Fish Culture in

POLAND

INTERNATIONAL CENTER FOR AQUACULTURE
RESEARCH AND DEVELOPMENT SERIES NO. 16
AGRICULTURAL EXPERIMENT STATION
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NOVEMBER 1977
PROJECT 211-d
AUBURN UNIVERSITY
AUBURN, ALABAMA

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PUBLISHED 11/77—1M

FISH CULTURE IN POLAND[1]

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INTRODUCTION

A VISIT WAS MADE to Poland in April 1977 to survey the current status of commercial fish farming and research programs related to fish culture in that country. Purpose of the survey was to evaluate prospects for increasing yield of fish through more intensive feeding of protein and energy rich feeds. The trip was arranged by the U. S. Feed Grains Council, the Agricultural Office of the U. S. Embassy in Poland, and the Institute of Zootechnics in Krakow, Poland.

Information for the survey was provided by the three supporting agencies mentioned above, by the Polish Academy of Sciences, and by other government and private concerns. Trips were made to several government experimental stations, research laboratories, and commercial fish farms. The itinerary for the visit is presented in Appendix 1.

Fisheries scientists from the Institute of Zootechnics cooperated in designing a research project to be conducted at the fisheries research station at Zator. The project, which concerns various supplemental feeding practices to increase yield of carp in ponds, is explained in Appendix 2.

This report presents data from the survey on the status of food fish culture in Poland, emphasizing the present state of the art, the environmental and physical resources, and the potential for increasing yield and production of fish in the country.

GEOGRAPHY AND CLIMATE

Poland lies in Eastern Europe in the same general latitude as Canada. It borders Russia on the east, East Germany on the west, the Baltic Sea on the north, and Czechoslovakia on the south. It ranks second in Eastern Europe, after Russia, in area (120,700 square miles) and population (33.5 million). The population density is high, 270 per square mile. Literacy rate is 98 percent.

The country consists primarily of lowlands, the main exception being the mountains in the south. Warmwater fish farms are mostly along rivers because of the water supply. Ground water is too cold to run directly into carp ponds during the summer growing season. Thus, fresh water from rivers is more desirable for replacement in periods of high biological oxygen demand because it is near the same temperature as pond water.

Poland's climate is temperate with moderately severe winters and cool to mild summers. The growing season for warmwater fish, when the water temperature is above 15 ° C, lasts only approximately 90 days. There are only about 40 days when water temperature is above 20 ° C and few days when water temperature reaches 25 ° C.

Fish ponds freeze in winter and fish have to be removed and concentrated in "wintering" ponds through which water is pumped or agitators move water to prevent freezing.

FOOD AND AGRICULTURAL PRODUCTION

Poland exported goods amounting to $6.1 billion (U.S.) in 1974, including coal, sulfur, and raw agricultural products. Imports, which included oil, iron ore, foods, and feed grains, totaled $7.1 billion (U.S.).

Thirty-eight percent of the labor force is engaged in agriculture. The principal products are rye, barley, potatoes, sugar beets, and hogs. Unlike other eastern European countries, Poland's agriculture is predominately non-socialized. Private farmers manage 85 percent of the land and state farms make up the remainder.

The farmer may use his land for any productive purpose so long as he farms it. He has no production quota to meet and may sell to either the open market or the state market. He is financially rewarded for yield and efficiency. One farmer may own a maximum of 100 hectares of land.

Because of small size of the farms and high cost of fuel, mechanization is used to a small extent. Fertilizer is expensive, and manure is more extensively used than commercial fertilizer.

Poland does not produce enough food, especially meats, or feed grains to meet the country's need. Pork is the favorite meat. Beef is much less popular and dairy calves are often exported rather than fattened for slaughter.

CURRENT STATUS OF FISH CONSUMPTION AND PRODUCTION

Fish is a popular food in Poland, but most of that consumed is canned or frozen marine fish that is caught by Polish fishing fleets or imported. Approximately 600,000 metric tons of fish are harvested annually, but only 15,000 tons are farm raised (approximately 14,000 tons of carp and 1,000 tons of trout).

All carp produced in Poland is consumed within the country. Several sources estimated that 90 percent of the carp consumed is marketed alive to be eaten on Christmas Eve as

[1]This survey was supported by the U. S. Feed Grains Council and U. S. Agency for International Development (Project 211-d).

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FIG. 1. This commercial carp pond in Poland was constructed more than 75 years ago and is over 20 hectares in size. Carp culture is generally extensive where ponds are large, stocking density is low, and natural pond organisms are a major source of the food for the fish.

a holiday tradition. Sources also indicated that carp is a well-liked fish and is potentially marketable at other times during the year.

Prices of farm-raised carp are comparable with pork. There is a scarcity of pork, the preferred meat, which makes markets favorable for increased quantities of fish. The government controls retail prices on many foods, including meats and fish, which may work at an advantage or disadvantage for expanding fish production. This can keep fish competitively priced with other meats or it may restrict the profitability of fish farming.

Cultured trout are marketed primarily in restaurants or exported. Their production costs are greater than for carp, which limits their sale in conventional fish or food markets.

Carp Farming in Poland

Carp is the major fish species cultured for food in Poland. There are approximately 38,000 hectares of ponds for carp production. Most of the ponds are well constructed but, because carp production has traditionally been on an extensive and not intensive basis, many are too large (larger than 20 hectares) for proper management. Water supply to most ponds is from rivers, but amount available is not always adequate for intensive production where exchange of water in the ponds is necessary. Amount of water used is regulated by the government. Ground water is too cold for extensive use.

FIG. 2. This 0.5-hectare pond has a ditch down the middle to concentrate fish when drained through the monk at the end. These ponds at the freshwater fishery research stations of the Institute of Zootechnics and the Polish Academy of Sciences are well constructed for fish culture research.

The growing season in Poland is short for warmwater fish. Carp selectively bred for conditions in Poland begin feeding when water temperatures reach 15° C, usually the last of May, and continue to feed through September. There are only approximately 40 days when the temperature is above 20° C, when carp feed actively. Because of the short growing season, 3 years are necessary for carp to reach 1 kilogram. With fertile ponds and some supplemental feeding, the fish reach 40 grams (class K_1) the first year, 250 grams (class K_2) the second year, and the third year they grow to a marketable size of 1 kilogram (class K_3).

The average yield of 3-year-old carp is less than 500 kilograms per hectare. Some farmers, by using supplemental grain feeding, can achieve 1,000 to 1,200 kilograms per hectare. Under experimental conditions, yields of 4,000 to 5,000

YIELD OF CARP FROM PONDS WITH VARIOUS EXPERIMENTAL FEEDING REGIMES OBTAINED AT THE POLISH ACADEMY OF SCIENCES EXPERIMENTAL FISH CULTURE STATION AT GOLYSZ

Year and treatment	Fish/ hectare	Year class	Gain, kg/ha	Av. fish size, kg	Kg feed/ kg gain
1969					
Control, nonfed	300	K_{2-3}	191	0.87	-
Fed whole	2,400	K_{2-3}	2,513	1.37	3.5
Fed dough	2,400	K_{2-3}	2,046	1.35	4.3
Fed standard pellet[1]	2,400	K_{2-3}	2,652	1.43	3.8
1971					
Control, nonfed	300	K_{2-3}	180	1.00	-
Fertilized ponds	900	K_{2-3}	477	.95	-
Fed whole wheat	3,600	K_{2-3}	2,565	1.09	4.2
Fed standard pellet[1]	3,600	K_{2-3}	2,748	1.45	4.1
Fed super pellet[2]	3,600	K_{2-3}	3,502	1.37	3.1
1972					
Control, nonfed	300	K_{2-3}	241	1.08	-
Fertilized ponds	900	K_{2-3}	518	.88	-
Fed super pellet[2]	4,000	K_{2-3}	3,825	1.23	2.2
Fed whole wheat	10,000	K_{1-2}	2,321	.33	3.5
Fed standard pellet[1]	10,000	K_{1-2}	3,346	.43	2.7
Fed super pellet[2]	10,000	K_{1-2}	3,762	.48	2.2
1973					
Control, nonfed	300	K_{2-3}	186	.93	-
Fertilized ponds	900	K_{2-3}	509	.85	-
Fed super pellet[2]	4,000	K_{2-3}	3,970	1.23	2.2
Fed super pellet in commercial pond	4,000	K_{2-3}	4,434	1.40	2.1

[1]Standard pellet contained 25 percent protein, mostly of plant origin.
[2]Super pellet contained 40 percent protein, mostly of animal origin.

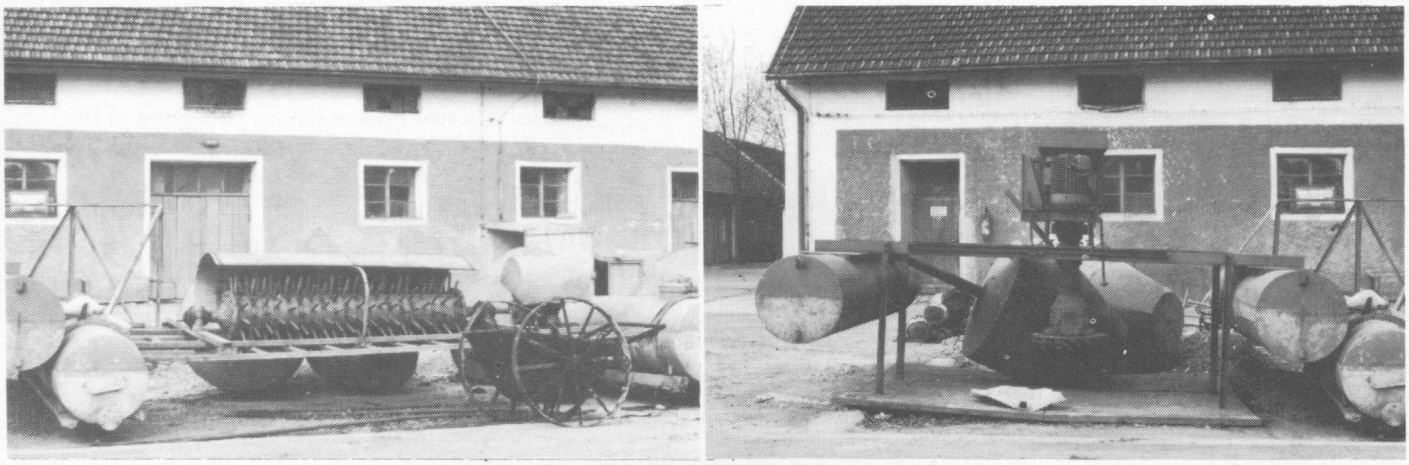

FIG. 3. Aerators, such as these which are electrically powered, are lately being used in carp culture ponds where more intensive culture is being practiced.

kilograms per hectare have been obtained by feeding nutrient rich pelleted feeds in static ponds without continuous aeration. Using continuous aeration during the heavy feeding period pushed yields to 8,000 kilograms per hectare.

Carp farming in Poland is based on low density culture. Among the several reasons for this are the scarcity of grains and especially high protein feedstuffs for feeding fish, the risk of oxygen depletion in heavily fed ponds, and tradition.

Most supplemental feed for carp is whole grains—barley, rye, wheat, and sorghum. Blended or pelleted rations are not commonly used. However, several commercial pellet mills have been constructed in the country in recent years for poultry and livestock feeds, and pelleted feeds for carp and trout are made in limited quantity.

The importance of a transition from extensive to intensive pond culture has been recognized by government fisheries agencies. The traditional system requires more land, water, maintenance, and time for fish production. In 1969, the Polish Academy of Sciences initiated a study for intensifying carp production by using heavier stocking rates and protein rich pelleted feeds. Yields up to 4,400 kilograms per hectare have been harvested from intensively fed ponds, as shown by test data in the table. Such intensive feeding of carp will be feasible only with a favorable market for the fish produced. Feed ingredients are expensive. Oil seed meals and fish meal are imported.

Pond aeration is not ordinarily used on commercial farms. When farmers have low dissolved oxygen problems, they add water to the ponds (when available) and reduce feeding. Aerators such as shown in figure 3 are used on experimental farms where intensive feeding is done. Demand feeders of the type shown in figure 4 proved more efficient than hand feeding when used on an experimental basis for feeding pellets.

Reducing the time from 3 to 2 years for carp to reach market size is another goal of researchers in Poland. If K_1 fish could reach 100 grams, it would be possible to get K_2 fish to a marketable size of 0.6 kilogram in 2 years. Early spawning is one approach being tried in an extensive research project at the Experimental Fish Culture Station of the Polish Academy of Sciences at Golysz. By spawning indoors in temperature controlled water, spawning may be accomplished about 2 months earlier. The fry would then be fed in heated water until pond water temperature increased to 15° C. This would allow K_1 fish to reach a larger size.

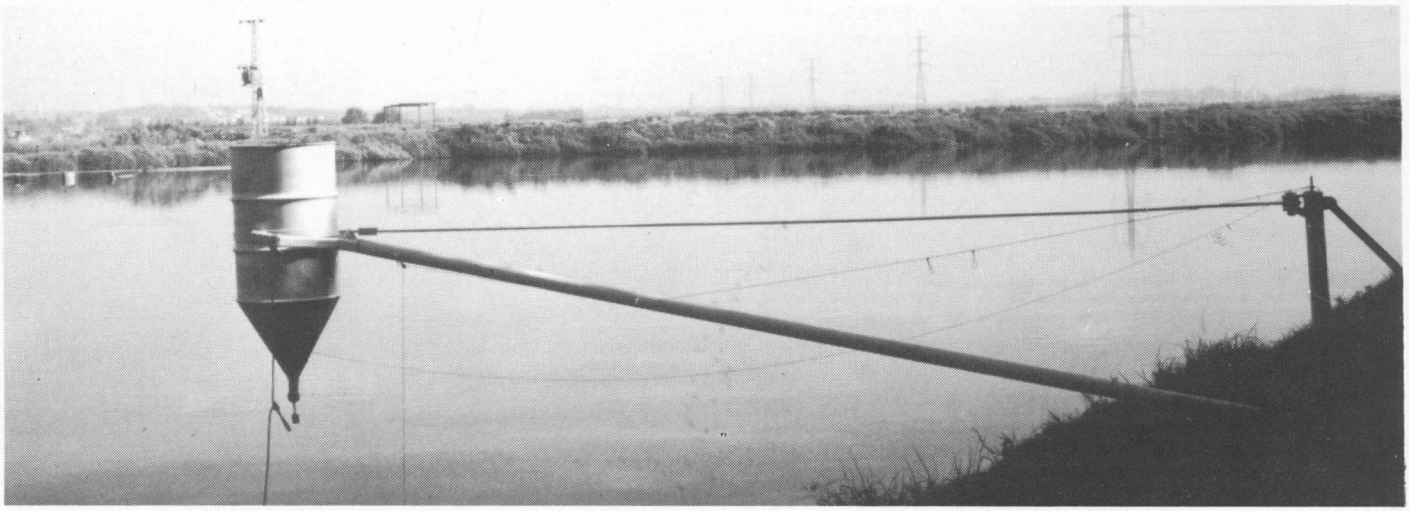

FIG. 4. Demand feeders have been introduced recently in carp culture to allow intensive but efficient feeding.

Trout Culture

Trout are raised commercially in Poland but to a much smaller extent than carp. Research on trout breeding, feeding, management, and use of heated effluent water from electric power plants is being sponsored by the Institute of Inland Fisheries at stations in Gdansk and Olsztyn. Commercial trout operations are found primarily in the north along the Baltic Sea. Growing season is normally about 3 months, but this can be extended by production in heated effluent from power plants. The volume of trout produced in Poland is approximately 1,000,000 kilograms. Production is in ponds, raceways, and suspended cages. Most trout are fed moist diets prepared from fish scraps or trash fish ground and mixed with dry ingredients and extruded through food grinders as soft pellets. Some pelleted feeds are prepared on special order by commercial feed plants in northern Poland. Production of rainbow trout in Poland is costly because of the artificial environment and complex diets required. Markets for Polish raised trout are limited to restaurants or export and will not likely be for family use in the home.

Inland Fisheries in Poland

The Ministry of Agriculture is responsible for inland fisheries in the country. Ministry departments and their responsibilities are: Department of Animal Breeding, which contains the Division of Inland Fisheries; Union of State Fish Farms, which is responsible for government managed fish farms; the Department of Veterinary, which contains a Fish Diseases section; the Institute of Zootechnics, which conducts research in livestock and fish production; and the Department of Agriculture Education, which is responsible for technical training in fisheries and other agricultural science areas.

The Polish Academy of Sciences has several fisheries experimental stations whose primary mission is research. Students may participate in research projects at the stations, but formal degree programs are not offered.

INVOLVEMENT OF U. S. FEED GRAINS COUNCIL IN FISH CULTURE IN POLAND

A representative of the International Center for Aquaculture at Auburn University, at the request of the U. S. Feed Grains Council, worked with the Institute of Zootechnics in Krakow to design a research project through which the fishery research station at Zator will attempt to enhance fish production through more intensive feeding systems. The project, which is related to a grains trade agreement between the United States and Poland, is outlined in Appendix 2.

APPENDIX 1

Itinerary

April 4 - Arrived Warsaw 12:50 p.m. Visited U. S. Embassy. Briefed on mission by Gerald Harvey, Agricultural Attache, and Dr. Halvor Kolshus, U. S. Feed Grains Council.

April 5 - Traveled to Krakow and met with Director and other administrators at the Institute of Zootechnics. Traveled to Zator and reviewed the Fishery Biology and Water Environment Laboratory and discussed a research project.

April 6 - Traveled to Golysz and visited the Polish Academy of Sciences Experimental Fish Culture Station. Reviewed projects on intensive feeding of carp for high pond production in Poland.

April 7 - Designed a research project with personnel from the Zator Station for feeding carp various test diets to evaluate sorghum grain as a replacement for barley and for developing a high protein pelleted carp feed.

April 8 - Met with Dr. T. Backiel, Director of Ponds and Rivers Department, Institute of Inland Fisheries, to discuss fish culture research in Poland. Debriefed European Director, U. S. Feed Grains Council, and Agricultural Attache, U. S. Embassy, on findings and proposed research project for carp culture.

APPENDIX 2
Research Project for Intensive Feeding of Carp in Poland

Project Design

A carp feeding experiment was designed to be conducted at the Zator station by fisheries scientists of the Institute of Zootechnics. The purpose is to compare grain sorghum with a traditional grain (barley) for carp fed at stocking densities used by farmers, but with the grains fed by demand feeders to allow the fish to feed as much as they want. The experiment will also demonstrate the yield from sorghum grain plus a protein supplement pellet fed separately. In addition, a 25 percent protein pelleted ration, the Zator No. 1, will be prepared and tested with carp stocked at 3,000 per hectare.

The fish used in the experiment will be 2 years old and weigh approximately 180 grams at the beginning of the study. They should reach a weight of near 1 kilogram during the experiment. Feeding will begin near May 1, 1977, when water temperature reaches 15° C, and will terminate October 15. All fish will be fed the grain or Zator No. 1 pellets by demand feeder. The protein supplement will be fed by hand in proportion to the amount of sorghum grain the fish consume (1 kilogram supplement per 3 kilograms grain). Each of the five treatments will be replicated four times in 0.2-hectare ponds which have been divided in half with a plastic net. Dissolved oxygen, temperature, and pH will be measured biweekly in the ponds. Dissolved oxygen will be monitored carefully at daybreak during the period of highest water temperature to avoid fish losses due to oxygen depletion. Yield of fish, feed consumed, and average body fat content will be measured for each pond.

The ingredient composition of the Zator No. 1 (25 percent protein) carp feed is as follows:

	Pct.
Sorghum grain	50
Soybean meal	25
Fish meal	12
Wheat	10
Pellet binder	2
Dicalcium phosphate	1

The formula may be modified by reducing fish meal to 10 percent and increasing soybean meal to compensate for the loss in protein. This change would not reduce the nutritional quality of the ration seriously, and economics might justify the change. Soybean meal may be substituted with sunflower seed meal on an equal protein basis without a loss in quality of diet provided fish meal is included in the formula. Wheat is used to help bind the pellet. The pellet binder should be a hemicellulose or lignin sulfonate product; however, molasses, whey, and other materials may suffice.

Recommendations

1. The fish feeding experiment should be conducted in 1977. It is only moderately intensive and should give useful results without great risk of fish losses. It should encourage the researchers at Zator toward more intensive production in the future.
2. An electronic oxygen meter to monitor dissolved oxygen in the experimental ponds should be purchased for the project. Cost is $500-$700 (U.S.).
3. A site visit by personnel from U. S. Feed Grains Council should be made in May or early June to see if problems have been encountered in getting the project started. Another visit in August, the most active growing period for the fish, should also be made to evaluate the conduct of the experiment.
4. After the data from the experiment have been collected, a copy should be sent to the U. S. Feed Grains Council. The Council will help the researchers of the Institute of Zootechnics prepare the data for publication in a fishery science bulletin as a progress report on a continuing research study, for distribution to fish farmers and feed producers in Poland.
5. The following year, 1978, modification of the Zator No. 1 should be evaluated for more intensive carp production. Yields of 4,000 kilograms per hectare and above should be sought. Aeration and other management practices necessary for intensive carp culture in Poland should be evaluated. Corn should be tested as a replacement for sorghum grain in carp feeds. After perhaps 3 years of biologically and economically evaluating formulations for pelleted feeds for carp under Polish conditions, consideration can be given to preparation of a comprehensive research bulletin to be published in international literature. Also an Institute of Zootechnics experiment station bulletin for farmers and feed producers should be published by that time.