

The International Center for Aquaculture



ANNUAL REPORT FOR FY 1976

AGRICULTURAL EXPERIMENT STATION
R. DENNIS ROUSE, Director

AUBURN UNIVERSITY
AUBURN, ALABAMA

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Information contained herein and programs described are available to all without regard to race, color, or national origin.

THE INTERNATIONAL CENTER FOR AQUACULTURE

Annual Report for 1976

E. W. SHELL*

INTRODUCTION

THIS REPORT SUMMARIZES the activities of the International Center for Aquaculture during the fiscal year 1976, particularly as related to support received from the U.S. Agency for International Development (AID) institutional grant AID/csd 2780. A highlight of the year was the 78 man-months of overseas service performed by Center staff. Academic and training programs were strengthened with the initiation of new courses in fish genetics and breeding, aquacultural economics, and a special 5-month aquacultural training program for foreign students. In total 656 students (504 American and 152 foreign) were enrolled in fishery subjects taught during the year. Country projects were operational in the Philippines, Brazil, Nigeria, and El Salvador. In addition, 19 special requests for international development services were received and appropriately serviced during the year.

Aquaculture is becoming increasingly important in developing countries as a means of providing larger quantities of the protein needed for more adequate diets and as an important contribution to economic growth. It utilizes infertile lands and runoff waters, along with agricultural wastes and surpluses, to intensively grow crops of high quality protein in the form of fish and other aquatic animals, thus greatly increasing the ability of each country to supply the protein needed by its own people. Aquaculture can be used to grow high quality protein locally where it is most needed, thereby reducing the cost of transportation, processing, and refrigeration. It also provides additional needed income and employment for farmers.

Auburn University has received worldwide recognition for its leadership in warmwater fisheries generally and aquaculture specifically. The University has committed itself to assist developing nations increase their supplies of high quality protein and improve their economic well-being through improved methods of aquaculture. No other American university presently has sufficient experience or program orientation to provide this type of assistance.

The AID grant was awarded to Auburn University to strengthen its research, teaching, and extension capabilities and to improve service capabilities in aquaculture. As a consequence, more significant contributions can now be made by the University in promoting aquaculture in developing countries. In addition, the grant can be used to develop methods and procedures for making the University's competence in aquaculture more readily available for those who need it. The initial grant for \$800,000 covered a 5-year period 1970-75. A 2-year extension for the grant, along with revised objectives and scale of operation, was approved covering the period 1976-78, with additional funds amounting to \$578,000. This report covers the first year of the 2-year extension period.

*Head, Department of Fisheries and Allied Aquacultures, and Director, International Center for Aquaculture.

GRANT OBJECTIVES

The program funded by the grant revision and extension has five primary objectives:

1. To provide educational and training opportunities in inland fisheries and aquaculture related to international development.

2. To continue to develop and improve the knowledge base of Auburn University, including the development of a capability in production economics as related to aquaculture.

3. To develop a more effective capability for advisory services and actively promote its utilization.

4. To continue to collect, analyze, publish, and disseminate information.

5. To develop a strong professional network of linkages between Auburn and LDC (less developed country) institutions, international development agencies, and U.S. institutions.

Specific work plans to achieve each of these objectives were developed at the beginning of the grant extension. These plans outline the activities of each principle person supported under the AID grant.



Philippine biologist completes 6 weeks of special training at Auburn.

PERSONNEL OF THE PROJECT

Following is a list of personnel who received grant funds as part of their salary during the year:

<i>Name</i>	<i>Position</i>	<i>Man-months</i>
Dr. E. W. Shell	Director	4.6
Dr. D. D. Moss	Assistant Director	3.1
Dr. R. T. Lovell	Professor	2.8
Dr. Ray Allison	Associate Professor	0.7
Dr. Claude E. Boyd	Associate Professor	1.8
Dr. Edward W. McCoy	Associate Professor	7.2
Dr. Mario M. Pamatmat	Associate Professor	5.3
Dr. R. O. Smitherman	Associate Professor	7.0
Mr. Jack R. Snow	Associate Professor	11.5
Dr. Werner G. Wohlfarth	Associate Professor	2.0
Dr. James R. Hubbard, Jr.	Associate Professor	1.0
Dr. Bryan L. Duncan	Assistant Professor	8.0
Dr. Ronald P. Phelps	Assistant Professor	10.6
Mr. John L. Boutwell	Research Associate	2.3
Mr. Kenneth W. Crawford	Research Associate	4.0
Mr. Randell K. Goodman	Research Associate	10.4
Ms. Margarita L. Hopkins	Research Associate	5.4
Ms. Ellen W. Scarsbrook	Research Associate	5.9
Mr. John P. Pugh	Technical Assistant	1.2
Ms. Belinda T. Jones	Lab Technician A	3.0
Ms. Christine B. Sherrer	Senior Clerk	5.6
Ms. Evelyn C. Talley	Typist A	3.3
Ms. Deborah A. Morgan	Typist	1.0
Ms. Teresa N. Tilson	Typist	4.5
Ms. Alma C. Tucker	Typist	3.2
Mr. Robert L. Busch	Graduate Research Assistant ¹	4.0
Mr. Jesse A. Chappell	Graduate Research Assistant	4.0
Mr. Michael C. Cremer	Graduate Research Assistant	3.0
Mr. David R. Dunseth	Graduate Research Assistant	3.1
Mr. Gary L. Jensen	Graduate Research Assistant	2.0
Mr. John W. Jensen	Graduate Research Assistant	4.0
Mr. Walter G. Jones	Graduate Research Assistant	2.5
Mr. Ralph W. Parkman	Graduate Research Assistant	4.0
Mr. Thomas J. Popma	Graduate Research Assistant	3.1
Mr. Edwin H. Robinson	Graduate Research Assistant	4.0
Mr. James A. Steeby	Graduate Research Assistant	3.1
Mr. Craig S. Tucker	Graduate Research Assistant	4.0

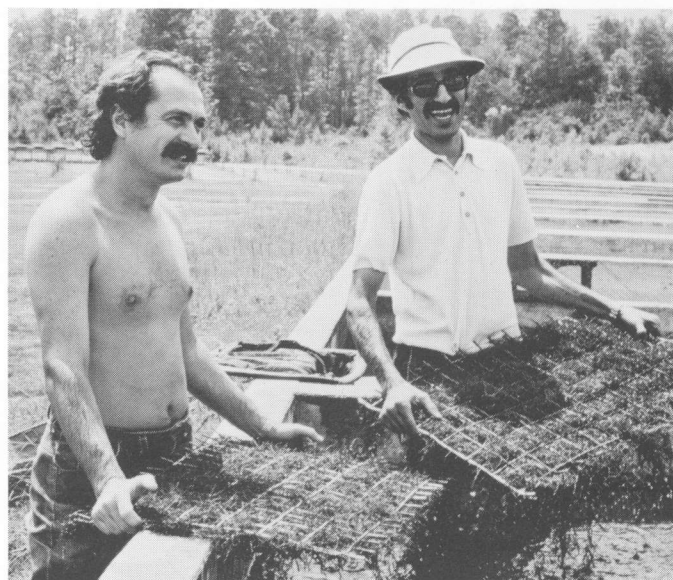
¹All graduate research assistants are generally expected to spend 1/3 time on activities related to their stipend and under normal circumstances do not contribute more than 4.0 man-months to a project in a year.

ACCOMPLISHMENTS

Education and Training

The activities programmed under this objective included developing new courses, providing practical training in short courses and for visitors, and providing support to graduate students interested in international-related aquaculture.

New courses to be developed included one in fish seed production. The 1975 goal was to prepare a course outline and plan facilities and training aids. This was accomplished by Jack Snow who, besides preparing the material, used parts of it during the non-degree training program. A training syllabus for the course was 40 percent drafted and visual aid materials were developed. A series of 263 Kodachrome slides (35-mm) were obtained and organized into several illustrated lectures to pre-



Students collect carp eggs as part of their practical training.

sent aspects not previously available on campus. This activity required 4.0 man-months.

A new course in aquacultural economics was developed. An initial course had been taught in 1974 as a special problems subject, and it was modified and offered as a formal course, Economics of Aquaculture, in spring quarter 1975. Thirteen graduate students registered, 7 foreign and 6 American. The seven foreign students were from Nigeria, Philippines, Taiwan, El Salvador, and Mexico. The course was accepted as a regular offering of the University and included in the 1976 catalog. When offered in winter quarter 1976, registration totaled 25, of which 16 were foreign students. The foreign students were from the Philippines, Taiwan, and the Netherlands. Experience and information gained from research results, technical assistance contracts, and published secondary information are utilized to prepare examples from countries represented by the students.

Two courses in fish genetics and breeding were developed and taught. These courses were completed with the assistance of Dr. W. G. Wohlfarth from Israel, who spent a year at Auburn as a visiting professor and taught the graduate-level courses in which a total of 60 students was enrolled. He received 2.0 man-months of support from grant funds for his work.

Practical training activities included the development and teaching of short courses emphasizing practical aspects of aquaculture and inland fisheries. A special training program for 15 Peace Corps Volunteers in fisheries scheduled for assignment in Camerouns and Zaire in Africa was presented at the request of Peace Corps, July 6-14.

A special 5-month short course in aquaculture, divided into two sessions, was initiated in March 1976. Thirteen students finished the first session and 8 students were enrolled in the second. Some of the materials developed for use in new courses covering fish seed production, breeding and genetics, and aquacultural economics were modified for use in these short courses. A similar short course will be offered in 1977.

During the report period 51 visitors from 15 different foreign countries were received at the Center. The names and addresses of these visitors are listed in the Appendix. Many of these visitors were provided special tours of the ponds, labs,

and other facilities. Meetings with appropriate University administrators or scientific staff were arranged according to the interest and intent of the visitors and, in selected cases, further tours to other facilities around the country were arranged.

Many visitors come to the Center specifically for information on international fisheries and aquaculture development. The numbers of such visitors each year since the inception of the grant are listed below:

<i>Year</i>	<i>Number of visitors</i>
1970-71 (FY 1971)	1
1971-72 (FY 1972)	41
1972-73 (FY 1973)	30
1973-74 (FY 1974)	58
1974-75 (FY 1975)	58
1975-76 (FY 1976)	51

¹Records not kept for fiscal year 1971.

Twelve graduate research assistantships were funded from grant money during the report year, supporting 40.8 man-months of service. Graduate student enrollment during the year averaged 73, of which 21 were foreign students. This is the largest number of graduate students the Department has ever enrolled. Thirty-four of the graduate students (12 foreign) had major professors and advisors who received some grant support.

The 37 foreign students enrolled during the year represented 10 different countries: Philippines (18), Taiwan (4), Thailand (3), Nepal (3), El Salvador (2), Colombia (1), Nigeria (1), Cambodia (1), Brazil (2), Panama (1), and Swaziland (1). USAID missions sponsored 22 of the foreign students, 5 were sponsored by FAO, 5 were self supporting, 2 were paid by their home country, and 1 each was sponsored by JCRR (Tai-

wan), IBRD (World Bank), and IDRC (Canadian aid group). The subject matter specialties of the foreign graduate students were in six general fields: fish feeding and nutrition (7), aquaculture (6), fish diseases and health (3), fisheries management (3), fishpond ecology (1), and aquacultural economics (1).

Twenty graduate degrees were awarded during the year (American: M.S.-10, Ph.D.-2; foreign: M.S.-7, Ph.D.-1). Seven of the foreign students returned to fisheries work in their home countries and the eighth continued his studies. Of the seven American graduates who have taken employment, three are working for state conservation agencies, three for universities, and one in the private sector. One graduate was recruited by the International Center to fill a fisheries project position in Indonesia.

Extended Knowledge Base

This activity area includes continuation of ongoing research programs plus the addition of new state-of-the-art study efforts in the subjects of aquaculture, aquacultural economics, minimum input aquaculture, and knowledge transfer technology.

A state-of-the-art survey in aquaculture was initiated to determine the nature and extent of aquaculture in the less developed countries. Presently information has been collected from various sources for 77 LDCs. A questionnaire was developed to gather information on types of fish cultured, techniques used, production cost, marketing, types of minimum input aquaculture being conducted, types of research being conducted, and nature of extension programs being carried out in fisheries. These questionnaires were mailed to 230 individuals either currently working in an LDC or those who have been there recently. Presently, 71 replies have been received. Follow-up letters have been mailed to individuals who did not reply initially. Interviews have been conducted with individuals who are in



Awarding of certificates at completion of 5-month aquaculture training program.



Peace Corps trainees get experience with pond seining.

the United States and have recently worked in aquaculture in an LDC.

A literature review is also in progress in which relevant information on aquaculture programs used in the LDCs will be gathered.

A bibliography on aquacultural economics has been developed using computer format in which new entries can be added as they become available. Letters requesting copies of published reports on aquacultural economics were sent to all land-grant colleges and to foreign countries. A computer search of documentary material was conducted. A request to the Smithsonian literature retrieval system was initiated. Simultaneously with literature collection, a computer storage and retrieval system has been developed for updating the bibliography.

Two fish marketing studies, El Salvador and Panguil Bay, Philippines, were completed during 1975-76. Production studies indicating budgeting procedures were also completed during the year. Publications resulting from this work are:

HOPKINS, M. L. AND E. W. McCOY (in press). Annotated Bibliography of Aquacultural Economics. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta.

PARKMAN, R. W. AND E. W. McCOY (in press). Fish Marketing El Salvador. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta.

BOUTWELL, J. L. AND E. W. McCOY. Planning and Evaluating Farms with Aquacultural Enterprises. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta. 53 p.

HOPKINS, M. L. AND E. W. McCOY. Marketing of Fisheries Products by Municipal Fisheries in Panguil Bay, Philippines. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta. 37 p.

PARKMAN, R. W. AND E. W. McCOY. Marketing as a Factor in Fishculture Development. El Salvador. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta. 25 p.

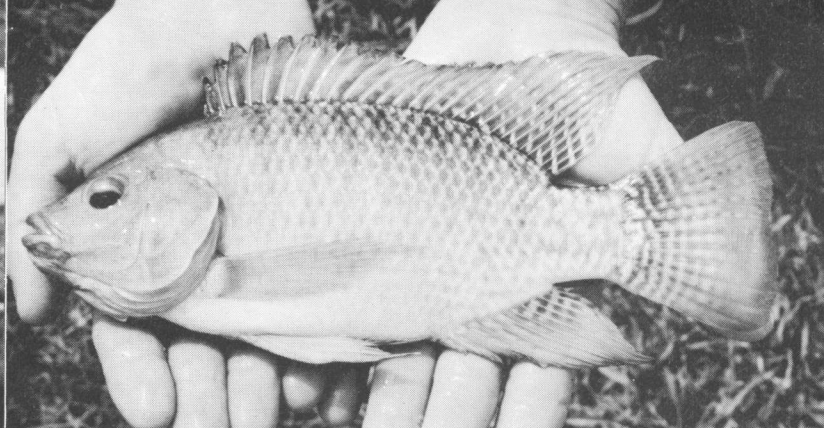
MCCOY, E. W. AND J. L. BOUTWELL. Preparation of a Financial Budget for Fish Production. Catfish Production in Areas with Level Land and Adequate Ground Water. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta. 73 p.

Additional studies are underway. One involves the ramifications of fish culture development in El Salvador, a second examines wholesale and retail marketing of fish in the Philippines, and another concerns extended use of productive facilities to improve income.

The questionnaire for aquaculture mentioned above includes primary economic data on fish culture in LDCs. These data will be used to determine areas where research and development efforts in aquaculture have the least constraints for success.

Questionnaires also asked for information about minimum input aquaculture, which was broadly defined. Results from the questionnaire indicate a general lack of data on methods and extent of practices.

A study was initiated to develop fishculture methods appropriate to low income small scale farmers in LDCs. The study



incorporated the level of available resources for aquaculture and the attitude of farm operators towards aquacultural production. Using currently available cultured species and production techniques a system of production will be developed to utilize the resources farmers currently have available.

A report demonstrating the economic costs and returns of shifting from higher to lower levels of input use has been prepared. This report, indicating the changes in capital, labor, and variable inputs needed as producers move from maximum to minimum input aquaculture, is listed as follows:

CRAWFORD, K. W. AND E. W. McCOY (in manuscript). Partial Budgeting for Selected Aquacultural Enterprises. International Center for Aquaculture, Auburn Univ. (Ala.) Agr. Exp. Sta.

A number of agencies involved in fisheries extension either in the United States or an LDC have been contacted concerning the nature of their programs. In the United States, various agencies such as the U.S. Fish and Wildlife Service, Soil Conservation Service, state agricultural experiment stations, and state game and fish commissions have fishery extension programs. The primary emphasis of their programs is generally sportfishing, although some agencies have good aquacultural extension programs. Twenty agencies have been contacted and nine interviews with fisheries extension agents have been conducted.

In the LDCs, fisheries extension programs are sponsored by a number of international and national agencies. The FAO agricultural education and training office has been contacted to determine the nature of its program. Of the 53 publicly sponsored service organizations contacted, 21 had some type of fisheries programs. The U.S. Peace Corps and other similar volunteer agencies are involved in fisheries extension. These agencies have been contacted and the extent of their involvement determined.

A number of national agricultural extension agencies in the LDCs have been contacted to determine their organization and the types of programs being carried on. Several individuals who have worked in LDCs under USAID sponsorship in agricultural extension were contacted for opinions as to the difficulties encountered in conducting extension programs in LDCs.

A collection of educational material used in fisheries extension both in the United States and the LDCs has been initiated.

A number of research projects are also in progress to expand the knowledge base and research capabilities. The following is a report on these various projects.

Various combinations of channel catfish, tilapia, silver carp, and grass carp are being evaluated in pond trials during the current growing season. The combinations offer potential for

Brand marked channel catfish brooder used in genetic studies, left, and fast growing tilapia hybrid *Sarotherodon niloticus* (female) x *S. honorum* (male), right.

optimum protein production at minimum cost. Results may have direct application for LDCs.

Twelve fed catfish ponds, containing 300 channel catfish and 3 grass carp each, were used in experiments to determine the effects of simazine and copper sulfate on water quality. Four ponds were treated biweekly with 0.75 pound per acre $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. Four other ponds were treated three times in a 4-month period with simazine; once with 0.8 milligram per liter and twice with 0.25 milligram per liter. Four untreated ponds were used as controls.

Phytoplankton numbers in simazine treated ponds averaged less than 10 percent of the control and chlorophyll *a* less than 5 percent of the control values. Chlorophyll *a* and numbers of phytoplankton were similar in copper sulfate treated and control ponds.

Treatment of ponds with simazine resulted in extended periods of low dissolved oxygen. On more than 60 days in the 4-month test period, dissolved oxygen did not exceed 50 percent of saturation. Treatment with copper sulfate resulted in dissolved oxygen values lower than the controls; however, afternoon values generally exceeded saturation.

Dissolved Cu^{++} , measured weekly, never exceeded 0.013 milligram per liter despite 9 biweekly additions of 0.023 milligram per liter Cu^{++} . Simazine residues were monitored and the residual remaining after treatment with 0.8 milligram per liter was toxic to phytoplankton for about 5 weeks. Treatments with 0.25 milligram per liter were effective for 2 to 3 weeks.

One graduate student measured the annual cycle of benthic metabolism, primary production, and total ecosystem respiration in two ponds under intensive catfish cultivation. On the basis of oxygen uptake, he estimated the relative oxidation of organic matter in the water column and in the sediment. Another student isolated pure bacterial cultures from pond bottom muds. Of these, different metabolic types were chosen for studying the relationship between metabolic heat production, ATP concentration, dehydrogenase activity, and cell concentration. Since much of the benthic bacterial activity in the ponds turned out to be anaerobic, for which oxygen uptake measurements are not realistic, a calorimetric method for measuring metabolic heat production was developed.

A master's thesis, "Metabolic Rate of Pond Ecosystems under Intensive Catfish Cultivation," will be submitted to the Graduate School in the fall. A manuscript resulting from this study, "Disadvantages of Deep Ponds for Intensive Catfish Culture," will be submitted for publication in the Agricultural Experiment Station's periodical. Two manuscripts on direct calorimetry are in preparation: "Direct Calorimetry of Benthic Infaunal Metabolism" and "Oxygen Uptake and Metabolic Heat Production in *Littorina irrorata* and *Uca pugnax*."



Market study in local supermarkets to determine consumer acceptance of new pond-reared species.

Work was begun to assemble a brood stock of several species of food fishes which will be needed for spawning and rearing of promising food fishes. Test animals for both training and research were involved. Species included so far are grass carp, silver carp, mirror carp, bighead carp, goldfish, and tilapia.

Considerable time was spent in planning for a fish hatchery building to provide facilities for research on fish spawning, incubation, and early development of the seedlings. A contract for construction of the building has been let and work is underway. Equipment for the building has been ordered, so prospects are favorable for a new hatchery facility for the 1977 spawning season.

Research activity in spawning and rearing promising food fishes was focused on the controlled spawning and hatching of the mirror carp to provide eggs and seedlings for overseas shipment.

Nine experimental diets were formulated for feeding to pond-raised omnivorous fish, such as channel catfish, for rapid gain and efficient food conversion. Diets of three protein levels, each containing 0, low, and moderate levels of fish meal, (3 x 3 treatment design) were prepared in pellet form and fed to channel catfish in 1/10-acre ponds for 198 days. The objective was to determine the effect of source of protein on the protein requirement of cultured fish.

Addition of fish meal improved the quality of an all-plant diet and reduced the optimum percentage of protein for fish

growth. For intensive feeding of a pond-cultured fish with food habits and nutrient requirements similar to channel catfish, a 36 percent protein ration with 1/3 of the protein from fish or animal origin appears to be satisfactory for a rapid rate of growth. Higher percentages of fish meal did not improve fish growth significantly. Subsequent studies will investigate the benefit of changing the protein percentage in fish diets as fish size increases.

Waste from cultured channel catfish (head, skin, and viscera) was collected from a processing plant on various dates throughout the year to compare variation in chemical (nutrient) composition of the waste from fish subsequent to heavy feeding (fall) or fasting (spring). The waste was homogenized, freeze-dried, and analyzed for protein, lipids, ash, Ca, P, amino acids, and fatty acids.

Analyses of the waste samples indicated that contents of lipids, protein, and energy vary with the previous feeding schedule of the fish. The waste material has high lipid or fat content, which indicates that the fat must be extracted prior to drying if the waste is to be made into fish meal. The lipids in the waste could be a valuable source of energy for animal or fish foods. Compared with commercial marine fish meal, cultured freshwater fish meal is somewhat lower in protein, slightly lower in the valuable amino acids lysine and methionine, and slightly higher in inorganic matter. The freshwater fish waste contains much less polyunsaturated fatty acids than marine fish, which means it will be less subject to oxidative change and will not give "fishy" flavor to animals to which it is fed. Subsequent studies will evaluate biological value of freshwater fish waste in fish and animal diets.

Advisory Capacity

Activities to be accomplished under this subject include (1) training of advisory staff, (2) formation of a list of potential people for work in LDCs with aquaculture, and (3) orientation support and technical backstopping for aquacultural development.

A letter of inquiry with an appropriate response form was sent to a wide variety of people who might be interested in aquaculture work overseas. Mailing lists included membership of the Fish Culture Section of the American Fisheries Society, the World Mariculture Society, Auburn fisheries alumni, and other who were suggested by the ICA staff or contacts. The Center now has a growing list of people who might be contacted should a specific demand develop. The list will be summarized further and circulated during the coming year.

No new field positions were filled in FY75 though several are projected in FY76 when contracts now being negotiated will be finalized. Drs. H.R. Schmittou and J.H. Grover will leave the Philippines and at least one replacement will need orientation on campus before joining the Philippines project.

Technical backstopping is available for AID-supported projects or other requests that may come in. During FY76, for example, a short-term soil expert was located and sent to the Philippines to assist the project there. In connection with an acid-sulfate soils problem, a number of lab analyses were performed on soil samples sent from the Philippines to help identify the cause of the problem and develop reasonable solutions. Fertilizer samples were analyzed for N-P-K content as requested by field staff in the Philippines. The Brazil project was assisted with the statistical analysis of some of their experimental data using the on-campus computers and expertise. Both projects had minor but locally unavailable parts or equipment essential for project functions secured for them. Some library references unavailable locally were secured and photocopied for field staff and foreign alumni. The field staff also received help in reviewing manuscripts for publication, making conference attendance arrangements, and in communicating with each other or other groups.

During the year the annual report for FY74 was prepared and submitted to AID/Washington. A number of publications were finished and others were in preparation by grant-supported staff. A reprint collection of more than 300 papers is maintained by the Department to answer numerous requests for information received each week.

Linkages and Networks

An objective of this year's work was to improve and expand linkages between the International Center for Aquaculture and other international development agencies. Continued contacts were maintained with the University of Rhode Island and its International Center for Marine Resource Development. Most notable about this relationship was arranging the loan of David Hughes, from Auburn, to work for 4 months with the Rhode Island program in Central America. Such an arrangement proved useful to both parties in employing experience and talent available for common objectives.

In February-March 1976, Dr. E. W. Shell, Head of the International Center for Aquaculture, and Dr. R. D. Rouse, Dean of the School of Agriculture and Director of the Agricultural Experiment Station, traveled to Southeast Asia to visit selected laboratories and institutions relative to establishing linkages for aquacultural development. Their contacts included the appropriate universities and government agencies in the Philippines, Thailand, and Indonesia, and with FAO in Rome. As a direct

result of the contacts made on this trip, a Memorandum of Cooperation was signed between the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) and Auburn University on May 31, 1976. Additional groundwork was laid for participation in other programs such as might be supported under a Title XII-type program.

Dr. Schmittou, at the request of AID/Washington, participated in a project review of the Oceanic Foundation in Hawaii in May 1976. Drs. Shell and R. T. Lovell have served on special committees of the National Academy of Sciences on world food problems and fish nutrition. Discussions have been held during the year with the Rockefeller-funded International Center for Living Aquatic Resource Management (ICLARM), the South East Asia Fisheries Development Council (SEAFDEC), and the Canadian-based International Development and Research Centre (IDRC).

IMPACT OF GRANT-SUPPORTED ACTIVITIES IN ACHIEVING GRANT PURPOSES

The purpose of the grant is to strengthen the International Center for Aquaculture for greater service to developing countries. It is evident, from the discussion of accomplishments, that reasonable progress is being made to realize this purpose. The International Center has been strengthened and the resulting capability for service is being maintained and enhanced. Furthermore, the increased capacity is being effectively utilized.

Grant funds were utilized during the year to purchase 270.0 man-months of personnel services. These services contributed significantly to the capability of the Center in the areas of education and training, extending the knowledge base, advisory capacity, information capacity, and linkages and networks. Man-months of personnel services purchased with grant funds each year since the beginning of the project are given below:

Year	Category of personnel			
	Academic and research	Technical and secretarial	Graduate research assistants	Field student labor
1970-71 (FY 1971)	47.8	12.0	15.2	17.6
1971-72 (FY 1972)	38.0	22.3	25.6	74.9
1972-73 (FY 1973)	45.2	16.1	16.3	65.6
1973-74 (FY 1974)	48.4	29.0	22.4	47.9
1974-75 (FY 1975)	44.2	30.6	19.5	26.8
1975-76 (FY 1976)	93.6	21.8	40.8	113.8

Funds were also used to increase library holdings, to support the activities of the Center staff, and to provide materials, supplies, and minor items of equipment utilized in graduate training.

The major contribution of the grant was to provide for the purchase of approximately 65.6 man-months of senior-level (assistant professor and above) staff during the year. These personnel are key elements in the strengthening of the International Center. They are primarily responsible for the training, extension of the knowledge base, advisory services, and other activities necessary for a vital program.

Virtually all of the grant-funded staff participated in the expansion of the knowledge base through research and development. Results of their activities were published as research papers in recognized scientific journals, as chapters in monographs or books, as parts of symposia, and as reports prepared for various USAID Missions and international development agencies. Those published during FY 1976 are listed in the Appendix.

The number of publications produced by grant-funded staff each year since the beginning of the grant is shown below:

Year	Number
1970-71 (FY 1971)	6
1971-72 (FY 1972)	8
1972-73 (FY 1973)	12
1973-74 (FY 1974)	13
1974-75 (FY 1975)	37 ¹
1975-76 (FY 1976)	35

¹Beginning in FY 1975, formal reports prepared as a result of USAID contracts are included in the number of publications.

Research interests, research projects, and publications of grant-funded staff are listed below:

Name	Research interests	No. of research projects	No. of publications ¹
Dr. E.W. Shell	aquaculture	1	0
Dr. D.D. Moss	aquaculture	0	2
Dr. R. Allison	aquaculture	2	0
Dr. C.E. Boyd	water quality and ecology	5	8
Dr. R.T. Lovell	fish nutrition and fish processing and technology	3	10
Dr. E.W. McCoy	aquacultural economics	5	3
Dr. M.M. Pamatmat	pond ecology	3	1
Dr. R.O. Smitherman	aquaculture	3	0
Mr. J.R. Snow	aquaculture and fish reproduction	2	4
Dr. W.G. Wohlfarth	fish breeding and genetics	0	0
Dr. J.R. Hubbard, Jr.	extension methodology	0	0
Dr. B.L. Duncan	tropical aquaculture	0	2
Dr. R.L. Phelps	fisheries extension	0	2
Mr. J.L. Boutwell	aquacultural economics	2	2
Mr. K.W. Crawford	aquacultural economics	2	3
Mr. R. Goodman	hatchery management	0	0
Ms. M.L. Hopkins	aquacultural economics	1	0
Ms. E.W. Scarsbrook	algal taxonomy and ecology	2	1
Mr. R.L. Busch	induced spawning of fish (with W. Shelton)	1	0
Mr. J.A. Chappel	quantitative inheritance in fish (with R.O. Smitherman)	1	0
Mr. M.C. Cremer	eel culture in Philippines (with R.O. Smitherman)	1	1 ²
Mr. D.R. Dunseth	polyculture of fishes (with R.O. Smitherman)	1	0
Mr. G.L. Jensen	tilapia spawning and reproduction (with W. Shelton)	1	0
Mr. J.W. Jensen	pond economics (with E.W. McCoy)	1	1
Mr. W.G. Jones	freshwater shrimp culture (with R.O. Smitherman)	1	0
Mr. R.W. Parkman	fish marketing in El Salvador (with E.W. McCoy)	1	1 ²
Mr. T.J. Popma	tilapia nutrition (with R.T. Lovell)	1	0
Mr. E.H. Robinson	catfish nutrition (with R.T. Lovell)	1	0
Mr. J.A. Steeby	feeding and pond management (with R.T. Lovell)	1	0
Mr. C.S. Tucker	pond water quality (with C. Boyd)	1	1 ²

¹Titles of publications are given in appendix, credit given to each joint author.

²Research thesis or dissertation.

Of special significance in the expansion of the knowledge base through the use of grant funds was the research conducted by foreign students. Not only did they contribute new information to various fields of aquaculture and inland fisheries, but they also learned something of the use of the scientific method for solving practical problems. A total of eight foreign students received graduate degrees during the year. Each student was required to submit a thesis or dissertation based on original research. Although only two foreign students were supported directly on grant funds in the form of hourly wages, all of the students utilized equipment and supplies, benefited from the availability of field labor, or received guidance and assistance from staff which was provided with grant funds. Name, country of origin, and title of the thesis or dissertation for each foreign student are listed below (name of major professor follows dissertation title):

Apolinario, K. M. (Philippines)	Recovery and Utilization of Boneless Flesh Mechanically Separated from Tilapia (<i>Tilapia aurea</i>), Buffalofish (<i>Ictiobus cyprinellus</i> x <i>Ictiobus niger</i>), and Channel Catfish (<i>Ictalurus punctatus</i>) (Lovell)
Canlas, J. R. (Philippines)	The Parasitic and Bacterial Loads of Channel Catfish, <i>Ictalurus punctatus</i> , Raised in Two Farm Ponds (Plumb)
Cruz, E. M. (Philippines)	Determination of Nutrient Digestibility in Various Classes of Natural and Purified Feed Materials of Channel Catfish (Lovell)
DeFigueiredo, J. (Brazil)	Comparison of Virulence of the Channel Catfish, <i>Ictalurus punctatus</i> (Rafinesque), of <i>Aeromonas hydrophila</i> (Chester) from Diseased Fish, Pond Water and Shrimp Lesion (Plumb)
Dureza, V. A. (Philippines)	The Determination of the Efficiency of Three Aeration Systems in the Production of Channel Catfish in Earthen Ponds (Allison)
Inko-Tariah, M. (Nigeria)	The Production of <i>Tilapia aurea</i> in Polyculture with Largemouth Bass or Monosex (male) Stocking for Population Control (Smitherman)
Li, Y. (Taiwan)	Vitamin D Requirement of Channel Catfish (Lovell)
Moreira, P. (Brazil)	Effects of Various Levels of Cooked and Uncooked Carbohydrate in Diets of Channel Catfish (Lovell)

Because of the availability of the staff funded from the grant, the Department has been able to attract a number of research grants and contracts that it could not otherwise have handled. In the past year the grant-funded staff was involved in a number of research projects supported by state appropriated University funds. Several of these research projects will result in information that will have direct transferability to developing countries.

Grant-funded staff taught 12 courses during the year. The university paid most of the costs for teaching the courses, but because of the use of grant funds, more specialists in different disciplines were available for teaching these courses. Nine

courses per 12-month academic year would be approximately a full-time teaching load for one professor if he were supported entirely by university teaching funds. Obviously, a single individual could not adequately teach the wide variety of courses offered in the Department of Fisheries and Allied Aquacultures. By combining university teaching funds and grant funds into joint appointments, 10 different teachers (specialists in their respective fields) were available to teach the courses.

A summary of courses taught and student enrollment is presented below:

Quarter	No. of courses	Number of students enrolled ¹	
		American	Foreign
Summer 1975	6	78	23
Fall 1975	11	178	47
Winter 1975	11	133	50
Spring 1967	11	115	32
TOTAL	39	504	152

¹Students normally take more than one course each quarter. The total number of students enrolled increased approximately 16 percent over the previous year.

The average number of graduate students enrolled during the year was 73, up 21 percent over the previous year. A summary of graduate enrollment during the past 6 years is presented in the following:

Year	Number of graduate students enrolled in each quarter			
	Summer	Fall	Winter	Spring
1970-71 (FY 1971)	24	23	31	28
1971-72 (FY 1972)	29	34	43	46
1972-73 (FY 1973)	43	48	50	51
1973-74 (FY 1974)	48	57	54	53
1974-75 (FY 1975)	50	57	65	69
1975-76 (FY 1976)	60	73	79	79

Foreign graduate student enrollment has been relatively stable for the past 3½ years, as shown by the following:

Year	Number of foreign graduate students enrolled in each quarter			
	Summer	Fall	Winter	Spring
1970-71 (FY 1971)	7	5	5	7
1971-72 (FY 1972)	5	5	13	15
1972-73 (FY 1973)	16	16	19	22
1973-74 (FY 1974)	22	27	26	26
1974-75 (FY 1975)	24	22	19	21
1975-76 (FY 1976)	20	20	22	22

A total of 20 advance degrees was awarded during the year (17 M.S. and 3 Ph.D.). Eight of the degrees were awarded to foreign students. Information on the total number of advance degrees awarded and the number awarded to foreign students is presented below:

Year	Graduates	
	M.S.	Ph.D.
1970-71 (FY 1971)	4(0) ¹	4(2)
1971-72 (FY 1972)	10(4)	4(1)
1972-73 (FY 1973)	18(8)	4(0)
1973-74 (FY 1974)	20(9)	5(3)
1974-75 (FY 1975)	24(12)	3(2)
1975-76 (FY 1976)	17(7)	3(1)
TOTAL	93(40)	23(9)

¹Number of foreign student graduates indicated in parenthesis.

OTHER RESOURCES FOR GRANT-RELATED ACTIVITIES

All funds received by the Department and International Center strengthen and support the Center. Information on the various sources of funds is presented in the following table:

Source of funds	Amount
State of Alabama appropriated funds	
For teaching	\$ 163,233
For research	155,580
Sales funds	
For sale of food fish and fingerlings	35,000
Federal appropriated funds for research	
USDA - Land-Grant College funds	87,140
Research grants from other state governments	124,000
Research grants from Federal agencies	115,097
Research grants from private enterprise	75,000
Sub-total	755,050
All USAID support	900,000
TOTAL	\$1,655,050

As the information indicates, the Department and Center receive funds from a wide variety of sources; however, USAID is the largest single source of funds. Appropriated funds from the State of Alabama to Auburn University for teaching and research represent the second largest source of funds. A number of separate research and development contracts provide the third largest source.

Interpreting the term "grant-related activities" in its broadest sense, virtually all funds received contribute directly or indirectly to achieving the purpose of the grant. Even industrial research grants contribute supplies, equipment, and personnel that are used to some extent in graduate training. By having this type of work going on in the same Department, foreign graduate students are able to better comprehend the complexity of problems they must face in the future when attempting to balance food and industrial production needs with the need for environmental protection.

UTILIZATION OF INSTITUTIONAL RESPONSE CAPABILITIES IN DEVELOPMENT PROGRAMS

Much information about service activities by the International Center for Aquaculture has already been presented. A total of 19 requests for assistance was responded to during the year. Additional requests were received mostly from private industry wishing to acquire staff services on a personal services contract basis, but this type of arrangement is generally discouraged by the Center.

The international service activities for the year can be divided roughly into four categories. The different categories with the number of man-months of each were as follows:

Category	Man-months
Activities by grant staff utilizing 211(d) funds	2.5
Activities by other staff utilizing 211(d) funds	0.8
Activities by grant staff utilizing other funds	6.0
Activities by other staff utilizing other funds	5.3
TOTAL	14.6

The specific people and the international service activities involved by each category were:

Professor	Activities and dates
Grant staff utilizing 211(d) funds	
E.W. Shell	Visit Southeast Asian institutions and FAO, Rome, to establish contacts and develop programs, March 3-12, 1976.

R.O. Smitherman El Rosario, Sinaloa, Mexico, to advise officials on aquacultural research procedures with tilapia and channel catfish, August 10-15, 1976.

Japan and Thailand to attend FAO Technical Conference on Aquaculture and conduct aquaculture survey in Thailand, May 24-June 24, 1976.

R.P. Phelps Bogota, Colombia, to develop plans for fisheries training for government fisheries personnel, August 3-16, 1975.

Other staff utilizing 211(d) funds

L.L. Lovshin Consult with Peruvian Government regarding South American fish culture developments, February 9-15, 1976.

R.D. Rouse Visit Southeast Asian institutions and FAO, Rome, to establish contacts and develop programs, March 3-12, 1976.

Grant staff utilizing other funds

E.W. Shell Philippines to advise on feasibility of relocating and expanding University of Philippines fisheries education program (AIS/W), July 25-August 9, 1975.

Japan and Philippines to develop linkages and programs (AID/ea-180), February 21-March 3, 1976.

D.D. Moss Colombia to develop plans for fisheries training for government fisheries personnel (AID/ta-BOA-1152, T.O. 5 and T.O. 9), August 3-13, 1975, and April 21-May 1, 1976.

Jamaica to review project proposal (AID/W), August 13-29, 1975.

J.R. Snow Colombia to develop plans for fisheries training for government fisheries personnel (AID/ta-BOA-1152, T.O. 5) August 3-9, 1975.

B.L. Duncan Central African Republic evaluation of Peace Corps Fisheries program (AID/ta-BOA-1152, T.O. 7), July 31-August 31, 1975.

El Salvador USAID Mission project work (AID/la-688), February 29-March 4, 1976.

Honduras project development tasks (AID/ta-BOA-1152, T.O. 8), March 4-22, 1976.

R.P. Phelps Colombia project development (AID/ta-1152), T.O. 9, April 21-May 1, 1976.

Other staff utilizing other funds

R.D. Rouse Japan and Philippines to visit Southeast Asian institutions and develop programs (AID/ea-180), February 21-March 3, 1976.

R.I. Barnhisel Philippines special consultant on acid soil conditions in fishponds (AID/ea-180), January 5-18, 1976.

H.R. Schmittou Hawaii project review on milkfish reproduction (AID/W), May 6-8, 1976.

J.H. Grover Indonesia project development in Lampung Province (AID/ta-BOA-1152), July 1-5, 1975.

Japan FAO Technical Aquaculture Conference (AID/ea-180), May 25-June 6, 1976.

L.L. Lovshin Ghana and Ivory Coast Regional Aquaculture Conference (AID/ta-BOA-1152, T.O. 2), September 26-October 6, 1976.

Peru consulting with USAID (AID/ta-BOA-1152, T.O. 2), June 5-9, 1976.

Japan FAO Technical Aquaculture Conference (AID/ta-BOA-1152, T.O. 2), May 24-June 4, 1976.

J.A. Plumb Canada parasite and disease program (P & D Proj.), August 20-23, 1975.

W.A. Rogers Germany scientific conference (P & D Proj.), August 24-31, 1976.

D.F. Leary Japan FAO Technical Aquaculture Conference (AID/ea-180), May 25-June 5, 1976.

D.G. Hughes Panama and Colombia with USAID project work (AID/ta-BOA-1152, T.O. 5), July 31-August 16, 1975.

In addition to the international service activities discussed above, the Center has provided 72 man-months of technical assistance to four international development projects overseas. Six Center staff were assigned to these projects full time. In addition, 12 man-months of technical backstopping support was provided by the Center on campus. Funds for this technical backstopping came from the individual projects and were utilized in the support of three different staff members. These projects were: (1) a USAID-supported aquaculture development project in Northeast Brazil (AID/la-1152, T.O. 2 ICA), (2) a USAID-supported aquaculture production project in fresh, brackish, and extension fisheries work in the Philippines (AID/ea-180-ICA), (3) an aquaculture development project in El Salvador, and (4) a freshwater aquaculture development project in Mid-Western State, Nigeria, supported by the Nigerian Government. The Brazilian and Nigerian projects are expected to continue through FY 77. The Philippines project will phase out one of the three positions July 1, 1976.

It is expected that negotiations in progress will lead to long term projects in Indonesia, Colombia, Jamaica, and possibly Honduras in the near future.

Man-months of overseas activities performed by grant-funded staff each year since the inception of the grant are given below:

Year	Man-months
1970-71 (FY 1971)	9.8
1971-72 (FY 1972)	8.0
1972-73 (FY 1973)	3.0
1973-74 (FY 1974)	4.5
1974-75 (FY 1975)	7.7
1975-76 (FY 1976)	14.6

APPENDIX
Publications Resulting from
Activity of Grant-funded Staff

- BOYD, C. E. AND J. R. SNOW. 1975. Fertilizing Farm Fish Ponds. Auburn Univ. (Ala.) Agr. Exp. Sta. Leaf. 88. 6 p.
- BOYD, C. E. 1976. Accumulation of Dry Matter, Nitrogen, and Phosphorus by Cultivated Water Hyacinths. *Econ. Bot.* 30:51-56.
- BOYD, C. E. 1976. Chemical and Textural Properties of Muds from Different Depths in Ponds. *Hydrobiologia* 48:141-144.
- BOYD, C. E. 1976. Fertilizing Farm Fish Ponds. Auburn Univ. (Ala.) Agr. Exp. Sta. Highlights of Agr. Res. 23(2):8.
- BOYD, C. E. 1976. Liming Farm Fish Ponds. Auburn Univ. (Ala.) Agr. Exp. Sta. Leaf. 91. 7 p.
- BOYD, C. E. 1976. Nitrogen Fertilizer Effects on Production of *Tilapia* in Ponds Fertilized with Phosphorus and Potassium. *Aquaculture* 7:385-390.
- CRAWFORD, K. W., V. L. MURPHY, AND E. W. MCCOY. 1975. A Cost Comparison of Selected Agricultural Protein Sources. Auburn Univ. (Ala.) Agr. Exp. Sta. Highlights of Agr. Res. 22(4):11.
- CRAWFORD, K. W. 1976. Factors Affecting Catfish Production in West-Central Alabama. Auburn Univ. (Ala.) Agr. Exp. Sta. Highlights of Agr. Res. 23(2):9.
- CREMER, M. C. 1975. Identification, Distribution, Relative Abundance and Culture of Anguillid Eels of Northern Luzon, Philippines. M.S. thesis, Auburn Univ.
- DUNCAN, B. L. 1975. Review of Peace Corps Fisheries Program in the Central African Republic. Auburn Univ. Dept. Fish. and Allied Aquacult. Rep. (AID/ta-BOA-1152, T.O. 7). 16 p.
- DUNCAN, B. L. 1976. Honduras Aquaculture Development Project. Auburn Univ. Dept. Fish. and Allied Aquacult. Rep. (AID/ta-BOA-1152, T.O. 8). 25 p.
- JENSON, J. W. 1976. Progress Report on Fisheries Development in Brazil. Auburn Univ. Intern. Center for Aquacult. Res. and Dev. Ser. No. 10 (AID/ta-BOA-1152, T.O. 2). 7 p.
- LEARY, D. F. AND R. T. LOVELL. 1975. Value of Fiber in Production-type Diets for Channel Catfish. *Trans. Amer. Fish. Soc.* 104:328-322.
- LOVELL, R. T. 1975. Environment-related off-flavors in Intensively Cultured Fish. Pages 259-262 in R. Krouzer, ed. *Fishery Products*. Fishing News (Books) Ltd., London.
- LOVELL, R. T. 1975. Nutritional Diseases in Intensively Cultured Catfish. Pages 721-731 in W. E. Ribelin and G. Moagki, eds. *The Pathology of Fishes*. Univ. of Wisc. Press, Madison, Wisc.
- LOVELL, R. T. 1975. Developing Marine Resources. Pages 9-13 in D. P. Thomas, ed. *Debate Issues*. National Textbooks Co., Skokie, Ill.
- LOVELL, R. T. 1975. Fish Feed and Nutrition. *Com. Fish Farmer* 1(6):26.
- LOVELL, R. T. 1975. Least-cost Fish Feeds. *Com. Fish Farmer* 2(1):26.
- LOVELL, R. T. 1975. Workshop IV: A Special Report. *Com. Fish Farmer* 2(2):36-37.
- LOVELL, R. T., E. E. PRATHER, J. TRES-DICK, AND L. CHHORN. 1975. Effects of Addition of Fish Meal to All-plant Feeds on Dietary Protein Needs of Channel Catfish. *Proc. 28th Ann. Conf. S. E. Assoc. Game and Fish Comm.* 28:222-228.
- LOVELL, R. T. 1976. Formulating Fish Feeds. *Com. Fish Farmer* 2(3):42-43.
- LOVELL, R. T. 1976. Energy in Fish Rations. *Com. Fish Farmer* 2(4):40-41.
- MCCOY, E. W., J. L. BOUTWELL, AND K. W. CRAWFORD. 1976. Preparation of a Financial Budget for Fish Production: Catfish Production in Areas with Level Land and Adequate Ground Water. Auburn Univ. Dept. Agr. Econ. and Rural Soc. Paper. 73 p.
- McVEA, C. AND C. E. BOYD. 1975. Effects of Waterhyacinth Cover on Water Chemistry, Phytoplankton, and Fish in Ponds. *J. Environ. Qual.* 4:375-378.
- MOSS, D. D. 1975. Jamaica Fish Culture Development Project. Auburn Univ. Dept. Fish. and Allied Aquacult. Rep. (AID/W). 22p.
- PAMATMAT, M. M. 1975. *In situ* Metabolism of Benthic Communities. *Cah. Biol. Mar.* 16:613-633.
- PARKMAN, R. W. 1976. An Overview of Fish Marketing in El Salvador. M.S. thesis, Auburn Univ.
- PARKS, R. W., E. SCARSBROOK, AND C. E. BOYD. 1975. Phytoplankton and Water Quality in a Fertilized Fish Pond. Auburn Univ. (Ala.) Agr. Exp. Sta. Cir. 224. 16 p.
- PHELPS, R. P., J. R. SNOW, D. G. HUGHES, AND D. D. MOSS. 1975. Aspects of the Columbia Fisheries Development Loan. Auburn Univ. Intern. Center for Aquacult. Rep. (AID/ta-BOA-1152, T.O.5) 20 p.
- PHELPS, R. P., AND D. D. MOSS. 1976. Progress in Columbian Fisheries Development. Auburn Univ. Intern. Center for Aquacult. Rep. (AID/ta-BOA-1152, T.O.9). 13 p.
- SIRIKUL, B. AND R. T. LOVELL. 1975. Winter Feeding of Channel Catfish. *Proc. 28th Ann. Conf. S. E. Assoc. Game and Fish Comm.* (in press).
- SNOW, J. R. 1975. Hatchery Propagation of the Black Basses. Pages 344-356 in R. H. Stoud and H. Clepper, eds. *Black Bass Biology and Management*. Sport Fishing Institute, Wash., D.C.
- SNOW, J. R. AND C. F. WRIGHT. 1975. Rearing Largemouth Bass Fingerlings in Cages. *Proc. 29th Ann. Conf. S. E. Assoc. Game and Fish Comm.* (in press).
- TUCKER, C. S. 1976. The Effect of Potassium Permanganate on Oxygen Demand, Bacteria, and Phytoplankton. M.S. thesis, Auburn Univ.
- WRIGHT, L. D. AND J. R. SNOW. 1975. The Effect of Six Chemicals for Disinfection of Largemouth Bass Eggs. *Prog. Fish-Cult.* 37:213-217.

Visitors Seeking Information on International Development

<i>Name</i>	<i>Date</i>		
		Prof. Dan Popper Department of Zoology Tel Aviv University Tel Aviv, Israel	February 11-12, 1976
Mr. Abraham Gaduang Mr. Joemari Gerochi Administrative Officers Bureau of Fisheries and Aquatic Resources Manila, Philippines	August 22-26, 1975	Dr. Steve Gage Aquaculture Coordinator Goddard College Plainfield, Vermont	February 16, 1976
Dr. Larry Wilson Fisheries Biologist University of Tennessee Knoxville, Tennessee	September 7, 1975	Mr. Neysa Cortes Director of Education and Mental Health Service Mayaguez Medical Mayaguez, Puerto Rico	February 17, 1976 Consultation Service
Mrs. Elizabeth Samson Miss Florentina Tan Management Analysts and Planners Department of Natural Resources Quezon City, Philippines	October 6-18, 1975	Mr. Richard C. Cortes Research Associate in Fisheries and Aquaculture Department of Marine Sciences University of Puerto Rico Mayaguez, Puerto Rico	February 17, 1976
Dr. A. Navarat Assistant Professor Department of Veterinary Medicine Faculty of Veterinary Science Chulalongkorn University Bangkok, Thailand	October 20-22, 1975	Dr. Francisco Pagan Director of Marine Sciences University of Puerto Rico Mayaguez, Puerto Rico	February 17, 1976
Mr. George Winston Miller Fisheries Officer Government of Belize Belize, Central America	October 21-24, 1975	Mr. Gill Chambers Baytown Petroleum Research Laboratory Exxon Research and Engineering Company P.O. Box 4255 Baytown, Texas	February 25-26, 1976
Dr. Stanislas F. Snieszko Senior Scientist U.S. Fish and Wildlife Service Leetown, West Virginia	November 6-7, 1975	Mr. Douglas Falzett, D.g.p. President, El Pez Volador, P.O. Box 2180 San Jose, Costa Rica	March 17-19, 1976
Dr. F. P. Meyer Director, Fish Control Lab U.S. Fish and Wildlife Service La Cross, Wisconsin	November 6-7, 1975	Dr. Hussein El-Ibiary Mr. John Joyce Catfish Genetics Program Skidaway Institute University of Georgia Savannah, Georgia	March 29-30, 1976
Miss Michael Libin Kibbutz Maayan Zwi D.N. Hof-Hacarmal Israel	November 12-16, 1975	Mr. David Pearce President, Alabama Catfish Farmers Browns, Alabama	April 1, 1976
Mr. R. Grant Gilmore Marine Biologist Harbor Branch Foundation Ft. Pierce, Florida	December 1, 1975	Mr. O. L. Green Fish Farming Extension Agent Marion Fish Hatchery Marion, Alabama	April 1, 1976
Mr. and Mrs. James Miller FAO Aquaculture Project Bangui, Central African Republic	December 8-1, 1975	Mr. Fred J. Laney Foreign Training Officer National Marine Fisheries Service (NOAA) Rockville, Maryland	April 1-2, 1976
Ms. Meredith Olsen Student from Puerto Rico Mayaguez, Puerto Rico	December 12, 1975— January 6, 1976	Dr. Pietro Ghittino University of Torino Torino, Italy	May 4-6, 1976
Dr. and Mrs. Ernest Williams Department of Marine Sciences University of Puerto Rico Mayaguez, Puerto Rico	December 12, 1975— January 6, 1976	Mr. Victor Smith Virgin Islands	May 9-10, 1976
Mr. Heine Rune Skoldal, Acting Director Lindaspollene Ecosystem Analysis Biological Station Espergrend, Norway	January 3, 1976	Mr. Laurence Taylor 3046 Cleveland Montgomery, Alabama	April 12, 1976
Mr. Eugeniusz A. Poplawski 30 Pot 81-813 25A Malopolska St Poland	January 29-30, 1976	Mr. Antoine K. Djedje (Student, Jamaica) Tuskegee Institute Tuskegee, Alabama	April 12, 1976
Dr. Glenn Hoffman Parasitologist USFWS Fish Farming Experiment Station Stuttgart, Arkansas	January 30, 1976	Sgt. John Anderson 4232 E. Lawnwood Drive Montgomery, Alabama	April 12, 1976

Mr. Abdoce Rahman Cisse B.P. 421 Dakar Senegal, West Africa	April 12, 1976	Dr. Janos Bakos Senior Research Worker Fish Culture Research Institute Hungary	June 15-17, 1976
Dr. James Avault Louisiana State University 249 Ag Center Baton Rouge, Louisiana	April 15-16, 1976	Mr. Zoltan Raki Veterinarian, Senior Officer Research and Training Department Ministry of Agriculture P.O. Box 1 1860 Budapest 55 Hungary	June 15-17, 1976
Dr. and Mrs. J.D. Drilon, Jr. Director Southeast Asian Regional Center For Graduate Study and Research in Aquaculture College, Laguna 3720 Philippines	May 30-June 2, 1976	Mr. Andras Ruttkay Fish Culture Research Station 5541 Szarvas, Hungary	June 15-17, 1976
Dr. Drashan S. Padda, Director Agricultural Experiment Station Box 920, Kingshill, St. Croix U.S. Virgin Islands	June 10, 1976	Mr. Idelisa Bonnelly de Calventi Centro de Investigaciones Cibima de Biologia Marina Universidad Antoniom de USAD Santa Domingo Washington Avenue Guibia, Santo Domingo Dominican Republic	June 16-17, 1976
Dr. J. Olah Mr. Jozsef Kovacs State Farm Bikal, Hungary	June 15-17, 1976	Mr. Porficio R. Manacop Engr. Rolando Platon SEAFDEC Tigbauan, Iloilo Philippines	June 17-19, 1976
Dr. Bela A. G. Entz Principal Research Officer Hydrobiologist Biological Research Mst. Hungary Academy Science Tihany, Hungary	June 15-17, 1976	Mr. Asim Jamal Mohamed Ahmed Mid Nite Corporation P.O. Box 1354 Khartoum Sudan	June 24, 1976

