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

The International Center for Aquaculture ANNUAL REPORT FOR FY 1977

E. W. SHELL*

INTRODUCTION

THIS REPORT SUMMARIZES the activities of the International Center for Aquaculture during the fiscal year 1977 (July 1, 1976-June 30, 1977), particularly as related to support received from the U. S. Agency for International Development (AID) institutional grant AID/csd 2780. Highlights for the year included providing 94 man-months of long-term overseas service by center staff. Country projects were operational in the Philippines, Brazil, Indonesia, Nigeria, Jamaica, Colombia,

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A young fish farmer begins to see results of his efforts.

and El Salvador. Additionally, 20 special requests for international development assistance were serviced during the year. In total, 744 students (517 American and 227 foreign) were enrolled in 41 academic courses taught during the year. The second 5-month special Aquaculture Training Program for foreign biologists was also in progress.

Aquaculture is becoming increasingly important in developing countries as a means of providing larger quantities of the protein needed for adequate diets and as an increasing contribution to economic growth. It utilizes infertile lands and run-off waters, plus agricultural wastes and surpluses, to intensively grow crops of high quality proteins in the form of fish and other aquatic animals, thus increasing the ability of each country to supply the protein needed by its own people. Aquaculture permits local production of high quality protein where it is most needed, thus reducing the cost of transportation, processing, and refrigeration. It also provides additional income and employment for farmers. Local food production saves foreign money reserves otherwise lost because of importation costs.

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

The AID grant was awarded to Auburn University to strengthen its research, teaching, and extension capabilities and to improve service capabilities in aquaculture. As a consequence, more significant contributions can now be made by the University in assisting with aquaculture in developing countries. In addition, the grant can be used to develop methods and procedures for making the University's competence in aquaculture more readily available for those who need it. The initial grant for \$800,000 covered a 5-year period, 1970-75. A 2-year extension for the grant, along with revised objectives and a modified scale of operation, was approved covering the period 1976-78 with additional funds amounting to \$578,000. This report covers the second year of the 2-year extension period. A 6-month extension of the grant has been requested to facilitate transition to some other form of institutional support. A comprehensive report will be prepared at the conclusion of the grant relationship.

GRANT OBJECTIVES

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

1. To provide education and training opportunities in inland fisheries and aquaculture related to international development.
2. To continue to develop and improve the knowledge base of Auburn University, including the development of a capability in production economics as related to aquaculture.
3. To develop a more effective capability for advisory services and actively promote its utilization.
4. To continue to collect, analyze, publish, and disseminate information.
5. To develop a strong professional network of linkages between Auburn and LDC institutions, international development agencies, and U.S. institutions.

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

PERSONNEL OF THE PROJECT

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

Name	Position	Support months
Dr. E. W. Shell	Director	2.2
Dr. D. D. Moss	Assistant Director	0.5
Dr. R. T. Lovell	Professor	2.9
Dr. Ray Allison	Associate Professor	0.7
Dr. C. E. Boyd	Associate Professor	2.4
Dr. E. W. McCoy	Associate Professor	9.0
Dr. M. M. Pammatat	Associate Professor	8.7
Dr. H. R. Schmittou	Associate Professor	12.0
Dr. R. O. Smitherman	Associate Professor	8.0
J. R. Snow	Associate Professor	7.4
Dr. J. H. Grover	Assistant Professor	5.7
K. W. Crawford	Research Associate	9.8
Randell K. Goodman	Research Associate	4.9
Margarita L. Hopkins	Research Associate	12.0
David G. Hughes	Research Associate	3.0
Ellen W. Johnston	Research Associate	7.4
Christine B. Sherrer	Administrative Secretary	3.6
Evelyn C. Talley	Staff Secretary	3.8
Kathy D. Dowling	Secretary	2.6
Deborah A. Morgan	Secretary	4.8
Carl E. Anderson	Graduate Research Assistant*	2.5
Leslie L. Behrends	Graduate Research Assistant*	2.0
Mark J. Brooks	Graduate Research Assistant*	2.0
Robert L. Busch	Graduate Research Assistant*	2.5
Jesse A. Chappell	Graduate Research Assistant*	4.0
John A. Davis	Graduate Research Assistant*	3.8
David R. Dunsath	Graduate Research Assistant*	3.0
John W. Jensen	Graduate Research Assistant*	4.0
Paul C. Lauenstein	Graduate Research Assistant*	2.0
Chhorn Lim	Graduate Research Assistant*	2.0
Robert G. Nelson	Graduate Research Assistant*	2.0
Edwin H. Robinson	Graduate Research Assistant*	4.0
John W. Sowles	Graduate Research Assistant*	2.0
Craig S. Tucker	Graduate Research Assistant*	4.0

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

ACCOMPLISHMENTS

At the beginning of the grant extension, work plans were submitted for outputs in five general areas: education and



TOP: Pond construction and operation can be labor intensive. **BOTTOM:** Management of natural stocks can help increase yield for open waters.



Group of foreign biologists at time of graduation from the second Aquaculture Training Program.

training, extended knowledge base, advisory capacity, information capacity, and linkages and networks. The accomplishments in each of these areas will be discussed in reference to the work plans as submitted.

Education and Training

Four activities were programmed in this category: develop new courses, provide practical training, develop special visitor training, and support graduate training. New courses to be developed were in fish seed production, economics of aquaculture, and fish genetics and breeding. These courses have been developed and will become part of the curriculum in the 1977-78 academic year. New courses include Hatchery Management of Food Fish (5 credits, summer quarter), Fish Breeding (3 credits, fall quarter), Economics of Aquaculture (5 credits, winter quarter), and Aquaculture Extension (5 credits, spring quarter).

A special 5-month Aquaculture Training Program for biologists from the international community, divided into two 2 1/2-month sessions, was offered March-August 1976 and is being repeated in 1977. There are 11 trainees enrolled in the second session of this program — 3 from India, 2 from the Philippines, and 1 each from Ghana, Nigeria, Jamaica, Dominican Republic, Syria, and Sierra Leone.

During the report period, 91 visitors from 19 foreign countries were received at the center, 80 percent more than in the previous year. The names and addresses of these visitors are listed in Appendix A. Many of these visitors were provided with special tours of the ponds, laboratories, and other facilities. Meetings with appropriate University administrators or scientific staff were arranged according to the interest and intent of the visitors and, in selected cases, additional tours to fish farms or other facilities around the country were arranged. In addition, a Fulbright exchange scientist, Thomas T. George from the Sudan, spent most of the summer quarter in residence

with the Department. More visitors were received during fiscal year 1977 than in any previous year since the International Center was established, as shown below:

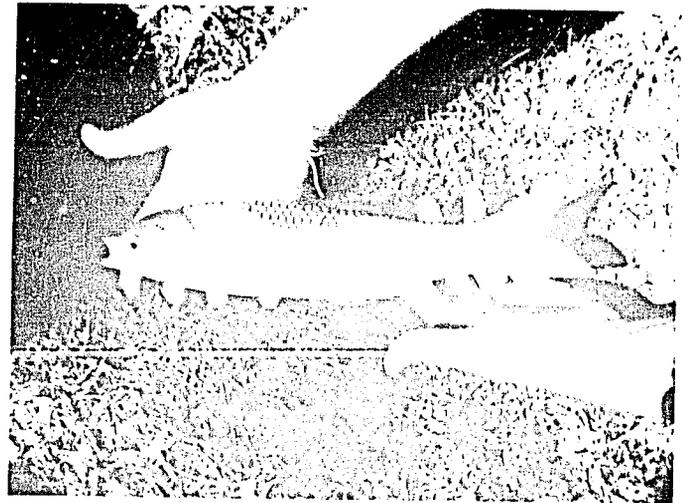
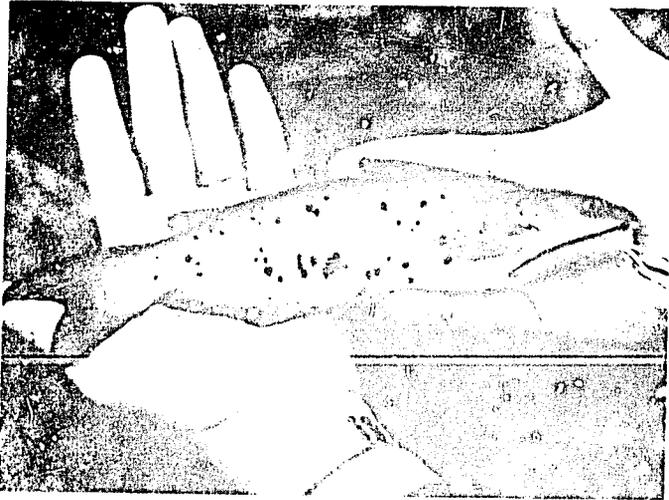
Year	Number of visitors
1970-71 (FY 1971)	1
1971-72 (FY 1972)	41
1972-73 (FY 1973)	30
1973-74 (FY 1974)	58
1974-75 (FY 1975)	58
1975-76 (FY 1976)	51
1976-77 (FY 1977)	91

*Records not kept for fiscal year 1971.

Fourteen graduate students with an interest in international development were provided some financial support from grant funds during the year. Graduate student enrollment during the year in fisheries academic courses averaged 85, of which 25 were foreign students. This is the largest number of graduate students the Department has ever enrolled and is up 16 percent from the previous year. Much of the increase in enrollment can be attributed to interest in the international program. Fifty-two of the graduate students (22 foreign) had major professors and advisors who received some grant support. Graduate student enrollment in FY 1977 is listed below by school quarter:

Quarter	U.S.	Foreign	Total
Summer	66	19	75
Fall	64	23	87
Winter	62	26	88
Spring	60	30	90

The foreign students represented 35 different countries: Philippines (8), Colombia (6), Thailand (6), Taiwan (5), Malaysia (3), Nepal (2), Kuwait (2), Cambodia (1), Panama (1),



LEFT: Rio Grande strain of channel catfish used in fish breeding and genetics studies. RIGHT: Grass carp produced at Auburn for use in pond weed control.

El Salvador (1), Honduras (1), Dominican Republic (1), Jamaica (1), India (1), and Belgium (1). Of these, 20 were sponsored by USAID missions, 9 by their home governments, 5 by personal resources, 4 by International Development Research Centre (Canada), and 2 by FAO. The subject matter specialities for the foreign graduate students were in five fields: fish feeding and nutrition (9), fish diseases and health (8), aquaculture (13), ecology and fish biology (6), and aquacultural economics (4).

Twenty-three graduate degrees were awarded during the year, 5 Ph.D. (3 to foreign students) and 18 M.S. (5 to foreign students). Seven of the 8 foreign degree recipients have returned to foreign countries and employment in the fisheries sector. The eighth married an American before coming to Auburn and is now working for a university in the United States. Of the 15 American graduates, 5 are teaching at the college level, 5 are working for private firms, 4 are employed by government, and 1 is pursuing a Ph.D. degree.

Extend Knowledge Base

The outputs targeted in this activity include continuation of ongoing research and preparation of state-of-the-art reports on the subjects of aquaculture, aquacultural economics, minimum input aquaculture, and knowledge transfer technology. The extent and nature of ongoing research is illustrated by the list of graduate student research topics given in Appendix B. A list of staff research publications during the year is presented in Appendix C. Additional manuscripts in press include reports on pond polyculture production, algae management with copper herbicides, energy flows in benthic organisms, and fish nutrition. During the year a new experimental fish hatchery building and two water storage ponds were added to the Experiment Station field facilities. These new facilities were constructed with University funds and reflect the continuing support provided by the University for the Center.

A state-of-the-art report giving examples of aquaculture in different countries, input levels, and technology transfer has been drafted. The report is now being discussed and improved before publication. Another manuscript, *The State-of-the-Art of Aquacultural Economics — 1977*, has been completed. This is supported with an annotated bibliography on aquaculture economics, an open-ended computer-format bibliography, that is a comprehensive search of the literature on this topic. The finalization of these reports will complete the state-of-the-art review activity planned at this time.

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

Name	Research interests	No. of research projects	No. of publications ¹
Dr. E. W. Shell	aquaculture	1	0
Dr. D. D. Moss	aquaculture	0	0
Dr. R. T. Lovell	fish nutrition and fish processing and technology	2	13
Dr. Ray Allison	aquaculture	2	0
Dr. C. E. Boyd	water quality and ecology	6	8
Dr. E. W. McCoy	aquaculture economics	3	2
Dr. M. M. Pamatmat	pond ecology	3	2
Dr. H. R. Schmittou	aquaculture	0	0
Dr. R. O. Smitherman	aquaculture	8	4
J. R. Snow	aquaculture and fish reproduction	4	6
Dr. J. H. Grover	aquaculture international training and development	0	3
K. W. Crawford	aquaculture economics	3	3
Randall K. Goodman	hatchery management	0	0
Margarita L. Hopkins	aquaculture economics	2	2
David Hughes	aquaculture	1	0
Ellen W. Johnston	algal taxonomy and ecology	3	0
Carl E. Anderson	tilapia production aquaculture (with Smitherman)	1	0
Leslie L. Behrends	polyculture and water quality (with Smitherman)	1	1
Mark J. Brooks	aquaculture (with Smitherman)	4	0
Robert L. Busch	induced spawning of fish (with Shelton)	1	0
Jesse Chappell	quantitative inheritance in fish (with Smitherman)	5	0
John Davis	elemental composition of fish (with Boyd)	1	0
David Dunseth	polyculture of fish (with Smitherman)	1	1
John Jensen	pond economics (with McCoy)	1	0
Paul C. Lauenstein	aquaculture (with Smitherman)	1	0
Chhorn Lim	nutrient requirements of fish (with Lovell)	1	1
Robert Nelson	pond culture of fish (with Dendy)	1	1
Edwin H. Robinson	nutrient requirements of cultured fish (with Lovell)	1	0
John Sowles	water quality (with Boyd)	1	1
Craig Tucker	prevention of oxygen depletion following plankton die-offs (with Boyd)	2	1

¹Titles of publications given in appendix, credit given to each joint author; includes thesis or dissertations that were completed.



Tropical tilapia raised in ponds at Auburn.

Advisory Capacity

This activity was to provide functional training to Center staff, develop a list of talent for work in aquaculture with international development, and to provide pre-departure orientation for Auburn staff being sent overseas. In July 1976, Dr. John Grover was sent as observer to the AID Program Review at the University of Rhode Island International Center for Marine Resources Development. Dr. Donovan D. Moss attended a special conference sponsored by the Southern Regional Conference on Training of International Students in Agriculture in Lexington, Kentucky, May 11-13, 1977. A list of potential consultants and overseas workers for aquaculture has been developed from an inquiry letter that was circulated the previous year. The Center is frequently asked to suggest people who might help with various overseas project activities. A 1-day seminar was held in January 1977 to provide an exchange of information between staff that had returned from overseas assignments and staff scheduled for overseas assignment. A total of 8.2 man-months predeparture orientation was held for staff members. Center staff also provided 22.7 man-months of coordination services for the seven overseas projects operational during the year.

Information Capacity

This activity was for publishing useful results of grant activities during the year. Three new titles were added to the Center's Research and Development Series during the report period:

Marketing As a Factor in Fishculture Development in El Salvador (Parkman and McCoy) 8 pp.

Fish Marketing in El Salvador (Parkman and McCoy) 19 pp.

Marketing of Fisheries Products by Municipal Fishermen in Panguil Bay, Philippines (Hopkins and McCoy) 11 pp. Two additional titles are in press.

Progress Report on Fisheries Development in El Salvador (August 1974-May 1976).

Progress Report on Fisheries Development in Northeast Brazil (July 1975-December 1976).

Linkages and Networks

Little new in the way of linkages developed during the report year. The Center continues to play an active role with a variety of international groups. For example, Dr. R. T. Lovell has been working for the U.S. Feed Grains Council in Poland reviewing fish nutritional work with the hope of finding outlets for American grain. The campus academic program continues to accept foreign students sponsored by a variety of international agencies and governments as indicated earlier in the report. Center staff participate on project development or consulting teams with people from a variety of institutions.

IMPACT OF GRANT-SUPPORTED ACTIVITIES IN ACHIEVING GRANT PURPOSES

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



Center staff provide technical advice about design for hatchery system.

Grant funds were utilized during the year to purchase 150.7 man-months of personnel services. These services contributed significantly to the capability of the Center in the areas of education and training, extending the knowledge base, advisory capacity, information capacity, and linkages and networks. Funds were also used to increase library holdings, to support the activities of the Center staff, and to provide materials, supplies, and minor items of equipment utilized in graduate training. Approximately 140 new titles or periodical subscriptions were purchased for the library during the year.

The major contribution of the grant was to provide for the purchase of approximately 525 man-months of senior-level (assistant professor and above) staff time. These personnel are key elements in the strengthening of the International Center. They are primarily responsible for the training, extension of the knowledge base, advisory services, and other activities necessary for a viable program.

Virtually all of the grant-funded staff participated in the expansion of the knowledge base through research and development. Results of their activities were published as research papers in recognized scientific journals, as chapters in monographs or books, as parts of symposia, and as reports prepared for various USAID Missions and International Development Agencies (see Appendix C).

Man-months of personnel services purchased with grant funds since the beginning of the project are given in the following table:

Year	Category of personnel			
	Academic and research	Technical and secretarial	Graduate research assistants	Field and student labor
1970-71 (FY 1971)	47.8	12.0	15.2	17.6
1971-72 (FY 1972)	38.0	22.3	25.6	74.9
1972-73 (FY 1973)	45.2	16.1	16.3	65.6
1973-74 (FY 1974)	48.4	29.0	22.4	47.9
1974-75 (FY 1975)	44.2	30.6	19.5	26.8
1975-76 (FY 1976)	93.6	21.8	40.8	113.8
1976-77 (FY 1977)	96.6	14.8	39.3	23.8

Research conducted by foreign students represents one of the significant ways in which grant-funded activity aids in the expansion of the knowledge base. Not only did the students contribute new information to various fields of aquaculture and inland fisheries, but they also learned something of the use of the scientific method for solving practical problems. A total of eight foreign students received graduate degrees during the year. Each student was required to submit a thesis or dissertation based on original research. Although foreign students were not supported directly on grant funds, all of the students utilized equipment and supplies, benefited from the availability of field labor, or received guidance and assistance from staff which was provided with grant funds. Names, country of origin, and title of thesis or dissertation for each foreign student are

Name	Thesis or dissertation title
Cabrero, Jose Eduardo, Jr. (El Salvador)	Production of Channel Catfish, <i>Ictalurus punctatus</i> (Rafinesque), in a Closed System with Circulation, Aeration, and Filtration (Ph.D. — Allison)
Cuenca, Michael (Philippines)	Application of Lime in Ponds, Its Penetration in Muds, and Effect on Water Hardness (M.S. — Boyd)
Lim, Chhorn (Cambodia)	Dietary Ascorbic Acid (vitamin C) Requirements of Channel Catfish in Ponds and in a Controlled Environment (Ph.D. — Lovell)
Liu, Chi-Yuan (Taiwan)	Aspects of Reproduction and Progeny Testing in <i>Sarotherodon aureus</i> (Steindachner) (M.S. — Shelton)
Manandhar, Hridaya (Nepal)	Digestibility of Phytoplankton by Silver Carp (<i>Hypophthalmichthys molitrix</i>) and Three Tilapias (<i>Sarotherodon</i> spp.) in Polyculture with Channel Catfish (<i>Ictalurus punctatus</i>) (M.S. — Smitherman)
Pretto, Richard (Panama)	Polyculture Systems with Channel Catfish as the Principal Species (Ph.D. — Smitherman)
Shrestha, Sundar (Nepal)	The Parasites of Different Strains and Species of Catfishes (<i>Ictalurus</i> sp.) (M.S. — Rogers)
Sun, Peter Lin (Taiwan)	Effects of Increasing or Decreasing the Protein Percentage in Isocaloric Rations for Pond-raised Catfish during the Summer Growing Period (M.S. — Lovell)

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

Grant-funded staff taught 13 courses during the year. The University paid most of the costs for teaching the courses, but the use of grant funds resulted in more specialists in different disciplines being available for teaching these courses. Nine courses per 12-month academic year would be approximately a full-time teaching load for one professor if he were supported entirely by university teaching funds. Obviously, a single individual could not adequately teach the wide variety of courses offered in the Department.

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

Year	Number
1970-71 (FY 1971)	6
1971-72 (FY 1972)	6
1972-73 (FY 1973)	12
1973-74 (FY 1974)	13
1974-75 (FY 1975)	37 ¹
1975-76 (FY 1976)	35
1976-77 (FY 1977)	50

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

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

Quarter	No. of courses	Number of students enrolled ¹	
		American	Foreign
Summer 1976	8	109	37
Fall 1976	12	164	73
Winter 1977	11	147	61
Spring 1977	10	97	56
TOTAL	41	517	227

¹Students normally take more than one course each quarter. The total number of students enrolled increased approximately 13 percent over the previous year. Foreign student enrollment increased 49 percent.

The average number of graduate students enrolled during the year was 85, up 16 percent over the previous year. A summary of graduate enrollment during the past 6 years follows:

Year	Number of graduate students enrolled in each quarter			
	Summer	Fall	Winter	Spring
1970-71 (FY 1971)	24	23	31	28
1971-72 (FY 1972)	29	34	43	46
1972-73 (FY 1973)	43	48	50	51
1973-74 (FY 1974)	48	57	54	53
1974-75 (FY 1975)	50	57	65	69
1975-76 (FY 1976)	60	73	79	79
1976-77 (FY 1977)	75	87	88	90

Foreign graduate student enrollment has been relatively stable for the past 5 years, as shown by the following:

Year	Number of foreign graduate students enrolled in each quarter			
	Summer	Fall	Winter	Spring
1970-71 (FY 1971)	7	5	5	7
1971-72 (FY 1972)	5	5	13	15
1972-73 (FY 1973)	16	16	19	22
1973-74 (FY 1974)	22	27	26	26
1974-75 (FY 1975)	24	22	19	21
1975-76 (FY 1976)	20	20	22	22
1976-77 (FY 1977)	19	23	26	30

A total of 23 advance degrees was awarded during the year (18 M.S. and 5 Ph.D.). Eight of these were awarded to foreign students. Information on the total number of advance degrees awarded and the number awarded to foreign students is presented below:

Year	Graduates	
	M.S.	Ph.D.
1970-71 (FY 1971)	4 (0)	4 (2)
1971-72 (FY 1972)	10 (4)	4 (1)
1972-73 (FY 1973)	18 (8)	4 (0)
1973-74 (FY 1974)	20 (9)	5 (3)
1974-75 (FY 1975)	24 (12)	3 (2)
1975-76 (FY 1976)	17 (7)	3 (1)
1976-77 (FY 1977)	18 (5)	5 (3)
TOTAL	111 (45)	28 (12)

¹Number of foreign student graduates indicated in parentheses.

OTHER RESOURCES FOR GRANT-RELATED ACTIVITIES

All funds received by the Department and International Center strengthen and support the Center. Information on the

various sources of funds received by the Center is presented in the following table:

Source of funds	Amount
State of Alabama appropriated funds	
For teaching	\$ 183,622.00
For research	185,678.00
Sales funds	
From sale of food fish and fingerlings	45,000.00
Federal appropriated funds for research	
USDA — Land-Grant College funds	107,731.00
Research grants from other state governments	128,000.00
Research grants from Federal agencies	61,150.00
Research grants from private enterprise	70,000.00
Sub-total	781,181.00
All USAID support — grant and country projects	570,204.00
TOTAL	\$1,351,385.00

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

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

UTILIZATION OF INSTITUTIONAL RESPONSE CAPABILITIES IN DEVELOPMENT

Much information about service activities by the International Center for Aquaculture has already been presented. A total of 20 requests for assistance was responded to during the year. Additional requests, mostly from private industry wishing to acquire staff services on a personal services contract (consulting) basis, were received, but this type of arrangement is generally discouraged by the Center.

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

Category	Man-months
Activities by grant staff utilizing 211 (d) funds	0.9
Activities by other staff utilizing 211 (d) funds	0.1
Activities by grant staff utilizing other funds	4.7
Activities by other staff utilizing other funds	2.7
TOTAL	8.4

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

Professor	Activity and dates
Grant staff utilizing 211 (d) funds	
David Hughes	Attended conference in Costa Rica and visited Honduras relative to project development, January 7-14, 1977.
H. R. Schmittou	Participated in conference in Costa Rica, January 9-15, 1977.
R. T. Lovell	Visited research laboratories in Italy and Israel, March 28-April 3, 1977.
Other staff utilizing 211 (d) funds	
C. C. Carroll	Visited Honduras to confer with officials of the government regarding fisheries development, January 4-6, 1977.

Grant staff utilizing other funds

- F. W. Shell Visited Brazil to provide consulting services and explore regionalization of project, September 27-October 4, 1976.
- J. R. Snow Visited Philippines to assist in design of fish hatchery, August 3-31, 1976.
Advised in Honduras, relative to hatchery plans, June 27-July 2, 1977.
- R. O. Smitherman Visited Greece and FAO, Rome, in response to request about fish culture development, September 2-16, 1976.
- Mario Pamatmat Presented a paper in Scotland, September 14-24, 1976.
- H. R. Schmittou Assisted with fisheries assessment team in Sierra Leone, September 21-October 2, 1976.
Advised relative to aquaculture extension efforts in Philippines, October 5-21, 1976.
Participated in project review of Oceanic Foundation in Hawaii, February 28-March 5, 1977.
- John Grover Assisted AID fisheries sector review in Egypt, November 14-December 17, 1976.
- R. T. Lovell Helped develop fish ratios and research programs in Poland for U.S. Feed Grains Council, April 4-10, 1977.
- F. W. McCoy Conducted aquaculture economics training in the Philippines for USAID, April 12-23, 1977.

Other staff utilizing other funds

- W. D. Davies Reviewed for USAID the lake fisheries in Zaire and Burundi, October 13-28, 1976.
Advised fisheries program in Colombia, March 25-April 6, 1977.
- K. N. Randolph Visited Jamaica relative to project development, October 18-November 13, 1976.
- Ronald Phelps Visited Colombia relative to project design, October 19-November 9, 1976.
- F. T. Lowshin Invited consultations about tilapia culture in El Salvador and conference in Costa Rica, January 5-15, 1977.
Provided advisory assistance to USAID in Paraguay, June 12-17, 1977.



Filipino doing research on hatchery design to improve fish survival.

In addition to the international service activities discussed above, the Center has provided 94 man-months of technical assistance to seven international development projects overseas. Twelve different Center staff were assigned to these projects full time. In addition, 15.1 man-months of technical coordination and support plus 7.6 man-months of secretarial support services were provided by the Center on campus. Funds for these came from the individual projects and were utilized in the support of five different staff members. These projects were: (1) USAID-supported aquaculture development project in Northeast Brazil (AID/ia BOA 1152 T. O. 2), (2) USAID-supported aquaculture production project in freshwater, brackishwater, and extension fisheries work in the Philippines (AID/ea 180 ICA), (3) freshwater aquaculture development project in Mid-Western State, Nigeria, supported by the Nigerian Government, (4) brackishwater intensification project in Indonesia sponsored by USAID (AID/ASIA-C-1177), (5) USAID-sponsored pond development project in Jamaica (AID/ia-C-1166), (6) USAID-sponsored aquaculture and fisheries development project in Colombia (AID/ia-C-1176), and (7) government-sponsored aquaculture project in Honduras.

Man-months of overseas activities by grant-funded staff since its inception are given in the following table:

Year	Man-months
1970-71 (FY 1971)	9.8
1971-72 (FY 1972)	8.0
1972-73 (FY 1973)	3.0
1973-74 (FY 1974)	4.5
1974-75 (FY 1975)	7.7
1975-76 (FY 1976)	9.3
1976-77 (FY 1977)	5.6

NEXT YEAR'S PLAN

The Center is fast approaching the state of development intended with the purpose of the AID grant. It should be clear that Auburn University has a strong commitment and sizable program for participation in international aquacultural development. In spite of this commitment by the University, it is also clear that the Center needs substantial core support from outside sources if the program is to sustain its workload.

It is expected that the current grant will be extended for a few months until new contractual arrangements can be developed between AID and the University. Activities called for under the present work plans will be continued in the meantime.

Title XII programs are a possible means to obtain core operating support for the Center. The Center plans to submit proposals and work with the Title XII programs as they develop. A special university services contract has also been proposed between AID and the Center. Both of these approaches have good potential, but neither appears far enough along administratively to become effective in time to meet the Center's immediate support needs. For this purpose a continuation of the current grant has been requested until such time as other arrangements are in force. Meanwhile, it is expected that overseas service, international training, and relevant research activities will continue with the same dynamic interest as in the past.

INVOLVEMENT OF MINORITY PERSONNEL AND WOMEN

The budgeted academic and non-academic personnel receiving support under the grant during the report year are classified below according to race and sex:

	<i>Men</i>	<i>Women</i>
Blacks.....	0	3
Spanish American.....	0	0
American Indians.....	0	0
American Orientals.....	2	1
Other.....	29	3
TOTAL.....	31	7

Student employment was provided to three foreign nationals, two female orientals and one oriental male, which enabled them to continue their studies. A special seminar was presented to three black male students from Alabama A&M University, who were employed by the School of Agriculture during the summer, to make them aware of available opportunities in graduate education in aquaculture.

Auburn University has an "affirmative action program" for the involvement of minority personnel and women and for recruiting students for training. The provisions of the program are followed closely by the Center in recruiting staff and in recruiting students for graduate training.

There are excellent opportunities for involving minority personnel and women in international development work and for significant contributions to Center activities. Unfortunately, few of either group are interested in careers in fisheries and aquaculture and even fewer are interested in international service in these areas of work.

APPENDIX A

Visitors Seeking Information on International Development

<i>Name</i>	<i>Date</i>
Dr. Jean Nyan Ngatchou, Director Research Institute of Agriculture and Forestry Research ONAREST Yaounde, Cameroon	July 2, 1976
Ms. Patricia T. Arroyo Assistant Professor Department of Fisheries and Technology College of Fisheries University of the Philippines Diliman, Quezon City Philippines 3004	July 8, 1976
President and Mrs. Amado C. Campos Central Luzon State University Munoz, N. E. 2320 Philippines	July 8, 1976
Mr. James Kapetsky Apartado AEREO 2458 Cartagena Bolivar Colombia	July 8-9, 1976
Chief Justice T. Mabandla Chief of the Bhele Tribe Cape Province, South Africa	July 12, 1976
Mr. George Crowell Department of State Washington, D.C.	July 12, 1976
Mr. J. Weihl Mr. I. Tzhak Mr. J. Levi Israeli Farmers Israel	July 14, 1976
Mr. E. Heckman Mr. M. Harvey Mr. Patterson Sudan Consultants Khartoum, Sudan	July 14, 1976
Mr. K. Sheets Mr. G. Weishbart Colorado Fish Farmers Colorado	July 14, 1976
Mr. John Hartzog Henry County, Alabama	August 10, 1976
Dr. Tapan Benergee Program Director (Fisheries) U.S. Peace Corps c/o U.S. Embassy Manila, Philippines	August 23-25, 1976
Mr. Emmitt Parrish P.O. Box 1155 Pensacola, Florida	August 27, 1976
Mr. C. E. White Mr. William Reeves Mr. Gerald Hooper Game and Fish Division Alabama Department of Conservation and Natural Resources 64 N. Union Street Montgomery, Alabama	September, 1976
Mr. Kermit Sneed Thompson Anderson Enterprises Thornton, Mississippi	September 1, 1976
Mr. Tirso Jamandre Fish Farmer and FAO Consultant Iloilo City, Philippines	September 1, 1976
Mr. Varadi Lazlo 5541 Szarvas Fish Culture Research Institute P.f. 47 Hungary	September 2-14, 1976
Mr. John Hester Mr. Bruce Bell U.S. Fish and Wildlife Service Box 836 Decatur, Alabama	September 9, 1976
Mr. Ken Corson Methodist Mission Casilla 356 La Paz, Bolivia, S.A.	September 23, 1976
Legislative Aides, U.S. House of Representatives Mrs. Thomas S. Joley, Chairman — Agriculture Mr. Yourman Ms. Ermann Mr. T. Adams Dr. Jim Halpin	September 27-28, 1976
Dr. Ralph Jones, Jr. Southern Union State Junior College 1414 Davis Drive Roanoke, Alabama	October 4, 1976
Mr. George Holmes Honalde 404 Maxwell Hall Syracuse University Syracuse, New York	October 5-6, 1976
Mr. Earl B. Terwillinger Chief, Production Programs Branch International Training Foreign Development Division U.S. Department of Agriculture Washington, D.C.	October 7-8, 1976
Hon. John Breaux (D-LA) U.S. House of Representatives Washington, D.C.	October 8, 1976

Mr. James Williams Caribe King Shrimp Co. Box 432 Cabo Rojo, Puerto Rico	October 11-12, 1976	Mr. Alfonse Catchy Director of Fisheries Central African Empire Africa	March 25-27, 1977
Mr. and Mrs. Michael Sipe Natural Systems Rt. 1, Box 363 Palmetta, Florida	October 12, 1976	Mr. Bob Thoesen U.S. Fish and Wildlife Service Atlanta, Georgia	April 4, 1977
Mr. Abd Al-Rahman Selin Political International Affairs Writer for Saudi Daily Box 4676 Jidda Kingdom of Saudi Arabia	October 13, 1976	Mr. Bruce G. Barelay, Jr., M.P. U.S. Fish and Wildlife Service Atlanta, Georgia	April 4, 1977
Dr. Q. F. Miravite Aquaculture Department Southeast Asian Fisheries Development Center Igbayan, Iloilo, Philippines	October 15, 1976	Mr. Emil R. Knutti U.S. Peace Corps Regional Representative Atlanta, Georgia	April 20, 1977
Ing. Joaquin Guevara Moran General Director of Natural Resources Ministry of Agriculture El Salvador	October 19-20, 1976	Mr. L. C. Berth Research Specialist L. D. Schreiber Cheese Co., Inc. 1601 Main Street P. O. Box 610 Green Bay, Wisconsin	April 20, 1977
Dr. Fay Hunter Southern University Baton Rouge, Louisiana	October 21-22, 1976	Dr. Jim Jones Director of Mississippi- Alabama Sea Grant Consortium Gulf Coast Research Laboratory Ocean Springs, Mississippi	April 25, 1977
Mr. Bill Myers Action-Recruitment Resources Room P-302 1735 I. Street, N.W. Washington, D.C.	October 29, 1976	Mr. Sherman Reed Mr. Mitch Olszewski Engineering Technical Division Oak Ridge National Laboratory Oak Ridge, Tennessee	April 27, 1977
Ms. Sophia I. Basa Senior Forestry Biologist Department of Natural Resources Bureau of Fisheries and Aquatic Resources P.O. Box 623 Manila, Philippines	November 3- December 17, 1976	Mr. Sam Suffern Mr. Jack Griffith Environmental Science Division Oak Ridge National Laboratory Oak Ridge, Tennessee	April 27, 1977
Mr. Geoffrey Parker Route No. 2 Milton, Wisconsin	January 6, 1977	Dr. Vasile Jurwbesco Ministry of Agriculture and Food Industry Technical Direction Buchark, Romania	April 28-29, 1977
Mr. Doug Jones USAID/Washington Office of Agriculture, (TAB) Washington, D.C.	January 24, 1977	Prof. Ivan B. Tokin Institute of Marine Biology Academic of Sciences of USSR Deline Zelentzy, 184531 Murmanskaya obl, USSR	April 28-29, 1977
Mr. Milton Bedard Apartado 7-2740 San Jose, Costa Rica	January 24-25, 1977	Ms. Valarie Anderson Gillen NOAA, Office of Public Affairs 6010 Executive Blvd. Rockville, Maryland	May 2, 1977
Mr. Paul Bedard 864 Chattahoochee Drive C.P.O. Box 10547 Gainesville, Georgia	January 24-28, 1977	Mr. Mustafa Bezikoglu Dr. Fethullah Koc. Mr. Kamal Oruc Mr. Orpah Ozbaysal Mr. Necmettia Alpturk Dr. Adnan Oaturk Turkish Government Fisheries Personnel	May 9, 1977
Mr. Dan Thomaston Mr. Dan Self Mr. Frank Ellis Department of Natural Resources Georgia	February 1, 1977	Mr. D. Kloen Otto van Gehreweg 35 Wageningen Holland	May 27, 1977
Dr. Donald F. Amend, Director of Research Tavolek, Inc 2779-152 Avenue N.E. Redmond, Washington	February 4, 1977	Mr. Rick Goodier Rt. 2, Box 3P Richmond, Texas	June 4, 1977
Dr. Ward Falkner Mr. Jack Mathias Mr. Burton Ayles Freshwater Institute Department of Fisheries and Environment Winnipeg, Canada	February 11, 1977	Mr. Chris Nugent Mr. Jim Miller FAO Country Program Central African Empire Bangui, CAE	June 8-10, 1977
Mr. Fleming Mr. Rasmusn Mr. Arne Mr. Anderson Danish Farmer Group	February 16, 1977	Mr. Joseph P. Senft Mr. Andrew Merkowsky Mr. James Fritch Rodale Press Reservoirs Division 576 North Street Emmaus, Pennsylvania	June 20, 1977
Mr. Philip Irwin Voice of America United States Information Agency Washington, D.C.	March 24, 1977	Dr. Dale Toetz Southeast Water Laboratory EPA Athens, Georgia	June 28, 1977

APPENDIX B

Graduate Student Research Topics and Advisors

Almazan, Guadosa*	Relationship between Alkalinity, Phosphorus, and Algae Growth (Boyd)	Hopkins, Kevin	Sex Reversal of <i>Tilapia aurea</i> with Synthetic Estrogens (Shelton)
Alston, Dallas	Microinvertebrate Study of Three Experimental Channels to Determine the Effects of Thermal Enrichment on Fish Food Organisms (Dendy)	Inko-Tariah, McKenzie*	Production of <i>Tilapia aurea</i> in Polyculture Using Largemouth Bass and Monosex Male as Population Controls (Smitherman)
Anderson, Carl E.	Comparison of <i>Tilapia aurea</i> , <i>T. nilotica</i> , and hybrid (<i>T. nilotica</i> x <i>T. hornorum</i>) in Polyculture Systems (Smitherman)	Jensen, Gary	Sex Reversal of <i>Tilapia aurea</i> with Three Naturally Occurring Estrogens (Shelton)
Behrends, Leslie	Comparison of Water Quality in Polyculture Systems (Smitherman)	Jensen, John	Alternative Production Systems for Hill Pond Culture (McCoy)
Boonyaratpalin, Mali*	Energy Requirement of Channel Catfish (Lovell)	Jones, Walter	Observations on Biology of <i>Macrobrachium ohione</i> (Smitherman)
Boonyaratpalin, Sitdhi*	Pathogenesis and Control of Bass Tapeworm (Rogers)	King, Terry A.	Population Dynamics of Largemouth Bass in West Point Reservoir-Georgia-Alabama (Davies)
Bowman, James	Culture of Larval Fishes (Snow)	Kubaryk, John	Protein-energy Requirements of <i>Tilapia</i> (Lovell)
Bowser, Paul	Studies on Vertical Transmission of Channel Catfish Virus Disease (Plumb)	Landesman, Louis	<i>Tilapia</i> Culture in Combination with a Recirculating Hydroponic System (Smitherman)
Braid, Malcolm	Intensive Culture of Striped Bass Fry (Shell)	Lauenstein, Paul	Culture of <i>Tilapia</i> in Tanks with Supplemental Species (Allison)
Bright, David	Stream Ecology-Insects (Dendy)	Lawson, Curtis	Dynamics of the Largemouth Bass Population in Lee County Public Fishing Lake (Davies)
Brooks, Mark	Effects of Initial Weight on Final Weight in Genetically Distinct Populations of Channel Catfish (Smitherman)	Lee, Jen-Chyuan*	Production of Hybrid <i>Tilapia</i> (Smitherman)
Burtle, Gary	Diets for Golden Shiners (Lovell)	Li, Yen-Pin*	Vitamin D ₃ Requirements of Channel Catfish (Lovell)
Busch, Robert	Induced Spawning of Channel Catfish Using Clomiphene Citrate (Shelton)	Lichtkoppler, Frank	Comparison of 20-10-5 and 20-20-5 Fertilization in Sunfish Ponds (Boyd)
Cabrero, Jose*	Recirculation in Intensive Culture (Allison)	Lim, Chhorn*	Vitamin C Requirements of Channel Catfish (Lovell)
Campbell, Terry	Study of Primary Productivity in West Point Reservoir (Bayne)	Lim, Ricardo*	Common Carp Population in the West Point Reservoir (Shelton)
Canlas, Joel*	Bacterial and Parasitic Loads of Cultured Channel Catfish in Farm Ponds (Plumb)	Liu, Chi-Yuan*	Progeny Testing of Sex Reversed <i>Tilapia aurea</i> (Shelton)
Carreon, Jose*	Feed and Feeding of Striped Bass Fry (Shell)	Malvestuto, Stephen	Harvest of Largemouth Bass in a Newly Impounded Reservoir (Davies)
Chappell, Jesse	Heterosis in Pond-reared, Crossbred Strains of Channel Catfish (Smitherman)	Manandar, Hridaya*	Digestibility of Phytoplankton by Silver Carp and <i>Tilapia</i> in Channel Catfish Ponds (Smitherman)
Chitwood, Brian	Growth and Production of Largemouth Bass with Forage Species and in Combination with Bluegill and Redear (Davies)	McGinty, Andrew	Effects of Initial Weight on Final Weight in Catfish Breeding Systems (Smitherman)
Chuapohuk, Wiang*	Nutritional Contribution of Natural Pond Organisms to Channel Catfish Growth in Ponds (Lovell)	McGinty, Paul	Management of Aquatic Plants in Farm Ponds (Boyd)
Clay, Larry	Pathology Associated with Healing After Surgery of Fish (Plumb)	Mezainis, Valdis	The Metabolic Activity of a Pond Ecosystem under Intensive Catfish Cultivation (Pamatmat)
Cook, Stanley	Larval Fishes of Jones Bluff Reservoir (Davies)	Minton, Vernon	Effect of Dietary Protein and Energy Levels on Voluntary Food Consumption of Channel Catfish in Ponds (Lovell)
Cox, Kenneth	Dynamics of the Black Crappie Population in Lee County Public Fishing Lake (Davies)	Mitchell, Andrew	Susceptibility of Homogenetic and Heterogenetic Strains of Channel Catfish (<i>Ictalurus punctatus</i> to <i>Chondrocyclus columnaris</i>) (Plumb)
Cuenca, Michael*	Crayfish Culture with Channel Catfish (Dendy)	Mohead, Malcolm	Comparison of Three Trap-harvest Systems for Channel Catfish (Smitherman)
Cuevas, Hugo*	Special Problems in Larval Fish Culture (Snow)	Moon, Charles*	Phytoplankton Abundance in Three Farm Ponds (Boyd)
Davis, John	Phytoplankton Related Fish Kills (Boyd)	Moreira, Paulo*	Effects of Lead and Source of Energy and Carbohydrates on Growth and Body Composition of Channel Catfish (Lovell)
Dobbins, Daniel	Effects of Phosphorus and Potassium Fertilization on Sunfish Production (Boyd)	Neils, Kenneth	The Grazing Effects of Phytophagous Fish in Polyculture Ponds (Dendy)
Dunseth, David	Production of <i>Tilapia aurea</i> (Steindachner) in Combination with the Predator <i>Chichlasoma managuense</i> (Meeks) at Different Stocking Rates (Bayne)	Nelson, Robert	Crayfish Culture Related to Cover "Hides" (Dendy)
Dureza, Virgilio*	Use of Recirculation and Aeration in the Culture of Channel Catfish (Allison)	Newman, Michael	A Comparison of Second-year Growth and Catchability Between the Northern and Florida Subspecies of Largemouth Bass (Davies)
Dutta, Omeo*	Sex Identification of Cichlids and Chinese Carp by Cytological Techniques (Shelton)	Osborn, Maury	Intensive Culture of Channel Catfish in Earthen Ponds (Allison)
Felts, Shawn	Winter Management of Channel Catfish (Lovell)	Pestak, James	Larvae Fishes in the Alabama River (Ramsey)
Foote, Karen	Studies of Some of the Possible Effects of Overturns in Fish Ponds (Boyd)	Popma, Thomas	Digestibility of Nutrients in Natural and Artificial Foods by <i>Tilapia</i> (Lovell)
Fong, Sunchio*	Dynamics of Bass-bluegill Population in Farm Ponds (Davies)	Pradhan, Bhola*	Age, Growth, and Reproduction of the Bowfin in West Point Reservoir (Davies)
Grizzle, John	Histological and Ultrastructural Changes in Gills of Channel Catfish Treated with Malachite Green (Rogers)	Pretto, Richard*	Polyculture Systems with Channel Catfish, <i>Tilapia</i> , Buffalo Fish, and Israeli Carp (Smitherman)
Hardin, Scott	Electrophoretic Determination of Sex in <i>Tilapia aurea</i> (Smitherman)	Romaire, Robert	A Dissolved Oxygen Model for a Catfish Pond (Boyd)
Hemstreet, William	Studies of the Parasites of Year-class Largemouth Bass in West Point Reservoir (Rogers)	Saad, Cheroos*	Evaluation of Full-fat Roasted Soybeans in Catfish Diets (Lovell)

*Foreign students

- Santiago, Alfredo*
Santiago, Corazon* Diets for Brood Channel Catfish (Lovell)
Nutritional Factors of Commercial Fish Production (Lovell)
- Schachte, John Immunity in Channel Catfish to *Aeromonas hydrophila* and *Chondrocyccus columnaris* (Rogers)
- Scott, Alan Stress Related Disease Development in Waters of Different Quality (Rogers)
- Sconell, Darrell Economical Factors in Aquaculture (McCoy)
- Scully, Richard Catch and Effort Assessment of the Fishery Resources on the Upper Meta River System (Davies)
- Seesock, Wendy The Life History and Ecology of the Cold Water Darter (Ramsey)
- Shaffer, Karl Growth Reproduction of the Redear x Green Sunfish Hybrid in Farm Ponds (Davies)
- Shaw, Cynthia Dehydrogenase Activity of Various Anaerobic Metabolic Types of Bacteria in Sediments (Pamatmat)
- Sherriff, Timothy Effects of a Fall Drawdown on the Benthic Population of Lee County Lake (Pamatmat)
- Shrestha, Sunder* Parasitic Load on Different Strains of Catfishes and its Mode of Transmission from Brood to Offspring (Rogers)
- Steeby, James Effects of Aeration on Channel Catfish and Water Quality in a Large Pond (Lovell)
- Sowles, John Effects of Nitrogen Fertilization on Plankton Production in Fish Ponds (Boyd)
- Sullivan, Joseph Parasites of Basses of the Southeastern United States (Rogers)
- Sun, Peter* Effects of Increasing or Decreasing the Protein Percentage in Rations of Pond Raised Catfish During the Grow-out Period (Lovell)
- Tapp, Ronnie Size Selection of Largemouth Bass and Bluegill by Sport Fishermen (Davies)
- Tave, Douglas Production of Hybrid Blue x Channel Catfish (Smitherman)
- Tayamen, Melchor* Androgen and Estrogen Sex Reversal of *Tilapia nilotica* (Shelton)
- Taylor, Peter Amoeba Incidences, Pathogenicity, and Potential Control in Fishes (Rogers)
- Thune, Ronald Methods of Vaccinating Fish Against Bacterial Diseases (Plumb)
- Timmons, Thomas Year-class Mortality of the Largemouth Bass in West Point Reservoir (Shelton)
- Tsao, Yi-Te* Use of Catfish Processing Wastes in Pet Foods (Lovell)
- Tucker, Luther Early Food Habits of Striped Bass Larvae (Snow)
- Vandemaele, Katherine* Tilapia Culture in Tanks with Filtration (Allison)
- Vanhooose, Mark Behavioral Characteristics Between the Northern and Florida Subspecies of Largemouth Bass (Davies)
- Wallace, Richard Systematics of Pimelodid Catfishes (Ramsey)
- Walters, Gerald Influence of Environmental Stress on Susceptibility to Bacterial Infections in Fish (Plumb)
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- CRAWFORD, K. W. 1976. Economic Comparisons of Single Cropped and Multiple Cropped Catfish Production Systems. Auburn Univ. (Ala.) Agr. Exp. Sta. Highlights of Agricultural Research, Vol. 23, No. 3.
- CRAWFORD, K. W., R. O. SMITHERMAN, AND D. R. DUNSETH. 1977. Consumer Response to Market-size Tilapia and Silver Carp Grown in Combination with Channel Catfish. Proc. of Sixth Annual Meeting, Inland Commercial Fisheries Workshop. Little Rock, Ark.
- DOBBS, D. A. AND C. E. BOYD. 1976. Phosphorus and Potassium Fertilization of Sunfish Ponds. *Trans. Amer. Fish. Soc.* 105: 536-540.
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- GROVER, J. H., R. D. RECOMETA, AND V. A. DUREZA. 1976. Production and Growth of Milkfish, Common Carp, and Catfish in Fertilized Freshwater Ponds. *Kalikasan, Philipp. J. Biol.* 5: 193-206.
- HOPKINS, M. L. AND E. W. MCCOY. 1976. Methods to Evaluate Investments in Alternative Farm Enterprises. Auburn Univ. (Ala.) Agr. Exp. Sta. Highlights of Agricultural Research, Vol. 23, No. 4.
- LOVELL, R. T. 1976. Developing Marine Resources. *Debate Issues*, 9(3): 9.
- LOVELL, R. T. AND R. R. SHICKNEY. 1976. Nutrition and Feeding of Channel Catfish. *Sou. Coop. Ser. Bull.* 218. Accepted for publication, 1976.
- LOVELL, R. T. 1976. Nutritional Diseases in Warmwater Fishes. Midwest Fish Disease Workshop. June 1976, Carbondale, Ill. (In press.)
- LOVELL, R. T. 1976. Factors Affecting Food Consumption of Channel Catfish. Fish Nutrition Workshop V. November 1976, Portland, Ore. (In press.)
- LOVELL, R. T. 1976. Flavor Problems in Intensively Cultured Fish. Proc. of Tropical and Subtropical Fish Technology Conf. April 1976, pp. 45-47.
- LOVELL, R. T. 1976. Formulating Fish Feeds. *Commercial Fish Farmer* 2(2): 42.
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- LOVELL, R. T. 1976. Energy Requirements for Fish. *Commercial Fish Farmer* 2(4): 40.
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- MCCOY, E. W. AND M. L. HOPKINS. 1977. Establishing a Market for Exotic Fish Species. Auburn Univ. (Ala.) Agr. Exp. Sta. Highlights of Agricultural Research, Vol. 24, No. 1.
- MCCOY, E. W. AND J. L. BOUTWELL. 1977. Preparation of Financial Budgets for Fish Production. Auburn Univ. (Ala.) Agr. Exp. Sta. Cir. 232.
- NELSON, ROBERT. Experiments on the Reproduction and Survival of the Louisiana Red Swamp Crayfish, *Procambarus clarkii* (Girard) in Intensive Culture Conditions. M.S. thesis, Auburn Univ.
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APPENDIX C

Publications of Grant-supported Staff

- APOLINARIO, K. AND R. T. LOVELL. 1976. Yield and Quality of Mechanically Deboned Flesh from Farm-raised Channel Catfish, Tilapia, and Buffalo Fish. Proc. of Tropical and Subtropical Fish Technology Conf., April, 1976, pp. 41-44.
- BEHREND, LESLIE. Effects of Three Tilapias (*Sarotherodon* spp.) and Silver Carp (*Hypophthalmichthys molitrix*) on Phytoplankton Communities and Water Quality in Ponds with Channel Catfish (*Ictalurus punctatus*). M.S. thesis, Auburn Univ.
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- BOUTWELL, J. L. AND E. W. MCCOY. 1977. Simplified Programming as a Farm Management Tool. Auburn Univ. (Ala.) Agr. Exp. Sta. Cir. 232.
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- SNOW, J. R. 1977. Increasing the Yield of Channel Catfish by Periodic Division of the Stock. Proc. Ann. Conf. Southeast Game and Fish Comm. (In press.)
- SNOW, J. R. 1976. Recommendation for Development of a Freshwater Fish Hatchery Center in Central Luzon, Philippines. Dept. of Fisheries and Allied Aquacultures, Auburn Univ. (Ala.) Agr. Exp. Sta.
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- YAST, D. R., R. O. SMITHERMAN, AND O. L. GILLEN. 1976. Production of Hybrid (Blue x Channel) Catfish and Channel Catfish in Ponds. Proc. 29th Ann. Conf. Southeast Game and Fish Comm. 29: 82-86.