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Inside this Issue:

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Linking Catfish Ponds to Conserve Groundwater and Reduce Effluent Release

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An ongoing study which links ponds for reducing groundwater consumption and effluent is proving to be a viable alternative water management strategy. Researchers at MSU designed and modeled a management approach based upon using some ponds not only for fish production but also storage of rainwater that otherwise would be released to the environment. The approach is based on the premise that one pond in a linked drainage system (referred to as the “production/storage pond”) is deepened to receive overflow from other ponds in a 2-pond and/or 4-pond configuration. Results suggested that effluent discharge may be reduced from 40–90% and groundwater use may be reduced 40–75%. The model is now being validated by field testing.

Currently, field tests are being conducted on seven one-acre ponds located at the National Warmwater Aquaculture Center in Stoneville, MS, and supported by the Southern Regional Aquaculture Center. Field system configurations include: 1 conventional production (control) pond; 1 conventional production pond linked to 1 production/storage pond; and 3 conventional production ponds linked to 1 production/storage pond (Figure 1, page 2). In the production/storage ponds, the water storage capacity (depth) is increased by 1 foot in an interconnected 2-pond module and 2 feet in a 4-pond module (Figure 2, page 2). The extra depth in the production/storage ponds allows for capturing rainwater from the connected production ponds. The stored water then may be used to replenish the production ponds as needed. Any additional water needs are met by pumping groundwater.

The stored water is moved from the production/storage pond to the production ponds by means of a PTO-driven, water pump. This pump was chosen for its availability and high volume capability, but any pump that can move the water in a reasonable amount of time may be used.

continued on page 2

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Linking Catfish Ponds

continued from page 1

Modifications to the ponds include earthwork required for increasing storage pond depth in one pond per system and alteration of outflow pipes to divert flow to the storage pond. Storing rainwater and linking ponds results in an operation depth fluctuation of +/- 1 foot in production ponds (varying between 3 and 4 feet deep) and +/- 2 feet in production storage ponds (varying between 4 and 6 feet deep). This allows use of all conventional catfish farm equipment. For monitoring purposes and data collection during the field test, open channel flumes, water level sensors and data loggers were installed.

In order to simulate commercial culture, each of the seven ponds was stocked with two sizes of commercial catfish. Harvesting was conducted as per routine commercial production. Production rates have been comparable with normal commercial production.

Dissolved oxygen and water quality (dissolved oxygen, temperature, total ammonia, nitrite, chlorophyll *a*, conductivity, alkalinity, and hardness) were not different between ponds of the three configuration types. Disease (proliferative gill disease and enteric septicemia of catfish) epizootics have occurred in all ponds, but the spread of the disease could not be attributed to connections between ponds. In some cases, a pond in a unit would contract a disease while other ponds in the module would not.

After one year and eight months of operation, water volume data indicates linking ponds in systems and increasing water storage capacity reduced effluent volume by approximately 50-75% and groundwater consumption by 40-50% compared to conventionally managed ponds. These field results are a balanced representation due to a drier first year and a wetter second year in the Mississippi Delta. Potentially, a greater reduction of groundwater use and effluent release may be achieved by other variations of similar water management techniques.

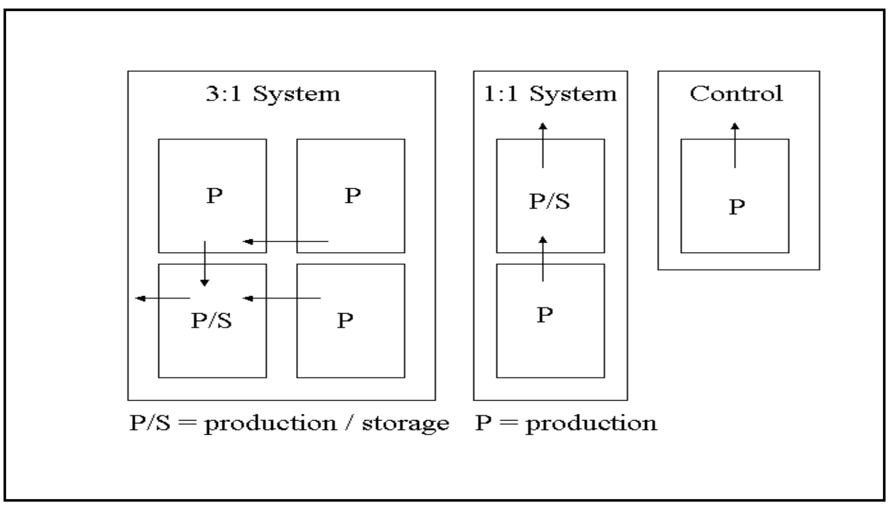


Figure 1. Pond linkage configurations.

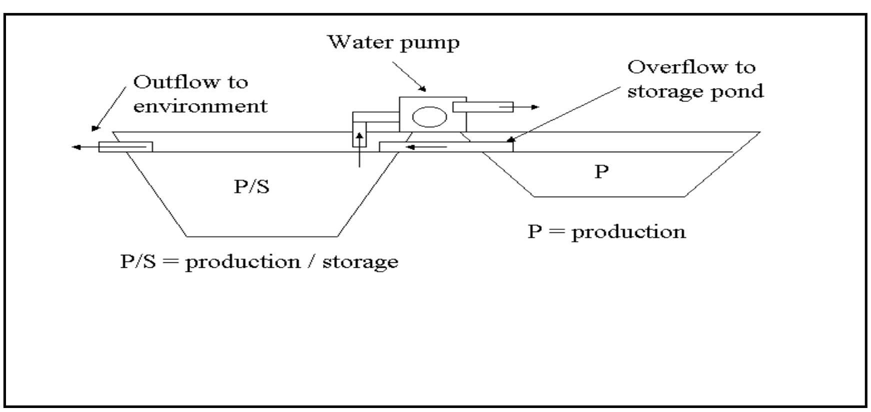


Figure 2. Pond linkage schematic.

Catfish Pond Effluents

Craig Tucker and Sarah Harris
Southern Regional Aquaculture Center

For many years catfish farmers produced good food for American consumers with little outside interference. As recent events have shown, those days are over and we are now faced with an increasingly competitive marketplace and closer scrutiny by outside interests.

In January 2000, the United States Environmental Protection Agency (EPA) announced that they would begin development of nationally applicable discharge standards for aquaculture. The draft regulations will be published by June 30, 2002 and the final rule will be published by June 30, 2004. The EPA decision to develop effluent regulations could profoundly affect catfish farmers because implementation of unreasonable effluent management practices will affect farm profitability. As such, technical decisions made by EPA must be based on sound science and reasoning.

Fortunately, considerable research has been conducted on pond effluents, despite the fact that the EPA regulatory activity caught most people in the catfish industry by surprise. This information appears to have put the catfish industry in reasonably good shape to argue that catfish pond effluents do not pose a significant threat to the environment.

Much of the early work on catfish pond effluents was conducted by Dr. Claude Boyd at Auburn University in Alabama. Dr. Boyd showed remarkable vision by conducting significant studies on catfish pond effluents as early as 1978, over 20 years before EPA focused on the issue.

In 1990, the Board of Directors of the Southern Regional Aquaculture Center (SRAC) also showed foresight by approving a comprehensive regional project to investigate pond effluents. The project was proposed by the SRAC Industry Advisory Council and Technical Committee in 1989 and research began in May, 1991. The objectives of the 3-year study were to characterize pond effluents, evaluate possible effluent management strategies, and assess the costs of treating effluents. The project was extraordinarily productive, and information produced by the 16 project participants still constitutes the core literature on the subject of aquaculture pond effluents.

A large, comprehensive data set on effluent quality was produced, which showed that effluents were dilute with respect to most constituents and pose little, if any, threat to the environment. Most effluent treatment options were too expensive to be practical, but results indicated that the impact of pond effluents could be minimized by using simple management practices, such as minimizing water exchange ("flushing"), operating ponds as long as possible before draining, and leaving some storage capacity when ponds are topped off with water. These practices are logical extensions of good overall farm management and do not require extra expenses to implement.

The results of the project were reported in 15 refereed scientific journal articles, 4 extension publications, 21 papers presented at scientific meetings, and 1 graduate degree thesis. Results are summarized in SRAC Final Project Report No. 600 (available online at http://www.msstate.edu/dept/srac/fprlink.htm).

The 1991 project provided a good basis for characterizing pond effluents and making some initial recommendations on effluent management. However, within a couple of years of project completion, it became evident that additional work was needed to fill in some important information gaps. As such, a second regional project was proposed in 1998 and initiated in 1999.

The new project, which is in progress, seeks to further characterize critical effluent components, assess the actual impact of aquaculture on receiving stream water quality, and provide simple effluent management alternatives. Once again, the scientists and farmers who worked together to develop this project showed remarkable foresight in anticipating the announcement of rulemaking by EPA in 2000. Up-to-date results of the new SRAC project are presented in SRAC's Fourteenth Annual Progress Report (available online at http://www.msstate.edu/dept/srac/apr14.pdf). For more information on other projects, visit the SRAC website at: http://www.msstate.edu/dept/srac

Evaluation of Low-Protein Diets for Production of Fingerling Channel Catfish

Edwin H. Robinson, Menghe H. Li, and Bruce B. Manning

Catfish fry and small fingerlings are typically fed a diet containing a higher level of protein than is used during grow-out. For example, fingerling diets generally contain 35 to 41% protein whereas diets used for grow-out generally contain 28 to 32% protein. This is reasonable from the standpoint that smaller fish have a higher protein requirement than larger fish. However, fry and fingerlings likely derive a significant amount of their nutrient requirements from organisms that naturally occur in pond water. Although the contribution of natural foods to the nutrient needs of small catfish has not been precisely determined and will vary in type and amount from pond to pond, it is reasonable to assume that abundant natural foods will generally be available in fry and fingerling ponds because of the heavy nutrient input into the pond through the feed. The study reported herein was designed to compare the performance of small catfish fingerlings raised in earthen ponds and fed either a 28, 32, or 41% protein diet.

Methods

Fifteen one-acre ponds at Delta Western Research Center, Indianola, MS, were stocked with 100,000 fingerling channel catfish (23 pounds per 1,000). Three diets containing 28, 32, and 41% protein were evaluated. Five ponds were assigned to each dietary treatment. The fish were fed daily to apparent satiation for 115 days. Management practices were typical of those used in commercial culture of fingerling catfish. At the end of the study, each pond was seined three times using a fingerling seine. The number of fish that remained was considered to be negligible.

Results and Discussion

There were no significant differences in the amount of feed fed, yield, final weight, estimated feed conversion, and estimated survival regardless of diet (Table 1). Based on these data, it appears that a 28% protein diet is satisfactory for raising fingerling catfish as small as 3 or 4 inches. If the actual protein requirement is higher than 28% as is generally thought, then the contribution of natural foods was significant. However, there is evidence that small catfish raised in the laboratory under controlled conditions without access to natural foods do not require more than 28% protein. If this is the case, then the contribution of natural foods may have been insignificant or a lower protein diet may be sufficient for fish raised in earthen ponds.

The estimated feed conversion ratios of fish in the present study were around 2.5. This is higher than the true physiological feed conversion that small catfish exhibit, which is typically around 1.2 to 1.3. This disparity is largely related to the fact that we did not account for all fish either because they died prior to harvest or were not removed during harvest. At any rate, the estimated feed conversion ratios were based on fish that were harvested and the total amount of feed fed. Even though the

Table 1. Performance data of channel catfish fingerlings fed diets containing 28, 32, or 41% protein. Means in each column were not different ($P > 0.05$).

Dietary Protein (%)	Number of fingerlings produced[1]	Gross yield[1] (lb/acre)	Final weight[2] (lb/1,000)	Amount of feed fed (lb/acre)	Estimated Survival[1] (%)	Estimated FCR[1]
28	77,878	8,006	104	14,391	77.9	2.58
32	76,505	8,114	107	14,398	76.5	2.54
41	74,466	7,859	107	14,132	74.5	2.60

[1] Values were based on the number and weight of fish harvested. Each pond was seined three times and fish that remained in the pond were considered to be negligible.
[2] Mean initial weight was 23 pounds per 1,000 fish. Fish were stocked at a rate of 100,000 fish per acre.

true physiological conversion rates were likely much lower than the values we estimated, the estimated values are accurate for calculating costs associated with fish production.

Summary

Since there were no differences in any production variable measured, it appears that a diet containing 28% protein is sufficient for rapid growth of catfish fingerlings with an initial weight of 20 pounds per 1,000 and up. To what extent the fish supplemented their diet with natural food was not determined. Additional studies are planned to further evaluate low-protein diets for fingerling production.

Welcome to New Personnel at NWAC

Sarah S. Harris

Dr. Lanie Bilodeau recently joined the USDA-ARS Catfish Genetics Research Unit as a Research Molecular Biologist where she will focus on gene expression and disease resistance in channel catfish. Dr. Bilodeau is a native of Maryland. She received her B.S. degree in Ecology with a minor in Mathematics and Master's Degree in Organismal Biology from Towson State University. Her Master's research involved the behavioral and genetic aspects of chemical communication and con- specific recognition in lungless salamanders. Dr. Bilodeau completed her doctorate in Environmental and Evolutionary Biology at the University of Louisiana – Lafayette, working on population genetics and ecology of marine organisms, particularly burrowing ghost shrimp. She also developed an ultrasensitive PCR-based larval detection technique and two likelihood-based statistical analyses for microsatellite and mitochondrial DNA population genetic data. Dr. Bilodeau performed postdoctoral research at The University of South Carolina where she studied the population genetic consequences of larval dispersal in a mussel hybrid zone. She can be contacted by phone at 662-686-3591.

Dr. Brian Peterson, Research Physiologist, is a new member of the staff of the USDA-ARS Catfish Genetics Research Unit here at the NWAC. Dr. Peterson is a native of Idaho and received both his B.S. (1994) and M.S. (1998) degrees in Animal Science from the University of Idaho. He attended the University of Idaho to work on his doctorate under the direction of Dr. Gerald Schelling. While pursuing his doctorate, Dr. Peterson was involved with rainbow trout growth, physiology and nutrition. Growth trials with other species such as channel catfish, sturgeon and shrimp were also investigated. Dr. Peterson was also involved in studying the physiology of smolts migrating to the ocean. The thrust of Dr. Peterson's doctoral research focused on utilizing the immune system of rainbow trout to regulate growth hormone and thus growth. Dr. Peterson's research focus at the Catfish Genetics Research Unit will be on regulation of catfish growth and correlations with disease resistance. Dr. Peterson can be contacted by phone at 662-686-3589.

Dr. Al Camus has accepted the position of Assistant Professor with the College of Veterinary Medicine, MSU and the Directorship of the Aquatic Diagnostic Laboratory at NWAC. Dr. Camus received his Doctor of Veterinary Medicine from Louisiana State University, School of Veterinary Medicine in 1984 and worked as a private practitioner for four years before returning to graduate studies in aquatic pathology at the University of Rhode Island in 1988. In 1991, he accepted a residency in the Department of Veterinary Pathology, LSU School of Veterinary Medicine and attained the rank of Clinical Instructor in 1992. While pursuing his doctorate in Veterinary Medical Sciences, Dr. Camus served as pathologist for the Louisiana Aquatic Animal Disease Diagnostic Laboratory at LSU. After completing his dissertation research, entitled "Pathobiology of *Streptococcus iniae* Infections in Cultured Tilapia," he received his Ph.D. in May 2001 and then spent a brief tenure as an Assistant Professor of Aquatic Medicine at LSU before joining the NWAC staff. Professional interests include the diagnosis of aquatic animal diseases and pathogenesis of infectious diseases of aquatic animals, with particular emphasis on diseases of

continued on page 11

Annual Fish Diagnostic Laboratory Report for 2001

Lester Khoo

This will be the last annual report from this laboratory that I will be associated with and I would like to include my personal thanks to each of you for your support of the past five and half years. I know that I have left the Fish Diagnostic Laboratory in very capable hands and believe that the best years are yet to come for the laboratory.

There were a total of 2001 case submissions to the Fish Diagnostic Laboratory at Stoneville for 2001. This was a decrease from the previous year's total of 2594. This decrease was from producer submissions (1602 compared to 2189) while research submissions remained relatively stable (399 versus 405). This drop may reflect a combination of climatic conditions that did not allow for severe epizootics for some diseases and perhaps better control and management strategies as well.

As with the previous years, each case represents fish from one pond. Routine diagnostics include evaluation of gill clips, fin and skin scrapes, gross external and internal lesions, touch impressions of tissues (particularly the liver and posterior kidney), bacterial cultures of the brain and posterior kidney, viral cultures of the spleen, posterior and anterior kidney, as well as histopathology. The diagnosis of the major diseases/conditions were based on the following criteria:

- Enteric septicemia of catfish (ESC) - isolation of *Edwardsiella ictaluri* on blood agar from cultures of the brain and posterior kidney.
- Columnaris - isolation of *Flavobacterium columnare* on dilute Mueller Hinton agar on microscopic identification of the typical slender filamentous bacteria on fin/skin scrapes, or gill clips of fish with the characteristic necrotic lesions. Our client reports differentiate between the two methods with the latter used for the designation of external Columnaris when the bacteria cannot be isolated on agar. For the purposes of this report, all cases of Columnaris (external or internal) have been grouped together.
- Proliferative Gill Disease (PGD) or Hamburger gill - diagnosis is based on microscopic detection of cartilage defects on gill wet mounts or in histopathology sections.
- Channel catfish virus (CCV) disease - based on observance of cytopathic effects in channel catfish ovary cell cultures that have been inoculated with suspensions from the spleen, posterior and anterior kidney.
- Saprolegnia (winter fungus) - based on microscopic identification of typical fungal hyphae on skin/fin scrapes or gill wet mounts.
- Channel catfish anemia - when the pack cell volume (PCV) in stocker or food fish is less than 10%
- Branchiomyces- based on microscopic identification of the characteristic fungal hyphae on gill wet mounts.
- Visceral toxicosis of catfish (VTC) - based on biological testing, i.e. injecting test fish with serum from affected fish (those with typical lesions, chylous effusions, intussusceptions, congested spleens, intestines with pale serosal surfaces and prominent blood vessels and a reticular pattern to the liver) and having the test fish succumb to this disease with similar gross lesions.
- Trematodes - the digenetic trematode that has been tentatively identified as Bulbophorus confusus. This is based on the morphological characteristics of the metacecariae that are obtained from the affected fish. This does not include yellow grub (Clinostomum).

The major diseases followed a trend similar to the previous year. Bacterial diseases were still the major problem with Columnaris representing 37.2 % (596 out of 1602) of the producer submitted cases. This is a drop from 2000 where it was 42.6% (933 out of 2189 cases). ESC was a close second with 36.4% (583 cases), which represents a rise in the percentage of cases (33.5% in 2000), but a decrease in actual cases (734 in 2000). PGD was again the third most common disease (20.1% or 322 cases in 2001 versus 29.8% or 653 cases in 2000). There were 167 cases of Saprolegnia in 2001 and 230 in 2000. However, the percentage of cases these represent are very similar (10.4% of cases in 2001 and 10.5% in 2000). There was, however, a dramatic increase in CCV cases (117 or 5.8% versus 51 or 2.3% in 2000). There was relatively no increase in percentages of channel catfish anemia cases; approximately 5% in both years (80 versus 108 in 2000).

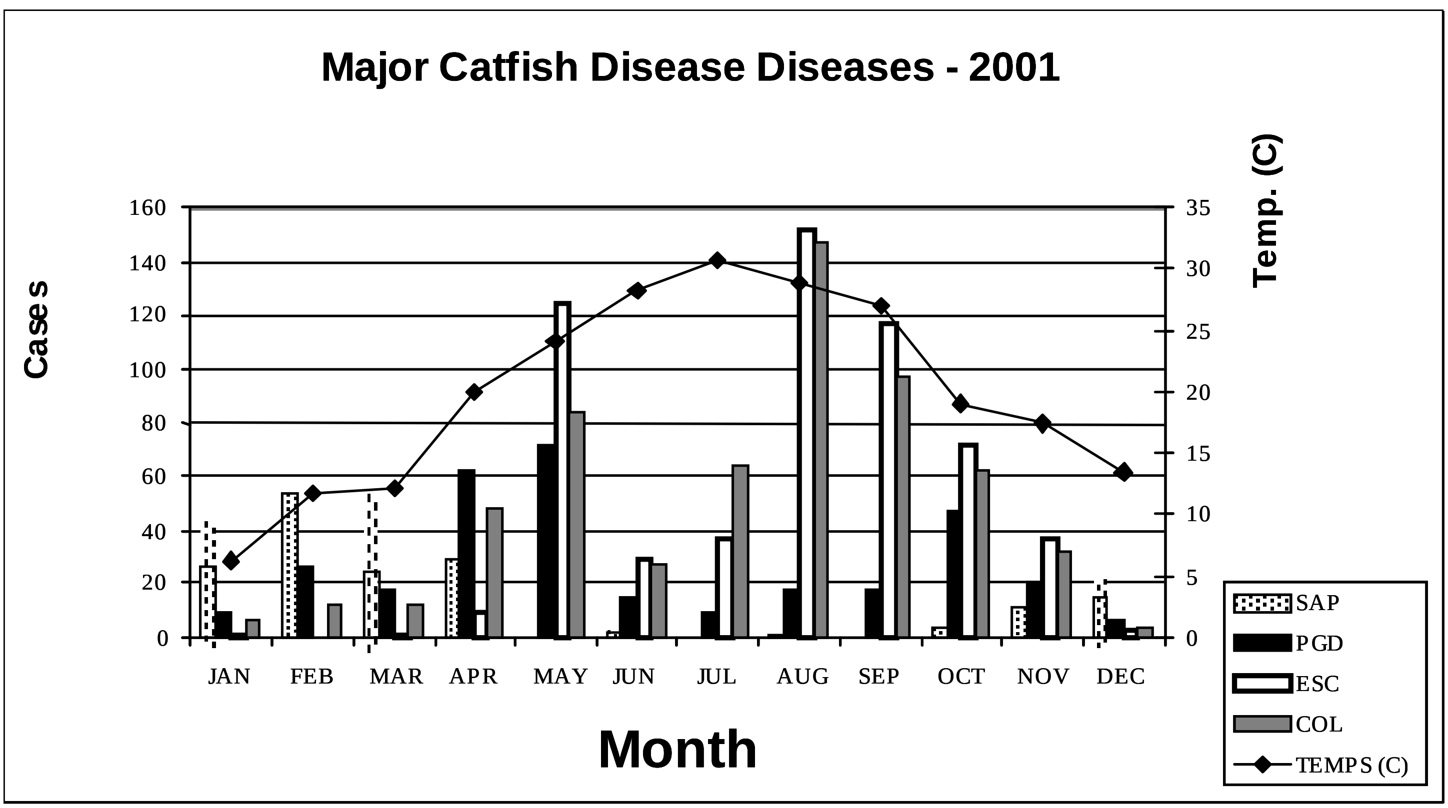
There was an increase in methemaglobinemia cases from 3 cases in 2000 to 10 cases in 2001 (0.14% and 0.62% respectively). The number of cases of *Ichthyophthirius multifilis* decreased in numbers: 29 cases versus 59 in 2000 (1.8% and 2.7% respectively). For the trematodes, there was a decrease from 123 cases (5.6%) to 70 cases (4.4%) in 2001. We were also able to document the confirmed VTC cases to be 41 or 2.6% of producer submitted cases. There were approximately 19% of cases (304) that we were unable to ascertain an etiology (disease check). This was an increase from 15% (328 cases) in 2000.

As a whole, the water temperatures (based on mid-morning temperatures on 35 ponds from 4 different locations in Sunflower, Humpherys and Washington counties) were higher than in 2000, except for the first three months of the year. The differences were most pronounced for the fall and winter months. This may have played an integral role in the incidence of several of the diseases.

Water quality submissions were increased from last year; 1037 compared to 888 submissions in 2000. However, there were less individual farms involved in these submissions (more samples from individual farms).

There was also a slight increase in the numbers of antibiotic resistant cases in the known pathogens for channel catfish. There were 4 cases of *Edwardsiella ictaluri* that were resistant to both Romet and Terramycin, as opposed to 2 cases in 2000.

We hope that we have provided you with some useful information. Please do not hesitate to contact the laboratory if there is some other information that you would like to see in the future included in this report. We would like to thank all of you who have utilized and/or supported the laboratory throughout the year and would encourage those of you who have not utilized our services to consider doing so. This report, like the previous iterations, represents the dedicated work of Ms. Cyndi Ware who reviewed all the case submissions and prepared this report. If there is other information that you would like that we have not included in the report, please let her or Dr. Al Camus know and I know they will try to accommodate your request.



NWAC Plans Spring Workshops

Jimmy Avery, Jim Steeby, and Charlie Hogue

A series of demonstrations and workshops is planned for March and April.

Harvesting and Grading

New technologies in harvesting and grading channel catfish will be featured at Aqua Farms beginning at 10:00 a.m. on Tuesday, March 19, 2002. Aqua Farms is located southwest of Leland, Mississippi. Exit Highway 82 and head south on new Highway 61. Go 8 miles and turn right on Wilmot Road. Aqua Farms' headquarters will be 5 miles on the right.

David Heikes, Extension Fisheries Specialist with the University of Arkansas at Pine Bluff, will demonstrate an in-pond catfish fingerling grader. The in-pond grader is designed to separate fingerlings into two distinct size groups at a rate of 400 pounds per minute.

Mack Fondren, Jason Yarbrough, and Jason Redden with the NWAC Harvesting Project will exhibit a prototype seine that incorporates several modifications. These modifications include improved mesh construction to improve selectivity of fish size harvested, an enlarged funnel to improve fish handling and reduce stress, and a "traveling" mud roller line to reduce seine bogging and improve seining efficiency. The seine also includes zippers to allow for easy replacement of seine components and installation and removal of "socks". The seine has been used on several commercial catfish farms and average seining time and socking time is reduced.

FISHY 2001

MSU's Agricultural Economics Department, MAFES, and the NWAC are cosponsoring two FISHY 2001 "hands-on" Computer Software Workshops for catfish producers. Wallace Killcreas from the Agricultural Economics Department at MSU will be leading the programs with assistance from Jim Steeby, Charlie Hogue, and Jimmy Avery with the NWAC. This version of FISHY has generated quite a lot of interest because it is the first version that runs on the Windows-based platform. FISHY 2001 also features more flexibility in reporting and an improved growth simulation program. If you are a new producer or experienced FISHY user with questions or suggestions for improvement in the program, please attend this workshop.

The first program will be held on Thursday, March 21, 2002 from 1:00 p.m. to 5:00 p.m. at Mississippi Delta Community College's Center for Career and Workforce Education. The Delta Center is located west of Indianola, Mississippi on Highway 82 near the Dollar Store Distribution Center. Registration is limited to the first 20 participants. Contact Mayme Pickens at (662) 686-3269. The second program will be held on Thursday, March 28, 2002, from 10:00 a.m. to 3:00 p.m. in the Agricultural Economics Computer Laboratory (Lloyd-Ricks 14) at Mississippi State University in Starkville. Registration is limited to the first 30 participants. To reserve a space, contact Teresa Atwater at (662) 325-7982.

Crawfish

A Crawfish Production workshop will be held in Greenwood, Mississippi on March 26, 2002 at the Leflore County Civic Center on Highway 7 North. The 1:00 p.m. workshop will compare the forage-based production systems typical of Louisiana with the non-forage, deep pond systems developed by Lou D'Abramo at MSU. Additional speakers include Terry Hanson and Jimmy Avery. There will be a **$10** registration fee to cover handouts.

Water Quality

Two workshops on water quality principles and testing are slated for April. The workshops are designed to give new commercial catfish producers a knowledge of the principles of water quality management and to provide hands-on instruction concerning water sample analysis. The first program is scheduled for April 9, 2002 in the auditorium of the Black Belt Experiment Station in Brooksville, Mississippi. The second program is scheduled for April 11, 2002 in the B.F. Smith Auditorium at the Delta Research and Extension Center in Stoneville, Mississippi. Both programs will begin at 1:00 p.m. and end by 5:00 p.m. Contact Mayme Pickens at (662) 686-3269 to reserve a space.

Contact

For more information on any of these workshops, contact Mayme Pickens at (662) 686-3269.

Gas Supersaturation in Catfish Hatcheries

Jimmy Avery and Jim Steeby

Water sources in catfish hatcheries may develop a condition referred to as "gas supersaturation". The problem is frequently experienced in new hatcheries or hatcheries that have made significant changes to the water delivery system. Gas supersaturation can cause a stressful or lethal condition in fry called gas bubble trauma. While gas supersaturation may be difficult to diagnose, the condition can usually be easily remedied.

Total dissolved gas pressure is a measure of the "concentration" of all gases dissolved in water. This concentration can be expressed in several terms. Scientists ususally express gas levels in pressure units such as millimeters of mercury (mm Hg). Values can also be expressed as "Δ-P", which is the difference in total dissolved gas pressure in water when compared to local barometric pressure. Total dissolved gas pressure (TGP) is also reported as a percentage of local barometric pressure. When Δ-P values are greater than zero or TGP percent is greater than 100, the water is considered supersaturated and gas will tend to leave the water by diffusion or by forming bubbles.

Instruments called "saturometers" are used to measure TGP. Saturometers are not commonly available to catfish hatchery managers, but supersaturated conditions can sometimes be diagnosed by the formation of bubbles on the surface of tanks or the milky appearance of water as gases come out of solution to form very small bubbles. Quite often, however, the first indication of supersaturated conditions is death of fry.

Channel catfish eggs are fairly resistant to high TGP values because the naturally high pressure within the eggs helps prevent bubble formation. At high TGP, (> 103% of saturation) bubbles may form on and in the egg mass causing it to float high in the hatching basket. The top of the egg mass may be above water and will tend to dry out. Dislodging the bubbles by shaking and rotating the mass will temporarily alleviate the problem, although decreasing the TGP of the water is the best solution.

Gas bubble trauma may occur in fish living in supersaturated water when gases in the blood or tissues come out of solution and form bubbles. These bubbles can block blood flow or damage tissues. Clinical signs of gas bubble trauma in catfish fry include loss of equilibrium, abnormal swimming, and gas bubbles in the yolk sac, behind the eyes, or on the skin. The bubbles prevent normal swimming and feeding, and fry may become trapped at the surface. In severe cases, newly hatched fry rapidly die as blood flow is restricted or the yolk sac ruptures.

Ground water is frequently supersaturated with nitrogen if it enters the hatchery without pre-aeration. Another common cause of supersaturation in supply systems is entrainment of air from a leak in the pipes on the suction side of a water pump. Some of the gases in the entrained air are driven into solution as the water is pressurized after moving through the pump. In those situations, it is often possible to hear air bubbles moving through elbows and valves in the delivery system. If supersaturation is caused by air leaks in the water supply line, the first course of action is to locate and repair the problem. Heating water can also cause considerable increases in TGP unless the water is degassed after heating. The increase in TGP attributable to heating can be substantial.

Pre-aeration of the influent water is commonly used to reduce supersaturation to tolerable levels but other types of systems providing vigorous aeration may be used. Be aware, however, that air bubbled through airstones is relatively inefficient at degassing waters and, in some systems, may actually cause supersaturation.

Packed column aerators are particularly effective at degassing supersaturated waters. A packed column consists of a vertical container filled with packing medium. Water to be treated enters the top of the column and breaks up randomly into a thin film that trickles down through a high surface area plastic packing medium. Exposing the water to the atmosphere allows excess gases to be released. Various plastic materials have been used as packing media and materials specifically designed for use in packed

continued on page 12

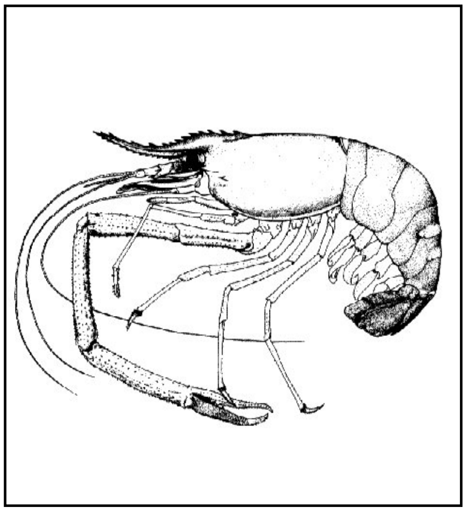
Freshwater Shrimp Farming - Why Now and What is the Attraction?

Louis R. D'Abramo

Over the past two years, freshwater shrimp has become a major species of interest among current and potential fish farmers in the United States. In the U.S., attempts at freshwater shrimp farming actually began during the late 1960s and early 1970s in Hawaii and Florida. These initial attempts failed, primarily due to poor management founded upon a lack of sufficient knowledge about the unique biology of the species.

During the 1970s, scientists at the South Carolina Department of Natural Resources developed more efficient techniques for the different phases of culture. Beginning in the mid-1980s, Mississippi State University began an intensive research effort to evaluate the potential of freshwater shrimp farming in Mississippi. The fruits of this 15-year effort are now beginning to be realized. Currently, two commercial freshwater shrimp hatcheries are located in Mississippi and approximately 300 acres were in production during the 2001 growing season. Total acreage devoted to freshwater shrimp farming in the entire southeast probably exceeded 600 acres in 2001.

Freshwater shrimp farming in the U.S. is riding the crest of a wave of development that could lead to the establishment of a true industry. The change in attitude is partially founded upon the efforts of some innovative and entrepreneurial farmers who chose to participate in verification projects with researchers of the NWAC a few years ago. These carefully monitored projects demonstrated that practices derived from small pond experimentation could be successfully applied to larger commercial ponds. Production ranged from 400 to 1000 pounds per acre of 10 to 25 whole shrimp per pound. Another beneficial factor was the decision by individuals who had years of experience in shrimp imports, processing, and marketing, including freshwater shrimp, to enter into commercial production.



So, why should you consider growing freshwater shrimp? One obvious answer is the increasing demand for shrimp by the U.S. population. In 2000, Americans consumed 4.3 billion pounds of domestically produced and imported seafood. That's 15.6 pounds consumed per person of which 3.2 pounds were shrimp. Approximately 80% of the shrimp consumed in the United States is imported. Therefore, a great opportunity exists for supplying the demand through domestic production. Although most of the shrimp consumed in the United States are from a saltwater environment, studies indicate that freshwater shrimp is well accepted by consumers, particularly for their taste and texture.

Freshwater shrimp farming has many attractive characteristics. For those individuals currently involved in aquaculture, freshwater shrimp farming offers diversification, the ability to draw upon an established infrastructure, and the potential to modify existing production ponds. Another appealing characteristic is the comparatively short time for return on investment. The time from stocking of juvenile freshwater shrimp in production ponds to harvest can be as short as 4 months. Growout of these shrimp in freshwater production ponds also removes the need for large quantities of saltwater for certain species of marine shrimp.

At densities ranging from 8,000 to 20,000 juveniles per acre, managing natural productivity through fertilization can contribute substantially to the nutrient needs for growth. Also, daily feeding rates generally do not exceed 80 pounds per acre. Potential problems in water quality and the incidence of disease are minimal. Although annual production is much lower than that of channel catfish, prices for the product are much higher.

Education of the public about the high quality and distinctiveness of freshwater shrimp is essential. Specific qualities that should prove attractive to the consumer are freshness, low levels of cholesterol, sodium, and iodine compared to marine shrimp, and the lack of a fishy odor characteristic of marine shrimp. The species is gradually gaining recognition as a product distinct from marine shrimp. Consumer acceptance may also be increased through educational efforts that focus on freshwater shrimp farming as a sustainable, environmentally-friendly form of aquaculture. A well-planned, cooperative marketing effort that parallels the promotion of catfish by The Catfish Institute would be helpful.

Marketing is critical. Any business plan must include identification of a market prior to the initiation of a pond production enterprise. Wholesale/retail prices are based upon size and the form that the product will be offered (heads-on, de-headed, frozen, iced, or live.) As the mean harvest size of the product increases, the price per pound generally increases. Therefore, the identified market will actually dictate the choice of initial stocking density and the corresponding management practices because growth is density-dependent. The highest possible production is not always the goal because revenue is strongly dependent upon size-dependent prices. Marketing strategies will ultimately depend upon the total production per farmer. A few hundred pounds of shrimp can be readily sold to meet a local demand in most areas. However, sale of larger volumes requires more up-front planning. Conducting marketing efforts just prior to harvest is a recipe for financial disaster. Establishment of shrimp growers' cooperatives may be the solution to some of the inevitable problems in marketing and availability of juveniles as production and volume increases.

Scientists at the NWAC continue to conduct research designed to evaluate different management practices. Some recent areas of investigation include feeding strategies, size grading of juveniles before stocking, the use of artificial substrate within the water column, and harvesting techniques. The goal of all efforts is to maximize net returns. Production results are always complemented by economic analysis by economists of the NWAC.

Another related area of investigation is short term holding (2 to 3 months) to extend the availability of a live or iced product. Overnight transport of a live product without large volumes of water is also being explored. Elimination of the prohibitive cost of transport in water would open a potentially lucrative live market, essentially free of competition from foreign imports.

Freshwater shrimp farming can be an integral component of sustainable rural development as well as a viable component of the U.S. aquaculture industry. The interest is keen, the demand for the product continues to increase, well-documented information about farming practices is available, and the entrepreneurial spirit has always been there. Now, the challenge of maximizing net returns by addressing the demands of the appropriate domestic market awaits.

Accurate and reliable information is essential for the continued development of the freshwater shrimp industry. Potential farmers can obtain the necessary information from experienced farmers, extension agents, and research-based publications. Other sources are unreliable. If you need more information about freshwater shrimp farming, contact the NWAC.

Welcome to New Personnel at NWAC

continued from page 5

aquaculture and their prevention. Dr. Camus can be contacted by phone at 662-686-3305.

Dr. Sylvie Quiniou has joined the USDA-ARS Catfish Genetics Research Unit as Research Associate Molecular Biologist. Dr. Quiniou is a native of France and received her doctorate in veterinary medicine from the National Veterinary School of Lyon, France in 1993. Her dissertation work involved looking at the influence of thyroid hormones on female turbot productivity in natural spawning conditions. She then did an internship at Biomed, Inc., WA, during which she studied the humoral response induced in fish by different bacterins. She recently completed her doctorate at the University of Mississippi Medical Center under the direction of Drs. Jan Bly, Norman Miller and Melanie Wilson. While pursuing her doctorate, Dr. Quiniou was involved with various aspects of specific and non-specific immune function in channel catfish. She brings a background in molecular biology, cell culture and fish immunology to the NWAC and will be working with Dr. Geoffrey Waldbieser on improving genome coverage and marker density of the microsatellite markers based catfish genetic linkage map. Dr. Quiniou's phone number is 662-686-3546.

Gas Supersaturation in Catfish Hatcheries

continued from page 9

columns are commonly available from aquaculture supply companies.

Column height, column diameter, size of the medium, and blower size are critical design components of a packed column aerator. Specific design criteria for packed columns are based upon water flow, water temperature, dissolved gas concentrations in the influent water, and desired dissolved gas concentrations in the effluent. As a rough guide, a packed column 4 to 6 feet high and about 30 inches in diameter will be sufficient to pre-aerate water for a catfish hatchery supplied with 100 gallons per minute of anoxic, 78ºF groundwater.

For more information on the construction of degassing units, read the Southern Region Aquaculture Center Information Publication No. 191 titled “Design and Construction of Degassing Units for Catfish Hatcheries” by John Hargreaves and Craig Tucker. Additional information on water quality issues in catfish hatcheries is available in the Southern Region Aquaculture Center Information Publication No. 461 titled “Water Quantity and Quality Requirements for Channel Catfish Hatcheries” by Craig Tucker. These publications are available on the SRAC website at http://www.msstate.edu/dept/srac/fslist.htm