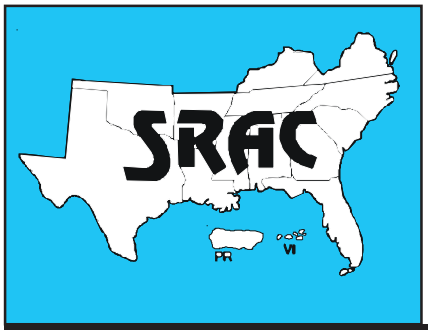

SOUTHERN REGIONAL AQUACULTURE CENTER

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

TWENTY-FIRST ANNUAL SUMMARY OF PROJECTS

For the Period Through August 31, 2008

Most of the $1 billion dollar domestic aquaculture industry is located in the southeastern United States, where important crops of catfish, crawfish, bait and ornamental fish, trout, and bivalve molluscan shellfish are produced. The USDA-CSREES Southern Regional Aquaculture Center (SRAC) supports this critical sector of southern agriculture by providing research and education funds to address key issues faced by the industry.

WHAT IS SRAC? . . . SRAC is one of five Regional Aquaculture Centers established by Congress and administered through the USDA Cooperative State Research, Education, and Extension Service. 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.

SRAC is a mechanism for identifying and solving problems. Priority research and education needs for the Southern Region are identified by the Industry Advisory Council, which consists of aquaculture industry representatives from throughout the region, and the Technical Committee, which consists of research and extension scientists. The two groups recommend project areas to the SRAC Board of Directors, which selects projects with the highest priority for development and funding. The best scientific talent in the region is then brought together to address the problem.

IMPACT . . . In the past year, four research projects funded at nearly $2 million were in progress. The Center's "Publications" project is in its thirteenth year of funding and has produced more than 200 publications with contributions from 186 authors from throughout the region. All publications are available at the SRAC web site (see box below).

Over the years, SRAC projects have identified many new technologies that benefit the aquaculture industry. In one current project, two modifications of traditional pond aquaculture systems show considerable potential for increasing production efficiency. The Clemson University Partitioned Aquaculture System (PAS) is particularly well-suited for production of channel catfish fingerlings, with fish growing to more than a quarter of a pound in one summer of growth. Meanwhile, a modification of the PAS, called the "split-pond system" has consistently produced 15,000 to 18,000 pounds of food-sized catfish per acre in tests at Mississippi State University. These two systems may become attractive alternatives to traditional aquaculture ponds.

This report summarizes these projects and others currently funded by SRAC.

For further information on the Southern Regional Aquaculture Center, fact sheets and 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 produces over 50% of the world's seafood supply and is one of the most rapidly expanding agricultural industries in the world. Most domestic aquaculture occurs in the southeast, 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 per year, with a total economic impact exceeding five billion dollars. Aquaculture is a relatively young, unique industry, and the need for information to sustain growth and development has increased dramatically over the past 30 years.

OUR RESPONSE . . .

Extension and research scientists in the southeastern United States initiated this project to produce educational materials to support regional aquaculture. The SRAC publication project uses a region-wide pool of experts to develop materials for distribution through the nationwide network of educators, Extension Specialists, and County Agents and the World Wide Web. 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, students, 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, consumer education, marketing, and much more.

PRINCIPAL ACCOMPLISHMENTS . . .

The Southern Regional Aquaculture Center has now published 188 fact sheets, 5 project reports, 19 research reports, 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. From September 2007 through August 2008, more than 37,800 unique visitors used the SRAC web site and accessed over 249,600 pages.

One of the most popular series of SRAC publications is "Species Profiles," which provides detailed technical information on the biology and culture of marine and freshwater fish with commercial potential. Among the species included in the series are grouper, largemouth bass, hybrid sunfish, cobia, pompano, southern flounder, queen conch, and sturgeon.

Eight fact sheets were completed this year, with seven in progress. The remaining eight VHS videos produced by SRAC were converted to DVD format this year. This year's publications were developed by 14 scientists associated with the following institutions and agencies:

- Mississippi State University
- Texas A&M University
- University of Arkansas at Pine Bluff
- USDA/APHIS/Wildlife Services, National Wildlife Research Center

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

Innovative Technologies and Methodologies for Commercial-scale Pond Aquaculture

THE CHALLENGE . . .

Aquaculture operations in the southern region of the United States are finding it difficult to maintain profitability. Production costs are increasing, but prices received for fish, shrimp, and other cultured aquatic animals are not keeping pace. Problems are especially troublesome for channel catfish farming, the major aquaculture activity in the region. Increasing profitability of channel catfish farming is a long-term, complex, multifaceted problem. Nevertheless, methods for reducing production costs would provide an immediate improvement in profitability.

OUR RESPONSE . . .

Eleven research scientists from seven institutions are collaborating in a 4-year project to investigate new technologies and methodologies to improve the efficiency and enhance the profitability of aquaculture in the Southern Region. The scientists represent the following institutions:

- Auburn University
- Clemson University
- Louisiana State University
- Mississippi State University
- University of Arkansas at Pine Bluff
- USDA-ARS (Pine Bluff, AR)
- USDA (Stoneville, MS)

Several possible methods for improving efficiency and profitability of aquaculture are under investigation:

- Evaluation of new production systems and improvements in existing production systems for channel catfish;
- Improvement in equipment used for mechanical aeration and for fish harvesting in channel catfish culture;
- Evaluation of energy, material, and economic efficiency of production systems.

continued on page 4

Innovative Technologies and Methodologies for Commercial-scale Pond Aquaculture
(continued from page 3)

PRINCIPAL ACCOMPLISHMENTS . . .

Several variations of the partitioned aquaculture system (PAS) concept are being evaluated for possible commercialization. The PAS concept is based on physically dividing a pond into sections for holding fish and treating waste produced during culture. The two sections are connected by large volumes of water flowing between the two systems. Research at Clemson University showed that the PAS has promise for accelerating the growth of channel catfish fingerlings. During 4 years of experimentation, the system has produced fingerlings of over a quarter pound in less than 5 months at a final carrying capacity equal to 4,000 pounds/acre. The system appears to have potential for commercial use. A less intensive approach, the split-pond system, can be built by modifying existing earthen ponds. Annual catfish production in the split-pond system has ranged from 17,000 to almost 20,000 kg/ha. This system also appears to have commercial potential.

Maintenance of water quality in most pond aquaculture systems depends on plant growth (autotrophy). However, under super-intensive culture conditions, autotrophy cannot provide adequate waste treatment and is supplemented by microbial-based (heterotrophic) processes. A heterotrophic, biofloc system for channel catfish production was tested by USDA scientists at Pine Bluff, Arkansas. Stocking rates of 2.9, 5.7, and 8.5 fish/m^2 resulted in linear increases in fish biomass with a net yield of 3.7 kg/m^3 at the highest stocking rate. This production is equivalent to about 50,000 pounds/acre in pond systems.

At Stoneville, Mississippi, USDA scientists tested a motor-powered U-tube aerator and confirmed that the device is highly efficient in moving water, but the oxygen transfer rate must be improved through design modifications. Considerable progress also has been made by researchers at the Delta Research and Extension Center towards a development of an electrically-enhanced seine.

continued on page 12

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish

THE CHALLENGE . . .

Commercial production of baitfish and tropical ornamental fish represents economically valuable components of the U.S. aquaculture industry. Market sizes of bait and ornamental fishes are relatively small and specific sizes are needed for specific purposes, so that repeated grading and handling during production are often required. After harvest, fish must withstand the additional demands of distribution and sales, and must survive for extended periods. Significant losses occur when fish are transported on trucks from the production facilities to distribution sites. A combination of handling stress and suboptimal environmental conditions can result in high mortality when fish are transferred between facilities. Therefore, effective management practices that enhance stress resistance and prolong survival of bait and ornamental fishes are critically needed.

OUR RESPONSE . . .

Six scientists from four institutions are collaborating to develop diets and feeding practices that enhance stress resistance and prolong survival of bait and ornamental fishes. Scientists participating in this project representthe following institutions:

- Texas A&M University
- University of Florida
- University of Arkansas at Pine Bluff
- University of Georgia

The project addresses the following objectives: 1) manipulation of diet composition and feeding strategy for economical production of "jumbo" golden shiners; 2) manipulation of diet composi-tion and feeding strategy to increase immuno-competence and resistance to stress in bait and ornamental fish during production, transport and live display; and 3) determination of the relative contribution of natural foods and prepared diets to growth, response to low dissolved oxygen, and other health indices for bait and ornamental fish in different production systems.

PRINCIPAL ACCOMPLISHMENTS . . .

The overall goal of this project is to assess changes in diet composition and feeding strategies on the growth, health, and body composition of freshwater baitfish and ornamental fish.

Feeds and feeding for "jumbo" golden shiners. There is an unmet demand for large baitfish ("jumbos") and there is currently no good way to produce these fish in one year. The first task was to determine the best stocking density for juvenile golden shiners to maximize the production of jumbos (larger than 12g) within a single growing season. In this trial, golden shiner juveniles were stocked at four densities and grown for 105 days while being fed once daily with a commercial 42% protein feed. Average fish weight decreased with increasing fish density, but gross yield (total pounds of fish produced) increased with density. Survival was not different among treatments. Fish stocked at 30,000/acre resulted in about 54% jumbos by weight. Stocking juvenile golden shiners in late July resulted in lower single-season yields of jumbos compared to direct stocking of hatchery fry at low densities. Direct stocking of fry in early May resulted in higher yield of jumbos in a single season.

continued on page 6

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish (continued from page 5)

However, the extra production of jumbos must be balanced against other uses for the ponds.

A second trial evaluated the effects of diet composition and feeding frequency on the growth and production of golden shiners. Juvenile golden shiners were stocked into earthen ponds at 30,000 fish/acre. Fish were fed either once or twice daily with a control diet or an experimental diet, with the intent of matching the performance of fish fed the control diet but at a lower cost. The diets were similar in total protein (42%) but the experimental diet contained no fish meal. At harvest, there was no difference in yield, average weight, or survival due to diet or feeding frequency. Feeding a diet with fish meal did not improve yields over a comparable diet formulated with poultry by-products, and feeding twice a day instead of once a day provided no benefits.

Feeds and feeding to enhance health of bait and ornamental fish. Multiple feeding trials with dietary additives that may stimulate fish health have been completed at Texas A&M University (TAMU) and the University of Arkansas at Pine Bluff (UAPB). Methodological problems hindered progress initially, but overall there have been few pronounced effects of these feed additives on general performance (growth, survival, feed conversion) of golden shiners and goldfish in tanks. Better methods of measuring immune and stress responses of small fishes must be developed to assess these diet additives fully. We developed a promising technique to measure cortisol (a stress hormone) in the whole body of the fish instead of the blood. This procedure has been validated in golden shiners and partially validated in goldfish. The technique has been published and is being implemented to measure stress from industry-relevant sources such as handling and transport. Golden shiners obtained from a study conducted during year 1 in which fish were subjected to normal harvesting, handling and distribution practices were analyzed for whole-body cortisol as well as zinc and ascorbic acid (vitamin C) as potential indicators of stressful conditions. The whole-body cortisol assay was the most sensitive measure of stress in golden shiners; whereas, whole-body zinc and ascorbic acid were not readily altered by the various harvesting, grading and transportation stressors.

The most promising feed additive tested is a prebiotic (GroBiotic®-A). This is a non-living product containing indigestible carbohydrates from dairy and yeast sources that stimulate “good bacteria” in the gut. Prebiotics can enhance fish performance under stress, such as exposure to pathogens. It is apparent now that GroBiotic®-A is more effective in protecting golden shiners against specific pathogens (such as the bacterium that causes columnaris disease), rather than enhancing the general immune response. Although goldfish have also been exposed to bacterial pathogens following feeding trials with GroBiotic®-A, so far the results have been inconclusive. Differences in diet composition and physical form of the diets used in different trials might contribute to differences in results between fish species. However, we have established that GroBiotic®-A is effective both in cold-pelleted sinking pellets, and in extruded, floating pellets.

The effects of diets with 4 or 10% lipid (fat) and diets with or without

continued on page 7

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish (continued from page 6)

fish meal on performance of golden shiners in tanks have also been examined. Previous studies showed some beneficial effects of high lipid levels in diets for golden shiner and goldfish. However, in tank studies with golden shiners there were no differences in growth, survival, or whole-body lipid of fish fed diets with 4 or 10% lipid. In general, feed conversion of golden shiners fed 10% lipid diets was higher than that of those fed 4% lipid diets, except for fish fed diets with GroBiotic®-A. It is likely that golden shiners did not respond to higher dietary lipid in this study because they were larger at the beginning of the trial (larger fish grow more slowly), and the diets were lower in protein than previous studies. Therefore, more protein may have been used for energy instead of tissue growth, and the benefits of extra lipid were not realized in aquaria. Goldfish in aquaria fed diets with or without the same prebiotic and 4 or 10% added lipid also showed no differences in growth, survival, or feed conversion. There were no major differences in performance of golden shiners fed diets with or without fish meal, consistent with previous studies. Exclusion of fish meal from production diets for golden shiners and goldfish would reduce feed cost and address environmental concerns over fish meal shortages.

A bacterial challenge on groups of golden shiners fed the standard diet (4% poultry fat), a 10% poultry fat diet, or a diet with both 10% poultry fat and 2% Grobiotic®-A was performed.

Golden shiners fed the diet with Grobiotic®-A had higher survival than fish fed the other diets when exposed to the bacteria that cause columnaris disease. This is a significant pathogen of golden shiners and other bait and ornamental fish. We also attempted to use a low dissolved-oxygen stress test to assess diet effects, but conditions were not lethal so results were inconclusive. In separate trials, TAMU found that GroBiotic®-A reduced the cortisol response of goldfish to crowding stress, which might be beneficial. Theoretically, the prebiotic functions by stimulating the good bacteria in the gut, which can stimulate the immune response. However, no differences in gut bacteria were detected in fish fed diets with or without prebiotic, and the mechanism of action still has not been demonstrated in baitfish.

At the University of Georgia, whole-cooked soybeans are being compared to soybean meal in diets for golden shiners, feeder goldfish and fathead minnows. During initial trials in aquaria, it was necessary to increase the salinity of the water to 3 parts per thousand using artificial sea salts to get significant improvement in survival of golden shiners from a commercial source or from a breeding population established onsite. Golden shiners from commercial ponds in Arkansas were transported to Georgia and held in vats for later distribution to area bait shops. However, they were not able to survive in aquaria as well as golden shiners from ponds at the research location in Tifton, Georgia. Survival of commercial golden shiners was 0% after 14 days in aquaria versus 97% survival for Tifton-reared golden shiners after 56 days in fresh water. Fathead minnows

continued on page 8

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish (continued from page7)

obtained from the same commercial source did not show signs of disease and survived at the rate of 95% for 56 days in aquaria in fresh water.

Golden shiners from Tifton ponds were used in the aquarium feeding trial to assess responses to a complete diet or whole-cooked soybeans. Weight gain for golden shiners fed to satiation for 56 days was similar for the two diets. Results were similar for fathead minnow fed the same diets in aquaria.

Golden shiners in ponds fed roasted full-fat soybean meal or a nutritionally complete diet showed similar growth. Consumption of natural food appeared to provide essential nutrients that are not present in the simple soybean meal diet.

The economics of feeding for baitfish changed over the course of this project. Roasted soybeans obtained for $500.00 per ton are currently available for $630.00 per ton FOB Missouri. While 48% protein soybean meal is available for $342.00 per ton, complete feed costs range from $360.00 to $640.00 per ton, depending on quantity and location. At on-the-farm prices of $11.00 to $12.00 per bushel, soybean roasting would put feed value between $407.00 and $444.00 per ton for whole roasted soybeans. Roasting costs another $25.00 to $40.00 per ton. Therefore, baitfish producers who also raised soybeans could consider on-farm roasting to reduce dependence on the feed milling industry during periods of price uncertainty.

Contribution of natural foods to growth and health of bait and ornamental fish. It is difficult to separate the effects of prepared diets and natural foods in outdoor systems (pools, ponds) on performance of fish, but most commercial production of bait and ornamental fishes is in outdoor systems. Multiple studies were conducted to determine the best diets to use in ponds where bait and ornamental fish will have access to both food sources.

At TAMU, two separate feeding trials with goldfish examined the effects of GroBiotic®-A in the presence or absence of natural foods. Fish were fed a commercially prepared control diet or a diet with GroBiotic®-A in both a recirculating system with well water, and an outdoor system with a continuous supply of pond water. Significantly improved feed efficiency was noted in both feeding trials for goldfish fed GroBiotic®-A when compared to the control diet. Weight gain and survival were not different by diet, although goldfish had better survival in the system with natural foods (pond water). A bacterial challenge with *Aeromonas* was inconclusive with respect to diet effects.

At UAPB, a 10-week feeding trial with golden shiner in outdoor pools was conducted using diets with or without GroBiotic®-A, with or without fish meal, or with 4 or 10% lipid from poultry fat. Weight gain and feed conversion did not differ by diet. There were slight differences in condition factor and survival that were not consistently associated with diet variables. Whole-body lipid was significantly higher in fish fed the 10% poultry fat diets compared to those fed the 4% poultry fat diets, regardless of other diet variables.

After harvest, shiners fed the control diet or diet with 2% GroBiotic®-A were acclimated to indoor tanks and challenged with the bacteria that cause columnaris disease (trial 1). In trial 2, shiners from the same treatments were subjected to confinement stress or left unmolested, then exposed to the bacteria. Mortality was not significantly different for the control diet, GroBiotic®-A diet, or GroBiotic®-A diet with stress treatments. Mortality for the control diet with stress treatment was significantly higher than the other treatments. Prebiotic supplementation in golden shiner feeds prior to a stressful event could significantly reduce associated mortality from columnaris disease.

The performance of juvenile golden shiners in ponds fed a control diet or the same formula with 2% Grobiotic®-A was evaluated. Fish were fed to satiation twice daily with custom-made 35% protein diets extruded as 1.5-mm pellets. The formula was similar to a commercial catfish diet. Due to small initial fish size and the relatively low stocking density, growth was very rapid and the study was harvested after 7 weeks to avoid reproduction. At harvest there were no differences in average fish weight,

continued on page 9

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish (continued from page 8)

net yield, or feed conversion ratio between treatments.

A bacterial challenge was performed as described for the pool trial with groups of fish from each pond divided into stressed or unstressed groups prior to bacterial exposure. Results were similar, and survival of stressed fish fed the diet with 2% Grobiotic®-A was higher than that of stressed fish fed the control diet, while no diet effect was apparent in unstressed fish. A partial budget analysis based on the results of the challenge indicates that the increased cost of feed containing 2% Grobiotic®-A would be fully justified based on increased survival of golden shiners exposed to stress and pathogens. However, as commercial implementation was explored further we discovered that the previously quoted price for the prebiotic was contingent on purchase of a large quantity of product. The minimum quantity that our local feed mill would have to purchase would be in excess of the amount that the small baitfish industry could use. Therefore, the economics of prebiotic use in baitfish diets need further evaluation.

A 10 week feeding trial with goldfish in pools was conducted using the 4- and 10% poultry fat diets with or without 2% Grobiotic®-A. Weight gain and condition index of goldfish fed diets with 10% poultry fat, 2% GroBiotic®-A plus 4% poultry fat or 2% GroBiotic®-A plus 10% poultry fat were higher than those of fish fed the control diet with 4% poultry fat and no prebiotic. Feed conversion and survival did not differ among diets. After the trial, goldfish were moved to indoor tanks for a bacterial (columnaris) challenge (in progress). This challenge includes groups of fish from each diet that were stressed (crowding) or unstressed prior to bacterial exposure.

The University of Florida conducted pond and tank trials on five species of ornamental fish – *Brachydanio rerio* (zebra danios), *Xiphophorus helleri* (swordtails), *Hypostomus sp.* (common plecostomus), *Cichlasoma meeki*, Firemouth Cichlid, and *Moenkhausia sanctaefilomenae*, Red-eye Tetra. The work was designed to address the basic question of whether farms producing small, ornamental species are feeding the fish, or feeding the pond when they use a commercial diet. When the work was proposed there was a commercial source of inexpensive, unprocessed meal diets, so this study compared the effects of the unprocessed diet with a processed (i.e. pelleted and reground) diet on ornamental fish growth and survival. Two fertilization regimes were also added to the tests to determine the ability of these species to utilize natural foods. Therefore, each pond trial tested 4 treatments: 1) cottonseed meal; 2) liquid fertilizer; 3) an unprocessed, 33%-protein meal diet; and 4) a processed, 33%-protein diet. A tank trial was also conducted with each species to compare growth and survival using the two diets in the absence of natural foods.

continued on page 10

Feed Formulation and Feeding Strategies for Bait and Ornamental Fish (continued from page 9)

There was a significant difference in the growth and survival of zebra danios produced in ponds receiving treatments of liquid fertilizer, cottonseed meal, an unprocessed meal diet, and a processed diet. Growth of zebra danios was best on the processed diet, followed by the unprocessed diet, then cottonseed meal, with lowest growth in the liquid fertilizer treatment. Nevertheless, the liquid fertilizer treatment alone produced many market-sized fish with minimal costs. In tanks trials, zebra danios fed the processed diet out-performed those fed an unprocessed diet.

Survival of swordtails in all pond studies was greater than 100% due to reproduction. Treatment effects on overall production were the same as for zebra danios, with highest production for fish fed the processed diet, followed by the unprocessed diet, then cottonseed meal, with lowest growth in the liquid fertilizer treatment. At harvest, the average size of a "small" graded fish was not yet saleable (less than 1.5 inches) but all "large" graded fish were saleable. Profit made by selling all saleable fish was higher from the processed diet, unprocessed diet, or cottonseed meal treatment than from ponds treated only with liquid fertilizer. Profits were also higher for the processed diet treatment than for the cottonseed-meal treatment. Growth and survival of swordtails in tanks were similar for fish fed the processed or unprocessed diet.

In pond studies with Plecostomus, production was highest for fish fed the unprocessed diet, followed in order by the processed diet, cottonseed meal, and liquid fertilizer treatments. Ponds receiving the unprocessed diet had the largest number of large fish and the best production and survival. Investment return for the unprocessed diet treatment was twice that of the processed diet and cottonseed meal treatments. Ponds treated with liquid fertilizer performed very poorly and did not produce enough sellable fish to cover the costs of the treatment. Percent survival varied dramatically, with liquid fertilizer producing only 10% survival compared to 65% survival for the unprocessed diet. In tanks, growth and survival of Plecostomas fed processed or unprocessed diets were similar.

Firemouth Meeki cichlids in ponds grew best on the processed diets, followed in order by the unprocessed diet, liquid fertilizer and cottonseed meal treatments. Interestingly, liquid fertilizer alone produced the highest number of fish. Firemouth Meeki cichlids readily spawn in ponds, and reproduction and survival of offspring was best in the liquid-fertilized ponds, but fish size was significantly smaller than in the ponds treated with either diet. In tanks, there was no difference in growth or survival of Firemouth Meeki cichlids fed the processed or unprocessed diet.

Production of Red Eye Tetras in ponds was best when fed the processed diet, followed by the unprocessed diet, cottonseed meal, and liquid fertilizer treatments. Tank studies using Red Eye Tetras showed no significant difference in growth or survival of fish fed the processed or unprocessed diet.

Overall, the ornamental fish study demonstrated that pond fertilization alone produces a significant number of fish at a relatively low cost, but the size of the fish is significantly smaller compared to other treatments. There also was a general trend toward increasing growth and survival in ponds with processing of the diet, but not for all species. Selection of an organic fertilizer such as cottonseed meal or an inorganic fertilizer such as the liquid used in this study, also produced different yields, but again there was variation in the relative trend between species. Firemouth Meeki cichlid showed a dramatic increase in survival and total yield with an inorganic fertilizer versus cottonseed meal.

The original objectives of this project have largely been met or exceeded, as additional lines of research have been generated that will continue past the completion of the project. Results indicate that there is good potential to improve production efficiency, product quality, and marketability of bait and ornamental fishes through changes in diet composition and feeding strategy. Based on the collective data generated from this project, several producers of bait and ornamental species have altered their stocking densities and feeding regimes. Further implementation of the results is expected when preliminary estimates of economic feasibility can be confirmed. ❖

DEVELOPMENT AND EVALUATION OF POND INVENTORY METHODS

THE CHALLENGE . . .

Maintaining accurate inventory records in large earthen-pond aquaculture systems has always been problematic. Accurate biomass, headcount and size distribution information is critical for production management, business planning, accounting and operation financing. With production costs rising and profit margins shrinking for many aquaculture enterprises, the development of more accurate inventory estimation techniques would help provide crucial business planning information.

OUR RESPONSE . . .

Nine research scientists from five institutions are participating in a two-year project to develop new methods and techniques for estimating inventory biomass, headcount, and size distribution of aquatic animals raised in earthen pond systems. The scientists participating in this project represent the following institutions:

- Louisiana State University
- Mississippi State University
- University of Arkansas at Pine Bluff
- University of Florida
- University of Mississippi

Various inventory techniques and methodologies tailored to different production facilities are under investigation. The primary objectives include efforts to:

- Determine the most accurate and reliable way to estimate ornamental fish inventories in ponds;
- Determine the most accurate and reliable way to estimate crawfish inventories in ponds;
- Modify the Aquascanner Catfish SONAR system to size individual catfish collected from ponds;
- Develop and evaluate several down-looking and low frequency side-scan sonar technologies to determine numbers of channel catfish in ponds;
- Develop and evaluate a catfish trawl and portable computing technologies to estimate inventory numbers in catfish ponds.

PRINCIPAL ACCOMPLISHMENTS . . .

Work at the University of Florida focuses on quantifying discrepancies between producer estimates of ornamental fish larvae and actual numbers of fish stocked into production facilities. Large systematic errors were identified, which has resulted in improved methods for estimation of number at stocking and improved record keeping procedures to improve inventory tracking over the production cycle for ornamental fish produced in ponds.

Research at Louisiana State University showed that crawfish sampling by test traps generally was a good indication of potential yield in crawfish test ponds and

continued on page 13

ECONOMIC FORECASTING AND POLICY ANALYSIS MODELS FOR CATFISH AND TROUT

THE CHALLENGE . . .

The U.S. aquaculture industry is facing challenging economic conditions. Increasing quantities of imports have made it difficult to pass rapid increases in feed and other costs on to consumers. Other segments of the agriculture and food sectors in the U.S. rely upon economic models to anticipate the effects of changing economic conditions on farm prices and quantities produced and to assess the effects of new policy initiatives. No such economic models exist for U.S. aquaculture industries.

OUR RESPONSE . . .

Nine research and extension scientists from five institutions have joined in a two-year project to develop models that will provide guidance to the catfish and trout industries on the effects of various types of changes in the economy. The scientists represent the following institutions:

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

The following types of economic models are under development:

- U.S. demand and supply of catfish and trout;
- International trade effects on the catfish and trout industries;
- Potential effects of various policy alternatives and external economic shocks on the catfish and trout industries.

PRINCIPAL ACCOMPLISHMENTS . . .

Economic models have been developed of demand and supply of U.S. catfish at both the farm and wholesale levels. The variables with significant effects on U.S. catfish supply and demand were identified for both the farm and wholesale levels. Other models have been developed that evaluate effects of international trade on the U.S. catfish and trout industries. The variables from the international models with significant effects on domestic catfish prices were identified. This project will now move to combine the most important variables from the domestic supply and demand models with those from the international trade models to begin to assess effects of various policy alternatives and external economic shocks. ❖

Innovative Technologies and Methodologies for Commercial-scale Pond Aquaculture (continued from page 4)

Research at Auburn University has developed indicators of resource use efficiency in catfish farming and other types of aquaculture. These indicators have been used by several environmental NGOs in developing aquaculture eco-label certification standards. Energy use for production and processing of catfish is about 9.059 kW · hr/kg of live fish. Grow-out of channel catfish and production of feed for use in grow-out accounts for about 50% and 25% of energy use, respectively.

Findings from research at the University of Arkansas at Pine Bluff were used to construct a commercial-size barrier system at a commercial fish farm in Arkansas. The barrier system has been stocked, and production data will be available at the end of 2008.

Cash flow budgets developed at the University of Arkansas at Pine Bluff are being used by several banks for making decisions about loans to catfish farmers. These budgets show that lending limits result in farmers removing ponds from production. Also, as cash flow is restricted, smaller farms switch to stocking smaller fingerlings, and larger farms switch to stocking fingerlings instead of stockers. ❖

Development and Evaluation of Pond Inventory Methods
(continued from page 11)

that simulated population recruitment was poorly correlated to crawfish yield in the ponds studied. The most accurate pond inventory methodology, and the best indicator of potential yield in this study, was the simple passive drop sampler. Additional research will determine how well these findings apply to large scale commercial operations and whether these methods are accurate enough to have practical applications.

The Aquascanner Catfish SONAR system has been modified by University of Mississippi reseachers to determine the size of individual catfish collected from ponds. An acoustic backscatter system has been built to measure the target strength of individual fish from a harvested population. That information can then be processed to predict the population weight distribution of the fish harvested.

First year research at Mississippi State University focused on obtaining and testing the inventory potential of a commercial side-imaging sonar unit. "Screen Snap Shots" obtained with the side scan lobes of the unit in commercial catfish ponds indicate that this technology can be used to image fish.

Researchers at the University of Arkansas at Pine Bluff have modified a commercially available "otter style" trawl for the purpose of collecting a large sample of catfish in levee-style production ponds. Early results suggest that the catfish sampling trawl may capture large stockers and food-size fish more effectively than it does fingerlings. Nevertheless, the trawl may still remain a viable sampling technique to assess the size distribution of catfish populations after these biases are quantified. Also, considerable progress has been made in the development of a sample data collection system based on a hand-held "PDA" computer platform. ❖

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