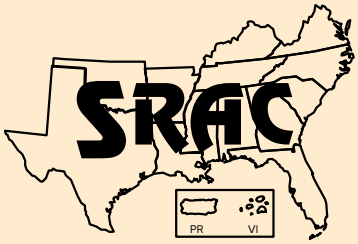

SOUTHERN REGIONAL AQUACULTURE CENTER

ARKANSAS *KENTUCKY* *TEXAS* *NORTH CAROLINA* *FLORIDA*
LOUISIANA *VIRGINIA* *ALABAMA* *SOUTH CAROLINA* *TENNESSEE*
MISSISSIPPI *OKLAHOMA* *GEORGIA* *VIRGIN ISLANDS* *PUERTO RICO*

December, 2001

SUMMARY OF PROJECTS

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The Southern Regional Aquaculture Center (SRAC) is one of five Regional Centers established by Congress and administered through the USDA Cooperative State Research, Education and Extension Service. The Centers provide a mechanism for assessing local aquaculture industry needs, establishing research and extension priorities, and implementing regional research and extension projects.

Projects supported by the Regional Centers are unique in several important ways:

- Center projects are responsive to regional industry needs;
- Projects usually address broad, fundamental issues rather than narrowly focused problems;
- Projects are planned and conducted as cooperative efforts that bring together competent scientific talent from several participating institutions; and
- Results of projects are made quickly available to the industry in an accessible, understandable format.

SRAC was organized in 1987, and the first research and extension projects were initiated in 1988. The thirteen states and two territories included in the Southern Region are listed in the masthead, above. Mississippi State University serves as the Host Institution for SRAC, and the Administrative Center is located at the Thad Cochran National Warmwater Aquaculture Center, Stoneville, Mississippi.

Priority research and eduction needs for the Southern Region are identified by the Industry Advisory Council, which consists of industry representatives from throughout the region, and the Technical Committee, which is composed of research and extension scientists. These two groups recommend project areas to the SRAC Board of Directors, who then selects priority categories for project development and funding.

This report presents a summary of projects currently being funded by SRAC.

For further information on the Southern Regional Aquaculture Center and detailed reports of the results of SRAC projects, visit the SRAC web site at ***http://www.msstate.edu/dept/srac***

Publications, Videos and Computer Software

THE CHALLENGE . . .

Aquaculture currently produces about 25% of the world's seafood supply, and is one of the most rapidly expanding agricultural industries in the world. Domestic aquaculture production is centered in the southeast region, where more than 100 species of fish, shellfish, aquatic reptiles, and plants are cultured for food or ornamental purposes. The total farm value of southeastern aquaculture is over one billion dollars. Aquaculture is a young, unique, and rapidly expanding industry, and the need for information to sustain growth and development has increased dramatically over the past 20 years.

OUR RESPONSE . . .

Extension and research scientists in the southeastern United States initiated this project to produce research-based fact sheets, videos, and other educational materials to support regional aquaculture production and marketing. The SRAC publication project uses a region-wide pool of experts to develop materials for distribution through the nationwide network of Extension Specialists and County Agents. This process makes efficient use of personnel and funds at the State level, and results in timely, high-quality educational materials. Each publication contains understandable, factual information that provides guidance for producers, processors, consumers, or investors. Subject matter includes biology and life history of specific culture species, culture techniques and systems, nutrition, water quality and waste management, disease treatment, off-flavor management, consumer education, marketing, and much more.

PRINCIPAL ACCOMPLISHMENTS . . .

The Southern Regional Aquaculture Center has now published 163 fact sheets and 20 videos. These publications provide essential information for aquaculture producers, lending agencies, and consumers of aquaculture products. Educators in high schools and colleges use SRAC publications in classrooms throughout the United States and the world.

Twelve publications were printed this year, with 13 more in progress. These publications were developed by nineteen scientists associated with the following institutions and agencies:

- Auburn University
- Iowa State University
- Louisiana State University
- Mississippi State University
- North Carolina State University
- Texas A&M University
- Texas A&M University - Sea Grant College
- University of Arkansas at Pine Bluff
- University of Georgia
- University of North Carolina at Wilmington
- USDA-ARS Pine Bluff, Arkansas

Copies of all fact sheets are available at http://www.msstate.edu/dept/srac on the Internet. ❖

Management of Environmentally-Derived Off-flavors in Warmwater Fish Ponds

THE CHALLENGE . . .

Blue-green algae and other naturally occurring aquatic microorganisms can produce odorous compounds that give fish objectionable off-flavors. The development of off-flavors in market-sized fish is a severe economic burden to fish farmers because it interrupts the orderly flow of fish from pond to processor. Holding fish in inventory while waiting for flavor quality to improve interrupts cash flow and increases the time needed to raise a crop, thereby exposing fish to increased risk of loss to diseases. Off-flavor increases the cost of producing pond-raised channel catfish by 5% to 20%, resulting in a cost to the industry that may exceed $50 million per year. Off-flavors also have impacts far beyond the farm because market development for aquaculture products depends on offering the consumer a consistently high-quality product. Over the long run, inconsistent product quality due to preharvest off-flavors may adversely affect market demand and aquaculture industry development, with the overall effect of reducing profits for all segments of the industry.

OUR RESPONSE . . .

Fourteen research scientists have teamed in a 5-year project that began on June 1, 1996, to investigate mangement practices that may reduce the economic impact of inconsistent flavor quality. The scientists represent these institutions:

- University of Tennessee
- University of Arkansas at Pine Bluff
- Auburn University
- Louisiana State University
- Louisiana Tech University
- University of Memphis
- University of Mississippi
- Mississippi State University
- Texas A&M University

Two broad approaches to management of fish off-flavors in ponds are being investigated in this project. First, there may be ways to prevent dominance of the summertime phytoplankton community by blue-green algae. This may be done by reducing nutrient loading in ponds to encourage the presence of other groups of algae, by inhibiting blue-green algae growth with plankton-grazing fish, plant pathogens, algicides, or by introducing other growth-inhibiting substances. The second approach involves production of fish without regard to management to avoid off-flavors. Fish found off-flavor when ready for harvest are moved to an environment free of off-flavor and allowed to "purge" themselves. Certain compounds are being looked at that may enhance more rapid purging. Other aspects of the study seek to quantify the variance components such as type of off-flavor, the physiological status of the fish, the season of the year and other factors associated with off-flavor intensity. Presently, identification of off-flavors emphasizes sensory evaluations. Innovative approaches that involve instrumental analysis and immunochemistry methodology are also being investigated.

PRINCIPAL ACCOMPLISHMENTS . . .

Work on this project showed that modifying feeds to reduce waste phosphorus generation can be accomplished from the nutritional standpoint but, at the high feeding rates used in commercial catfish farming, the reduction in phosphorus input has little impact on algae that develop in ponds. Although dietary phosphorus modification may not lead to

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Verification of Management Practices for Major Aquatic Species

THE CHALLENGE . . .

Verification programs are designed to validate agricultural research and extension recommendations in a commercial setting and to shorten the time between research discoveries and their adoption on farms. The results of verification programs also show whether recommendations and research programs need to be modified based on what has been learned. Adoption of verification program practices usually increases industry yields, and by demonstrating an integrated management plan on an existing farm, producers can relate to the results more than to typical research results. Although research verification programs are common in agriculture, they have yet to be conducted in United States aquaculture.

OUR RESPONSE . . .

This project was initiated to establish verification programs in five states in the region. The emphasis is on developing the interdisciplinary process and internal committees within each state. While actual field results of verification trials of different management protocols will be valuable, this project is intended to stimulate development and use of verification trials as a new extension tool. Nineteen research and extension scientists are participating in the three-year project, which started on January 1, 1997. The following institutions are involved:

- Auburn University
- Clemson University
- Louisiana State University
- North Carolina State University
- University of Arkansas at Pine Bluff

PRINCIPAL ACCOMPLISHMENTS . . .

Four states (Alabama, Arkansas, North Carolina, and South Carolina) are conducting verification programs for catfish production systems (including levee ponds, watershed ponds, hybrid watershed-levee ponds, and cages). The Louisiana program is concentrating on crawfish. Management protocols and verification committees have been developed for each state and full verification trials are underway. In all, there are 16 cooperators, 27 ponds, and 6 cage culture systems enrolled in the program that represent various regions of the participating states.

One of the most significant, and unanticipated, benefits of this project has been the increased trust and confidence that farmers have in county agents and in extension recommendations. The verification programs did, in fact, demonstrate that current extension guidelines will result in profitable production. Also, county agents have shown increased interest in aquaculture programs due to the proactive nature of the verification program. Agents have requested that verification programs continue indefinitely in their counties. They have stated that the program is of particular benefit to new producers and to new county agents as a training tool for them. Validation of the benefits of the production practices used in verification trials has prompted several cooperators to implement verification practices in other ponds on their farm. ❖

Management of Aquacultural Effluents from Ponds

THE CHALLENGE . . .

Aquaculture operations in the United States have recently come under increased scrutiny because of potential or perceived environmental degradation caused by the discharge of water from production facilities. Aquaculture is now under consideration by EPA as a candidate industry for new regulatory activity. Therefore, regulation of pond aquaculture effluents in the southeastern United States within the next few years is a distinct possibility. Regulatory requirements to operate ponds without discharge could drastically alter the way pond aquaculture facilities have traditionally been managed. Additionally, these requirements would impose additional financial burdens on existing operations and restrict further development of the regional aquaculture industry.

OUR RESPONSE . . .

The aquaculture industry has an opportunity to participate in the process of formulating regulations, because the approach and framework for the regulatory process have not yet been decided. Through this regional research project, the research community can provide information required by permit writers for the development of rational regulatory mechanisms. This project will provide important information on the character of effluents from aquaculture ponds and explore management methods for reducing the volume and improving the quality of pond effluents. This information will be used to develop a set of best-available pond water management practices which will be evaluated for environmental risks and economic performance.

Fourteen research scientists and extension agents are collaborating on a three-year project initiated on April 1, 1999. The following institutions are involved:

- Auburn University
- University of Arkansas at Pine Bluff
- Louisiana State University
- Mississippi State University
- North Carolina State University
- Virginia Polytechnic Institute and State University
- South Carolina Department of Natural Resources - Waddell Mariculture Center

PRINCIPAL ACCOMPLISHMENTS . . .

Solids in pond overflow from rainfall and in 80% of the water discharged during intentional drawdown of ponds are very difficult to settle because most particles are small and organic. Treatment of the final 20% of water during intentional discharge can be accomplished with sedimentation basins designed with a hydraulic retention time of 8 hours, although a settling time of 2 to 4 hours is sufficient to reduce total suspended solids in effluents to 75 to 90% of original concentrations. Solids removal is associated with settling of the mineral fraction, with little change in organic solids concentrations in effluents. Project research also indicates that drainage ditches can be used to settle the heaviest solids that are discharged when internal drains are first opened and during discharge of the last 10 to 20% of effluent volume.

Effluent volume from catfish ponds can be reduced by increasing pond depth by 1 foot to increase rainwater storage capacity and linking the deeper combined storage/production pond to one or three adjacent conventional ponds. After 20 months,

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Management of Aquacultural Effluents from Ponds (continued from page 5)

effluent volume was reduced by approximately 50 to 75% and groundwater consumption was reduced by 40 to 50% compared to conventionally managed ponds.

Effluent volume from baitfish pond can be reduced if water can be reused. Research in Arkansas has demonstrated that water from baitfish ponds can be reused if it is filtered to remove zooplankton predators of newly stocked baitfish fry.

Economic analysis indicates that construction of settling basins or combined storage/ production ponds will require a large investment of financial resources and result in a reduction in revenue. The results of this analysis suggest that using existing ponds as sedimentation basins is more economical than building new sedimentation basins.

Project scientists have been active participants in the Federal Joint Subcommittee on Aquaculture - Effluents Task Force. They have assembled and provided the Task Force and EPA with general information on the aquaculture sectors in the Southern region, the characteristics of pond effluents, and the effectiveness of various effluent management options and best management practices. ❖

Management of Environmentally-Derived Off-flavors in Warmwater Fish Ponds (continued from page 3)

improved water quality in ponds, the information gathered from investigations of phosphorus availability from various feedstuffs is already being used by feed manufacturers to refine commercial diet formulations, with a cost savings to the farmer.

Another finding of this project that has been adopted by the aquaculture industry is the use of routine, low-level copper sulfate treatments for preventing algae-related off-flavors. Under experimental conditions, weekly treatments of catfish ponds with copper sulfate reduced the incidence of off-flavor by 80% and increased net revenues by over 40% compared to untreated ponds.

Several other treatments and practices investigated in this project show promise. For example, phosphorus levels in ponds can be reduced by precipitating phosphorus as aluminum or calcium salts, or by treating the pond bottom to reduce phosphorus flux from soils to water. These practices could be an important management procedure for improving quality of pond water and effluents and in combating off-flavor. Another example of a potentially effective practice is the use of filter-feeding fishes, which has been shown to be effective in controlling odor-producing algae in small-scale systems. Perhaps the most intriguing result is the success achieved using bacterial pathogens of odor-producing blue-green algae. If these results can be transferred to pond-scale ecosystems, the work may lead to a novel, safe, and effective method of controlling flavor problems in fish.

Monoclonal antibodies have been produced that bind the methylisoborneol (MIB), the major cause of off-flavor in fish. Also, immunochemical methods have been used to detect MIB down to levels of 0.01 ppb, low enough to be comparable to the human sensory threshold for the chemical. ❖

Control of Blue-Green Algae in Aquaculture Ponds

THE CHALLENGE . . .

Excessive abundance of blue-green algae in aquaculture ponds can cause low dissolved oxygen concentrations and other water quality problems that affect fish growth, health, and product quality. Therefore, the ability to control the composition of these algal blooms could result in better fish growth and lower costs for aeration and other water quality management procedures. Several species of blue-green algae also produce compounds that are highly toxic to aquatic animals. Blooms of these algae occur in all aquaculture ponds, including those used to raise catfish, hybrid striped bass, and baitfish. The annual economic loss associated with blue-green algae blooms in southeastern aquaculture ponds exceeds $50 million, and methods for controlling these troublesome algae would be of tremendous benefit to the aquaculture industry.

OUR RESPONSE . . .

The overall goal of this project is to identify methods of controlling or eliminating blue-green algae from aquaculture ponds. Treatments being evaluated include the use of natural chemicals as algicides, nutrient manipulations, water circulation techniques, biocontrol using planktivorous fishes, and a modified pond culture system called the Partitioned Aquaculture System, or PAS.

Twenty-one research and extension scientists representing the following institutions and agencies are participating in the 3-year project which began on 1 January 1999:

- University of Arkansas at Pine Bluff
- Auburn University
- Clemson University
- University of Georgia
- Louisiana State University
- University of Mississippi
- Mississippi State University
- North Carolina State University
- University of Tennessee
- USDA/ARS, Southern Regional Research Center

PRINCIPAL ACCOMPLISHMENTS . . .

Research has recently been initiated at two institutions to develop natural chemicals that prevent the establishment of noxious blue-green algal communities. More than 2,300 crude extracts of more than 1,050 species of rainforest plants, marine algae, and wetland plants were evaluated in a high-throughput screening system. Active extracts that showed non-specific anti-microbial activity or cytotoxicity were not selected for further study. The most potent blue-green algae-selective plant extracts were those obtained from the roots and stems of a Peruvian collection of the tropical shrub *Dulacia candida*. The crude *D. candida* extracts showed extremely potent activity against blue-green algae.

Researchers at six institutions are evaluating nutrient manipulations to promote more desirable phytoplankton communities by eliminating blue-green algae. Methods being evaluated include manipulating the ratio of nitrogen-to-phosphorus in the water, reducing the availability of phosphorus from bottom muds, enhancing the availability of inorganic carbon, increasing levels of salinity and potassium, and manipulating trace metal availability. Studies in Mississippi and Alabama indicate that various manipulations of waterborne plant nutrients have little promise for controlling phytoplankton community composition in catfish ponds with high feeding rates. However, phosphorus-only fertilization was as effective as nitrogen

Control of Blue-Green Algae in Aquaculture Ponds (continued from page 7)

plus phosphorus fertilization in bait minnow ponds. Phosphorus-only fertilization is less expensive, it conserves nitrogen, and it lessens the possibility for nitrogen pollution of natural waters by pond effluents. Removal of soft sediment from old (25 years or more) bait minnow ponds should improve bottom soil quality, but the usual method of pond renovation had little effect on subsequent levels of soluble reactive phosphorus in baitfish pond waters or on average concentrations of phosphorus in bottom sediments. A possible explanation for these results is that pond bottom soils are used to rebuild levees during renovation and not removed from ponds.

The effects of water circulation on phytoplankton communities is under investigation at five institutions. Research in Mississippi suggests that some threshold level of turbulent mixing is necessary to overcome light limitation of phytoplankton production and shift phytoplankton community composition from dominance by cyanobacteria. Application of turbulent mixing should attempt to develop a uniform flow field to avoid areas of concentrated turbulence that can suspend pond soils. Ponds with two mixers were more turbid than ponds in the other treatments; the turbidity was dominated by suspended mineral matter. In Louisiana, three water management practices were evaluated, each at two levels to determine their effects on blue-green algal community composition and water quality in experimental mesocosms managed to simulate commercial catfish production practices. A continuously-operating, horizontally-mounted pump mixed water in these ponds. Suspension of sediments in the water column from vertical mixing increased total nitrogen, total phosphorus, nitrate, and pH but had no discernible effect on the phytoplankton community.

The use of plankton-feeding fish is being evaluated at three institutions. Polyculture of threadfin shad with channel catfish in relatively small experimental ponds resulted in improved water quality conditions and enhanced catfish survival. The stocking of threadfin shad in four commercial channel catfish ponds in Alabama did not result in improved water quality when compared to four similar ponds having catfish, but no threadfin. In Georgia, blue-green algae numbers were reduced by threadfin shad over a three-year period in intensively-managed catfish ponds. In Louisiana, the presence of shad did not reduce the percentage of blue-green algae in the phytoplankton community, but did significantly reduce total algal biomass and, most important, nearly eliminated species of blue-green algae known to cause off-flavor in catfish.

Researchers at Clemson have previously demonstrated that catfish production can be more than tripled through the use of an innovative new technique, the Partitioned Aquaculture System (PAS). Recent studies indicate this system also offers the potential to eliminate blue-green algal dominance and associated fish off-flavor problems, while recovering wasted nitrogen and phosphorus discharges, which currently pose the threat of eutrophication to surface and groundwater supplies. Economic projections suggest that catfish production costs are $0.15 to $0.17 per pound lower in the PAS than in conventional ponds. ❖

Development of Improved Harvesting, Grading and Transport Technology for Finfish Aquaculture

THE CHALLENGE . . .

Inefficient harvesting, improper sizing, and stresses related to handling and hauling of fish are seriously affecting profitability of the finfish aquaculture industry. Market-size fish that escape harvest continue to grow and create additional inefficiencies resulting from higher feed conversion ratios and carry-over of large fish that are unacceptable to processing plants. In addition, if the stress is sublethal, incidence of disease increases and growth rate, fecundity, and product quality may be lessened. Losses during transport can result in even greater overall reductions in farm profits, particularly since losses at this stage are generally market-size fish that represent investment of full production costs.

OUR RESPONSE . . .

Twelve research scientists have teamed in a three-year project that began on January 1, 2001, to investigate methods to improve harvest efficiency, grading selectivity, and transport of finfish, and thus improve profitability of finfish aquaculture. The scientists represent these institutions:

- Mississippi State University
- University of Tennessee
- North Carolina State University
- University of Memphis
- University of Florida
- University of Arkansas at Pine Bluff

Several possible solutions to this problem are under investigation:

- developing new gear and methods or modifying exist-ing methods to improve harvest efficiency and fish grading selectivity as well as reducing fish stress associated with these activities;
- evaluating methods used for loading and transporting of fish to reduce fish mortalities and the negative effects of stress on product quality; and
- comparing new technology and current technology for harvesting, grading, and loading fish for efficiency and profitability.

PRINCIPAL ACCOMPLISHMENTS . . .

Work during the first year of the project indicated that braided polyethylene mesh is a good choice for use in constructing seines and socks for harvesting and grading catfish. In addition, mesh sizes of the braided material that retain fish of a certain size have been determined.

Another result from this work, is that a horizontal floating platform grader with adjustable spacing can be effectively integrated into current harvest procedures to grade catfish in ponds. With certain modifications, the grader appears to work well for striped bass. ❖

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