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ANNUAL REPORT FOR FY 1973

THE INTERNATIONAL CENTER FOR AQUACULTURE

Auburn University Agricultural Experiment Station
Auburn, Alabama 36830

E.W. Shell, Director
Project: AID/csd-2780

August 15, 1973

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211(d) Annual Report

Date August 15, 1973

Title: To Strengthen Specialized Competency in Aquaculture, Specifically the International Center for Aquaculture

Grantee: International Center for Aquaculture
Auburn University; Auburn, Alabama

Director: Dr. E. W. Shell

A. Statistical Summary:

Period of Grant: June 25, 1970 to June 30, 1975 Amount of Grant $800,000
Expenditures for Report Year $167,394.28 Accumulated $441,155.76
Anticipated for next year $176,519

B. Narrative Summary:

Progress was made in meeting all Grant Objectives. Grant funds were utilized to purchase 45.2 man-months of academic staff time, 14.5 man-months of secretarial time, 16.3 man-months of Graduate Research Assistant time and 65.6 man-months of field and students labor. The Academic Grant-funded staff produced 13 major research publications. Graduate Research Assistants completed eight research projects.

Grant funds were utilized to purchase 299 books, 9 periodicals and 1 film. Seven University courses, 33-credit hours and 5,841 students credit hours, were taught by the academic staff. A total of 2,310 of the credit hours were for foreign students. It was possible to accept approximately 15 additional graduate students in the Department as a result of the availability of the Grant-funded staff. Twenty-two students (12 American and 10 foreign) received advanced degrees. Twelve of these are now involved in international development. Three other students joined the Peace Corps and are working with Auburn-USAID Projects abroad.

Thirty persons came to the Center on visits related to international fisheries development. These visitors required 170 man-days of training, seminars and discussions. Staff members of the International Center participated in 6.7 man-months of international fisheries development activities abroad.

Approximately $636,000 were available from other sources for development of the International Center for Aquaculture.

I. General Background and Purpose of the Grant

Aquaculture is becoming increasingly important as a means of providing a significant part of the protein needed for more adequate diets and as an important contribution to the economic growth of developing countries. It utilizes infertile lands, and runoff waters plus agricultural wastes and surpluses to intensively grow crops of high quality proteins 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, thus reducing the cost of transportation, processing and refrigeration and it provides additional needed income and employment for farmers.

Auburn University has worldwide recognition for its leadership in warm-water fisheries generally and aquaculture specifically and has committed itself to assist developing nations to develop and increase their supplies of high quality protein, and improve their economic well-being through improved methods of aquaculture. No other American University has the capability of providing this type of assistance.

While growth of the research and training program at Auburn has been rapid and a broad base of competency has been developed in aquaculture, much of the available funding has required special emphasis on problems at the state, regional and national levels and cannot adequately support the needed international dimensions of the University's program.

This Grant will be utilized by Auburn University to strengthen its research, teaching, consultation and other service capabilities in aquaculture. As a

consequence, more significant contributions may be made in developing aquaculture as an effective means of alleviating protein deficiency and malnutrition and of contributing to the economic growth of developing nations around the world. In addition, the Grant will be used to develop methods and procedures for making the University's competence in aquaculture more readily available for those who need it.

II. Objectives of the Grant

A. Objectives Restated

The objectives of the program are:

1. To add to the faculty, experts with competence in selected fields so as to provide broader technical assistance in aquaculture to developing nations.

2. To develop a library containing worldwide literature on aquaculture and more effective methods of dissemination of information on aquaculture.

3. To provide training and educational opportunities through short courses, symposia, and University courses for professional staff members of A.I.D., other federal agencies and private foundations, for students interested in careers in international development, for Peace Corps Volunteers and for foreign nationals.

4. To develop a worldwide collection of data on important food fishes and other aquatic organisms presently cultured or that appear suitable for culture.

B. Review of Objectives

The four primary objectives as approved in the Grant proposal are still appropriate to the goal of strengthening the International Center for Aquaculture at Auburn; however, as specific phases of each objective are completed, emphases are re-directed to other priority areas.

In the first phase of the Objective to increase the competence of the staff (Objective 1.) most of the emphasis involved employment of new staff members with competence in specific areas of aquaculture. Once the new men were employed, emphasis was shifted by involving them to a greater extent in activities related to international aquaculture and fisheries development. In the remaining two years of the Grant, it is anticipated that the involvement of the staff in these types of activities will be increased.

In the first two years of the grant, an effort was made to obtain literature on worldwide aquaculture for the library (Objective 2.). In the past year, we have made an effort to obtain literature on native fishes found in developing countries. This emphasis will probably be continued for the next two years as we attempt to obtain information on the species of fish in each developing country that might be used for culture.

The demand for training and education opportunities related to international fisheries and aquacultural development (Objective 3.) has increased each year since the grant was approved. These services represent a major share of staff activities and it appears that the emphasis on providing those services will have to be increased in the future.

Relatively less progress has been made on developing a worldwide reference data collection on important aquatic animals suitable for culture (Objective 4.). A considerable amount of information has been accumulated, but we have not yet decided on a system for storage and retrieval. More emphasis will be directed to this Objective in the coming year.

III. Accomplishments

A. Accomplishments of the Report Year

1. Personnel on the Project

Following is a list of personnel who received Grant funds as part of their salary during the report year.

Name	Position	Man-Months
Dr. H.S. Swingle	Director (July 1, 1972 - May 20, 1973)	6.2
Dr. E.W. Shell	Director (May 21, 1973 - June 30, 1973)	2.1
Dr. C.E. Boyd	Associate Professor	7.8
Dr. R.T. Lovell	Associate Professor	3.2
Dr. W.D. Davies	Assistant Professor	7.4
Dr. J.L. Gaines	Assistant Professor	6.6
Ms. E.W. Scarsbrook	Research Associate	12.0
Ms. M.A. Hodgkins	Lab. Tech. A	1.6
Ms. P. Argo	Typist	2.5
Ms. E.C. Talley	Typist	12.0
Mr. D.E. Alston	Graduate Research Assist.	1.3[1]
Mr. R.L. Busch	Graduate Research Assist.	4.0
Mr. R.E. Buttermore	Graduate Research Assist.	1.6
Mr. R.K. Goodman	Graduate Research Assist.	2.3
Mr. J.P. Hawke	Graduate Research Assist.	1.3

[1] Graduate Research Assistants are generally expected to spend 1/3 time on activities related to their stipend and would not contribute more than 4.0 man-months to a project in a year.

Mr. J.D. Grogan	Graduate Research Assist.	2.8
Mr. W.L. Lane	Graduate Research Assist.	2.3
Mr. J.W. Miller	Graduate Research Assist.	0.7

2. Research Projects

All Grant-funded personnel participated in research projects during the year either as Project Leaders, Research Associates, Laboratory Technicians, Graduate Research Assistants or Clerical personnel. Following are general remarks about the research accomplishments of each. A more detailed description of the results of specific research projects is presented in Appendix IA. Research at least in part supported by Grant-funds resulted in 13 major research publications during the year. A list of these publications is presented in Appendix IB.

Dr. H.S. Swingle

Dr. Swingle's research interest was aquaculture. He provided overall direction for all research efforts on the project and conducted one research project himself on the use of a predator to control reproduction in Tilapia. This type of research is particularly important to many developing countries because it demonstrated that unwanted reproduction of Tilapia could be controlled through the addition of a predator. The many small Tilapia which were too small for marketing were eaten by and thus converted into the more desireable largemouth bass. Similar research projects in which Tilapia are grown with a predator are being conducted in Thailand, El Salvador and Brazil.

Dr. E.W. Shell

Dr. Shell's research interest is aquaculture. He served as Associate Director of the project and supervised one research problem on the culture of larval fishes, specifically the striped bass Morone saxatilis. This type of research is pertinant in many developing countries. For many species of fish that are used for culture, survival and growth of larval forms are constraints in the development of that culture.

Dr. C.E. Boyd

Dr. Boyd's research interests are aquatic ecology and nutrient cycles in aquacultural systems. He was responsible for four research projects during the year. Dr. Boyd was sole author or senior author on nine major research publications published during the year. He was a junior author on two others.

Dr. R.T. Lovell

Dr. Lovell's research interests are fish nutrition and fish processing and technology. He worked on five research projects during the year. He published four major research papers.

Dr. W.D. Davies

Dr. Davies conducted research on fish population dynamics and fisheries management. He participated in a research project on methods of controlling the catch or of preventing over-exploitation from small man-made ponds. He served a senior author on a research paper published in Brazil based on research he conducted there along with several Brazilian counterparts.

Dr. J.L. Gaines

Dr. Gaines' research interest is fish pathology. He participated in two research projects. He was a junior author on one research paper published.

Mr. D.E. Alston

Mr. Alston is conducting research on the aquaculture of fish food organisms. This research was initiated just prior to the end of the project year. Final results will not be available until later. If cheap and efficient methods can be developed for culturing fish food organisms such as immature insects, it may be possible to use these as a source of animal protein in the diets of cultured fish in developing countries. Mr. Alston is conducting his research under the direction of Dr. J.S. Dendy, Professor, Department of Fisheries and Allied Aquacultures.

Mr. R.L. Busch

Mr. Busch conducted research on the polyculture of the Asiatic clam, Corbicula, and channel catfish. The Corbicula feeds on particulate matter (uneaten feed, feces, plankton) in the water where the fish are cultured, and are produced free of feed costs. In addition, they remove the organic wastes from the water which aids in maintaining good water quality. This species of clam is a choice food item in some countries of Asia. Mr. Busch conducted his research under the direction of Dr. Shell.

Mr. R.E. Buttermore

Mr. Buttermore is continuing research on pen culture. Results of his research will not be available until later. Mr. Buttermore's research is

under the direction of Dr. M.M. Pamatmat, Associate Professor, Department of Fisheries and Allied Aquacultures.

Mr. R.K. Goodman

Mr. Goodman's research on the comparison of morphometric measurements of channel catfish from seven geographical locations was part of a larger project on genetics and breeding of that species. He conducted this research under the direction of Dr. Shell.

Mr. J.P. Hawke

Mr. Hawke is conducting research on incidence of fish disease in populations of fish from natural waters. This type of research is of importance in many developing countries where fingerling fish to be used in culture are often taken from natural waters. Results of Mr. Hawke's research will not be available until later. He is working under the direction of Dr. J.A. Plumb, Assistant Professor, Department of Fisheries and Allied Aquacultures.

Mr. J.D. Grogan

Mr. Grogan experimented with the use of an active-carbon, expanded-bed filter to maintain water quality in a closed circuit culture system for channel catfish. He conducted his research under the direction of Dr. J.M. Lawrence, Professor, Department of Fisheries and Allied Aquacultures.

Mr. W.L. Lane

Mr. Lane compared the proteolytic enzymes of the channel catfish, an omnivore, and the Chinese grass carp, a herbivore. His research was under the direction of Dr. R.T. Lovell.

Mr. J.W. Miller

Mr. Miller conducted research on pen culture of channel catfish. His research was part of an informal cooperative research project between the Center and the Department of Fisheries in Thailand. This research was under the direction of Dr. J.S. Dendy and Dr. H.S. Swingle.

Research Work by Foreign Graduate Students

Ten foreign students received graduate degrees from Auburn during the year. Each of these students was required to submit a thesis or dissertation based on their original research. Although none of these students was supported directly on Grant funds, all of them utilized equipment and supplies purchased with Grant funds, benefitted from the availability of the field labor purchased with Grant funds or received guidance and information from staff paid on Grant funds. The names, country and title of the thesis or dissertation for each student follows:

Chailiang Chaitiamvong (Thailand)	Polyculture of Channel Catfish and Common Carp in Ponds.
Charng-jyi Chiou (Taiwan)	The Availability of Mud Phosphorus for Algal Growth.
Sompong Hiranvat (Thailand)	Preimpoundment Age and Growth of the Redbreast Sunfish, Lepomis auritus, in the Proposed West Point Reservoirs, Alabama and Georgia.
Dilip Mathur (India)	Ecology of Feeding Fishes in Halawakee Creek, Lee and Chambers Counties, Alabama.
Oopathon Pawaputanon (Thailand)	The Effects of Three Methods of Aeration, of Biofiltration and of Aeration Plus Nutrient Removal with Water Hyacinths on Water Quality in Catfish Ponds.
Charoen Phanil (Thailand)	The Effects of Water Hyacinths on Plankton in Fed Channel Catfish Ponds.

Somsuk Singlholka (Thailand)	Growth and Feed Conversion of Common Carp (Cyprinus carpio) Fed at Different Rates in Cages.
Prasert Sitasit (Thailand)	Dietary Levels of Calcium and Phosphorus for Cage-Cultured Channel Catfish.
Pichit Srimukda (Thailand)	The Effect of Pen-Culture on the Dissolved Oxygen Concentration in Pens and in Adjacent Water.
Pramot Suwanasart (Thailand)	Effects of Feeding, Mesh Size and Stocking Size on the Growth of Tilapia aurea (Steindachner) in Cage-Culture.

3. Teaching Activities

Six of the staff members of the project taught seven courses during the year. A summary of each person's teaching activities follows:

Dr. H.S. Swingle

Dr. Swingle taught one course during the year--a 5-credit hour graduate course in Aquaculture.

Dr. E.W. Shell

Dr. Shell taught a 5-credit hour graduate course in Advanced Fisheries Biology. He also served as advisor to undergraduate students in the Fisheries Curriculum and supervised the graduate program for the Department. He served as major professor for 14 graduate students. Seven of these were foreign students.

Dr. C.E. Boyd

Dr. Boyd taught three courses. Nutrient Cycles in Aquacultures, a 5-credit hour course, was offered two times. He also taught Biological Productivity and Water Quality, a 5-credit hour course. He served as major professor for 5 graduate students. Three of these were foreign students.

Dr. R.T. Lovell

Dr. Lovell taught a course on Fish Processing and Technology, a 5-credit hour course. He served as major professor for 11 graduate students. Nine of these were foreign students.

Dr. W.D. Davies

Dr. Davies taught a course in Fisheries Biology, a 3-credit hour course. He served as major professor for five graduate students. Two of these were foreign students.

Dr. J.L. Gaines

Dr. Gaines taught a course in Fish Morphology.

A seminar series emphasizing international fisheries development was offered for graduate credit during the year. Seminar topics and speakers are presented in Appendix IC.

4. International Service Activities

All academic staff members on the project participated in international service activities during the year. A summary of participation of the staff on foreign assignments and in international seminars follows:

Dr. H.S. Swingle

Dr. Swingle participated in a seminar on Marine Biology and Fisheries held under the auspices of the U.S. - Republic of China Cooperative Science Program in La Jolla, California, April 10 - 13, 1973.

Dr. E.W. Shell

Dr. Shell reviewed progress of the Auburn - USAID project in the Philippines (AID/ea-180) during the period September 22 - October 1, 1973. He reviewed research work and aided in the planning of new research with the Department of Inland Fisheries in Thailand, October 1 - 28 (AID/csd-2270, T.O. 9). He discussed the International Center's activities with the FAO Fisheries Liaison Officer in Rome, October 29 - 30, 1972.

Dr. R.T. Lovell

Dr. Lovell visited the Philippines, Thailand and FAO in Rome with Dr. Shell. In addition, he served as an advisor in fish nutrition and feeding to the Auburn - USAID Project in Panama (AID/la-684), December 17 - 23, 1972.

Dr. W.D. Davies

Dr. Davies attended the FAO-sponsored Technical Conference on Fishery Management and Development held in Vancouver, British Columbia, February 11 - 23, 1973. He conducted a pre-feasibility survey of fisheries development on Lake Izabal, Guatemala, June 11 - 22, 1973.

5. Library Acquisitions

During the year, 299 books were purchased for the Library utilizing Grant funds. A majority of these books are references on fishes found in developing countries. These books will be used as a source of information on species of fish in these countries that have potential for use in aquaculture.

Grant funds were also used to purchase subscriptions to nine periodicals and a film.

IV. Impact of Grant Supported Activities in Developing Institutional Capabilities

The Grant allowed the Department of Fisheries and Allied Aquacultures and the International Center for Aquaculture to significantly increase its international capabilities and activities without interferring with its traditional programs. Interaction between the international and traditional programs resulted in the strengthening of both. The Grant has allowed the University to take a more active role in international fisheries and aquacultural development through the teaching of foreign students, by conducting relevant research and by extending information to developing countries. Although the University has been in international work to a limited degree for a number of years, without the support provided by the Grant, the present degree of involvement would not be possible.

Grant funds were used to purchase the following personnel time during the past year:

Staff Category	Man-Months
Academic	45.2
Laboratory Technician	1.6
Secretarial	14.5
Graduate Research Assistants	16.3
Field Labor	65.6

No more than a fraction of this level of staffing would be available to the Center without funds provided by the Grant.

The academic staff with support from the laboratory technicians, secretaries and field labor produced 13 major research publications during the year. The Graduate Research Assistants funded from the Grant conducted

eight research projects. Four of these projects resulted in theses prepared to meet the requirements for the Master of Science Degree.

The number of research publications and research projects directly attributable to the Grant are indicative only of a portion of the contribution that those funds make to our over-all research program. Grant-funded staff regularly collaborate with other members of the staff on research projects.

We have three research projects funded by extramural sources that we were able to obtain because of the availability of the specialists employed with Grant funds. Without the field labor purchased with Grant funds it would be extremely difficult to provide the large number of USAID-supported foreign students at Auburn with effective field research experiences.

The academic staff on Grant funds taught seven University courses during the past year, producing a total of 5,841 student-credit hours (177 students x 33 credit hours). Of these, 2,310 student-credit hours were for foreign students. Seventeen of the 33 credit hours taught were new courses added to the curriculum because of the availability of these specialists on the staff.

The Graduate School at Auburn has established as a general guide-line that no professor may have more than five graduate students. Because of this regulation, our graduate training program would be considerably smaller without the additional staff available as a result of the Grant. The additional staff allowed us to accept approximately 15 more graduate students than we would have been able to accept otherwise. Because of the large number of qualified American applicants desiring admission to Auburn,

it is unlikely that we could have accepted many foreign students without the additional staff provided by Grant funds. A total of 11 foreign students were awarded advanced degrees during the year. Staff funded from the Grant served as major professors for nine of these.

V. Utilization of Institutional Resources in Development

Four Auburn-based staff members participated in on-site reviews of Auburn - USAID Fisheries Development Projects or served as advisors on these projects during the year. These activities required approximately 4.9 man-months.

One staff member served as a consultant to the International Bank for Rural Development planning a fisheries development project in Bangladesh. This activity required 1.7 man-months of service.

Approximately 1 man-month of staff time was spent away from campus participating in an FAO-sponsored seminar, meetings with FAO personnel and seminar sponsored by the U.S. - Republic of China Cooperative Science Progr

Thirty persons came to the Center during the year on visits related to international fisheries development. The visitors required approximately 170 visitor days of short-term training, seminars, meetings, discussions with individual staff members, tours and administrative support. These visitors came from eight different countries. A list of these visitors is presented in Appendix IIA of this report. The Center was responsible for planning and conducting extended special training programs for three visitors from Thailan and one from El Salvador. Copies of these programs are presented in Appendi IIB.

Twenty-two students (12 American and 10 Foreign) received advanced degrees during the year. Twelve of these students are now actively involved in some aspect of international fisheries development. Three Americans receiving graduate degrees are involved in international work. Nine of the

foreign students returned to their native countries to continue their work in fisheries development.

One American student took a leave of absence from his graduate work to enter the Peace Corps. He is working on a fisheries project in El Salvador under the direction of the Chief of Party of the Auburn - USAID project (AID/la-688) there. He will use the results of his research there for a thesis.

Two students who received B.S. degrees also joined the Peace Corps. One of them is working with the Auburn - USAID project in El Salvador. The other will be working with the Auburn-USAID project (AID/ea-180) in the Philippines.

Twenty-eight students (16 American and 13 Foreign) entered the Graduate Program of the Department during the year. A number of American and foreign students that were qualified for admission could not be accepted because present facilities and staff cannot accommodate more than the approximately 50 graduate students presently enrolled.

VI. Other Resources for Grant-Related Activities

Because the basic purpose of the Grant is to improve and to strengthen the International Center for Aquaculture, virtually all other funds received are considered to be available for Grant-related activities. The Department and Center received funds from several sources during the year. Data on the sources of funds and the amount from each source are presented in the following table. A more complete description of the sources of other funds is presented in Appendix III.

Source of Funds	Amount
State of Alabama Appropriated Funds:	
For teaching	$151,331[1]
For research	82,925
Sales Funds	
For sale of food fish and fingerlings	19,301
Federal Appropriated Funds for Research	
USDA-Land-Grant College Funds	67,000
Research Grants from Other State Governments	100,820
Research Grants from Federal Agencies	160,800
Research Grants from Private Enterprise	54,000
	$636,177

The Department and Center occupied a new building, Swingle Hall, in August, 1972. The cost of this building was approximately one million dollars. All of the funds for the building were appropriated by the Alabama Legislature. These funds represent a significant contribution for Grant-related activities.

[1] A total of $103,283 from this source was available on a one-time basis. Most of the funds were used for equipment purchased when the Department occupied the new Fisheries Building. These funds will not be available in the following year.

VII. Next Year's Plan of Work and Anticipated Expenditures

We plan to devote attention to all objectives of the project during the next year. Following are specific plans for work on each of the objectives.

A. Adding to Competence of the Staff of the Center

We plan to continue to add to the competence of the staff and to its ability to provide broader technical assistance in aquaculture by employing new staff members, by changing the composition of the staff somewhat, by encouraging the staff to continue their research efforts, by encouraging them to participate in seminars sponsored by international development agencies and by involving them in international development projects.

1. Addition of New Grant-Funded Staff and Changes in Staffing Patterns

The proposed staffing pattern for the coming year is shown below. The staffing pattern for the previous year is shown for comparison.

Staff Category	Proposed Man-Months	1972-1973 Man-Months
Academic	44.7	45.2
Secretarial	25.7	14.5
Graduate Research Assistants	16.0	16.3
Field Labor	24.0	65.6

Dr. H.S. Swingle died before the end of the past year. He was scheduled for retirement June 30, 1973. Dr. W.D. Davies will continue to participate in activities of the Center, but he will be paid from other than Grant funds during the coming year. Drs. Boyd, Lovell and Gaines will contribute less time to Grant-funded activities than last year.

Three new men will be added to the staff paid from Grant funds. Dr. R.O. Smitherman, Associate Professor, who has returned from Panama will be added to the staff. He served as Project Leader of the Auburn-USAID (AID/la-684) in that country. His interests are aquaculture and selective breeding of fishes. He will teach the course in Aquaculture taught by Dr. Swingle for a number of years. Dr. D.D. Moss, Professor, will also join the Grant-funded staff. He has the responsibility for the day-to-day supervision of the Auburn-USAID projects abroad. He has also been involved with virtually all of the Grant-related activities of the Center since the inception of the Grant. Dr. M.M. Pamatmat, Associate Professor, will be the third new member of the staff. He has a strong background in biological oceanography and aquaculture. He will be responsible for increasing the Center's activities in mariculture. Before coming to the U.S., several years ago for training, Dr. Pamatmat was employed by the Philippines Fisheries Commission. Dr. Shell, as the new Director of the Center and Head of the Department of Fisheries and Allied Aquacultures, will contribute a larger percentage of his time to Grant-related activities. The over-all result of the proposed changes will be an academic staff more familiar with and with more experience in international fisheries development

We also plan to increase the amount of secretarial time on the project to more accurately reflect the amount of those services required. The amount of field labor on this project will be reduced.

2. Planned Research Projects

Seven members of the academic staff will have research projects during the year. Research projects for each staff member are as follows:

Dr. E.W. Shell

a. Factors affecting the survival and growth of the early life history stages of the striped bass Marone saxatilis.

Dr. C.E. Boyd

a. The effect of agricultural limestone on productivity in aquacultural ponds.

b. The influence of water hyacinths on productivity of aquacultural ponds.

c. Relationships between bottom soils, alkalinity and hardness of the water and fish production in earthen ponds.

d. Contribution of nutrients to pond water by decaying aquatic plants.

Dr. R.T. Lovell

a. Use of fermentation preserved, channel catfish slaughter wastes in fish feeds.

b. Comparison of meal made from catfish slaughter wastes and marine fish meal in fish feeds. This is a cooperative project between Auburn and the Southeastern Warm-Water Fishcultural Research Laboratory of the U.S. Fish and Wildlife Service at Marion, Alabama.

c. Comparative digestibility by Chinese grass carp of feeds containing high, medium and low levels of fiber.

d. Methods of predicting availability of nutrients from practical diets by channel catfish.

e. Protein requirements of channel catfish being grown to harvestable size in ponds.

Dr. M.M. Pamatmat

a. Pen culture techniques for channel catfish in multipurpose reservoirs.

b. Organic matter metabolism in bottom muds of aquacultural ponds.

Dr. R.O. Smitherman

a. Selective breeding of channel catifsh

Dr. J.L. Gaines

a. Histology of healthy channel catfish.

b. A study of "fright-reaction" substances produced in the skin of channel catfish.

Ms. E. Scarsbrook

She will serve as a Research Associate on the projects proposed for Dr. Boyd.

All of the projects listed above will be partially supported with funds other than from the Grant. At least 10 graduate students will participate in this research. Most of these will be foreign students.

3. Participation in International Meetings

Plans are being made for participation of the staff in a number of international meetings, seminars and conferences. Dr. Pamatmat will review the work of and establish contacts with mariculture research scientists in Western and Northern Europe. He will also serve as a consultant to the University of Bergen in Norway for three months. This latter activity is funded by the University of Bergen.

Dr. Smitherman will participate in a seminar, "Aquaculture in the Americas", co-sponsored by the American Association for the Advancement of Science and a similar organization in Mexico. He will probably attend a similar meeting proposed for Uraguay and sponsored by FAO in early 1974.

Dr. Lovell has been invited to present a paper at the "Colombian Fish-culture Seminar" sponsored by the Colombian Government during November. He has also been invited to participate in the "Technical Conference on Fishery Products" sponsored by FAO to be held in Tokoyo in December, 1973.

B. Developing the Library

Efforts will be continued to develop the library. Procedures have been established for locating sources of library materials. In the coming year, efforts to obtain more items on foreign fisheries and aquacultures will be intensified. Auburn personnel abroad on Auburn-USAID contracts will be asked to suggest titles and sources of library materials from their areas.

C. Provide Training and Education Opportunities

There is little doubt that these activities will be increased during the year. There will be more visitors coming to the Center. We do not anticipate an increase in foreign graduate student training because of the limit set on graduate training in the Department. We expect that with changes made in staffing that we can provide more meaningful and appropriate training experiences for the international students.

We expect to be more involved in the training of Peace Corps Volunteers and visitors sponsored by this organization. There are excellent opportunities

for involving Peace Corps Volunteers with some of the Auburn-USAID projects.

D. Collection of Data of Worldwide Food Fishes

Much of this data has already been collected and is available in the library. The major problem is to determine how to make this information readily available to scientists in developing countries. An effort will be made to develop data retrieval and delivery systems during the year.

E. Estimated Costs of Project Activities

It is relatively easy to predict the cost of budget line items for project activities. These projected costs for the coming year are presented in table I. However, it is difficult to make accurate estimates of costs of reaching specific objectives. Many of the activities of the objectives are inter-related and it is difficult to accurately divide the costs between those objectives. Some estimates of this nature have been made and these are presented in table II. Even in table II the costs are not closely related to specific objectives. An estimate of costs related to the objectives would be as follows:

Objective		Costs
Increasing the Competence of the Staff		$114,519
1. New Staff and Staff Changes	$82,000	
2. Research Projects	26,519	
3. Participation in international meetings	6,000	
Developing the Library		4,000
Providing Training and Education Opportunities		50,000
Collecting Worldwide Data on Fishes		8,000
		$176,519

Table I

Distribution of 211(d) Grant Funds and Contributions From Other Sources of Funding*

Review Period July 1, 1972 to June 30, 1973

(List all grant related activities)		211(d) Expenditures				Non 211(d) Funding Amount
		Period Under Review	Cumulative Total	Projected Next Year	Projected to end of Grant	
e.g.	Research	105,796.00	271,365.00	108,388.00	486,882.00	410,400
	Teaching	35,310.00	102,215.00	41,135.00	186,291.00	161,300
	Libraries	5,929.86	6,990.13	4,000.00	15,000.00	1,500
	Consultation	12,425.00	36,372.00	13,855.00	64,525.00	15,000
	Publication	3,027.83	10,089.36	3,000.00	15,000.00	5,000
	Other	4,905.59	14,124.27	5,141.00	32,302.00	43,000
TOTAL		167,394.28	441,155.76	175,519.00	800,000.00	636,200

* These figures are your best estimates

Table II

Expenditure Report

(Actual and Projected)

Under Institutional Grant #AID/csd - 2780

Review Period July 1, 1972 to -- June 30, 1973

(Line Items to Conform to Budget in Grant Document)	Expenditures to Date		Projected expenditures				Total
			Year				
	Period Under Review	Cumulative Total	2	3	4	5	
e.g. Salaries	68,145.91	196,077.61		81,240		85,300	362,617.61
Travel	2,556.66	10,634.39		8,000		8,000	26,634.39
Equipment	1,107.62	9,510.24		1,200		1,200	11,910.24
Personnel Benefits	8,398.30	20,812.48		11,374		11,942	44,128.48
Graduate Research Assistants	12,801.17	40,132.84		13,200		14,000	67,332.84
Supplies, Library and other	74,384.62	163,988.20		61,505		61,883.24	287,376.44
	167,394.28	441,155.76		176,519		182,325.24	
							800,000.00

Appendix I

Accomplishments

A. Summaries of Research Projects Conducted by Grant-Funded Academic Staff and Graduate Research Assistants

Dr. H.S. Swingle

Tilapia aurea stocked at 5,000 per acre with 300 largemouth bass fry in a split-stocking, and fed Auburn No. 3 pelleted feed produced 2,121 pounds harvestable fish, including 129 pounds harvestable bass per acre in 200 days. Total net gain in weight was 14.27 pounds per day.

Dr. E.W. Shell

Striped bass fry cultured in hatching jars and fed brine shrimp during the first 18 days of culture followed by a 4-day or 12-day transition to dry feed grew faster than fry receiving brine shrimp throughout the culture period.

Feed conversions for striped bass fingerlings cultured in 100-liter stainless steel troughs with automatic feeders and recirculating water ranged from 1.71 to 3.10, with the most effecient conversion (1.71) being attained with a feeding rate of 4.2% of body weight per day. A feeding rate of 8.4% produced the largest average size fish (4.2 g), but also resulted in the highest conversion (3.10).

Research on the effects of increased sodium chloride concentrations on fry survival was conducted using twelve, 0.10-acre earthen ponds. Six of the 12 ponds received applications of rock salt to increase the sodium chloride concentration. Mean survival was significantly higher in ponds with increased sodium chloride.

Dr. C.E. Boyd

The rate of oxygen consumption by plankton communities in pond waters is positively correlated with chemical oxygen demand. Respiration increases by about 0.05 mg/1 of oxygen per 24 hr with each mg/1 increase in chemical oxygen demand (COD). The major source of COD in all ponds was carbon fixation by photosynthesis.

Laboratory studies revealed that seven species of blue-green algae excreted substances which inhibited the growth of several species of green algae. Field studies suggested that excretory substances of algal origin favored the persistence of blooms of certain troublesome blue-green algae.

Other laboratory studies indicated that phytoplankers can utilize phosphorus from muds for growth. The availability of mud phosphorus can be estimated by extraction with 0.05N HCL plus 0.025N H_2SO_4 and several other extractants.

Concentrations of chlorophyll a proved a good estimate of the amount of phtosynthesis in pond waters. In experiments which were conducted in plastic pools, fish production increased with increasing concentrations of chlorolphyll a.

Dr. R.T. Lovell

Past studies (1970 - 71) demontrated that high protein feeds (45%) produced 24% more gain than lower protein feeds (32%) when channel catfish were fed in ponds where the maximum safe level of feeding was 32 lbs/acre/day In 1972, it was shown that increasing available energy levels from 1,000 to 1,300 K cal. per lb of feed further increased gains of high protein diets by 12%.

Catfish fed to harvestable size in concrete ponds on feeds containing appreciable levels of various fats had body fat similar chemically to the fats in the diets. The only fat that adversely affected flavor in the fresh fish or frozen keeping quality was marine fish fat. This fat gave the catfish a "fishy" flavor and caused the frozen fish to oxidize more readily than those fed other animal or plant fats.

Catfish waste from processing plants was fed in a moist-feed, balanced diet preparation to channel catfish for a 150-day growing period. The moist feed was allowed to ferment and when stored in an air-tight container remained in good condition for six months at ambient temperature. Feed conversion for the moist diets containing uncooked waste was 2.11 compared with value of 1.67 for cooked waste in the diet. The diet containing commercial marine fishmeal gave conversion of 1.12. Catfish waste is a useful source of animal protein but inferior to marine fishmeal. Cooking destroys antinutritional factors and improves digestibility of collagen in catfish waste.

Smoked catfish has excellent consumer appeal, will keep well in refrigeration for several months, and represents 45% of the original live fish weight. Recommendations for a "hot-smoke" process for catfish were developed and submitted to governmental agencies for review regarding compliance with food safety laws.

Dr. W.D. Davies

In a 25-acre pond where fishing was allowed along the bank halfway around the pond, 54 percent of the total catch was removed during the first 5 days the pond was opened to fishing.

About 27 percent of the catch was Tilapia and channel catfish, the remainder bluegill, shellcracker and bass. The number of fishermen decreased rapidly after most of the large catfish had been removed. Closing half the lake did not appear to greatly reduce the rate of catch.

Dr. J.L. Gaines, Jr

Studies on the anatomical and histological structure of the channel catfish, Ictalurus punctatus were started this year. The histologic description of the skin was completed, as was the description of the internal anatomy. Hematologic studies which were started this year will continue through next year.

Mr. R.L. Busch

Reproduction of Corbicula was noted in 20 of the 24 pools comprising the five treatments with clams. Reproduction was estimated as high as 686 young clams per square foot of pool bottom mud.

The Corbicula initially cleaned the water so well that the introduction of submerged aquatic weeds and filamentous algae occurred in 14 of the 24 pools containing clams. Fewer fish kills due to oxygen depletion occurred in treatments containing Corbicula in suspended trays or Corbicula stocked at the heavier concentrations in the pool mud. Treatments containing Corbicula in floating trays maintained the lowest turbidity readings throughout the summer. Turbidity determinations increased with a decrease in the stocking rate of clams in the pool mud. Clam survival was highest in treatments containing Corbicula in floating trays. This survival decreased with a decrease in the stocking rate

of clams in the pool mud. Catfish survival was highest in those treatments containing Corbicula in floating trays and Corbicula stocked in the heavier concentrations in the pool mud. The highest average net weight of fish per treatment, average mean fish weight and best food conversion ratio occured in that treatment containing about 30 clams per square foot in the pool mud.

Mr. R.K. Goodman

Channel catfish, Ictalurus punctatus (Rafinesque), from seven different geographical locations and two interpopulation crosses were stocked into 0.1-acre ponds at a rate of 1,500 per acre at the Auburn University Fisheries Research Unit. The fish were fed a supplemental diet at the rate of 5 per cent of their body weight per day for approximately 6 months.

In November the fish were harvested and ten fish of "average" size were taken from each of the nine strains tested. Nine morphometric measurements were performed on each fish and the means for each strain were compared statistically.

Highly significant differences between strains were found for all the measurements except caudal peduncle width. A strong divergence between these geographically separated strains of channel catfish was indicated. Two of the wild strains, those with little or no inbreeding, exhibited a large degree of variability with respect to those characteristics that could be of potential use in selective breeding.

Mr. J.D. Grogan

The effect of an active-carbon expanded-bed filter on water quality in a closed culture system stocked with channel catfish was evaluated.

The water quality parameters measured during the experiment were ammonia, nitrite, nitrate, dissolved oxygen, temperature, pH, dissolved carbon, particulate carbon, total carbon, turbidity and carbon dioxide.

An analysis of variance was caluclated for daily control and experimental tank mean water quality values. Correlation coefficients were calculated among all parameters in each tank and for mean parameter values for the control and experimental tank series. The statistical analysis indicated no significant improvement in water quality in tanks with active-carbon filters.

Mr. W.L. Lane

Chymotrypsin, carboxypeptidase and trypsin were found to be present in the liver and intestine of the white amur and channel catfish. Leucine aminopeptidase was located in the intestine of these two fish. The liver of the channel catfish was the primary site of carboxypeptidase secretion, while the liver of the white amur seemed to play the dominant role in tryptic, chymotryptic and carboxypeptidase secretion. There appeared to be a backwash of enzymes from the intestine into the stomach of the channel catfish.

There was no discernible evidence to suggest that enzyme production in either of the fish was dependent on feeding conditions. Seasonal variation did, however, express effects on the level of carboxypeptidase in the liver of the channel catfish and white amur, and chymotrypitc levels in the intestine of the channel catfish.

Mr. J.W. Miller

Experiments in a 25.5-acre pond on pen culture of channel catfish

stocked at 10 to 15 fish/m^2 plus Tilapia aurea stocked at 2 fish/m^2 pens demonstrated that under these conditions, channel catfish, an insect-feeder, must be fed upon a complete fish feed. In contrast, the Tilapia which feed upon plankton entering the pen with inflowing water from the pond itself, developed no deficiencies and no mortality resulted. Harvestable catfish (10-inch or larger) made up 67 percent of the total number and 88.2 percent of the total weight of catfish recovered. Harvestable Tilapia (6-inch group or larger) made up 97.6 percent of total number and 98.8 percent of total weight of Tilapia at harvest. Maximum production (19,999/lb/A or 19.9 lb/m^2) was obtained in pens constructed singly with wide spacing (100' or more) between pens. Production was lower in pens sharing one or more common sides.

B. List of Publications

Dr. C.E. Boyd

Amino acid composition of freshwater algae. Arch. Hydrobiol. Vol. 72: 1-9.

A bibliography of interest in the utilization of vascular aquatic plants. Economic Botany 26: 74-84.

Biotic interactions between different species of algae. Jour. of the Weed Science Soc. of America, Vol. 21 (1): 32-37.

The chemical oxygen demand of waters and biological materials from ponds. Trans. Amer. Fish. Soc. 102.

Ou 1972 last ✓ Phosphorus dynamics in ponds. Proc. S.E. Game and Fish Commrs. 25: 418-426.

Sources of CO_2 for nuisance blooms of algae. Weed Science, Vol. 20 (5): 492-497.

Summer algal communities and primary productivity in fish ponds. Arch. Hydrobiol.

Dr. R.T. Lovell

Catfish need Vitamin C. Highlights of Agr. Research, Vol. 20 (2), Summer 1973. Agricultural Exp. Sta., Auburn Univ.

Catfish processing-waste utilization. FAO Fish-Culture Bulletin 4 (2): 5.

Essentiality of Vitamin D in feeds for intensively fed caged channel catfish. Jour. of Nutrition, Vol. 103 (1): 134-138.

Protein requirements of cage-cultured channel catfish. Proc. 26th Ann. Conf. Southeastern Assoc. Game and Fish Comm.

Dr. W.D. Davies

Idade e crecimento da curimata comum, Prochilodos cearensis, Steindachner, no agude. "Pereira de Miranda", Pentecoste, Ceara, Brazil. Bol. Tec. DNOCS 29 (2) Frt. 1972.

Dr. J.L. Gaines

Aeromonas induced deaths among fish and reptiles in an eutrophic inland lake. JAUMH 161 (6): 603-607. (With E.B. Shotts, L. Martin, and A.K. Prestwood).

C. List of Seminar Dates, Speakers and Topics

August 11, 1972

Mr. Vanich Varikul, Department of Fisheries, Bangkok, Thailand. "Fisheries Research in Thailand".

September 8, 1972

Mr. Josef Scherzer, Director of Fish Ponds, Kibbuz Maayan Zwi, Israel. "Communal Fish Culture Program in Israel"

September 15, 1972

Dr. N.K. Fijan, Department of Veterinary Medicine, University Zagreb, Yogoslavia. "Major Diseases of European Cultured Fishes.

September 29, 1972

Dr. Claude Boyd, Associate Professor, Department of Fisheries and Allied Aquaculture. "Primary Productivity by Aquatic Plants".

October 6, 1972

Dr. Thomas Hill, University of Georgia Experiment Station, Tifton, Georgia. "Culture of Catfish and Trout in Rotation in South Georgia".

October 13, 1972

Mr. O.L. Green, Fishculturist, U.S. Warmwater Fish Culture Research Laboratory, Marion, Alabama. "Selective Breeding Programs with Channel Catfish"

October 20, 1972

Dr. Bill Davies, Assistant Professor, Department of Fisheries and Allied Aquaculture. "Reservoir Fisheries in Northeast Brazil".

October 27, 1972

Mr. Dan Leary, Ph.D. candidate, Department of Fisheries and Allied Aquacultures. "Effects of Dietary Fiber-level on Production of Channel Catfish in Ponds".

November 3, 1972

Mr. Malcolm Johnson, Jr., M.S. candidate, Department of Fisheries and Allied Aquacultures. "White Amur".

November 10, 1972

Mr. Randell Goodman, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Catfish Genetics Studies".

November 24, 1972

Mr. Don Keller and Mr. David Morris, M.S. candidates, Department of Fisheries and Allied Aquacultures. "Age and Growth of Largemouth Bass in Eufaula Reservoir, Alabama".

January 10, 1973

Dr. Ilan Paperna, Fish Pathologist, Virginia Institute of Marine Science, Glouchester, Va. "Pathology of Fish Diseases in Central Africa".

January 12 1973

Mr. Jack Snow, Director National Fisheries Station, Marion, Alabama. "Chemical Changes in Bottom Soils in Fish Ponds during a 10-year Period".

January 19, 1973

Dr. R.D. Rouse, Dean, School of Agriculture, Director, Agricultural Experiment Station. "The Progress and Present Status of the Regional Catfish Project - S-83".

January 26, 1973

Mr. William Atkins, Commercial Fisherman, Theodore, Alabama. "Commercial Fishing in the Gulf and Tidal Streams of South Alabama".

February 2, 1973

Dr. John Greenfield, Regional Fisheries Economist, National Marine Fisheries Service, St. Petersburg, Florida. "Need for Adequate Economic Data in Aquaculture Projects".

February 9, 1973

Mr. S.Y. Lin (Retired) Principal Fisheries Biologist, Joint Commission for Rural Reconstruction, Taipei, Taiwan. "Aquaculture in Taiwan".

February 16, 1973

Mr. Ed Chamberlin, Deputy Regional Director, USF&W Ser., Atlanta, Georgia. "Fisheries Programs of the U.S. Fish and Wildlife Service".

February 23, 1973

Mr. I.B. Byrd, Chief, State-Federal Relationships Division, National Marine Fisheries Service, St. Petersburg, Florida. "Regional Federal Aid Programs in Fisheries and Aquaculture".

March 2, 1973

Mr. Hugh Barwick, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Effects of Two Feeding Rates on the Survival and Production of Advanced Fingerling Striped Bass."

Mr. Rob Busch, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Using Clams as Bio-filters in Catfish Cultures".

Mr. Rafael Guerrero, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Sex Reversal in Tilapia".

Mr. Somsuk Singholka, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Growth and Feed Conversion of Common Carp fed at Different Rates in Cages".

March 9, 1973

Mr. Arsenio Camacho, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Utilization of Fish Waste in Diets for Fishes".

Mr. Romy D. Fortes, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Studies of Chlorophyll in Pond Waters".

Mr. Pichit Srimukda, M.S. candidate, Department of Fisheries and Allied Aquacultures. "The Effect of Pen Culture on Oxygen Concentration in the Pens and in Adjacent Waters".

Mr. Prasert Sitasit, M.S. candidate, Department of Fisheries and Allied Aquacultures. "Dietary Levels of Calcium and Phosphorus for Cage Cultured Channel Catfish".

Appendix II.

Utilization of Institutional Resources in Development

A. List of Visitors

Dr. Thomas C. Juelson Peace Corps Volunteer in Fisheries Brazil	July 24 - 25, 1972
Mr. Vanich Varikul Chief of Inland Fisheries Research Department of Fisheries Bangkok, Thailand	August 4 - 15, 1972
Mr. Josef Scherzer Director of Fish Ponds 30803 Moayan Zwi D.N. Chat Hacarmel, Israel	September 5 - 8, 1972
Mr. Fred Laney International Training Office National Marine Fisheries Service Rockville, Maryland	November 1 - 3, 1972
Mr. Michael Fivez 18th Avenue Helene 2000 Antwerp, Belgium	January 3, 1973
Mr. Manu Potaros Chief Biologist Bankhen Fisheries Station	January 3 - April 14, 1973
Mr. Chirdchan Amatayakul Chief of Fisheries Extension Department of Fisheries Bangkok, Thailand	January 3 - April 14, 1973
Mr. S.Y. Lin (Retired) Principal Fisheries Biologist Joint Commission for Rural Reconstruction Taipei, Taiwan	February 8 - 11, 1973
Dr. Joel Bernstein Assistant Administrator Bureau for Technical Assistance Agency for International Development Washington, D.C.	February 8 - 9, 1973

Mr. Jim Urano Chief, Agricultural Inputs Division Office of Agriculture Agency for International Development Washington, D.C.	February 8 - 9, 1973
Mr. I.B. Byrd Mr. Paul Hooker National Marine Fisheries Service St. Petersburg, Florida	February 22 - 23, 1973
Dr. Pietro Ghittino Professor of Pathology University of Torino Italy	March 8, 1973
Dr. Harlan Davis Food and Agriculture Officer USAID/El Salvador	March 14 - 16, 1973
Mr. Stanley Heishman Contract Officer Agency for International Development Washington, D.C.	March 14 - 16, 1973
Mr. Richard Schneider PCV Project Leader and Six Peace Corps Voluneer Trainees from Michigan State University	March 19 - 21, 1973
Sr. Jose Cabrero Chief of Fisheries Ministry of Agriculture San Salvador, El Salvador	May 1 - 31, 1973
Mr. Sibley Kawi Chief, Training Division USAID/Philippines	May 2 - 3, 1973
Mr. Andy Hernadez USAID/Guatemala	May 15, 1973
Dr. Nelson Marshall Director Center for Marine Resource Development University of Rhode Island	June 9, 1973

Dr. Erven Long
Associate Assistant Administrator
Office of AID Research & University Relations
Bureau of Technical Assistance
Agency for International Development
Washington, D.C. — une 9, 1973

Mr. Jim Urano
Chief
Agricultural Inputs Division
Office of Agriculture
Agency for International Development
Washington, D.C. — J[illegible] 3

Sr. Pedro Godoy I.
Incubadoras Protinal, C.A.
Valencia, Venezuela — July 18, 1973

Mr. John Hummon
Agency for International Development
Washington, D.C. — July 20, 1973

Dr. Z.H. Shehadeh
Fisheries Department
Food and Agriculture Organization
Rome, Italy — June 29 - 30, 1973

B. Program for Mr. Vanich Varikul (Thailand)

August 4, 1972	Conferences with Dr. H.S. Swingle and Dr. D.D. Moss discussing the overall fisheries program, International Center for Aquaculture, Auburn University, Auburn Alabama.
	Observations of the experimental ponds and reservoir construction at the Fisheries Research Unit with Dr. H.S. Swingle.
	Discussion with Dr. R.T. Lovell on fish feeds.
	Visit to the new Fisheries Building with Dr. H.S. Swingle.
August 8	Departed Auburn with Dr. H.S. Swingle for Dauphin Island, Alabama.
	Visited Alabama Department of Conservation Marine Resources Laboratory, Dauphin Island. Mr. Wayne E. Swingle and Mr. Hugh A. Swingle conducted tour. Observed cage culture of pompano and oyster culture.
August 9	In the company of Dr. H.S. Swingle and Mr. Wayne E. Swingle, visited new site of experimental pond fish culture to observe construction of ponds.
August 10	Departed Dauphin Island for Auburn University.
August 11	Presented seminar of fisheries research in Thailand.
August 14	Discussed fisheries research in Thailand with Dr. E. W. Shell.
	Discussed aquatic weeds and aquatic weed control with Dr. J.M. Lawrence.
	Discussed fish parasites and diseases with Dr. W.A. Rogers.
	Discussed fish taxonomy with Dr. W. Shelton
August 15	Departed Auburn University, Auburn, Alabama, for Stuttgart, Arkansas. Dr. Ray Allison and Mr. Catalino Dela Cruz accompanying me.

C. Program for Mr. Jose Cabrero (El Salvador)

May 1, 1973	Arrive on Auburn University campus.
May 2 - 4	Tour of fisheries research field facilities; small pond experimental area; large pond area; fish holding and counting shed; fish hatching field laboratory. Review of aquaculture projects being carried out in experimental ponds. Tour of Fisheries Building and various fisheries research laboratories.
May 7 - 9	Trip to Tifton, Georgia to observe raceway culture systems for commercial food-fish production. Also visit to Gold Kist Fish Processing Plant at Quitman, Ga.
May 10 - 11	Interviews with staff of Department of Fisheries and Allied Aquacultures to review research programs by major areas including fish taxonomy, fish parasites and diseases, fish technology, fish feeds and nutrition, aquaculture, large impoundments and rivers, sport fish management and water chemistry.
May 14 - 18	Visit to Alabama Marine Resources Laboratory at Dauphin Island to review progress on mariculture projects on oysters, shrimp and marine fish species. Travel to Marion, Alabama to observe National Fisheries Station with emphasis on program concerned with distribution of fish fingerlings to pond owners; hatchery management program. Tour of U.S. Southeastern Fishcultural Laboratories also located at Marion.
May 21 - 25	Trip to selected commercial fish farming areas of Mississippi and Arkansas to observe channel catfish culture operations; visit to the Federal Fish Farming Experimental Station at Stuttgart, Arkansas to review all station projects concerned with fishculture. Visit Southern Catfish Processors, Inc., a catfish processing plant in Dumas, Arkansas.
May 28 - 30	Final week on Auburn University campus and at field research facilities of our Department to observe graduate student's projects being carried out in the field; pond construction plans of water supply reservoir; discussions with graduate students regarding their academic and research programs. Review of International Fisheries Programs of the International Center for Aquaculture, Auburn University.
May 31	Depart Auburn for return to El Salvador.

D. Program for Mr. Manu Potaros and Mr. Chirdchan Amataykul (Thailand)

March 16 - 17, 1973	Observed raceway culture for trout and catfish at Tifton, Georgia and Goldkist Fish Processing Plant at Quitman, Georgia with Drs. Allison and Plumb.
March 19 - 20	Visited the Alabama Marine Resources Laboratory, Dauphin Island and the brackishwater experimental aquaculture facilities near Gulf Shores with Drs. Shell and Pamatmat.
March 27 - 30	Visited the experimental Fish Farming Station at Stuttgart, Arkansas with Dr. Pamatmat.
April 4 - 6	Visited the State Fish Hatchery at Fastaboga, Alabama. Visited trout production farms in Tennessee and National Trout Fisheries Station, Dale Hollow, Tennessee with Dr. Moss.

Appendix III.

Other Resources for Grant-Related Activities

A. State Appropriated Funds

Auburn University as a State-supported institution receives appropriated funds from the Alabama Legislature. The majority of funds coming from this source are for the general teaching function (General Funds) of the University; however, the University budget also contains a line item for the Agricultural Experiment Station. The Department and Center performs a dual function within the University. We teach formal courses as part of the regular curriculum offered by the University and we also function as part of the Agricultural Experiment Station System; consequently, we receive appropriated funds from both sources.

Funds provided for the teaching function of the Center were as follows:

Budget Category	Amount
Teaching Salaries	$ 36,480
Teaching Maintenance	11,568
Teaching Equipment	7,700
Equipment for New Building	95,583
TOTAL	$151,331

A total of $82,925 of State appropriated funds were received through the Auburn University Agricultural Experiment Station budget for research. Of this amount, $77,820 was required for salaries and $5,105 was spent for maintenance.

B. Sales Funds

The University allows us to sell products resulting from our research projects and we are allowed to utilize those sale funds for research. During the year we obtained $19,301 from the sale of food fish, fingerlings and fishing permits.

C. Federal Appropriated Funds

Auburn, as a Land-Grant University, receives Federal Appropriated Funds through the U.S. Department of Agriculture. Last year the Department and Center received $67,000 from this source. Of this amount, $40,560 was used for salaries and $26,440 was used for maintenance.

D. State Government Research Grants and Contracts

The following research grants and contracts were in effect during the year.

1. Alabama Commission of Conservation and Natural Resources

a. Alabama Department of Game and Fish--This agency provided $20,000 for research on fisheries management in public waters. They also provided a grant of $8,000 for the operation of the Alabama Cooperative Fisheries Unit.

b. Alabama Marine Resources Department--This agency provided $3,000 for a study of diseases associated with maricultural operations.

2. Cooperative Fish Parasite and Disease Project

The states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, South Carolina, Maryland and Tennessee jointly support this research and service project at $6,480 each, totaling $53,320 annually.

3. Missouri Department of Conservation

This project was initiated for the purpose of studying the normal histology of the channel catfish. The project is funded at a level of $6,500/year.

4. Tennessee Game Fish Commission

This grant for research on the diseases of channel catfish in aquaculture was for $5,000.

E. Federal Government Research Grants and Contracts

1. National Marine Fisheries Service (NOAA, U.S. Department of Commerce)

The research project on the culture of fry and fingerlings striped bass was continued in 1972. The grant is for $9,000 per year and must be matched on a 50/50 basis. The source of funds is the Anadromous Fish Act (PL. 88-304).

2. U.S. Bureau of Sport Fisheries and Wildlife

This agency provided $46,000 for the operation of the Alabama Cooperative Fishery Unit. The Unit is a cooperative project between the University, the Alabama Commission of Conservation and Natural Resources and the Bureau of Sport Fisheries and Wildlife.

3. U.S. Corps of Army Engineers

The project with the Corps was continued and expanded in 1972 to study biological weed control with herbivorous fishes. Included under this project is a $15,000 contract for preparation of environmental impact statements on three Reservoirs on the Chattahoochee River.

A project was initiated in 1972 to develop fish management plans for 13 Corps of Engineers Reservoirs in the Mobile District. The project was funded at $69,800 for the year.

4. U.S. Agency for International Development

U.S.A.I.D. funded seven contracts with the l during the year; AID/csd-2270, (Worldwide); AID/csd-2270, T.O.9 (Thailand); AID/csd-2270, T.O.4 (Brazil); AID/la-180 (Philippines); AID/la-684 (Panama); AID/la-688 (El Savlador) and AID/csd-2780. Other than AID/csd-2780 which is covered elsewhere in this report, only AID/csd-2270, (Worldwide), provided funds that contributed to the development of the Center. Funds from the other contracts were for specific overseas projects and because of their nature, relatively little of those funds could be used for development. It is estimated that $21,000 from AID/csd-2270 (Worldwide) was available for development of the Center.

F. Grants and Contracts with Private Enterprise

1. Alabama Power Company

This grant of $30,000 per year is for rese effects of steam generation plants upon aquatic environments in Alabama streams.

2. Container Corporation

A project to monitor the biological indicators of pollution in the Conecuh and Escambia Rivers, Alabama, was initiated in 1972. The project was funded at a level of $12,000.

3. Monsanto Company

This contract was for the purpose of studying the effect of a heated water effluent on the ecology of an embayment in Wheeler Reservoir, Alabama. A total of $12,000 was available for the research.