March 2026

36th ANNUAL PROGRESS REPORT

SRAC

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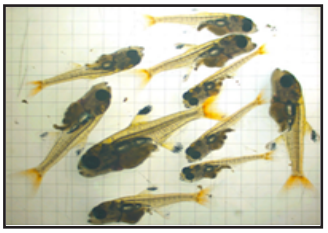
Supporting research and Extension projects based on industry needs and designed to directly impact commercial aquaculture development.







For the period through June 30, 2025

USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

THIRTY-SIXTH ANNUAL PROGRESS REPORT

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EXECUTIVE SUMMARY

This Thirty-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 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 $2.83 million. During the past year, these projects have resulted in 5 journal articles and abstracts, 3 Extension/Outreach publications, 15 oral presentations, 5 poster presentations, 4 digital products, and has supported 2 post-doctoral fellows, 4 Ph.D. students, 5 M.S. students, and 3 graduate students.

Rapid Detection Methods for Emerging Aquatic Animal Pathogens

There is an urgent industry-defined need for rapid, sensitive methods to detect emerging aquatic animal pathogens in their hosts and environments. This project delivered a suite of validated, rapid, and highly specific molecular diagnostic assays for priority emerging aquatic animal pathogens across multiple aquaculture sectors. A TaqMan RT-qPCR assay for iridoviruses threatening Florida's ornamental fish industry was designed and validated, demonstrating excellent sensitivity, linearity across seven orders of magnitude, and high reproducibility without cross-reactivity to related viruses. In parallel, genomes of 22 *Erysipelothrix* isolates were sequenced and annotated, increasing publicly available *E. piscicarius* genomic resources more than ten-fold. This effort led to the identification and validation of a previously published but unrecognized qPCR assay that is highly specific, efficient, and reproducible for *E. piscicarius*. Finally, a qPCR assay targeting *A. crassostreae*, the etiologic agent of *Roseovarius* Oyster Disease, was validated for use across all oyster life stages and tissue types. For each pathogen, standard operating protocols (SOPs) were developed, including detailed instructions on equipment, reagents, reaction conditions, and interpretation criteria, ensuring that laboratories with qPCR capability can readily implement these tools.

Improving the Position of Southern Aquaculture Products in the Grocery Marketplace

This project is aimed at tailoring marketing information relevant to the southern aquaculture industry by focusing on seafood sales in grocery stores and purchases of seafood at the household level in major markets. To examine retail market trends for seafood in the U.S., seafood scanner data (ScanTrack®) were purchased from A.C. Nielsen Consumer LLC. The first effort was to develop retail market trends for general seafood products. This was followed by generating detailed retail market information for regionally important species such as catfish, trout, tilapia, oysters, and crayfish. Later, upon gathering insights from retail market analysis, the project purchased HomeScan® from A.C. Nielsen Consumer LLC to analyze consumer characteristics affecting retail purchases. Industry-specific reports were generated and disseminated to stakeholders. Sixteen presentations, including eight at catfish and trout stakeholder meetings were made.

Novel Flavobacterium Columnare Vaccine Candidates

In the southeastern U.S., columnaris disease is responsible for significant losses in the catfish industry, along with other economically important fish species. The development of an efficacious vaccine to prevent and control columnaris disease has been restricted partially due to a lack of understanding of the broad genetic diversity of columnaris-causing bacteria. To date, eighteen rifampicin-resistant strains of *F. columnare*, *F. covae*, *F. davisii,* and *F. oreochromis* hane been developed. Several of these (n = 13) have been confirmed to be attenuated and lacking the ability to cause disease. These strains can serve

as potential live-attenuated vaccines against columnaris disease in either catfish, tilapia, rainbow trout, or baitfish. Ten attenuated mutant isolates have been tested for vaccine efficacy. Of those, three vaccine candidates, *F. covae* B1M and C3M, and *F. columnare* FcΔ101, show moderate protection in Nile tilapia and rainbow trout, respectively. These vaccine candidates will be further optimized and pursued during the next reporting period.

Optimizing Production Systems for Removal of Ammonia

Traditional water quality methods as well as novel techniques to characterize nitrification, denitrification, and the microbial community were conducted on split-ponds and intensively aerated ponds. These data are being used to compare the nitrogen removal processes and potential of both production systems and both sides of the split-pond systems. Removal of nitrogenous waste in split-ponds can be optimized by keeping the water moving throughout the entire pond basin during the daytime and by providing substantial aeration in the fish side at night. However, the full ammonia- and nitrogen-removal potential of the system is only reached if the waste treatment side is allowed to go fully anaerobic at night, with no extra aeration and fully separate from the fish side. Intensively aerated ponds can approach the nitrification rates of split-ponds, but only if ample (>10 hp/acre) aeration is provided relative to the stocking density (approximately 1,500 lbs/acre can be produced per 1 hp/acre of aeration provided

Bird Depredation of Traditional and Non-Traditional Species

With over 30,000 water acres in catfish aquaculture production, the Black Belt region of eastern Mississippi and western Alabama lies within a major migratory route for several species of fish-eating birds. Fish-eating birds, mainly double-crested cormorants, commonly feed on commercially produced catfish whereas common grackles prey upon commercially produced baitfish and sportfish. Aerial, in-person, or camera surveys were conducted at a random sample of fish production farms to estimate changes in abundance of predatory birds throughout the production season. Double-crested cormorant abundance on catfish ponds had two peaks, one occurring in October-November and a second during March-April which coincided with cormorant migration through the region, indicating catfish ponds may be more of a stopover site than an overwintering site. In-person surveys showed grackles were more efficient predators at removing fish under sheds compared to open pond spawning mats. These results will assist fish producers in focusing loss mitigation efforts at peak times of bird abundance and/or specific production facilities where most losses occur.

Utilizing Feeding Stimulants and Liquid Diets to Improve Larval Feeding Performance

The goal of this study is to determine the most effective methods for replacing live feeds with inert diets including microparticulate diets enhanced with feed attractants or commercially available liquid diets. Investigations into top-dressing microparticulate diets with three different feed attractants, L-alanine, betaine, and L-tryptophan to enhance larval feeding response have been carried out for the Siamese fighting fish (*Betta splendens*), X-Ray Tetra (*Pristella maxillaris*), and Black Skirt Tetra (*Gymnocorymbus ternetzi*). Three 14-day dose identification trials were completed, one per feed attractant, to determine the feed attractant inclusion rate that best promoted larval survival and growth. These results were then used to conduct a final trial for each species to test a combination of all three feed attractants against each singular feed attractant and a control microparticulate diet without any feed attractant.
The efficacy of inert liquid Artemia diets (LA, Cargill Liqualife or Zeigler EZ Artemia), their inclusion level, and a weaning schedule were also examined in a series of experimental trials for Siamese fighting fish, X-ray tetra, Rainbow sharkminnows (*Epalzeorhynchos frenatum*), and Tiger barb (*Puntigrus tetrazona*).

These trials investigated the brand of liquid diet that best promoted larval survival and growth, graded replacement levels of live Artemia with the selected LA diets, and the effect of weaning age on the performance of larvae transitioning from live Artemia to LA.

Training Videos for Regulatory and Certification Compliance
The project team (Virginia Seafood AREC, Mississippi State University, Engle–Stone Aquatic$ LLC, and Wing Media Group) developed scripts and storyboards in close collaboration with industry stakeholders, including Catfish Farmers of America, the Arkansas Bait and Ornamental Fish Growers Association, the Arkansas Department of Agriculture, and representatives from USDA AMS PVP. Scripts developed with input from farmers and USDA personnel have been finalized for catfish environmental sustainability, baitfish biosecurity, and aquatic animal care and handling training videos. On–location videography was completed at eight industry sites across Mississippi and Arkansas (b–roll, interviews, and photos). English and Spanish narration for catfish training video was completed with Spanish translation led by native speaker. English narration with Spanish subtitles was done for baitfish training video. Editing and post–production of training videos has been completed

Restaurant and Supermarket Demand for Important Aquaculture Species
In the Southeastern U.S. there is limited market information available for most aquaculture species, and particularly for new or emerging aquaculture species. Given that significant quantities of seafood are consumed at-home and at restaurants, it makes both grocery stores and restaurants important outlets for marketing aquaculture products. Researchers at three institutions are conducting market research using four different approaches: surveys of restaurants and supermarkets, retail scanner data, restaurant menu data, and internet search data. A postcard invitation to complete a web-based survey was mailed to restaurants and supermarkets using a database from Chain Store Guide. Scanner data was obtained from AC Nielsen Inc, which consisted of weekly sales data across 62 markets from September 2016 to August 2021. Data was also collected from restaurant menus to examine product availability and product characteristics across states and different types of restaurants, as well as to quantify how much product information is passed to the consumer. Web scraping was used to collect a sampling frame of restaurants in the states of interest.

First Steps Towards Genetic Improvement of Red Drum Stocks
Unlike many cultured fish species, red drum broodstock used for commercial production are still primarily of wild origin, and genetic improvement of broodstock for improved growth and survival is critical for securing reliable production in the future. TAMU, TAMU-CC, and NC State Universities initiated a selective breeding program for red drum genetic improvement for growth rate and cold tolerance. Fingerlings have been obtained from 50% of commercial red drum hatcheries in Texas as well as two wild populations from TPWD. Growth trials are underway with cold tolerance trials slated to start in December of 2025. Every red drum producer in the state has been contacted regarding participation in the project with a basic explanation of the project. When the project data has finally been completed, the project PIs will develop a guidance document for current and future red drum producers to demonstrate how to implement a selective breeding program.

Feed Application of Recombinant Attenuated Channel Catfish Virus (CCV) for Vaccinating Catfish against CCV and Blue Catfish Alloherpesvirus (BCAHV) Disease
CCV can cause over 75% losses in affected catfish fingerling ponds. The objective of this study is to evaluate the feasibility and utility of orally applying recombinant attenuated CCV vaccine (CCVd150) on commercial feed and the protection provided against CCVD in young catfish fingerlings. Researchers will

attempt to accomplish this objective by addressing five specific aims: 1) Determine the dose of CCVdl50 in the feed that induces protective immunity to CCVD, 2) Determine if orally provided CCVdl50 protects blue catfish against BCAV disease, 3) Determine the safety of orally applied CCVdl50 when channel catfish are stressed, 4).Determine the effect of CCVdl50 exposure, CCV exposure following vaccination, and CCV exposure in naive fish have on channel catfish production performance, and 5) Establish and validate a rapid differential diagnostic test that can distinguish wtCCV, BCAV, and CCVdl50 and test this on vaccinates vs. CCVD and BCAV survivors. To date, researchers have demonstrated that CCVdl50 is stable under dry conditions for over 1 hour, and that feed based application can be used to infect the fish with the attenuated virus.

INTRODUCTION

Mission

The mission of the USDA NIFA Southern Regional Aquaculture Center (SRAC) 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. 95113) 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. Funding for the Centers was reauthorized in subsequent Farm Bills (the Food, Agriculture, Conservation, and Trade Act of 1990 [P.L. 101- 624]; the Agriculture Improvement and Reform Act of 1996 [P.L. 104-127]; the Farm Security and Rural Investment Act of 2002 [P.L. 107-171]; and the Food, Conservation, and Energy Act of 2008 [P.L. 110-246]). The Agricultural Act of 2014 [P.L. 113-179] stipulated that these were “Competitive” grants and changed the authorized appropriations from $7.5 million to $5 million for each of fiscal years 2014 through 2018.

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 USDA, 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, SRAC has become the most important regional aquaculture activity in the southeastern United States. In its 39 years of operation, the Center has disbursed more than $21.4

million to fund multi-state research and Extension projects. More than 200 scientists from 41 institutions in the southeast have participated in Center projects.

Productivity from SRAC research projects has been excellent since the Center's inception more than three 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 SRAC, 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 acknowledges the contributions of the Project Leaders and Participating Scientists involved in the projects reported in this Thirty-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 these vital committees.

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 and territories within the region, works with the IAC to prioritize problem areas. The two groups then work together to develop "Requests for Pre-proposals" describing objectives of work to solve problems with the highest priority. The best proposals submitted by individuals or teams are used to form a regional Work Group that plans and conducts the work. Regional aquaculture funds are allocated to participants in SRAC projects approved by the Board and USDA 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.

Board of Directors

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

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 allocations of fiscal resources to ensure that the center develops strong programs in both research and Extension; 3) approval of priorities for regional aquaculture research and Extension education activities based on inputs from the TC and IAC; 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:

Dr. Keith Coble, Mississippi State University (Chair)
Dr. Phil Elzer, Louisiana State University AgCenter
Dr. John Anderson, University of Arkansas
Dr. Steve Lommel, North Carolina State University
Dr. Ashley Stokes, University of Tennessee
Dr. Scott Willard, Mississippi State University
Dr. Angus Catchot/Dr. Steve Martin, Mississippi State University
Dr. Edmund Buckner, Alcorn 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 and progress 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:

Margie Saul, AR
Rick Murdock, KY
Jon Cooper, MS
Martha Campbell, FL
Marty Tanner, FL
Brad Graham, AR
Richard Eager, SC
Robert Wright, IV; MS
Shance Nicaud, LA
Wec Terry, VA
Kim Edge, GA
Douglas Kuenz, LA
Rob Ellis, NC
Shawn McNulty, AL
Townsend Kyser, AL
Mark Kubecka, TX
Tom Houston, AL

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 IAC to prioritize research and Extension needs; 2) works with the IAC to develop problem statements and recommend funding levels for projects addressing priority research and Extension needs; 3) reviews proposals and progress 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:

Dr. Brian Bosworth, USDA-ARS Warmwater Aquaculture Research Unit
Dr. Ben Reading, North Carolina State University
Dr. Waldemar Rossi, Jr./Dr. Ken Semmens, Kentucky State University
Dr. Allen Davis, Auburn University
Dr. Amit Sinha, University of Arkansas at Pine Bluff
Dr. Amrit Bart, University of Georgia
Dr. Delbert Gatlin, Texas A&M University
Dr. Cortney Ohs, University of Florida
Dr. Bill Walton, Virginia Tech University
Dr. Mike Denson, National Oceanographic and Atmospheric Administration
Dr. Elizabeth Robinson, Louisiana State University
Dr. Kamal Gosh, Langston University
Dr. Larkin Root, University of the Virgin Islands

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

Dr. Lance Beecher, Clemson University
Dr. Harry Daniels/Dr. Mike Frinsko, North Carolina State University
Dr. Thomas Bliss, University of Georgia
Dr. Luke Roy, Auburn University
Dr. Todd Sink, Texas A&M University
Todd Fontenot, Louisiana State University
Dr. Michael Schwarz, Virginia Tech University
Dr. Matt DiMaggio, University of Florida
Janelle Hager/Forrest Wynne, Kentucky State University
Dr. Ganesh Kumar, Mississippi State University
Dr. Marley Beem, Oklahoma State University
Creig Kimbro, University of Tennessee
Dr. Dayan Perera, University of Arkansas of Pine Bluff

PROGRESS REPORTS

Development of Rapid Detection Methods for Emerging Aquatic Animal Pathogens Threatening Southern Region Aquaculture

Reporting Period: 1/1/2024 – 12/31/2024
Length of Project: 2 Years
Current Project Year: 3 (Extension until 12/31/2024)
Total Funds Committed: $196,036
Principal and Co-Investigators: Matt Griffin, *Mississippi State University*; Tanya Darden, *South Carolina Department of Natural Resources*; and Kuttichantran Subramaniam, *University of Florida*

Relevance: Iridoviruses (i.e., megalocytiviruses) negatively impact Florida ornamental aquaculture. Despite the impact of iridoviruses on Florida aquaculture, a simple (pondside), rapid, and economical diagnostic test for detecting megalocytivirus is unavailable to Florida ornamental fish farmers. Similarly, *Roseovarius* Oyster Disease (ROD) is a major disease of eastern oysters and has caused seasonal mortality events, up to 90% in first year hatchery-reared crops, in the Northeast. Using microscopy, the manifestation of the disease has been found to coincide with the presence of the bacteria, *Aliiroseovarius crassostreae*. Despite knowledge about the causative agent of ROD, there is still no reliable standard diagnostics to test for the presence of the pathogen. Likewise, *Erysipelothrix* spp. are Gram-positive bacteria that can infect a variety of hosts including mammals, fish, birds, reptiles and insects. While *Erysipelothrix* spp. are generally considered commensal organisms in fish, outbreaks of piscine erysipelas caused by *Erysipelothrix piscisicarius* have been reported from the US ornamental aquaculture industry and *E. piscisicarius* was found in a survey of western mosquitofish (*Gambusia affinis*) from catfish aquaculture ponds. There is an urgent industry defined need for rapid, sensitive methods to detect these pathogens in their hosts and environments.

Response: Project teams used comparative genomics to identify unique regions in the megalocytivirus and *A. crassostreae* genomes, leading to the development and validation of rapid qPCR primers and probes that provide highly sensitive detection across host tissues and environments. A simple pondside iridovirus assay was optimized and field tested with Florida ornamental producers, while a new qPCR assay for *A. crassostreae* was validated with both experimental and field-collected oyster samples. In parallel, 22 *Erysipelothrix* genomes were sequenced, expanding available resources more than ten-fold, and *in silico* analyses revealed that previously published assays from the late 2000s were in fact highly specific to *E. piscisicarius*, now recognized as a distinct emerging pathogen. Standard operating protocols were created for each assay to ensure broad accessibility and adoption by diagnostic laboratories, researchers, and resource managers.

Results: The assays consistently demonstrated high sensitivity (detecting as few as 1–10 DNA copies), specificity (no cross-reactivity with related organisms), and reproducibility across laboratory and field settings. Field testing confirmed their ability to detect subclinical infections in clinically healthy ornamental fish and oysters, greatly improving surveillance capacity. Genomic sequencing expanded *E.*

piscisicarius references more than ten-fold, providing a foundation for ongoing research and strengthening pathogen identification.

Outreach Activity: There have been three oral presentations, one journal article, and two Ph.D. dissertations completed to date.

Targeted Audience: Targeted audiences include aquaculturists, aquatic animal health professionals, policymakers, researchers, industry organizations, congressional members and staff, and the general public.

Outputs: This project delivered a suite of validated, rapid, and highly specific molecular diagnostic assays for priority emerging aquatic animal pathogens across multiple aquaculture sectors. A TaqMan RT-qPCR assay for iridoviruses threatening Florida's ornamental fish industry was designed and validated, demonstrating excellent sensitivity (10 copies per reaction), linearity across seven orders of magnitude, and high reproducibility without cross-reactivity to related viruses. In parallel, genomes of 22 *Erysipelothrix* isolates were sequenced and annotated, increasing publicly available *E. piscicarius* genomic resources more than ten-fold. This effort led to the identification and validation of a previously published but unrecognized qPCR assay that is highly specific, efficient, and reproducible for *E. piscicarius*. Finally, a qPCR assay targeting *A. crassostreae*, the etiologic agent of *Roseovarius* Oyster Disease, was validated for use across all oyster life stages and tissue types. For each pathogen, standard operating protocols (SOPs) were developed, including detailed instructions on equipment, reagents, reaction conditions, and interpretation criteria, ensuring that laboratories with qPCR capability can readily implement these tools.

Outcome/Impacts: Collectively, these outputs strengthen the diagnostic and biosecurity infrastructure of U.S. aquaculture by enabling early, accurate, and scalable detection of key emerging pathogens. Producers in the ornamental, shellfish, and catfish sectors gain practical tools to rapidly confirm infections, supporting timely management actions that can reduce mortalities, limit disease spread, and protect industry viability. The generation and release of new genomic resources clarify the taxonomy and epidemiology of *E. piscicarius*, providing a foundation for future comparative and applied research. By providing validated assays alongside detailed SOPs, this work ensures broad accessibility and adoption by diagnostic laboratories, resource agencies, and researchers. Overall, the project enhances capacity to detect, manage, and mitigate disease threats, thereby safeguarding the health, sustainability, and competitiveness of U.S. aquaculture.

Partnerships: USDA-ARS Warmwater Aquaculture Research Unit

Targeted Marketing Research and Outreach for Improving the Position of Southern Aquaculture Products in the Grocery Marketplace

Reporting Period: 1/1/2024 – 6/30/2024
Length of Project: 3 Years
Current Project Year: 4 (Extension through 6/30/2024)
Total Funds Committed: $290,893
Principal and Co-Investigators: Ganesh Kumar, *Mississippi State University*; Jonathan van Senten, *Virginia Polytechnic Inst. and State University*

Relevance: The U.S. seafood markets are highly competitive and diversified in terms of species and product forms sold. Domestic aquaculture producers must be highly competitive to survive in this global marketplace that is dominated by imports. Domestic producers, who are at the upper end of the supply chain, are often unaware of the dynamic consumer interactions that occur in retail markets. Success in these dynamic and competitive environments can only be achieved by making effective marketing decisions. Such decisions rely on the availability of information on actual consumer behaviors (i.e., purchases) in retail markets. Detailed analysis of such downstream signals can assist with formulation of effective marketing strategies that are vital for improving the positioning of southern aquaculture products.

Response: Seafood retail scanner data is one of the best sources of information that cover the magnitude, dynamism, and diversity of the U.S. seafood grocery markets. These big data are generated by scanning the Universal Product Code (UPC) or the barcode of the products. This project is aimed at tailoring marketing information relevant to the southern aquaculture industry by focusing on seafood sales in grocery stores and purchases of seafood at the household level in major markets. To examine retail market trends for seafood in the U.S., seafood scanner data (ScanTrack®) were purchased from A.C. Nielsen Consumer LLC. Later upon gathering insights from retail market analysis, the project purchased HomeScan® from A.C. Nielsen Consumer LLC to analyze consumer characteristics affecting retail purchases.

Results: The dataset was purchased and downloaded on September 13, 2021. Retail seafood sales amounted to $16.7 billion in the 2020-2021 time period registering an annual average growth rate of 8.1%, fueled mostly by the 21% increase in total the year after the onset of the COVID-19 pandemic. Shrimp, salmon, tuna, crab, and tilapia were the top five most-sold seafood categories in U.S. retail markets. The South Atlantic region had the greatest total sales and sales per capita among regions. New York City had the greatest total seafood sales, followed by Los Angeles and Philadelphia. U.S. farm-raised catfish was the only domestic aquaculture product sold in retail stores among the top ten seafood consumed (top 8th). Catfish registered an annual average growth of 5.8% while swai registered only 0.7% annual growth. Dallas/Fort Worth had the greatest total retail seafood sales for U.S. catfish products, followed by Chicago and St. Louis. Los Angeles was the most important city for retail swai sales. Seattle/Tacoma Market had the greatest total retail seafood sales for trout products followed by Portland (OR) and Atlanta. St. Louis and Atlanta were the two cities that registered relatively higher growth rates for both catfish and trout products. About 72% of trout products sold in U.S. retail markets are steelhead trout products. Rainbow trout prices increased by 12% annually in contrast to those for

steelhead trout which were relatively constant. Seafood products sold in retail groceries including catfish and trout were mostly sold in small packages (1-2 lb packs). Frozen and refrigerated seafood was the most popular product form sold in grocery stores. Econometric analysis provided insights into the inverse relationship between retail seafood prices and the quantities demanded. Product form, package size, promotion, region, and seasonality were found to influence seafood demand at the retail stores. Demand for major finfish products such as trout, catfish, salmon, tilapia, and pangasius was found to be elastic. Trout and salmon were found to be substitutes in retail markets, with trout exhibiting stronger substitution for salmon than vice versa. Pangasius and tilapia were found to be mutual substitutes in U.S. retail markets. Expenditure elasticities revealed that expenditures on catfish and salmon were highly sensitive to price whereas pangasius, trout, and tilapia expenditures also were price sensitive but to a lesser degree. Seafood purchases during the COVID-19 pandemic period (March 2020-Feb 2021) were significantly higher than during the non-pandemic period. Analysis of the HomeScan® data revealed key demographic and socioeconomic trends not available with the retail Scan Track Data. The sharp increase in retail sales of seafood products during the initial COVID-19 period largely seems to persist, except for shelf-stable products. As such, the pandemic significantly boosted the retail sales of seafood in the U.S. After March 2020, the *fresh* and *frozen* seafood categories, as well as *entrées,* experienced a significant surge in sales that has largely persisted. For *shelf-stable* seafood, there was a stronger surge in sales in the spring of 2020, but as sales quickly reverted to normal levels, suggesting that the sales increase was hoarding of these storable products.

Outreach Overview: Five separate industry-specific reports were generated and disseminated to stakeholders. Sixteen presentations, including eight at catfish and trout stakeholder meetings were made.

Targeted Audiences: The targeted audience includes aquaculture producers and processors in the southern region, policymakers, researchers, industry organizations, congressional members and staff, and the general public.

Outputs: Three peer-reviewed manuscripts have been published, one is in review with a journal, another is in review by co-authors, and 2 others are in preparation. In addition, 16 presentations have been made, as well as five separate industry-specific reports generated as part of this project.

Outcomes/Impacts: The project has provided considerable knowledge that was not available about dynamic trends in US seafood retail markets.

Partnerships Developed: Leslie Noel Sturmer, Shellfish Aquaculture Extension Specialist, *University of Florida*; Lianqun Sun, Assistant Professor, *Tennessee Tech University*; and Matt Parker, Extension Specialist, *University of Maryland*.

Identification of Novel *Flavobacterium* spp. Vaccine Candidates for Catfish and Other Aquaculture Fish Species in the Southern Region

Reporting Period: 1/1/2024 – 6/30/2025
Length of Project: 3 Years
Current Project Year: 3 (Extension through 6/30/25)
Total Funds Committed: $296,425
Principal and Co-Investigators: Timothy Bruce (PI), *Auburn University*; Matt Griffin, *Mississippi State University*; Thomas Loch, *Michigan State University*; Esteban Soto, *University of California-Davis*; and Benjamin LaFrentz, *USDA-ARS Aquatic Animal Health Research Unit*

Relevance: Columnaris disease is a leading pathogen in global aquaculture. In the southeastern US, columnaris disease is responsible for significant losses in the catfish industry, along with other economically important fish species. The development of an efficacious vaccine to prevent and control columnaris disease has been restricted partially due to a lack of understanding of the broad genetic diversity of columnaris-causing bacteria. *Flavobacterium columnare*, once thought to be the only species of bacteria to cause columnaris disease, now represents four distinct species of columnaris-causing bacteria: *F. columnare*, *F. covae*, *F. davisii*, and *F. oreochromis*, formerly genetic groups 1, 2, 3, and 4, respectively. One reason for the lack of efficacy is the sub-optimal host-pathogen dynamics. With the recent advancements in our understanding of columnaris causing bacterial genetic diversity, we hypothesize that this new information will aid in developing an efficacious live-attenuated vaccine for use in catfish and other southern region aquaculture fish species to prevent columnaris disease.

Response: To date, our team has developed eighteen rifampicin-resistant strains of *F. columnare*, *F. covae*, *F. davisii,* and *F. oreochromis*. Several of these (n = 13) have been confirmed to be attenuated and lacking the ability to cause disease. These strains can serve as potential live-attenuated vaccines against columnaris disease in either catfish, tilapia, rainbow trout or baitfish.

Results: Ten attenuated mutant isolates have been tested for vaccine efficacy. Of those, three vaccine candidates, *F. covae* B1M and C3M, and *F. columnare* FcΔ101, show moderate protection in Nile tilapia and rainbow trout, respectively. These vaccine candidates will be further optimized and pursued during the next reporting period.

Outreach Activity: Since the last report, we have presented our research findings at the 2025 Alabama Catfish Conference and Aquaculture America 2025.), and two international meetings (ISAAH 2022 and Aquaculture Africa 2023). During this past reporting period, the lead graduate student published a review article entitled “An overview of vaccine development strategies for columnaris-causing bacteria in cultured fish species” in the Journal of Fish Diseases.

Targeted Audience: Southern region fish producers, Extension specialists, aquaculture researchers, and fish health experts.

Outputs: Outputs generated during this reporting period include the development of eighteen rifampicin-resistant strains of CCB. Ten of the mutants were tested for attenuation and eight were pursued as viable vaccine candidates. Twelve of these mutant strains have been tested for vaccine efficacy, and three have shown promise and are likely to be successful in subsequent tests following optimization. Genetic comparisons for eighteen rifampicin-resistant strains have assessed mutations potentially contributing to rifampicin resistance and attenuation

Outcome/Impacts: Outcomes to date include the generation of eighteen rifampicin-resistant strains of CCB, thirteen of which have been confirmed to be attenuated and are currently being tested for use as potential live attenuated vaccines. Three of the tested strains show moderate protection in catfish, Nile tilapia and rainbow trout. The next steps are pond trials to assess the efficacy of the selected vaccines. Our research aims to produce an effective vaccine for economically important fish species in the southern region to minimize loss due to columnaris disease.

Partnerships: Partners have yet to be generated during this reporting period.

Optimizing Production Systems for Removal of Ammonia

Reporting Period: 1/1/2024 – 3/31/2025
Length of Project: 2 years
Current Project Year: 2
Total Funds Committed: $356,624
Principal and Co-Investigators: Brian Ott, Caitlin Older, Bradley Richardson, *USDA ARS WARU*; Charles Mischke, *MSU NWAC*; Jason Taylor, *USDA ARS WQERU*

Relevance: Catfish aquaculture production systems began as large ponds with few fish and over time have transformed into systems with higher densities in smaller ponds. These ponds require large amounts of commercial feed to grow the fish and results in nitrogen loading of the ponds, typically in the form of ammonia. At lower feeding rates, most ammonia is assimilated by phytoplankton, with little remaining in the water. However, once the carrying capacity of phytoplankton is reached, excess ammonia begins to accumulate.

Response: Researchers at three institutions are investigating how nitrogen moves through two different commercial-scale aquaculture pond systems. Split-ponds and intensively aerated ponds will be used to evaluate accumulation and removal rates of ammonia, nitrite, and nitrate. Hybrid catfish will be raised at stocking rates consistent with industry practices in four intensively aerated ponds and four split-ponds over two production cycles, and the different forms of nitrogen will be quantified. *In situ* measurements of nitrification and denitrification and a survey of the distribution of dissolved oxygen will be performed to characterize the function of these ponds. Microbial populations will be assessed using various molecular methods.

Results: Traditional water quality methods as well as novel techniques to characterize nitrification, denitrification, and the microbial community were conducted on split-ponds and intensively aerated ponds. These data are being used to compare the nitrogen removal processes and potential of both production systems and both sides of the split-pond systems. Removal of nitrogenous waste in split-ponds can be optimized by keeping the water moving throughout the entire pond basin during the daytime and by providing substantial aeration in the fish side at night. However, the full ammonia- and nitrogen-removal potential of the system is only reached if the waste treatment side is allowed to go fully anaerobic at night, with no extra aeration and fully separate from the fish side. Intensively aerated ponds can approach the nitrification rates of split-ponds, but only if ample (>10 hp/acre) aeration is provided relative to the stocking density (approximately 1,500 lbs/acre can be produced per 1 hp/acre of aeration provided).

Outreach Overview: No outreach has been conducted to date. In 2026 scientists from the project will provide presentations to stakeholders at NWAC seminars and other venues. Peer-reviewed publications will be generated and SRAC fact sheets if requested.

Targeted Audiences: Commercial aquaculture producers are the main target audience. Certain components of the research results will be of interest to scientists working on aquaculture and freshwater ecology.

Outputs: None to date.

Outcomes/Impacts: A well-designed and managed split-pond is able to maintain a higher biomass of phytoplankton on average than intensively aerated ponds, allowing for more ammonia to stored within phytoplankton relative to intensively aerated ponds. This larger phytoplankton bloom arises from the ability of a circulated pond to continually move phytoplankton into the sunlight and addition of phosphorous arising from sediment of the waste treatment side. Additionally, the fish side of split ponds is inherently optimized to transform excess ammonia into nitrite and nitrate through nitrification because of high rates of aeration and oxygen, high suspended solids, and direct mixing of ammonia with both important factors for nitrification. Finally, split ponds are more conducive to actually remove nitrogen from the system through denitrification, whereas a traditional pond typically will not possess a stable anaerobic environment favorable for this process. Elevated rates of denitrification were found in the waste treatment side of the split pond system, as nitrogen gas concentrations and rates of denitrification in the sediment are highest there. Intensively aerated ponds can also effectively remove ammonia through nitrification, but intensive aeration (>10 hp/acre) is required.

Partnerships Developed: None to date.

Evaluation of Bird Depredation of Traditional and Non-Traditional Species

Reporting Period: 4/1/2023 – 6/30/2025
Length of Project: 3 years
Current Project Year: 3 (Extension through 3/31/2026)
Total Funds Committed: $329,189
Principal and Co-Investigators: Mark Smith, Luke Roy, Anita Kelly, *Auburn University*; Brian Dorr, Paul Burr, *USDA WS NWRC*; Jonathan van Senten, *Virginia Polytechnic Inst. and State University*

Relevance: With over 30,000 water acres in catfish aquaculture production, the Black Belt region of eastern Mississippi and western Alabama lies within the Mississippi Flyway, a major migratory route for several species of fish-eating birds. These fish-eating birds, mainly Double-Crested Cormorants, commonly feed on commercially produced catfish. Similarly, in Arkansas, Lonoke and Prairie counties produce 72% of the United States' total baitfish and sportfish sales. Research in both areas is needed to understand the foraging patterns of these fish-eating birds and to quantify losses to whole-farm profitability so that effective management strategies can be developed to mitigate losses.

Response: Aerial, in-person, or camera surveys were conducted at a random sample of fish production farms to estimate changes in abundance of predatory birds throughout the production season. A sample of birds were then collected using firearms and necropsied to determine their consumption of farmed fish. Information from these diet studies will be used to estimate total fish consumption and ultimately the economic cost to fish farmers.

Results: Double-crested cormorant abundance on catfish ponds had two peaks, one occurring in October-November and a second during March-April which coincided with cormorant migration through the region, indicating catfish ponds may be more of a stopover site than an overwintering site. In-person surveys showed grackles were more efficient predators at removing fish under sheds compared to open pond spawning mats. These results will assist fish producers in focusing loss mitigation efforts at peak times of bird abundance and/or specific production facilities where most losses occur.

Outreach Overview: Project results will be disseminated to commercial aquaculture producers via traditional Extension techniques and approaches by Extension faculty on the project via Extension fact sheets, timely information press releases, newsletters, the Alabama Fish Farming Center website, trade journals such as the Catfish Journal, and websites/social media outlets managed by Extension. Project results have been shared at producer association meetings at the annual Alabama Catfish Conference and the AR Bait and Ornamental Fish Grower Association meeting.

Targeted Audiences: Baitfish, sportfish, and catfish producers, the aquaculture scientific community, and state/federal agencies are the main targeted audiences for this work.

Outputs: To date there have been two Extension articles published on this work in Fish Farming News, a biannual electronic newsletter of the Alabama Fish Farming Center, that specifically targets aquaculture producers. In addition, seven oral presentations and two abstract submissions (Aquaculture 2026) have

been made to date. Seven research-in-progress posters showcased summaries of first-year results at various national wildlife conferences.

Outcomes/Impacts: Because results are preliminary at this time, the final impact of this collective work cannot yet be ascertained as the study is not yet completed and results put into practice. However, both the data related to common grackle predation on baitfish and sportfish and cormorant predation on catfish will help to inform commercial producers regarding the true economic costs of fish loss and the development of management strategies to mitigate these losses. Predatory birds such as cormorants and grackles may consume substantial amounts of commercially produced fish; however, mitigation strategies may be most effective when focused during times and locations where losses occur.

Partnerships Developed: None to date.

Utilizing Feeding Stimulants and Liquid Diets to Improve Larval Feeding Performance

Reporting Period: 1/1/2024 – 6/30/2025
Length of Project: 2 years
Current Project Year: 3 (Extension through 5/14/2026)
Total Funds Committed: $424,077
Principal and Co-Investigators: Matt DiMaggio, Casey Murray, Cortney Ohs, *University of Florida*; Ganesh Kumar, *Mississippi State University*

Relevance: This research aims to reduce reliance on *Artemia* spp. nauplii as a first feed prey item in freshwater and marine larviculture due to inherent issues with supply shortages, high costs, and labor-intensive maintenance. The goal of this study is to determine the most effective methods for replacing live feeds with inert diets including microparticulate diets enhanced with feed attractants or commercially available liquid diets. The outcomes will benefit the ornamental aquaculture industry in the Southeastern United States by improving larval growth, survival rates, and culture efficiency, leading to increased profitability and resilience for the ornamental fish industry.

Response: Investigations into top-dressing microparticulate diets with three different feed attractants, L-alanine, betaine, and L-tryptophan to enhance larval feeding response have been carried out for the Siamese fighting fish (*Betta splendens*), X-Ray Tetra (*Pristella maxillaris*), and Black Skirt Tetra (*Gymnocorymbus ternetzi*). Three 14-day dose identification trials were completed, one per feed attractant, to determine the feed attractant inclusion rate that best promoted larval survival and growth. These results were then used to conduct a final trial for each species to test a combination of all three feed attractants against each singular feed attractant and a control microparticulate diet without any feed attractant.
The efficacy of inert liquid *Artemia* diets (LA, Cargill Liqualife or Zeigler EZ Artemia), their inclusion level, and a weaning schedule were also examined in a series of experimental trials for Siamese fighting fish, X-ray tetra, Rainbow sharkminnows (*Epalzeorhynchos frenatum*), and Tiger barb (*Puntigrus tetrazona*). These trials investigated the brand of liquid diet that best promoted larval survival and growth, graded replacement levels of live Artemia with the selected LA diets, and the effect of weaning age on the performance of larvae transitioning from live Artemia to LA.

Results: Results from feed attractant (FA) trials were species specific. L-alanine (0.50% inclusion) top-dressed onto a microparticulate diet increased *B. splendens* survival by approximately 16.5% compared to the control. *P. maxillaris* larvae offered different FA diets in the combination trial exhibited similar survival to larvae fed the Artemia reference diet or the control microdiet. The feed attractant combination diet (L-alanine, betaine, and L-tryptophan) yielded survival (~42%) statistically similar to the Artemia reference diet (~44%) in *G. ternetzi*.
Replacing up to 50% of *Artemia* spp. nauplii in the diet of larval *B. splendens* with either LA resulted in similar survival compared to the control diet of exclusively *Artemia* spp. nauplii. Conversely, when *P. maxillaris* were fed the same diets, larval survival was significantly lower in the 50% LA treatments compared to the *Artemia* reference diet. *P. maxillaris* larvae fed increasing amounts of LA diets, resulted

in significant decreases in survival as inclusion increased. Gradual weaning of *P. maxillaris* larvae from *Artemia* to LA diets also resulted in poor survival. Partial replacement of *Artemia* with up to 50% liquid diets in *P. tetrazona* larvae led to moderate growth and survival, while complete replacement reduced performance, and a no-weaning strategy (75% *Artemia* + 25% liquid diet) yielded survival rates close to the *Artemia*-only diet. Partial replacement of *Artemia* with 25–50% liquid diets in *E. frenatum* larvae supported moderate survival, while full replacement and early weaning (12–15 DPH) reduced survival, with the no-weaning strategy achieving rates (34%) close to the reference diet (47%).

Outreach Overview: Transfer of information and relevant production protocols to stakeholder groups will be accomplished through various outreach methods. Workshops, tours, and site visits will provide opportunities for stakeholder engagement and training. Quick reference guides and updated production protocols for each species of interest in this study will be made and distributed directly to ornamental fish producers. Publication of Extension and research literature will be pursued.

Targeted Audiences: The target audience for this work includes industry stakeholders within the ornamental fish industry throughout the Southeastern United States.

Outputs: Refined larval culture protocols will be developed for eight freshwater and one marine ornamental fish species that account for the most cost-effective feeding strategies for each species. Protocols will be available as user-friendly quick reference guides and more detailed information sheets. Technology transfer will occur through research and extension publications, farm visits, and workshops, ensuring stakeholders have access to the latest findings. Finally, an industry decision tool will be created to aid producers in selecting the most economically viable larval production protocols.

Outcomes/Impacts: The outputs of this research will lead to the implementation of improved nutrition protocols by the ornamental aquaculture industry and production and economic efficiency improvement for current producers of these fish species. Future long-term impacts of this research will include reduced reliance on *Artemia* spp. nauplii and increased resiliency of the ornamental aquaculture industry in the southern region due to increased production efficiency and cost-effectiveness.

Partnerships Developed: None to date.

Training Videos for Regulatory and Certification Compliance

Reporting Period: 1/1/2024 – 6/30/2025
Length of Project: 1 year
Current Project Year: 2 (Extension through 6/30/2025)
Total Funds Committed: $147,052
Principal and Co-Investigators: Jonathan van Seten, Michael Schwarz, Katheryn Estrada, Keri Rouse, *Virginia Polytechnic Inst. and State University*; Ganesh Kumar, *Mississippi State University*

Relevance: U.S. aquaculture sectors face stringent regulatory frameworks and complex certification landscapes. Producers and their employees require accessible, consistent training to maintain compliance with programs such as the USDA–AMS Process Verified Program (PVP) U.S. Farm–Raised Catfish Environmental Sustainability Certification and the Arkansas Baitfish Certification Program. Professionally produced training materials—available in both English and Spanish—help reduce compliance costs, improve employee preparedness, and address consumer confusion around eco–labels, which increases the value of verified programs and labels.

Response: The project team (Virginia Seafood AREC, Mississippi State University, Engle–Stone Aquatic$ LLC, and Wing Media Group) developed scripts and storyboards in close collaboration with industry stakeholders, including Catfish Farmers of America, the Arkansas Bait and Ornamental Fish Growers Association, the Arkansas Department of Agriculture, and representatives from USDA AMS PVP. Driven by identified visual needs, the videography team coordinated filming across eight sites in Mississippi and Arkansas covering feed production, farming practices, research, and processing. Interviews with industry representatives were recorded. Videos have been edited and produced, with motion graphics, audio, and stock items being integrated to reinforce key training messages. Video footage and photographs captured under this project have been provided to the Southern Regional Aquaculture Center on an external hard drive. The training videos produced have been hosted online at the Virginia Seafood AREC website and have been shared with relevant industry groups (Catfish Farmers of America, Arkansas Bait and Ornamental Fish Growers Association, etc.). Videos are available for viewing and sharing at: https://www.arec.vaes.vt.edu/arec/virginia-seafood/media-center.html

Results: Scripts developed with input from farmers and USDA personnel have been finalized for catfish environmental sustainability, baitfish biosecurity, and aquatic animal care and handling training videos. On–location videography was completed at eight industry sites across Mississippi and Arkansas (b–roll, interviews, and photos). English and Spanish narration for catfish training video was completed with Spanish translation led by native speaker. English narration with Spanish subtitles was done for baitfish training video. Editing and post–production of training videos has been completed (footage compilation, visual gap–filling, motion graphics, and audio integration).

Outreach Overview: Stakeholder engagement during this project took place during planning meetings, script and storyboard reviews, and iterative revisions with industry and agency partners (Catfish Farmers

of America, Arkansas Bait and Ornamental Fish Growers Association, Arkansas Department of Agriculture, USDA AMS PVP). Training videos were also presented and shared with industry partners for review and comments before the final post-production process. Final videos have been shared with relevant industry groups. Videos are available on the Virginia Seafood AREC website in the Media Center and on the YouTube Channel for the Virginia Tech College of Agriculture and Life Sciences.

Targeted Audiences: The targeted audiences for this project are catfish farmers supplying USDA–AMS–PVP–approved processors, baitfish and sportfish producers participating in the Arkansas Baitfish Certification Program, aquatic animal producers and processors seeking training in animal care and handling, Extension specialists and technical service providers supporting Southern aquaculture, and Spanish–speaking farm employees across participating sectors.

Outputs: Scripts and storyboards have been completed with video footage captured across eight sites. Three training videos are under production (Catfish Environmental Sustainability; Arkansas Baitfish Biosecurity; Aquatic Animal Care & Handling).

Outcomes/Impacts: It is expected that this project will provide improved employee training and preparedness, reduced compliance costs, stronger alignment with certification program requirements, expanded access via Spanish–language materials, and improved animal care and handling practices on aquaculture farms.

Partnerships Developed: Engle-Stone Aquatic$ LLC, Wing Media Group, Catfish Farmers of America, Arkansas Bait and Ornamental Fish Growers Association, Arkansas Department of Agriculture, USDA AMS PVP, and the MSU National Warmwater Aquaculture Center.

Restaurant and Supermarket Demand for Important Aquaculture Species

Reporting Period: 5/15/2024 to 5/14/2025
Length of Project: 2 Years
Current Project Year: 1
Total Funds Committed: $236,268
Principal and Co-Investigators: Taryn Garlock, *Auburn University;* Frank Asche, *University of Florida*; Madan M. Dey, *Texas State University;* Andrew Ropicki, *University of Florida*

Relevance: In the Southeastern U.S. there is limited market information available for most aquaculture species, and particularly for new or emerging aquaculture species. Given that significant quantities of seafood are consumed at-home and at restaurants, it makes both grocery stores and restaurants important outlets for marketing aquaculture products. The limited information on seafood consumption trends in both the grocery and restaurant sector limits the industry's ability to increase consumption in existing markets and expand markets to new geographic areas, markets outlets, and consumer segments. This research aims to address these data gaps by exploring purchaser preferences, sales trends, and product availability, focusing on three emerging species in the southeastern region: red drum, oysters, and crawfish; and the two main outlets: restaurants and grocery stores.

Response: Researchers at three institutions are conducting market research using four different approaches: surveys of restaurants and supermarkets, retail scanner data, restaurant menu data, and internet search data. Web-based surveys were developed to quantify purchasing patterns and preferences of grocery stores and restaurants in the southeastern U.S. A postcard invitation to complete a web-based survey was mailed to restaurants and supermarkets using a database from Chain Store Guide. Analysis of survey results will quantify purchasing patterns and preferences and identify factors influencing purchasing behavior.
Scanner data was obtained from AC Nielsen Inc, which consisted of weekly sales data across 62 markets from September 2016 to August 2021. An analysis of scanner data was conducted to quantify sales retail trends for oysters, crawfish, and red drum in the U.S.
Data was also collected from restaurant menus to examine product availability and product characteristics across states and different types of restaurants, as well as to quantify how much product information is passed to the consumer. Web scraping was used to collect a sampling frame of restaurants in the states of interest. Data was manually collected from restaurants menus, including presence or absence of a product, number of products, production method, country of origin, and price.
Internet search query data was obtained from Google's search data platform, Google Trends. We examined trends in U.S. public interest in seafoods by product form, major species groups, and market channel.

Results: Postcard invitations for the surveys have been distributed to over 10,000 grocery stores and restaurants in the four states of interest. Data collection is ongoing. In year 2 of the project, the data will be used to examine purchasing patterns and preferences, and to identify market outlets with high potential to expand sales of aquaculture products.
An analysis of scanner data obtained from AC Nielsen Inc was conducted to quantify sales trends for oysters, crawfish, and red drum from 2016-17 to 2020-21. Sales by product type, shelf-life, product

origin, region and seasonality were examined. Oyster sales showed consistent growth in both volume and revenue, with non-value-added products leading the market, and the South Atlantic and South Central regions were the top markets. Crawfish sales also expanded significantly, driven by non-value-added product, with strong demand in Louisiana and Texas. Red Drum sales, although small, showed growth potential, especially for whole fish products in major cities of the West North Central and South Atlantic regions.
A sampling frame of over 85,000 restaurants in Alabama, Louisiana, Mississippi and Texas was scraped from the TripAdvisor website. Menu data was collected for a 1% sample of restaurants in each state. Menus were sourced via TripAdvisor and/or the restaurant web pages. Data analysis is in progress. Preliminary data show many restaurants analyzed do not carry any seafood products and very few carry crawfish, red drum or oysters. Menu data is now being collected from a narrower sample of restaurants classified as seafood restaurants using similar methods. Preliminary data from Alabama suggests that crawfish, red drum, and fresh oysters are served in seafood restaurants in this region and were found on 12-28% of menus analyzed. Additional data analysis is underway for Alabama seafood restaurants, and similar analysis will be conducted for the other regions in year 2 of the project.
The analysis of internet search data showed that changes in search frequencies can reveal short-term shocks as well as longer trends; however, there was not enough data to show trends for niche species. The results showed a major shift in relative search volumes for fresh and frozen fish, as well as a shift from seafood restaurants to seafood recipes, and was attributed to COVID-19.

Outreach Activity: To date, one article has been published in an aquaculture extension newsletter, and one presentation was given at the Aquaculture 2025 conference in New Orleans. The results of the project will also be distributed to aquaculturists and other groups through referred journal articles, extension publications, and presentations at conferences.

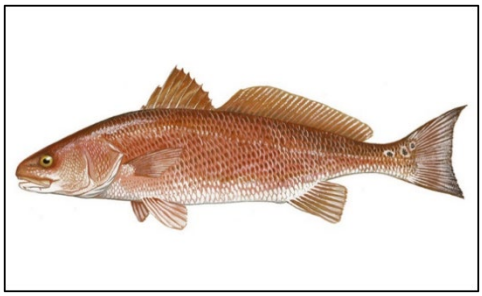
Targeted Audience: The targeted audiences for this project are aquaculture producers and processors in the southeastern region of the U.S., as well as policymakers, Extension professionals, and researchers.

Outputs: One manuscript is under review, and two manuscripts are under preparation. One newsletter article has been published, and one presentation has been made thus far.

Outcome/Impacts: The impacts of this ongoing study cannot be estimated at this time.

Partnerships: None outside of project participants.

First Steps Towards Genetic Improvement of Red Drum Stocks



Reporting Period: 8/1/2024 to 6/30/2025
Length of Project: 3 Years
Current Project Year: 1
Total Funds Committed: $297,705
Principal and Co-Investigators: Todd Sink, Brittany Chesser, *TAMU AgriLife Ext.;* Christopher Hollenbeck, David Portroy, *TAMU Corpus Christi*; Benjamin Reading, *North Carolina State University*

Relevance: Recently, the red drum aquaculture industry in Texas has experienced major challenges related to extreme environmental conditions, including a cold-weather event in February 2021 that decimated the industry. Unlike many cultured fish species, red drum broodstock used for commercial production are still primarily of wild origin, and genetic improvement of broodstock for improved growth and survival is critical for securing reliable production in the future.

Response: TAMU, TAMU-CC, and NC State Universities initiated a selective breeding program for red drum genetic improvement for growth rate and cold tolerance. Fingerlings have been obtained from 50% of commercial red drum hatcheries in Texas as well as two wild populations from TPWD. Growth trials are underway with cold tolerance trials slated to start in December of 2025.

Results: No results have been obtained yet.

Outreach Activity: No results have been obtained yet, but the project was presented to producers at the Texas Aquaculture Association Annual Meeting in Palacios, TX, and several producers/farms are actively involved in the project. Every red drum producer in the state has been contacted regarding participation in the project with a basic explanation of the project. When the project data has finally been completed, the project PIs will develop a guidance document for current and future red drum producers to demonstrate how to implement a selective breeding program. PIs Reading and Sink will develop a document detailing the red drum domestication and selective breeding program, its implementation for producers, and construction of key deliverables from the project including a technical report of the breeding program design and output including enhancements of traits. Participating producers will also receive a genetic analysis of their broodfish and offspring pertaining to only the fish from their facility. Finally, at the completion of the project, the red drum broodstock selected during the project will be distributed back to participating project producers. The remaining broodstock will be made available to non-participating producers. At least one producer in Florida and one University in Mississippi have also requested remaining project broodstock.

Targeted Audience: The targeted audience is red drum producers and production facilities in the United States.

Outputs: No results have been obtained yet. Future products include broodfish, a customized genetic analysis of broodfish for participating producers, a document detailing the red drum domestication and

selective breeding program, its implementation for producers, and construction of key deliverables from the project including a technical report of the breeding program design and output including enhancements of traits, and presentations for the Texas Aquaculture Association and Aquaculture America.
Outcome/Impacts: None to date.

Partnerships: Gulf States Aquaculture (Shane Nicaud), Turtle Creek Aquaculture (Nasir Kureshy), Homegrown Seafood (Mark Kubecka), Texas Parks and Wildlife Department (Christopher Mace), Live Advantage Bait (Nicole Kirchoff), and University of Southern Mississippi (Angelos Apeitos).

Feed Application of Recombinant Attenuated Channel Catfish Virus (CCV) for Vaccinating Catfish against CCV and Blue Catfish Alloherpesvirus (BCAHV) Disease

Reporting Period: 7/1/2024 to 6/30/2025
Length of Project: 3 Years
Current Project Year: 1
Total Funds Committed: $175,000
Principal and Co-Investigators: Larry Hanson, Fernando Yamamoto, Matt Griffin, David Wise, *Mississippi State Univ.*

Relevance: Channel catfish virus disease can cause over 75% mortality in less than 10 days in catfish fingerling ponds.

Response: Feed based vaccines are currently being used to reduce losses to enteric septicemia of catfish (ESC). If an oral CCVD vaccine is shown to be effective it could easily be administered in much the same way as the ESC vaccine

Results: Research showed that an attenuated vaccine candidate can infect catfish fingerlings when given orally. This indicates that feed-based vaccination has the potential to prevent CCVD.

Outreach Activity: No outreach has occurred. When results from vaccine trials are complete, researchers plan to present at producer meetings and fish health meetings.

Targeted Audience: Catfish fingerling producers.

Outputs: Researchers have demonstrated the feed-based application of an attenuated vaccine strain of CCV can infect channel catfish. The method of vaccinating fish using this vaccine coated feed has been developed.

Outcome/Impacts: None to date.

Partnerships: None.

Products Developed and Students Supported

Journal Articles and Abstracts

Harrison, C.E., LaFrentz, B.R., Shoemaker, C.A., Lange, M.D., Liles, M.R., Mohammed, H.H., Beck, B.H., Churchman, E.M., Peatman, E. and Bruce, T.J., (2025). An Overview of Vaccine Development Strategies for Columnaris-Causing Bacteria in Cultured Fish. *Journal of Fish Diseases*, p.e14155.

Koda, S. A., Subramaniam, K., Hick, P. M., Hall, E., Waltzek, T. B., and Becker, J. A. (2023). Partial validation of a TaqMan quantitative polymerase chain reaction for the detection of the three genotypes of Infectious spleen and kidney necrosis virus. PloS one, 18(2), e0281292.

Older, C. E., Griffin, M. J., Ware, C., & Ott, B. D. (2025). Development of qPCR assays for bacterial nitrification and denitrification genes in catfish aquaculture ponds. *Microbiology Spectrum* 13:E03088-24.

Sun, L., Kumar, G., and Engle, C. (2025). Factors influencing seafood sales in US retail markets. *Journal of the World Aquaculture Society*, 56(1), e70000. https://doi.org/10.1111/jwas.70000

Hossain, Md. E., Bhattacharjee, D., & Dey, M. (2025). Market trends for seafood products in the United States during the COVID-19 period: An analysis of retail scanner data. Aquaculture Economics & Management, 1–18. https://doi.org/10.1080/13657305.2025.2560820

Extension/Outreach Publications

Sink, Todd. AgriLife Extension launches genetic improvement program for Texas red drum. AgriLife Today. https://agrilifetoday.tamu.edu/2024/07/24/agrilife-extension-launches-genetic-improvement-program-for-texas-red-drum/

Knutson, S. How many fish could a cormorant catch of catfish if a cormorant could catch catfish? Alabama Fish Farming News. Issue 2, December 14, 2023.

Redd, M. Blackbird depredation impact on Arkansas baitfish and sportfish aquaculture. Alabama Fish Farming News. Issue 2, December 14, 2023.

Oral Presentations

Soto, E., Nguyen, D.T., Shahin, K., Yazdi, Z., Kawahara, M., Heckman, T.I., LaFrentz, B.R., Harrison, C.E., Bruce, T., Loch, T.P., Griffin, M.J., and Subramaniam, K. Generation and efficacy of a live attenuated vaccine against columnaris disease in a salmonid model of infection. 2025. Aquaculture America 2025. New Orleans, LA.

Knorr, T.G., C.A. Murray, A.L. Wood, O.I. Markham, B.D. Lacy, M.A. DiMaggio. 2025. Changing up the protocol: can alternative first feeds improve the culture efficiency of the cherry barb *Puntius titteya*? World Aquaculture 2025, New Orleans, LA, USA (invited); pg. 639.

Murray, C.A., T.G. Knorr, A.L. Wood, O.I. Markham, B.D. Lacy, M.A. DiMaggio. 2025. Investigating liquid diets as live feed replacements in freshwater angelfish (*Pterophyllum scalare*) larviculture. World Aquaculture 2025, New Orleans, LA, USA (invited); pg. 805.

Farias, R.S., C.L. Ohs, F. Shopnitz, J.R.O. Montoya, M.A. DiMaggio, C.A. Murray. 2025. Effectiveness of *Artemia* replacement for larvae of two ornamental freshwater fish species. Oral Presentation. Aquaculture America 2025. New Orleans, LA, USA. pg. 380.

Harrison, C.E., LaFrentz, B.R., Griffin, M.J., Loch, T.P., Soto, E., and Bruce, T.J. Vaccine development against columnaris disease and other aquaculture fish species in the Southern region. 2025 Alabama Catfish Conference. January 9, 2025.

Knutson, S., M. Smith, B. Dorr, A. Kelly, and L. Roy. (submitted) GULP! Impacts Of Double-Crested Cormorant *Nannopterum auritum* on Catfish Ictalurus sp. Aquaculture in The Black Belt Region of Alabama and Mississippi. Aquaculture 2026, Las Vegas, NV, February 16-19, 2026.

Knutson, S., M. Smith, B. Dorr, A. Kelly, and L. Roy. GULP! Impacts of Double-Crested Cormorant *Nannopterum auritum* on Catfish *Ictalurus* sp. Aquaculture in The Black Belt Region of Alabama and Mississippi. The Wildlife Society 32nd Annual Conference, Edmonton, Alberta, October 5-8, 2025.

Knutson, S., M. Smith, B. Dorr, A. Kelly, and L. Roy. GULP! Impacts of Double-Crested Cormorant *Nannopterum auritum* on Catfish *Ictalurus* sp. Aquaculture in The Black Belt Region of Alabama and Mississippi. The Alabama Catfish Annual Conference, Marion Junction, AL. January 9, 2025.

Knutson, S., M. Smith, B. Dorr, A. Kelly, and L. Roy. The impact of double-crested cormorants on catfish aquaculture in west Alabama and east Mississippi. 2024 Alabama Catfish Conference, Marion Junction, AL, January 11, 2024.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. (submitted) Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. Aquaculture 2026, Las Vegas, NV, February 16-19, 2026.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. The Wildlife Society 32nd Annual Conference, Edmonton, Alberta, October 5-8, 2025.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. Alabama Chapter TWS Annual Conference 2025, Anniston, AL, March 19, 2025.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. Arkansas Bait and Ornamental Fish Growers Association Meeting, Lonoke, AR, February 4, 2025.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. Aquaculture 2025, New Orleans, LA, March 6-10, 2025.

Reading, B. and T. Sink. Genetic Improvement Programs for Aquaculture and the USDA-SRAC First Steps Towards Genetic Improvement of Red Drum Stocks Project. Texas Aquaculture Association Annual Meeting. Palacios, TX, 2025.

Poster Presentations

Knutson, S., M. Smith, B. Dorr, A. Kelly, and L. Roy. (submitted) GULP! Impacts Of Double-Crested Cormorant *Nannopterum auritum* on Catfish *Ictalurus* sp*.* Aquaculture in The Black Belt Region of Alabama and Mississippi. The 21st Wildlife Damage Management Conference 2025, Starkville, MS, March 24-28, 2025.

Knutson, S., M. Smith, B. Dorr, A. Kelly, and L. Roy. (submitted) GULP! Impacts Of Double-Crested Cormorant *Nannopterum auritum* on Catfish *Ictalurus* sp*.* Aquaculture in The Black Belt Region of Alabama and Mississippi. Aquaculture 2025, New Orleans, LA, March 6-10, 2025.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. The 21st Wildlife Damage Management Conference 2025, Starkville, MS, March 24-28, 2025.

Redd, M., M. Smith, B. Dorr, A. Kelly, and L. Roy. Impact of blackbird depredation on baitfish and sportfish aquaculture in Arkansas. Aquaculture 2025, New Orleans, LA, March 6-10, 2025.

Rowden, C., M.E. Redd, A.M. Kelly, B.S. Dorr, M.D. Smith, L.A. Roy, and K.L. Sheehan. 2025. Blackbirds in baitfish aquaculture: An overlooked interaction. Joint meeting of The Waterbird Society and the Pacific Seabird Group, San Jose, Costa Rica, January 6-9, 2025

Digital Products

Southern Regional Aquaculture Center – Catfish PVP Training Video (English), https://www.arec.vaes.vt.edu/arec/virginia-seafood/media-center.html

Southern Regional Aquaculture Center – Catfish PVP Training Video (Spanish), https://www.arec.vaes.vt.edu/arec/virginia-seafood/media-center.html

Southern Regional Aquaculture Center – Arkansas Fish Farming Training Video, https://www.arec.vaes.vt.edu/arec/virginia-seafood/media-center.html

SRAC Home Website: www.srac.msstate.edu

Students and Post-Docs Supported

Sarah Knutson. Auburn University, College of Forestry, Wildlife and Environment, M.S. degree track. Degree has not been completed (anticipated completion date of May 2026). Thesis Title: *Impact of Double-crested Cormorants on Catfish Aquaculture in West Alabama and East Mississippi.*

Madeline Redd. Auburn University, School of Fisheries, Aquaculture and Aquatic Sciences, M.S. degree track. Degree has not been completed (anticipated completion date of May 2026)
Thesis Title: *Impact of Avian Predators on Baitfish Aquaculture.*

Aidan Alvarodo, Texas A&M, Dept. of Rangeland, Wildlife, and Fisheries Management, Red Drum Genetics, Degree in progress. Anticipated graduation May 2026.

Liliana Rogers, Texas A&M, Dept. of Rangeland, Wildlife, and Fisheries Management, Red Drum Genetics, Degree in progress.

Brittany Chesser, Texas A&M, Dept. of Rangeland, Wildlife, and Fisheries Management, Ph.D. Student. Red Drum Genetics, Degree in progress. Anticipated graduation December 2025.

Caitlin Older. USDA-ARS Warmwater Aquaculture Research Unit, Post-doctoral fellow.

Samantha Koda. University of Florida, Ph.D. Student. Graduated. Dissertation title: *Megalocytiviruses in aquaculture: Genetic diversity, improved molecular diagnostic tools, and the development of an experimental challenge model to determine the effect of water temperature on disease.*

Courtney Harrison. Auburn University, Ph.D. Student. Anticipated date of completion: Spring 2026. Dissertation title: *Columnaris-causing bacteria vaccine development for catfish and tilapia.*

Divya Rose. Mississippi State University, Ph.D. Student. Anticipated date of completion: Spring 2026. Dissertation title: TBD.

Oai Li Chen, Post Doctoral Research Associate, Texas State University

Quinn LaFontaine, Graduate Research Assistant, Auburn University

Debarshi Bhattacharjee, Texas Tech University, M.S. Student. Graduated. Dissertation title: *Market trends and consumer demand for Southern aquaculture products of USA: An analysis of seafood scanner data.*

Isabella Medina Silva, Mississippi State University, M.S. Student. Anticipated date of completion: December 2026. Thesis title: *Feed application of recombinant attenuated channel catfish virus (CCV) for vaccinating catfish against CCV*.

Travis Knorr. University: University of Florida, MS Student. Degree date: August 2025. Thesis title: *Evaluating feed attractants and liquid Artemia diets for larviculture of five ornamental fish species.*

Appendix 1. List of Completed SRAC Projects to Date

Managing Larval Feeding for Improved Survival by Reduction of Artemia Use and Replacement with Fortified Rotifers or Artificial Feeds
Duration: 2020-2023 Funding Level: $269,520
Participants: NCSU, SCDNR, TAMU

Investigating the Emergence of Vibriosis in Catfish Hatcheries
Duration: 2020-2023 Funding Level: $53,411
Participants:MSU, UGA, MT SU

Investigating the Epidemiology of *Edwardsiella piscicida* -Septicemia in Hybrid Catfish and Other Commercially Important Fish Species in the Southern United States
Duration: 2019-2023 Funding Level: $293,007
Participants: MSU, UG, VT, UAPB, LSU, UCD

Evaluation of Probiotics and Prebiotics in Finfish Hatcheries to Improve Larval Production
Duration: 2018-2023 Funding Level: $167,837
Participants: TAMU, NCSU, TxPW, UAB

Economic Impact Assessment and Monitoring Progress of Technology Adoption in the U.S. Catfish Industry
Duration: 2018-2021 Funding Level: $111,895
Participants: MSU, VT, AU

Increasing Understanding of and Developing Management Strategies for *Edwardsiella ictaluri* in Ornamental Fish
Duration: 2018-2021 Funding Level: $204,208
Participants: MSU, UF, LSU

Evaluation of Protein and Lipid Concentrations in Commercially Available Tilapia Feeds and Their Effect in Intensive Production Systems
Duration: 2017-2021 Funding Level: $184,844
Participants: TAMU, VT, BROCK FARMS, ASTOR FARMS

Policy Analysis of the Implications of Changes in Federal Authority Under the Lacey Act to Prohibit Interstate Movement of Injurious Wildlife
Duration: 2019-2021 Funding Level: $110,283
Participants: LSU, UF, UT, VT

Predation Risk and Economic Impact of Lesser Scaup and Piscivorous Waterbirds on Commercial Baitfish and Catfish Production
Duration: 2016-2018 Funding Level: $286,780
Participants: UAPB, MSU, USDA/WS/NWRC, VPI

Commercial Production of Selected Native Freshwater Ornamental Species
Duration: 2017-2019 Funding Level: $148,890
Participants: UF, LSU, VPI

Repeatability of Incidence and Time of Ovulation, Fecundity and Fertility in Channel Catfish Females Induced to Ovulate for Production of Hybrid Catfish Fry
Duration: 2017-2019 Funding Level: $126,619
Participants: AU, USDA/ARS/WARU, MSU

Techniques to Improve Production of Off-bottom Cultured Oysters
Duration: 2017-2019 Funding Level: $168,576
Participants: SCSGC, UG, UF, LSU, AU, NCSU

Field-Testing of a Rapid LAMP Assay to Detect the Marine Parasite *Amyloodinium ocellatum* in Commercial Aquaculture Facilities
Duration: 2017-2018 Funding Level: $92,018
Participants: AU, UF, USM

Improved Reproduction in Foodfish (Catfish and Largemouth Bass), Baitfish and Ornamentals Using a New Spawning Aid (GNRH IIA)
Duration: 2017- 2019 Funding Level: $192,287
Participants: AU, USDA ARS WARU

Evaluation of Probiotic and Prebiotic Supplements with Catfish, Golden Shiners, Hybrid Striped Bass and Tilapia under Conditions of Commercial Production
Duration: 2015-2017 Funding Level: $274,308
Participants: TAMU, AU, USDA ARS WARU, UAPB, ESA

Improvement of Blue Catfish Germplasm for Hybrid Catfish Production
Duration: 2014-2017 Funding Level: $44,343
Participants: USDA ARS WARU, LSU

Integrated Approaches to Reducing Individual Variability and Providing Year Round Harvest of Channel-Blue Hybrid Catfish
Duration: 2015-2017 Funding Level: $275,232
Participants: AU, USDA ARS WARU

Performance Evaluation of Intensive, Pond-Based Culture Systems for Catfish Production
Duration: 2012-2016 Funding level: $292,891
Participants: USDA ARS WARU, AU, MSU, UAPB

Split-Pond Aquaculture Systems: Design Refinements for Catfish Production and Evaluation for Culturing Other Species
Duration: 2014-2017 Funding level: $452,824
Participants: USDA ARS WARU, MSU, AU, USDA ARS NPURU, UAPB

Studies to Improve the Control of Virulent *Aeromonas hydrophila* and Evaluate the Impact of Environmental Factors on its Abundance in Catfish Aquaculture Ponds
Duration: 2014-2016 Funding level: $354,287
Participants: AU, MSU, USDA NWRC

Using National Retail Databases to Determine Market Trends for Southern Aquaculture Products
Duration: 2009-2015 Funding level: $397,845
Participants: UAPB, TTU, AU, UF

Improving Catfish Broodstock Management by Manipulating Diet, Stocking Densities, and Sex Ratios
Duration: 2011-2015 Funding level: $382,463
Participants: UAPB, TAMU, USDA ARS WARU

Identification and Removal of Adhesive Proteins from Goldfish and Baitfish Eggs and Egg Masses
Duration: 2014-2015 Funding level: $32,432
Participants: LSU, UAPB, UF

Implementation of Collective Action Alternatives Identified for the U.S. Catfish Industry
Duration: 2014-2015 Funding level: $121,120
Participants: UAPB, AU, UCD, UMo

Effects of Mosquito Abatement Pesticides on Various Life Stages of Commercially Important Shellfish Aquaculture Species in the South
Duration: 2011-2012 Funding level: $39,973
Participants: Coll. of Charleston, Sanibel-Captiva Conservation Foundation Marine Laboratory

Development of Baitfish, Goldfish and Ornamental Fish Hatchery Methods
Duration: 2011-2012 Funding level: $59,957
Participants: UAPB, LSU, UF

Reproduction and Larval Rearing of Freshwater Ornamental and Marine Bait Fish
Duration 2011-2014 Funding level: $499,400
Participants: UF, LSU, MSU

Potential Marketing Structures for the Catfish Industry
Duration: 2011-2013 Funding level: $244,591
Participants: UAPB, AU, KSU, UCDavis, UMo

Evaluation of Impacts of Potential "Cap and Trade" Carbon Emission Policies on Catfish, Baitfish, and Crawfish Farming
Duration: 2011-2013 Funding level: $119,952
Participants: AU, UAPB, LSU

Development and Evaluation of Cool-Water Crawfish Baits
Duration: 2011-2014 Funding level: $124,326
Participants: LSU, TAMU, AU

Identifying Determinants for Development of Live-Market Grading Standards for Crawfish
Duration: 2011-2012 Funding level: $49,952
Participants: LSU, UAPB

Improving Reproductive Efficiency of Cultured Finfish
Duration: 2009-2011 Funding level: $493,973
Participants: USDA/ARS/CGRU, TAMU-CC, TAMU, AU, UF, UT, UAPB, USDA ARS NRAC

Economic Forecasting and Policy Analysis Models for Catfish and Trout
Duration: 2007-2009 Funding level: $148,335
Participants: UAPB, LSU, MSU, NCSU, UF, AU

Improving Reproductive Efficiency to Produce Channel x Blue Hybrid Catfish Fry
Duration: 2004-2008 Funding level: $460,000
Participants: AU, LSU, MSU, UMem, USDA/ARS CGRU

Development and Evaluation of Pond Inventory Methods
Duration: 2007-2009 Funding level: $294,976
Participants: UAPB, LSU, MSU, UF, UMiss

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish
Duration: 2005-2008 Funding level: $335, 063
Participants: UAPB, TAMU, UF, UG

Innovative Technologies for Commercial-Scale Aquaculture
Duration: 2004-2008 Funding level: $935,726
Participants: AU, CU, LSU, MSU, UAPB, USDA ARS CGRU, USDA ARS NARC

Identification, Characterization, and Evaluation of Mechanisms for Control of Bolbophorus Trematodes and Columnaris-Like Bacteria Causing Disease in Warm Water Fish
Duration: 2003-2006 Funding level: $598,947
Participants: USDA APHIS WS, USDA-ARS SNARC, AU, CU, LSU, MSU, NCSU, UAPB, UT

National Aquaculture Extension Conference
Duration: 2002 Funding level: $4,500
Participants: University of Arizona

Development of Improved Harvesting, Grading and Transport Technology for Finfish Aquaculture
Duration: 2001-2003 Funding level: $750,000
Participants: UMem, MSU, NCSU, UAPB, UF, UT

Control of Blue-green Algae in Aquaculture Ponds
Duration: 1999-2001 Funding level: $836,247
Participants: AU, CU, LSU, MSU, NCSU, UAPB, UG, UMiss, UT

Management of Aquacultural Effluents from Ponds
Duration: 1999-2002 Funding level: $555,353
Participants: AU, LSU, MSU, NCSU, UAPB, Waddell MC

National Aquaculture Extension Conference
Duration: 1997 Funding level: $3,700
Participants: Univ. of Maryland

Verification of Recommended Management Practices for Major Aquatic Species
Duration: 1997-2000 Funding level: $160,305
Participants: AU, LSU, NCSU, UAPB

Optimizing Nutrient Utilization through Diet Composition and Feeding Strategies
Duration: 1996-1999 Funding level: $732,804
Participants: AU, LSU, UMem, MSU, NCSU, LSU, TAMU, UAPB, UG

Management of Environmentally-Derived Off-Flavors in Warmwater Fish Ponds
Duration: 1996-1999 Funding level: $866,281
Participants: AU, LSU, LaTech, UMem, MSU, TAMU, UAPB, UMiss, UT

Publications, Videos and Computer Software (Years 1-12)
Duration: 1995-2008 Funding level: $826,000
Participants: TAMU

Improving Production Efficiency of Warmwater Aquaculture Species through Nutrition
Duration: 1994-1996 Funding level: $760,466
Participants: AU, ECU, KSU, LSU, UMem, MSU, TAMU, UAPB, UG

Delineation and Evaluation of Catfish and Baitfish Pond Culture Practices
Duration: 1994-1997 Funding level: $332,993
Participants: AU, LSU, MSU, TAMU, UAPB, UG

Aquaculture Food Safety: Residues
Duration: 1992-1995 Funding level: $351,929
Participants: AU, LSU, MSU, TAMU, TennTech, UF, UG

National Coordination for Aquaculture Investigational New Animal Drug (INAD) Applications
Duration: 1992 Funding level: $2,000
Participants: North Central Regional Aquaculture Center

National Extension Aquaculture Workshop
Duration: 1991 Funding level: $3,005
Participants: UAPB, ACES, TAMU

Educational Materials for Aquaculturists and Consumers
Duration: 1991-1992 Funding level: $133,142
Participants: AU, KSU, LSU, MSU, NCSU, OSU, TAMU, UF, UG, UVI

Characterization of Finfish and Shellfish Aquacultural Effluents
Duration: 1991-1994 Funding level: $442,041
Participants: AU, CU, LSU, MSU, NCSU, TAMU, UAPB, UF, UG, VSU, Waddell MC

Food Safety and Sanitation for Aquacultural Products: Microbial
Duration: 1991-1995 Funding level: $535,338
Participants: UT, AU, LSU, UF, UG

Preparation of Extension Publications on Avian Predator Control in Aquaculture Facilities
Duration: 1990-1992 Funding level: $15,000
Participants: TAMU, MSU, UG, USDA APHIS ADC (MS, AR, LA, and S&T Field Station)

Effect of Nutrition on Body Composition and Subsequent Storage Quality of Farm-Raised Catfish
Duration: 1990-1992 Funding level: $822,843
Participants: AU, KSU, LSU, MSU, TAMU, UG

Harvesting, Loading, and Grading Systems for Cultured Freshwater Finfishes and Crustaceans
Duration: 1990-1993 Funding level: $373,952
Participants: LSU, AU, CU, UMem, MSU, UG, USL

Immunization of Channel Catfish
Duration: 1990-1991 Funding level: $99,789
Participants: AU, LSU, UG

Enhancement of the Immune Response to *Edwardsiella ictaluri* in Channel Catfish
Duration: 1990-1991 Funding level: $98,363
Participants: CU, TAMU, UG

Develop a Statistical Data Collection System for Farm-raised Catfish and Other Aquaculture Products in the Southern Region
Duration: 1989-1990 Funding level: $13,771
Participants: MSU, LSU, AU, UA, TAMU, UG, LU, CU, UF, UT, VTU, USDA NASS

Performance of Aeration Systems for Channel Catfish, Crawfish, and Rainbow Trout Production
Duration: 1988-1990 Funding level: $124,990
Participants: AU, LSU, MSU, NCSU, TAMU

Analysis of Regional and National Markets for Aquacultural Products Produced for Food in the Southern Region
Duration: 1988-1990 Funding level: $346,038
Participants: AU, CU, LSU, MSU, TAMU

Preparation of Southern Regional Aquaculture Publications
Duration: 1988-1990 Funding level: $150,000
Participants: AU, UA, UF, UG, KSU, LSU, MSU, NCSU, UPR, USC, TAMU, UVI