THAD COCHRAN
NWAC NEWS
NATIONAL WARMWATER AQUACULTURE CENTER

Volume 2, Number 1 November, 1999

Inside this Issue:

Early Spring Losses of Foodfish and Broodfish - **1**

NWAC Coordinator's Comments ---------- **2**

New Personnel at the NWAC ---------- **2**

Strategies for the Use of Diuron ---------- **3**

Proliferative Gill Disease More Prevalent than Previously Thought ---------- **4**

Effect of Protein Level on Dressed Yield and Production of Channel Catfish ---------- **6**

New Research Project on Water Quality and Catfish Production ---------- **7**

CFM to Sponsor Fall Seminar Program at NWAC ---------- **7**

Farm/Processor Price Spreads in Catfish Markets ---------- **8**

Cormorant Roost Dispersal Program Seeks Assistance ---------- **8**

THAD COCHRAN NATIONAL WARMWATER AQUACULTURE CENTER
127 Experiment Station Road
P.O. Box 197
Stoneville, MS 38776-0197
Phone: 662-686-3242 FAX: 662-686-3320
www.msstate.edu/dept/tcnwac

Early Spring Losses of Foodfish and Broodfish

Jim Avery, Lester Khoo, Jim Steeby, Jeff Terhune, and David Wise

Several commercial catfish producers experienced sudden losses of foodfish and broodfish during the early spring of 1999. These losses were most severe from mid February until early May. Historically this is the period during which most of our losses of larger production fish occur, typically from winterkill. What was particularly unique this season was the loss of large numbers of broodfish. Previous laboratory reports and publications describe a disease of this type but occurrences were rare and did not allow further study. Research and Extension personnel at the NWAC, as well as other experts across the region, spent considerable effort this spring trying to identify the causative agent.

The affected fish showed very few clinical signs. Externally, the fish were perfectly normal with no eroded areas or fungal patches. Some larger fish had their stomach protruding into their mouth. Exopthalmia or "pop-eye" was more apparent in stocker-size fish. The only behavioral sign was "porpoising" or swimming rapidly at the surface for short periods of time. Internally, some fish exhibited a prolapsed or "telescoping" intestine, white fluid in the body cavity, a dark congested spleen, and the end of the gut had a white, opaque appearance. The cause of this syndrome still remains unknown. To date, all diagnostic submissions have been negative for bacterial and viral pathogens.

Personnel at the NWAC are developing a research protocol to continue the investigation of this phenomenon if it occurs next spring. Dr. David Wise and Dr. Jeff Terhune will be placing cages of specific pathogen free fish into diagnosed ponds to determine if the problem is an inducible disease. Dr. Lester Khoo will provide diagnostics, histology studies, virology determinations, and disease challenges. Dr. Jim Avery and Mr. Jim Steeby will be assisting producers with presumptive diagnosis and helping to coordinate out-field research.

Producers can play a significant role in assisting the Center's attempts to understand the cause of these losses. If you feel that your farm is experiencing these types of losses next spring, please submit fish to the Center for diagnosis. This will help us to document the distribution and prevalence of losses and provide researchers the material on which to conduct the experiments.

NWAC News is edited by Jimmy L. Avery. This publication is bi-annual and is available free upon request.

NWAC Coordinator's Comments

Ed Robinson

We are well into our second year of operation of the NWAC and everything has gone as well as could have been expected. Several new scientists have been hired and new programs have been implemented in concert with the needs of the catfish industry. We are extremely fortunate to have the resources that we have, and we are indebted to the catfish industry for making the Center become a reality. We thank all of you for your support and pledge to do everything humanly possible to provide solutions to your most pressing problems. While many industry problems remain unsolved, we are making progress. We ask for your continued support and patience.

As of July 1, 1999 on-campus aquaculture scientists in the Department of Wildlife and Fisheries were given appointments to the NWAC. The individuals are Dr. Lou D'Abramo, Dr. John Hargreaves, and Dr. Anita Kelly. Each of these individuals are exceptional scientists and are a welcome addition to the NWAC faculty. The NWAC will assume management responsibilities for the aquaculture facility located on the south farm on main campus. This move will further strengthen our aquaculture program and enable us to better serve our clientele.

Dr. Jimmy Avery has taken on the task of editing our newsletter. We are fortunate to have someone with Jimmy's capabilities as editor. I am sure you will see an improvement in the newsletter under his leadership. If you have comments or suggestions, please give Jimmy a call or better yet come by to visit.

New Personnel at the National Warmwater Aquaculture Center

Harriet Greenlee

Dr. Jimmy Avery, Associate Extension Specialist – Aquaculture, will provide technology transfer, presumptive diagnostics, as well as assist commercial fish farmers to assess needs, develop, implement, and evaluate educational programs. Dr. Avery had been with the Louisiana Cooperative Extension Service for the past 14 years. He obtained his Ph.D. from Louisiana State University in Wildlife and Fisheries Science.

Dr. Patricia (Pat) Gaunt has recently been appointed as Assistant Professor with the CVM in the Fish Diagnostic Laboratory. Dr. Gaunt served as an intern at the NWAC from July 97-98 and worked as a toxicologist for the USEPA the following year. She received her DVM and Ph.D. in toxicology from Louisiana State University. Her research interests include development of pharmaceutical drugs for aquaculture.

Dr. Bruce Manning has joined the staff as the Tom L. Reed, III Post-Doctoral Assistant working in the area of catfish nutrition and feeding research. Dr. Manning received his Ph.D. in Fish Nutrition from Auburn University. He has extensive research experience in the area of animal science.

Dr. Doug Minchew has recently taken the position of Assistant Fishery Biologist in the area of Harvest Technology/Fish Behavior. The area of fish behavior is relatively new, with the focus centering on the relationship between behavior and environmental factors, feeding, and fish health. He will also assist in the technology and development of the electrical seine and work on fish transport. Dr. Minchew received his Ph.D. in Zoology from Mississippi State University and has 9 years research experience as well as 18 years experience as a fish farmer.

Dr. Dan Nonneman, Research Molecular Biologist in the Catfish Genetics Unit, is working to develop genetic linkage and physical maps for channel catfish. He will characterize polymorphism and gene expression at candidate loci that correlate with phenotype in select populations. He was previousely a Research Animal Physiologist with the ARS US Meat Animal Research Center in Clay Center, Nebraska. Dr. Nonneman received his Ph.D. in Pathiobiology from the University of Missouri - Columbia.

Dr. Jeff Terhune, Assistant Fishery Biologist, is developing a comprehensive research program in fish immunology and fish diseases to support the ongoing fish health management program. He gained valuable hands-on experience as Area Extension Agent – Aquaculture working with producers in east Mississippi. Dr. Terhune received his Ph.D. in Microbiology from Clemson University.

Dr. Les Torrans, Research Fisheries Biologist in the Catfish Genetics Research Unit, is conducting research on the impacts of water quality on catfish growth. He has a great deal of international experience as an aquaculture consultant, as well as research, teaching, and administrative experience. Most recently he helped to operate a catfish farm in Alabama. Dr. Torrans received his Ph.D. in Zoology from the University of Oklahoma.

Dr. Paul Zimba, Research Microbiologist in the Catfish Genetics Research Unit, is conducting research on water quality with a major emphasis on off-flavor and other problematic algae. For the last three years, he has conducted research on channel catfish off-flavor at the USDA Southern Regional Research Laboratory in New Orleans, Louisiana. Dr. Zimba received his Ph.D. in Biology from Mississippi State University.

Strategies for the Use of Diuron

Jim Steeby

The Environmental Protection Agency has approved the use of diuron in commercial catfish ponds in Mississippi, Arkansas, Alabama, and Louisiana under a one-year emergency exemption. Diuron, when used according to label directions, effectively blocks the growth of a certain blue-green algae species that causes "blue-green" off-flavors in catfish. It has been estimated that as much as 75% of off-flavor occurrences can be attributed to these "blue-green" off-flavors.

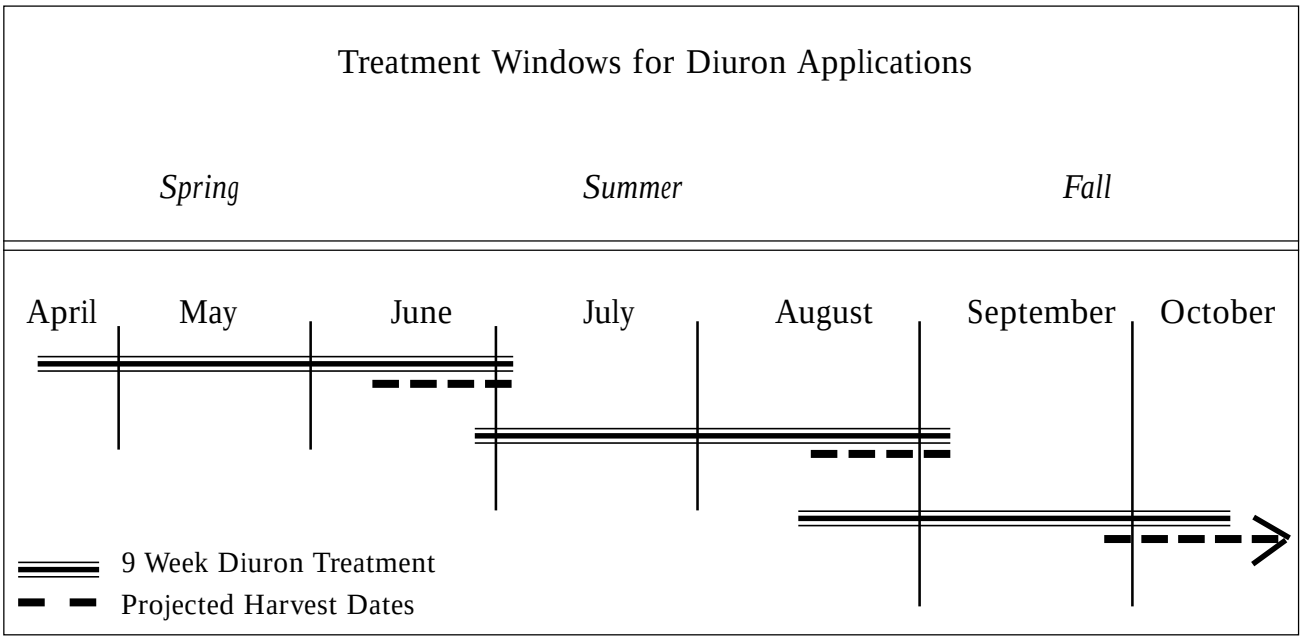
The objective of a diuron application is to prevent the growth of problem algae long enough to allow the fish to be harvested. Based on label restrictions, diuron can only be applied to a pond (or group of fish) 9 times per calendar year. This makes the timing of application an important consideration. Computer software programs such as "FISHY 99" (available free from the Mississippi State University Extension Service) allow producers to predict expected harvest dates and time diuron applications accordingly.

An example of application timing is illustrated in the table below. Since the algae that causes "blue-green" off-flavor grows at water temperatures above 60° F, application of Diuron prior to April 1 or later than November 1 would not be recommended as water temperatures during this period are historically less than 60° F. Ponds that should be harvested in late June or early July would be started on the treatment program in late April or early May. Ponds with expected harvest dates in mid to late August would be treated beginning in mid June. Ponds expected to be harvested in fall or winter would be started in late July or early August.

Fish identified as being "blue-green" off-flavor will likely not be ready for market until several weeks into a diuron treatment regimen. The problem algae must first be reduced and fish allowed to purge. Producers should be ready to harvest fish as soon as they are determined to be "on-flavor". While ponds that have received the full 9-week regimen are likely to remain free of "blue-green" off-flavor for some period after treatments stop, other off-flavors may appear. Treatments should be discontinued if the pond is harvested prior to completion of the full 9-week regimen and future harvest is not expected for some time.

Fish that are moved from ponds receiving diuron treatment should not receive treatments in a subsequent pond that would exceed the total maximum of 9 treatments per calendar year. For example, fish that received 4 diuron treatments in pond A are then transferred to pond B. These fish should not receive more than 5 additional treatments in pond B that year. If you are purchasing fish larger than fingerlings be sure to ask if they have come from ponds treated with diuron in that year.

Keep good records of the amounts of diuron you purchase, and the dates and amounts used by pond. This could prove invaluable if there is ever a question of residues in your fish.



Proliferative Gill Disease More Prevalent Than Previously Thought

David Wise, Jeff Terhune, and Lester Khoo

Proliferative Gill Disease (PGD) has become one of the major diseases affecting the culture of channel catfish with pond mortality rates capable of approaching >50% in severe cases. In 1997, PGD constituted 22% of the fish disease cases submitted to the Mississippi State University fish diagnostic laboratory at Stoneville, Mississippi. PGD is characterized by swelling of the gills and lesions in the cartilage of the gill filaments, resulting in severe necrosis of the gills and the inability to properly regulate the exchange of ions and oxygen across the gill membrane. Although the causative agent of the PGD has not been confirmed, it is has been linked to the myxosporean parasite *Aurantiactinomyxon ictaluri*. The oligochaete "worm", *Dero digitata*, which inhabits the sediment of catfish ponds, is an intermediate host for the parasite; however, other phases of its life cycle remain unknown.

In general, catastrophic losses occur mainly in fish that have been most recently stocked into food-fish production ponds. In many cases, mortalities may even take place within the first 2 weeks of stocking without visible signs of the disease occurring in the older fish remaining in the pond. These types of losses frequently occur during the spring when PGD is most active. Currently, there is no effective treatment for PGD, nor is it known how certain catfish production practices affect the occurrence of the disease.

The Fish Health Management Program at the NWAC has successfully developed a protocol to determine the severity of PGD in ponds. The protocol calls for floating net-pens stocked with 10, 4-8 inch specific pathogen free fish to be placed in ponds diagnosed with PGD. The fish are removed from the pond 7 days after stocking and returned to the laboratory for examination. Gill tissue is removed from five fish and preparations are made for both wet-mount and histological examinations. In wet-mount observations, the severity of PGD is defined as the percent of gill filaments observed with "holes or breaks" in the filamental cartilage. Based on past studies and observations, 1-5% of gill filaments with lesions represents a low infection rate, while 6-15% of gill filaments showing lesions is a moderate infection and maybe associated with an increased risk in mortality of newly stocked fish. Lesions in >15% of the filaments after 7 days is ranked as a severe infection and is usually followed by death within one to two weeks. For the histological examinations, severity is based on a graded evaluation of the pathological changes that occur in the gill tissue.

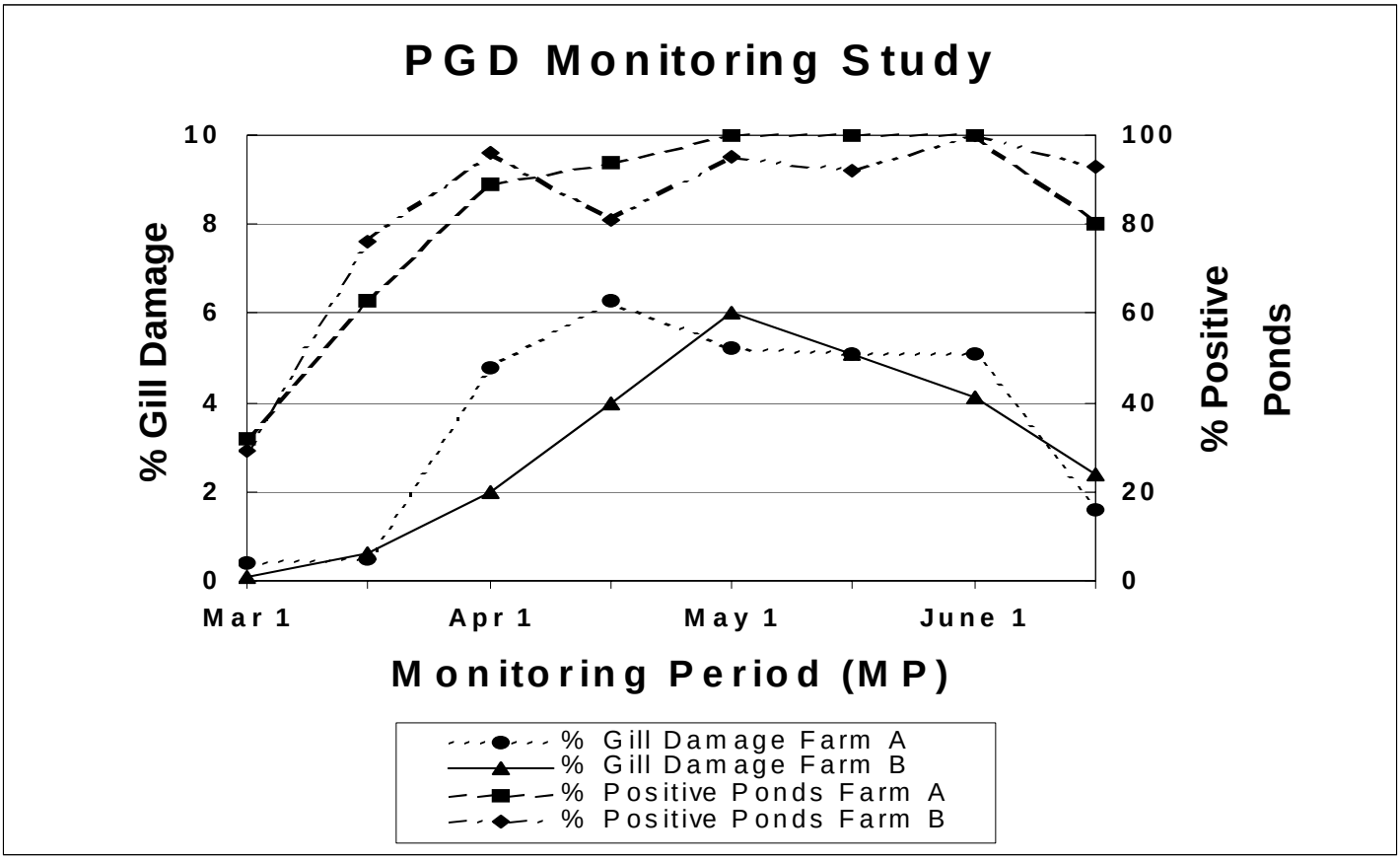
Table 1. Percent of positive PGD ponds categorized by severity of outbreak. Severity is ranked as low, moderate, or high and is based on the percent of gills observed as having damage in the cartilage filaments.

MP	Farm A			Farm B		
	Low (1-5%)	Moderate (5-15%)	High (>15%)	Low (1-5%)	Moderate (5-15%)	High (>15%)
March-1	100%	0	0	100%	0	0
March-15	100%	0	0	100%	0	0
April-1	64%	26%	10%	92%	8%	0
April-15	43%	50%	7%	53%	47%	0
May-1	58%	39%	3%	52%	38%	10%
May-15	62%	33%	5%	52%	48%	0
June-1	53%	47%	0	67%	33%	0
June-15	100%	0	0	100%	0	0

Beginning the first week of March 1999, 61 food-fish production ponds on two farms in the Mississippi Delta were incorporated into a "PGD Monitoring" study. Fish were stocked into each pond and examined as described in the protocol. All ponds were stocked and monitored twice a month (every other week) from March-June 1999. On Farm A, the severity of the disease (based on wet-mount observations) increased every monitoring period (MP) in the months of March and April, peaking in the April-15 MP. The severity remained constant throughout the month of May and the June-1 MP, with a marked decrease on the June-15 MP. The same general pattern developed on Farm B as on Farm A with the severity peaking on the May-1 MP followed by a decrease through the end of June. Although the overall average severity was relatively low for a given MP, the results were extremely variable from pond to pond as shown in the accompanying table. For example, on Farm A during the April-1 MP 10% of the ponds were classified as having a severe infection representing a significant risk to production. Based on previous studies, stocking fish under those conditions would likely result in moderate to high losses of recently stocked fish. The percent of ponds with positive PGD lesions in at least one fish also increased every MP until May, when 100% of the ponds proved positive for PGD. The June-15 MP showed a decrease in percent positive ponds from 100% to 80%. Again, Farm B followed a similar pattern as Farm A with the percent of positive ponds increasing from March to April and remaining relatively constant throughout the rest of the MP.

Based on this protocol, we suspect that all intensively managed foodfish production ponds undergo a PGD infection, varying in severity. This protocol appears to be an accurate method to monitor the severity of PGD and can be used to help minimize the risk of stocking fish in the spring or following PGD associated losses. Presently, it is not known what factors lead to severe manifestations of the disease, nor how mild infections contribute to other production components such as feeding performance or the outbreak of other diseases like Columnaris or ESC.

An expanded monitoring project is being planned to gain better understanding of the severity of PGD outbreaks and associated pond factors. The objectives of this project are to correlate pond environmental factors and farm management practices (including treatments) with the severity of PGD and to make a predictive model of PGD severity through these correlations and seasonal variabilities within ponds. The monitoring project will include 20 ponds with 18 MP over the course of one year (two per month in the months of March-June and October-November and one per month in the other six months). Data from the MP will then be statistically correlated to production practices. Hopefully through this and other studies, information on this disease will become available that will lead to treatments and/or methods on managing around the disease.



Effect of Protein Level on Dressed Yield and Production of Channel Catfish

Edwin H. Robinson, Meng H. Li, and Brian Bosworth

Although numerous studies have been conducted on the use of 28% protein feed for pond-raised catfish, this subject is still under debate among catfish producers. Research conducted at NWAC and other institutions has demonstrated that dietary protein concentration in catfish feeds can be reduced from the 32% that has been traditionally used in commercial catfish feeds to 28% without significantly affecting fish growth, dressout, or body composition. Some commercial producers have been feeding the 28% protein feed for several years without detrimental effect on fish production. However, there are anecdotal reports that fish fed a 28% protein feed may not grow out quite as well and that processing yields may be reduced as compared to a 32% protein feed. In previous studies, we hand-dressed fish to determine dressed yield, which might have affected the results. Therefore, a study was conducted to compare carcass and fillet yields between catfish fed a 28% and 32% protein diet using processing equipment similar to that used in catfish processing plants.

Catfish fingerlings (average weight: 88 lb/1000 fish) were stocked into 10 1/10-acre ponds at a rate of 7,500 fish/acre. Five ponds were used for each dietary treatment. Fish were fed either a 28% or 32% protein feed to satiation once daily from May to October 1998. Ponds were managed in a similar manner as in commercial catfish production. At the end of the study, all fish were harvested, counted, and weighed. Thirty fish from each pond were weighed individually and deheaded using a deheading machine, eviscerated by hand, and visceral fat removed and weighed. Then the carcass was skinned using a skinning machine and weighed. Finally the carcass was hand-filleted by trained employees from a local processing plant to mimic commercial catfish processing. Percentage visceral fat and carcass, fillet, and nugget yields were determined.

Results show that there were no significant differences in percentage visceral fat or in carcass, fillet, and nugget yields between fish fed a 28% and a 32% protein feed (Table 1). No significant differences were observed in feed consumption, weight gain, or survival between catfish fed the two feeds (Table 1). Feed conversion ratio was lower for fish fed the 28% protein diet. This response is inconsistent with those of other studies that we have conducted and probably does not reflect a true effect of diet. There is no reason to expect fish to convert the 28% protein diet any better than a 32% protein diet.

Data from this study support that from numerous other studies that have demonstrated that a 28% protein feed is not detrimental to catfish production or processed yield. Even though current feed prices are relatively low, using a 28% protein feed will still result in considerable savings on feed costs.

Table 1. Mean weight gain, feed consumption, feed conversion ratio (FCR), survival, and carcass, fillet and nugget yields of catfish fed a 28% or a 32% protein diet. Means within a column followed by different letters were different (Least significant difference test, $P \leq 0.05$).

Dietary protein (%)	Feed consumption (lb/fish)	Final Weight[1] (lb/fish)	FCR	Survival (%)	Visceral Fat (%)	Carcass	Fillet	Nugget
28	1.44	0.93	1.70b	96.3	3.09	60.3	36.1	8.9
32	1.39	0.88	1.77a	96.7	3.05	60.4	35.8	9.0

[1]Mean initial weight was 88 lb/1000 fish

New Research Project on Water Quality and Catfish Production

Les Torrans and Paul Zimba

One major obstacle hindering growth of commercial catfish operations is managing pond water quality to maximize economic gain. The direct and indirect losses from poor water quality are staggering. Nearly half of the potential farm gate revenue is lost annually due to low oxygen and a variety of environmental and pathogenic diseases directly related to the stresses of poor water quality. Also, problems associated with "off-flavor" have been estimated to cost the industry at least 20% of the additional market revenue possible.

The USDA ARS Catfish Genetics Research Unit at the NWAC recently hired Dr. Paul Zimba and Dr. Les Torrans to develop a new research project addressing these issues. The project will focus on the impacts of water quality on production and off-flavor in commercial catfish ponds.

Dissolved oxygen is the most critical water quality parameter in warmwater aquaculture. While monitoring and control systems are available and aeration costs are low relative to net production, we know little about the effects of low and/or varying oxygen levels on the overall metabolic efficiency of catfish. Once the impacts of oxygen on food consumption, feed conversion, growth rates and disease resistance are quantified, and the modifying roles of factors such as temperature, pH, ammonia, carbon dioxide, and various respiratory pathologies are known, the economic management decisions with respect to aeration can be made.

The feeding rates used with intensive catfish production result in dense algal blooms during most of the growing season. While these blooms help to recycle nutrients in the pond and provide most of the oxygen required for fish respiration, poor water quality conditions may result from the presence of harmful algal species. Some blooms are unstable and can "crash" overnight. Some species of algae cause toxic blooms, killing the fish directly, and others produce compounds in the water that cause off-flavor. Understanding the conditions necessary for these species to bloom, and the physical/chemical/biological relationships correlated to/related to bloom proliferation will allow control points to be determined.

The overall goals of this project may be summarized as follows:

1. To understand the impact of the combination of water quality parameters on catfish metabolism, and ultimately on the efficiency of food conversion, growth and production;

2. To establish sound biological data to base economic decisions related to aeration practices such as placement, number of devices, hours of operation, etc.;

3. To determine if remote sensing technology can play a role in monitoring and detection of problem algal growth as well as the response of fish to various environmental conditions;

4. To better understand the conditions that promote blooms of problem algae and the mechanisms they employ to produce offensive secondary metabolites such as toxins and off-flavors, and to develop practical methods of prevention and control.

Although this is a relatively new project, one study is underway examining the impacts of diuron on off-flavor and secondary water quality effects in 15 one-acre ponds. Additional projects are at various stages of development.

Catfish Farmers of Mississippi to Sponsor Fall Seminar Program at NWAC

The Catfish Farmers of Mississippi will sponsor the NWAC's Fall Seminar Program on November 11, 1999. The program will be held in the B.F. Smith auditorium at the Delta Research and Extension Center located in Stoneville, Mississippi. The event will begin at 10:00 a.m. and conclude around 3:00 p.m.

The seminar will include topics such as the economics of copper sulfate use, a new trematode in channel catfish, effects on dressed yield of catfish, and other fish farming issues. Those planning to attend are asked to call (662) 686-3242. A lunch will be provided by CFM.

Farm/Processor Price Spreads in Catfish Markets

Darren Hudson[1] and Terry Hanson

A study looking at the difference between farm prices and wholesale price for catfish fillets and whole fish has recently been completed. Using 1987 to 1998 price data for whole fish, filleted fish, farm price and processor wage rates, computer models were developed to explain pricing methods. The results have implications for processors, catfish farmers, and consumers.

Two basic findings are apparent. First, catfish processors appear to use a simple percentage mark-up pricing relationship, a finding consistent with earlier studies. Second, the difference between farm prices and wholesale prices appears to have been significantly lowered.

[1]Dept. of Agricultral Economics

One reason for the lowered difference is technical innovation and adoption of cost-saving technologies by processors. Specifically, technology adoption in fillet processing and decreased reliance on labor has reduced processing costs. Lower wholesale prices suggest that the benefits of these technologies have been passed on to consumers.

Another factor influencing the downward pressure on farm to wholesale price margins is competition brought on by an increase in the number of processors. National Agricultural Statistic Service data shows there were 10 to 12 processing firms in the early 1980's compared to about 30 firms in the early 1990's. New catfish processors have tended to lower wholesale prices, especially for fillets.

This has implications for existing catfish processing firms. As the market for catfish continues to expand and new processing firms enter the market, price spreads are expected to decrease. This means that existing firms will have to continue to increase technical efficiency and decrease processing costs in order to compete with incoming firms.

What these results mean to catfish farmers is that pond bank prices are a greater portion of the wholesale price of whole and fillet than in the past. For consumers, these findings suggest that processor competition and technology innovation result in lower relative catfish prices in the stores.

Cormorant Roost Dispersal Program Seeks Assistance

The USDA Wildlife Services (WS) agency works to resolve conflicts between wildlife and human activities. In 1996, catfish producers from 15 states reported $11.5 million in losses to wildlife. The average loss reported per operation was $13,700 while producers claimed an average expense of $6,200 to prevent such losses.

In Mississippi, WS works closely with aquaculture producers in site-evaluations and developing a damage management strategy. The strategy usually consists of techniques (lethal and non-lethal) designed to minimize losses caused by fish-eating birds. One such non-lethal technique is the cormorant roost dispersal program. The program is a cooperative effort between WS, Aquaculture producers, hunting clubs and landowners. The program was first implemented in the fall of 1993 and has proven successful in dispersing cormorants out of the aquaculture producing region of the Mississippi Delta. More participants are needed to improve the effectiveness of this important program. If you are interested and would like to know more about the program, please call Greg Ellis at the WS office in Stoneville, Mississippi at (662) 686-3157.

Mississippi State University

Mississippi State University and U.S. Department of Agriculture Cooperating