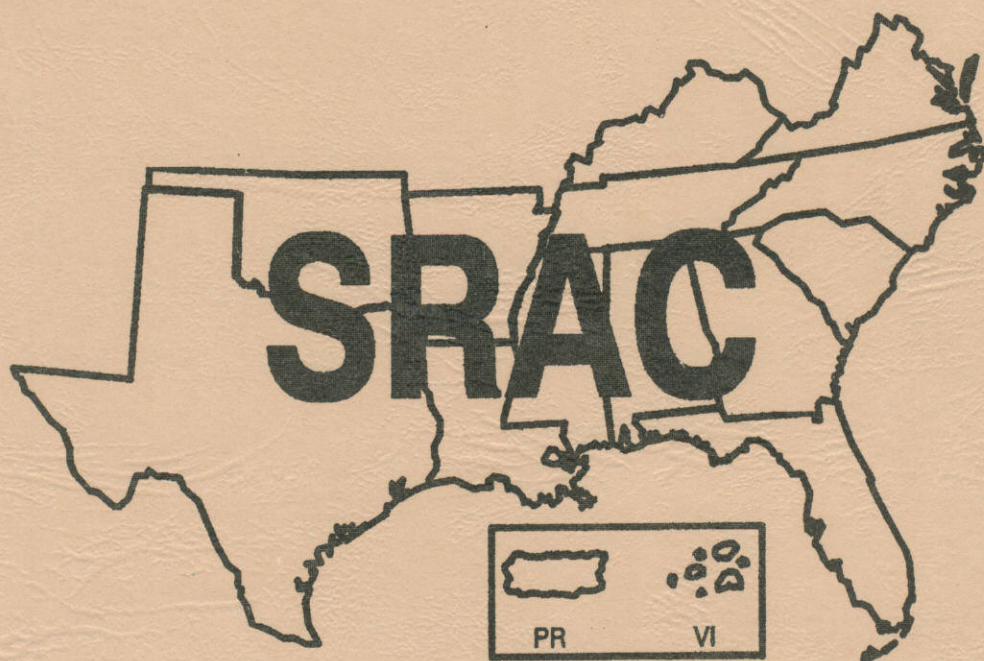


SOUTHERN REGIONAL AQUACULTURE CENTER



SECOND ANNUAL PROGRESS REPORT

JANUARY, 1990

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I. INTRODUCTION

Title XIV of the Agriculture and Food Act of 1980 and the Food Security Act of 1985 authorized establishment of aquacultural research, development, and demonstration centers in the United States (Subtitle L, Sec. 1475[d]) in association with colleges and universities, State Departments of Agriculture, federal facilities, and non-profit private research institutions.

The Regional Aquaculture Centers encourage cooperative and collaborative research and extension educational programs in aquaculture having regional or national application. Center programs complement and strengthen existing research and extension educational programs provided by the Department of Agriculture and other public institutions.

Objectives of the Centers are to promote aquaculture research, development, and demonstration for the enhancement of viable and profitable commercial aquaculture production in the United States for the benefit of producers, consumers, and the American economy; and to utilize the regional center in a national program of cooperative and collabor-

ative research, extension, and developmental activities among public and private institutions having demonstrated capabilities in support of commercial aquaculture in the United States.

The thirteen states and two territories represented by the Southern Regional Aquaculture Center (SRAC) are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, U.S. Virgin Islands, and Virginia.

The SRAC First Annual Progress Report (February, 1989) covered progress made from the inception of SRAC in 1987 through December, 1988, which included three projects. This Second Annual Progress Report includes accomplishments for the second year of the original projects plus accomplishments for the first year of projects initiated in 1989.

A detailed description of each project, including objectives and progress to date is included in the Project Progress Reports section of this report.

II. ORGANIZATIONAL STRUCTURE

Components of the Southern Regional Aquaculture Center include an Administrative Center, a Board of Directors, an Industry Advisory Council, and a Technical Committee.

A. ADMINISTRATIVE CENTER

The administrative center is located at the Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville,

Mississippi. Mississippi State University serves as the Host Institution. SRAC responsibilities include (1) coordinating proposals and negotiating and entering into one or more Regional Aquaculture Center funding agreements (grants) with USDA; (2) serving as fiscal agent in receiving and disbursing monies made available under the grants, utilizing normally accepted accounting practices and in accordance with the terms and provisions of the grants; (3) developing and executing appropriate agree-

ments with the other parties for purposes of transferring funds and for coordinating and implementing proposals approved under the grants; and (4) assuring legal compliance with the terms of the grants and agreements.

The Center Director provides executive leadership for the consortium including (1) serving as executive secretary to the Board of Directors; (2) serving as an ex-officio member of the Technical Committee and Industry Advisory Council; (3) coordinating the development of research and extension plans, budgets and proposals; (4) coordinating and facilitating interactions among the Administrative Center, Board of Directors, Industry Advisory Council, and Technical Committee; (5) monitoring research and extension activities sponsored by SRAC; (6) arranging for review of proposals for technical and scientific merit, feasibility, and applicability to priority problems; (7) preparing summary budgets and reports as required under the grants; and (8) maintaining liaison with other Regional Aquaculture Centers.

B. BOARD OF DIRECTORS

The Board of Directors is the policy-making body for SRAC. Membership of the Board of Directors for the Southern Region provides an appropriate balance among representatives from State Agricultural Experiment Stations, Cooperative Extension Services, 1890 Institutions, and the Council of Administrative Heads of Agriculture.

The structure of the Board is as follows:

- Three members of the 1862 Southern Extension Service Directors Association
- Three members of the 1862 Southern Experiment Station Directors Assn.
- One member of the 1890 Association of Research Administrators
- One member of the 1890 Association of Extension Administrators

One CAHA administrator from the host institution

Members of the Board are:

- Dr. Arthur L. Allen, University of Arkansas at Pine Bluff
- Dr. Harold R. Benson, Kentucky State University
- Dr. W. H. Brown, Louisiana State University
- Dr. Gale A. Buchanan, University of Georgia
- Dr. R. Rodney Foil, Mississippi State University (Chairman)
- Dr. B. G. Hicks, Tennessee Cooperative Extension Service
- Dr. Hiram Palmertree, Mississippi Cooperative Extension Service
- Dr. David H. Teem, Auburn University
- Dr. J. T. Woeste, Florida Cooperative Extension Service

Ex-officio Board members are:

- Mr. Lester Myers, Chairman, Industry Advisory Council
- Dr. James T. Davis, Co-chairman, Technical Committee
- Dr. J. Larry Wilson, Co-chairman, Technical Committee
- Dr. Charles G. Shepherd, Director, SRAC

The Board is responsible for (1) overall administration and management of the regional center program; (2) establishment of overall regional aquaculture research and extension goals and allocate fiscal resources to ensure that the center develops strong programs in both research and in extension; (3) establishment of priorities for regional aquaculture research and extension education activities based on inputs from the Technical Committee and Industry Advisory Council and guidance from the National Aquaculture Development Plan; (4) review and approval of annual plans of work and accomplishment reports; and (5) final selection of proposals for funding by SRAC.

C. INDUSTRY ADVISORY COUNCIL

The Industry Advisory Council (IAC), which meets at least annually, is composed of representatives of state and regional aquaculture associations, federal, state and territorial agencies, aquaculture producers, aquaculture marketing and processing firms, financial institutions, and other interests or organizations as deemed appropriate by the Board.

The IAC provides an open forum wherein maximum input from private and public sectors can be gained and incorporated into annual and ongoing plans for SRAC. As states and territories implement aquaculture plans, other representatives may be incorporated into the IAC. The chairman is elected by the Council and serves for two years.

Members of the IAC are:

Mr. R. F. Odom, Commissioner of
Agriculture, Southern Region, Louisiana
Mr. David Pearce, Producer, Alabama
Mr. J. Neal Anderson, Producer, Arkansas
Mr. Harold Benoit, Producer, Louisiana
Dr. Kenneth Semmens, Producer, Georgia
Mr. Samuel I. Hinote, Processing/
Marketing, Mississippi
Mr. Charles Thomas, Financial Institution,
Alabama
Mr. Timothy K. Hennessy, Producer,
Florida
Mr. Roy S. O'Connor, Producer, Texas
Mr. Lester Myers, Feed Mill/Service,
Mississippi (Chairman)

IAC members serve three-year appointments having staggered terms with options for reappointment.

The IAC (1) recommends to the Board research and extension needs and priorities from an industry perspective; (2) reviews annual plans of work and accomplishment reports

developed for the Southern Region; and (3) recommends to the Board, jointly with the Technical Committee, actions regarding new and continuing proposals, proposal modifications and terminations.

D. TECHNICAL COMMITTEE

The Technical Committee (TC) is composed of representatives from participating research institutions and State Extension Services, other state or territorial public agencies as appropriate, and non-profit private institutions. Membership of the TC for the Southern Region includes 12 research and 12 extension scientists representing essentially all states within the region. The TC meets as needed, but at least annually, and has a co-chairman for research and for extension. Co-chairmen serve for two years and are elected by the Committee members.

Members of the TC are:

Research:

Dr. C. E. Boyd, Alabama
Dr. R. O. Smitherman, Alabama
Dr. J. V. Shireman, Florida
Dr. Vicki S. Blazer, Georgia
Dr. J. O. Hearnberger, Mississippi
Dr. J. E. Waldrop, Mississippi
Dr. J. A. Collier, South Carolina
Dr. J. L. Wilson, Tennessee (Co-chairman)
Dr. Delbert Gatlin, Texas
Dr. Carole Engle, Arkansas
Dr. Nick C. Parker, Texas
Dr. R. P. Romaine, Louisiana

Extension:

Dr. M. D. Beem, Oklahoma
Dr. Marty W. Brunson, Mississippi
Dr. Charles E. Cichra, Florida
Dr. G. W. Lewis, Georgia
Dr. M. P. Masser, Alabama
Mr. Larry de la Bretonne, Louisiana

Dr. Gary Jensen, Louisiana
Dr. Tom M. Losordo, North Carolina
Dr. J. M. Hinshaw, North Carolina
Dr. T. E. Schwedler, South Carolina
Dr. James T. Davis, Texas (Co-chairman)
Dr. G. J. Flick, Jr., Virginia

Technical Committee members serve three-year appointments having staggered terms with options for reappointment.

The TC (1) recommends to the Board research and extension needs and priorities from a scientific perspective; (2) develops problem statements for research and extension areas under consideration for inclusion in an annual plan of work for the Center; (3) plans, develops, and implements regional proposals; (4) prepares and reviews annual proposals, accomplishments and termination reports; and (5) recommends to the Board, jointly with the IAC, actions regarding new and continuing proposals and proposal modifications and terminations.

Subcommittees or work groups for research and extension may be appointed and will be responsible for specific planning, development and evaluation of selected regional proposals. Subcommittees or work groups: (1) identify specific problems for regional proposals; (2) classify and rank proposals by common factors and relationships and by adaptability for cooperative proposals; and (3) work with participating scientists to develop regional

proposals for high priority areas identified by the Board of Directors, IAC and TC as appropriate for the Southern Region.

The Board-approved SRAC Operations Manual, January, 1989, is used for development of cooperative regional aquaculture research and extension activities. Guidelines used to establish regional projects include: (1) institutions receiving program dollars must have a demonstrated capacity to perform the work; (2) a problem concerns two or more states or territories; (3) a project addresses programmatic issues that could not be addressed by a single institution; (4) a project requires more manpower, equipment, and facilities than are available in one state or territory; and (5) a project can be effectively and efficiently organized and conducted on a regional level.

Separate funding allocations will be made for research and for extension to ensure strong programs in each area. All funds allocated for extension activities will be administered through State Cooperative Extension Services.

E. ADMINISTRATIVE ADVISORS

An Administrative Advisor is appointed for each active project area. The Advisor serves as the coordinator for activities related to the project with responsibilities outlined in the SRAC Operations Manual.

III. ADMINISTRATIVE OPERATIONS

A. SRAC ADMINISTRATIVE ACTIVITIES

The Southern Regional Aquaculture Center administrative staff provides a variety of support functions for the Board of Directors, Technical Committee, Industry Advisory

Council, and Work Groups. These responsibilities include the following:

-- Provide documentation for, attend and assist with meetings of the Board of Directors, Technical Committee and Industry Advisory Council; prepare minutes of Board meetings.

- Solicit and receive nominations for membership on the TC and IAC.
- Attend and participate in meetings of the National Coordinating Council.
- Prepare Grant Application for each FY.
- Establish and maintain mailing lists for solicitation of proposals and announcements of Ad Hoc Work Group meetings.
- Attend and participate in meetings of producers, industry representatives, scientists, and others involved in the aquaculture industry in the Southern Region and nationally.
- Prepare and submit to USDA Annual Plans of Work.
- Coordinate and participate in testimony before the House Subcommittee on Rural Development, Agriculture and Related Agencies Appropriations in support of the Regional Aquaculture Centers.
- Contact members of the House Appropriations Committee as well as other members of Congress in the Southern Region regarding support for the Regional Aquaculture Centers.
- Assist Steering Committees and Work Groups with preparation and revisions of project proposals.
- Serve as fiscal agent in distributing grant monies; receive and process invoices from participating institutions and track budget expenditures for each funded proposal; monitor proposal status and progress.
- Establish procedures for publication of manuscripts and videos.
- Review project progress reports, publications and videos.
- Assist Administrative Advisors and Principal Investigators.
- Assist Grant Office personnel of lead institutions in establishing procedures for obtaining reimbursements.
- Prepare SRAC Annual Progress Reports.
- Prepare interim reports on SRAC activities to provide information regarding ongoing projects.
- Prepare budget reports for the Board of Directors tracking expenditures of all projects and the Administrative Center.
- Prepare budgets for the Administrative Center, track expenditures, and obtain CSRS approval for project and budget changes.

B. PROJECTS FUNDED UNDER GRANT NO. 87-CRSR-2-3218

During 1989, the second year's work continued on the three projects proposals funded in the SRAC First Annual Plan of Work. A total of \$625,000 was allocated to the categories of Marketing/Economics and Statistical Database; Regional Educational Programs; and Water Quality, Conservation and Reuse. These funds were obligated for the duration of the proposals selected, with second and/or third year funding contingent on satisfactory progress and accomplishment of the work proposed.

Projects funded were:

"Analysis of Regional and National Markets for Aquacultural Products Produced for Food in the Southern Region" (two-year project funded at \$350,000 for duration)

"Preparation of Southern Regional Aquaculture Publications" (two-year project funded at \$150,000 for duration)

"Performance of Aeration Systems for Channel Catfish, Crawfish, and Rainbow Trout Production" (two-year project funded at \$125,000 for duration)

SRAC's First Annual Plan of Work contains a summary of the procedures used for selection of priority categories and solicitation of proposals, the procedures used for selection of proposals, and copies of the final proposals funded with first year grant funds. Work on these projects will be completed in 1990.

C. PROJECTS FUNDED UNDER GRANT NO. 88-38500-4028

During 1989, work was initiated on five new projects.

The process used to develop these proposals, together with a copy of the final proposals as approved by the Board of Directors on December 14, 1988, was included in the Southern Regional Aquaculture Center Second Annual Plan of Work. Projects funded were:

"Develop a Statistical Data Collection System for Farm-raised Catfish and Other Aquaculture Products in the Southern Region" (one-year project funded at \$50,000)

"Effect of Nutrition on Body Composition and Subsequent Storage Quality of Farm-Raised Channel Catfish" (three-year project funded at \$275,000 for year one)

"Enhancement of the Immune Response to *Edwardsiella ictaluri* in Channel Catfish" (two-year project funded at \$46,736 for year one)

"Immunization of Channel Catfish" (two-year project funded at \$50,000 for year one)

"Harvesting, Loading and Grading Systems for Cultured Freshwater Finfishes and Crustaceans" (three-year project funded at \$125,000 for year one)

D. PROJECTS APPROVED FOR FUNDING UNDER GRANT NO. 89-38500-4516

On December 8, 1989, the Board approved continuation of the following projects:

"Effect of Nutrition on Body Composition and Subsequent Storage Quality of Farm-Raised Channel Catfish" (three-year project funded at \$275,000 for year two)

"Enhancement of the Immune Response to *Edwardsiella ictaluri* in Channel Catfish" (two-year project funded at \$53,264 for year two)

"Immunization of Channel Catfish" (two-year project funded at \$50,000 for year two)

"Harvesting, Loading and Grading Systems for Cultured Freshwater Finfishes and Crustaceans" (three-year project funded at \$125,000 for year two)

The Board also approved development of a Work Group and funding of a project on vertebrate depredation at \$15,000. One objective of this project will be to produce an educational video that profiles the major vertebrate predators, their potential economic importance, and up-to-date, non-lethal control methods. The Board requested the Technical Committee to impanel a Work Group for the purpose of proposing regional publications needed in aquaculture. SRAC participation in a national extension workshop and funding at \$5,000 was approved if all other Centers agree to participate and fund the project.

IV. PROJECT PROGRESS REPORTS

A. PROJECTS INITIATED 1988 (GRANT NO. 87-CRSR-2-3218)

1. Analysis of Regional and National Markets for Aquacultural Products Produced for Food in the Southern Region

Annual Progress Report
For The Period
October 1, 1988 to September 30, 1989

COOPERATING INSTITUTIONS:

Auburn University -- Carole Engle¹, Upton
Hatch and Henry Kinnucan
Clemson University -- Robert Pomeroy
Louisiana State University -- Lynn Dellenbarger
Mississippi State University -- James Dillard
Texas A&M University -- Oral Capps

ADMINISTRATIVE ADVISOR:

T. J. Helms, Assistant Director
Ms. Agric. & Forestry Exper. Station
Mississippi State, Mississippi

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS:

Objective 1: To obtain and analyze comprehensive market information from consumers, retail groceries, and restaurants.

Market data for this objective were obtained from national surveys of 3600 households, 1800 grocery stores and 1800 restaurants. These surveys were completed in July,

¹Carole Engle moved to the University of Arkansas at Pine Bluff, but continues to participate in the project on an informal basis.

1988. The work group spent considerable time during the past year editing, "cleaning-up", and analyzing the survey data. Summary statistics were developed for slide presentations to producer groups in the participating states, and to industry organizations. Several articles were written for presentation at professional meetings and/or for submission to Journals and published proceedings.

Four SRAC/Experiment Station research bulletins are in various stages of completion; one bulletin containing detailed data from each of the three surveys, and one highly illustrated bulletin containing the most interesting summary data from all three surveys. The latter bulletin will be designed for popular consumption; the first three are more technical and contain much more detailed information. One bulletin has been submitted for final SRAC approval; one has cleared internal review and is being readied for submission to SRAC, one is undergoing review and one (the popularized publication) is currently being written.

Analyses of data from the three surveys by the cooperating researchers have resulted in a large volume of information. Some highlights are:

-- There is a tremendous variation in preference for fish and seafood in the U.S. Over 70 different species of fish and seafood were named as favorites; however, catfish was named as favorite more often than any other finfish.

-- Broad, demographic variables are relatively unimportant in explaining differences in consumers and non-consumers of catfish. Out of the 11 demographic characteristics studied, only place of residence, occupation, education and race were significant. How-

ever, attitudinal variables, including awareness of advertising, perceptions of high quality and good flavor of catfish, and perceived availability of catfish, were important in discriminating between consumers and non-consumers of catfish.

- The surveys revealed that awareness of catfish is increasing--over half of consumers nationwide have heard of farm-raised catfish. Over 40 percent reported they had eaten catfish.

- Forty-three percent of grocery stores reported they offered some form of catfish.

- Catfish were included on the menu of 29 percent of restaurants surveyed; however, only four percent served catfish.

- Sales of catfish ranked second among all fish and seafood in grocery stores. Catfish ranked third in restaurants.

- Attributes of catfish that received the highest ratings by consumers were nutritional value, ease of preparation and flavor.

- The lowest consumer ratings of catfish were on perceived availability, appearance and packaging and odor.

- The average consumer ratings (6.4 on a 1-10 scale) of catfish on all 10 attributes studied suggest the "poor image" problem of catfish is improving.

A study of retail demand for catfish and crawfish in a local market using scanner data obtained from retail supermarkets in Houston, Texas was included as a part of Objective 1, but also contributes to Objectives 2 and 3. The analysis centers on specification and estimation of econometric models which relate point-of-sale purchases per 1000 customers, the dependent variable, to price variables, seasonality, advertising and trend. This research is near completion and a publication of

results has been submitted for review and approval. The preliminary results of this analysis are very promising; consequently, this research will be continued in the future to "fine tune" the model. Results of the model should provide some useful knowledge concerning retail demand for catfish and crawfish in a local market.

Objective 2: To assess the effectiveness of advertising and promotion of farm-raised catfish.

Data obtained from The Catfish Institute (TCI), USDA reports, and the national survey have been incorporated in two econometric models designed to isolate the effect of generic advertising.

One of the models estimated contains three structural equations; a farm-level supply equation, a processor price-markup equation, and a wholesale-level demand equation. Processor inventories and industry advertising were singled out for special attention in the model because of the importance of these variables for industry policy and analysis. Advertising showed only a weak statistical significance in the model, probably the result of the relative newness of the TCI sponsored generic advertising program. More experience (data) is needed before a definitive statement can be made about the effectiveness of the program. One important observation noted in this research is the apparent positive change in the consumer perception of catfish. Again, however, more research is needed to substantiate this observation.

A second eight equation econometric model was estimated in an attempt to describe a hierarchy of effects of advertising. This model utilizes data on consumer perceptions obtained from the national survey. Not surprisingly, the econometric results show the nascent advertising program exerting its influence through heightened consumers' awareness and improved perceptions of farm-raised catfish.

Objective 3: To develop an overall assessment of potential for producing and marketing catfish and crawfish in the Southern Region.

Work on this objective is just getting underway. One model, using a multinomial Logit-Probit approach, has been developed and will be used to analyze different economic and geographic factors influencing consumption of fish and seafood in general, and catfish in particular. Assessment of market potential will draw from this analysis, plus results from Objectives 1 and 2.

USEFULNESS OF FINDINGS:

Information contained in forthcoming publications should be of much interest to processors and other marketers of catfish. Following is a summary of findings of major interest:

Catfish is no longer (if it ever was) a product consumed primarily by low income, poorly educated persons living primarily in the deep South. Catfish is now being consumed in significant quantities by persons of all income and education levels, nearly all race and ethnic backgrounds, and in all major regions of the U.S., although a majority of consumption is still in the traditional consuming area. Changes in attitudes and perceptions of farm-raised catfish were evident from the survey. Differences in consumer ratings across regions are present, but not as large as anticipated. Although industry advertising and promotional programs are relatively new, they obviously have had an impact and should be continued at the highest level feasible. Many consumers outside the traditional catfish consuming region perceive that catfish are not readily available. Catfish also received low ratings on appearance and packaging, odor, and having few bones. These misconceptions should be addressed in future advertising and educational programs. Attributes

of catfish that received relatively high ratings were nutritional value, flavor, and ease of preparation. Catfish were not perceived as being over priced relative to other fish and meat. Marketers should take advantage of these favorable attributes.

WORK PLANS FOR NEXT YEAR:

Plans are to complete the research proposed under the three objectives by March 31, 1990. This will require a six months, no cost, extension beyond the September 30, 1989 termination date contained in the proposal, but does not require more time than the two years proposed, since the project was not initiated until April, 1988.

Work for the next six months will focus on publishing the research that is already completed for Objectives 1 and 2, and completing Objective 3. It should be noted that this project has generated a large database that will continue to be used in research after the project is officially terminated. Some of the econometric models developed as a part of this effort will have even greater pay-off in the future as more data become available.

PUBLICATIONS (status shown in parentheses):

Alabama

Hatch, L. U. "National Survey of U.S. Fish Consumption" Proceedings, Aquaculture International Congress and Exposition, Vancouver, Canada, Sept. 1988, (Published in Proceedings).

Hatch, L. U., et al. "Survey Analysis of Existing and Potential Retail Grocery Markets for Farm-Raised Catfish in the United States," Proposed SRAC Bulletin (In process of review).

Zidack, Walter, et al. "A Dynamic Monthly Econometric Model of the U.S. Catfish Industry," Department of Agricultural Economics

and Rural Sociology," Auburn University, March 1989, (Published in Working Paper Series).

Mississippi

McGee, Mitchell, et al. *"Demographic and Attitudinal Characteristics of Catfish Consumers,"* Proposed SRAC Bulletin (Submitted to SRAC for approval).

South Carolina

Pomeroy, Robert S. and J.C.O. Nyankori, *"Aquaculture Products in the Marketplace: Full-Service Restaurant Survey,"* (Proposed SRAC Bulletin, internally reviewed and ready for submission to SRAC for final approval).

Texas

Capps, Oral, Jr., and John Lambregts, *"Retail Demand for Catfish and Crawfish in a Local market,"* (Proposed SRAC publication, approved by SRAC).

PAPERS AND ARTICLES:

Alabama

Hatch, Upton, et al. *"Market Dynamics of the U.S. Catfish Industry,"* presented paper, Western Economics Association, Lake Tahoe, California, June 1989.

Hatch, Upton, et al. *"Potential New Retail Grocery Markets for Farm-Raised Catfish,"* presented paper, American Fisheries Society Annual Meetings, Anchorage, Alaska, September 1989.

Kinnucan, Henry and Walter Zidack,

"Effects of Industry Structure on the Stability of Aquaculture Markets," presented paper, American Fisheries Society Annual Meetings, Anchorage, Alaska, September 1989.

Zidack, Walter, et al. *"A Dynamic Monthly Econometric Model of the U.S. Processed Catfish Industry,"* presented paper, American Agricultural Economics Association Annual Meetings, Baton Rouge, Louisiana, July 1989.

Louisiana

Dellenbarger, Lynn E., et al. *"Socioeconomic Factors Associated with Catfish Consumption in the U.S.,"* presented paper, Southern Agricultural Economics Association Annual Meeting, Nashville, Tennessee, February 1989 (Abstract accepted for Journal).

Dellenbarger, Lynn E., et al. *"Socioeconomic Factors Associated with At-Home and Away-From-Home Catfish Consumption in the U.S."* Article submitted to Journal of World Aquaculture Society (in review).

Dellenbarger, Lynn E., et al. *"Nationwide Grocery Store Market for Crawfish."* Article accepted for publication in Louisiana Rural Economist, published by Department of Agricultural Economics and Agribusiness, LSU (date not provided).

Dellenbarger, Lynn E., et al. *"Household Consumption Patterns for Crawfish in the United States."* Article accepted for publication in Crawfish Tales, Louisiana Crawfish Farmers Association (date not provided).

Numerous slide presentations have been made by cooperating scientists to producer and industry organizations in all five cooperating states, plus Arkansas.

2. Preparation of Southern Regional Aquaculture Publications

Annual Progress Report
For The Period
October 1, 1988 to September 30, 1989

COOPERATING INSTITUTIONS, AGENCIES AND BUSINESS ENTITIES:

Authors

John Jensen - Alabama Cooperative Extension Service
Leroy Gray - Arkansas Cooperative Extension Service
Charles Cichra - Florida Cooperative Extension Service
Thomas Wellborn - Florida Cooperative Extension Service
George Lewis - Georgia Cooperative Extension Service
Ronnie Gilbert - Georgia Cooperative Extension Service
Michael Masser - Kentucky State University (presently with Alabama Cooperative Extension Service)
Larry de la Bretonne - Louisiana Cooperative Extension Service
Gary Jensen - Louisiana Cooperative Extension Service
Joe McGilberry - Mississippi Cooperative Extension Service
Jeffrey Hinshaw - North Carolina Cooperative Extension Service
Ronald Hodson - North Carolina University
Andrew McGinty - Puerto Rico Agricultural Experiment Station
Thomas Schwedler - South Carolina Cooperative Extension Service
Joe T. Lock - Texas Agric. Extension Service
Billy Higginbotham - Texas Agricultural Extension Service
George Chamberlain - Texas Agricultural Extension Service
Russell Miget - Texas Agricultural Extension Service

J. T. Davis - Texas Agricultural Extension Service
James Rakocy - Virgin Islands Agricultural Experiment Station

Reviewers - In addition to the above

Tom Hill - Tennessee Cooperative Extension Service
Delbert Gatlin - Texas Agricultural Experiment Station
Kirk Strawn - Texas Agricultural Experiment Station
Michael Haby - Texas Agricultural Extension Service
Jack Whetstone - South Carolina Cooperative Extension Service
Wendell Lorio - Agricultural Research Service, USDA
Louis Helfrich - Virginia Cooperative Extension Service
Mac V. Rawson - Georgia Cooperative Extension Service
Robert Romaine - Louisiana Agricultural Experiment Station
R. L. Noble - North Carolina State University
James Rice - North Carolina Cooperative Extension Service
Charles M. Collins - U. S. Fish and Wildlife Service
Nick Parker - U.S. Fish and Wildlife Service
Guthrie Perry - Louisiana Department of Wildlife and Fisheries
Paul Sandifer - South Carolina Wildlife Resources
Edwin Robinson - Mississippi Agricultural and Forestry Experiment Station
Tom Linton - Texas Agricultural Extension Service
Brian Murphy - Texas Agricultural Experiment Station

ADMINISTRATIVE ADVISOR:

Milo J. Shult, Associate Director
Texas Cooperative Extension Service
College Station, Texas

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS:

Objective 1: Prepare a series of reference manuals for use and distribution by Cooperative Extension Services and other information-purveying agencies throughout the Southern Region for the following subjects:

- A. Channel catfish in Delta ponds - Author - Tom Wellborn
 - 1. Construction of levee-type ponds for fish
 - 2. Site selection of levee-type fish production ponds
 - 3. Channel catfish: Life history and biology
 - 4. Feeding intensively cultured catfish in levee-type ponds
- B. Channel catfish in hill country ponds - Author - John Jensen
 - 1. Watershed fish ponds: Site selection and construction
- C. Rainbow and brown trout - Author - Jeffrey Hinshaw
 - 1. Trout production: Handling eggs and fry
 - 2. Four other fact sheets in preparation
- Baitfish - Authors - Leroy Gray and Carole Engle
 - 1. Baitfish biology and life history
 - 2. Baitfish feeding practices
 - 3. Baitfish production and feeding practices
- E. Tilapia - Authors - Jim Rakocy and Andrew McGinty
 - 1. Pond culture of tilapia
 - 2. Feeding strategies for efficient tilapia production
 - 3. Cage culture of tilapia
 - 4. Tank culture of tilapia (in process)
- F. Small scale marketing - Authors - George Lewis and Ronnie Gilbert
- G. Caged fish production - Author - Michael Masser
 - 1. What is cage culture?
 - 2. Cage culture site selection and water quality
 - 3. Cage culture construction and placement
 - 4. Species suitable for cage culture
 - 5. Handling and feeding caged fish
 - 6. Cage culture problems
 - 7. Cage culture harvesting and economics
- H. 4-H Fish production - Author - Tom Schwedler
 - 1. 4-H Aquatic science project - Raising catfish in a cage
 - 2. 4-H Aquatic science project - Catfish cage culture record-keeping project
- I. Aeration equipment and utilization - Author - John Jensen
 - 1. Pond aeration principles
 - 2. Pond aeration - Types and uses of aeration equipment
- J. Catfish processing - Six fact sheets are in process at this time
- K. Striped bass hybrids - Author - Ronald Hodson

1. Hybrid striped bass - Biology and life history
 2. Hybrid striped bass - Hatchery phase
 3. Hybrid striped bass - Pond production of fingerlings
 4. Hybrid striped bass - Pond production of food fish
- L. Red drum production - Author - James T. Davis
1. Red drum - Biology and life history
 2. Red Drum - Care of brood stock and hatching techniques
 3. Red drum - Pond production of fingerlings
 4. Red drum - Pond production of food fish
 5. Red drum - Construction of coastal ponds including site selection
- M. Penaeid shrimp production - Author - George Chamberlain - Fact sheets are in the writing phase
- N. Crawfish production - Author - Larry de la Bretonne - Fact sheets are in the writing phase
- O. Largemouth bass - Author - Joe T. Lock
1. Largemouth bass - Biology and life history
 2. Largemouth bass - Production and economics
- P. Forage fish production - Author - Billy Higginbotham
1. Forage species - Range, description and life history
 2. Forage species - Production techniques
 3. Forage species - Return on investment
- Q. Extra nonassigned publications
1. Aquatic weed management: Control methods - Authors - James L. Shelton and Tim R. Murphy
 2. Aquatic weed management: Herbicides - Authors - Tim R. Murphy and James L. Shelton
 3. Computer software for aquaculture: Description and evaluations - Authors - Rebecca Kruppenbach and James T. Davis
 4. Control of bird depredations in aquacultural operations - Authors - Christopher Oliver and James T. Davis
 5. Sorting and grading warmwater fish - Author - Gary Jensen
 6. Handling and holding warmwater fish - Author - Gary Jensen
 7. Transportation of warmwater fish - Author - Gary Jensen
- Objective 2: Prepare video productions to demonstrate succinct points in the production of aquacultural products for the following subjects:
- A. Induced spawning - Responsible institution - Florida Cooperative Extension Service - Script approved and filming completed - Expected date of delivery - December 1989.
- B. Crawfish production - Responsible institution - Louisiana Cooperative Extension Service
- C. Catfish production - Responsible institution - Louisiana Cooperative Extension Service. Gary Jensen has completed this

video and it is available for distribution.

- D. Trout production - Responsible institution - North Carolina Cooperative Extension Service
- E. Alligator production - Responsible institution - Louisiana Cooperative Extension Service
- F. Hybrid striped bass production - Responsible institution - North Carolina Cooperative Extension Service. Script has been completed and filming is mostly complete. Expected date of distribution - December 1989 - Ronald Hodson
- G. Penaeid shrimp production - Responsible institution - Texas Agricultural Extension Service
- H. Red drum production - Responsible institution - Texas Agricultural Extension Service. This video has been completed by Russell Miget and George Chamberlain and is available for distribution.
- I. Pond management, water quality and instrument use - Responsible institution - South Carolina Cooperative Extension Service. Script has been completed, reviewed and approved. Filming is in process. Expected date of receipt for distribution - December, 1989

Objective 3: Catalog all of the computer software available on aquaculture production in the Southern Region and evaluate the possibilities of developing a common format.

This objective was expanded to include analysis of all aquacultural or related software available in the United States. Because there were insufficient funds in the project to buy software, we limited our evaluation to those programs which were in the public sector and available for a minimum charge or those which the owning institution would send as a dem-

onstration program or on a loan basis.

As a result of this effort a publication was prepared and its availability indicated in Objective 1.

Objective 4: Perform all management services necessary to allow the maximum output with the least travail on cooperating Extension Services.

At the completion of this year there are over 35 publications completed and available for distribution through cooperating Extension Services in the Southern Region. In addition at least six are being processed, five are in varying stages of writing or review and ten to twelve still require some action on the part of the assigned authors. Most of the latter have indicated in writing that they will complete their assignments prior to November 30, 1989. If this does in fact occur, the targeted 60 publications will be ready for distribution by March 1, 1990.

Because the Southern Region has the only products of this nature and completeness, requests for copies have proliferated. No effort has been made to advertise their availability. Because the expense of answering the requests is more than any single state can bear, a distribution policy will be recommended to the Aquaculture Center Directors at the National Coordinating Council meeting in November of 1989.

USEFULNESS OF FINDINGS:

The best statement about the usefulness of this project is the acceptance that has been achieved and the number of requests to receive, market and stock the materials. The interest has overwhelmed our ability to respond.

WORK PLANNED FOR NEXT YEAR:

During the next six months of the project

it is expected that the remaining publications and videos will be completed, reproduced and distributed to the using states. A follow-up project to fill in the publication gaps is being discussed. If there is sufficient interest, this will be presented to the Board of Directors at the appropriate time.

**PUBLICATIONS ISSUED OR MANUSCRIPTS
APPROVED DURING THE YEAR:**

These are described earlier in the report.

**3. Performance of Aeration
Systems for Channel Catfish,
Crawfish, and Rainbow Trout
Production**

Annual Progress Report
For The Period
October 1, 1988 to September 30, 1989

COOPERATING INSTITUTIONS:

Auburn University -- Claude E. Boyd
Louisiana State University -- F. Eugene
Baker, J. David Bankston, Thomas B.
Lawson, and Robert P. Romaine
Mississippi State University -- C. S. Tucker
North Carolina State University -- Jeffrey
M. Hinshaw
Texas A & M University -- James T. Davis

ADMINISTRATIVE ADVISOR:

David H. Teem, Associate Director
Alabama Agricultural Experiment Station
Auburn, Alabama

Auburn University (Claude Boyd,
Principal Investigator):

**PROGRESS OF THE WORK AND PRINCIPAL
ACCOMPLISHMENTS:**

A water circulator was designed and fabri-

cated last year. This 3-hp device consists of a large casing, fan-blade impellers, flow stabilizer surfaces, bearings, drive system, motor, and support frame. The initial tests to determine flow rates were hampered by excessive velocity of return flow in the comparatively small test tank. After consultation with a hydraulics expert, a baffle was constructed to reduce velocity of return flow and successful tests were conducted. Tests included several impeller speeds 90 to 180 rpm, two fan blade widths (6 inches and 3 inches), and one to four fan-blade assemblies on the shaft. Each fan-blade assembly had four blades and was 24 inches in diameter. The three-inch wide blades tended to produce turbulent flow and give inconsistent results. The best water discharge rate was 16,600 gpm with four, 6-inch wide fan blades operated at 144 rpm. A 3-hp motor was required to produce this discharge. Results of tests are summarized below:

	No. fan-blade rpm assemblies	Discharge (gpm)	
		6"-wide blade	3"-wide blade
90	1	7,200	6,600
	2	7,400	8,400
	3	7,500	5,700
	4	8,000	6,300
120	1	9,500	8,100
	2	10,600	7,900
	2	11,000	8,800
	4	10,400	8,300
144	1	12,900	9,300
	2	12,400	9,900
	3	15,300	9,400
	4	16,600	10,700
180	1	13,800	12,300
	2	overloaded motor	13,900
	3	overloaded motor	overloaded motor
	4	overloaded motor	overloaded motor

C. S. Tucker of Mississippi State University visited Auburn University in July, 1989 and made drawings and took pictures of the water circulator. He will have water circulators constructed for experimental use in catfish ponds of the Delta Branch Experiment Station. These units will have 6-inch wide fan blades, four fan-blade assemblies on the shaft, and rotate at 144 rpm.

A hood was designed and constructed to permit use of pure oxygen with a paddlewheel aerator. The hood is fabricated of sheet metal. It encloses the paddlewheel but allows plenty of space for development of the normal spray pattern of the paddlewheel. The hood then extends into the water to a depth of about 2 feet. Pure oxygen can be monitored into the hood for contact with water. Initial tests indicated some faults in the shape of the hood. These faults are being corrected. The new version will take water in from a depth of about 2 feet and discharge water at the same depth. This water intake and discharge design is necessary to prevent rapid loss of oxygen from the water to the air.

PLANS:

1. The water circulator will be placed in a 0.4-hectare pond and water circulation patterns will be studied.
2. Investigations on gypsum block dissolution rates to measure water circulation in ponds will continue.
3. The efficiency of the hooded aerator in transferring pure oxygen will be determined by introducing pure oxygen gas into the hood at different flow rates and measuring the percentage of the oxygen that dissolves in the water at each flow rate.
4. Craig Tucker will test the water circulator and the hooded paddlewheel aerator in large catfish ponds at the Delta Branch Experiment Station. Researchers from Auburn

University plan to go to Stoneville and help Tucker make some measurements of water circulation by the gypsum block dissolution procedure.

**Louisiana State University -
Research Activities (Thomas B.
Lawson and Robert P. Romaine,
Investigators):**

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS:

Six 2.0-hectare (5 ac) crawfish ponds were prepared for this project. Pond levees were prepared in 1988 and ponds were stocked and managed using commercial recommendations of the Louisiana Cooperative Extension Service. Paddlewheel aerators were purchased and installed in two of the ponds (two 3-hp aerators per pond). Aerators were powered with a diesel generator. Since, electrical service has been installed to all ponds. Electric power is currently operational and will be used to power aerators in the future.

Preliminary studies indicate that a water exchange of twice daily was achieved with two 3-hp paddlewheels per 5-ac pond, which by far exceeds minimum water exchange requirements as recommended by the LCES (one exchange every 3-5 days). Dissolved oxygen concentrations remained above 5-6 mg/L. It is anticipated that 0.3 to 0.5 hp per acre may be sufficient to oxygenate crawfish ponds, as compared to 1 hp per acre recommended in the catfish industry.

Two graduate assistantships have been filled to work on this project: one M.S. student in School of Forestry, Wildlife and Fisheries and one Ph.D. student in Agricultural Engineering. The "Forestry" student will study water quality aspects of paddlewheel aeration in crawfish ponds. The "AGE" student will study effects of rotational speed, paddle depth, hp requirements, operating characteristics, flow rates, etc.

Goals for 1989-90 are to install paddlewheel aerators in one additional 5-acre pond (making a total of three ponds with aerators) to compare crawfish production and water quality to three 5 ac-ponds not equipped with paddlewheel aerators. The six ponds were stocked with adult crawfish in May/June at the rate of 25-50 kg/ha. Rice for forage was planted the first week of August. Ponds will be flooded in late September/early October, 1989 for commencement of next season's research efforts.

Louisiana Cooperative Extension Service (F. Eugene Baker and J. David Bankston, Investigators):

COOPERATING INSTITUTIONS, AGENCIES AND BUSINESS ENTITIES:

Institutions of Auburn University,
Texas A & M, and LSU
Louisiana Department of Environmental
Quality
S & N Sprayer
Geddie Machine Works
Diesel Engine Center
Louisiana Department of Natural
Resources

PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Successful demonstrations of paddlewheel aerators in recirculating type crawfish ponds were accomplished in the 87-88 season. A series of producer meetings and association meetings were used to report the results. Approximately 350 producers attended meetings in the winter of 88-89. As a result, several individuals committed to installing paddlewheels in a recirculating crawfish pond. Work is continuing with these individuals to guide them in the direction to best utilize the knowledge gained in the area demonstrations.

A paper was presented at the International Meeting of the American Society of Ag-

ricultural Engineers on this work in Quebec City in June, 1989.

Because of the tremendous potential for energy savings, the Louisiana Department of Natural Resources has further supported this effort by supporting a one year educational effort to do additional demonstrations and hold additional workshops. That series of workshops is approximately half over, with five meetings and two result demonstrations being held in the spring and fall of 1989. One of the demonstrations carried out during this effort involved a pond owned by Jim Synder, crawfish grower in Calcasieu Parish, Louisiana. A five horsepower S&N aerator was placed in his twenty-two acre, recirculating type crawfish pond. The unit was operated for the entire season and was effective in generation and distribution of oxygen. The studies in this installation of a five horsepower S&N unit, installed with restrictions on both sides of the paddle apparatus, showed an increase in the volume of water moved nearly four fold compared to the 1988 application. Extension educational work with crawfish producers continues, covering both the aerators and the necessity of correct pond design to allow utilization of the paddlewheel aerator as an efficient means of accomplishing aeration within crawfish ponds.

**North Carolina State University
(Jeffrey M. Hinshaw, Investigator):**

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS:

Due to record levels of rainfall in the spring and summer of 1989, and atypically low temperatures during this same period, the need for supplemental aeration in trout aquaculture has been minimal. During the months of April through August of 1989, the precipitation in the southern Appalachian region was double the average for those months. Typically, pure oxygen systems are used as supplemental aeration in this time period,

but have not been necessary this year. As a result, we have been monitoring water quality and production conditions on our cooperating farm, but the oxygen systems will not be used until August or September. The operators of three commercial farms that use pure oxygen continually (not previously identified as cooperators) have tentatively agreed to assist us by providing economic information on the installation and operational costs of their pure oxygen systems for 1988/1989. We have not compiled production figures for the individual systems for 1989, but the costs of operating a low pressure packed column system versus a high pressure packed column system were approximately \$0.03 and \$0.10/pound of fish produced in 1988, respectively, excluding labor costs for maintenance.

Since no oxygen was being used on our monitored farm thus far this growing season, we have started experimentation on the physiological effects of elevated oxygen levels in our small wet lab system as a complement to the field studies. Rainbow trout have been stocked in six 150 gallon tanks at densities normally carried in commercial farms (3 - 10 pounds/cubic foot), with pure oxygen added to three tanks in the system. We are using this experimental system to test primarily for physiological effects of the elevated oxygen on the fish including measures of stress (plasma cortisol, chlorides, glucose, and lactate), growth and growth potential (adenylates), and blood chemistry (hematocrit and total hemoglobin). These measures will also be taken from the fish at the commercial site in the study. One manuscript has been developed on the use of a solid phase enzyme immunoassay for the measure of plasma cortisol in rainbow trout, which was partially supported by this project. This manuscript will be submitted in September, 1989.

PLANS:

We have made arrangements to complete the "on-farm" study of pure oxygen use on a

commercial farm which uses pure oxygen addition on a continual basis and which has a "constant" water supply. The economic and production information from the additional three farms indicated should provide good information on the practicality of this type of intensification. Our small experimental system of controlled exposure of the trout to supersaturated oxygen conditions will also allow us to test a wide range of oxygen levels which may be encountered on different commercial trout farms.

Mississippi State University
(Craig S. Tucker, Investigator):

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS:

Three 3-horsepower water circulators are being fabricated at the Delta Branch Experiment Station in Stoneville, Mississippi. The devices are based on the design optimized in preliminary work at Auburn University.

PLANS:

Water blenders will be installed in 4-acre ponds at Stoneville in early spring 1990 and tested during the 1990 growing season. Measurements will include stability of thermal stratification as well as common water quality variables.

Texas A & M University
(James T. Davis, Investigator):

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS:

We have continued to operate the paddle-wheel aerators on demonstration ponds and compared their efficacy to ponds receiving aeration from limited amounts of fresh water from irrigation canals. This method and result demonstration have been viewed by seven organized groups during the year and numerous visits by producers from the area and

adjoining states. Actual numbers on the latter have not been kept by the personnel working at the site for our cooperator.

Due to heavy flood waters associated with two hurricanes, we were not able to conduct the summer demonstrations as planned. Levees washed out of eight ponds and crawfish populations became mixed. We do plan to operate the aerators during the coming season with flood-up planned for 15 September 1989.

**B. PROJECTS INITIATED 1989
(GRANT NO. 88-38500-4028)**

1. Immunization of Channel Catfish

Annual Progress Report
For The Period
May 2, 1989 to September 30, 1989

COOPERATORS:

John A. Plumb
Chairman
Department of Fisheries and Allied
Aquacultures
Auburn University, AL 36849

Ronald L. Thune
Department of Veterinary Microbiology
and Parasitology
College of Veterinary Medicine
Louisiana State University
Baton Rouge, LA

Vicki S. Blazer
Fisheries Research Unit
School of Forestry
University of Georgia
Athens, GA 30602

ADMINISTRATIVE ADVISOR:

Lowell T. Frobish, Director
Alabama Agricultural Experiment Station
Auburn University, AL 36849

INTRODUCTION:

Initiation of work was slowed by the funding of the project beginning on May 2, 1989. Also initiation of experiments at the University of Georgia was delayed by a fire which destroyed their "wet laboratory" facility in March. Difficulty resulting from the fire has been overcome and a temporary facility is in place.

Progress towards the fulfillment of the objectives and plans for next year at Auburn University, the University of Georgia, and Louisiana State University are as follows:

**Auburn University ("Isolation,
Purification and Determination of
the Degree of Antigenicity of Outer
Membrane Protein of *Edwardsiella
ictaluri*"):**

ACCOMPLISHMENTS:

A single protein with a molecular weight of 36,000 daltons was isolated and purified from *Edwardsiella ictaluri* by a combination of cell disruption by French press, dissolution of the protein, SDS-PAGE electrophoresis, and Elutrap apparatus. The pure protein was confirmed by using ELISA and specific antibody made against pure *E. ictaluri* protein preparations. Its immunocompetency was shown by injection into channel catfish and the immune response compared to that produced by whole cells, broken cell preparations, and crude envelope preparations. It was further shown that the protein was immunodominant because antibody responses were similar between the single protein vaccinated fish and fish vaccinated with other *E. ictaluri* preparations. The peak immune response

developed at about 3 weeks post vaccination. Preliminary protection studies are currently underway.

PLANS FOR NEXT YEAR:

Large quantities of the *E. ictaluri* immunodominant protein will be produced and purified as previously described. Channel catfish will be vaccinated with the specific protein by injection, immersion, and orally. After the immune response has developed to its highest level (3 to 4 wks), the level of protection will be determined by exposure to live, virulent *E. ictaluri*, and efficacy of the preparations and delivery methods compared.

Louisiana State University ("Cloning and mapping of the CCV thymidine gene and cloning of the *Aeromonas hydrophila* S-layer protein"):

ACCOMPLISHMENTS:

Our objectives were to determine if the channel catfish virus (CCV) codes for thymidine kinase (TK), distinguish this enzyme from cellular isozymes, and isolate the TK gene for recombinant vaccine research. We isolated a TK-deficient channel catfish ovary cell line (CCOBr) by culturing CCO cells in increasing amounts of 5-bromo-2'-deoxyuridine (BUdR). This cell line exhibited low TK activity in comparison to its parent CCO cell line. Infection of the CCOBr line with CCV resulted in increased amount of TK activity, indicating that CCV coded for this enzyme. CCV was shown to be sensitive to the TK-activated antiherpetic agent 1-B-D arabinofuranosylthymine (Ara-T). An Ara-T-resistant mutant of CCV was selected (CCVAr) and was shown to lack the TK-inducing ability of the wild-type virus. Extracts from CCO cells and CCV-infected CCOBr cells were used to characterize the cellular and viral TK isozymes. Substrate specificity tests were performed by comparing the enzyme's use of ATP or CTP as phosphate donors or dA, dC, dG, A, G, Ara-T,

and BUdR as competitive inhibitors.

A CCV genomic library was developed by cloning DNA from purified virus into plasmid pUC19 and cosmid pH79. Also, the purified viral DNA was used in polymerase chain reactions (PCR) with degenerate oligonucleotide primers. These primers were based on conserved amino acid sequences among previously sequenced herpes virus TK genes. The PCR-generated fragments were cloned into pUC18. The cloned PCR fragments are being used as probes in DNA-DNA hybridizations to the cloned genomic library to map the TK gene on the CCV genome.

PLANS FOR NEXT YEAR:

¹⁴C labeled thymidine will be used in mark and rescue studies. TK-negative CCV will be used to localize the TK gene by autoradiography. Also DNA extract from *Aeromonas hydrophila* will be purified and cloned into cosmids and then clones that produce *A. hydrophila* S-layer proteins will be selected.

University of Georgia ("Effects of fatty acid profiles and dietary vitamin E on immunity of channel catfish"):

ACCOMPLISHMENTS:

To date we have obtained fingerling catfish, acclimated them to our reuse systems and begun the feeding trials. We are feeding five different diets - a commercial feed and four semipurified, laboratory-prepared diets. These diets are identical except for the lipid source. The lipid sources are menhaden oil, soybean oil, beef tallow, and a combination of the three in equal proportions. We are maintaining 300 fish on each of the experimental diets. The fish are held in 90% reuse systems at 24-28 degrees Centigrade.

Four vaccination protocols for protection against *Edwardsiella ictaluri* will be tested for

each of the dietary treatments: bath immunization only, oral immunization only, bath followed by an oral booster and nonimmunized. Macrophage function, humoral immunity, and survival after exposure to live, virulent bacteria, will be evaluated in each group. We expect to have these assays finished and the analyses completed by late February.

PLANS FOR NEXT YEAR:

Two diets will be compared: (1) a commercial feed, and (2) the diet which gives the best results in Year One. Fish will be fed the appropriate test diet for one week before and after bath exposures. We will then feed all fish the commercial feed for varying times before switching to the laboratory diet. Groups will be maintained on the laboratory diet for 4 weeks, 2 weeks, or 1 week prior to the oral feeding, and be provided with the appropriate experimental diet for 2 weeks after oral immunization.

2. Enhancement of the Immune Response to *Edwardsiella ictaluri* in Channel Catfish

Annual Progress Report
For The Period
May 2, 1989 - September 30, 1989

COOPERATORS:

J. R. Tomasso and T. E. Schwedler
Department of Aquaculture, Fisheries and
Wildlife
Clemson University
Clemson, SC 29634-0362

D. M. Gatlin and W. H. Neill
Department of Wildlife & Fisheries
Sciences
Texas A&M University
College Station, TX 77843

Vicki S. Blazer
Georgia Cooperative Fish & Wildlife
Research Unit
University of Georgia
Athens, GA 30602

D. H. Lewis
School of Veterinary Medicine
Department of Veterinary Microbiology
College Station, TX 77843

ADMINISTRATIVE ADVISOR:

J. R. Fischer, Director
South Carolina Agricultural
Experiment Station
Clemson University
Clemson, SC 29634

The SRAC project entitled "Enhancement of the immune response to *Edwardsiella ictaluri* in channel catfish" was initiated on May 2, 1989. Six researchers from Clemson University, the University of Georgia and Texas A&M University are involved.

ACCOMPLISHMENTS:

1. All administrative arrangements for funding the project with Clemson University acting as the lead institution have been completed.

2. All diets required for the study have been prepared and distributed to the appropriate institutions.

3. Fish to be used in the selenium feeding study have been screened for antibody to *Edwardsiella ictaluri* and the initial feeding trials have begun.

4. Most assays required for the levamisole feeding studies have been developed. Feeding trials will begin soon.

5. A recent fire at the University of Georgia destroyed the wet lab facilities to be used

in the vitamin E studies. However, construction of a similar facility has just been completed at Clemson University. Feeding trials will begin in the new facility within a month. Also, techniques have been developed to allow transportation of fish tissues from Clemson University to the University of Georgia for required analyses.

A more detailed description of the progress of each component of this project is given in the following sections:

EFFECT OF SELENIUM ON THE IMMUNE RESPONSE

Diets containing 0, 0.25 and 10 mg selenium/kg have been prepared and are being fed to fingerling channel catfish in aquaria at the Aquacultural Research Center (ARC) of the Texas A&M University System. Basal serum antibody titers to *E. ictaluri* have been determined; and, immunized and non-immunized fish are being fed the different diets for approximately 3.5 months as proposed. At the end of the feeding trial, fish fed the different diets will be evaluated using several different immune function tests and a live bacteria challenge to determine the effects of dietary selenium on immunocompetence. Results from this experiment should provide information about the use of dietary selenium supplementation to improve the immunocompetence of farm-raised catfish.

EFFECT OF VITAMIN E ON THE IMMUNE RESPONSE

Due to a fire which destroyed the wet laboratory facilities at the University of Georgia, the location of experiments has been changed. Fish will be fed the experimental diets in a recently-completed laboratory at Clemson University. Immune function tests will be conducted at either Clemson or Athens. All methods necessary to evaluate macrophage function and humoral immune response have been developed. In addition, methods

have been developed and tested to allow transporting tissues from Clemson to Athens for use in immune function tests.

Fish for this study have been stocked into experimental tanks and are presently being fed commercial diets (as outlined in the proposal). Feeding of experimental diets will begin in a few weeks to allow sampling of animals in late January or early February.

EFFECT OF LEVAMISOLE ON THE IMMUNE RESPONSE

Efforts during this initial phase were directed toward ascertaining immunologic status of experimental fish and conducting an *in vitro* assay of levamisole using catfish leukocytes. Immunologic status of fish were assessed using microtiter agglutinin assays, macrophage phagocytic and bactericidal assays and phage neutralization assays.

All fish to be used in the initial phase of the study were bled using cardiac puncture technique and the resulting serums tested for bacterial agglutinins using heat-killed suspensions of *Edwardsiella ictaluri* (for specific agglutinins) and *Escherichia coli* (for non-specific agglutinins). A small number of the fish possessed low titered (1:8 or less) non-specific agglutinins. Phage neutralization assays using doubling dilutions of serum and 2×10^8 PFU coliphage were negative. Ten fish were sacrificed for macrophage assay tests. Phagocytic index of fish were approximately 10% and nondetectable levels of bactericidal were observed. Immune function tests reveal that fish are capable of immunologic stimulus, susceptible to *E. ictaluri* and acceptable for use in the studies.

Preliminary *in vitro* mitogenic assays of fish leukocytes exposed to levamisole suggest that levamisole acts as an immunopotentiator in fish as it does in other vertebrates via reactivating T-cell populations. Based upon these preliminary observations, the hypothe-

sis is advanced that pharmacologic activity of levamisole is related to its ability to reverse the inhibitory activity of one or several of the stress hormones upon T-cell population.

PLANS FOR NEXT YEAR:

After completion of the initial selenium, vitamin E and levamisole studies, the investigators will meet to discuss the design of follow-up experiments (Obj 4, 5 and 6 in the proposal) and begin discussions on the content of an extension publication concerning nutrition and health in channel catfish (Obj 7). The follow-up experiments to be discussed are:

Objective 4: What combinations of vitamin E, selenium, and levamisole might best enhance the immune response?

Objective 5: What concentrations of dietary levamisole and cortisol should be used to investigate the interactive effects of these agents on immune function?

Objective 6: What combinations of vitamin E, selenium and levamisole might best alleviate stress-induced immunosuppression?

3. Effect of Nutrition on Body Composition and Subsequent Storage Quality of Farm-Raised Channel Catfish

Annual Progress Report
For The Period
May 2, 1989 - September 30, 1989

COOPERATING INSTITUTIONS:

Auburn University

Fisheries R.T. Lovell (Leader)
Ag. Economics Upton Hatch

Kentucky State University

Aqua. Res. Ctr. J.H. Tidwell (Leader)
C. Webster

Louisiana State University

Forestry, Wildlife
& Fisheries R.C. Reigh (Leader)
Food Science J. Samuel Godber

Mississippi State University

Delta Branch
Exper. Station E.H. Robinson (Leader)
Biochemistry R.P. Wilson
Wild. & Fish. H.R. Robinette
Ag. Economics J.E. Waldrop
Food Sci. &
Human Nutri. J.O. Hearnberger

Texas A&M

Wildlife & Fish.
Sciences D.M. Gatlin (Leader)

University of Arkansas at Pine Bluff

Agriculture D.O. Balogu (Leader)
H.F. Phillips

University of Georgia

Food Science
& Technology J.J. Jen (Leader)
J.W. Huang
D.A. Lillard
P.E. Koehler
R.R. Eiten Miller

Georgia Exp.

Station, Griffin M. Erickson
Coastal Plains
Exp. Station,
Tifton G. Burtle

ADMINISTRATIVE ADVISOR:

Gale A. Buchanan, Associate Director
Georgia Agricultural Experiment Station
Tifton, Georgia

PROGRESS OF WORK:

The project was approved May 2 of this year and all stations began their studies. At this time no final results are available, so this report covers progress for the 4 to 5-month period.

Objective 1: A feeding study was conducted at Auburn University (AU) to evaluate effects of feeding practical diets containing five digestible energy (DE)/protein (P) ratios to year-3 channel catfish for a growing season. (Year-3 fish were used because of availability of suitable size and number of fish. Year-2 fish will be fed next year). The DE/P ratios, in kcal/gram, were 10, 9.4, 8.5, 7.7 and 7.0 with protein percentages of 24, 28, 32, 36 and 40%. The ponds were harvested September 18-20. Fish yield, dressing percentage, and body composition are being measured. Data analysis is not complete. Some ponds yielded 7000-8000 kg/ha. Personnel from the Food Science Department from University of Georgia came to Auburn, Alabama, at the time of harvest and dressed, filleted, injected, packaged and froze fish from each of the treatments. They transported fresh and frozen fish back to Athens, Georgia, for the prescribed analyses and frozen storage studies. The Department of Agricultural Economics at AU will evaluate the economics of the effects of the diets on growth and quality of the processed product.

Nonstandard objective procedures for measuring autoxidation in frozen stored catfish are being pursued at the Georgia Agricultural Station in Griffin. Progress to date has involved selecting and adapting methodology required for quantitation of the components to be measured. The procedures to be evaluated are monitoring the loss of unsaturated fatty acids and the status of the endogenous antioxidants, vitamin E and carnosine.

A feeding experiment was initiated at Louisiana State University on June 1 to evaluate effects of top dressing feed with different amounts and types of fats on yield, body analysis and frozen storage quality of channel catfish. Commercial type feeds were supplemented with 2 or 4% beef fat, catfish oil, or menhaden oil. The diets are being fed in triplicate ponds stocked at a rate of 13,585/

ha (5,500 fish/acre). At the end of October, fish will be taken from each pond for measurement of weight gain, dressout percentage, visceral fat, muscle fat, fatty acid composition, and frozen storage quality of the fillets. The remaining fish in the ponds will be fed for a second growing season and evaluated in Fall of 1990. The storage quality studies will be conducted by the Department of Food Science who will coordinate experimental protocols with the other institutions doing similar studies (Mississippi State and University of Georgia).

Objective 2: A study to evaluate the effects of a high-protein finisher feed on yield and fattiness in catfish is underway at the Delta Branch Experiment Station (DBES), Stoneville, Mississippi. Average fish weight at 60 days was about 0.7 pound. There was no difference in fish fed 32 or 38% protein feeds for this period. Viscera fat was determined at 60 days and proximate analysis of edible tissue is currently underway. The experiment is progressing as planned. Feeding will continue until mid-October. The Department of Wildlife and Fisheries at Mississippi State University (MSU) has initiated a study to evaluate the effects of dietary protein level (32% vs. 38%) and feeding regime (satiation or restricted). The fish were sampled after 45 days and no differences were found. The fish will continue to receive experimental feeds until mid-October.

Fish from the feeding studies at the DBES and the Department of Wildlife & Fisheries, MSU, will be evaluated for weight gain, dressing percentage, and body composition. Fillets will be processed and frozen by procedures used commercially and evaluated for frozen storage quality. The Department of Food Science and Human Nutrition at MSU will be responsible for the storage quality evaluation. The Department is presently developing procedures for thiobarbituric acid (TBA) test, fatty acid analysis, and aldehyde determination which will be used to evaluate

the frozen fillets. The Department of Agricultural Economics at MSU will make an evaluation of the economic impact of the various dietary treatments on fish growth and product quality for the feeding studies at the DBES and at MSU.

The University of Arkansas at Pine Bluff stocked 12 ponds with catfish (13,585/ha or 5,500/ac) on May 3 to evaluate time of day feeding on feed intake, growth, feed efficiency, body composition and dressing yield. Feeding times are 800, 1200, and 1600 hours. Four ponds are fed by each schedule with floating feed containing 34% protein. The fish will be harvested at a size of 0.45 to 0.68 kg (1 to 1.5 lb).

A study was initiated at Kentucky State University to evaluate effects of frequency of feeding (once or twice daily) at two protein levels (32% and 38%) on growth and body composition of channel catfish. Most of the fish were lost from an epizootic of *Edwardsiella ictaluri* and the study had to be discontinued. It will start again next year.

Objective 3: A series of feeding trials in aquaria are currently in progress at Texas A&M University to determine the effects of natural and synthetic antioxidants in the diet on body composition and storage quality of channel catfish. Ethoxyquin, butylated hydroxyanisole (BHA), and butylated hydroxytoluene (BHT) are the synthetic antioxidants being evaluated along with the natural antioxidant vitamin E in 12-week feeding trials. The effects of these various antioxidants on chemistry and stability of lipids in channel catfish will be determined before and after six months of frozen storage.

A pond feeding study is underway at the Delta Branch Experiment Station to evaluate the effect of megadoses of vitamin E on catfish growth and subsequent storage of the frozen fish. The feeding portion of the study will continue until mid-October, then the fish

will be processed and evaluated for rate of autoxidation of lipids in the frozen fillets.

Feeding trials have begun at the Coastal Plains Experiment Station in Tifton, Georgia, using diets supplemented with 0.1% of l-carnitine with fingerling channel catfish. Diets containing 32% crude protein and graded energy levels of 2240, 2880 and 3520 kcal/kg of digestible energy were formulated to provide energy to protein ratios of 7, 9 and 11 kcal/g. Growth results are expected to be complete by October 31, 1989 and at that time analyses of carcass and tissue lipids and fatty acids will begin.

Studies are being conducted at Mississippi State University to determine quantitative essential fatty acid requirements of channel catfish. This will indicate the type and amount of fat to add to fish feeds to meet the fatty acid requirement. Also, the effects of amino acid supplementation on body composition is being investigated. Essential fatty acid deficiency signs have been identified.

USEFULNESS OF FINDINGS:

Feed composition and feeding regime influence growth and composition of gain and possibly frozen keeping quality of channel catfish. Results from these studies will show the effects of feeding catfish various ratios of protein to energy, various fat sources, or at various feeding schedules (daily or seasonally) on growth and on body composition and storage quality of frozen catfish fillets. If these treatments have measurable effects on frozen keeping quality of processed catfish, the benefits of a specific feeding regime can be compared with fish growth and production costs to determine the best feeding program for an optimum marketable product. Possible benefits of various feed supplements, such as extra vitamin E, commercial antioxidants and carnitine, on reducing fat content and suppressing subsequent autoxidation of the fat during frozen storage will be ascertained. These

studies will also reveal useful information on the optimum percentage of protein in commercial catfish feeds for weight gain, which is of great economic importance to the industry. The studies will also provide useful information of the storage quality of processed catfish under controlled packaging and frozen storage conditions. Improved objective procedures for evaluating quality in frozen stored catfish should emerge from these studies. No information is available to report at this time.

WORK PLANNED FOR NEXT YEAR:

All stations will proceed with their projects generally as stated for Year 2 in the Project Proposal. Auburn University will evaluate second-year catfish since third-year fish were evaluated during Year 1. The other stations will retain fish from this year's study and evaluate third-year fish during Year 2. Kentucky State University will repeat the study planned for Year 1 since disease and heavy loss of fish terminated the initial study. Frozen storage studies, which will last for six or more months post-harvest, will continue into the next project year.

4. Harvesting, Loading and Grading Systems for Cultured Freshwater Finfishes and Crustaceans

Annual Progress Report
For The Period
May 2, 1989 to September 30, 1989

COOPERATING INSTITUTIONS:

Louisiana State University (Lead Institution) - Robert P. Romaine, Tom B. Lawson, Gary Jensen, Lawrence W. de la Bretonne, Jr.
Auburn University - J. W. Jensen, John Grizzle, Leonard L. Lovshin, R.O. Smitherman, R. K. Goodman
Clemson University - John Collier, Thomas E. Schwedler

Memphis State University - Kenneth B. Davis, James F. Payne, Bill A. Simco
Mississippi State University - M. J. Fuller, J. G. Dillard, M. W. Brunson
University of Georgia - George W. Lewis, James Shelton
University of Southwestern Louisiana - Jay V. Huner

ADMINISTRATIVE ADVISOR:

W. H. Brown, Associate Director
Louisiana Agric. Experiment Station
Baton Rouge, Louisiana

PROGRESS:

Auburn University:

Auburn University's primary responsibility is channel catfish harvesting, loading, and grading research. The period from May 1, 1989, through September 30, 1989 was used to purchase equipment and supplies, prepare ponds, and acquire harvesting gear needed for the project. Two of the three harvesters to be evaluated, boom and basket and the Trasvac vacuum pump, have been obtained. An arrangement has been made to lease the third harvester, Aqua-Life impeller pump, for the duration of the three-year project, and its projected arrival date at Auburn is early October. Seines, grading socks, and transport tanks have been ordered and will arrive in early October. A graduate research assistant was hired to assist in the research. Six thousand pounds of market-sized channel catfish were purchased, and with 4,000 pounds of Auburn-reared catfish, they were stocked into ponds assigned to the SRAC harvesting project.

The proposed research methodology to evaluate loading efficiency and loading-induced fish trauma have been modified from that in the original proposal, and the modifications are as follows: (1) Loading Efficiency: loading efficiency (time expired between moving fish from rearing unit to transport tank) will be

tested in concrete holding vats to reduce human influence on harvest. Three holding vats will be stocked with equal weights (2,000-4,000 pounds) and sizes of market-sized catfish. Fish can be more easily crowded and loaded into the harvester from a vat, making the time to lift the fish onto the transport tank a better indicator of transfer efficiency of each harvest device tested; (2) Harvest Trauma: Physical and physiological trauma incurred by catfish during removal from ponds will be examined with market-sized fish stocked in three one-acre ponds containing 5,000 pounds of fish per acre each, rather than with one pond as was originally proposed. This is to minimize fish stress associated with repeated harvest measurements on the same fish with different harvesting gear.

A portion of the fish harvested with each of the three devices will be stocked at random into .04-acre ponds at equal standing crops and held for two weeks after which fish mortality associated with harvest will be determined. Harvesting research trials with channel catfish will begin in mid-October and will continue at monthly intervals until April, 1990.

Clemson University:

The period from May 1, 1989, through September 30, 1989, was used to purchase supplies to construct an experimental observation tank from non-conductive materials in order to evaluate the avoidance response and learned behavior of channel catfish to an electrical stimulus. Electrical equipment was ordered, and the electrical delivery system is presently being designed so that water in the "non-conductive" observation tank can be supplied with variable voltage, amperage, and frequency control. A graduate research assistant is being recruited to assist in this research. The period from October 1, 1989, through April 30, 1990, will be spent constructing and calibrating the electrical system on the observation tank. A series of laboratory experiments will be conducted in the tank to observe channel catfish

avoidance response to electrical stimulus. These data will be used to design an electrical harvesting system for channel catfish that will be evaluated in year two.

Louisiana State University:

Six, 5-acre experimental crawfish ponds were stocked with brood crawfish at rates of 45-90 pounds per acre in May and June, 1989. Ponds were drained and rice (Tebonnet variety) was planted in all ponds in mid-August as crawfish forage. The six ponds were serviced with electrical power, and two 3-hp aerators were installed in each of three ponds to generate water currents. The six ponds will be filled with water in mid-October 1989 for crawfish production, and harvesting research will be initiated in late November/mid-December and continue through May 1990. A graduate research assistant has been hired to assist in the crawfish harvesting research, and a part-time research associate to assist in the harvesting component of the project will likely be hired in November.

An in-boat (on-board) crawfish grader was purchased. The grader will be evaluated from late November/mid-December, 1989 through May, 1990 in the six 5-acre ponds. Site visits were made in April to observe two types of crawfish graders in operation, obtain preliminary information on the graders, and to discuss with the manufacturers the benefits and problems associated with each unit. Other grader manufacturers have been contacted, and additional site visits and grader evaluations will be made with initiation of the crawfish harvesting season in late November/mid-December. A graduate research assistant is being recruited to assist in the crawfish grading research.

Production of a video on finfish grading, handling, and transportation was initiated by Louisiana Cooperative Extension Service (LCES) personnel. In early October a site visit will be made to Scottsboro, Alabama to

film, at a commercial catfish farm, use and operation of a fish pump for harvesting channel catfish. Video will be taken at a SRAC finfish harvesting demonstration at Cohutta, Georgia, and catfish harvesting with seine-trapping techniques will be filmed by LCES personnel at the Alabama Agricultural Experiment Station in Auburn, Alabama. A draft of an extension publication "Sorting and Grading Warmwater Fish" has been prepared by Dr. Gary Jensen as part of the SRAC project "Preparation of Southern Regional Aquaculture Publications" approved for funding in 1987.

University of Georgia:

The period from May, 1989 through September, 1989 was spent organizing a Southern Regional Aquaculture Harvesting Workshop held in Cohutta, Georgia on October 10, 1989. The workshop, which featured harvesting of finfishes, included: (1) demonstrations of fish harvest procedures with seines; (2) demonstration of partial harvest and trapping techniques with seines; (3) harvesting demonstrations using fish transfer pumps; and (4) vendor displays of a variety of harvesting equipment and live-hauling tanks.

Memphis State University:

The period from May through October, 1989 was used to refine analytical laboratory techniques on blood chemistry analysis of channel catfish and crawfish. These techniques will be used to assess the physiological response of these two species to harvesting, grading, loading, and hauling activities. Analytical techniques were refined for osmotic pressure, sodium, and chloride measurements with crawfish hemolymph. A graduate research assistant was hired during the summer to assist in conduct of this project. A trip was made by Memphis State personnel to Auburn University to discuss time tables, sampling protocols, and procedures for transfer of cat-

fish blood samples from harvesting, loading, and grading research at Auburn University (beginning in October, 1989) to Memphis State University. Memphis State University researchers will visit researchers in Louisiana (LSU and USL) this fall to develop protocols and procedures for sampling and shipment of crawfish hemolymph samples to Memphis State for analysis.

Mississippi State University:

Economic analysis of harvesting, loading, and grading systems for channel catfish and crawfish is dependent on data collected by researchers at cooperative institutions during the 1989-1990 production seasons. Mississippi State University aquacultural economists have visited with Louisiana State University crawfish researchers and Auburn University catfish researchers to discuss experimental design and data needs for economic analysis for the harvesting, loading, and grading project. No work was scheduled for Mississippi Cooperative Extension Service personnel in the first year of this project.

University of Southwestern Louisiana:

University of Southwestern Louisiana (USL) personnel had a meeting with manufacturers of "experimental" automated crawfish harvesters in August 1989 to discuss potential and opportunities for automated crawfish harvesting equipment. A 30-acre experimental crawfish pond at USL's agricultural research station at Cade was planted with sorghum-sudan grass as forage for crawfish in September. USL researchers ordered materials and supplies to construct an experimental bow-mounted beam trawl for harvesting crawfish. The experimental beam trawl will be evaluated in the USL research pond and at commercial crawfish farms from late November/mid-December, 1989 through May, 1990.

USEFULNESS OF FINDINGS:

The research efforts have not progressed far enough from May-September, 1989 to benefit producers. The finfish harvesting demonstration workshop that will be held in Cohutto, Georgia, on October 10, 1989, will be the first workshop in the Southern Region to demonstrate the potential for use of "new" finfish harvesting equipment such as fish pumps.

WORK PLANNED FOR THE REMAINDER OF THE PROJECT'S FIRST YEAR:

The work plan for the remainder of the first year by the various institutions is essentially the same as that outlined in the original proposal. The research plan at Auburn University has been modified slightly as reported herein to improve data generated from the channel catfish harvesting studies. Work at all institutions is progressing satisfactorily. Several graduate research assistants and other personnel have been employed to date to assist in various components of the project, and other personnel are in the process of being employed to work on the project.

PUBLICATIONS:

The project has not been in progress long enough for preparation of research reports. However, a draft of one extension publication "Sorting and Grading Warmwater Fish" by Dr. Gary Jensen has been prepared as part of the SRAC project "Preparation of Southern Regional Aquaculture Publications".

BUDGET:

Louisiana State University, as lead institution, finalized sub-contracts with each participating institution from during the period May-October 1989. Co-principal investigators at the cooperating institutions are spending year-1 funds for personnel, supplies, equipment, and travel.

5. Develop a Statistical Data Collection System for Farm-raised Catfish and Other Aquaculture Products in the Southern Region

Annual Progress Report
For The Period
May 2, 1989 to September 30, 1989

SUGGESTED REPRESENTATIVES AND INSTITUTIONS:

John E. Waldrop, Mississippi State University
Marty W. Brunson, Mississippi State University
Larry de la Bretonne, Louisiana State University
Ken J. Roberts, Louisiana State University
Gary Jensen, Louisiana State University
John Jensen, Auburn University
D. Leroy Gray, Arkansas Cooperative Extension Service
James T. Davis, Texas A&M University
George W. Lewis, University of Georgia
Jeffery Hinshaw, Mt. Horticultural Crops Research Station, Fletcher, N.C.
Glen Gebhart, Langston University, Okla.
Thomas E. Schwedler, Clemson University
Charles Cichra, Florida Cooperative Extension Service
Tom Hill, Tennessee Cooperative Extension Service
Extension Aquaculture Specialist, Kentucky State University
Extension Aquaculture Specialist, Virginia Polytech/Virginia State Universities
USDA/CSRS/ERS/SRS/NASS
State Departments of Agriculture
Industry Representatives

ADMINISTRATIVE ADVISOR:

Verner G. Hurt, Director
Ms. Agric. & Forestry Experimt Station
Mississippi State, Mississippi

PROGRESS OF THE WORK:

The Steering Committee for Data Collection Systems met on August 4, 1989. A general discussion was held regarding the need to establish protocol, method of data collection, follow-up meetings, and identification of individuals recommended to assist with development of procedures to address objectives outlined in the Problem Statement developed earlier by this Committee.

Available information for catfish, which includes a monthly processing report from NASS/USDA, Washington, D.C., was reviewed. This information is supplied by different processors and lacks consistency. Processors voluntarily submit these reports on a monthly basis, therefore, much information is lacking since not all processors participate. There was concern expressed about the degree of accuracy of information reported and standardization of data submitted.

Consensus of the Committee was that a national government agency should be designated to collect data needed, primarily because some sources would not be willing to report sales, distribution, and similar data, to private or possibly regional agencies. The need for consistency of data and good definitions of the survey information requested was repeatedly stressed.

The Office of the Mississippi Commissioner of Agriculture collects some processing data, but this, too, is limited.

This Steering Committee needs to identify and summarize the types of information now available, the frequency of reporting, and the types of information needed. The specifics of data needed by different segments of industry must be clearly designated. This summary should be distributed to Committee members and others who will attend the next meeting.

Dr. Marty Brunson (MCES) is trying to

reinstate a report previously prepared for Mississippi which included estimates of the number and size of (1) ponds in production, (2) ponds under construction, and (3) ponds being renovated at each of the reporting intervals, and an estimate of the number of acres involved in fingerlings and food fish. The group suggested it would be best to obtain this information from the county level coordinated by one person in each state, perhaps the Extension Aquaculture Specialist. Thus, information from the states could come from the grassroots level, be compiled by each state CES, and then coordinated regionally or nationally by a central reporting agency.

Following is a summary of the sources of information now available:

1. Catfish Report -- Mississippi only. Distributed by the Mississippi Agricultural Statistics Service (Dick Knight, et al), Jackson, Mississippi (see Addendum A).

2. Mississippi Weekly Processors' Report -- distributed by the State Commissioner of Agriculture's office (see Addendum B).

3. Monthly Farm-Raised Processed Catfish Report -- distributed by the Economics Research Service/National Agriculture Statistics Service, Rockville, Maryland² (see Addendum C).

4. The report previously prepared and distributed by MCES three times a year.

5. Aquaculture -- Situation and Outlook Report -- distributed in October, 1988, and up-

²In May, 1988, a group from USDA/NASS/ERS visited the Mississippi catfish industry with Dick Knight and Harold Ishee of the Mississippi Agricultural Statistics Service. These were Bill Pratt, Doyle Fox, Ron Sitzman and Fred Hoff. When visiting with Dr. Shepherd, they expressed sincere interest in assisting with data collection for aquaculture.

dated in March and September, 1989. These were prepared by Mike Dicks and David Harvey of the USDA/Economics Research Service. It is uncertain as to whether this will be a continuing effort.

The group asked Mr. Sam Hinote to identify the types of information needed by the industry at this time. These were:

1. Acreage and production statistics -- what is happening in each state at the current time. These reports are needed in July and December of each year. They could be submitted to specified individuals in each state (Cooperative Extension Service) and then possibly coordinated, compiled and distributed on a regional level by organizations similar to the Mississippi Agricultural Statistics Service. Information included in this category needs to be separated by fingerlings, food fish, renovations, construction and hatcheries. Recreational and fee fishing acreages also need to be identified.

2. Catfish feed report -- feed manufacturing information could be correlated with the fish production and processing reports. It was felt that this may need to be developed by the State Departments of Agriculture for effective, reliable and official reporting. Information is needed on the amount and types of feed being manufactured and distributed in the different states.

3. A state-by-state breakdown on the amount of fish processed and sold is needed. At the present time there is no true supply and demand picture. This information is urgently needed by the industry. The National Marine Fisheries Report was discussed. Catfish as a commodity is not identified in this report. There is certainly a need to get this 300 million pound commodity properly identified in all aquaculture statistical reports.

4. The poultry database model can possibly be modified and used as guidelines to develop

a format suitable for aquaculture.

Item #4 is primarily needed after a satisfactory system to obtain and distribute information described in Items #1, #2, and #3 has been developed and established.

The Committee felt it would be appropriate for John Waldrop and Larry de la Bretonne to check with sources distributing the information previously discussed and get a current update on exactly what is available. They should contact State Statistical Reporting Services, State Departments of Agriculture and Commerce, National Agriculture Statistical Service and USDA/ERS. They should also contact key Extension representatives in major states producing finfish (catfish, etc.) and crustaceans (crawfish, etc.).

On October 10, 1989, the Steering Committee met with representatives of NASS, Mississippi Statistics Service, and ERS and established avenues of communication and cooperation. During the December 8, 1989, Board meeting, Dr. Verner G. Hurt, Administrative Advisor, requested approval to proceed with the establishment of a Work Group from the agencies to be involved in collecting the data (State Statistical Reporting Services, State Departments of Agriculture and Commerce, NASS and USDA/ERS). Plans are to develop information for catfish as a model which can be used as a "suggested" approach for other aquacultural species. Following development of the initial model, modifications, adaptations, and other improvements will be solicited from all interested parties. Objectives are to identify data needs and develop plans to collect the data. Board approval has been given for this group to proceed with these plans as outlined.

If these efforts result in a satisfactory data collection system, it may be appropriate to expand similar activities to include inputs from other Regional Aquaculture Centers in order to obtain information on a national basis.

V. SUMMARY COMMENTS

Significant future aquaculture development will result from the coordinated programs of the Regional Centers. Scientific and user inputs are assured in these programs through their respective Boards of Directors, Technical Committees and Industry Advisory Councils.

The Board is the policy-making body for SRAC and established the IAC and TC. IAC members represent different segments of the aquaculture industry throughout the Region. This group provides valuable inputs for identifying research and extension needs and priorities from an industry perspective. The TC is composed of research and extension scientists from essentially all states within the Region and helps identify research and extension needs for the Southern Region from a technical perspective. The IAC and TC make joint recommendations to the Board for priority needs and for new and continuing projects.

A number of technical and popular-type bulletins are being prepared from the research being done on "Analysis of Regional and National Markets for Aquacultural Products Produced for Food in the Southern Region". This information should be of interest to processors and other marketers of catfish. The database being compiled from this research effort will be of benefit for some time. One major finding of this project shows that catfish is now being consumed in significant quantities by persons of all income and educational levels in all major regions of the U.S.

Of the 60 publications to be prepared by the "Preparation of Southern Regional Aquaculture Publications" project, over half have been published and the remainder are nearing completion. Two videos have been completed and nine others are in production. These publications and videos will be provided to Extension Aquaculture Specialists throughout the Southern Region for distribution. Very

good response nationwide has been received regarding completed materials and numerous requests for copies have been received.

The Southern Regional Aquaculture Harvesting Workshop held on October 10, 1989, at Cohutto, Georgia, was quite successful and demonstrated several types of harvesting activities. In the fall of 1990, a demonstration workshop on harvesting methods for crawfish will be scheduled in Louisiana.

Aquaculture is the most rapidly growing segment of U.S. agriculture, increasing at a rate of over 20% annually. In 1987, private production was valued over \$650 million. In 1988, per capita consumption of fishery products, which includes only products that moved through commercial channels, was 15.0 pounds, and the U.S. had a trade deficit of more than \$6.6 billion for all fishery products.

The potential for domestic aquaculture success is tremendous. An excellent example is catfish production in the Mid-South where the on-farm value of catfish in 1988 was greater than \$300 million. Including revenues from feed mills, processing and other allied businesses, the total value of the catfish industry is approximately \$1.0 billion in the U.S.

Potential for aquaculture expansion exists in many states. However, experience has shown that additional services from research and extension scientists are essential for aquaculture to reach its full economic potential.

There has been considerable interest among research and extension scientists from numerous universities and agencies to work cooperatively in the new regional aquaculture programs. Approximately 69 scientists representing all states and territories within the Southern Region have collaborated on the eight projects discussed in this report.

ADDENDA

Catfish

February 9, 1989

Mississippi
Agricultural
Statistics Service
U.S. Department of Agriculture
Mississippi Department of Agriculture &
Commerce
P.O. Box 980
Jackson, Mississippi 39205
Phone 601/965-4575

RESULTS OF CATFISH GROWERS SURVEY

Catfish growers in 17 selected States had sales of 285 million dollars during 1988. Value of sales from Hatchery operations totaled 20 million dollars while the value of sales from production units totaled 265 million dollars. Total sales for 1987 were 243 million for the same 17 States.

Hatchery operations had 1.35 million broodfish, 85.0 million stockers and 365 million fingerlings on hand January 1. Production operations had 3.77 million large fish (over 3 pounds); 147 million foodsize fish (3/4 pound to 3 pounds); 261 million stockers and 516 million fingerlings.

Water acres totaled 139,399 acres compared with 130,170 acres July 1988.

SALES OUTLETS FOR PRODUCING UNITS

Sales of foodsize fish was dominated by sales to processors with 89 percent. Live-haul amounted to 4 percent; retail, restaurant and food stores, fee and recreation, and direct sales to consumers each received 2 percent of the sales. Sales to other producers accounted for 1 percent while all other outlets together had less than 1 percent.

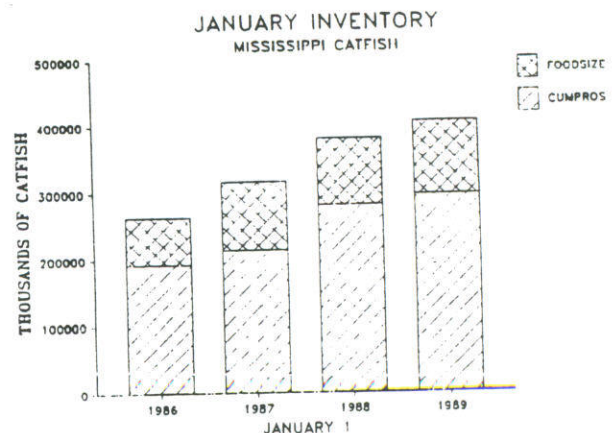
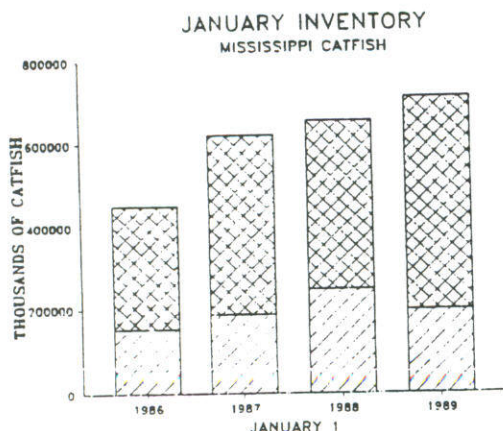
LOSSES OF FISH

The 1,922 producers in these 17 states reported losses of 100 million fish in 1988. Causes of these losses were: disease 39 percent; oxygen depletion, 18 percent; winterkill 12 percent; flood, 9 percent; all other causes were 22 percent.

MISSISSIPPI CATFISH

Mississippi sales from catfish during 1988 totaled 211 million dollars, 74 percent of the total sales from the 17 states.

Acres of water being used for catfish production totaled 88,000, January 1, 1989. Another 1,900 acres of ponds were out of production; 700 of these acres were being renovated. New pond construction totaled 1,800 acres. Construction of 500 of these acres started since July 1, 1988.



FINGER - TOTAL FINGERLING AND FRY
INVENTORY JANUARY 1.
STOCKER - SIX INCHES TO 3/4 POUND
FISH JANUARY 1.
FOODSIZE- TOTAL FOODSIZE INVENTORY
JANUARY 1.
CUMPROS - POUNDS PROCESSED
JANUARY - DECEMBER 1988
PROCESSOR REPORT.

CATFISH GROWER SURVEY
January 1987 - January 1989

	Foodsize Inventory				Total	
	(3/4 - 3 lbs.)		(over 3 lbs.)			
	number (000)	pounds (000)	number (000)	pounds (000)	number (000)	pounds (000)
January 1987	91676	100179	10905	20603	102581	120782
April 1987	51954	51244	4473	8689	56067	59933
July 1987	85030	84341	7379	13621	92409	97962
October 1987	117391	124399	21628	40136	139019	164535
January 1988	83339	92081	15451	29148	98790	121229
April 1988	48110	48038	178	418	48288	48456
July 1988	104667	103297	973	3214	105640	106511
October 1988	145826	167808	747	2565	146573	170373
January 1989	107259	129369	2708	8934	109967	138303

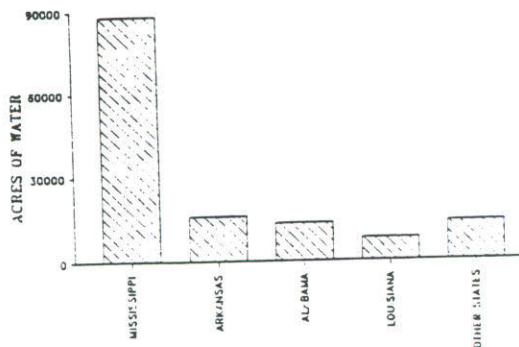
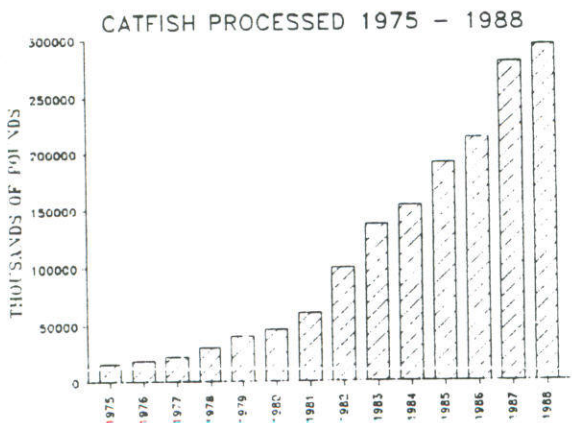
As of April 1988, size groups were changed from 3/4 - 1 1/2 lbs. to (3/4 - 3 lbs.) and from over 1 1/2 lbs. to over 3 lbs. Total no. and lbs. are comparable with previous quarters.

	Stocker Inventory		Fry/Fingerlings Inventory	
	(6 in. to 3/4 lb.)		(less than 6 inches)	
	number (000)	pounds (000)	number (000)	avg. in.
January 1987	26993	185303	248511	5.0
April 1987	7357	234531	195500	4.7
July 1987	32327	281380	487317	3.8
October 1987	75192	236351	363481	4.1
January 1988	30379	245500	235289	5.1
April 1988	6908	232399	211860	5.0
July 1988	20200	245348	306732	4.0
October 1988	97453	207136	445743	4.5
January 1989	33800	196671	291606	4.7

Hatchery Inventory						
	Fry/Fingerlings		Stockers		Losses number (000)	Previous Year pounds (000)
	number (000)	avg. in.	(6 in. to 3/4 lb.)			
			number (000)	avg. lbs		
January 1987	186243	5.0				
April 1987	140500	4.3				
July 1987	344963	4.5				
October 1987	243745	4.5				
January 1988	173371	2.1			59621	N/A
April 1988	116547	5.1	14610	.132		
July 1988	469778	2.6	39977	.322		
October 1988	151068	4.3	4802	.397	68770	27508
January 1989	222068	4.8	65380	.379		

USDA-NASS

17 Selected States
January 1989
Water Acres



UNITED STATES DEPARTMENT OF AGRICULTURE
NATIONAL AGRICULTURAL STATISTICS SERVICE
AGRICULTURAL STATISTICIAN
POST OFFICE BOX 980
JACKSON, MISSISSIPPI 39205



OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF AGRICULTURE
AGR-101

FIRST CLASS



MISSISSIPPI
DEPARTMENT
of
AGRICULTURE
and
COMMERCE

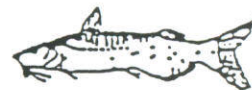
P. O. Box 1609
Jackson, Mississippi 39215-1609

JIM BUCK ROSS
COMMISSIONER

July 28, 1989



Catfish



FOR THE WEEK OF July 21, 1989, PRICES AND
VOLUME OF FARM-RAISED CATFISH PROCESSED WERE:

PRICE RANGE: 63-74c
WEIGHTED AVERAGE PRICE: 69c
VOLUME PROCESSED 5,601,273 LBS.

THE FOLLOWING PLANTS IN MISSISSIPPI, ALABAMA, GEORGIA,
OKLAHOMA, ARKANSAS AND LOUISIANA REPORTED THIS WEEK:

GUIDRY'S CATFISH PROCESSORS
AMITE RIVER INDUSTRIES
DELTA CATFISH PROCESSORS
COUNTRY SKILLET
HUMPHREY'S COUNTY PROCESSORS
FARM FRESH, AL & MS (NO REPORT) *
GULFSOUTH PROCESSORS
SOUTHERN PRIDE CATFISH
SIMMONS CATFISH
PRIDE OF THE POND
FRANKLIN CATFISH
CRAWFORD CATFISH ACRES
SAUL FISH PROCESSORS
AQUACULTURE PRODUCTS
SOUTH FRESH FARMS
AMERICA'S CATCH

NOTE: THE CIRCULATION OF THIS REPORT IS RESTRICTED TO
MISSISSIPPI CATFISH FARMERS AND THOSE PROCESSORS
TO WHOM THEIR FISH IS SOLD.

THIS PAPER IS MADE FROM 75% WOOD AND 25% COTTON FIBER - PRODUCTS OF MISSISSIPPI

ADDENDUM "B"

Catfish



National
Agricultural
Statistics
Service

Fact Finding
for Agriculture
Since 1863

United States
Department of
Agriculture

Agricultural
Statistics
Board

Washington, D.C.

RELEASED: July 20, 1989
3:00 P.M. ET

CATFISH PROCESSING UP 21 PERCENT

Farm-raised catfish processed during June totaled 27.6 million pounds round weight, according to the Agricultural Statistics Board, up 21 percent from June 1988.

The June average price paid to growers was 75 cents per pound, 3 cents below the same month last year.

Net pounds of processed fish sold during June totaled 14.4 million pounds, 20 percent above the comparable month in 1988. Sales of whole fish represented 36 percent of the total and fillets accounted for 46 percent. The remaining 18 percent were mostly steaks, nuggets, and value added products. Ice pack sales were 49 percent of the total amount sold.

The June average prices received by processors for whole fish were \$1.51 per pound for ice pack and \$1.70 for frozen fish.

Freshwater catfish imports during May totaled 952 thousand pounds, 90 percent of which were from Brazil. Imports were down 6 percent from the amount imported a year earlier. Import data were compiled by the U.S. Bureau of the Census.

Processing data were compiled in cooperation with the following processors:

America's Catch
Amite River Industries
Aquaculture Products
Carolina Classics Catfish, Inc.
Cole Foods, Inc.
Corbin Fish Farm
Country Fresh Catch
Country Skillet (Con Agra)
Delta Pride Catfish, Inc.
Dillons Fresh Catfish
Dorey Fish Co.
Farm Fresh Catfish Co.
Franklin Catfish
Freshwater Farms, Inc.
Fish Breeders of Idaho
Guidry Catfish Processors, Inc.

Gulf South Processors, Inc.
King Kat, Inc.
Kueter's Lake
Lake's Farm Raised Catfish, Inc.
Limestone Fish Processors
Louisiana Catfish, Inc.
Pisces
Pond Fresh
Pride of the Pond
Prime Line Catfish Co.
Red-Ark (Aqua Farms)
Simmons Farm-Raised
Southfresh Farms
Southern Pride Catfish
U. S Fish Corp.

SpCr 8 (7-89)

For Information Call: (202) 447-2123

FARM - RAISED CATFISH, 1988-89
QUANTITY PROCESSED AND PRICES PAID TO PRODUCERS,
REPORTED BY MAJOR PROCESSORS; AND U.S. IMPORTS

MONTH	ROUND WEIGHT PROCESSED				AVERAGE PRICE		IMPORTS	
	MONTHLY		CUMULATIVE		PAID TO		OF	
	1988	1989	1988	1989	1988	1989	1988	1989
	THOUSAND POUNDS				DOLLARS PER POUND		THOUSAND POUNDS	
JAN	26,018	26,948	26,018	26,948	.68	.78	451	588
FEB	27,786	28,559	53,804	55,507	.72	.78	508	117
MAR	28,179	29,458	81,983	84,965	.75	.77	577	795
APR	20,805	27,310	102,788	112,275	.75	.76	217	417
MAY	20,351	28,892	123,139	141,167	.75	.76	1,015	952
JUN	22,839	27,598	145,978	168,765	.78	.75	26	
JUL	23,687		169,665		.80		724	
AUG	26,941		196,606		.80		414	
SEP	24,611		221,217		.79		669	
OCT	26,221		247,438		.79		674	
NOV	25,037		272,475		.78		388	
DEC	22,634		295,109		.78		182	

CATFISH PROCESSORS' SALES VOLUME, AVERAGE PRICE, AND ENDING INVENTORY,
JUNE

ITEM	:	WHOLE	:	FILLETS	:	OTHER	:	TOTAL								
	:	FISH 3/	:	4/	:	5/	:									
YEAR	:	1988	:	1989	:	1988	:	1989	:	1989						
FRESH	:															
QUANTITY (000) LB:	:	2,740	:	3,709	:	1,754	:	2,658	:	368	:	630	:	4,862	:	6,997
PRICE (\$ / LB)	:	1.68	:	1.51	:	2.83	:	2.67	:	1.84	:	1.73	:	2.11	:	1.97
INVENTORY (000) LB:	:	264	:	300	:	218	:	338	:	57	:	72	:	539	:	710
FROZEN	:															
QUANTITY (000) LB:	:	1,497	:	1,518	:	3,724	:	3,935	:	1,935	:	1,923	:	7,156	:	7,376
PRICE (\$ / LB)	:	1.80	:	1.70	:	2.79	:	2.63	:	2.14	:	2.03	:	2.41	:	2.28
INVENTORY (000) LB:	:	761	:	1,580	:	885	:	3,524	:	1,601	:	1,156	:	3,247	:	6,260

1/ PRICES PAID TO PRODUCERS FOR FISH DELIVERED TO PROCESSING PLANT. 2/ DATA FURNISHED BY U.S. BUREAU OF CENSUS. 3/ DRESSED WEIGHT, (HEAD, VISCERA, AND SKIN REMOVED). 4/ INCLUDES REGULAR, SHANK, AND STRIP FILLETS; EXCLUDES ANY BREADED PRODUCT. 5/ INCLUDES ALL PRODUCTS NOT ALREADY REPORTED, INCLUDING WEIGHT OF BREADING AND ADDED INGREDIENTS.

* NOTICE *
*
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*should be directed to ERS/NASS, P.O. Box 1608, Rockville, MD. 20850 *
* or call 800-999-6779. *
*
* The next issue of this report will be published August 21, 1989 *

CATFISH,
JULY 1989

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AGRICULTURAL STATISTICS BOARD,
NASS, USDA



MONTHLY FARM-RAISED PROCESSED CATFISH REPORT

Form Approved
OMB Number 0535-0150
Expiration date 6/30/91
E-060100

Dear Processor:


Delta Catfish Processors, Inc.
P.O. Box 850
Indianola, Mississippi 38751

ATTENTION: Ms. Marsha Evans

Two copies of this report are sent to you. One copy is for your files and the other is to be returned within six working days after the end of the month in the enclosed self-addressed, stamped envelope. These reports are requested from all processors of farm-raised catfish having a production capacity of at least 2,000 pounds, liveweight, per 8-hour day.

Response to this survey is voluntary and not required by law. However, cooperation is very important in order to estimate accurately catfish processed in the United States. All information is kept confidential.

Very truly yours,


Richard D. Allen, Chairperson
Agricultural Statistics Board

Please make corrections in name, address and
Zip code, if necessary.

FOR MONTH OF: JULY 89

1. Total round weight processed during the current month Pounds _____
2. Average price paid for live fish delivered to plant \$/Pound _____
3. Sales of Catfish from this operation (exclude dressed catfish purchased from other plants). 1/

ITEM	Whole Fish 2/	Fillets 3/	Other 4/	Total
FRESH Lbs.				
Average \$ per Lb.				
Inventory End of Month Lbs.				
FROZEN Lbs.				
Average \$ per Lb.				
Inventory End of Month Lbs.				

- 1/ All sales f.o.b. plant.
- 2/ Dressed weight, (head, viscera and skin removed)
- 3/ Include regular, shank and strip fillets; exclude any breaded product.
- 4/ Includes all products not already reported, including weight of seasoning and added ingredients.

COMMENTS: _____

Reported by: _____ Date: _____

