

TWENTY-SIXTH ANNUAL PROGRESS REPORT

For the Period Through August 31, 2013



**Supporting research and extension
projects based on industry needs and
designed to directly impact
commercial aquaculture development.**



United States
Department of
Agriculture

National Institute
of Food and
Agriculture

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TWENTY-SIXTH ANNUAL PROGRESS REPORT

SOUTHERN REGIONAL AQUACULTURE CENTER

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EXECUTIVE SUMMARY

This Twenty-sixth Annual Progress Report seeks to provide a summary of work completed and outreach activities of the Administrative Center during the past year. Full progress reports on the six multi-year research and extension projects supported by SRAC during this reporting period are available at <http://www.srac.msstate.edu/annualprogressreports.html>. In the past year, SRAC funded projects totaling more than \$1.7 million. These projects resulted in 26 oral presentations, 3 poster presentations, 13 Extension publications, 5 journal articles, 6 digital products, and has supported 11 students.

The Center's "Publications" project is in its eighteenth year of funding. Twelve new fact sheets, one DVD, and one mass media presentation were completed while 19 fact sheets and three mass media presentations are in the process of review or revision. To date, the project has generated 225 technical fact sheets, 5 mass media presentations, and 30 videos with contributions from 225 authors.

Results of the "Market Trends" project have been shared with stakeholders through presentations, workshops, meetings, and field-day events. Summaries of market trends in 52 cities across the U.S. for the past five years have been sent to 19 catfish processing companies, and detailed customized reports have been sent to six catfish processing companies at their request. The catfish industry has requested help from project participants in organizing region-specific advertisement messages for the industry.

While key response variables were documented and are deemed valuable, a significant pivotal breakthrough was not realized from the "Cool Water Crawfish Baits" project. This research suggests that key amino acids may play a vital role in determining the quality of a crawfish attractant and has identified several amino acids that may be most important. Moreover, it was determined that the rate and timings of key amino acid released from baits in water may affect the efficacy of different baits. This provides the impetus and possible direction for further research.

Guidelines developed from the "Ornamental and Marine Baitfish" project have significantly helped growers reduce operating costs and the potential for introduction of disease. An emerging bio-plastic has been developed to remove ammonia from indoor fish breeding operations using a novel assimilation technique. Broodstock maturation and larval rearing techniques specific to pinfish and bala sharks have led to successful commercial scale production.

The "Catfish Broodstock Management" project aims to identify the most cost-effective method of increasing catfish fry production efficiency through manipulation of broodfish diets, gender ratios, and stocking densities. Diets with different proteins, lipids and supplements were tested for efficacy in improving fry production. Different ratios of males to females and stocking rates were tested for their ability to improve fry production. Economic analysis of fry production efficiency was conducted. Economic analysis of data to date has shown that some of the biological results that were significantly different among treatments did not translate to improved cost efficiency of fry production.

The "Intensive, Pond-based Systems" project will evaluate the production efficiencies of three new catfish production systems; smaller conventional earthen ponds with increased aeration rates, split-pond systems, and in-pond raceways. Based on these findings, a complete economic analysis will be performed and will provide the necessary guidance to make recommendations to farmers. Although the project is only six months into development, cooperators have been recruited and experimental production units are being built. The potential impact of this project cannot be measured at this point as the data is incomplete.

INTRODUCTION

Mission

The mission of the Southern Regional Aquaculture Center is to support aquaculture research, development, demonstration, and education to enhance viable and profitable U.S. aquaculture production to benefit consumers, producers, service industries, and the American economy. Projects that are developed and funded are based on industry needs and are designed to directly impact commercial aquaculture development in the southern region and the nation.

Background

The Agriculture Acts of 1980 and 1985 authorized establishment of aquaculture research, development, and demonstration centers in the United States. With appropriations provided by Congress for the 1987 and 1988 FYs, efforts were undertaken to develop the five Regional Aquaculture Centers now in existence. Organizational activities for SRAC began in 1987, with the first research and extension projects initiated in 1988.

In 1980, Congress recognized the opportunity for making significant progress in domestic aquaculture development by passing the National Aquaculture Act (P.L. 96-362). The Act established USDA as the lead agency for aquaculture coordination and called for development of a National Aquaculture Plan. The next year, Congress amended the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (P.L. 95-113) by granting, in Title XIV, Subtitle L, Sec. 1475(d) of the Agriculture and Food Act of 1981 (P.L. 97-98), authority to establish aquaculture research, development, and demonstration centers in the United States.

Congress envisioned the Centers as focal points in a national program of cooperative research, extension, and development activities that would be developed in association with colleges and universities, state Departments of Agriculture, federal facilities, and non-profit private research institutions with demonstrated excellence in aquaculture research and extension. Eventually, five such Centers were established—one in each of the northeastern, north central, southern, western, and tropical Pacific regions of the country.

Although government agencies, particularly the United States Department of Agriculture, have provided significant support for aquaculture research and development, much of that funding is earmarked for specific use by specific institutions. The USDA/NIFA Regional Aquaculture Center program is the only funding activity with the flexibility to stay abreast of industry development, identify problems on a region-wide scale, and implement cooperative, interstate projects to solve those problems.

Since its inception in 1987, the Southern Regional Aquaculture Center has become the most important regional aquaculture activity in the southeastern United States. In its 26 years of operation, the Center has disbursed more than \$17 million to fund multi-state research and extension projects. More than 200 scientists from 30 institutions in the southeast have participated in Center projects.

Productivity from SRAC research projects has been excellent since the Center's inception more than two decades ago. Information derived from SRAC-funded projects has been transferred to producers and

other scientists in thousands of scientific papers and presentations. Currently funded projects continue this trend of high productivity.

Beginning with the first projects funded by the Southern Regional Aquaculture Center, interest among aquaculture research and extension scientists in Center activities has been excellent. In fact, funding and project coordination provided by SRAC has become so embedded in the fabric of southeastern aquaculture research and extension that it is difficult to envision what these activities would be like without the program. We are pleased with the participation by our research and extension scientists in the Southern Region in ad hoc Work Group meetings and Steering Committees, and their willingness to serve as Project Leaders and Principal Investigators for the projects. We believe this broad-based representation has resulted in strong, cooperative research that will be of long-lasting benefit to aquaculture producers and consumers, and to the growth of the aquaculture industry in the Southern United States.

Acknowledgments

The Southern Regional Aquaculture Center (SRAC) acknowledges the contributions of the Project Leaders and Participating Scientists involved in the projects reported in this Twenty-sixth Annual Progress Report. Members of the SRAC Board of Directors, Industry Advisory Council, and Technical Committee have provided valuable inputs to the successful operation of SRAC during the past year. We particularly appreciate the assistance of the chairs of our Board, IAC, and TC.

We also thank the scientists and aquaculturists from across the country who contributed their expertise and valuable time to review SRAC project proposals and publications. Without their help, it would be impossible to maintain the high quality of this program.

ORGANIZATIONAL STRUCTURE

Research and extension problem areas for the southern region are identified each year by the Industry Advisory Council (IAC), which consists of fish farmers and allied industry representatives from across the region. The Technical Committee (TC), consisting of research and extension scientists from states within the region, works with the IAC to prioritize problem areas. The two groups then work together to develop “Problem Statements” describing objectives of work to solve problems with the highest priority. Using inputs from industry representatives, regional Work Groups of the most qualified research and extension scientists are formed. The Work Groups then plan and conduct the work. Regional aquaculture funds are allocated to participants in SRAC projects approved by the Board and NIFA. Reviews of project proposals, progress reports, and recommendations for continuation, revision, or termination of projects are made jointly by the TC and IAC and approved by the Board.

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

Administrative Center

The Administrative Center is located at the Delta Research and Extension Center, Stoneville, Mississippi. Mississippi State University serves as the Host Institution. All necessary support services for the Board, IAC, TC, Steering Committees, and project Work Groups are provided by the Administrative Center. This includes monitoring status and progress of projects, preparing and executing Letters of Agreement, tracking administrative and project expenditures, reviewing progress reports, and assisting Project Leaders and participating institutional Grants Offices as needed.

Operation and funding are approved by the Board for inclusion in the Grant Application submitted annually to USDA/NIFA. The Center staff also prepares and submits to USDA/NIFA an Annual Plan of Work covering Center activities and projects to be funded. Following final approval, Letters of Agreement are prepared and executed with all participating institutions. The Center acts as fiscal agent to disburse and track all funds in accordance with the provisions of the grants. Additional Administrative Center responsibilities are detailed in the “Administrative Activities” section of this report.

Board of Directors

The Board is the policy-making body for SRAC. Membership provides an appropriate balance among representatives from State Agricultural Experiment Stations, Cooperative Extension Services, 1890 Institutions, and the Administrative Heads Section of the Board on Agriculture Assembly of the National Association of State Universities and Land Grant Colleges.

The Board is responsible for 1) overall administration and management of the regional center program; establishment of overall regional aquaculture research and extension goals and allocations of fiscal resources to ensure that the center develops strong programs in both research and extension; 3) establishment of priorities for regional aquaculture research and extension education activities based on inputs from the TC and IAC 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.

Members of the Board for the reporting period were:

Gregory Bohach, Mississippi State University
Dwight Landreneau, Louisiana State University
Bobby Fletcher, Louisiana State University
John Liu, Auburn University
Wondi Mersi, Virginia State University
Phil Elzer, Louisiana State University
Joe Street, Mississippi State University Extension Service
Tony Windham, University of Arkansas Cooperative Extension Service
Wes Burger, Mississippi State University

Industry Advisory Council

The IAC is composed of representatives of state and regional aquaculture associations, federal, territorial and state agencies, aquaculture producers, aquaculture marketing and processing firms, financial institutions, and other interests or organizations. 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.

The IAC 1) identifies research and extension needs; 2) works with the TC to prioritize research and extension needs; 3) works with the TC to develop problem statements and recommend funding levels for projects addressing priority research and extension needs; 4) reviews project proposals, progress reports, and termination reports; and 5) recommends to the Board, jointly with the TC, actions regarding new and continuing proposals, proposal modifications, and terminations.

Members of the IAC for the reporting period were:

J. Neal Anderson, AR	Lynn Blackwood, VA
Bill Cheek, LA	Sandy Miller, GA
Robert Mayer, KY	Jane Corbin, TN
Ben Pentecost, MS	Jim Ekstrom, TX
Martha Campbell, FL	Shorty Jones, MS
Rob Ellis, NC	Chase Holub, TX
Marty Tanner, FL	Bill Livingston, SC
Butch Wilson, AL	Joey Lowery, AR
Townsend Kyser, AL	Jenny Davis Fagan, TN

Technical Committee

The TC consists of representatives from participating research institutions and state extension services, other state or territorial public agencies as appropriate, and private institutions. Membership of the TC includes research and extension scientists representing essentially all states in the region. The TC 1) works with the Industry Advisory Council to prioritize research and extension needs; 2) works with the Industry Advisory Council to develop problem statements and recommend funding levels for projects addressing priority research and extension needs; 3) reviews proposals, progress reports, and

termination reports; and 4) recommends to the Board, jointly with the IAC, actions regarding new and continuing proposals, proposal modifications and terminations.

Members of the TC for research for the reporting period were:

Brian Bosworth, USDA-ARS Warmwater Aquaculture Research Center
Harry Daniels, North Carolina State University
Jim Tidwell, Kentucky State University
Allen Davis, Auburn University
Gary Burtle, University of Georgia
Carole Engle, University of Arkansas at Pine Bluff
Delbert Gatlin, Texas A&M University
Chris Green, Louisiana State University
Tom Murray, VIMS Marine Advisory Services
Cortney Ohs, University of Florida
Don Bailey, University of the Virgin Islands
Bill Shelton, University of Oklahoma

Members of the TC for Extension for the reporting period were:

Jack Whetstone, University of South Carolina
Mike Frinsko, North Carolina State University
Ron Blair, University of Tennessee
Patricia Duncan, Fort Valley State University
Jesse Chappell, Auburn University
David Heikes, University of Arkansas at Pine Bluff
Todd Sink, Texas A&M University
Robert Romaire, Louisiana State University
Michael Schwarz, Virginia Tech University
Craig Watson, University of Florida
Forrest Wynne, Kentucky State University
Anita Kelly, University of Arkansas at Pine Bluff

PROGRESS REPORTS

PUBLICATIONS, VIDEOS, AND COMPUTER SOFTWARE

Reporting Period: March 1, 1995 – August 31, 2013

Length of Project: Ongoing

Current Project Year: 18

Total Funds Committed: \$68,664

Principal Investigator: Michael Masser, *Texas A&M University*

Relevance: When this project was initiated, fewer than half the states had educational materials covering the major aquacultural species in their state. The concept of using the SRAC program to produce timely, high-quality educational materials is based upon the benefits of centralizing the production process while using a region-wide pool of expertise to develop materials. Distribution is then decentralized through the nationwide network of Extension Specialists and County Agents including the National eXtension Initiative. This process assures an efficient publication process that makes use of the best available talent in specific subject areas.

Response: A Committee of Extension Specialists and researchers solicit input on publication and digital product needs from their counterparts across the region. These suggestions are prioritized during an annual meeting of the committee based on need and available funding. The best talent from within and outside the region are then recruited to submit proposals to develop these products.

Results: The result is widespread availability of high-quality educational materials for scientists, educators, producers, students, and the general public.

Outreach Overview: SRAC factsheets and videos are distributed by direct request and via Extension Specialists, County Extension Agents, and other RACs. These products are used regularly by clientele in all 50 states as well as internationally. Factsheets and mass media presentations are accessed daily from the SRAC website by people searching for technical information.

Targeted Audiences: The target audiences for this project are educators, consumers, producers, potential investors, students, and the general public.

Outputs: Twelve new fact sheets, one DVD, and one mass media presentation were completed this year. The SRAC Publications and AquaPlant websites were also updated. All publications have been distributed electronically throughout the Southern Region and to interested Extension Specialists in other regions. Nineteen fact sheets and three mass media presentations are in the process of review or revision.



Outcomes/Impacts: Publications and videos produced by SRAC are increasingly used in educating high school and college students about aquaculture. These programs heavily utilize SRAC publications and videos for educational purposes but usage is impossible to measure because access to the information is gained from many different Internet sites.

Another important impact is the education of local, state, and federal regulators about the aquaculture industry. This impact is difficult to measure but feedback from personnel in two states have indicated that the fact sheets are recommended reading for all new employees dealing with aquaculture, water quality, exotic species, and other permitting duties. This should be a positive influence toward making aquaculturists better understood and the development of more enlightened regulations.

The impact on consumers of aquaculture products is also likely significant. Consumers are primarily interested in a wholesome, safe, and inexpensive product, and it has been reported that the consumer-oriented fact sheets and videos developed within SRAC have generated more interest than the producer-directed materials. The factsheets are in demand in both the English and Spanish versions and, as more information becomes available, extension materials on food safety will be in increased demand by health conscious consumers.

The Southern Regional Aquaculture Center commenced the Publications, Videos, and Computer Software Project in order to provide these materials in a timely and relevant manner. Since that time, more than 225 technical fact sheets and numerous update revisions, 5 mass media presentations, and 30 videos have been produced through the SRAC PVCS Project. In the current year alone, 26,021 visitors from 164 countries/territories (a 9% increase from the previous year) used the SRAC Publications website to access SRAC publications 106,042 times. The AquaPlant web site, started with funding from the SRAC PVCS Project, had 300,763 visitors that accessed 1,035,786 pages. These visitors came from 191 countries/territories.

USING NATIONAL RETAIL DATABASES TO DETERMINE MARKET TRENDS FOR SOUTHERN AQUACULTURE PRODUCTS

Reporting Period: June 1, 2009 – August 31, 2013

Length of Project: 4 years

Current Project Year: 4

Total Funds Committed: \$398,397

Principal Investigators: Madan Dey and Carole Engle, *University of Arkansas at Pine Bluff*; Benaissa Chidimi, *Texas Tech University*; Terry Hanson, *Auburn University*; Sherry Larkin, Charles Adams, *University of Florida*

Relevance: Though the demand for fresh and chilled/frozen seafood has been increasing over time in the U.S., the market size and share of U.S. farm-raised catfish are declining. Increased understanding of demand structure of sales of seafood and fish over season and space could help the U.S. aquaculture industry refine marketing strategies and targets.

Response: The study found that the catfish industry needs to develop market specific strategies in order to gain further market share in the U.S. Results show that the responsiveness of catfish demand to changes in its own and substitute products prices vary over seasons and U.S. census divisions. Researchers have conveyed to stakeholders (catfish farmers, processors, policy makers) that understanding the consumer demand behavior across seasons and over space is essential as (i) fish demand varies over species, season and space; and (ii) not only does the degree of competition among finfish products vary considerably over space, but substituting products themselves change.

Results: Based on these findings, several catfish farmers and processors have expressed intention to develop market specific strategies for catfish marketing. The industry has invited the Aquaculture/Fisheries Center to further assist them with designing their marketing plans. The Catfish Institute, an industry managed organization responsible to raise consumer awareness of the positive qualities of U.S. farm-raised catfish, has requested the Aquaculture/Fisheries Center to help them in organizing region-specific advertisement messages for the industry.

Outreach Overview: Results have been shared with stakeholders through presentations, workshops, meetings, and field-day events organized by the UAPB Aquaculture/Fisheries Center. Summaries of market trends in 52 cities across the U.S. for the past 5 years have been sent to 19 catfish processing companies, and detailed customized reports have been sent to 6 catfish processing companies at their request.

Targeted Audiences: The targeted audiences are catfish farmers, catfish processors, other fish famers, other fish processors, and The Catfish Institute.



Outputs: There were 14 stakeholders' workshops during 2012-2013 (six in 2013) across the county. Summaries of market trends analysis were presented to 19 catfish processing companies while detailed customized reports were presented to six catfish processing companies. Summaries of market trends analysis were provided to 19 catfish processing companies. Detailed customized reports were provided to six catfish processing companies. Fourteen stakeholders' workshops were held during 2012-2013 (six in 2013) across the county.

Outcomes/Impacts: The Project procured and analyzed market-level weekly scanner data of A.C. Nielsen on frozen/chilled seafood sales in 52 markets of the U.S. covering the period of July 2005 to July 2012. The UAPB research team analyzed market trends and estimated demand for various seafood products. The results have been communicated among existing and potential fish farmers throughout the country.

Partnerships Developed: The National Aquaculture Association is a national commodity association that jointly organized and implemented stakeholders' workshops.

DEVELOPMENT AND EVALUATION OF COOL-WATER CRAWFISH BAITS

Reporting Period: January 1, 2011 – August 31, 2013

Length of Project: 3 years

Current Project Year: 3

Total Funds Committed: \$124,896

Principal Investigators: Ray McClain, Robert Romaine, Charles Lutz, *Louisiana State University*; Delbert M. Gatlin, III, *Texas A&M University*; D. Allen Davis, *Auburn University*

Relevance: Manufactured crawfish bait is inferior to fresh-frozen fish when water temperatures are below about 70 degrees F, and rough fish, costing over twice that of commercially formulated bait, is frequently in short supply. Development of effective and economical cool-water formulated crawfish bait will address not only some of the cost and handling/storage issues with fish baits, but would also help conserve the fishery for many of these species.

Response: Numerous proteinaceous substances, feedstuffs, and amino acid mixtures were incorporated into a gelatin matrix, singularly or in combination, and the gelatin bait blocks were placed in crawfish traps to compare quality of the attractants based on crawfish catch under commercial harvesting conditions. A number of the attractants were analyzed for amino acid composition and compared with the amino acid profile of fish and manufactured baits. Leached amino acids from selected soaked baits were also quantified over time.



Results: This work confirmed that attractants with key amino acid concentrations similar to that of fish flesh yielded best catches, but it also revealed the complexity of formulating an effective crawfish bait. Although subtle differences in catch were observed among the various attractants tested, the most notable observation was that poultry meal resulted in the best catch of all ingredients tested. Poultry meal resulted in catches as good, or better, than the commercial formulated bait, and in several subsets approached that with cut fish. Although poultry meal was not as effective as cut fish, it was consistent throughout the trial and was among the best single ingredient tested. It deserves further scrutiny for increased potential, possibly as a base for further formulation. This work established that further research will be needed to identify a cost effective formulation to serve as an alternate to cut-fish for crawfish bait in cool water.

Outreach Overview: Concise reports of the methodology and findings of this study, written for a lay audience, have been published annually in the Aquaculture Section of the Annual Report – Rice Research Station, Louisiana State University Agricultural Center. This is available in printed form and a copy resides on the LSU AgCenter’s website. Results have also been extended orally at various producer meetings and individually with numerous producers, scientists, and agribusiness associates. Upon completion of all analyses, a manuscript will be prepared and submitted to an appropriate journal.

Targeted Audiences: The ultimate goal of this research is to identify attractants, bait formulations, and/or potential manufacturing processes that provide crawfish producers with an effective formulated bait alternative to expensive and ecologically sensitive cut-fish baits for cool water temperature harvesting. Targeted audiences for the dissemination of any findings include crawfish producers and fishermen, crawfish bait manufacturers, and scientists interested in crustacean response to attractants. These audiences are the beneficiaries or facilitators of this goal.

Outputs: The overwhelming efforts of this research to date have been directed at addressing specific research objectives and analyzing the findings, and while key response variables were documented and are deemed valuable, a significant pivotal breakthrough was not realized. Thus outputs have been limited mainly to reports of continuing research. One noted output has been the development of a gelatin-based matrix as an effective medium for testing various attractants under commercial crawfish harvesting conditions. This has been successfully used in research outside of this project. A Crawfish Producer Meeting was held in Lafayette, Louisiana on April 10, 2012.

Outcomes/Impacts: The primary impact of these results has been to provide scientists with valuable information regarding the identification of potential attractants for further testing. Efforts have provided quantitative assessments of the value of limited substances and feedstuffs as potential crawfish attractants, and have provided valuable information regarding certain physical aspects needed for effective crawfish baits. Specifically, this research suggests that key amino acids may play a vital role in determining the quality of a crawfish attractant and has identified several amino acids that may be most important. Moreover, it was determined that the rate and timings of key amino acid released from baits in water may affect the efficacy of different baits. This provides the impetus and possible direction for further research.

REPRODUCTION AND LARVAL REARING OF FRESHWATER ORNAMENTAL AND MARINE BAITFISH

Reporting Period: January 1, 2011 – August 31, 2013

Length of Project: 3 years

Current Project Year: 3

Total Funds Committed: \$499,547

Principal Investigators: Cortney Ohs, Craig Watson, *University of Florida*; Chris Green, Ronald Malone, *Louisiana State University*; Lou D'Abramo, *Mississippi State University*

Relevance: Methods for aquaculture of marine baitfish (such as killifish, pinfish, and ballyhoo) and marine ornamental fish (bala sharks) were largely unknown and hindered the development of commercial production. There was a lack of knowledge concerning stocking density, optimized salinities, spawning, egg collection, larvae culture, and nutrition. Marine ornamental fish breeders were having problems maintaining water quality in indoor recirculating systems with traditional biofiltration formats. Low pH, low water mineral content or sudden changes in loading when spawns occurred aggravated the problem.

Response: Fish culturists conducted experiments on spawning hormones, spawning substrate, stocking density, optimum salinity, and feeding strategies for larval and juvenile fish. Engineers used waste loading analyses to simulate the response of traditional filters. Airlift design criteria for small pipes were refined and a novel assimilation approach was developed to avoid the impact of reduced pH and water.



Results: Guidelines developed from the salinity experiments and larval/juvenile feeding of killifish have significantly helped killifish growers reduce operating costs and potential for introduction of disease. Optimal methods have been identified to spawn pinfish using different hormones. Feeding experiments have defined an optimal feeding protocol for larval pinfish using enriched rotifers. Results have shown that ballyhoo prefer to spawn eggs onto a hard structure such as airline tubing and zip ties versus foam or common spawning mats used for freshwater baitfish. An emerging bio-plastic is used to remove ammonia from indoor fish breeding operations using a novel assimilation technique. Broodstock maturation and larval rearing techniques specific to bala sharks have led to successful commercial scale production.

Outreach Overview: The results of this project have been extended through multiple sources. The LSU AgCenter organized a killifish workshop for potential producers, posted outreach materials on its website, and prepared a SRAC factsheet. Over 160 people attended three Extension meetings held in Florida. Additionally, over 20 tours of the University of Florida Tropical Aquaculture Laboratory (TAL) facility have been given to current and potential aquaculture producers. Due to outreach activities of the TAL staff, three ornamental fish farms are now producing bala sharks at their facilities.

These research findings have been presented orally at professional aquaculture conferences, targeting both the scientific and producer communities. The design guidelines and drawings developed in this project will be used to construct demonstration units at the TAL. These units will be used to introduce technology directly to the ornamental fish industry. The commercial collaborator/partner is considering incorporating assimilation strategies into their product line.

Targeted Audiences: The target audiences for this project are current and potential ornamental and baitfish producers, marina owners that hold or harvest baitfish, and academic institutions that are also researching both biological and aquaculture properties of estuarine fish.

Outputs: Outputs from this project spanned a wide range of products including four workshops, 20 tours, a LSU AgCenter website, design guidelines and drawings, numerous popular articles and a SRAC factsheet on killifish production. Oral and poster presentations were also made to the scientific community. The main output of the LSU engineering effort is a novel biofiltration strategy and associated sizing guidelines that will likely stimulate the introduction of new commercial products. Although not the objective of this effort, patents on the specifics of implementation can be expected in the commercial sector.

A Cocahoe Minnow Workshop was held at the LSU AgCenter, Aquaculture Research Station, Baton Rouge, Louisiana in April 2012. Three additional Extension workshops on marine baitfish and ornamentals were held in Brevard County, Florida (56 people), Miami Dade County, Florida (58 people), and Pinellas County, Florida (43 people).

Outcomes/Impacts: With the assistance of the commercial collaborator, the research has resulted in the development of a technique for ammonia removal by aerobic assimilation using PHA bioplastics as a carbon source. These findings are expected to feed back into the ongoing commercial efforts of the commercial collaborator.

One new large scale producer has started business in Stuart, Florida that is using these techniques in their commercial pinfish hatchery. Four other producers are only growing out wild caught pinfish to market size. In the next year they all plan to use these methods to start a hatchery to produce their own fish for growout. Several Florida killifish producers will start to tank spawn their fish this year.

The addition of bala sharks to their product line will allow Florida producers to increase their market share over foreign producers.

Partnerships Developed: Aquaculture Systems Technologies (Beadfilters.com) is a regional industry that provided materials and technical advice.

IMPROVING CATFISH BROODSTOCK MANAGEMENT BY MANIPULATING DIET, STOCKING DENSITIES, AND SEX RATIOS

Reporting Period: January 1, 2011 – August 31, 2013

Length of Project: 3 years

Current Project Year: 2

Total Funds Committed: \$388,352

Principal Investigators: Rebecca Lochmann, Carole Engle, Alf Haukens, *University of Arkansas at Pine Bluff*; Alejandro Buentello, *Texas A&M University*; Brian Bosworth, Sylvie Quiniou, Geoff Waldbieser, *USDA-ARS Warmwater Aquaculture Research Unit*

Relevance: Industry wide, only 30 to 40% of female catfish spawn each year. The reasons for the low spawning rates are unclear. Producers maintain an excess of broodstock to meet egg production goals, which is inefficient. This project aims to identify the most cost-effective method of increasing catfish fry production efficiency through manipulation of broodfish diets, gender ratios, and stocking densities.

Response: Diets with different proteins, lipids and supplements were tested for efficacy in improving fry production. Different ratios of males to females and stocking rates were tested for their ability to improve fry production. Economic analysis of fry production efficiency was conducted.

Results: Most of the information has not been disseminated yet. The researchers have used the economic results to adjust their research strategies aimed at improving fry production efficiency.



Outreach Overview: Results from this project will be disseminated through presentations at scientific and producer meetings, through trade publications, and publications in peer-reviewed journal articles. There should be enough information synthesized to increase outreach efforts in 2014.

Targeted Audiences: The targeted audience includes catfish producers, feed mills, research scientists, and interested laypersons.

Outputs: Economic models and undergraduate student trainees.

Outcomes/Impacts: Economic analysis of data to date has shown that some of the biological results that were significantly different among treatments did not translate to improved cost efficiency of fry production.

PERFORMANCE EVALUATION OF INTENSIVE, POND-BASED CULTURE SYSTEMS FOR CATFISH PRODUCTION

Reporting Period: October 1, 2012 – August 31, 2013

Length of Project: 3 years

Current Project Year: 1

Total Funds Committed: \$300,000

Participants: Les Torrans, Travis Brown, Craig Tucker, *USDA-ARS Warmwater Aquaculture Research Unit*; Luke Roy, Jesse Chappell, Terry Hanson, Claude Boyd, *Auburn University*; David Wise, Terry Greenway, Matt Griffin, *Mississippi State University*; Carole Engle, Yushun Chen, David Heikes, Matt Recsetar, *University of Arkansas at Pine Bluff*



Relevance: Many farmers feel that intensifying fish production will reduce production costs. They are currently using three production systems to do this; smaller conventional earthen ponds with increased aeration rates, split-pond systems, and in-pond raceways. Intensified production systems will likely continue to draw the interest of catfish farmers in the future but without a thorough economic analysis there can be no definitive recommendations.

Response: This study will evaluate the production efficiencies of these new production systems on commercial catfish farms. Based on these findings, a complete economic analysis will be performed and will provide the necessary guidance to make recommendations to farmers. In addition, detailed physical descriptions of each culture system will be thoroughly investigated and the most efficient and practical designs will be recommended to farmers. Data will be used to identify fish health related risk factors associated with each type of production system. Information will be used to develop disease management programs to complement specific production parameters.

Results: Two commercial catfish farms in Mississippi have been enlisted as cooperators on this project. Additionally, six-commercial-sized ponds at the MSU Delta Research and Extension Center are being used in this study. Electric monitors have been installed on all equipment, production facilities have been stocked with either hybrid or channel catfish, and management inputs are being monitored. Harvesting of the first year production has begun. Three commercial catfish farms in Arkansas have been enlisted as cooperators on this project. Production facilities have been stocked with either hybrid or triploid (on three occasions) hybrid catfish, and management inputs are being monitored. Harvesting of

the first year's production has begun. The framework for the economic analysis of split pond and intensively-aerated ponds has been developed and preliminary analyses are underway.

Outreach Overview: Results from this project will be disseminated through presentations at scientific and producer meetings, through trade publications, and publications in peer-reviewed journal articles. There should be enough information synthesized to increase outreach efforts in 2014.

Targeted Audiences: Catfish producers and the aquaculture scientific community.

Outputs: None to date.

Outcomes/Impacts: The impact of this project cannot be measured at this point as the data is incomplete. However, it can be said that the early crops of hybrid catfish produced in the IPRS system compare favorably or better to traditional multiple batch pond production systems. The economic analyses of these first crops from the IPRS have not been conducted yet but when the analysis is complete will provide a good insight into the viability of this system.

PRODUCTS DEVELOPED AND STUDENTS SUPPORTED

Oral Presentations

Alt D., J. Wagner, and R. F. Malone. 2011. Verification of an airlifted PolyGeysers design for a warmwater marine RAS fingerling application. Aquaculture America 2011, New Orleans, LA, February 28-March 3, 2011.

Alt, D. and R. F. Malone. 2012. Mitigation of shock loading in ornamental fish Hatcheries. 9th International Conference on Recirculating Aquaculture. Roanoke, VA, August 24-26, 2012.

Alt, D. and R. Malone. 2013. Mitigation of Shock Loading in Ornamental Fish Hatcheries. Aquaculture America 2013, Nashville, TN, February 21-25, 2013.

Broach, J., C. Ohs, M. DiMaggio, G. Wallat, and S. Grabe. 2013. Effects of egg incubation density on larval quality and morphometrics for pinfish *Lagodon rhomboides* and pigfish *Orthopristis chrysoptera*. Aquaculture 2013. Nashville, TN.

Brown, C., F. Galvez, and C. Green. 2011. Metabolic and embryogenic responses to terrestrial incubation of Gulf killifish *Fundulus grandis* eggs across a temperature gradient. American Fisheries Society, Louisiana Chapter Annual Meeting, Lafayette, LA.

Brown, C., F. Galvez, and C. Green. 2011. Metabolic and embryogenic responses to terrestrial incubation of Gulf killifish *Fundulus grandis* eggs across a temperature gradient. Aquaculture America 2011, New Orleans, LA.

Dey, M. M. 2013. Market trends for fish/seafood products: global and U.S. city-level analysis. Aquaculture Business Management and Marketing Workshop, Charleston, SC, May 22, 2013.

Dey, M. M. 2013. Market trends for fish/seafood products: global and U.S. city-level analysis. Aquaculture Business Management and Marketing Workshop. University of Hawaii at Manoa Campus, Hawaii, July 29, 2013.

Dey, M. M. 2013. Market trends for fish/seafood products: global and U.S. city-level analysis. Aquaculture Business Management and Marketing Workshop. Hilo, Hawaii, July 30, 2013.

Dey, M. M. 2013. Market trends for fish/seafood products: global and U.S. city-level analysis. Aquaculture Business Management and Marketing Workshop New Bern, NC, August 14, 2013.

Dey, M. M. 2013. Market trends for fish/seafood products: global and U.S. city-level analysis. Aquaculture Business Management and Marketing Workshop University of Southern Illinois, Carbondale, IL, September 24, 2013.

Dey, M. M. 2013. Market trends for fish/seafood products: global and U.S. city-level analysis. Aquaculture Business Management and Marketing Workshop. Galloway, NJ, October 17, 2013.

Dey, M., K. Singh, and P. Surathkal. 2013. Seasonal and spatial variation in demand for and elasticity of fish products in the United States: an analysis of market-level scanner data. World Aquaculture Society Conference, Aquaculture 2013, Nashville, TN, February 21-25, 2013.

DiMaggio, M. A., C. L. Ohs, A. T. Palau, and J. A. Broach. 2013. Evaluation of culture techniques and spawning substrates for ballyhoo *Hemiramphus balao*. Aquaculture 2013, Nashville, TN.

DiMaggio, M., J. Broach, and C. Ohs. 2013. Evaluation of ovaprim and human chorionic gonadotropin doses on spawning induction and egg and larval quality of pinfish *Lagodon rhomboides*. Aquaculture 2013, Nashville, TN, February 21-25, 2013.

Fisher, C. and C. Green. 2013. Manipulation of the divalent ions Ca²⁺ and Mg²⁺ and their role in biochemical and molecular homeostasis in larval Gulf killifish. Aquaculture 2013, Nashville, TN. February 21-25, 2013.

Greensword, M. and R. F. Malone. 2012. Use of airlift design guidelines for ornamental fish and baitfish systems. 9th International Conference on Recirculating Aquaculture, Roanoke, VA, August 24-26, 2012.

Greensword, M. and R. Malone. 2013. Estimating BOD₅ and nitrogen loading from decaying egg mass. Aquaculture America 2013, Nashville, TN, February 21-25, 2013.

Hannani, S., F. Fahandezhsadi, and M. Greensword. 2013. Pilot study predictions of the relationship between airflow volume and water flow in airlift. Aquaculture America 2013, Nashville, TN, February 21-25, 2013.

Malone, R. F. 2012. Airlift supported recirculating aquaculture systems. Aquaculture America 2012, Las Vegas, NV, February 29-March 3, 2012.

Malone, R. F., R. Tabor, D. Alt, and C. Cristina. 2011. An examination of the simplified kinetic assumptions underlying the analysis of airlifted PolyGeyser designs. Aquaculture America 2011, New Orleans, LA, February 28-March 3, 2011.

McClain, W. R. and R. P. Romaine. Procambardid crawfish aquaculture: a look ahead at the next 40 years of research needs. Aquaculture America 2011, New Orleans, LA, February 28-March 3, 2011.

O'Malley, P., A. Palau, C. Ohs, L. D'Abramo, and C. Green. 2013. Feeding larval Gulf killifish: utilizing a transitional feeding regime of live and artificial feeds. Aquaculture 2013, Nashville, TN, February 21-25, 2013.

Patterson, J., R. Reigh, C. Fisher, and C. Green. 2013. Replacement of live *Atemia* nauplii with commercial diet at first feeding in larval Gulf killifish and subsequent growth effects of dietary protein level. Aquaculture 2013, Nashville, TN, February 21-25, 2013.

Patterson, J., T. Allgood, C. Gothreaux, and C. Green. 2012. Intraspecific variation in reproductive potential with body size in female Gulf killifish *Fundulus grandis*. Aquaculture America 2012, Las Vegas, NV, February 29-March 3, 2012.

Surathkal, P., M. Dey, and K. Singh. 2013. Consumer demand for frozen seafood products in the United States: an analysis using market-level retail scanner panel data. North American Association of Fisheries Economists Forum 2013, St. Petersburg, FL, May 21-24, 2013.

Poster Presentations

Fisher, C. and C. Green. 2012. Effect of stocking density and potassium ion concentration on growth, survival, and ion regulation in Gulf killifish *Fundulus grandis*. American Fisheries Society, Louisiana Chapter Annual Meeting, Lafayette, LA.

O'Malley, P., C. Brown, J. Patterson, and C. Green. 2012. Physiological effects of terrestrial stranding on *Fundulus grandis*. American Fisheries Society, Louisiana Chapter Annual Meeting, Lafayette, LA.

Patterson, J., T. Allgood, C. Gothreaux, and C. Green. 2012. Intraspecific variation in reproductive potential with body size in female Gulf killifish *Fundulus grandis*. American Fisheries Society, Louisiana Chapter Annual Meeting, Lafayette, LA.

Extension/Outreach Publications

Anderson, J., C. Green, J. Christoferson, and J. Patterson. 2012. Cocahoe Minnow Production Manual. Louisiana AgCenter/Louisiana SeaGrant, Baton Rouge, Louisiana.

Bankston, J. D., Jr. and E. Baker 2013. Piping systems. SRAC Publication No. 373 (Revision). Southern Regional Aquaculture Center, Stoneville MS.

Gatlin, D. M., III and A. Peredo. 2012. Prebiotics and probiotics: definitions and applications. SRAC Publication No. 4711. Southern Regional Aquaculture Center, Stoneville MS.

Green, C. C. 2013. Intensive (non-pond) Culture of Gulf Killifish. SRAC Publication No. 1202. Southern Regional Aquaculture Center, Stoneville MS.

Hargreaves, J. 2013. Biofloc production systems for aquaculture. SRAC Publication No. 4503. Southern Regional Aquaculture Center, Stoneville MS.

Kelly, A. and D. Heikes. 2013. Sorting and grading warm water fish. SRAC Publication No. 391 (Revision). Southern Regional Aquaculture Center, Stoneville MS.

Li, M. H. and E. H. Robinson. 2013. Feed ingredients and feeds for channel catfish. SRAC Publication No. 1806. Southern Regional Aquaculture Center, Stoneville MS.

Masser, M. 2013. Aquatic weed management. SRAC Publication No. 361 (Revision). Southern Regional Aquaculture Center, Stoneville MS.

O. Gill, A. O. and H. V. Daniels. 2013. Consumer Information Series – Hybrid Striped Bass. SRAC Publication No. 7302. Southern Regional Aquaculture Center, Stoneville MS.

Parker, M., D. DeLong, R. D. Dunning, T. M. Losordo, and A. O. Hobbs. 2012. A spreadsheet tool for the economic analysis of a recirculation tank system. SRAC Publication No. 456 (Revision). Southern Regional Aquaculture Center, Stoneville MS.

Reames, E. 2012. Nutritional aspects of seafood. SRAC Publication No. 7300. Southern Regional Aquaculture Center, Stoneville MS.

Stone, N., J. L. Shelton, B. E. Haggard, and H. Thomforde. 2013. Interpretation of water analysis reports for fish culture. SRAC Publication No. 4606. Southern Regional Aquaculture Center, Stoneville MS.

Tidwell, J. H. 2013. Consumer Information Series – Freshwater Prawns. SRAC Publication No. 7303. Southern Regional Aquaculture Center, Stoneville MS.

Wurts, W. A. and M. P. Masser. 2013. Liming ponds for aquaculture. SRAC Publication No. 4100 (Revision). Southern Regional Aquaculture Center, Stoneville MS.

Journal Articles

Dey, M. M., A. G. Rabbani, K. Singh, and C. R. Engle. 2013. Determinants of retail price and sales volume of catfish products in the United States: an application of retail scanner data. Accepted for Publication in *Aquaculture Economic and Management*.

DiMaggio, M.A., J.S. Broach, and C. L. Ohs. 2013. Evaluation of Ovaprim and human chorionic gonadotropin doses on spawning induction and egg and larval quality of pinfish, *Lagodon rhomboides*. *Aquaculture* 414-415: 9-18.

Fisher, C., C. Bodinier, A. Kuhl, and C. Green. 2013. Effects of potassium ion supplementation on survival and ion regulation in Gulf killifish *Fundulus grandis* larvae reared in ion deficient saline waters. *Comparative Biochemistry and Physiology, Part A*. 164:572-578.

Ofori-Mensah, S., C. C. Green, and F. K. E. Nunoo. 2013. Growth and survival of juvenile Gulf killifish, *Fundulus grandis*, in recirculating aquaculture systems. *N. American Journal of Aquaculture*. 75:436-440.

Singh, K., M. M. Dey and P. Surathkal. 2013. Seasonal and spatial variations in demand for and elasticities of fish products in the United States: an analysis based on market-level scanner. Accepted for publication in *Canadian Journal of Agricultural Economics*.

Digital Products

SRAC Publications website - <https://srac.tamu.edu/>

AquaPlant website - <http://aquaplant.tamu.edu/>

Cline, D. 2013. Introduction to aquaculture. SRAC Presentation No. 005.
<https://srac.tamu.edu/index.cfm/event/CategoryDetails/whichcategory/37/>

Stone, N. 2013. Safety for fish farm workers. SRAC DVD No. SP-485. Southern Regional Aquaculture Center, Stoneville MS. <http://www.srac.msstate.edu/sracdvd.html>

Parker, M., D. DeLong, R. D. Dunning, T. M. Losordo, and A. O. Hobbs. 2012. A spreadsheet tool for the economic analysis of a recirculation tank system. SRAC Publication No. 456 (Revision). Southern Regional Aquaculture Center, Stoneville MS. ftp://ftp.mdsg.umd.edu/Public/MDSG/SRAC_456_NCSURASS.xls

Cocahoe Minnows - http://www.lsuagcenter.com/en/crops_livestock/aquaculture/baitfish/minnows/

Students Supported

Daniel Alt, Louisiana State University, M. S. (Spring 2014), *A Modeling Performance and Risk of Failure for Airlifted Recirculating Aquaculture Systems*.

Jason Broach, University of Florida, Ph.D. (May 2014), *Spawning, Egg Incubation, and Larval Culture of Two Marine Fish, Pinfish, Lagodon rhomboides, and Pigfish, Orthopristis chrysoptera*.

Rafael Buford, University of Arkansas at Pine Bluff, B.S. (Completed.)

Fatemeshadat Fahandezhsa, Louisiana State University, M. S., (December 2014), *Water Filtration of Oligotrophic Broodstock and Fry System with Nitrogen Assimilating Biofilters*.

Calvin Fisher, Louisiana State University, M.S. (Spring 2014), *Determining a Stocking Density Range and Investigating the Effects of Environmental Ion Concentrations on the Biochemical and Molecular Homeostasis in Larval Gulf Killifish Fundulus grandis*.

Marlon Greensword, Louisiana State University, M.S. (May 2014), *Economics of Airlifted Recirculating Aquaculture Systems*.

Sima Hannani, Louisiana State University, M. S. (December 2014), *Mobilization of Nano-Particles*.

Samuel Ofori-Mensah, Louisiana State University, M. S. (Completed), *Effects of Stocking Density on Survival and Growth of the Gulf Killifish in Recirculating Tanks*.

Camilo Pohlenz, Texas A&M University, Post-doctoral Student.

Prasanna Surathkal, University of Arkansas at Pine Bluff, M.S. (Completed), *Market for Fresh and Frozen Aquaculture Products for Southern USA: Trends and Consumer Preferences*.

Alicia Wilson, University of Arkansas at Pine Bluff, B.S. (Completed.)

SUMMARY METRICS

Publications

Presentations		Extension / Outreach Products			Peer-reviewed Articles	Students		Partnerships
Oral	Poster	Print	Workshops	Digital		MS	PhD	
0	0	12	0	5	0	0	0	0

Market Trends

Presentations		Extension / Outreach Products			Peer-reviewed Articles	Students		Partnerships
Oral	Poster	Print	Workshops	Digital		MS	PhD	
8	0	25	14	0	2	1	0	1

Cool-Water Crawfish Baits

Presentations		Extension / Outreach Products			Peer-reviewed Articles	Students		Partnerships
Oral	Poster	Print	Workshops	Digital		MS	PhD	
1	0	0	1	0	0	0	0	0

Ornamental and Marine Baitfish

Presentations		Extension / Outreach Products			Peer-reviewed Articles	Students		Partnerships
Oral	Poster	Print	Workshops	Digital		MS	PhD	
17	3	2	4	1	3	6	1	1

Catfish Broodstock Management

Presentations		Extension / Outreach Products			Peer-reviewed Articles	Students		Partnerships
Oral	Poster	Print	Workshops	Digital		BS	PhD	
0	0	0	0	0	0	2	1	0

Intensive, Pond-Based Systems

Presentations		Extension / Outreach Products			Peer-reviewed Articles	Students		Partnerships
Oral	Poster	Print	Workshops	Digital		MS	PhD	
0	0	0	0	0	0	0	0	0

