. Later, the Program would expand into the "real world" when its students began to participate in the successful Oyster Gardening Program being managed by P. J. Waters at AUMERC.

THE 'CASH' PROJECT

In 1996, the personnel at AUMERC began work on the 'CASH' (Coastal Alabama Seafood Harvest) 'Outreach' Project. Its goal was to develop and disseminate sound, sustainable brackishwater aquaculture technology. In the initial planning for the Project, it was estimated that it would require 3 years to complete and that it would cost \$3 million. Congressman Callahan's office had planned to get \$1 million each from three agencies (Sea Grant, EPA and USDA). Unfortunately, only NMFS/Sea Grant provided any money. They funded the Second Phase of the larger project, which emphasized shrimp production in brackishwater ponds. All of the research was conducted at the Alabama Marine Resource Division's, Claude Petet Mariculture Research Station in Gulf Shores. The first research was initiated in May, 1996, with David Rouse as the Project Leader and Bill Hosking as Co-Project Leader.

While the primary emphasis was on research and extension related to shrimp production, the 'Investigators' also devoted some effort to encourage the development of bait production in brackishwater ponds. They also spent a considerable amount of time in assisting Alma Bryant High School in Bayou La Batre in the establishment of a 'hands-on' aquaculture teaching program for students at the school. This effort was described in considerable in a preceding paragraph.

On completion of Phase II, Rouse and Hosking issued a Project Completion Report: Coastal Alabama Seafood Harvest (CASH – Phase II). Some of the publications resulting from research completed under this project were listed in a preceding Section on the production of marine shrimp.

AUMERC OUTREACH PUBLICATIONS

AUMERC personnel have produced a large number of publications for educating various groups of stakeholders in Alabama's Coastal Zone. I have included the titles of only some of them as a means of describing some of the types of work that they do. Most of them also carry Mississippi-Alabama Sea Grant Consortium Publication Numbers. Complete citations for these publications are given in the LITERATURE CITED Section. These numbers are also included where applicable.

1. Oysters in Alabama (Wallace, 1993).
2. Stovetop seafood cooking (Perkins, 1994).
3. Basics of saltwater shrimp farming (Wallace and Rikard, 1996a).
4. Saving your catch (Perkins, 1996).

5. **Aquacultured oysters (Perkins, 1997).**
6. **Grilling Alabama seafood (Wallace, 1997).**
7. **Growing bull minnows in Alabama (Wallace and Rikard, 1996b).**
8. **The citizen's guide to reducing polluted runoff in coastal Alabama (Scanlan, et al., 2001).**
9. **Oyster gardening in Mobile Bay (Waters, 2003).**
10. **Blue crabs in Alabama (Wallace, 2005a).**
11. **Red drum in Alabama (Wallace, 2005b).**
12. **Aquaculture of bait shrimp on the Gulf Coast (Waters, et al., 2006).**
13. **Spotted sea trout (Wallace, 2006).**
14. **Off-bottom oyster farming in the Gulf of Mexico: evaluation of start-up costs and labor requirements of different aquaculture gear in side-by-side comparison (Chaplin, et al., 2011).**
15. **Evaluation of a mechanical grader for the Improvement of the aquacultural production of the Eastern oyster, *Crassostrea virginica*, in the northern Gulf of Mexico (Coddington-Ring, 2012).**
16. **Off-bottom oyster farming (Walton, et al., 2012a).**
17. **Effects of basket arrangement and stocking density when using the adjustable long-line system for oyster grow-out (Davis, 2012).**
18. **Gulf Coast off-bottom oyster farming gear types: adjustable long-line system (Davis, et al., 2012a).**
19. **Gulf Coast off-bottom oyster farming gear types: bottom cages (Walton, et al., 2012b).**
20. **Gulf Coast off-bottom oyster farming gear types: floating cage system (Davis, et al., 2012b).**
21. **Gulf Coast off-bottom oyster farming gear types: floating bags (Walton, et al., 2012c).**
22. **Template for Alabama Public Health Oyster Farm Operational Plan (Walton and Rikard, 2013).**

These and a number of related publications are available for review on the ALEARN web-site. Search for 'Marine Resources.'

OFF-CAMPUS OUTREACH TO THE CATFISH FARMING INDUSTRY

As detailed in a preceding Section, the formal involvement of Auburn's Fisheries Program in outreach to the commercial catfish farming industry was limited until 1982, when the Agricultural Experiment Station joined several other governmental agencies to establish the Alabama Fish Farming Center. Then in 1983, the Department employed Larry Hanson as a Research Associate in Fish Health. He was assigned to the Center to work with fish farmers on their fish disease problems. The involvement of the Department and now the School in the activities of the Center have grown substantially since.

In the late 80s, the Cooperative Extension Service decided to make a special effort to expand the commercial catfish farming in the State. Consequently, they established several local development projects in different areas. They also assigned personnel to those locations. Some details on the progress and results of these major outreach efforts (the Center and local projects) are also presented in the following Section.

DEVELOPMENT OF THE ALABAMA FISH FARMING CENTER¹³

The Alabama Fish Farming Center is an off-campus, Auburn University extension (outreach) program meeting a specific need for technology transfer to the commercial catfish farming industry. In the early 1980's, the industry was growing rapidly in Hale and several of the surrounding counties. Elvin Wright, Conservationist for the Hale County Soil Conservation District, although not a professional engineer, had been extremely active in the area for some time, assisting farmers with pond design and construction supervision. During the same period, Dave Kelly, SCS State Soil Conservation Service Biologist, was active in providing assistance in water quality management to catfish producers. Soon, it became obvious that the industry was in dire need of expanded technical support, especially in the areas of fish health, pond construction and pond management.

¹³Greg Whitis, Extension Aquaculturist with the Fish Farming Center, provided much of the information for the Section.

THE ALABAMA FISH FARMING CENTER 'TASK FORCE'

To seek ways to meet the rapidly growing needs for technology transfer, the Alabama Fish Farming Center Task Force was established, with J. Michael Sprott, Director of the Alabama Cooperative Extension Service, as its Chairman. Bob Gay, Chairman of the Alabama Soil and Water Conservation Committee (ASWCC) was also a member. In 1982, with the support of Senator Ed Robertson of Tuscaloosa County, the legislature agreed to provide funding for the establishment of a Fish Farming Center in Hale County. Its primary purpose was to meet the growing needs for additional technology for the industry. Initially, \$200,000 was appropriated to the Alabama Soil and Water Conservation Committee (SWCC) to establish it. Because of proration that year, the Committee received only \$170,000.

ESTABLISHING THE CENTER

In the fall of 1982, using the funds provided by the Legislature, the Committee contracted with the Alabama State Office of the USDA's Soil Conservation Service (\$23,500) for the services of a Civil Engineer to assist with the growing demand for help with pond design and construction, the Alabama Cooperative Extension Service (\$23,500) for the services of an Area Specialist Agent – Aquaculture, and the Alabama Agricultural Experiment Station (\$23,500) for the services of a Research Associate – Fish Diseases. The Hale County Soil and Water Conservation District also received funding (\$32,000) for expenses (rent, secretarial services, utilities, supplies, etc.) related to the day-to-day operation of the Center. It was agreed by the Task Force that the management of 'day-to-day' operation of the Center would be the joint responsibility of the Alabama Agricultural Experiment Station, the Alabama Cooperative Extension Service and the Soil Conservation Service. The Center was formally established on October 1, 1982.

With base funding made available by the Alabama Soil and Water Conservation Committee, four persons were employed to assist fish farmers with the formal establishment of the Center: Steve Brown – Area Specialist Agent; Keith Penrod – Agricultural Engineer; and Mary Britton – Secretary. Cecil Cothran served as Technician for the Engineer. Shortly after the Center was formally established, Larry Hanson was employed as the Research Associate – Fish Diseases.

Early in 1983, the Center moved into the renovated Hale County Farmers Market Building. Keith Penrod did not remain with the Center very long. He was soon replaced by Larry McCray (1984-1987). Then Perry Oakes (1987-1991) replaced McCray. Later, in 1985, William 'Bill' Hemstreet replaced Hanson when Larry decided to continue his graduate education.

Bill Hemstreet is a native Floridian. He attended Valdosta State College, and

was awarded the B.S. Degree in 1970. During the period 1970-1972, he served as a Peace Corps Volunteer in Sarawak, Malaysia. While there, he worked as a secondary school teacher. Afterwards, he spent a year (1973) as an ordinary seaman with the U.S. Merchant Marine.

In 1976, he entered the graduate program at Auburn and was awarded the M.S. Degree in 1978. After receiving the M.S. Degree, he worked for a time (1980-1982) as an Environmental Supervisor with AMAX Chemical in Lakeland, FL and as a Senior Environmental Technician (1983-1984) with Gurr & Associates, Scientists and Engineers, Inc., also in Lakeland.

In 1987, Steve Brown decided to leave the Center to enter private business. He was replaced by Gregory N. Whitis. Gregory is a native of Iowa. He joined the U.S. Marine Corps out of high school, serving during the period 1975-1978. Later, in 1980, he was awarded the B.S. Degree by Iowa State. After a semester at the Gulf Coast Research Laboratory in Ocean Springs, MS, he enrolled in the graduate program at Auburn in 1981. After completing all of the required course work and a 2-year apprenticeship as a 'fish head' with Randell, he was awarded the M.Aq. Degree in 1983. Soon afterwards, he was employed to manage the Pearce Catfish Farm in Browns (Dallas County).

In 1986, Gayle Barnette, employed by the Hale County Soil and Water Conservation District, joined the Center staff as Administrative Assistant.

THE RICHARD AVERY BUILDING

By 1990, it was obvious that the space available in the renovated Hale County Farmers Market Building was no longer meeting the needs of the Center. As a result, Richard Avery, retired three-time Probate Judge of Hale County, took the lead in an effort to secure funding for a new facility. It was estimated that it would cost between \$170,000 and \$200,000. A substantial amount of the required funds (\$100,000) were borrowed from the Alabama Farmers Market Authority, repayable over 20 years, interest free. Substantial amounts of additional funds were donated by the Industrial Development Board of Hale County, the West Alabama Catfish Producers Association, and the Alabama Catfish Producers. Smaller amounts and in-kind contributions were provided by a large number of local groups and agencies. The largest 'in-kind' donation was provided by Charles Farquhar (now deceased), Superintendent of the State Cattle Ranch, a minimum security prison in rural Hale County. He agreed to provide the services of inmate carpenters, plumbers and painters, free of charge. Center staff were responsible for picking-up and returning inmates, providing their lunches, and more or less supervising their activities in the absence of correctional officers. Center personnel moved into the newly completed Richard Avery Building on May 29, 1992 (Figure 103). The cost of the new facility (5658 square feet) which featured spacious labs, offices, a one hundred seat auditorium and fully-

equipped kitchen was less than \$250,000 – a testament to Avery’s abilities in getting donations and ‘in-kind’ services from the community.

Later, the Center purchased a Recreational Vehicle (Figure 104). It was outfitted as a ‘laboratory on wheels.’ It enabled Center personnel, especially those working with fish health, to operate effectively away from the Avery Building. The vehicle was purchased in 2004, but it was not completely outfitted until 2005. Bill Kyser, Auburn Fisheries Alum and catfish producer, graciously welded tow hooks on the front of the RV in the event of a mishap while negotiating muddy levees.

In 2003 as a result of persistent problems with fish-eating birds, namely the double-crested cormorant, the U.S. Department of Agriculture (Animal and Plant Health Inspection Service’s Wildlife Damage Control, now Wildlife Services) rented space in the Richard Avery Building and located a Wildlife Biologist and several technicians there to assist farmers with their bird predation problems.

CENTER FUNDING CHALLENGES

The Alabama Soil and Water Conservation Committee (ASWCC) was largely responsible for major administrative oversight and was the largest source of operational funding of the Alabama Fish Farming Center. Two major funding crises occurred in 1992-1993 and 2003-2004. At one point, the senior staff wondered whether they’d be padlocking the doors at the end of fiscal year 2004. All the support staff had been terminated due to lack of funding in October of 2003.

To bring this into better perspective, the ASWCC was originally allocated \$170,000 in 1983 for the total budget of the Fish Center. Minus salary appropriations of \$70,500, remaining operating monies amounted to \$104,500. In 1993, the Fish Center’s operating budget was reduced from its original funding level by 50 percent (\$52,000), despite the steady increase in requests for services from the aquaculturist, fish health specialist and the agricultural engineer. As a result, in the early 2000’s, ASWCC was spending more money on rent and janitorial services than the outreach budget of the Center. By FY 2003, the NRCS, ACES, and AAES had already assumed most of the salary costs of their respective staff members.

In 2004, a severe reduction in state funding for ASWCC resulted in a draconian reduction in the budget. It declined from a FY 2003 funding of \$52,000 to \$13,000 in FY 2004. Much of this short-fall was made-up by Auburn University and the Alabama Catfish Producers. In 2004 with construction of new catfish production ponds at a stand-still, due mainly to the growing impact of imported catfish, the Natural Resource Conservation Service (formerly the Soil Conservation Service) withdrew support for

engineering services at the Center, thus terminating its participation in the program. In 2005, under John Jensen's leadership, Auburn University assumed budgetary support of the Center. The ASWCC continued to participate by providing the services of an Administrative Assistant through the Hale County Soil and Water Conservation District until 2006.

In 2005, the University added the services of an agricultural economist (Jamie Yeager) and in 2006, Dr. Luke Roy joined the Center staff as a Research Fellow. Later, he joined the staff at University of Arkansas at Pine Bluff as an Extension Specialist.

Later, the Alabama Cooperative Extension System decided to terminate its Farm Analysis program, which paid a portion of Yeager's salary. As a result, he moved to become the Superintendent of the Black Belt Research and Extension Center of the Alabama Agricultural Experiment Station at Marion Junction in Dallas County.

A NEW DIRECTION FOR THE CENTER

Since about 2010, with the advent of new fish production strategies and a new species (Pacific white shrimp) on the horizon, the Alabama Fish Farming Center has become increasingly more involved in aquacultural research. From the beginning, it has served as an off-campus field laboratory for the Department and the School. In 2005, the Department decided to expand its research efforts at the Center, and as noted previously, in 2006, Dr. Luke Roy was employed as a Research Fellow. Later, after Dr. Tomasso became Director of the School, it was decided to establish a more permanent research program there. In 2017, Dr. Roy was employed in a tenure-track position as an Extension Aquaculture Specialist. While he is in an extension-funded position, his primary responsibility is aquacultural research. He is permanently assigned to the Center. Adding this permanent research component of the mission to the Center is a major step forward in ensuring that the School continues its outreach and research support for commercial aquaculture in Alabama.

Dr. Roy is a native of Michigan. He was awarded a B.S. (Environmental Science and Geographical Information Systems) by Samford University in 2000. Then in 2002, he was awarded the M.S. in Soil and Water Science by the University of California – Riverside. In 2006, he was awarded the Ph.D. in Fisheries and Allied Aquacultures by Auburn University.

Although Roy is employed as an Extension Specialist, he and his Work Group have completed several research projects related to commercial aquaculture in the Black Belt. Several of their publications have been cited in preceding Sections (Alternative Production Systems; Recirculating Systems; Aquacultural Economics; Fish Processing and Technology and Production of

Marine Shrimp in Low Saline Water. Their publications include the following:

- 1. Supplementation of potassium, magnesium and sodium chloride in practical diets for Pacific white shrimp, *Litopenaeus vannamei*, reared in low salinity waters (Roy, et al, 2007).**
- 2. Pond-to-pond variability in post-larval shrimp, *Litopenaeus vanammei*, survival and growth in inland low-salinity waters of west Alabama (Roy, et al., 2009a).**
- 3. Supplemtation of chelated magnesium to diets for *Litopenaeus vannamei* reared in low salinity waters of west Alabama (Roy, et al., 2009b).**
- 4. Shrimp culture in inland low salinity waters (Roy, et al., 2010).**
- 5. Survival of postlarval *Litopenaeus vannamei* following acclimation to low salinity waters at different temperatures (Paz, et al., 2011).**
- 6. Demonstration of blue crab *Collinectes sipidus* culture in inland low salinity waters of west Alabama (Roy, et al., 2012b).**
- 7. Effect of feeding rate and pond primary productivity on growth of *Litopenaeus vannamei* reared in inland waters of west Alabama (Roy, et al., 2012a).**
- 8. Correlations of xanthophylls in catfish fillets, plankton, shad and snails in catfish production ponds in west Alabama (Hu, et al., 2013).**
- 9. Research verification of production practices at an intensive aeration at a hybrid catfish operation (Bott, et al., 2015).**

ACHIEVEMENTS OF THE CENTER STAFF

Accomplishments of the Center since its inception include the following:

- 1. Designing and supervising the construction of hundreds of ponds and pond systems in west Alabama during the industry's major growth period in the mid- to late-1980's. Several engineers since the tenure of Perry Oakes, namely Jeff Allred and Tim Williams, "cut their teeth" in west Alabama as NRCS agricultural engineers. Perry Oakes went on to become Chief Engineer of Alabama's NRCS office in Auburn.**
- 2. William "Bill" Hemstreet has probably diagnosed more fish diseases**

than any other diagnostician in the country over the past thirty-three years at the Center. He has also served as the office manager for most of those years (Figure 122A).

3. As early as the first year of the Centers operation (1987), it became obvious that Alabama's catfish producers needed to conduct more of their routine water quality analyses, rather than depending on Center personnel to do them. Consequently, Greg Whitis conducted numerous workshops on water quality management, and personally conducted dozens of one-on-one workshops demonstrating the use of personal water quality kits. He also designed and installed water quality labs for many larger farms. The Center in the late 80's was analyzing over 4000 water samples annually. As a result of his efforts, the number finally declined to less than a thousand.
4. Another important Center accomplishment was the introduction of the automated oxygen monitoring systems to the industry. Around 1991, producer George Smelley was encouraged to install the first Royce monitoring system on his farm. Smelley later became a 'true believer' in automatic oxygen monitoring when the system activated during a 'bloom' die-off and saved a pond of fish, while he was sitting in church. Now the majority of the catfish acreage in the industry is monitored remotely for oxygen.

ALABAMA FISH FARMING CENTER PERSONNEL (PAST AND PRESENT)

Note the in the following list, a hyphen indicates that the individual is still employed by the Center.

ADMINISTRATIVE ASSISTANTS

- Mary Britton 1982-1986
- Gayle Barnette 1986-
- Jaky Broussard 2012-

LABORATORY, QUALITY ASSURANCE, AND ENGINEERING TECHNICIANS

- Martin Dombhart 1986-1989
- D. Gordon Woods 1989-1995
- Keat Dyer 1995-?
- Alice Miller Moore 1990, 1993-1994
- Barbara Brown Evans 1990-
- Deborah Rox 1993-1995
- Jennifer Truelove 1995-

- Nancy Taylor 1994-1995
- William Bennett 1996-2003
- Roy Wilcox 1996-1997
- Barbara Williams 1997-2002
- Emily Hollingsworth 1998-
- Mickey Barton 2001-2004
- Lisa Bailey Bott 2003, 2010-
- Sunni Dahl 2013-
- Grant Harless 2017-

VISITING RESEARCH FELLOWS AND GRADUATE STUDENTS INVOLVED IN RESEARCH

- Dean Earlix 1991
- Terry Goldsby 1991
- Nelson Sansing 2007
- Travis Brown 2007
- Luke Roy 2006-
- Jesse James 2017-

ADJUNCT FACULTY WITH SPECIAL ATTENTION TO THE CATFISH INDUSTRY

- Kristin Woods 2005

CIVIL AND AGRICULTURAL ENGINEERS

- Keith Penrod 1983
- Larry McCray 1984-1987
- Perry Oakes 1987-1991
- Tim Williams 1991-1996
- Jeff Allred 1996-2001

MANAGEMENT BIOLOGIST

- Steve Brown 1983-1987

EXTENSION AGRICULTURAL ECONOMIST

- Jamie Yeager 2005-

STATE EXTENSION SPECIALIST FOR AQUACULTURE

- Gregory N. Whitis 1987-

FISH HEALTH SPECIALIST

- Larry Hanson 1983-1985
- William “Bill” Hemstreet (1985-

EXTENSION SPECIALIST

- Dr. Luke Roy, Ph.D. (2017-

OFF-CAMPUS LOCAL FISH FARMING DEVELOPMENT PROJECTS

By the late 80s, it was obvious that the commercial catfish farming industry in west central Alabama was self-sustaining; however, at the same time, it was also obvious that the industry was not going to expand out of that limited area without some additional encouragement. As a result, the Cooperative Extension Service decided to establish local off-campus development projects in several areas across the State. Some details related to their establishment follow.

CENTRAL TENNESSEE VALLEY FISH FARMING DEVELOPMENT PROJECT

In the mid-60s, Lester and Milton Taylor established a small catfish ‘fish-out,’ operation near Town Creek (Lawrence County, AL). As part of the operation, they provided a fish-cleaning service (Perez, 2006). Soon, they were receiving requests for processed catfish; so in 1970, they constructed a small market building with a processing facility attached.

Later, the demand for processed fish became so great that they were unable to supply the demand from fish produced in their ponds. As a result, they began to harvest fish from local fish farmers who were without marketing outlets. In this contractual relationship, the Taylors were using the ‘vertically integrated-model’ that had been established in broiler industry in the area. They stocked the ponds, provided the feed and harvested the fish. Producers fed the fish and maintained the ponds. On harvest, they were paid for their inputs on a ‘per-pound’ basis.

Recall that John Jensen had been employed by ACES to provide technical assistance to catfish producers in Alabama. Soon, he was thoroughly familiar with all of the small fish farming operations, including the Taylor operation in Town Creek. In the late 80s, ACES, with our encouragement, decided to try to expand catfish farming in the Central Tennessee Valley. The area was so far removed from the rapidly expanding west Alabama catfish production industry, that we decided that it was impractical to expect Jensen and Masser to spend the necessary amount of time there; consequently,

Chris Hyde was employed in 1988 as Aquaculture Extension Agent for that area.

Chris had received a M.Aq. Degree from Auburn in 1983. Afterwards, he operated a 'fish-out' operation for a period of time. Later he managed a fish farm in the Mississippi Delta. After joining ACES, he provided technical assistance to the fledging fish farming industry in the Central Tennessee Valley until he resigned in 1993 to enter private business. By 1993, there was little evidence of expansion in catfish farming in the area. As a result, Hyde was not replaced.

THE JACKSON COUNTY CATFISH FARMING DEVELOPMENT PROJECT

The Alabama Fish Farming Industry continued to grow slowly into the 80s. Most of the growth was taking place in the Black Prairie Physiographic Section, centered on Hale County in west-central Alabama. Most of the growth was the result of the increase in the average size of farms in use. The number of operators did not increase substantially during this period.

As detailed in a preceding paragraph, Chester O. "Check" Stephens was involved from the very beginning in the establishment of the commercial catfish farming industry in west Alabama. In the mid-80s, he was also involved in business/family interests in Jackson County. Sometime in this period he began discussions with personnel of the Jackson County Economic Development Authority on the possibility of establishing commercial catfish farming in the eastern end of the Tennessee Valley. It seemed like an ideal location. There was plenty of water. It had good soil quality for pond building, and its topography made it ideal for the construction of large 'seine-through' ponds. Further, it was located within one of the State's major large and growing population centers. Almost from the beginning, the Auburn Fisheries Program became interested in the project and agreed to provide all the technical assistance required. The Development Authority and Auburn made a determined effort to rally local, public support for the project. On July 29, 1987, Senator Shelby and President Martin attended a luncheon for local officials and businessmen in Scottsboro to voice their support for the project.

It was decided that the first step in development process would involve the establishment of a "fish-out" facility at a busy intersection on the south side of Scottsboro. The facility consisted of two ponds of about a half-acre each, a small fish-holding area, and an office. It also included a small processing facility. At the same time a small, working fish farm was developed north of town to provide fish for the fish-out operation. Initially, Dave Dunset (an Auburn Ph.D.) managed the farm. Also, local business interests were

encouraged to establish commercial production farms. As I remember, at least two of these reached the early pond construction phase, but I do not believe that either farm was ever completed.

Unfortunately, for several reasons, the Scottsboro operation never reached the 'critical mass' required for 'self-sustaining' momentum. In 1997, *The U.S. Census of Agriculture* reported that there were only five commercial fishing operations in Jackson County, and that production was too low to report. The situation was even worse in 2002. That year, the Census only reported two fish farms in Jackson County.

THE PIEDMONT CATFISH CAGE CULTURE PROJECT

As detailed in a preceding Section, many problems associated with attempts to establish commercial catfish farming in terrace-water ponds in 'hilly' areas of Alabama had been repeatedly demonstrated at Auburn. Most of them were related to difficulties associated with water supply management and harvest. However, Schmittou (1969) had demonstrated that some of these problems could be avoided by culturing the fish in cages suspended in the surface waters of these ponds.

In late 1984, Robert Berry, SCS Area Conservationist; H. D. Kelly, SCS Biologist; and Ron Burdett, Coosa County Resource Conservation and Development (RC&D) Council Projects Coordinator, were meeting in Berry's office in Oxford to discuss the potential for the commercial production of channel catfish in the Coosa Valley (Perez, 2006). At that time, pond production of catfish was growing rapidly in west central Alabama; however, it was quickly recognized that pond production had little potential in the Valley. Then Kelly remembered Schmittou's work on cage culture, and 'putting-two-and-two together,' they decided to pursue the possibility of developing an RC&D project to help with the development of the concept for application there.

They quickly found that Schmittou was an enthusiastic collaborator. He had returned from his USAID-supported work in the Philippines. On campus, he was teaching a new course on Aquaculture Extension, providing leadership for the Master of Aquaculture Program, and continuing his research on cage culture. Everyone agreed that cage culture of catfish in the Coosa Valley was an idea worth pursuing, and Schmittou decided to use technical assistance to the project as a field exercise for his classes.

Later, interest in cage culture in the Valley literally 'exploded,' and Shep Phillips, a Coosa County farmer, became an active participant in the movement. At the time, Shep was a Coosa County Supervisor and a member of the Coosa Valley RC&D Council. He discussed the concept with both groups, and they wholeheartedly agreed to support the formal development

of the project.

By the end of 1989, caged-fish producers in the Valley had some three-fourths of a million pounds of fish ready for the market. Suddenly, the young industry was 'all-dressed-up, but with-no-place-to-go.' Quickly, all kinds of problems were beginning to limit their future growth, as well as their survival. H. D. Kelly, who had been providing them with technical assistance, was assigned other duties within SCS. Schmittou was also assigned to another long-term AID-supported project.

At this point, the farmers decided that they had to become 'masters-of-their-own-fate.' They needed a Producers Association to develop a unified approach to deal with their mounting difficulties. By April, 1990 the Piedmont Association of Caged Catfish Producers was a reality. Initially, the Association was extremely active, and accomplished a number of important objectives, but ultimately the negative aspects of the development of the industry were just too powerful for an Association to overcome. Perez (2006) describes the slow demise of the industry in detail.

In March of 1990, Claude Reeves was awarded a Master of Aquaculture Degree by Auburn. Afterwards, he was employed by the Coosa Valley RC&D Council to provide technical assistance to the growing industry. Unfortunately, by October of 1990, it was increasingly obvious that the problems facing the production of catfish in cages were likely insurmountable in the short-term; consequently, the Council terminated the Reeves position.

Later, in 1994, David Cline was employed by ACES to provide technical assistance and to assist with market development to the industry in the Valley. Later, he was moved to the campus to provide more general support for ACES fisheries programs state-wide. David is a native of New York. He was awarded the B.S. Degree (Biology) by Colgate University in 1986. He attended the University of New Hampshire for a period in 1986. In 1991, he received the Master of Aquaculture Degree from Auburn. Afterwards, he worked for a period (1991-1992) as manager of Eastwood Aquaculture, Inc. Later (1993-1994), he worked as an Extension Specialist with the University of Arkansas. Initially, Cline worked with caged catfish producers in the Piedmont. After joining ACES in 1994, he entered the Ph.D. Program. He was awarded the Terminal Degree in 2011.

PROMOTING THE DEVELOPMENT OF CATFISH FARMING IN SOUTHEAST ALABAMA

In the spring of 1964, W. B. Easterling hatched the first channel catfish eggs on a commercial scale in southeast Alabama. Perez (2006) provides an interesting story about how the Easterling Fish Hatchery was

established. His facility, located near Ariton, later became the focal point for efforts to establish a commercial catfish farming industry in that area. Once Easterling's fingerlings were available, he began to sell small 'lots' of the fish to pond owners in several adjacent counties. Many of these fish were stocked in ponds already containing populations of bass and bluegills, and in some cases, they were used to establish small fish-out operations. There seemed to be little real interest in establishing a commercial food fish industry.

Sometime later, the Suttons in Ariton began to serve farm-raised catfish at their restaurant. They produced, harvested and processed their own fish. We thought that their experience might be used as a model for establishing a commercial catfish farming industry in southeast Alabama.

In 1984, the West Alabama Catfish Producers Association (WACPA) was established (Perez, 2006), and from the beginning, it was extremely successful in representing the interests of producers on a number of issues. Later, a similar organization was established in east Alabama with Bill Easterling as its first President. Unfortunately, this organization accomplished little; primarily because there were few if any catfish producers in this area.

In 1995, the Department hired Claude Reeves as an Extension Specialist in Aquaculture. He was assigned to the Extension Office in Clayton with the responsibilities of providing technical assistance to local recreational fishing pond owners; while working to encourage the establishment of a commercial catfish farming industry in the area. Remember that earlier Claude had worked for a short time with the Coosa Valley Resource Conservation and Research Council on the cage culture project in the Piedmont. Later, he worked with the Florida Aquaculture Processors Cooperative, Inc. (1991-1993) and the Alabama Fisheries Section's Marion Fish Hatchery (1993-1995). After two years in Clayton, he was re-assigned to the newly-established Wiregrass Research and Extension Center in Headland, where he continued to work with fish farmers and recreational pond owners in southeast Alabama. In 2000, he was assigned to the position of Office Coordinator for the Center. He retired in 2012.

The 2002 *U.S. Census of Agriculture* reported that there were 4-5 farm operations in each of the counties in southeast Alabama selling catfish, although the quantity sold was too low to be reported. The 2012 *Census* indicated that only 2-3 operations in each of those counties were still selling catfish, and several of the counties did not report any sales. Again, the Department's efforts to assist in the establishment of a viable catfish farming industry had failed. Further, the failure was still primarily the result of factors that could not be dealt with through research and extension alone.

INFORMATION¹⁴

One of the truly unique characteristics of the Auburn Fisheries Program has been its concerted efforts to establish and maintain an *Information Base* to undergird its broad range of activities. It contains an enormous amount of 'published' material – much of it prepared by the Auburn faculty, but an even larger amount was obtained from external sources. A consideration of the different elements provides an interesting view of the evolution of the entire Program. A description of these elements follows.

The basic elements of the Information Base were established over a period of well over a half-century; however, it is helpful to divide them into two periods:

1. 1934-1948 (the 'Traditional' period)
2. 1949-The present

In the initial period (1934-1948), the various elements (Annual Reports, AAES Publications, Journal Publications, etc.) were established within a traditional Land Grant University environment. In contrast, the elements established in the second period (1949-the present) were established in a rapidly expanding extramural program environment. Generally, elements added from each of the two periods are described in chronological order.

ELEMENTS ESTABLISHED IN THE 'TRADITIONAL' PERIOD

The first element (Annual Reports) of the Information Base of the Auburn Fisheries Program was established in 1934 with the preparation of the Report describing the work of the 'Investigators' for the period July 1, 1934-December 31, 1935. Subsequent elements were established later and included:

1. Annual Reports, 1934
2. Photograph Collection, 1935-1936
3. Scientific Journal Articles
4. Experiment Station Publications, 1937
5. Public Education Publications, 1938

¹⁴ Dr. John Grover was especially helpful in assembling the material on the International Center for Aquaculture.

6. Theses and Dissertations, 1948
7. The 'Book' Collection, early 30s
8. The 'Reprint' Service.

The second element (The Photograph Collection) was established at about the same time of the preparation of the first Annual Report when a number of photographs were taken during the construction of Farm Pond 1, on the South Auburn Farm. The third element (Scientific Exchanges) was established in 1936 when the article *Fish Ponds in Alabama* was published in the Journal of the Alabama Academy of Science (8:27). A fourth element (Experiment Station Publications) was established in 1937 when Swingle and Sturkie wrote a publication for the AAES Mimeograph Series on *Raising Fishworms in Tubs*. A fifth element (Public Education) was established when the 'Investigators' wrote an article (*Pond Fish Growing Experiments Conducted at Auburn*) for the Alabama Game and Fish News in October, 1938. Finally, a sixth element was established in 1948, when Jack Snow's thesis was accepted by the School of Graduate Studies at Auburn. Additional details regarding these various elements follow.

FISHERIES PROGRAM ANNUAL REPORTS

The determination of Swingle and Smith to keep a detailed record of their early work was noted in a preceding Section. Their first Annual Report detailed the activities and accomplishments of the Auburn Fisheries Program for the period July 1, 1934 through December 31, 1935. At that time, the Report was given the name of the Experiment Station Project supporting the work – *The Purnell Project*. Similar titles were used for the Reports for a number of years. In the later years, they were simply titled as *Fisheries Research Annual Reports*.

The early Reports included an amazing amount of detail – names of personnel, construction projects completed, detailed descriptions and records of experiments conducted in each pond on all the farms, spawning records, food habits of experimental fish, weather records and water temperatures, notes on work with private ponds, notes on pond management schools, publicity by project personnel, expenditures and budgets.

The first Report included only a single volume, but by 1938, it included two. During the 'war-years' of the 40s, with Prather and Lawrence in service, it became much reduced in size; however by the early 60s, the Report included 5 or 6 volumes, sometimes with multiple parts; then, finally in 1978, it totaled 18 volumes. At that point, the Department was spending an inordinate amount of time and effort preparing them, and we decided that we should change the reporting system. Afterwards, the field data was eliminated and

only the conclusions reported. We also began to place even greater emphasis on the publication of research results in journals.

From the beginning, multiple copies were made of each Annual Report. For several years each 'Investigator' received one. Swingle maintained the primary copy. All corrections and marginal comments were made in his copy. Beginning in the late 90s, individual faculty members began to transfer their collections of reports to the Special Collections and Archives Department in the Ralph Brown Draughon (RBD) Library. Each collection was assigned a Record Group Number, Accession Number and a Location Number before they were cataloged and stored. Information on the different collections available are presented in Table 103. Individual volumes in each collection associated with a given Accession Number are stored in large cardboard boxes.

Collection 04-024 was transferred by Bill Rogers. It contains many of the Annual Reports of the Southeastern Fish Parasite and Disease Project. Similarly, David Bayne transferred Collection 08-027. It contains a large number of reports prepared by the Lawrence/Bayne Work Group for submission to agencies funding their research. Collections 97-068, 98-16a and 97-029, contain copies of the Annual Reports. Contents of these Collections are shown in Appendix Tables 9, 9A and 9B. Annual Reports still stored in Swingle Hall (Room 102) are included in Appendix Table 9C.

Collection 97-029 was transferred to RBD by Bill Davies near the time of his retirement in 1996. He had 'inherited' Prather's collection when he retired in 1985. This is the largest collection of Annual Reports in Archives. It is stored in nine boxes. Annual Reports included in this collection along with the volumes available are listed in Appendix Table 9B.

Along the way, part of Swingle's collection was lost. Only a few volumes from an unidentified single collection (1959-1976) remains in Swingle Hall (Room 102). There is no single complete collection remaining anywhere. In fact, when all contents of all collections are combined, there is still no complete collection remaining. Further, I have been unable to find any of the post-1978 Reports. Apparently, they have all been discarded.

THE PHOTOGRAPH COLLECTION

The Photograph Collection is an invaluable part of the Information Base of the Fisheries Program at Auburn. It also had its beginning with Swingle and Smith in the early 30s. From the early days, they made pictures of virtually everything that they did. Some of you will remember that all students in Swingle's course – *Management of Impounded Waters* (ZY 620) – had to learn to operate both print and slide cameras and to develop black and white prints in the dark-room. Fortunately, both Prather and Lawrence were also

inveterate 'picture-takers,' and after Swingle became too busy to take pictures, both of them continued the practice. Representatives of the Editors Office of the Agricultural Experiment Station were also active photographers. They documented many of the activities of the Fisheries Program over the years. Many of their photographs also became part of the collection.

Before John Lawrence retired in 1981, he made slide copies of virtually all of the old black and white photos in Swingle Hall. He added captions for most of them and submitted the entire collection to the Department of Special Collections and Archives in the RBD Library for inventory and storage. Most of the originals were submitted at the same time. These images are also stored in the RBD Library as part of Record Group 240 and Accession Number 88-45. This collection is a particularly good source of early material. There are also several boxes of originals stored with the two designated collections. Currently there is no index for this collection.

Bryan Duncan, with the assistance of several students, digitized the hundreds of colored slides that were part of the ICA collection of photographs taken in many LDC locations. A substantial share of this collection is stored as negatives in Record Group 240, Accession Number 00-076.

During the period 2003-2004, Len Lovshin, Troy Hahn and a number of students, collaborating on the new Departmental Information Technology (IT) Project, digitized approximately 2000 different images from the Fisheries Program Photograph Collection stored in the Department of Special Collections and Archives Department. In turn, these copies were placed in a file (*Media Gallery*) on the newly created Departmental web-page. They can be accessed in one of some 31 different subject matter categories; including historical, aquaculture, fisheries biology, recreational pond management, international projects, facilities, etc. Also, a copy of all of these images has been submitted to the Special Collections and Archives Department of RBD where they will be placed in permanent digital storage.

SCIENTIFIC JOURNAL ARTICLES

As detailed in a preceding paragraph, Swingle and Smith published their first Scientific Exchange as a Journal article (*Fish Ponds in Alabama*) in 1936, in the Journal of the Alabama Academy of Science. Others quickly followed. They began their research on pond fertilization in the 'D' Series on the South Auburn Farm in 1936, and experiments on fertilization and fish production in 1937. Then in 1938, they published the results of that research in the *Transactions of the American Fisheries Society* (Smith and Swingle, 1938). In the following years, they regularly published results of their research, either in that journal or in *Transactions of the North American Wildlife Conference*.

When I began graduate study at Auburn in the summer of 1952, Swingle and/or Smith had published 29 'papers' in national journals – 11 in the Transactions of the American Fisheries Society and 7 in Transactions of the North American Wildlife Conference. In the over three-quarters of a century of its history, personnel with the Fisheries Program have published hundreds of articles in dozens of Journals. Throughout most of this long period, a list of all of the citations has been maintained. Further, a few copies of virtually all of them have been kept in files in the Program's various offices.

In 2003, the Department established the Information Technology (IT) Program with the employment of Troy Hahn. At the same time, Len Lovshin was employed to work half-time with Troy in developing the Information Base. During this period, the entire collection of Journal publications was digitized. In the process, programs were developed to search the entire database by author, date and subject matter. I do not think that it has been 'up-dated' since 2012. The entire list is stored on the School's 'web-page.' Also, a copy has been submitted to Media and Digital Resources Lab.

ALABAMA AGRICULTURAL EXPERIMENT STATION (AAES) PUBLICATIONS

One of the important aspects of State Agricultural Experiment Stations, developed over the years is their publication system. Reports of research conducted by station scientists are assigned to one of several groups (Bulletins, Circulars, Series, Leaflets and Special Reports), depending on the status of the research being described. For example, *Bulletins* were expected to summarize the results of a number of years of research at the termination of the project – a terminal report. *Circulars* were used to report the results of on-going projects. Swingle and Smith seldom used Experiment Station Publications as an outlet for reporting the results of their original research, choosing instead to publish in recognized journals. Rather, AAES publications were utilized to publish the combined results of a number of years of research; although they did use this 'outlet' to publish three early papers (raising fish worms and crickets and pond construction). They were based on little, if any, organized research; consequently, they were published as part of the Mimeograph Series. When I began graduate study at Auburn in the summer of 1952, Swingle and/or Smith had published 13 research reports in AAES publications and 22 in national journals.

Their first really significant AAES publication was their widely distributed Bulletin 254, *Management of Farm Fish Ponds*. As noted in a preceding Section, it was published in 1942, and in 1947, it was revised. In 1943, Swingle and Smith used the AAES *Circular Series* (Number 87) to describe the results of their studies on *Factors Affecting the Reproduction of Bluegill Bream and Largemouth Bass in Ponds*. They published only one additional Bulletin – 264, *Relationships and Dynamics of Balanced and Unbalanced Fish Populations* (Swingle, 1950). Prather, Fielding, Johnson and Swingle (1953)

also used the AAES Circular Series (Number 112) to publish their *The Production of Minnows for Bait in the Southeast*. All of these early AAES publications helped to establish a solid foundation for the evolving Information Base of the Fisheries Program.

Several years ago, the Alabama Agricultural Experiment Station digitized its entire collection of publications, and put the collection on-line (aaes.auburn.edu/publications). Further, most of those hundreds of publications on the 'site' can be 'down-loaded' in their entirety.

PUBLIC EDUCATION PUBLICATIONS

In the early days of the Auburn Fisheries Program, Swingle and Smith regularly wrote articles for newspapers and magazines in order to keep the public informed about their research. One of the first of these – *Pond Fish Growing Experiments Continue at Auburn* – was published in *Alabama Game and Fish News* in December, 1938; and another one – *Construction of Farm Ponds* – was published in the *Southern Agriculturist* in November, 1939. Later, Swingle would prepare several additional articles for the *Alabama Game and Fish News*. During the 'War-Years,' Swingle and Smith collaborated in the preparation of several articles for *Progressive Farmer*. Remember that Smith left the Program in 1944. Available records indicate that after the War, even after Prather and Lawrence returned, very few newspaper and magazine articles were prepared. A few of these early articles are still available in the School's *Historical Records Series*.

Beginning in April, 1945, Swingle began to write a series of short articles for release to local news outlets. Titled '*Fish and Fishing*,' each article included a wealth of general information on different species that fishermen fishing in Alabama might encounter, fish conservation, fishing hints and fish pond construction and management. These short news releases were made available at weekly intervals. In 1945, he released 29 of them; unfortunately, after the end of World War II, his research opportunities and responsibilities began to increase rapidly, and he no longer had time to prepare the articles. The last one was released on February 3, 1946. He only released four that year. Copies of the entire collection of the 33 articles are stored in Special Collections and Archives in RBD Library.

THESES AND DISSERTATIONS

Remember that the Graduate Program in Fisheries Management was established in the 1946-1947 Academic Year. From the beginning, satisfying Auburn Graduate School Rules, all candidates for the Master of Science Degree were required to submit a thesis. It was to be based on original research conducted under the direction of a Major Professor and approved by a Graduate Committee which included the Major Professor and three

additional faculty members. As noted in a preceding Section, Jack Richard Snow submitted the first thesis (1948) prepared by a graduate student in the Fisheries Management Curriculum. It was titled: *A Preliminary Study of the Toxicity of 2,4-D to Pond Fishes and its Effectiveness in the Control of Emergent Species of Pond Weeds*. Swingle served as Major Professor for the study. Snow's thesis was the first of scores that would be submitted over the years.

The Ph.D. Program in Fisheries Management was established in the 1952-1953 Academic Year, and was the first Terminal Degree program established at Auburn. In 1955, Abdul Rahman Khan Zobari, a student from East Pakistan and a candidate for the Terminal Degree, submitted a dissertation to the Graduate School. It was entitled: *Experiments on Feeds and the Rates of Feeding for the Common Carp, Cyprinus carpio, Linnaeus, in Troughs*. Swingle also served as the Major Professor for this study.

Historically, one copy of all theses and dissertations submitted by students in the Fisheries Program has been kept in the main office. Beginning in 1973, when Swingle Hall was completed, they were moved to Room 203. Over the years, a few copies borrowed from the collection have not been returned. As a result, it is no longer complete. The only complete collection is maintained by the Graduate School. Currently all theses and dissertations must be submitted to the Auburn University Graduate School in electronic format where they become part of the Auburn University Electronic Thesis and Dissertation Library (AUETD). AUETD allows each student's work to be freely downloaded by anyone on the World-Wide 'Web.' This new database was established in 2005. The School no longer requires that a copy be submitted for its use; consequently, it is likely that the Swingle Hall collection will slowly erode as copies are borrowed, but not returned.

In 2004, the entire list of theses and dissertations in Swingle was digitized by Lovshin and Hahn with the help of student labor, and can now be accessed on the School's web-page. The list is searchable by author. Each entry includes the title of the thesis or dissertation, name of the author, the name of the Chairman of the Graduate Committee, the year that it was submitted to the Graduate School and the abstract. All of this data can be downloaded from the School 'web-page.' Theses or dissertations submitted in 2005 or later can be downloaded in their entirety. A copy of this entire Lovshin/Hahn 'list' has been submitted to Media and Digital Research Lab of RBD, where it will be placed in permanent digital storage.

The Lovshin/Hahn list has not been up-dated since 2014, but with the data available from AUETD, a complete list of all theses and dissertations submitted by students in the Fisheries Program from 1948 to the present time is still available. It is likely that in the future that an up-to-date list will be available only from AUETD.

THE BOOK COLLECTION

When I first came to Auburn in the Fall Quarter of 1948, the College of Agriculture Library was located in Comer Hall. It contained copies of a few fisheries-related journals (*Transactions of the American Fisheries Society*, *The Progressive Fish-Culturist*, *Limnology and Oceanography*, *Copeia*, etc.). It also contained a modest collection of reference or text books. In 1948, while there were many books available on fish systematics, there were very few related to fish management, and nothing remotely related to the management of fish populations in 'terrace-water' ponds. Unfortunately, this availability situation did not change very rapidly. I have no information on when the first fisheries-related books were added to the collection. Certainly, there was no reason to purchase many before 1934.

THE 'REPRINT' SERVICE

The publication of AAES Bulletin 254 (*Management of Farm Fish Ponds*) had a long-lasting effect on the development of the 'Information Base.' Remember that soon after its publication, with the assistance of the U.S. Soil Conservation Service, the information that it contained quickly received nation-wide recognition. Soon requests from throughout the country for '254' and other Program publications literally 'exploded.'

In response to this growing demand, the Fisheries Program established a stock of reprints, and made them available to anyone requesting them. Later, lists of publications were developed annually and distributed to interested parties. Over time, filling requests for publications began to be such a chore that the Secretary could no longer devote the time required to respond in a timely fashion. Subsequently, we hired local high school students to serve as Publications Clerks. It was their primary responsibility to mail publication lists and to respond to requests for publications. It was also their responsibility to alert the Secretary when the supply of a specific reprint had been exhausted, so that an additional supply could be purchased.

INFORMATION BASE ELEMENTS ESTABLISHED IN THE 'RECENT' PERIOD (1948-Present)

After 1948, additions to the Information Base Elements established in the 'Traditional Period' continued to accumulate. In most of the areas established in that period, accumulations increased rapidly. At the same time, new Elements would be established that would increase the rate of accumulation even more:

1. The 'Grey' Literature
2. The 'Modern' Book Collection

3. **Publications of the International Center for Aquaculture**
4. **The Aquaculture Information Network (AIN)**
5. **USDA Collaborative Research Reports**
6. **Alabama Cooperative Extension Service Publications**
7. **AUMERC Publications**
8. **MISSISSIPPI-ALABAMA SEA GRANT (MASG) CONSORTIUM Publications**
9. **School of Fisheries, Aquaculture and Aquatic Sciences ‘Web-Pages’**
10. **Individual Faculty ‘Web-Sites’**
11. **Field Operations Records.**

Details regarding each of the ‘Elements’ are presented in the following paragraphs.

‘GREY’ LITERATURE

Generally, research supported with appropriated funds available to faculty of the Alabama Agricultural Experiment Station did not have specific requirements concerning the writing of reports detailing accomplishments. Obviously, this was not the case with research supported with extramural funds. Those funds were usually made available for the explicit purpose of obtaining specific data and information, and it was expected that a report(s) detailing the results of the purchased research would be submitted in a timely fashion. As detailed in a preceding Section, The Alabama Water Improvement Commission provided the Fisheries Program with its first extramural funding, and the Agency expected a timely report on the study of the status of the fish population in the Coosa River, near Childersburg, in 1949 (Scott, 1951).

Extramural funding for the Fisheries Program increased slowly in the 50s, but later increased at an exponential rate, and the preparation and submission of progress and terminal reports increased apace. They received almost no external review and their distribution was extremely limited. Consequently, they have been included in the so-called ‘Grey’ Literature. Over the years, Auburn faculty have prepared literally hundreds of reports that are included in this category. They generally accumulated in the files of the faculty doing the research. Unfortunately, a substantial share of them have been discarded. During the period 2003-2004, Lovshin, Hahn and several student

workers retrieved and digitized a number of these reports. They were deposited in a newly created Departmental (now School) database entitled *Historical Reports*, according to the year they were prepared. Also, a copy of this entire 'list' has been submitted to the Media and Digital Resources Lab of RBD, where it will be placed in permanent digital storage. The 'list' has not been 'up-dated' for a number of years, and it is likely that in the absence of a new Information Technology effort, it will not be in the future.

In 1994, members of the Lawrence-Bayne Work Group assembled a number of reports on weed control research and environmental monitoring, and submitted them to the Special Collections and Archives Department for cataloging and storage. This collection has been assigned the Accession Number 08-027 (Table 103). Some of these reports were originally included in the Annual Reports Series described in a preceding Section.

In 2004, someone in the Fish Health Work Group assembled a number of reports and newsletters related to the Southeastern Cooperative Fish Parasite and Disease Project and sent them to Archives. This collection was assigned 08-027 as the Accession Number (Table 103).

THE MODERN BOOK COLLECTION

Remember that the Ph.D. Program in Fish Management was established in 1953. One of the essential ingredients of this program was access to an adequate research library. Approval of this new program meant that the University would have to increase its library holdings in the area.

The Agricultural Library was moved to the newly-constructed Ralph Brown Draughon Library in 1963. With the availability of this new facility, the University made a determined effort to expand its 'holdings' in all areas. The fisheries faculty tried to take advantage of this opportunity. Unfortunately, there was still the problem of availability.

The effort to build our book collection increased significantly in 1970 after Auburn was awarded a 211-d *Institution Building Grant* (AID/csd-2780). Remember that *Objective (b)* of the Grant was to *Develop a library of world-wide literature on aquaculture* (Table 98). Further, *Objective (e)* requested that the University *Develop a collection of data on fishes and other aquatic organisms from throughout the world that appear suitable for culture*. During the years that this and similar follow-on Grants were in effect, we made a determined effort to add to the holdings in all areas of aquatic ecology, aquaculture and fisheries. Of course it is difficult to build a collection 'after-the-fact,' but we tried to get all the books and related materials that were still available. All of this collection is maintained in the Circulation/Reserved Department of RBD. Most of it is located on the fourth floor.

PUBLICATIONS OF AUBURN'S INTERNATIONAL AQUACULTURE OUTREACH PROGRAM

The Auburn Fisheries Program began to accumulate information related to aquacultural development in Less Developed Countries (LDCs) in 1958, when Swingle prepared his report on the review of the program of the Department of Fisheries in Thailand. Later, in 1966, Dendy, Prather and Shell prepared their first report on their work in northeast Brazil. Then in 1967, Auburn contracted with the U.S. Agency for International Development (USAID) for the implementation of the Caton 'Model' (Table 92) for the improvement of fish production in LDCs through the use of warm-water aquaculture on a world-wide basis. The initiation of this international development outreach effort resulted in a rapid accumulation of new information. Then in 1970, the establishment of the International Center for Aquaculture provided a structured mechanism for its accumulation and storage.

Virtually all of the information produced and accumulated by Auburn's long-term effort in aquacultural development in LDCs actually belongs with the 'Grey' Literature Section; however, there is so much of it, and most of it so specialized, that it was decided to describe it in this different Section. Further, the wide range of activities involved made it necessary to develop several different kinds of reports. They include the following:

1. Country Survey Reports
2. ICA Annual Reports
3. The Research and Development Series
4. 'WHAP' Manuals
5. The ICA 'Communicae'
6. The 'Hook-Line-and-Sinker.'

Details related to the development of these publication series are presented in the following paragraphs.

'SURVEY' REPORTS

The first elements of this Information Base were established as a result of implementation of *Phase 1(a)* of Caton's 'Model' – the In-Country Surveys (Table 92). As noted in a preceding Section, these surveys were primarily funded by contract AID/csd-1581. Remember that the ICA had not been established at this point. Also, as noted earlier, Auburn faculty conducted surveys in 17 countries during the 2 years that the contract was in

effect (Table 94). Several additional countries were visited in the following years under contract AID/csd-2270 (Table 95). The information obtained in each survey was used to produce a Country Report. Copies of each Report were submitted to the USOM in the country and to USAID/Washington. These Reports provided a wealth of information related to the potential for the development of aquaculture.

Many of the Reports developed from these 'short-term' assignments can be found and down-loaded in/from the "Historical Reports" on the School's web-page. 'Historical Reports' is also available in a digital version in the Media and Digital Resource Lab of RDB. A few of the Reports, especially the earlier ones, are stored in the Special Collections and Archives Department of RDB. After 1977, details relating to some of these visits can be found in the different issues of the *ICA Communicae*.

ICA ANNUAL REPORTS

Beginning with the awarding of the Title XII, 211-d, Institutional Development Grant: *Increased Fish Production Through Improved Fish-cultures in Less Developed Countries* (AID/csd-2780) in July, 1970, USAID provided a substantial amount of annual funding to support 'Institution Building' on campus, overseas development projects and for 'on-campus' funding for teaching. Subsequently, a number of other grants provided similar support for Auburn's Fisheries Program. All of these various Grants were described previously in the Section on the International Program. All of them required fairly detailed reports of our annual activities utilizing those funds. The first of these, the ICA Annual Report for FY 1971, reporting activities conducted under AID/csd-2780, was submitted in December of 1971. Some of these reports can be down-loaded from the 'Historical Records' file on the School's web-page, or in the collection in the Media and Digital Resources Lab. Copies of several of them are stored in the Circulation/Reserve Department (Call Number: SH 11.A6 A642).

THE RESEARCH AND DEVELOPMENT (R&D) SERIES

This Series includes 46 different reports. It primarily contains Progress Reports and 'End-of-Project' Reports from long-term, USAID-funded Projects in LDCs. Some 24 of the Reports are in this category. There are also a few reports resulting from specific short-term projects, and a few more on tilapia aquaculture. Each Report can be downloaded from the School's web-page in the International Program File. Also, most of the Series is stored in the Circulation/Reserve Department (Call Number: SH 11.A6 A65).

THE 'WHAP' MANUALS

As detailed in a preceding Section, the *Water Harvesting/Aquaculture ('WHAP') Project* (1984-1989) involved a collaborative

effort between ICA, the Joint PVO/University Center for Rural Development located at Western Carolina University, and six Private Volunteer Organizations (PVOs). One of the objectives of this contract was to prepare a series of manuals to be used in the implementation of 'WHAP' in the LDCs. The series includes 20 different publications on different aspects of aquaculture; however, the primary emphasis is on the culture of *Oreochromis niloticus*. Each of the publications is available in English, French and Spanish. Alex Bocek was given the primary responsibility of preparing the publications; although he received considerable input from other faculty members as well. Illustrations were prepared by Suzanne Gray. Translations were done by foreign graduate students fluent in those languages. Individual manuals are stored on the School's web-page in the International Program file. The entire series has also been stored by the Media and Digital Resources Lab.

THE ICA COMMUNICAE

As discussed in a preceding Section, Title XII, 211-d, *Institutional Development Grant (AID/csd-2780)*, terminated in April, 1978, and was replaced by another Title XII Grant (*Aquaculture Technology Development – AID/DSAN-G-0039*) which became effective in May, 1978. One of the objectives of this new Grant was *To publish a newsletter on a quarterly basis as an aid to communication among aquaculturists working in developing countries* (Table 98). In order to meet this objective, the ICA developed the *ICA Commuicae*. It generally included sections on research highlights, training activities, staff activities, travel, contracts and grants, alumni news, new graduate students, visitors, recent publications and a detailed report on a specific area of research. The first issue (Volume 1, Number 1) was distributed in mid-1978. Mike Cremer served as Editor for the publication for a period of time before he was assigned to the Banda Aceh Project in Indonesia. Brian Nerrie served as Editor in 1987-1988.

A few issues of the publication are stored in the 'Historical Records' file on the School's web-page. Larger collections are available in two locations of RBD Library: The Microfilm Periodical Collections, and in the Special Collections and Archives Department (Call Number: SH 1.12).

'HOOK-LINE-AND-SINKER'

In June, 1976, when John Grover returned from his long-term assignment in the Philippines, it was immediately obvious to him that the Department's program was growing so rapidly and in so many directions that the "*left hand did not know what the right hand was doing.*" He proposed that we deal with that unhealthy situation by preparing and releasing a Departmental newsletter each month. It would summarize the wide range of teaching, research and outreach activities in which we were involved.

I thought that this was a wonderful idea as long as I did not have to prepare it. John volunteered to accept this responsibility. It was usually 1-2 pages in length, and duplicated on our photo-copiers. It was widely distributed within the Department, and mailed to all ICA staff overseas. Copies were also distributed in the Dean's office. Initially, John generally prepared a new issue on a monthly basis. Later, as he became involved in other projects, it was released on a quarterly basis. He continued to prepare and release the publication sporadically until he left for another long-term assignment in 1999 (Bangladesh). Unfortunately, we have been unable to find a single copy of this publication.

THE AQUACULTURE INFORMATION NETWORK

In January, 1982, Auburn signed a contract with USAID/W to implement a Cooperative Agreement for the *Development of Aquacultural Technology* (AID/DAN 1314-A 002500). It was scheduled to continue in effect through December, 1987. One of the objectives of the Agreement was to "Improve the Information Base in Aquaculture in Developing Countries through the Development of an Aquaculture Information Network (AIN)." By the summer of 1984, the ICA faculty had spent countless hours on the design of the 'Network,' and on the questionnaire that would be circulated world-wide to collect the data that would become part of its 'Information Base.' We had decided that we would send questionnaires to our alumni in the various countries with the hope that they would take the time to respond to them. In the summer of 1984, we were still working on details. We were still not ready to distribute it.

In January, 1987, we distributed the first set of questionnaires. In the following months, we received almost no replies to our requests for data. Even our most loyal alumni did not respond. In September, 1987, we sent a follow-up request for the return of the completed questionnaires, but still received virtually none. At this point we realized that the 'AIN' had been 'stillborn.' After considerable soul searching, we began to understand that the 'Network' had been dead at conception. To begin with, the expectation that we could get all of the data required on a voluntary basis was based on pure 'wishful thinking.' Few, if any, persons in an LDC would have access to all of the data that we requested, and if they could assemble the volume of data, few would have time required to place it in the format requested. It was never a matter of disinterest on the part of our many alumni; we had requested that they do something that they were not prepared to do. However, even though the effort to establish the 'Network' failed miserably, the work that we had put into it was not wasted. As a result of a series of unexpected events, our efforts received widespread attention – attention that would result in a highly positive public perception of the University and its efforts to provide technical assistance to people in LDCs.

G. J. Tankersley was a native of Decatur, AL. He received a Degree in Mechanical Engineering from Auburn in 1943. He began his career in the natural gas industry in 1949. In 1966, he joined Consolidated Natural Gas Company as President of the East Ohio Gas Company. Later, in 1979, he became Chairman and CEO of the parent company. In that capacity, he led Consolidated into gas exploration in the Gulf of Mexico. Over time, it became a significant producer in the industry. He retired in 1987.

Sometime prior to August, 1984, Auburn University and the University of Miami (Florida) agreed to participate in the *Kick-Off Classic* to be played on the home field of the New York Giants of the National Football League in East Rutherford, NJ. Mr. Tankersley had maintained close contact with Auburn over the years, and apparently he decided to provide the funds to use this event as a means of highlighting University programs other than football. Further, he wanted to use the United Nations as a vehicle to identify them.

Although, I was not involved in any of the preliminary details, he apparently contacted President Martin regarding his interest in such a project. Subsequently, the President was involved with other University officials concerning the identification of a program to 'highlight.' At that point, the ICA was near the apex of its efforts to implement Caton's 'Model' throughout the world. We were involved in a number of short-term and long-term projects in a number of countries. At the same time, international students were swarming to our Fisheries Program on campus to participate in a variety of both degree and non-degree training programs. As a result, I was contacted about identifying a portion of our Program that might be 'highlighted' at the UN.

Finally, in our efforts to respond to the President's request that we identify a specific project, we decided that we would use the event to announce the official establishment of the Aquaculture Information Network (AIN); although at this point, we had not even completed the design of the questionnaire. Mr. Tankersley employed a local Public Relations firm to arrange the details for the presentation with the United Nations. The presentation involved appearances on local media outlets, a press conference and a major address by the University President to a large number of invited guests. It was scheduled to take place over portions of a 2-3 day period in late August, 1984.

The presentation received a considerable amount of attention. Aquaculture was the new 'buzz-word' in the mid-80s, and many people wanted to learn more. Richard Pretto came from Panama to help with the presentation. His presence added a measure of authenticity to our efforts. The press conference was well attended, and there seemed to be a genuine interest in our USAID-funded efforts to provide assistance to people in less developed countries. Dr. Martin's address was well received by a surprisingly large and

attentive audience. I attended the only scheduled 'media' event, and was saddled with explaining to a radio audience why shrimp contain so much cholesterol.

Mr. Tankersley seemed to be well pleased with the presentation that we had put together and with the public's response. It is doubtful whether 'highlighting' any other Auburn Program would have drawn more attention. Further, information concerning the event received considerable national attention. Sometime afterwards, I found a detailed news release about it in the Fort Scott, Kansas Tribune.

Unfortunately, as noted previously, the ICA was in no position to take advantage of the event. We did not realize it at the time, but 'AIN' was already dead. The proposal to establish the 'Network' was ill conceived. In deciding to make it an objective of the USAID/W-funded Cooperative Agreement, we had not given any consideration to what would be required to establish and maintain it.

Auburn's response to his UN proposal and the presentation resulting from it pleased Mr. Tankersley. In December 1988, he and his wife, Mary Louise (Armstrong), established an endowment "For the support of the International Aquaculture Network." Proceeds were to be used for the purpose of providing support of the IAN; as determined by the Director of the International Center for Aquaculture. Remember that shortly thereafter the ICA was removed from the Department, and Bryan was made Director. He spent some of the available funds for travel, and a substantial amount was used to purchase student labor for the purpose of digitizing the large number of colored slides related to ICA activities. Funds from the endowment are still accumulating, but apparently very little use has been made of them in the last few years.

PD/A CRSP PUBLICATIONS

Details regarding the establishment of the Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP) were presented in a preceding Section. Remember that Oregon State University was chosen as Management Entity for the implementation of that 'long-term' AID/W-funded effort. In that capacity, they were responsible for preparing all reports and publications related to the Program. In the beginning, Auburn faculty were heavily involved with implementation efforts. Their contributions are described in Annual Reports of the PD/A CRSP. Virtually all of these materials are readily available online.

USDA COLLABORATIVE RESEARCH PUBLICATIONS

Beginning in the early 70s, USDA funded a considerable amount of catfish

research at Auburn through the Cooperative State Research Service and its successor agencies. The initial research was funded through two cooperative projects: S-83 (Freshwater Food Animals, 1971-1981) and S-168 (Warmwater Aquaculture, 1981-1986). Annual Reports describing accomplishments of the cooperative research effort were prepared and published each year. Work completed by Auburn 'Investigators' was usually well represented in each report. Auburn faculty prepared five Southern Cooperative Series Bulletins for these projects (Catfish Processing – 193, Nutrition and Feeding – 218, Genetics and Breeding – 223 and 325, Principal Diseases of Catfish – 225). Copies of these publications are maintained in the Alabama Agricultural Experiment Station Publications holdings.

SOUTHERN REGION AQUACULTURE RESEARCH CENTER PUBLICATIONS

USDA's Southern Regional Aquaculture Center (SRAC) was organized in 1987. It is housed at the Mississippi State University (MSU) Delta Research and Extension Center, located at Stoneville, MS. MSU serves as the host institution. Specific details regarding its establishment will be presented in a following Section. Details describing current programs of the Center are presented on its Home-Page (SRAC.msstate.edu). Publications prepared and released by the Center include: Annual Progress Reports, Fact Sheets, Final Reports, Research Publications and SRAC DVDS.

SRAC was established to support cooperative research in aquaculture in thirteen states and two territories in the Southern Region. Its first research and extension projects were initiated in 1988. Over the years, faculty of FAA and the School have received a substantial amount of funding from this USDA agency. Details related to their contributions have been included in a number of SRAC Publications (SRAC.msstate.edu.publications). A number of SRAC publications can also be down-loaded from ALEARN.

ALABAMA COOPERATIVE EXTENSION SERVICE PUBLICATIONS

As detailed in a preceding Section, the Department was not assigned formal responsibility for extension efforts until the late 80s. John Jensen's position was added to the FAA 1990-1991 Budget; however, he had been employed by the Alabama Cooperative Extension Service in 1979 as Extension Specialist in the areas of fisheries, aquaculture and aquatic sciences. In the late 80s, Jensen began to prepare publications to provide management information to recreational pond owners and fish farmers. These publications would provide the foundation for the Information Base of Extension Publications. Over the years, this collection has been expanded to serve a broader range of stake-holders. Holdings in this collection can be accessed at *ACES Publications* on the internet. On that site, they are located in the Recreational Fishing and Pond Management Subsection of the Natural Resources Section.

During the period 2003-2004, an important expanded repository for fisheries-related extension publications was created. ALEARN was designed and 'built' by Lovshin, Hahn and David Cline with assistance from ACES Information Technology Specialists. Later, Rusty Wright would contribute a substantial amount of information to the new extension information vehicle. ALEARN was designed primarily for providing useful information related to marine and freshwater fisheries and aquaculture to educators and the general public. The 'site' contains an enormous quantity of information produced by the Auburn faculty, as well as faculties and staffs from other institutions and agencies. It is accessible through its own website **ALEARN.**

ALEARN is a cooperative effort between the Auburn University School of Fisheries, Aquaculture and Aquatic Sciences and the Alabama Cooperative Extension System (ACES). It maintains a wealth of information related to aquaculture, natural resources, education and recreational fishing in Alabama and the Southeast. It is designed as an outreach resource for anglers, pond owners, catfish farmers, citizen groups, interested individuals, teachers and students.

It makes available a large number of technical articles, data sheets, Timely Information Releases, lesson plans, student study materials, videos and photographs. Virtually all of these materials can be down-loaded, 'free-of-charge' from the 'website.'

Len Lovshin initiated the development of ALEARN, and he continued to provide input for it until he left Auburn. He was assisted by Troy Hahn, the Department's Information Technology Specialist, and personnel from the ACES Information Technology group. Later, Rusty Wright and David Cline provided input to it. It was finally put 'online' in October, 2005. David Cline has the major responsibility of maintaining it

AUMERC PUBLICATIONS

Recall that Billy Powell established the ACES Information Base in matters related to Alabama's Coastal Zone after he was appointed Marine Advisory Specialist in 1974. Later, Rick Wallace, Bill Hosking, Brian Perkins, Scott Rikard and others contributed. These publications did not become a formal part of the Information Base of the Department of Fisheries and Allied Aquacultures until the establishment of the Auburn University Marine Extension and Research Center (AUMERC) in 1988. The establishment of this Center, as part of the Departmental structure, added an entirely new dimension to the original 'Base' that had been largely limited to publications related to freshwater aquatic environments.

Copies of AUMERC publications are generally available through the ACES

Publications website described in a preceding paragraph. Most of them are also available through ALEARN.

MISSISSIPPI-ALABAMA SEA GRANT (MASG) CONSORTIUM PUBLICATIONS

Recall that in 1972 the Mississippi-Alabama Sea Grant Consortium was approved as the first bi-state program in the nation. From that time, a number of Auburn faculty have participated in many aspects of Consortium activities and their contributions have been included in its Information Base. This site (masgc.org/publications) contains information about Auburn's work in the Central Gulf Coastal Zone that is not generally available anywhere else. Remember that LaDon Swan is Director of both AUMERC and the Consortium.

The Consortium (MASGC) issues a number of publications about their work: Newsletters, Brochures/Fact Sheets, Technical Reports, Books, Journal Reports, Theses and Dissertations and Administrative Reports. As part of the National Sea Grant College Program, it maintains a portion of an enormous, nation-wide information base. The MASGC information base also includes publications of the Auburn University Marine Extension and Research Center (AUMERC). Virtually all of the AUMERC publications also carry a MASGC identification number.

Most of their publications are available on their web-site: Publications – Mississippi-Alabama Sea Grant Consortium.

SCHOOL OF FISHERIES, AQUACULTURE AND AQUATIC SCIENCES WEB-PAGE

After Len Lovshin completed his last long-term overseas ICA assignment (Panama, 1981-1984), he returned to campus and became involved in the regular teaching and research programs of the Department. He also continued to undertake short-term ICA assignments in various LDCs. In the mid-90s, he became interested in Information Technology (IT), and its use in the management and utilization of the FAA Information Base. During this period, he along with several graduate students, became involved in designing and coding a web-page for the Department. He maintained the site until his retirement in December, 2003. Over time it became an easily accessible repository for a large share of the entire Information Base of the Fisheries Program.

As a result of the obvious positive contributions of Lovshin's web-page to the advancement of the Department's overall mission, John Jensen who was Department Head at that time, decided that it would be advantageous to the entire Fisheries Program to develop a working group in Information Technology (IT). Consequently, he utilized Departmental funds to employ

Troy Hahn, an Information Technology Specialist. Later, David Rouse would increase funding for the IT effort. Some of the additional funds were used to employ a number of support personnel. Hahn joined the Department in June, 2003 as an Information Technician, Specialist III. He had been awarded an Auburn Degree in Information Management Technology in 2003. Before joining FAA, he had been employed as Assistant Webmaster by the Alabama Cooperative Extension System. After Lovshin's retirement in 2003, he continued to assist Troy on a volunteer basis with the development of the Department's IT program.

In 2005, Lovshin was retained by a Memorandum of Understanding to assist Troy, part-time, to improve accessibility to the Department's widely dispersed Information Base. It was through this Hahn/Lovshin collaboration that the most important information elements were added to the FAA web-page. They pulled-together a wide variety of information from different far-flung parts of the Base, and made it part of the web-page. Elements added included:

- Media Gallery
- Research Publications
- Historical Records
- Theses and Dissertations
- ALEARN.

Details regarding each of these Elements have been presented in the preceding paragraphs, and will not be repeated here.

INDIVIDUAL FACULTY 'WEBSITES'

Individual faculty websites are a relatively new Element in the Information Base of the School of Fisheries, Aquaculture and Aquatic Sciences, and it is likely that they will become the most important ones in the future. If adequately maintained, they can provide a wealth of real-time information about the activities and accomplishment of their individual Work Groups. They provide a valuable *picture* of the activities and accomplishments of the entire School. They can be accessed through individual entries in the "Faculty and Staff" file listed on the 'Home' Page of the School's web-page.

In their present form, the formats of the individual 'websites' vary considerably, but most include essentially the same kinds of information: CV data, research interests, current projects, publications and teaching responsibilities.

FIELD OPERATIONS RECORDS¹⁵

All records related to the formal teaching, research and extension programs of the School are maintained in Swingle Hall; however, there are several activities related to Field Operations requiring that permanent records be maintained.

With the completion of the new Field Operations Headquarters Building in 1990, Randell began to keep those records there. Then with the completion of the Center for Aquatic Resources Management in 2011, all of those records maintained in the Field Operations Office were moved to the office in the new building.

The Fisheries Program is responsible for meeting requirements for a number of federal mandates related to the use and operation of our research facilities. Most of them require that detailed records be maintained. Karen is ultimately responsible for collecting and maintain them, but generally Rene has the day-to-day responsibility. These are also maintained in the Field Operations Office of Building 2 in the Center. Most of these mandates and the records required are described in the following Section.

CERTIFIED PESTICIDE APPLICATOR

Federal regulations require that certain hazardous chemicals can only be applied by a person who has been qualified as a Certified Pesticide Applicator. Records are kept on applications of these chemicals. Obtaining and maintaining Certification is a continuing process, and must be renewed periodically.

HAZARDOUS MATERIALS MANAGEMENT

Continuing management of waste chemicals generated by research on the four Farms is also governed by Federal regulations. These chemicals must be collected and stored. Relevant data must be entered into the *Chematix* system. When sufficient quantities have accumulated, a 'pick-up request' must be forwarded to the University. This is an important stage in the process; as there are monthly limits on the quantity that the University will remove. Monthly reports must be prepared on the current chemical waste and waste oil inventory. Chemicals used in research must be removed from inventory. Exhausted batteries and burned-out fluorescent bulbs must be collected and a request for 'pick-up' sent to the University.

¹⁵ I am indebted to Renee Beam for providing much of the material for this Section.

WEIGHMASTER

State regulations require that in order to sell fish, based on weight, to the public that a certified and bonded Weighmaster is required. This individual must schedule annual scale calibrations/certifications and annual device registrations.

INVESTIGATIVE NEW ANIMAL DRUG (INAD) MANAGEMENT

Federal regulations also govern the use of new experimental drugs that are being evaluated for their efficacy and safety. Auburn is currently involved in evaluating two of these:

- a. Diquat for treatment of Columnaris Disease
- b. MT (methyl testosterone) feed for sex reversal of tilapia.

Requirements for inventory control of these drugs and chemicals are very precise. Further, their use in research requires a large amount of record keeping and reporting.

SPILL PREVENTION, CONTROL AND COUNTERMEASURE COORDINATION

This activity pertains primarily to petroleum products utilized regularly on the four Farms and requires monthly inspections of fuel tanks, reports on spills, and the clean-up of small spills. In the case of major spills – arrange with University for assistance.

SAFETY TRAINING

Must conduct multiple annual training sessions for students and employees. Maintain records of training sessions and have them available for inspection at any time.

SHOP INSPECTION – SEMI-ANNUAL

The Farm has a shop with bays for vehicle maintenance, electrical repair, welding and other maintenance activities. The shop must be inspected for a safe working environment. Some examples of items the inspector looks for are: neat and tidy, no trip hazards, all tools are in good working condition and have appropriate safety controls, chemicals and petroleum products are stored properly and a functioning safety shower/eyewash station is available. In addition, the welding area (hot work) is inspected for the absence of flammables, appropriate safety shielding and equipment in good working order.

LAB SAFETY INSPECTIONS – SEMI-ANNUAL

These are inspections of chemistry labs. Inspectors look at chemical labels and storage, neat and tidy work areas, properly functioning safety showers/eyewash stations, and properly functioning fume hoods. They check whether or not Material Safety Data Sheets (MSDS) are easily accessible and that good laboratory practices are followed.

ENVIRONMENTAL COMPLIANCE AUDIT – EVERY 2 YEARS

EPA has developed an Environmental Compliance Audit Initiative for Colleges and Universities. In 2008, Auburn University entered into an Audit Agreement with EPA. Initially, there was a peer review of AU's compliance with environmental regulations. Any deficiencies or problems were corrected at that time and EPA gave amnesty from any fines. After that, Risk Management agreed to be responsible for self-policing the university's compliance. At 2-year intervals, Risk Management does an audit of each facility on campus. They check that there is a SPCC plan in place and that it is being properly carried out. They also check how the unit handles their chemical waste and help with asbestos and lead paint mitigation for repairs, renovations and demolition of pre-1978 buildings.

USDA CATFISH PRODUCTION SURVEYS AND CENSUS

Providing periodic records to USDA regarding various classes of catfish held on and sold from the Farms is required by Federal Law. Every 5 years, a more detailed report is required for preparation of the National Agricultural Census.

CHEMICAL TERRORISM VULNERABILITY INFORMATION

Federal Law requires some chemicals held in certain quantities, must be secured, inventoried and reported. KMnO_4 is one of these.

USFWS DEPREDATION PERMITTEE

Federal permit allows the depredation of a certain number of fish-eating birds each year on the Farms. Records must be maintained on the number taken, annual reports submitted and application filed for new permit each year.

STATE PROPERTY CONTROL

State Law requires a biennial inventory of property items worth over \$5,000. In 2016 there were 122 items in the inventory on the Farms.

ANIMAL WELFARE MANAGEMENT

The Animal Welfare Act was signed by President Johnson in August, 1966. Its provisions require that each research institution receiving federal funds establish an Institutional Animal Care and Use Committee (IACUC). Each Committee includes a veterinarian in its membership.

In order to conduct an experiment using fish, the Principal Investigator(s) must submit a request (Animal Subjects Review Form) to the Committee for a Protocol Number. The Form requires the submission of a highly detailed description of the proposed research, including data bases searched to determine the availability of alternatives, and the expected disposition of the experimental animals after the research is completed. On reviewing the Form, the Committee may approve it as presented, request more information or disapprove it.

An approved Protocol Number is valid for only three years. If a longer time period is required, a new Review Form must be submitted. Annual progress reports are required.

Procedures developed under the provisions of the Act also require that IACUC conduct two formal site inspections of all approved Protocol research being conducted each year, and that additional inspections may be conducted as needed. All pertinent information regarding each specific Protocol must be posted near each research site.

Under the provisions adopted by the IACUC, each live fish under the purview of the School of Fisheries, Aquaculture and Aquatic Sciences at Auburn must be covered by an Approved Protocol. Those being used in specific experiments are covered under Protocols described in the preceding paragraphs; however, by-far the largest share of fish being held by the School are covered by a so-called Standard Operating Procedure Protocol. It includes fish that have been removed from completed experiments, those being held for future experiments, those being held for the market or for sale to live-haulers, as well as all brood fish.

Theoretically, detailed records must be maintained on the current location of each fish, and must be up-dated as they are moved from place to place. The P.I. must also keep detailed records on the care of the fish including feed records, mortality records and water quality checks. Currently, Renee is responsible for maintaining the location records.

Representatives of AAALAC (Association for Assessment and Accreditation of Laboratory Animal Care) conduct inspections every 3 years for compliance with all Animal Welfare regulations. Inspectors are mostly veterinarians and agricultural scientists. Most are employees of Land Grant universities.

Technically it is considered a 'peer review' and not an 'inspection.' They review every aspect of the program involved in animal use, including feed storage and animal holding areas. They also review health records, treatment records, standard operating procedures for the program, disaster plans, IACUC protocols, animal care and safety training records, IACUC inspection records, new employee orientation book, pesticide applicator licenses, records of controlled substances, evidence of compliance with Occupational Health and Safety Programs, and the presence of personal protective equipment (PPE) and records of PPE training.

If they encounter deficiencies in any of these areas, they include them in the preliminary report, and the facility has 10 days to correct the problem(s), at which point they will be removed from the final report. Based on these 'peer reviews, they recommend whether or not accreditation of the Program be continued. Many federal agencies require continued accreditation as a factor in grant and contract approval.

SPECIAL RELATIONSHIPS

Over the long history of the Auburn Fisheries Program, it has received a tremendous amount of encouragement and support from a number of off-campus organizations, both public and private. I am confident that the Program would have never achieved the national and international impact that it has without the assistance provided by these groups. In the following Section, the nature of the relationships with several of the most important ones will be described. Of course, there are many more that deserve consideration, but time and space limitations make it impossible to mention all of them. Many of these relationships have been mentioned briefly in different Sections. Here, more information is included on how they evolved.

THE U.S. DEPARTMENT OF AGRICULTURE

No other outside Agency or group has provided as much support for the Auburn Fisheries Program over such a long period of time as USDA. However, as noted in a preceding Section, in the beginning there was considerable concern whether USDA funds could legally be used to conduct research on recreational fishing. It was argued that research in this area probably belonged within the purview of the Department of the Interior, which had been established in 1849. Finally, it was decided that indeed federal funds could be used to support Auburn's research on fish production for recreation in private ponds. As a result, in every year since May, 1934, when Farm Pond 1 was stocked with fish, some form of USDA funding has been included in the Program's support mix. Some details related to this long-term funding 'stream' will be discussed in the following pages.

Remember that USDA ('the people's department') was created by Abraham Lincoln in May, 1862. However, also remember that USDA was not given cabinet status until 1889. Later in May, 1862, the Homestead Act was passed, and in July, the Land Grant College Act was signed. By 1887, Congress finally realized that USDA needed to play a more formal role in promoting agricultural research in the nation. As a result, in 1887, the Hatch Act was signed into law. The Act was designed to provide dependable annual funding for the State Agricultural Experiment Stations (SAES). Later, it was deemed necessary to provide more positive guidance for the cooperative research efforts between USDA and the SAES; consequently, in October of 1888, the Office of Experiment Stations (OES) was established. In the early years, it had the responsibility of managing the 'flow' of Hatch Act Funds to the SAES.

SOURCES OF USDA FUNDING FOR THE FISHERIES PROGRAM

Over the years, we have received financial support from several groups within the Agency. Generally, however, the funds have been provided by four general sources in the U.S.D.A. Budget:

1. Funds made available through the Hatch Act of 1887.
2. Funds made available as a result of several specific congressional actions.
3. Funds appropriated for USDA's various "in-house" research programs.
4. The Natural Resources Conservation Service.

Details related to the use of these different sources are discussed in the following pages.

HATCH FUNDS

The Office of Experiment Stations (OES) had the responsibility of administering the so-called Hatch funds, which were authorized by the original Hatch Act, and are provided to the State Agricultural Experiment Stations on an annual basis. Approximately 75 percent of those funds were allocated for agricultural research in the individual states (Regular Hatch Funds). The remainder was allocated for cooperative research involving groups of states (Regional Hatch Funds).

'REGULAR' HATCH FUNDS

From the beginning, Regular Hatch Funds have been extremely important to the day-to-day operation of the Alabama Agricultural Experiment Station. For

example, in FY 1939-1940, total funds received from Hatch were slightly greater (\$172.7 thousands versus \$162.3 thousands) than those received from the State of Alabama (State Research). This relationship changed over the years, and by 2014-2015, Hatch Funds represented only about 14 percent of the total.

I am not certain when the Fisheries Program received its first Hatch Funds. As late as FY 1954-1955, none were included. All of the funding for the Program was appropriated annually by the Alabama Legislature; however, by FY 1969-1970, salaries for Dendy, Lawrence and Allison included some of those Federal funds. Remember that at that time, the Program was administered through the Department of Zoology-Entomology. The first FAA Departmental Budget (1970-1971) included \$81,625 from State Research and \$26,860 from Regular Hatch funds. There were no Hatch Regional Funds included. The first Regional Funds (\$6,000) appeared the following year (1972-1973).

The Program continued to receive Regular Hatch Funds for many years. In the 1999-2000 Budget, the Department received \$272,342 from this source. In '04-'05, the total remained at approximately the same level; however, by FY '10, no funds from this source were included in the Budget.

'REGIONAL' HATCH FUNDS

As noted in the preceding paragraph, the first FAA Budget (1970-1971) did not include any Regional Hatch Funds. The first support from this source was added in the following year (1971-1972), and was continued through 1986-1987. Remember that the Hatch Act of 1887 required that 25 percent of the funds had to be used for Regional Research. Later legislation created the Office of Experiment Stations (OES), which had the responsibility of managing the 'Regional' Fund-s. The relevant program activities of the OES was shifted several times within USDA until finally, in 1961, they were assigned to the newly created Cooperative State Experiment Station Service (CSESS). Then in 1963, that Agency was re-designated as the Cooperative State Research Service (CSRS). The Southern Regional Research Project (Freshwater Food Animals – S-83) was developed as a program within CSRS.

REGIONAL PROJECT S-83

The S-83 project was established in October, 1971 for the purpose of promoting cooperative research and the exchange of information among aquacultural scientists within the Southern Region. Seventy-five scientists from twelve Agricultural Experiment Stations and several federal agencies formed the Technical Committee for the Project. This Committee was responsible for developing the annual plans of work. Tom Lovell served as its first Chairman. Beginning in 1972, R. Dennis Rouse, then Dean of the

School of Agriculture and Director of the Agricultural Experiment Station at Auburn, became Administrative Advisor for the Project.

The initial research protocol called for cooperative work in the following areas:

- 1. Production**
 - a. Nutrition**
 - b. Breeding and Genetics**
 - c. Water Quality**
 - d. Diseases**
 - e. Culture Systems**
- 2. Economics**
- 3. Product Development**
- 4. Quality Assurance**

In 1978, CSRS was abolished and its programs were assigned to the Cooperative Research staff within the newly created Science and Education Administration (SEA). S-83 continued to operate as originally developed within SEA until the project was terminated in 1981.

REGIONAL PROJECT S-168

SEA was abolished in 1981 and replaced with a new, independent version of CSRS. The new version of the Regional Aquaculture Research Project, S-168, was administered by this new agency. S-83 was officially terminated in September, 1981, and immediately replaced by S-168 (Warmwater Aquaculture). It was scheduled for termination in September, 1986. The new project represented a continuation of S-83, except that it would also include research on the culture of estuarine species. Further, it would also place some emphasis on technical assistance and extension education programs. With this expansion of mission, additional institutions within the Region became involved. In 1980, R. Dennis Rouse, who had served as Administrative Advisor for the regional projects, vacated the position of Dean and Director at Auburn, and Gale Buchanan was selected to fill the position. Buchanan served as Administrative Adviser for S-168 until he left Auburn in 1985.

In S-168, the Southern Region Research Development Committees (SRDC) provided leadership in these areas of research:

- 1. SRDC-85-12 Finfish Production Systems.**

2. SRDC-87-01 Nutrition and Feeding.
3. SRDC-87-02 Product Development and Quality Control for Processing.
4. SRDC-87-03 Water Quality Management.
5. SRDC-87-04 Technology Development/Transfer of Crustacean Aquaculture.
6. SRDC-87-05 Reproduction, Genetics and Breeding.

These SRDCs remained functional until 1989. When the Southern Region Aquaculture Center (SRAC) was established in 1986, within the Cooperative State Research, Education, and Extension Service (CREES), the research component was removed from S-168. Consequently, it was reorganized as the Southern Region Information Group (SRIEG-41). Its sole purpose was information exchange among regional aquacultural scientists. There was no research funding associated with it, and only a little money for travel. After the SRAC was established, participants in SRIEG-41 often met in conjunction with its annual meeting.

In 1991, SRIEG-41 was re-organized to become the Southern Extension and Research Information Group for Aquaculture (SERA- IEG-9). During the period 1991-1994, the information exchange project was administered through CSRS. In 1994, the Cooperative State Research Service (CSRS) and the Extension Service (ES) were combined to establish the Cooperative State Research, Education and Extension Service (CREES). Coordination of SERA-IEG-9 activities was handled by CREES until, as a result of a lack of interest and participation, it was not renewed in 2008.

THE SOUTHERN REGIONAL AQUACULTURE CENTER (SRAC)

The Regional Aquaculture Centers (RACs) were authorized by Congress by Title XII of the Agriculture Act of 1980 and the Food Security Act of 1985. The Southern Regional Center was organized in 1987. It is housed at the Mississippi State University (MSU) Delta Research and Extension Center, located at Stoneville, MS. MSU serves as the host institution. Initially it was administered through CREES; however, as a result of language in the 2008 Farm Bill, CREES was abolished and its various functions became part of a new USDA entity – the National Institute of Food and Agriculture (NIFA).

Dr. Jimmy Avery currently serves as Director of the Southern Regional Aquaculture Center (SRAC). Dr. Craig Tucker serves as Research Leader of the USDA Warmwater Aquaculture Research Unit. Craig was awarded the Terminal Degree by Auburn in 1978. Boyd served as Chairman of his

Graduate Committee. After graduation, he joined the Faculty of Mississippi State University. He served for many years as Director of their Aquaculture Research Program. He joined USDA (ARS) in 2011.

SRAC was established to support cooperative research in aquaculture in thirteen states and two territories in the Southern Region. Its on-going program was to be largely determined by a Board of Directors, an Industry Advisory Council, and a Technical Committee. Federally-funded research and extension projects were developed by *ad hoc* working groups. Its first research and extension projects were initiated in 1988. Over the years, the Department received a substantial amount of funding from this USDA agency. Details related to their contributions have been included in a number of SRAC Publications and journal articles. Lists of all of these sources of information are available at: srac.msstate.edu/researchpubs.

SPECIFIC CONGRESSIONAL ACTS

As noted in a preceding paragraph, the Hatch Act was signed into law in 1887. It made federal funds available for the support of agricultural research in the individual states and groups of states. However, in the early 1900s, some members of Congress became dissatisfied with certain aspects of the administration of the Act, which they sought remedy through additional legislation. As noted in preceding Sections, funding from three of these Acts played a role in the evolution of the Fisheries Program:

1. The Adams Act.
2. The Purnell Act.
3. The Bankhead-Jones Act.

Comments related to each of these funding sources follow.

THE ADAMS ACT

In March of 1906, President Theodore Roosevelt signed an Act related to the funding of agricultural research in the nation's Agricultural Experiment Stations (SAES). Sponsored by Representative Henry C. Adams of Wisconsin, it increased the annual allocation of USDA funds to each SAES from \$15,000 to \$30,000. It also required that all funds should be expended only for original research. The language of the Hatch Act had not been that restrictive.

As noted in a preceding Section, in 1934-1935, Swingle received an annual salary of \$3,060. A portion (\$260) came from State Research, and the remainder (\$2,800) came from Adams funds. At that time, he was being paid

to work on a project in insect physiology. Although he had begun to work on the establishment of the Fisheries Program in 1934, he continued to be paid from the same sources (Adams and State Research) in 1934-1935 and 1935-1936. I have no record on the source of his salary in 1936-1937.

THE PURNELL ACT

The Purnell Act was passed by Congress in 1925, and the Office of Experiment Stations (OES) was given the responsibility of managing the funds authorized by the Act. These funds were to be shared equally by the State Experiment Stations over a 5-year period. They were authorized primarily for supporting agricultural research related to economics and sociology; although the Stations were given considerable leeway in deciding how to use them. Recall that funds from this source provided some of the initial support for the establishment of the Fisheries Program.

The 1936 Experiment Station Annual Report included summaries of both Swingle's Adams-sponsored work on insect physiology and fish food production, which was partially funded by Purnell. Apparently, at that point, his salary for the fish food work was also partially paid from Adams, and maintenance costs for the fish food organisms research was paid by Purnell.

THE BANKHEAD-JONES ACT

The Bankhead-Jones Act of 1935 provided additional funds for the support of research at the nation's Agricultural Experiment Stations. The primary sponsor of the Act, John Bankhead, a native Alabamian, served in the U.S. Senate from 1907 until his death in March, 1920. The Act encouraged the SAES to use the funds primarily for research in the following areas:

1. Laws and principles underlying the basic problems of production.
2. Development of new and improved methods of production.
3. Development of new and extended uses and markets for agricultural commodities.
4. Research on conservation and use of land for agricultural purposes.

The Act also provided for a basic change in the allocation of federal funding for agriculture. The Hatch funds were shared equally by all states. Bankhead-Jones retained this provision, but also added a new provision. It appropriated additional funds that were to be distributed on the basis of a state's share of the U.S. population. The Act also added a provision where, for the first time, States were required to "match" their federal allocations with non-federal funds.

The 1937-1938 Zoology-Entomology Budget indicates that all of Swingle's salary was paid from Bankhead-Jones. Also, the Fisheries Program Annual Report for Calendar Year 1938 indicated that it was a Bankhead-Jones Project. Subsequent Annual Reports through 1956 also indicated the same primary source of funding for the Program. The 1957 Report indicated that it was a State Research Project (417). There was no indication that Bankhead-Jones was involved in any way.

THE 1955 HATCH ACT

Congress amended the Hatch Act in 1955. The amended version continued its basic support for the Agricultural Experiment Stations, and included the funding mechanisms of the Adams Act of 1906, the Purnell Act of 1925, and the Bankhead-Jones Act of 1935.

USDA 'IN-HOUSE' RESEARCH

From its beginning in 1862, USDA has conducted a large amount of in-house research in all areas of agriculture. Over the years, several independent research groups (Bureaus) were established within the Agency. In 1942, the Agriculture Research Administration (ARA) was established to coordinate the activities of the Bureaus and the Regional Research Centers. Then in 1953, ARA was abolished along with a number of the Bureaus. It was replaced by the Agricultural Research Service (ARS).

WEED CONTROL DIVISION

According to the Annual Report of the Farm Ponds Project for 1958, the Weed Control Division within ARS contracted with Auburn University to screen newly developed chemicals for herbicidal activity. In most cases, the chemicals were identified by only a number. This contract funded this research for a 2-year period, but it was extended for several years until it was finally terminated after 1962. During this period, John Lawrence and his Work Group screened hundreds of chemicals, both in the laboratory and in plastic pools at the Sougahatchee Farm.

AQUATIC ANIMAL HEALTH RESEARCH

The Regional Animal Disease Research Laboratory at Auburn was one of four such institutions established within USDA under provisions included in the Bankhead-Jones Act of 1935. It was established to conduct research on the control of important livestock diseases. The Auburn laboratory was officially established in 1938, with Dr. Bennett T. Sims serving as Director. For many years, the Laboratory was located on Wire Road – west of the present-day varsity tennis complex. Later, its offices and various programs were transferred to a new facility further out Wire Road; after the College of

Veterinary Medicine Department was later assigned space in the various vacated buildings near the tennis center.

In 1982, Dr. Phillip Klesius was appointed Director of the Laboratory, replacing Dr. Wilford Bailey (1980-1982). In 1992, ARS made the decision, with considerable support from Senator Howell Heflin, to change the mission of the Laboratory from research on the control of farm livestock diseases to research on control of diseases of aquatic animals. As a result, the name of the program was changed to Aquatic Animal Health Research Laboratory (AAHRU).

The primary mission of the AAHRU was to find ways of reducing the impact of infectious diseases on the commercial production of channel catfish. Research at the Laboratory has focused on fish parasitology, microbiology, immunology, nutrition and their effect on fish health. Special emphasis has been on the development of vaccines for the control of bacterial diseases.

In the late 1990s, John Jensen and Phil Klesius were able to secure funding from USDA for cooperative research on catfish diseases. Annually, for well over a decade, approximately \$1 million of these so-called 'pass-through' funds were shared with the Department. Much of it was used for the training of graduate students in various aspects of fish health research. Remember that the Mellon Foundation Grant provided funds for the development of the fish breeding and genetics facility. The University agreed to provide the funding for its operation. The USDA funds provided through the ARS Laboratory were extremely valuable for that purpose. Further, Laboratory personnel provided invaluable assistance in the Graduate Training Program by serving on many graduate advisory committees.

When Dr. Klesius retired, Dr. Benjamin Beck was named Research Leader for the Laboratory (2015). Ben received B.S. (2002) and M.S. (2005-Grizzle) Degrees in Fish Management from Auburn. He was awarded the Ph.D. Degree (Molecular and Cellular Pathology) from the University of Alabama-Birmingham in 2009.

The current research program of the Laboratory includes reducing the use of chemicals and drugs, such as antibiotics, in the production of aquatic animals through a multidisciplinary approach. This approach consists of the application of genetics and genomics of host and pathogen, parasite-host interactions (Xu, et al., 2014), disease resistance phenotyping to examine additive genetic variation against economically important diseases of tilapia (LaFrentz, et al., 2016 and Shoemaker, et al., 2017), infectious disease modeling (Zhang, et al., 2016), vaccine development and evaluating dietary interventions that maximize fish performance and health.

The following publications are indicative of the kinds of research in fish health that personnel of AAHRU have completed over the years:

1. Nutrition and fish health (Lim and Webster, 2001).
2. Enhanced susceptibility of hybrid tilapia to *Flavobacterium columnare* after parasitism by *Ichthyophthirius multifiliis* (Xu, et al., 2014).
3. Replicating viruses (Shoemaker and Klesius, 2014).
4. Optimized reverse primer for 16S-RFLP analysis and genomovar assignment in *Flavobacterium columnare* (LaFrentz, et al., 2016).
5. Experimental induction of motile *Aeromonas septicemia* in channel catfish by waterborne challenge with virulent *Aeromonas hydrophila* (Zhang, et al., 2016).
6. Additive genetic variation in resistance of tilapia (*Oreochromis niloticus*) to *Streptococcus iniae* and *S. agalactiae* capsular type Ib: Is genetic resistance correlated (Shoemaker, et al., 2017).

Over the years, several FAA graduates have worked or are still working at the Laboratory: Chhorn Lim, '77; De-Hai Xu, '88; Joel Bader, '90; Craig Shoemaker, '96; Mary Delaney, '00; Benjamin Beck, '02 and '05; Mediha Yildirim-Aksoy, '03; Shawn McNulty, '04; Richard Whittington, '05; Julio Garcia, '07 and Alyssa Wiedenmayer, '07.

THE NATURAL RESOURCES CONSERVATION SERVICE

Over the years, personnel of USDA's Natural Resources Conservation Service (NRCS) have been extremely important collaborators in the evolution of the Fisheries Program at Auburn. This agency was known as the Soil Conservation Service until 1994. Established at nearly the same time in the early 30s, both NRCS and the Fisheries Program played important long-term roles in the utilization of soil and water resources in the nation.

As detailed in a preceding Section, without question, employees of USDA's Soil Conservation Service (SCS) were primarily responsible for the rapid progress of national recognition of the Fisheries Program. By 1936, the agency had employees in every state working in the broad field of soil erosion, and in a large number of states, the management of water run-off from cultivated fields was also a major concern. Later, many of their employees began to understand that the construction and management of farm fish ponds led directly to increased interest by landowners in adopting

good soil and water conservation practices. Ponds that provided good fishing only enhanced this interest.

The establishment of SCS was an extremely fortuitous development for creating an interest in fishing in impounded rainfall on private land. Nationwide, most state fish and game agencies were forbidden by law to provide technical assistance to private landowners. Further, State Agricultural Extension Service employees generally had little interest in promoting pond construction and fishing. Their primary mission was the production of crops and livestock.

Federal concerns for soil erosion and conservation were formally 'institutionalized' with the establishment of the Soil Erosion Service (SES) within the Department of the Interior in 1933. Then in 1935, the program was transferred to USDA. Shortly after its transfer, it was combined with several other USDA units to establish (Soil Conservation Act, PL74-46) the Soil Conservation Service as an independent unit. In the mid-90s, the mission of the agency broadened; consequently, in 1994, the Soil Conservation Service became the Natural Resources Conservation Service.

Initially, local SCS activities were administered through regional offices. Alabama was part of the Southeastern Region which included Florida, Georgia, Mississippi, North Carolina, South Carolina and Virginia. Later, the primary administrative responsibility would be shifted to State Offices. In 1935, Richmond Y. Bailey was appointed the first Head of the SCS office in Alabama.

THE VERN DAVISON CONTRIBUTION

Auburn pond management technology 'swept' rapidly across the nation following the publication of Bulletin 254 – *Management of Farm Fish Ponds*. Although the history of its widespread acceptance in such a short period of time is poorly documented, it is likely that Vern Davidson, Regional Biologist with SCS, played a major role in its rapid adoption. Vern E. Davidson was a native of Kansas; although his family moved to Oklahoma when he was 5 years old. He was a 'self-taught' wildlife biologist. The Oklahoma Department of Game and Fish recognized his acquired expertise when they hired him in 1931 to demonstrate wildlife management techniques on ranches in the State. He joined the newly-established Soil Conservation Service in 1935 as Wildlife Biologist for the Upper Mississippi Region. Later, in 1937, he became the Biologist for the Southeastern Region. I can find no record of when Davison might have first visited Auburn and the Fisheries Program. Remember that the 'Eureka' Experiment was initiated in Farm Pond 4 in 1939. Sometime during the period 1939-1942, Davidson must have had the opportunity to see and understand what was happening in Farm Pond 4 and at Auburn. He also likely understood what the technology being developed

here for constructing and managing so-called 'terrace-water' ponds could mean for the future of the mission of the newly-created Soil Conservation Service.

According to Annual Report information, Vern Davidson attended the Pond Management Short Course taught by Swingle and the Auburn Faculty during the period June 7-11, 1948. Additional details concerning these informal courses were presented in a preceding Section. Later that year, Auburn faculty presented a short course to SCS Biologists in the Northwest.

NATIONAL AQUACULTURE ACTIVITY TEAM

In 1980, SCS established the National Aquaculture Activity Team. The objectives of the Team were to:

1. Develop SCS aquaculture policy.
2. Evaluate state aquaculture activities.
3. Assist with SCS aquaculture coordination at the federal, state and local levels.
4. Assist specified states in developing resource assessments on aquaculture needs.
5. Develop technical standards on aquaculture and related conservation practices.
6. Develop informational and educational materials.
7. Assess aquaculture training needs of the SCS and develop training programs.

Jesse Bush, an engineer with the Alabama State SCS Office, was chosen as Team Leader. Other members on the Team included Earl Norwood, SCS Biologist from Grenada, MS and Ellis Prather from FAA. The Team office was located at the Fisheries Annex on Wire Road (which was the vacated office of the Regional Animal Disease Research Laboratory).

HENRY MILLER AND THE 'B' PONDS

SCS and NRCS personnel assisted the Department with a number of projects over the years. As noted in a preceding Section, one of these projects was the design of the 'B' Series of ponds by Henry Miller, engineer with NRCS (Figure 18D). Additional details regarding the details of construction were presented in a preceding Section. Over the years, this Series, completed in

1981, has become one of our most valuable because of the flexibility it provides in the harvest and holding of fish from the up-land ponds on the Farms. They are a vital part of the School's fish sales efforts.

NATURAL RESOURCE CONSERVATION & DEVELOPMENT COUNCILS

As detailed in a preceding Section, one of the more important collaborative efforts between FAA and agencies of USDA involved a project to establish the cage culture of channel catfish as a viable commercial industry in the Coosa Valley. It involved a long-term collaborative effort between the Coosa Valley Resource Conservation and Development (RC&D) Council and the Department. The Resource Conservation and Development (RC&D) Council concept was developed by the U.S. Department of Agriculture in the early 1960s, and implemented in the field by the Soil Conservation Service. These organizations were established to help address rural poverty concerns in the various states and to encourage rural communities to establish sustainable natural resource-based economies. Individual Councils were established in different areas, judged to be critical 'centers' of rural poverty. The Councils are composed primarily of local community leaders who serve as volunteers to help identify projects in their communities that are expected to have a good likelihood of help in efforts to relieve rural poverty. Councils receive both state and federal funds to support their efforts. The Coosa Valley RC&D Council was the first one established in Alabama (1965). Perez (2006) describes the stages in the evolution of this Project in detail.

THE ALABAMA SOIL AND WATER CONSERVATION COMMITTEE

Including the Soil and Water Conservation Committee (SWCC) within the USDA agencies collaborating with the Department may seem strange, because the SWCC was established by the Alabama Legislature in 1939 through the passage of the Soil Conservation Act. However, as its website suggests, SCS and SWCC were 'joined-at-the hip' from the beginning. This agency (SWCC) would play a major role in the early establishment and operation of the West Alabama Fish Farming Center described in a preceding Section. From the beginning, this Center has played a major role in the evolution of the commercial catfish production industry in west central Alabama and east central Mississippi.

In 1936, Congress passed the Soil Conservation and Domestic Allotment Act, which allowed the federal government to pay farmers to reduce crop production in order to 'conserve soil' and prevent erosion. In turn, the enactment of this federal legislation made it necessary to establish a locally controlled agency in each state to administer the utilization of the funds. As a result, USDA sent each governor proposed language for the enactment of legislation which would establish Soil Conservation Districts in each state. As noted in the preceding paragraph, this legislation was enacted in Alabama

in 1939. The early federal legislation also mandated that the Soil Conservation Service would work closely with these local Districts in cooperative projects designed to reduce soil erosion. It further required that any payments to land owners designed to reduce soil erosion would be contingent on certification by SCS (now NRCS), and that practices for which payment were being made met SCS standards and specifications. Later, the missions of these cooperating agencies would be expanded to include water conservation.

The Alabama legislation also provided for the establishment of the Alabama Soil Conservation Committee (later to become the Alabama Soil and Water Conservation Committee) to coordinate the activities and provide leadership for 67 local county Soil and Water Conservation Districts. Further, the legislation also called for the establishment of a State staff charged with conducting the day-to-day activities of the Committee. In the early 1980s, this Committee would provide leadership for the development of the Alabama Fish Farming Center. Many of the details related to the establishment and operation of the Center were presented in a preceding Section.

ALABAMA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

Almost from the beginning of the Fisheries Program at Auburn in the early 30s, the Alabama Department of Conservation in its various forms has been one of its most supportive collaborators. As early as 1939, Swingle and Smith were involved with the Department in helping them determine whether a 'closed season' on recreational fishing was needed in Alabama. They concluded that, given the reproductive potential of fish species found in state waters, a 'closed season' was not warranted. Later beginning in 1946, Auburn 'Investigators' assumed the responsibility of managing the state's fish hatcheries at Spring Hill, Lane Park and Estaboga. This arrangement continued until the Fisheries Section was established in 1951.

HISTORICAL¹⁶

Documents maintained by the Commission of Public Records indicates that the first regulations pertaining to hunting and fishing in Alabama were published in the 1867 Code of Alabama (Sections 3750-3753). These regulations prohibited the hunting of deer at night with fire and gun, and poisoning a stream to catch fish. In 1891, the legislature established the position of State Oyster Inspector, and gave him the responsibility for the enforcement of oyster laws. In 1907, the legislature conferred upon the State legal ownership of all wild birds and game not privately owned, and

¹⁶ I am deeply indebted to Johnie Crance for assembling much of this historical information.

established the Department of Game and Fish to supervise the state's interest. Beginning in 1915, the legislature began to consolidate all of the various agencies and offices responsible for natural resources and wildlife management within the Department of Game and Fish. When the consolidation was completed, they renamed it the Department of Conservation. The name was changed again in 1923 to the Department of Game and Fisheries, and again in 1935 to Department of Conservation of Game, Fish and Seafood. In the same year, a seven-member Conservation Board was established. Then in 1939, the legislature abolished the Conservation Board and the Department of Conservation of Game, Fish and Seafood, and replaced them with the Advisory Board of Conservation and the Department of Conservation. Within the Department they established a Division of Game, Fish and Seafoods; a Division of Forestry; and a Division of State Parks, Monuments and Historic Sites. In 1945, the Office of Land Agent was moved to the Department of Conservation. In 1951, the work in seafoods was removed from the Division of Game, Fish and Seafood to create a new Division – the Division of Seafoods. In the same year, the Fisheries Section was established. Then in 1959, the Water Safety Division was established. In 1971, the name of the Department was changed once again to the Department of Conservation and Natural Resources.

FISHERIES SECTION¹⁷

As noted in the preceding Section, in 1951, the Fisheries Section was established within the Department. Earl McGowan of Butler County was Director of Conservation at about the time the new Section was established. I. B. (Buck) Byrd was employed as new Chief of the Section (Biologist III) and D. D. (Don) Moss (Biologist II) was employed to assist him. Later, Archie Hooper was also employed and John Hester was transferred from the Parks Division.

Appendix Table 10 provides a list, in chronological order, of some of the events related to the development of recreational fishing in Alabama and the role of the Section in its efforts to manage it.

Buck Byrd continued to serve as Chief of the Section until 1965, when he left to take the position of Federal Aid Coordinator for the Southeast Region with the National Marine Fisheries Service. Other persons serving as Chief included:

- Archie Hooper (1965-1971)
- Sam Spencer (1971-1982)

¹⁷ I am deeply indebted to Nick Nichols for providing information on the more recent developments of the Activities of the Fisheries Section.

- Barry Smith (1982-1986)
- Clarence White (1986-1990)
- Fred Harders (1990-2000)
- Stan Cook (2000-2015)
- Nick Nichols (2015-Present)

State funding for the new Section came primarily from the sale of fishing licenses (Figure 123). As was the situation with fisheries work in most states at that time, no appropriated funds were made available for its operation. Fortunately, about the time the new Section was established, federal funds from the Federal Aid in Sport Fish Restoration Act of 1950 (Dingle-Johnson Funds) were being made available to the States. Alabama utilized its first allocation (\$30,600 in 1952) to conduct a state-wide assessment of fisheries resources and for the construction of Oak Mountain Lake in Jefferson County.

Collaboration between Auburn and the Alabama Department of Conservation (ADC) began shortly after the end of World War II, when the Department contracted with the Agricultural Experiment Station for Fisheries Program personnel to manage the state's Fish Hatcheries during the period 1946-1950. During this same period, the two groups collaborated in the collection of fish from a 3-acre area of Lake Martin (Blue Creek) using rotenone. Later, after the establishment of the Fisheries Section (1951), they collaborated in a project to study the effect of the stocking (1957) of threadfin shad on the fish population of Lake Martin. This study, conducted from the late 50s through the early 60s, made extensive use of rotenone sampling.

After Auburn ended its supervision of the State Fish Hatcheries, ADC continued to make \$5,000 available annually to the Fisheries Program to conduct research on pond management. In 1959, the amount was increased to \$15,000 annually and in 1962, it was increased again to \$20,000. In the late 50s, ADC decided to support the continuing collaborative effort with Auburn with Federal Aid Funds. Unfortunately, those funds could not be used for research that would provide direct benefits to private land-owners. That was a matter for the U.S. Department of Agriculture to deal with; not the U.S. Department of the Interior. As a result, in 1960, the ADC contract was restructured as a regular Federal Aid Project (*Management Techniques for Public Fishing Waters – F10-R-1*) with the same accountability and reporting requirement as other Federal Aid projects. Funding from Federal Aid was maintained at a level of \$20,000 for a number of years. Eventually, when the Fisheries Program became involved with international 'outreach' in 1967, it was terminated. The termination of this ADC-supported research also marks the approximate end of the long-term collaborative effort of sampling the fish populations of Alabama's rivers and reservoirs with rotenone.

The U.S. Corps of Engineers Project to study the transitioning of the riverine system to a lacustrine system on the Chattahoochee River near West Point, GA was described in considerable detail in a preceding Section. Publications produced in the study described the sampling techniques utilized there. Although some rotenone sampling was employed in the pre-impoundment phase, extensive electro-fishing and creel studies became the primary 'tools' employed once the reservoir reached full-pool. The results obtained in the West Point Study demonstrated the utility of non-rotenone sampling of fish population studies on rivers and reservoirs. As a result of the collaborative studies of ACD and Auburn Fisheries, scientists began to use them routinely.

One of the first collaborative projects utilizing the 'West Point' population sampling protocols involved a study conducted by Jeff Reed and Bill Davies (1991) on the population dynamics of black and white crappie on Weiss Reservoir in the late 80s. They utilized electro-fishing and trap nets to collect fish, and tagging studies and creel surveys to obtain additional information. Support for the project (F-40) was made available from Alabama's share of funds from the Federal Aid in Sport Fish Restoration Act (D-J Funds).

Later, during the period 2002-2008, Dennis DeVries, Rusty Wright (2005) and a large number of graduate students were involved in a long-term project studying the population dynamics of largemouth bass in the waters of the Mobile Delta. Several Fisheries Section biologists were also involved. This long-term study involved extensive use of electro-fishing to collect samples of largemouth bass. It also involved the use of a tagging study, aided by the use of acoustic telemetry. They also were able to utilize data collected from a local fishing tournament. This research was also supported by D-J Funds (F-40-R).

During the period 2006-2007, Mike Shepard and Mike Maceina (2009) used monofilament gill nets and electrofishing to collect fish in their collaborative study on the effect of stocked striped bass on populations of largemouth and spotted bass in Smith Lake. This work was also supported by Federal Aid Funds.

Numerous other collaborative studies by Section and FAA personnel have been completed over the years. Many of them were listed previously in the descriptions of the activities of various Departmental Work Groups.

MARINE RESOURCES DIVISION

As noted in a preceding Section, the Seafoods Division was established within the Department of Conservation in 1951. In the following year, the Seafoods Office which had been located on Dauphin Island at Cedar Point, was moved to a new building at Bayou LaBatre. In 1971, the name of the Division was changed to Marine Resources (MRD). John Rockwell was

appointed Director of the Seafoods Division when it was established in 1951. Other individuals serving in the position in subsequent years included:

- B. Larimore (1951-1954)
- Ralph Allen (Acting) (1959)
- George Allen (1959-1966)
- William Anderson (1966-1974)
- Wayne Swingle (1974-1977)
- Hugh Swingle (1977-1990)
- Vernon Minton (1990-2010)
- Chris Blankenship (2011-2017)
- Vacant (Major Scott Bannon is serving as Acting Director).

The Claude Peteet Mariculture Center was completed in December, 1973 (Figure 97). It is located adjacent to the Intracoastal Waterway, just north of Gulf Shores in Baldwin County.

As noted in a preceding Section, in the early years, the Auburn Fisheries Program was only minimally involved in any aspect of marine science in the northern Gulf. In 19781, the Alabama Legislature established the Marine Sciences Environmental Consortium. Initial membership in the Consortium included Auburn University and 16 other institutions of higher learning in the State. The Legislature later institutionalized the Consortium by providing funds for the establishment and operation of the Dauphin Island Sea Lab (DISL) as Alabama's Marine science Education and Research Center. However, the Fisheries Program was generally not directly involved in any of these developments.

There are no records of the Fisheries Program receiving funding from the Seafoods Division until 1967. In 1965, Congress passed the Anadromous Fish Conservation Act (PL 89-304). The National Marine Fisheries Service (NMFS) was assigned the responsibility of implementing the provisions of the Act. The Act authorized the use of federal funds for the states to conduct work on the conservation, development and enhancement of anadromous fish. It also required that they would have to provide 50 percent of all project costs. About that time Johnie Crance was employed to serve as Federal Aid Coordinator for the Alabama Marine Resources Division (MRD). I. B. Byrd was the Federal Aid Coordinator for NMFS. Remember that Byrd served for a number of years as Chief of the Fisheries Section in Alabama. At that time MRD was not in position to provide the 'match' for the federal funds. As a result, the decision was made to 'pass-through' the funds to Auburn to conduct research on the intensive culture of striped bass fry. I was Project Leader. Most of the grant funds were used for hiring graduate students to conduct the actual research. The project was continued for several years, and provided assistantships for a number of students before it was

terminated. Details regarding research results were presented in a preceding Section.

In 1984, the mission of MRD changed significantly with congressional approval of the Wallop-Breaux Amendment to the Fish Restoration Act of 1950 (Dingell-Johnson). This Amendment required that all federal funds given to the states had to be apportioned between freshwater and marine fish restoration efforts.

In 1997, Vernon Minton, Director of the Division, made a series of ponds and support facilities available to David Rouse and his graduate students to conduct research on the production of marine shrimp. This research was supported by funds from the 'CASH' Project. Details regarding the Project were included in the Section on AUMERC. Later, when Allen Davis joined the faculty, he and his graduate students assumed primary responsibility for the shrimp research. The Division continued to actively support this research until the ponds were renovated in 2013.

As detailed in a preceding Section, Auburn University formally established the Marine Extension and Research Center (AUMERC) in 1989. With this development, the Agricultural Experiment Station and the Department quickly began to develop a research program to complement its already active marine extension program. With Auburn personnel and funding available for research in the marine resources area, the Division quickly began to take advantage of MRD personnel as active collaborators. In the early 2000s, the Division funded several studies on oyster reef biology and production by David Rouse and his graduate students. Steve Szdelmayer was employed by the Department in 1990, specifically to conduct research in marine fisheries. Since that time, the Division has provided long-term support for his research on the biology of the red snapper and implication for management. In 2002, Ron Phelps and his graduate students began research on the induced spawning of red snapper and larval culture. The base of operations for the work was the Claude Peteet Mariculture Center. This research was continued for several years and was actively supported by the Division.

In 2009, Bill Walton joined the faculty as an Extension Specialist, and was assigned to the AUMERC program, where he was expected work to with the oyster harvesting industry. As part of his responsibility, he began to work on developing technology associated with 'off-bottom' culture. From the beginning, the Division has been extremely supportive of his work. They have been especially helpful in developing the regulatory framework required for private oyster production in state waters.

Historically, the Seafoods Division was primarily concerned with the management of Alabama's shellfish resources; however, over time, its area of responsibility has literally exploded to include all aspects of the

commercial fishing industry (oyster, shrimp, finfish, etc.). That large area of responsibility has grown even larger and more complex with the increasing importance of the marine recreational fishing industry. As a result, the Marine Resources Division has become involved in several complex jurisdictional issues including: management of the commercial/recreational fishery for shrimp, the commercial/recreational gill-net fishery, and the federal/state management of snapper grouper and triggerfish resources. In addition, they are now deeply involved in all aspects of a large 'artificial' reef program.

Recently the Division has taken a very pro-active role in the management of red snapper and triggerfish resources in State waters. For a number of years, the Gulf of Mexico Fisheries Management Council has been primarily responsible in setting regulations on the management of these species. Recent events suggest that the individual States should have more input into the management of these resources. MRD has played a leading role in these deliberations.

In 2017, Chris Blankenship was promoted to the position Deputy Commissioner in the Department. Scott Bannon was appointed Acting Director of the Division in April, 2017.

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT¹⁸

Early collaboration between Auburn's Fisheries Program and the Alabama Water Improvement Commission (AWIC) was described in detail in a preceding Section. Then in 1949, AWIC had a contract to study the effect of water pollution on fish stocks in the Coosa River. Later, the Legislature replaced AWIC with the Alabama Department of Environmental Management (ADEM). Subsequently, the new agency has been one of the Fisheries Program's most important collaborators.

HISTORICAL

Recall that Congress passed the Federal Water Pollution Control Act in 1948. It established the basic structure for regulating pollutant discharges into waters of the United States. It also gave individual states most of the responsibility for dealing with the growing problem. Passage of this national Act lead to the establishment of the Alabama Water Improvement Commission. Later, in 1982, the Alabama Legislature approved the Alabama

¹⁸ I am deeply indebted to Fred Leslie for assembling this information on ADEM. Before retiring, he served as Chief of the Montgomery Branch of the Field Operations Division of ADEM.

Environmental Management Act. This Act established the Alabama Environmental Management Commission and created the Alabama Department of Environmental Management (ADEM). All responsibilities of AWIC were transferred to the new agency. The same Act also transferred to ADEM several other commissions, agencies and programs. With these changes, the Commission became responsible for implementing virtually all of the environmental laws in the State.

Joe Broadwater as the first Director of ADEM. He served in that position until 1985. Other individuals serving in that capacity include:

- Leigh Pegues – 1985-1993
- James Warr (Acting Director) – 1993-1994
- John Smith – 1994-1995
- James Warr (Acting Director) – 1995-1996
- James Warr – 1996-2004
- Trey Glenn – 2005-2009
- James Haygood – 2009-2010
- Lance LeFleur – 2010-Present.

ADEM SUPPORT FOR WATER QUALITY RESEARCH IN PUBLIC WATERS

The Lawrence-Bayne's Work Group in the Department's Rivers and Reservoirs Laboratory has received a large amount of ADEM funding over the years. In 1989, it received funding for conducting studies related to 'Water Quality Assessment of Alabama Lakes.' Then, from 1990 through 1994, the Work Group participated in ADEM's Clean Lakes Program. This collaboration resulted in studies being completed on West Point, Weiss and Walter F. George Reservoirs and on Neely Henry and Lewis Smith Lakes.

Over the years, Claude Boyd, Rick Wallace and Elise Irwin (Alabama Cooperative Fish and Wildlife Research Unit) also received agency funding for water quality-related research. Reports detailing accomplishments of some of these projects were listed in a preceding Section. A number of the reports are maintained by the Department of Special Collections and Archives of the RBD Library (Record Group 240, Accession Number 08-027).

SUPPORT FOR THE DEVELOPMENT OF THE ALABAMA 'WATER WATCH' PROGRAM

The Alabama Water Watch Program (AWW) has been one of the Department's most successful outreach efforts. Details related to the establishment of this Program and its activities were presented in a preceding Section.

UNITED STATES DEPARTMENT OF INTERIOR

Over the years, collaboration with different agencies within the Department of the Interior have been extremely beneficial to the Auburn Fisheries Program. The more specific details have been included in preceding Sections. Here, details from a more historical perspective are presented.

HISTORICAL

Information provided by the Department of the Interior notes that from the early days of the Republic, there was considerable interest in establishing a Cabinet-level Department that would take responsibility for managing the nation's internal affairs. Finally, on the last day of the 30th Congress (1847-1849), March 3, 1849, the Act establishing the Department of the Interior was passed. After its establishment, a number of federal agencies was moved into it (General Land Office, Patent Office, Indian Affairs Office). Over the years, there were numerous changes in the composition of the Department, but in recent years, it has included the following nine Technical Bureaus:

1. Bureau of Indian Affairs
2. Bureau of Land Management
3. Bureau of Ocean Energy Management
4. Bureau of Reclamation
5. Bureau of Safety and Environmental Enforcement
6. National Park Service
7. Office of Surface Mining, Reclamation and Enforcement
8. U.S. Fish and Wildlife Service
9. U.S. Geological Survey
10. National Biological Survey.

Collaboration with the Department has primarily involved two of them: The U.S. Fish and Wildlife Service and the U.S. Geological Survey.

THE U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service was not officially created until 1940, but its function had been established in 1871 with the creation of the U.S. Fish

Commission. The Commission was created as an independent agency with the mandate of studying the causes for the decline of commercial fish and other aquatic animals in the coastal waters of the United States. It included three divisions:

- 1. Division of Inquiry Respecting Food-Fishes and Fishing Grounds.**
- 2. The Division of Fisheries.**
- 3. The Division of Fish-Culture.**

In 1903, Congress established the Department of Commerce and Labor and the Fish Commission was moved to this new Department as the United States Bureau of Fisheries. In 1939, the Bureau was transferred to the U.S. Department of the Interior. Then in 1940, it was merged with the Division of Biological Survey to form the new United States Fish and Wildlife Service (USFWS). In 1956, USFWS divided its operation into two Bureaus:

- 1. Bureau of Sport Fisheries and Wildlife.**
- 2. Bureau of Commercial Fisheries.**

In 1970, the Bureau of Commercial Fisheries was moved to the newly established National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce, and re-named the National Marine Fisheries Service (NMFS).

So far as I am able to determine, USFWS established its first official fisheries presence in Alabama when the Marion Federal Fish Hatchery began operation in 1934. Remember that this is the year when Swingle and Smith conducted their first research in the 'D' Series on the South Auburn Farm. I can find no indication of any official collaboration between the Auburn Fisheries Program and USFWS until 1948; although a list of visitors in the 1945 Annual Report indicated that Arno Fuller and John Bloz, officials with the Bureau, visited with Swingle. Afterwards, collaboration increased, and in subsequent years, became very important in the evolution of the Fisheries Program. Several of these collaborative efforts are described in the following Sections.

POND MANAGEMENT SHORT COURSES

In the period July 12-23, 1948, USFWS personnel cooperated with Auburn 'investigators' to teach a Short Course in pond management to Service Biologists. Eugene Surber, a USFWS biologist, taught the portion of the course on Warmwater Fish Hatchery Management at the Marion National Fish Hatchery. Afterwards, the class moved to Auburn. These courses were continued annually for several years. After Jack Snow became

Superintendent at Marion (1950), he provided the instruction on hatchery management.

FEDERAL 'AID'

As noted in a preceding Section, the Federal Aid in Sportfish Restoration Act (Dingell-Johnson Act) was passed by Congress in 1950. The Act placed a 10 percent excise tax on the sale of fishing rods, reels, lures, line and related equipment. Funds obtained from this tax were placed in the Sport Fish Restoration Trust Fund. The Act also authorized payments to the states for work in various areas of sportfish restoration. Most of these funds were used by the states to expand fisheries work within their boundaries, but the Act also required that some of the money had to be used for establishing cooperative projects benefitting several states.

In 1984, Congress made substantial changes to the 1950 Sport Fish Restoration Act (D-J Act) by enacting the so-called Wallop-Breaux Amendment. Wallop-Breaux significantly increased the funding base by extending the excise tax to all items of fishing-related equipment, by placing import duties on fishing tackle and boats, and adding a motorboat fuel tax. This Amendment made four important changes in the original Act:

- 1. Significantly increased funding for Sport Fish Restoration.**
- 2. Provided additional funding for boating access.**
- 3. Mandated that a portion of the funds be spent on aquatic resources education.**
- 4. Provided for equal funding for freshwater and marine projects.**

Over the years, the Auburn Fisheries Program received funds from both Dingell-Johnson and Wallop-Breaux allocations. Details on the allocation of and use of those funds were described in preceding Sections.

THE COOPERATIVE FISHERIES RESEARCH UNIT

The National Cooperative Wildlife Research Unit Program was established in 1935. Under the program, Units were established in Oregon, Utah, Texas, Iowa, Maine, Connecticut, Virginia, Alabama and Ohio. Then in 1960, Congress passed the Cooperative Units Act. Under the provisions of the Act, the Program was provided with its own budget within the U.S. Fish and Wildlife Service.

As noted previously, in the 1962-1963 Academic Year, the curriculum in Fisheries Management had undergone significant changes, but when all the

changes were in place, it was obvious that one of its most glaring deficiencies was a course in ichthyology. At that time, it was unlikely that the University would employ a new faculty member to teach the course. While at Cornell, I had had the opportunity to work with personnel of the New York Cooperative Fisheries Unit. Later, while working on curriculum development at Auburn, I decided that we should try to get a Unit here – one that would emphasize research and teaching in ichthyology. As noted above, Auburn had had a Cooperative Wildlife Research Unit for many years. I approached Swingle with the idea, and he agreed to seek the support of Dr. Arant (Head of the Department of Zoology and Entomology) and Dean E. V. Smith. Fortunately, Dean Smith was a close personal friend of Congressman George Andrews, who lived in Union Springs.

George Andrews had been first elected to Congress in 1944. By the early 60s, he was one of the most senior members of the House Appropriations Committee, and served as Chairman of one of its important Subcommittees. The Congressman agreed to support our request for the establishment of a Cooperative Fisheries Research Unit at Auburn, and arranged for me to appear at a congressional hearing regarding the request. With the support of the Congressman, it was highly likely that the Fish and Wildlife Service of U.S. Department of the Interior would be happy to place a Unit here. It was officially established in June 1967. They also approved our request that teaching and research in ichthyology would be its primary focus.

The new Unit was organized as a cooperative effort between the Fish and Wildlife Service, the Alabama Department of Conservation, and the Agricultural Experiment Station at Auburn. In addition to providing personnel costs, the Service agreed to make a sum of \$40,000 available for operations and maintenance. The Department of Conservation agreed to contribute \$8,000 annually.

As noted previously, in 1968, Dr. John Ramsey was chosen as the Leader of the Unit. In 1969, J. M. Barkuloo, an Auburn fisheries graduate was chosen as Assistant Leader. Barkuloo resigned in 1970. In 1971, William L. Shelton replaced him. The Wildlife Research and Fisheries Research and Units were combined in 1984. Nicholas R. Holler (Wildlife Unit) became Leader of the combined Units, and John Ramsey became the Assistant Leader. When Ramsey left in 1986, Dr. Mark Bain replaced him. Then in 1991, when Bain left to become Leader of the New York Unit, Dr. Elise Irwin came to Auburn as Assistant Leader.

Some of the many contributions of the Unit to the Auburn Fisheries Program have been described in detail in preceding Sections. From the beginning, it has been one of the most productive elements of the Fisheries Program. The Unit's Work Groups have been involved in a broad range of activities in hydrobiology.

In 1993, with the creation of the National Biological Survey in the Department of the Interior, the Unit programs were transferred from USFWS to the new agency. In 1995, its name was changed to National Biological Service (NBS); then in 1996, NBS was re-assigned to the fourth Division within the U.S. Geological Survey, and the Unit program moved with it.

THE HEFLIN AQUACULTURE RESEARCH PROJECT

In the early 90s, Alabama's Senior U.S. Senator, Howell Heflin, decided to provide some federal support for aquacultural research at Auburn; consequently, he had funding added to the budget of USFWS, specifically designated for this purpose. The funds were placed in the budget of the USFWS Exotic Species Laboratory in Gainesville, FL. If I remember correctly, that Lab was established in the mid-80s, with Dr. Jim McCann as Director. We had considerable freedom in deciding how we would spend the money. As a result, we began several sub-projects in various areas of aquaculture. Several of those were established in other Departments. For example, Dr. Will Blevins, of the Department of Botany and Plant Pathology, conducted research on factors related to the production of geosmin by blue-green algae.

Dr. McCann served as USFWS Coordinator of the project, and made several visits to the campus to review progress of the research. He was very much interested and supportive of the work that we were doing with these pass-through funds. Unfortunately, as a result of the political 'sea-change' that occurred in the fall of 1993, the funding for the project was withdrawn. Only with 'super-human' efforts by Bill Rogers and Dr. Nick Holler, Leader of the Alabama Fisheries and Wildlife Research Unit, were they able to get the funding restored, but only for one year and at only one-half of the original funding level.

THE U.S. GEOLOGICAL SURVEY

Based on recommendations from the National Academy of Sciences, the U.S. Congress, in 1879, enacted legislations establishing the U.S. Geological Survey (USGS) within the Department of Interior. The new agency was given the responsibility for "classification of public lands, and examination of the geological structure, mineral resources, and products of the national domain." There has been relatively little collaboration between the Fisheries Program and USGS over the years, but although limited, it has been extremely important.

THE WATER RESOURCES RESEARCH INSTITUTE

In 1964, Congress enacted legislation (PL 88-378) authorizing the establishment of Water Resources Research Institutes (WRI) within USGS in several participating states. The Act stipulated that each Institute be

established in cooperation with the Land-Grant University in participating states. A primary objective of the Institutes was to “conduct research, investigations, experiments, and the training of scientists in the fields of water resources and of resources which affect water.”

Alabama was chosen as one of the first few states for the establishment of a WRRRI. It was apparently included in the first group in order to achieve a broad geographical coverage of water resource studies. Later, pursuant to the Water Resources Research Act of 1984, Institutes would be established in all states and territories. Before the Institute could be officially established in Alabama, the Legislature had to enact legislation designating Auburn as the state agency for receiving federal funds appropriated under the Water Resources Research Act of 1964. This legislation is described in the Code of Alabama (Sections 9-8-1-3) (Acts 1963, 2nd Ex. Sess., No. 149, p 338, § 1-3).

The WRRRI at Auburn was officially established either in late '64 or early '65. Jim Warman arrived in early 1965 to become the first Director. Later, Howard Clonts, Upton Hatch and Dennis Block would serve in that capacity. Sam Fowler became Director in 2008, after retiring from the Alabama Cooperative Extension System with 32 years of service. He retired in May, 2015, and WRRRI Associate Director, Dennis Block, replaced him.

In 1965, John Lawrence received support for what must have been one of the first projects funded by WRRRI at Auburn. He received \$42,000 to study various aspects of the limnology of Lake Eufaula. He conducted extensive field work on the reservoir in 1965, 1966 and 1967. The final report was submitted in 1968. This project was extremely important in the evolution of the Fisheries Program, because it took Lawrence and his Work Group out of herbicides, weed control and farm ponds into the broader world of aquatic ecology in public waters. This was a strange place for an AAES researcher to be. Fortunately, it provided the Program with a much broader avenue of service to the people of Alabama.

This early WRRRI-funded research resulted in the establishment of an effective Work Group, acquisition of new analytical technology, and a new mind-set that was utilized effectively later in the long-term study on West Point Reservoir. Publications resulting from that study firmly established the reputation of the Department as a leading research group in large reservoir limnology in the nation. Further, these early studies provided a base for over a half-century of solid accomplishment in water-related studies, and it is likely that this would not have happened without that WRRRI grant.

NATIONAL BIOLOGICAL SURVEY AND THE STREAM ECOLOGY FIELD STATION

In early 1993, President Clinton appointed Bruce Babbitt as Secretary of the Department of the Interior. Under his leadership, a new research agency was established in DOI. It was deemed necessary to counter the criticism of the quality of research produced by DOI in the spotted owl situation in the Northwest. The new Agency, the National Biological Survey (NBS), was formally established in October 1993. No new funds were appropriated for its operation. From the beginning, NBS experienced all kinds of problems. These were exacerbated when the Republicans won control of Congress in 1993. From the beginning, business and farm interests assumed that NBS was simply a 'stalking horse' for environmental activism – especially for support of the *Endangered Species Act*. As a result of these 'head-winds' the Secretary tried to reduce them by re-naming the Agency the National Biological Service. Unfortunately, a simple name change alone was not sufficient to satisfy the critics, consequently, in October 1996, NBS relinquished its 'stand-alone' status in DOI to become the Biological Resources Division in the Department's U.S. Geological Survey. Remember that the Cooperative Fisheries and Wildlife Units had been transferred from USFWS to NBS in 1993, and that they, along with NBS, ultimately became part of USGS.

Congressman Bill Nichols was appointed to the Auburn University Board of Trustees in 1968. He dearly loved fly fishing for bluegills. Sometime after I became Department Head, the President invited him to come fishing in our ponds. Because I was about the only avid fly fisherman on the faculty at that time, I agreed to serve as his guide. This visit became a more-or-less annual event for several years. In the mid-80s, the Department began to work with a large natural lake owned by John Harbert at Pinebloom Plantation, near Newton, GA. Once David Bayne was able to get the severe weed problem in the lake under control, the bluegill fishing became exceptional, especially during spawning season. Nichols and Harbert had been friends for many years; consequently, the next time the Congressman wanted to arrange a fishing trip to Auburn, I asked Harbert for permission to carry him to Pinebloom instead. Harbert was extremely pleased to agree. Afterwards, we made several trips down there. Finally, on what proved to be his last trip before his untimely death, he asked me if there was anything that he could do for us in Washington. I told him that we had been interested in doing some research on warm water streams in the State for some time, but that we had been unable to find the money. He told me that he had a good friend on the House Armed Services who might be able to help us. Nichols died in 1988, but the process that he had initiated continued. In 1989, the Instream Flow Group of the National Ecology Research Center (NERC) in Fort Collins, CO, agreed to establish the Southeastern Stream Ecology Field Station at Auburn.

At that time NERC was administered by USFWS; however, later USGS assumed that responsibility.

As noted in a preceding Section, Johnie Crance, an Auburn alumnus, was selected as Leader and Bill Fisher was chosen as Assistant Leader. Fisher remained at Auburn until 1991, when he left to join the Oklahoma Cooperative Fisheries Research Unit. He was replaced by Mary Freeman.

Also, as detailed in a preceding Section, the Field Station conducted research projects in warm-water streams in Alabama, Arkansas, Tennessee and Virginia, but most of their work involved obtaining base-line data on streams in the Chattahoochee, Coosa and Tallapoosa River Basins. They also conducted Short Courses on Physical Habitat Suitability Indices and Instream Flow Methodology. The Field Station was closed as a result of the political 'sea-change' which followed the congressional election of 1993.

THE NATIONAL MARINE FISHERIES SERVICE

Remember that the Bureau of Commercial Fisheries (BCF) was created within the U.S. Fish and Wildlife Service (USFWS), and that it was moved to the National Oceanic and Atmospheric Administration (NOAA) in 1970. At the same time, it was re-named as the National Marine Fisheries Service (NMFS). As detailed in preceding Sections, over the years, the Auburn Fisheries Program has been involved informally and formally with first BCF, and then NMFS. For example, in the mid-60s, BCF used 'pass-through' funds from USAID/Brazil to fund the Dendy, Prather and Shell 'short-term' assignments in Northeast Brazil. In the mid-80s, the Alabama Marine Resources Division used 'pass-through' funds to conduct research on campus on the grow-out of striped bass fry in re-circulating systems.

DENDY, PRATHER AND SHELL IN NORTHEAST BRAZIL

Details regarding this project were discussed in a preceding Section, and additional details are included in a following Section. We were never sure why the Bureau of Commercial Fisheries chose Auburn as a source of personnel to conduct the work in Brazil. We had been involved in collaborative research and development in warm-water fish hatchery management with the Alabama Department of Conservation (ADC) since the mid-30s, and in reservoir management with the Fisheries Section of ADC since the early 50s; however, we did not have a strong, published 'track-record' in either area in the mid-70s.

Work on the project by the three of us was especially fortuitous. It provided us with a 'foreign assistance' perspective that would prove to be especially helpful when the Auburn Fisheries Program began the formal implementation of Caton's 'Model,' funded by the United States Agency for International

Development. The experience would also be especially helpful to me when I became Director of the International Center for Aquaculture.

STRIPED BASS RESEARCH

As noted in a preceding Section, the U.S. Congress approved the Anadromous Fish Act (Public Law 89-304) in 1966. Under the provisions of the Act, federal funds were given to the States to conduct research on these unique aquatic animals. The Act also assigned the responsibility of the administration of the program to the Bureau of Commercial Fisheries (BCF). The responsibility of administering the program in Alabama was assigned to the Seafoods Division of the Department of Conservation (ADC). As noted previously, Johnie Crance (AU '56 and '58) had moved from the Game and Fish Division to the Seafoods Division to become State Coordinator for the 89-304 Program. I. B. Byrd (AU '50), who was Chief of the Fisheries Section for many years, had resigned from ADC and was serving as BCF Federal Aid Coordinator for the Program in the Southeast Region.

For several reasons, the Seafoods Division was unable to utilize all of the federal funds available to the State. As a result, it was decided that they would be 'passed-through' to Auburn to conduct research on the production of striped bass fingerlings. We initiated this research in 1967, and it was continued until the late 70s. Specific details related to the research were discussed in a preceding Section.

U.S. ARMY CORPS OF ENGINEERS

According to information released by the U.S. Army Corps of Engineers (CoE), its establishment can be traced to 1775, when it was authorized by the Continental Congress. The Agency, as it exists today, was created in 1802 when President Jefferson was authorized to "organize and establish a Corps of Engineers that the said corps shall be stationed at West Point in the State of New York and shall constitute a military academy." From the beginning, the planning and supervision of military construction for the nation was one of CoE's major responsibilities; but in later years, it was given more and more authority in civil works activities. In the 20th century, it became the lead federal agency in flood control, a major provider of hydroelectric power, and the nation's leading provider of outdoor recreation. In support of these activities, CoE also played a significant role in the construction and management of many multi-purpose reservoirs on rivers throughout the nation. In the late 1950s, CoE became an important source of research funding for the Fisheries Program at Auburn. The primary CoE Projects included the following:

1. Evaluation of potential herbicides.

2. Weed control research on Walter F. George Reservoir.
3. Draft Fish Management Plans.
4. The West Point Project.

A description of several of these areas of research follows.

EVALUATION OF POTENTIAL HERBICIDES

The 1959 Annual Report notes that CoE was providing John Lawrence with funding for research on the evaluation of potential herbicides for the control of emergent weeds. The 1963 Report noted that this contract research was being continued. A more detailed summary of some of the results of this research was presented in a preceding Section.

WEED CONTROL RESEARCH OF WALTER F. GEORGE RESERVOIR

The 1964 Annual Report noted that Lawrence's Work Group was conducting CoE-sponsored research on the control of aquatic weeds in Walter F. George Reservoir. This work continued throughout the 60s. This was important research. It provided 'real-world' insights into the difficulties of controlling aquatic weeds in large, multi-purpose reservoirs on large rivers. Unfortunately, the Project generated only a few technical reports; consequently, it received almost no public exposure.

DRAFT FISH MANAGEMENT PLANS

In the early 70s, CoE contracted with the Departments of Agricultural Economics and Rural Sociology (AERS), and the Department of Fisheries and Allied Aquaculture through the Alabama Agricultural Experiment Station for the preparation of Draft Fish Management Plans for several large multi-purpose CoE reservoirs in Alabama. Howard Clonts provided most of the input from AERS. At the time, he was actively involved in research in outdoor recreation.

These plans were prepared in accordance with the provisions of the Fish and Wildlife Coordination Act of 1958 (PL 85-624) and the Federal Water Project Act of 1965 (PL 89-72). They were highly detailed, broadly organized drafts. They contained a wealth of data and information. Unfortunately, so far as I can determine, the drafts were never seriously reviewed by CoE. Certainly, no publications were ever developed from them.

THE WEST POINT PROJECT

As detailed in a preceding Section, in the late 1960s, activities related to the construction of a new U.S. Corps of Engineers Reservoir on the Chattahoochee River near West Point, GA, were continuing at a rapid pace. Several of the faculty in the Fisheries Program were well aware that this would likely be the last, large, main-stream reservoir to be constructed in the South. Further, this would likely be the last opportunity to study changes in the limnology and fish population as a river transitioned to a reservoir. With this in mind, I contacted U.S. Corps of Engineers (CoE) offices in Atlanta, Mobile and New Orleans on the need for funds to conduct this extended study. Unfortunately, I received no encouragement from any of them. Along the way I had talked with Ray Scott, Founder and President of the Bass Anglers Sportsmen Society, about this project. Sometime later at a public hearing in Washington, Scott talked with the Commanding General of the Corps about it, and the fact that Auburn had received no response to its request for funds from the Regional Offices. The General commented that I had been talking with the wrong people.

Within a relatively short period of time, Auburn received a contract from that Agency for the long-term study that we wanted to do. The pre-impoundment study began in 1973. Remember that the research was divided into two distinctly different sub-projects:

1. The expanding fish population and its exploitation.
2. Limnological characteristics of the expanding reservoir.

The results of the research has been reported in considerable detail in two preceding Sections. From a Departmental perspective, this CoE-funded study was one of the most important ones ever undertaken by its faculty. The publications and reports produced and the graduate students trained, quickly and radically altered the national image of Auburn's Fisheries Program.

U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

In 1798, the federal government established the Marine Hospital Service (MHS) to provide medical care for merchant seaman. In the 1880s, Congress requested that MHS also accept the responsibility of examining passengers on arriving ships for clinical signs of infectious diseases. These early actions would initiate a long chain of events that would ultimately lead to the establishment of the Department of Health, Education and Welfare (HEW). As early as 1923, President Harding had requested that Congress establish such a Department, but for several reasons, they chose not to honor his request. In 1939, President Roosevelt recommended the establishment of the Federal

Security Administration (FSA) to bring together federal programs in Health, Education and Social Security into a single agency. Later, in 1953, President Eisenhower recommended that FSA be abolished and that all federal programs in health, education and welfare be brought into a single cabinet-level Department. As a result of this request, HEW was finally established. Then in 1979, the education function and Social Security were removed, and the name of the resulting organization was changed to Health and Human Services. The U.S. Public Health Service is the primary division in HHS.

Beginning in the late 50s, agencies (Public Health Service-National Institutes of Health) began to fund specific research projects in Auburn's Fisheries Program. As detailed in a preceding Section, the availability of these funds was one of the American responses to the 'Sputnik' phenomenon. Specific projects included the following:

1. The use of herbivorous fishes to control pond weeds.
2. The use of shellcrackers to control snails in ponds.
3. Biological control of trematode parasites in fish.
4. Parasitocidal activity of organophosphates.
5. A study of metabolic cycles in fish.

Detailed results of these studies were presented in preceding Sections.

By the late 60s when the interests of the Fisheries Program began to shift toward international development, efforts to secure research funding from PHS-NIH were discontinued. In the beginning, HEW funding played an important role in the evolution of the Program. It demonstrated that the 'Investigators' could compete successfully for research funding from non-traditional (Agriculture and Interior) federal agencies. This HEW funding provided the old 'terrace-water' pond program with a completely new perspective.

PEACE CORPS

On March 1, 1961, President John F. Kennedy announced the establishment of the U.S. Peace Corps. Its purpose was "to promote world peace and friendship through the Peace Corps, which shall make available to interested countries and areas men and women of the United States qualified for service abroad and willing to serve, under conditions of hardship if necessary, to help the peoples of such countries and areas in meeting their needs for trained manpower." Their work is generally related to social and economic development. Each program participant, a Peace Corps Volunteer, is an

American citizen, typically with a college degree, who works abroad for a period of 24 months after three months of training. Volunteers work with governments, schools, non-profit organizations, non-government organizations, and entrepreneurs in education, hunger, business, information technology, agriculture, and the environment. Between 1961 and 2013, over 210,000 Americans joined the Peace Corps and served in 139 countries.

The first Volunteers, specifically trained to promote aquaculture as a means of improving family nutrition, were selected in 1966. A group of 13 volunteers received aquaculture training at the University of Oklahoma under the direction of Dr. Howard Clements. These volunteers were sent to Togo, West Africa in September of 1966 to build family and community fish ponds and stock them with tilapia. The program lasted for 2 years, and was the first of many Peace Corps programs to provide technical assistance in aquaculture and fisheries in Asia, Africa, Latin America and the Caribbean and Pacific Islands from 1970 to early 1990.

Fortunately, a number of the Peace Corps Volunteers who had worked on overseas assignments in aquaculture and fisheries, enrolled in our Graduate Program once their period of service was completed. As noted in a preceding Section, Leonard (Len) Lovshin was the first of this group to arrive. Over the years, he would be followed by at least 68 others (Appendix Table 7). As detailed previously, these *Returned Volunteers* would ultimately become a vital element in virtually all aspects of our International Program.

Auburn provided pre-assignment training for at least one group of volunteers during the 80s. Unfortunately, I have been unable to find any of the details regarding the contract. It was handled as one of our regular ICA activities. I cannot remember who was in charge. I do remember that the group constructed a small pond on a tiny spring-fed creek west of the current location of the genetics research area.

THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

As suggested in a preceding Section, the USAID-funded Outreach effort to increase the production of fish in warm water ponds in LDCs, played a major role in establishing the evolutionary 'path' of the Auburn Fisheries Program from the late 60s through the end of the century. Many of the operational details of this effort were described in the same Section. In this Section, some of the details related to its early development will be described.

HISTORICAL

After the end of World War II, with the political developments in Eastern Europe and the establishment of the *People's Republic* in China, it quickly

became the working hypothesis of the American government that Communism would rapidly move to extend hegemony over as much of the world as possible. These events gave rise to the concept of the so-called “Domino Theory” in American foreign policy. Out of this growing concern came the official understanding and policy that the best defense against the advancement of communism was enhanced economic stability and growth in less-developed countries. In support of this concept, the U.S. Congress created the highly successful *Marshall Plan* to encourage and stabilize economic recovery in Europe. Afterwards, Congress created one government agency after another in an effort to find the right ‘mix’ of policies and actions to improve the ‘lot’ of people in developing countries throughout the world. The communist attempt to take control of the entire Korean peninsula in 1950, and the French defeat in Indochina in 1954, suggested that at that time the U.S. had not yet found the right formula.

In the late 1940s and early 1950s, Communists, Socialists and other Progressive groups were actively organizing people in Brazil’s Northeast into “Fronts” such as the Peasants League and the Front of Recife, for the purpose of taking over the Governments of the States of the Region (Pereira, 1999). Later, in 1959, Communists under the leadership of Fidel Castro took over the Government of Cuba. These developments brought swift and significant reaction on the part of the American Government. In 1961, President Kennedy created the *Alliance for Progress*, an organization to counter the Communist advances. Under this program, the U.S. Agency for International Development quickly established a Mission in Recife, the Capital of Pernambuco State. Soon afterwards, in 1962, a leftist, former Mayor of Recife was elected governor of the State. By the end of June, 1963, there were some 133 USAID personnel working in the Recife USAID/ Mission.

Since time immemorial, the nine-states in the Northeast Brazil have been beset by periodic droughts; some of epic proportions. In some years, the region received virtually no rain, and in the best of years, there was little rain for 6 to 9 months. Generally, the severe droughts only lasted for a single year. From the beginning of European colonization, farmers have suffered grievously from crop losses, loss of livestock, and in the worst cases, significant loss of human life, especially among the elderly and children. As a result, poverty in all of its forms has been greater there than in any other region in the western Hemisphere.

The problem of periodic drought in the Northeast was a continuing and heavy burden for the Brazilian government. As a result, in 1910, it established the National Department for Works to Combat the Drought (DNOCS). Shortly after its establishment, DNOCS began to address the drought problem through the construction of reservoirs on public and private property throughout the region. Over time, hundreds were constructed. In normal times, they provided access to a good, dependable source of water. In the

drought years, they became havens for large numbers of people and livestock. Some farmers moved their families hundreds of miles to camp near these dependable sources of water. While food availability in these 'camps' might have been a problem, at least they had a source of water.

As these man-made reservoirs filled, the native fish populations in the impounded streams expanded. These expanded populations provided the base for the development of substantial capture fisheries, which quickly became a source of large quantities of low priced, high quality animal protein – a protein source that became especially important in the drought years. DNOCS operated fish hatcheries throughout the region to produce fingerlings for stocking the reservoirs. They also used the hatcheries as a source of fingerlings to stock some promising species in river systems where they were not native.

When the USAID/Mission in Recife began to decide on a strategy for providing assistance to poverty-stricken people in the Northeast, one of their first priorities was searching for ways to increase production, capture and utilization of fish in those reservoirs. USAID did not have personnel to undertake projects like this; consequently, they asked the U.S. Bureau of Commercial Fisheries (BCF) to provide them with consultants in hatchery management, fish capture and fish processing technology through a Participating Agency Services Agreement (PASA). In 1965, Bill Stevenson (Fish Capture) and Charlie Lee (Processing and Technology) were assigned to the Recife Mission under contract AID/BCF/PASA-Brazil. Stevenson was designated 'Chief of Party.' They quickly realized that they needed some expertise in the biology and management of reservoir fish populations. As a result, early in 1966, BCF contacted Auburn concerning the availability of consultants in reservoir limnology, biology and management of reservoir fishes and in hatchery management. This participation was to be funded through personal service contracts with BCF. Given the nature of the work required, it was decided that Dendy, Prather and I should take the assignment. We arrived in Brazil on the first of three annual visits in late June, 1966.

THE CREATION OF THE U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

American efforts to help preserve the freedom of many struggling nations achieved a 'mixed-bag' of results throughout the 1950s. These 'shaky' efforts led to a growing world characterization of the nation's foreign assistance policies as the era of the *Ugly American*. In 1961, the Kennedy Administration moved decisively to improve the government's developmental assistance efforts by getting Congress to pass the *Foreign Assistance Act of 1961*. The Act created the U.S. Agency for International Development (U.S.A.I.D), and gave it the mission of promoting "economic and democratic,

political stability in the developing world to combat both the perceived spread of ideological threats such as communism and the threat of instability arising from poverty.”

U.S.A.I.D. AND THE LAND-GRANT UNIVERSITIES

In many of the countries threatened with Communist ‘take-over,’ food security was a primary concern. Obviously, the U.S. Government did not have the personnel or the expertise to deal with this massive problem, so they turned to the nation’s Land Grant Universities for assistance. By the mid-60s, a number of these large American Universities were under contract with the Agency for International Development to provide technical support for its Missions in developing countries throughout the world. The emphasis of these early contracts were on countries that were the best candidates for communist advances (India, Indonesia, Thailand, the Philippines, Northeast Brazil, etc.).

As detailed in preceding Sections, the Auburn aquaculture and fisheries faculty has been involved in fish farming research, teaching and outreach since the early 1930s. In the early years, their objective in producing fish was to provide high quality food and recreation for farm families through pond fish culture. By the early 1940s, they had developed an ‘easy-to-apply’ technology that could be used to realize those aims on a sustainable basis in farmer’s ponds. They explained this technology in Bulletin 254, *Management of Farm Fish Ponds*, published by the Alabama Agricultural Experiment Station in April of 1942. With the help of the Soil Conservation Service of the United States Department of Agriculture, the use of this technology quickly spread throughout much of the nation. Then in 1967, the Agency requested that Auburn provide its ‘lessons learned’ in warm-water fish culture to improve ‘food security’ in ‘less developed countries’ throughout the world – especially in those countries where a large share of animal protein was obtained from the consumption of fish.

THE VIETNAM WAR AND A NEW TECHNICAL ASSISTANCE PARADIGM

Beginning in 1967, Auburn had been the principal source of technical assistance in warm-water fish production in ponds for USAID/Washington throughout the developing world, but in the mid-70s, the Congressional response, especially the U.S. Senate, to the Vietnam conflict resulted in a permanent change in Auburn’s role in improving ‘food security.’ Remember that the Paris Peace Accords were signed in 1973, and that American troops were permanently withdrawn from Vietnam in 1975, but long before that time, the American people had grown disenchanted with the war and, over time, had grown openly hostile to it. The mood of Congress, especially the Senate, had closely tracked the mood of the people, and in 1973, they acted. In that

year they approved legislation that sharply altered the operational mandate of USAID. The legislation shifted the emphasis from a 'top-down' approach, which had concentrated AID funding on the development of infrastructure and large projects in LDCs, to an emphasis on a basic 'human-needs' strategy that directly targeted the poorer segment of the population.

This change in strategy would have been a disaster for all of the long-term USAID-University relationships – the Auburn University International Center for Aquaculture, for example. With this new strategy, there would be little need for 'long-term' development contracts. The Universities responded to this serious threat to their AID funding by getting their congressional delegations to amend the Title XII Section of the 1961 Foreign Assistance Act. This Act was still the controlling legislation governing U.S. foreign assistance. The Amendment (The International Development and Food Assistance Act of 1975 – P.L. 94-161) provided language for the establishment of a new organization – BIFAD (Board for International Food and Agricultural Development). BIFAD, which was composed primarily of University faculty and administrators, was charged with advising USAID on dealing with problems related to food, hunger and famines in LDCs. The legislation also included language that provided for the establishment of a new USAID emphasis – Collaborative Research Support Programs (CRSPs). In this emphasis, groups of U.S. Universities would be organized to partner with Universities in LDCs to conduct research on specific problems related to food and fiber production. Traditional development quickly became a 'dinosaur.' Funding for U.S. University participation in the CRSP's would be provided by USAID/W, and virtually all of the research would be conducted at sites in the various LDCs. This new approach to international development effectively took the management of international development by USOMs out of the equation and replaced them with BIFAD and groups of Universities. USOMs had almost no 'clout' in Congress, but groups of Universities did. This approach also gave 'new-life' to funding for Universities by USAID. It also provided a mechanism whereby the number of Universities involved could be expanded exponentially.

A BIFAD Committee – JCARD (Joint Committee on Agricultural Research and Development) – was charged with developing the procedures for implementing the program. JCARD recommended that eight groups of universities be established to implement the program. Each of these groups was assigned the responsibility for conducting collaborative research in a specific area (Sorghum/Millet, Beans/Cowpeas, Small Ruminants, Fisheries/Aquaculture, etc.).

In the late 70s, BIFAD contracted with Resources Development Associates (RDA), a California Company specializing in program planning, to provide recommendations for the establishment of a Collaborative Research Support Program in Fisheries and Aquaculture. Based on RDA recommendations, in February, 1980, JCARD selected Auburn, the Consortium for International

Fisheries and Aquaculture Development (University of Arkansas-Pine Bluff, University of Hawaii, University of Michigan, Michigan State University and Oregon State University) and the University of California-Davis to participate in the establishment of the Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP). Details on the implementation of this new program were discussed in a preceding Section

ALABAMA FARMERS FEDERATION (ALFA)

The Farm Bureau movement began in up-state New York in 1911. The American Farm Bureau (AFB) was formally established in Chicago in 1914. The Alabama Farm Bureau was established in 1921. In 1986, as a result of a dispute with the parent organization over the sale of insurance, the Alabama group withdrew from the national organization and formed the Alabama Farmers Federation (ALFA). The new State organization quickly agreed to continue and even expand the activities initiated earlier by AFB.

ALFA AND THE CATFISH FARMERS

With the catfish production industry in west Alabama growing rapidly, in 1974, ALFA decided to establish the Alabama Catfish Producers (ACP) as a Commodity Group supported by the organization. The establishment of this new Commodity Group was one the most important developments in the evolution of the commercial catfish industry in Alabama. Further, no other group has been more supportive of Auburn's efforts to provide the growing industry with the technical assistance that it required. Over the years, they have been so unfailingly supportive that, at one point, I suggested that several ALFA personnel should be added to our payroll.

Jack McGaughey, who was working with the Alabama Pork Producers at the time the Alabama Catfish Producers was established, was chosen to provide leadership for the new fish farming group. In 1978, Jimmy Carlisle was employed as Director of the Poultry and Catfish Divisions. Carlisle, who had grown-up on a Montgomery County dairy farm, attended Troy University. After graduation, he worked for a time with an integrated poultry company in Laurel, MS. From the beginning, Carlisle's support for the catfish industry and the Department went 'far beyond the call of duty.' Remember that on January 1, 1979, John Jensen was employed by the Alabama Cooperative Extension Service as its Fisheries Specialist. Carlisle and Jensen worked closely together in providing encouragement for the rapidly growing industry. They provided exceptional leadership in its critical formative period. It is not likely that any commodity group anywhere ever had two more effective advocates. Jimmy retired in 2013. Rick Oates served as Director of the Catfish Division of ALFA from 2013 through 2016, when he was appointed State Forester.

THE STATE CATTLE RANCH MEETING

In early October, 1984, ALFA arranged what was arguably the most important meeting ever held concerning the farm-raised catfish industry in Alabama. It was held at the State Cattle Ranch in Hale County. At that time, as a result of the interest of the late Charlie Farquhar, who was then Warden at the facility, the Ranch was beginning to invest heavily in the production of catfish on its property. The meeting involved virtually every group involved with the rapidly growing new agro-enterprise (producers, processors, agri-business interests, universities and the legislature). The presence of Senator Hinton Mitchem (Albertville) was especially important. At that time, he was Chairman of the powerful Senate Finance and Taxation Committee. Of equal importance was the participation of Representative Curtis Smith from Clanton. At the time, he was serving as Chairman of the House Committee on Agriculture. The meeting served as a mechanism for summarizing the present status of the industry, its future prospects, and inputs required to insure its orderly development. Without question, both Mitchem and Smith were impressed with what they learned about the industry. Going forward, both were extremely supportive.

ALFA AND THE WEST ALABAMA CATFISH PRODUCERS ASSOCIATION

In the mid-80s, with encouragement of ALFA and FAA, catfish producers in west Alabama established an organization to more effectively deal with some of their specific problems. At that time, the cost of feed for fish farmers in Alabama was considerably higher than in Mississippi. Generally, farms in Alabama were much smaller, and as a result, their purchases were too small to qualify for lower 'bulk' rates. Then, in 1984, farmers formed the West Alabama Catfish Producers Association (WACPA). In one of their first actions, they decided to work on the problem of feed prices. Subsequently, they combined all of their separate feed requirements into a single large order and submitted it to several feed processors for bids. As a result of this cooperative action, the feed processors of both states reduced their feed prices significantly (Perez, 2006). This is but one example of the involvement of WACPA members working to solve their own problems.

ALFA AND THE ALABAMA CATFISH 'CHECK-OFF' PROGRAM

For a number of years, so-called 'check-off' programs provided much needed financial support for agricultural commodity groups across the country. These programs provided funding for the support of research, education and promotional activities aimed at furthering the growth and development of production of specific farm commodities. Usually, funds were obtained through contributions by the industry, which were expected to 'pass-on' their added costs to producers.

Initially, all 'check-off' programs must be approved by a majority of producers. Further, this same group must reaffirm their support for the program at five-year intervals. Use of the funds are generally determined by a group of individuals selected by producers. In Alabama, 'check-off' programs must first pass through the legislative process. Once approved by the Legislature, a Constitutional Amendment is placed on the next 'state-wide' ballot for approval and certification by all the voters of the state. If it is approved, the commodity group involved holds a 'state-wide' referendum to assess themselves a fee to fund "education, research and/or promotional activities" for a five-year period. Then at five-year intervals, the certified group must conduct additional referenda. Periodic re-approval by the commodity group is required if the program is to be continued.

The Alabama Catfish Producers 'check-off' program was initially established by a 92 percent 'affirmative' producer vote in 1989. Its approval was strongly supported by ALFA and its commodity group (ACP). Producers voted to have feed manufacturers remit \$2.00 per ton on all catfish feed sold in the state to the Alabama Department of Agriculture and Industries (ADAI). Then quarterly, the Board of Directors of ADAI transferred these funds to ACP. A producer committee of ACP determined how the funds would be distributed. After the initial five years, it was decided that the assessment rate would be reduced from \$2.00 per ton to 50 cents per ton. Over the years, these 'check-off' funds have provided valuable support for several aspects of the Department's research program, especially in the areas of water quality, nutrition and diseases.

ALFA ASSISTANCE IN SECURING FUNDING FOR FISHERIES RESEARCH

From the beginning, funding for catfish research has been a troublesome problem for the Alabama Agricultural Experiment Station (AAES). Generally, the funding pattern for the support of research for the other commodities (cotton, cattle, pecans, etc.) had been established decades earlier, and except for minor changes, the distribution had not changed very much over the years. Generally, the largest share of research costs in agricultural research is related to personnel. Further, as a result of tenure, once a commitment is made to support research in a specific area, it becomes a long-term proposition. As a result, beginning research in new areas, such as catfish farming, usually requires a new source of funding.

In the 1970s, catfish farming literally 'exploded' in Alabama. Quickly, producers began to request information on hatchery management, stock management, feeds and feeding, disease control, water quality management, harvesting and marketing. Given the aforementioned problem with the funding of agricultural research, there was no practical way that the rapidly growing needs for catfish research could be accommodated easily. Short-

term accommodation would have meant a major reallocation of existing funds in AES.

In the early years, legislative funding for higher education in Alabama had been a 'three-ring-circus.' Annual appropriations were dependent on the relative strengths of the various Universities among the legislators. Finally, it was determined that this 'rooster-fight' system was not working very well. As a result, it was decided that each institution would 'hash-out' their individual needs, and then join the other institutions in presenting a 'unified' budget request to the Legislature. This system precluded the Department from going directly to the legislature for funding for catfish research.

Over a period of time, we discussed our catfish research funding situation with industry leaders and with ALFA. Everyone agreed that we desperately required funds to meet the immediate needs of the Industry for practical information. Unfortunately, given the budgetary process in place, no one had a solution. As discussed previously, just then disaster struck the industry in the form of 'off-flavor.' It appeared for a time that the industry might 'die' before it was fully 'born.' In a preceding Section, I have discussed in some detail how Senator Hinton Mitchem, with the encouragement of ALFA, intervened in that situation to provide an immediate source of funds for work on the problem.

From its beginning, ALFA was a powerful force in Alabama politics. The organization had many friends in the Legislature. It was eternally vigilant of the needs of farmers and agriculture in the State, and for over three decades, Milton Parsons, Director of Public Affairs for ALFA, was responsible for seeing that the organization's legislative agenda was translated into legislation. He was extremely good at what he did. Alabama farmers never fully realized what an effective advocate he was in support of their interests. From our perspective, it was also important that he was an avid fisherman.

Milton played an essential role in working with Senator Mitchum to secure the funding for 'off-flavor' research. When the 'sky-did-not-fall' with ALFA's assistance, the Department was later able to secure research funding directly from the legislature for the 'off-flavor' problem, it encouraged us to consider this pathway as a source of funding for other specific projects. In the '86-'87 Budget, ALFA was instrumental in having a \$100,000 Line Item inserted in Auburn's budget for catfish research. Two years later, the amount was increased to \$220,000. Later, with strong ALFA support, Representative Jimmy Clark, Speaker of the Alabama House, had a Line Item inserted for the support of research on the red-claw crayfish. In the '92-'93 budget, again with strong ALFA support, Representative Taylor Harper, Chairman of the powerful Ways and Means Committee, inserted a \$250,000 Line Item in the budget for oyster research. Later, as detailed in a preceding Section, some of these funds were used to construct the Shellfish Laboratory on Dauphin

Island. There is virtually no possibility that this important facility would have ever been developed without ALFA support.

ALABAMA POWER COMPANY

The Alabama Power Company provided significant funding to the Lawrence-Bayne Work Group through the years. Early work involved studies related to the discharge of heated cooling-water from steam-electric generating plants back into receiving streams and lakes and measuring the effects, if any, upon water quality and aquatic communities. The Company had numerous such plants positioned throughout the state. To better understand effects to be expected from aquatic biota exposed to heated water under controlled conditions, the Company constructed three earthen raceways (300' X 50" X 6') at the Greene County steam plant near Demopolis, AL. Using ambient water from the Black Warrior River and heated water from the steam plant, the temperature of the raceways could be manipulated. Experiments were conducted for about two years, with two graduate students living at the site and managing the day-to-day operation of the facility. They also carried out the prescribed research activities. In later years, the Company funded limnological studies of most of their hydroelectric generating impoundments (large lakes). More information on these activities can be found in the Section on *WATER QUALITY IN PUBLIC WATERS*.

POND MANAGEMENT COMPANIES

Over the years, recreational fishing in Alabama changed significantly. In the early 50s, there was much more interest in fishing in farm ponds than today. This change is likely related to the loss of farms in the State. In 1954, there were approximately 177,000. In 2012, there were approximately 43,000. There are still lots of ponds (50,000, +/-) on rural lands in Alabama, but there is considerably less interest in managing them (Figure 118). At the same time, there has been a steady increase in the number of individuals who have a special interest in their management. Generally, these individuals are not active farmers, but urban dwellers with large tracts of rural land. Further, they are generally not interested in the routine management of their ponds. Instead, they want customized management designed to produce narrowly restricted outcomes – usually the production of large bass.

Further, the intensity of management required for the production of these restricted outcomes requires considerable time, effort and money. Over the years, several companies have been established to provide these customized services at a price. Two of the most active in Alabama are American Sportfish and Southeastern Pond Management. Both have been very supportive of Auburn Fisheries Program activities, and we have been involved in several collaborative projects with them. Some of the details of their history and pond management activities are listed in following pages.

AMERICAN SPORTFISH

American Sportfish was established in 1985 by Don Keller and Barry Smith. Both are Auburn Fisheries Alumni and former employees of the Fisheries Section of the Alabama Department of Conservation and Natural Resources. Barry served as Chief of the Section for several years. The Company is located on a large tract of land along Highway U.S. 231, southeast of Montgomery. The facility includes some 100 ponds, ranging in size from 0.5 to 5 acres. All of the ponds are dedicated to the production of several species of warm-water fish (northern largemouth bass, Florida largemouth bass, coppernose bluegill, shellcracker, fathead minnows, grass carp, threadfin shad, golden shiners and black crappie).

The Company also produces the so-called 'Tiger' Bass which is a cross between the northern sub-species and the Florida sub-species, and both diploid and triploid grass carp. The sterile grass carp are widely marketed in the Southeast, in those states which require that only triploid fish be stocked.

Barry and Don recently sold the company to a group of employees, but they both continue to be involved in some aspects of its operation.

SOUTHEASTERN POND MANAGEMENT

The parent Company was formed in mid-1980s by Bill Phillips – one of Bill Davies' Ph.D. students – and was initially named *Small Waters*. Tim Sherriff worked with Bill in getting the Company established. Later, Mark Nieman and Robert Beauchamp joined them. In the late 1980s, Nieman and Beauchamp left *Small Waters* and formed their own company – *Auburn Aquatics*. Shortly thereafter, that company went bankrupt. Later, Tim Sherriff, along with David Kastner, reformed the company as *Lake Management Specialists*.

In the fall of 1989, Norman Latona incorporated *Southeastern Pond Management* while he was still a fisheries student at Auburn. It did not become fully operational until the summer of 1990. The first office was established in Auburn. At that time Kedric Nutt joined the Company. Scott Cheronis joined in 1993. Later that year, the Birmingham (Calera) office was established. Norman and Scott were located there. In the fall of 1996, *Lake Management Specialists* merged with *Southeastern Pond Management*. Scott Kirk joined the company sometime in the late 1990s. Graves Lovell worked for *Southeastern Pond Management* in the 1990s to 2000s before leaving to take a position with the Fisheries Section of DCNR. Sometime in early 2000s, *Lake Management Specialists* ceased operations and Mark Nieman joined *Southeastern Pond Management*. Currently the Company has offices in Auburn, Birmingham (Calera), Canton, MS and Jackson, TN. It offers a variety of services related to pond management: design and construction,

stocking, fertilization and liming, stock analysis using electrofishing, installation of artificial fish habitat and supplemental feeding.

COLLABORATORS IN OTHER DEPARTMENTS

Literally dozens of faculty members in other Auburn University Departments have made really important contributions to the development of the Fisheries Program over the years. Virtually all of our Graduate Committees have included at least one faculty member from outside the Program. These individuals have provided invaluable services by contributing advice, technical input and 'peer review' to our graduate students in their efforts to learn how to 'do' research. In Appendix Table 11, I have included some of the names of those individuals who have contributed so much to our program. I am sorry that I could not list them all.