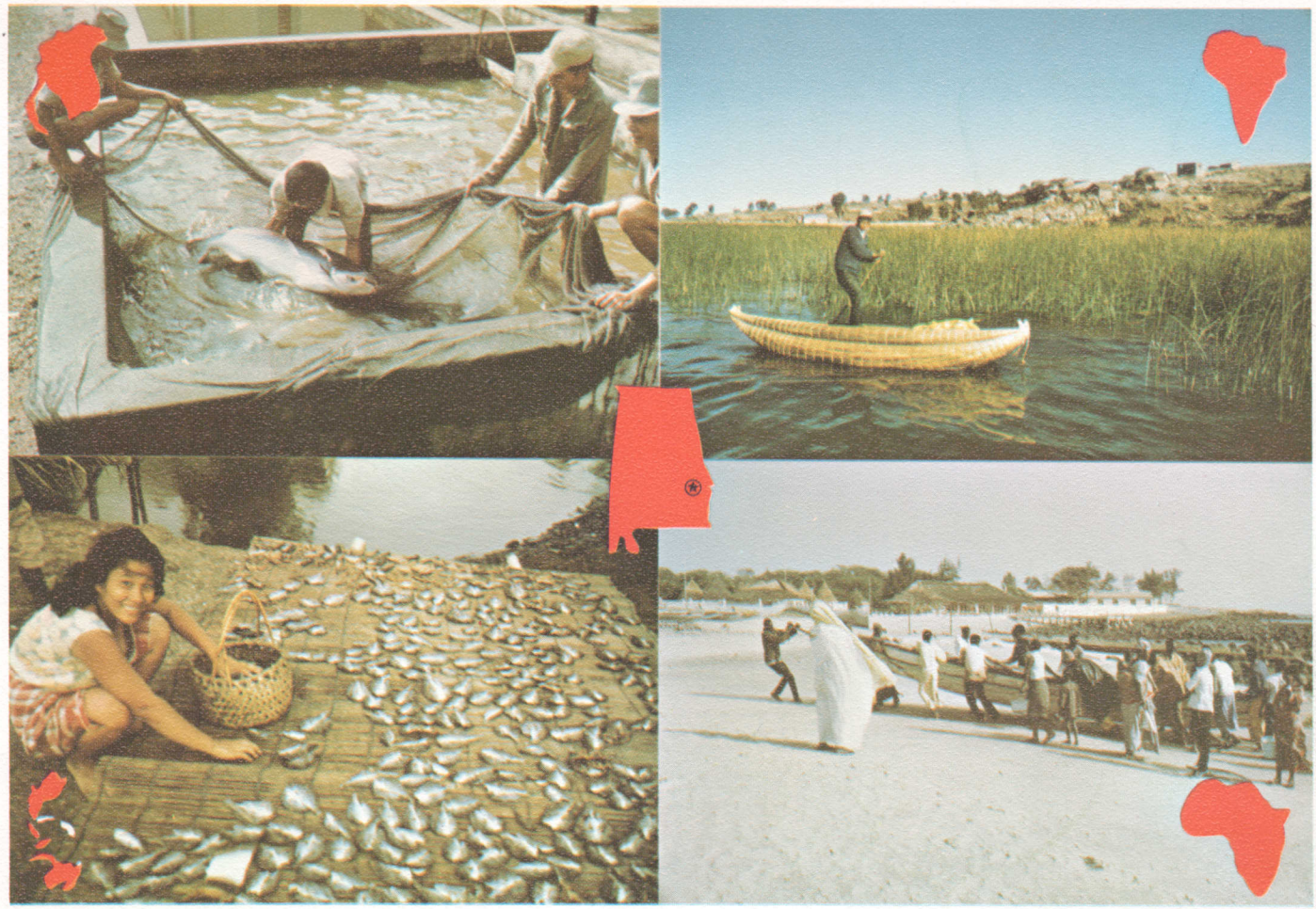


THE INTERNATIONAL CENTER FOR AQUACULTURE

Agricultural Experiment Station
AUBURN UNIVERSITY
E.V. Smith, Director Auburn, Alabama
December 1970

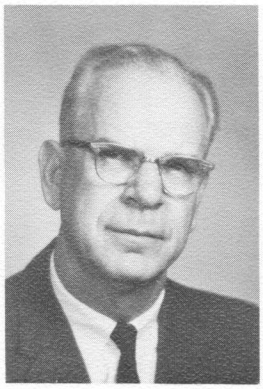
We at Auburn University feel especially honored by the world-wide recognition accorded our fisheries program. The Land Grant University system in the United States was an outgrowth of the idea of service to people, and we feel our fisheries program has fulfilled every charge placed on it by that idea. With the awarding of the A.I.D. Institutional Grant for support of the International Center for Aquaculture and the elevation of the fisheries program to the Department of Fisheries and Allied Aquacultures, we are now able to offer more of the benefits of the Land Grant system to the rest of the world. Through this brochure we hope to make that offer known to those who would take advantage of it.

Sincerely,

Harry M. Philpott
President

Auburn University's School of Agriculture-Agricultural Experiment Station pioneered in freshwater fisheries management research in the United States. Following World War II, the foreign assistance agency of the U. S. Department of State, the FAO, and some foreign governments sent students from other countries to Auburn to study fisheries management.

Although many of the leading fisheries personnel in developing nations received all or some of their scientific training at Auburn, the program was more or less informal. Our scientists did not feel this relationship permitted the University to make its full contribution to the solution of the world's food-protein problem. Therefore, the opportunity to expand our contribution as a result of an A.I.D. Institutional Grant in support of the International Center for Aquaculture was most welcome. This brochure was developed to present some of the major programs offered by the Center.



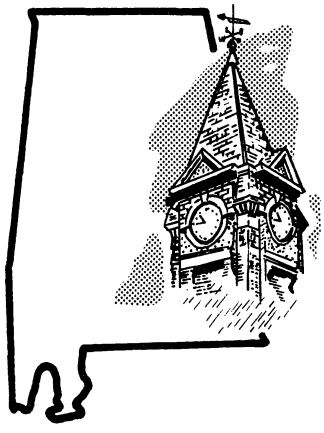
Yours very truly,

E. V. Smith
Dean and Director

Fish of the oceans, the streams, lakes, and man-made ponds are one of the important renewable natural resources of the world. The effective management of this resource for food and for recreation can only be realized through the activities of trained men utilizing research-proven management techniques. In this brochure we are describing some of the contributions that Auburn University is making to the management of the fisheries resource in Alabama, the United States, and the World through research, training, and extension.

Sincerely,

H.S. Swingle
Director, International
Center for Aquaculture



Auburn University has gained a worldwide reputation for its warmwater fisheries research and teaching program. This brochure describes briefly the programs Auburn supports through the Department of Fisheries and Allied Aquacultures and the International Center for Aquaculture. Also described are the various services available to fisheries agencies of foreign countries, U.S. Missions, and other organizations supporting international aquacultural activities.

The formal program in fisheries research and management at Auburn University was started in 1933 by Dr. H. S. Swingle. Since then pond and laboratory research facilities have been continually expanded and modernized, creating what is now the largest pond research station in the world. Current replacement value of field facilities is approximately $2 million.

Courses in fisheries were established in 1946, and the first graduate degree was awarded in 1948. Fisheries students have come to Auburn from throughout the United States and from many foreign countries.

On July 1, 1970, the fisheries program, which had been conducted as part of the Department of Zoology-Entomology, was accorded full departmental status. At the same time, the International Center for Aquaculture was established as an associated entity. Both the Department and the Center are part of the University's Agricultural Experiment Station System.

RESEARCH AND TRAINING

Auburn University gained worldwide recognition for its fisheries activities through the efforts of a competent and dedicated staff. No small part of their accomplishments was the development of the research program, physical facilities, and training program described in this section.

Research Program

From the beginning, efforts in fisheries research at Auburn have been unique in a number of respects—the most unusual of which was the development of the idea of using ponds for direct experimentation on the principles of applied aquatic ecology in much the same way that field plots are used in agronomic research.

The unique approach to experimentation, supported by the excellent field facilities, has produced techniques and procedures of warmwater fisheries management that are today in general use throughout much of the United States and the rest of the world. These research efforts at Auburn University have provided the information for over 300 scientific publications on aquaculture, warmwater fisheries management, and related subjects.

Management techniques that have come in whole or in part from research at Auburn University include:

Farm pond construction techniques that are suited to a wide range of conditions and make application of management practices less complicated for the non-professional. As an example, deepened pond edges such as those shown in this partially drained pond help control both mosquitoes and aquatic weeds.

Methods of control of submersed pond weeds.

Development of inorganic fertilizer mixtures for pond fertilization.

Methods of commercial bait minnow production.

Methods for commercial production of food fish in ponds.

Establishing criteria and methods for measuring balance in fish populations in ponds, large impoundments, and rivers.

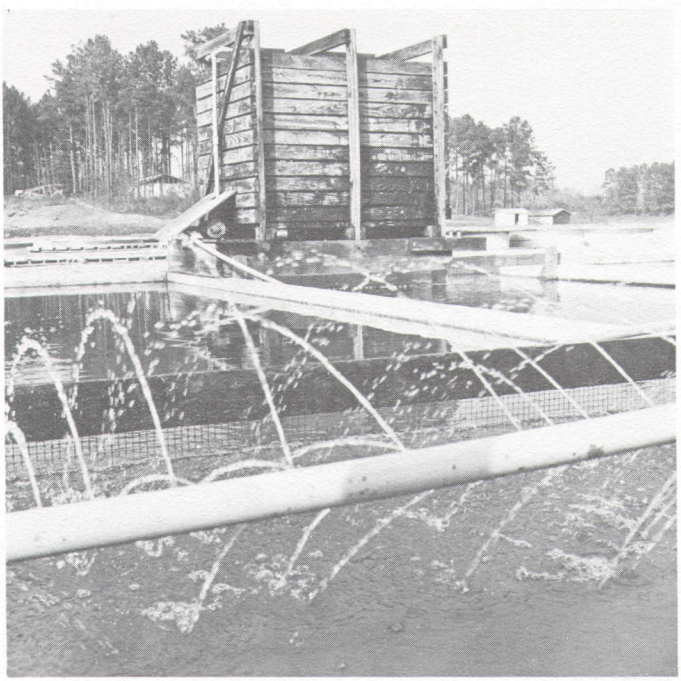
Methods of managing bluegill-bass combinations in warmwater ponds so that the fisherman can collect strings such as this.

Some of the current research in the Department of Fisheries and Allied Aquacultures concerns:

Sportfishing Management. This involves testing native and introduced species, methods for fertilization, use of fish feeds, and methods of management to provide high yields to hook-and-line fishing.

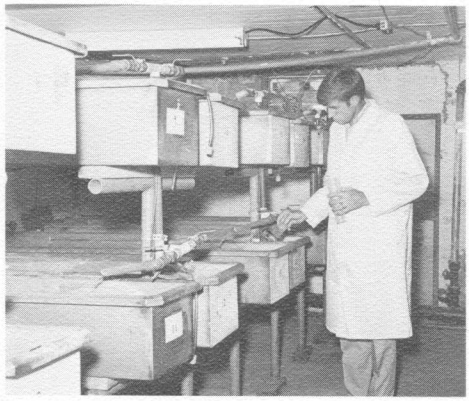
Commercial Fish Production. From this research has come methods for producing channel catfish commercially in ponds in the Southern States. As an indication of the success of this research, total production reached 30 million pounds in 1969 and is expected to double in 1970. Research is now in progress with the channel catfish and white catfish on spawning, raising fingerlings for stocking, feeding, and producing marketable fish. Cultural methods being tested are covered in other sections.

Pondculture with Biological Filters. Water, pumped from a pond where fish are fed, is filtered through gravel covered with living microscopic organisms then returned through a gravity flow system. The photo shows a filter in the background, some of the ponds it serves, and the water return system in the foreground. With this system production of 10,000 pounds of catfish per acre in approximately 6 months has been obtained. Practical applications of the system are now being studied.



Pondculture in Still Water. Maximum production obtained by feeding was slightly over 2,500 pounds per acre in 10 months. The addition of air released from pipes in the pond bottom doubled production. An evaluation of the economics of aeration is being made.

Suspended Cage Culture. Catfish are fed in wire cages such as the one seen here. Water circulates through the cages, which are suspended in the top water of ponds, and solid wastes fall through the wire floor. Maximum production, part of which is shown, has been about 400 pounds of catfish per cubic meter of cage in 180 days. This culture is being refined for use in ponds, streams, and large reservoirs.

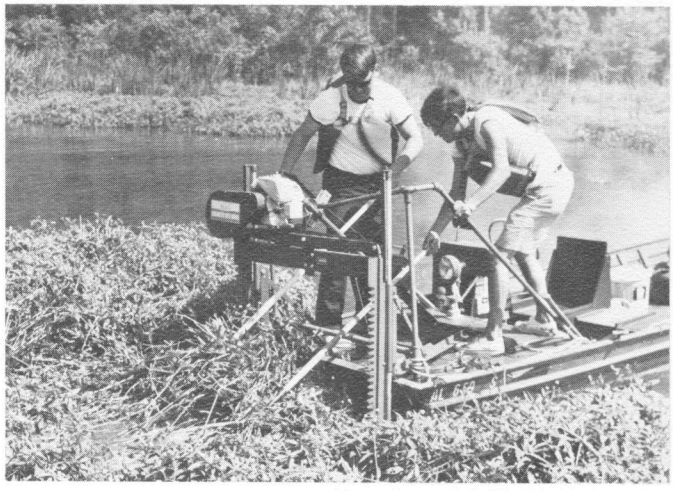


Fish Feeds and Feeding. In addition to testing conventional feeds, scientists are studying aquatic plants as possible sources of protein, minerals, or growth factors for supplemental fish feeding. Basic studies in mineral and fiber requirements and nutrient digestibility are being conducted with catfish. Experimental diets are formulated under exacting standards and fed to fish maintained in stainless steel troughs equipped with continuously flowing filtered water. Practical feed mixtures and feeding rates for other species of fish are also being studied.

Biological Waste Disposal in Ponds. Wastes from fish and other biota limit the amount of fish that can be produced in ponds by feeding. Various species of fish, mussels, and aquatic plants are being evaluated for their effectiveness in maintaining clean water in ponds where heavy daily feeding is used.

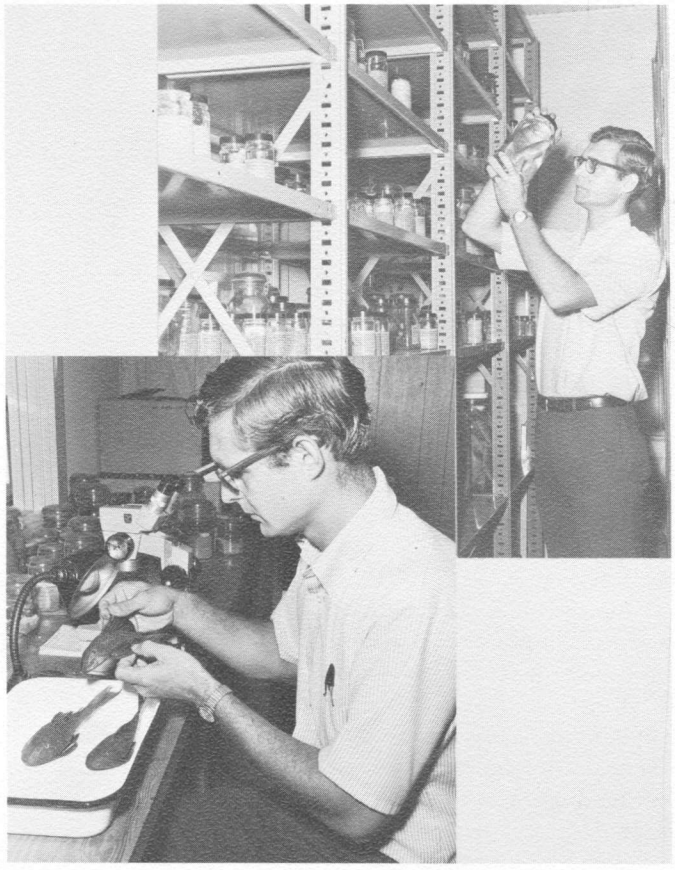
Hybridization. Crosses are being made between various species of sunfish and between species of tilapia in an effort to produce more desirable individuals.

Biological Control of Aquatic Weeds. Because few herbicides have been cleared for use in water, herbivorous fishes are being tested as control agents for submersed aquatic weeds. The Chinese grass carp and Congo tilapia have proved most effective, giving better control than is usually obtained by chemical treatment. The effects of these species on natural fish populations are under study to determine if their use is feasible in ponds and lakes. Work on control of emergent aquatic weeds, which includes sampling such as that shown, is another main part of this research.



Fish Taxonomy. A key to the fishes of Alabama, prepared by William F. Smith-Vaniz, is now in print as a result of research conducted here. The Cooperative Fisheries Research Unit is currently specializing in taxonomy and ecology of fishes in the Chattahoochee River System.

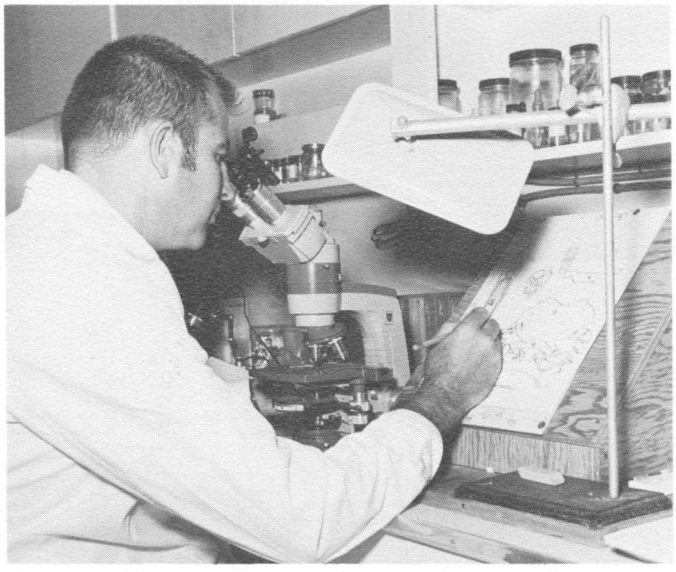
There is a 500,000-specimen fish collection maintained at Auburn. Most specimens are from eastern U.S. waters but many are from other parts of the world.



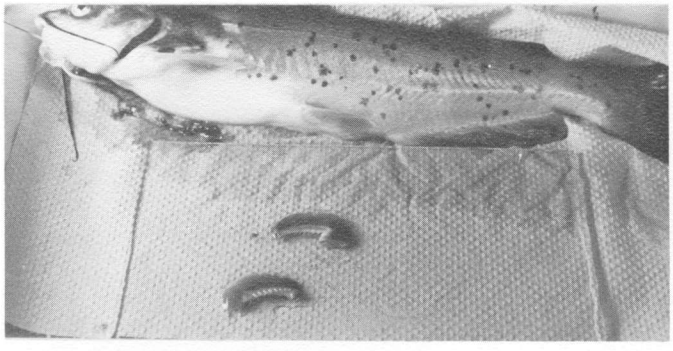
Fish Population Dynamics. Results of 16 years of surveys on fish populations in Alabama rivers and impoundments have been summarized.

Control of Phytoplankton Blooms in Ponds. Enrichment of the pond environment through heavy fertilization or feeding normally results in dense phytoplankton blooms that occasionally cause severe fish kills. The use of plankton-feeding fishes and certain aquatic plants to control these blooms is being investigated.

Ecology of Aquatic Insects. Since aquatic insects are the principal food of many fish species, investigations into the ecological requirements of various insect groups are carried out.

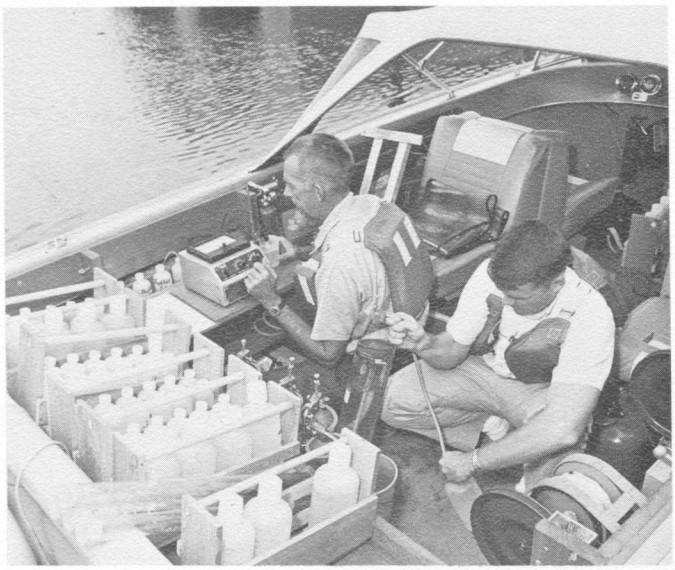


Fish Parasites and Diseases. A regional project at Auburn is supported by eight Southern States. Causes of fish kills in cooperating states are determined and the organisms responsible are cultured and identified. Typical of this work is the removal of gills from a channel catfish for parasitological examination. The fish parasitologist examines and draws the parasites with the aid of a camera lucida. In this manner research is conducted on taxonomy, life cycles, development, control methods, and related problems.



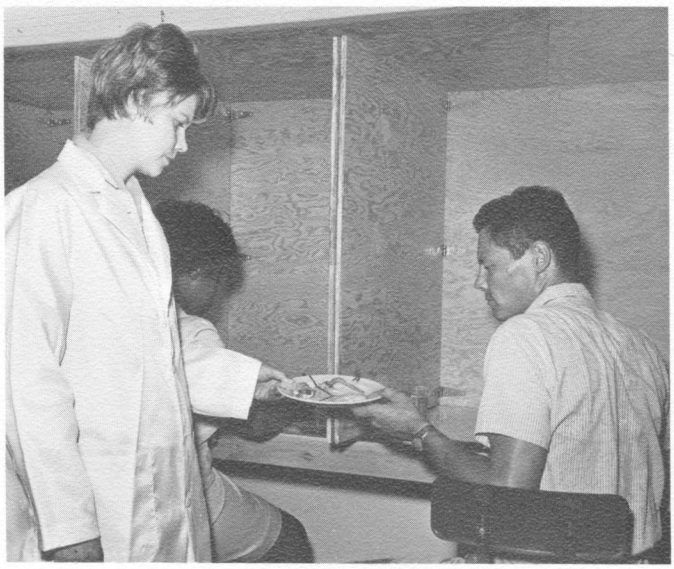
Small Pond Research Area

Large Pond Research Area



Nutrient Balance in River Impoundment. Cations, anions, phosphates, chlorides, sulfates, and carbonates entering Eufaula Reservoir from the polluted Chattahoochee River and from unpolluted creeks are being determined. Their distribution within the water, plankton, higher plants, fishes, and bottom muds of the impoundment is being monitored, as is the amount lost downstream. This is providing new insight into the role of major and minor elements in fish production.

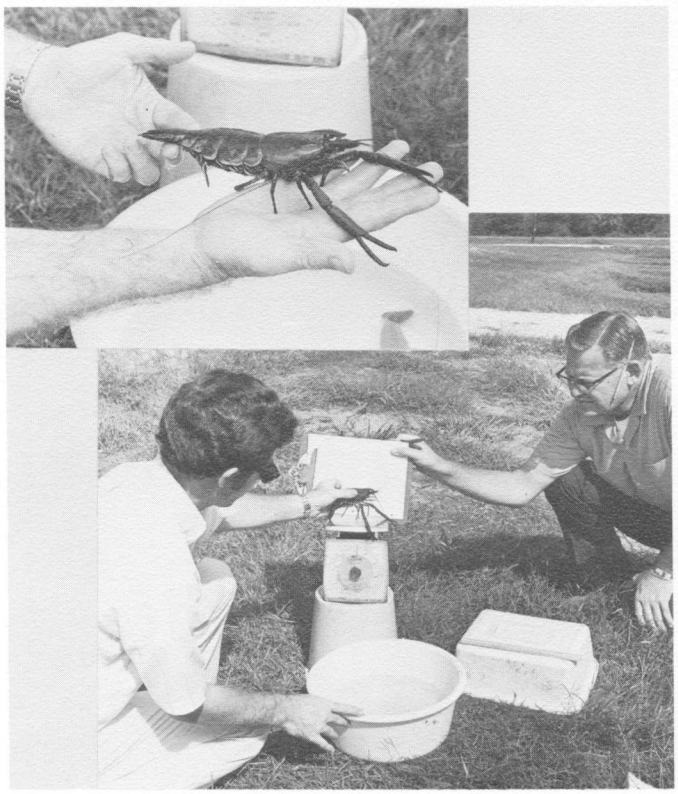
Fish Processing Technology. A broad-based program concerned with various aspects of fish processing has been implemented. Many processing techniques are tested and the end products are subjected to trained taste panels to determine desirability.



Biology and Ecology of Stream Fish. The biology and ecology of stream fishes native to the area are being studied, partly to determine their potential for pond culture.

Genetics and Selective Breeding. A program in genetic selection and selective breeding of channel catfish to produce superior strains has been initiated. Variation within and among family groups is being measured so that selection criteria can be more firmly established.

Production of Other Aquatic Animals. Studies involving other aquatic food species are being conducted on a limited scale at Auburn. Researchers are shown here weighing freshwater shrimp grown in ponds. This female shrimp, *Macrobrachium* sp., weighs approximately 80 grams.

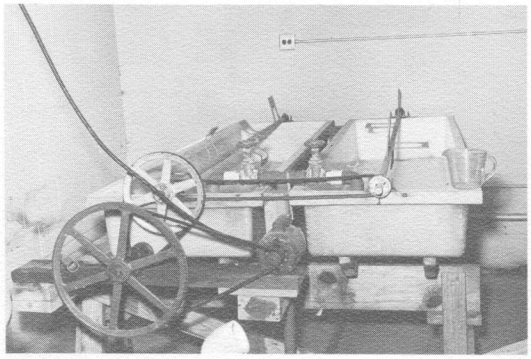


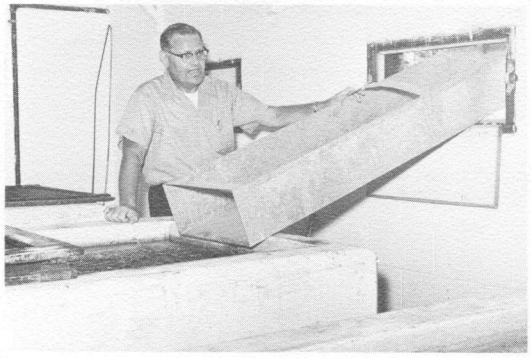
Physical Facilities

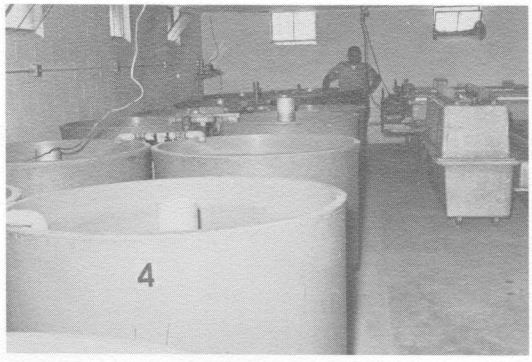
Field facilities of the Fisheries Research Unit of the Agricultural Experiment Station are located on a 1,300-acre tract approximately 5 miles north of the campus. Over the past 36 years, a field research facility consisting of 228 earthen ponds with a surface area of 170 acres, plus approximately 92 concrete ponds and 366 plastic pools, has been constructed. Several different types of experimental ponds can be seen in photographs in this brochure.

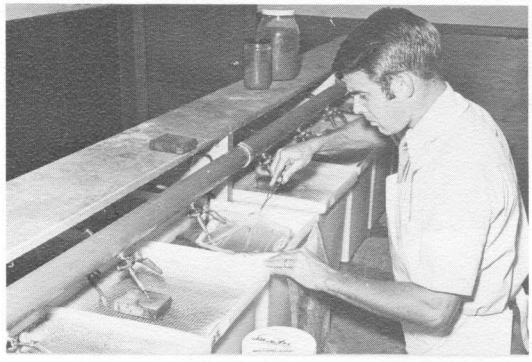
In addition to the experimental ponds, there are buildings housing laboratories, offices, and service facilities. Included in the facilities are 1/10-acre ponds constructed with concrete sides and with electrically operated feeders programed to deliver specific quantities of fish feed at specific times; mechanical hatching units capable of handling 100,000 channel catfish eggs per week; concrete and fiberglass tanks for holding and overwintering fish; and plastic and glass aquaria for conducting experiments under controlled conditions.

Because of the continued growth of the program, the present complex of fisheries buildings on campus has become overcrowded. A new building, the first of a proposed Fisheries-Wildlife complex, is scheduled for 1972 occupancy. This building is illustrated on the back cover. Completion of the complex should relieve the crowding and provide adequate housing for the expanded programs and responsibilities in research and teaching.









Training Program

Of the 174 Auburn fisheries students graduated from regular courses and special training programs, 56 were from foreign countries. Twenty-four Ph.D degrees and approximately 70 M.S. degrees have been awarded to students studying in fisheries and aquaculture. These graduates are employed in 30 states in the United States and in 23 countries throughout the world. Many of them hold high administrative and research positions in the fisheries organization of their respective state or country.

Auburn University offers one of the strongest curricula in fisheries and allied aquacultures to be found anywhere in the United States. Fourteen professional scientists offer 17 regularly scheduled courses in various aspects of fisheries. These courses are in addition to the courses in basic biological sciences offered by the University. The formal courses taught by the fisheries staff which are available to undergraduate and graduate students are listed with a brief description of each.

Limnology. Biological, chemical, and physical factors affecting aquatic life.

Advanced Limnology. Principles and methods employed in modern limnological research.

Biological Productivity and Water Quality. Biological and chemical measures of water quality in streams and impoundments as related to fisheries. Effects of pollution, fertilization, and feeding of fish upon water quality.

Marine Biology. Introduction to the physical, chemical, and biological characteristics of the marine environment.

Fisheries Biology. An introduction to the study of vital statistics of fish populations.

Advanced Fisheries Biology. The concepts of population dynamics and of the interaction of reproduction, growth, and mortality in fish populations, and the use of these concepts in fish population management.

Aquaculture. Principles underlying aquatic productivity and levels of management as demonstrated by domestic and foreign lotic and lentic cultures of fish and other aquatic crops.

Management of Streams and Large Impoundments. Fish populations of streams and large impoundments and a consideration of methods for managing those populations.

Management of Small Impoundments. Consideration of species of fish used in management of small impoundments, species balance, population balance analysis, methods of correcting unbalanced conditions, renovation of old impoundments, and related problems of water management.

Hatchery Management. Operation of hatcheries for production of cold- and warm-water game fish and bait minnows; care of brood fish; methods of stocking, fertilizing, supplementary feeding, and controlling weeds; transportation of fish; control of parasites, and related hatchery problems.

General Ichthyology. Morphological, functional, geographical, and behavioral survey of fishes. Classification of fishes using monographs and keys. Field trips and laboratory work emphasize local species.

Systematic Ichthyology. Fishes of the world, emphasizing morphology, distribution, and life history. Review of world literature on fish systematics.

Fish Parasites. The external and internal parasites of fishes, their identification and control; laboratory studies on life histories and epidemiology of parasite populations in ponds and impoundments.

Fish Diseases. Bacterial and viral diseases of fishes, their isolation, culture, identification, and control.

Aquatic Communities. Environmental relationships of the biota of freshwater habitats.

Fish Culture. Construction and management of ponds, and the principles underlying fish production; also fishing methods, bait production, and the identification of of the more common sport fish.

Fish Processing Technology. Chemical and biological aspects of fishery products as related to their use as human food, principles of preservation, unit operations in processing fishery products, product evaluation, and packaging.

Fish Nutrition. Basic and applied aspects of warm-water fish nutrition: includes nutrient requirements and metabolism; nutrient sources; diet formulation; feeding practices.

Marine Invertebrate Zoology. A general study of the anatomy, life histories, distributions, and phylogenetic relationships of all marine phyla below the chordates. Laboratory and field work included. Offered only at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Marine Vertebrate Zoology and Ichthyology. A general study of the marine chordata, including lower groups and the mammals and birds, with most emphasis on the fishes. Offered only at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

THE STAFF

The fisheries staff is a highly qualified assemblage of specialists. Of the 15 staff members, 13 hold doctorates and the academic rank of assistant professor or higher. Many of these have achieved international as well as national recognition in their fields of specialization, and over half the staff has considerable experience in foreign fisheries work. An annotated list of the staff follows.

H. S. Swingle (D.Sc.). Head, Department of Fisheries and Allied Aquacultures and Director, International Center for Aquaculture. Fish population dynamics and methods of intensive aquacultural management.

Ray Allison (Ph.D.). Fish parasitology and parasite-induced immunity in fishes.

W. D. Davies (Ph.D.). Population dynamics of reservoir fishes and analysis of fishery statistics. (At present serving assignment with Auburn University-U.S.A.I.D. cooperative fisheries program in Northeast Brazil.)

J. S. Dendy (Ph.D.). Limnology of impounded waters and ecology of fish food organisms.

N. B. Jeffrey (Ph.D.). Intensive aquacultural methods. (At present serving assignment with Auburn University-U.S.A.I.D. cooperative fisheries program in Northeast Brazil.)

J. M. Lawrence (Ph.D.). Mineral inflow and outflow relationships in impounded waters and aquatic weed control.

R. T. Lovell (Ph.D.). Technology and biochemistry of fish and shellfish and general aspects of fish nutrition.

D. D. Moss (Ph.D.). Aquaculture and factors affecting production of fish in impounded waters.

G. B. Pardue (Ph.D.). Aquaculture and genetic improvement and hybridization of fishes.

J. A. Plumb (Candidate for Ph.D.). Bacterial and viral disease of warmwater fishes.

E. E. Prather (M.S.). Intensive management of catfish ponds for sport fishing and commercial production, and commercial production of minnows for bait.

J. S. Ramsey (Ph.D.). Systematic ichthyology and zoogeography of fishes.

W. A. Rogers (Ph.D.). Taxonomy and ecology of fish parasites.

E. W. Shell (Ph.D.). Fish population dynamics.

R. O. Smitherman (Ph.D.). Aquacultures and sportfish management.

INTERNATIONAL CENTER FOR AQUACULTURE

Advisory assistance from Auburn University to foreign countries began in 1958 in Thailand and Israel and in 1961 in India under direct contract with the countries or through the Rockefeller Foundation.

U.S.A.I.D. Worldwide Contract

In 1967, a formal worldwide project for technical assistance in fisheries to developing countries was initiated between Auburn University and the U.S. Agency for International Development. This international project has as its principal function assistance to developing countries in increasing their capabilities to produce adequate amounts of high-quality protein through cultures of fish, shrimp, and other aquatic organisms.

Auburn University assists in planning the necessary experimental facilities and in training host-country personnel in modern testing and management methods for developing highly productive aquacultures.

Services available under this program include:

1. Services to evaluate the problems and to develop plans of operation to increase fish production in developing countries.

2. Planning of pondcultural research stations, including soil examination, details of pond construction, accessory research facilities, and cost estimates.

3. Providing assistance to the cooperating fisheries departments in host countries in developing research programs and experimental procedures for various phases of aquacultures.

4. Conducting short courses both at the Center and in host countries to inform fisheries research and extension personnel of newest advances in aquacultures and to help develop their competence in areas of particular need.

5. Training of personnel at B.S., M.S., and Ph.D. levels in academic subjects and research methods at Auburn University under U.S.A.I.D. and foundation scholarships.

6. Providing assistance to personnel in the cooperating fisheries departments of host countries in preparation of research results for publication and in producing more effective extension leaflets on improved methods of aquaculture.

7. Providing experts in various phases of aquaculture from Auburn University and other institutions for short-term visits to developing countries to help solve special problems as they arise. These may include one or more of the following subjects:

- Water chemistry problems in aquacultures
- Inventory of species—fish taxonomy
- Fish feeds and feeding
- Fish parasites and diseases
- Shrimp culture
- Fish cultures
- Aquatic weed control—chemical and biological
- Fish technology—processing and preservation
- Limnological surveys
- Reservoir fisheries management
- Riverine fish populations

8. Providing a limited number of staff trained in aquacultures for 2-year tours of duty in host countries.

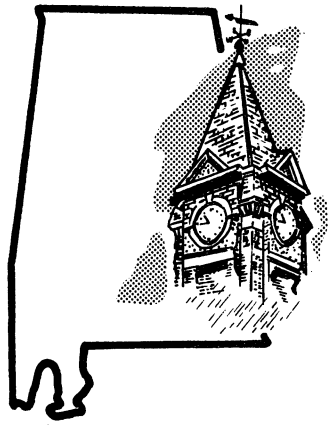
Under the U.S.A.I.D. worldwide contract, fisheries surveys have been conducted in Africa (Senegal, Ivory Coast, Togo, Ghana, Nigeria, Cameroon, and Central African Republic); Asia (Philippines, Thailand, Vietnam, Malaysia, India, and Pakistan); and Central and South America (Brazil, Colombia, Ecuador, Panama, Paraguay, and Peru).

Cooperative programs in aquacultures and other areas of fisheries are in progress in Brazil, Thailand, and the Philippines under sponsorship of the respective A.I.D. Missions and host governments.

Additional programs of cooperation are being developed and surveys will be conducted in various other developing countries as requested by the U.S. Missions. Requests for surveys and other consultation services from foreign governments and other organizations must have the appropriate support of the U.S. Mission and U.S. Department of State, Washington. Hence, foreign governments desiring services available under the International Center for Aquaculture should submit a formal request to the Director of the U.S. Mission within the host country.

Institutional Grant Program

In July 1970, the U.S. Agency for International Development awarded Auburn University an Institutional Grant for the purpose of improving its International Center principally by supporting personnel in various specialties relating to aquaculture. This, in turn, will result in increased competence and capability for providing expertise in various phases of aquaculture to better serve the needs of U.S.A.I.D. and other organizations, under appropriate contractual agreements, in intensifying efforts to promote more rapid development of aquaculture in programs of technical assistance to developing countries.



Information

For information concerning any of the programs mentioned in this brochure contact:

Director
International Center for Aquaculture
Auburn University
Auburn, Alabama 36830

Architects' drawing of Auburn University's new Fisheries Building. The building, the first of a proposed three-building Fisheries-Wildlife Complex, is scheduled for 1972 occupancy. Laboratories, classrooms, and offices will be in the 26,000 sq. ft. facility.