THAD COCHRAN

NWAC NEWS

NATIONAL WARMWATER AQUACULTURE CENTER

Volume 3, Number 1 June, 2000

Inside this Issue:

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

Investigations into Biological Control of a Parasitic Trematode in Commercial Catfish Ponds

Anita M. Kelly

Recently, an internal parasitic trematode, tentatively identified as *Bolbophorus confusus*, has been found in channel catfish from Louisiana, Arkansas and the Mississippi Delta (see NWAC News, November 1999). A survey of 360 commercial catfish ponds in the Mississippi Delta revealed mainly mild infections with a majority of the ponds surveyed being negative. However, isolated ponds on these farms experienced severely compromised production and large economic losses. In young fish, the parasitic trematode can be fatal and can cause severe losses of young fish or fingerlings.

The life cycle of this parasite is believed to begin in the white pelican, move into the ram's horn snail and from there infect catfish in commercial production ponds. Once a sufficient number of trematodes infect larger catfish, the fish appear to have diminished appetites causing them not to grow as well as uninfected fish. However, the trematode is much more devastating to smaller fish. The parasite develops under the skin of the fingerlings causing liver and kidney damage and kills many of the infected fingerlings.

Currently, there are no FDA approved therapeutic treatments for trematode infections in catfish. Therefore, control is dependent on breaking the life cycle of the trematode by eliminating or at least reducing the presence of the intermediate or final host. Controlling the snail population appears to be the best strategy. Hydrated lime or copper sulfate applications near the pond edges seem to offer some form of snail population control. However, researchers at the NWAC's Eastern Research Unit (Starkville) are evaluating the effectiveness of biological control species to reduce snail populations.

Researchers will examine the efficiency of triploid black carp, redear sunfish, freshwater drum, the redear x bluegill hybrid, and freshwater prawns for controlling snail populations in commercial catfish ponds. The black carp is known to prey on snails often eliminating them in ponds. Because the black carp is not native to Mississippi waters, triploid fish will be used. (Triploid fish are considered sterile and will not reproduce in the wild.) The black carp will be used as a comparative reference for the other species. The redear sunfish, freshwater drum and redear-bluegill hybrids are also known to eat snails.

continued on page 11

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

I have heard many discussions concerning feed conversion of catfish. One common question is why feed conversion ratios (feed/gain ratio) from research studies, which may be as low as 1.5 but are generally always under 2.0, differ so greatly from those typical of commercial catfish operations, which range from 1.8 to 3 or more. Most suggestions generally center around the fact that small ponds are used for research studies. The argument is that it is easier to manage dissolved oxygen and other water quality variables and feed is more widely dispersed and readily available to the fish. There is some small improvement in feed conversion because smaller ponds are easier to manage, but in reality this cannot explain the magnitude of the differences in feed conversions observed between fish raised commercially and in research. The truth is that if the feed is eaten conversion efficiency of catfish is about the same in large or small ponds under a wide range of environmental conditions. The confusion lies in the semantics. Researchers generally report an actual (physiological or biological) conversion ratio that accounts for the weight of fish that died during the growing season. On the other hand, catfish producers generally speak in terms of feed bought and fish sold or what I would term more of an economic measure than a physiological one. Fish that die on a commercial catfish farm convert part of the feed but the gain does not show up as revenue; thus, the feed conversion ratio is effectively increased. So one reason that feed conversion ratios between research and commercial culture is different is fewer fish are lost in research ponds and losses are accounted for, which leads to lower apparent feed conversion ratios. The lower mortality rate is not because researchers are better at managing diseases, but simply due to the way research is conducted. Most research projects are conducted over relatively short periods of time, which provides less opportunity for disease outbreaks to occur. Also, for some unknown reason, infectious diseases seem less common and less severe in small ponds. And finally, when they do occur, diseases are more easily managed in small ponds.

New Personnel at the National Warmwater Aquaculture Center

Harriet Greenlee

Mr. Charles Hogue will provide technology transfer, presumptive diagnostics, and assess needs, develop, implement, and evaluate educational programs to address fish health, water quality, production, and other management related problems in the East Mississippi area. Mr. Hogue received a B.S. degree from MSU and has over 14 years of experience in commercial catfish production.

Dr. Brian Small, Research Physiologist with the Catfish Genetics Research Unit, works in the area of catfish physiology and reproduction. Dr. Small received his Ph.D. from the University of Maryland-College Park. The major emphasis of his doctoral research was the physiological control of growth and the identification of predictive criterion for selecting superior growing striped bass.

Dr. Charles Mischke, Assistant Fishery Biologist, has recently joined the staff to work in the area of water quality and off-flavor. Dr. Mischke received his B.S. degree in Fisheries Management from Mississippi State University, graduating magna cum laude, and obtained his Ph.D. in Fisheries Biology from Iowa State University.

Farming of Red Swamp Crayfish - New Approaches, New Horizons

Lou D'Abramo

Crayfish farming in Mississippi has declined dramatically over the last 20 years. Farmers in Mississippi have been unsuccessful in implementing the flood-drain-flood management practice that is characteristic of crayfish farming in Louisiana. This practice incorporates the planting of a forage, generally rice, that may or may not be harvested as a crop. Decomposition of the forage stimulates the production of food for crayfish. Farmers in Mississippi found that costs of the Louisiana-style operation that they had adopted often exceeded revenue. Many crayfish farmers in Mississippi could make more money purchasing crayfish from Louisiana and returning to Mississippi to sell them, rather than selling their own farmed crayfish. Two factors that led to the economic difficulties of crayfish farming in Mississippi were improper management techniques that resulted in low yields and a crop that became available when production levels peaked in Louisiana and lower prices resulted.

Over the past ten years, research at the NWAC's Eastern Unit has focused on developing a crayfish farming system that is based on a continuous flood without planted forage. The goal is to establish a semi-intensive system of farming that is more controlled and sustainable than the farming system currently practiced in Louisiana. Water depths for this non-traditional system are similar to those in commercial catfish production ponds. The depth of Louisiana-style crayfish production ponds rarely exceeds 18 inches resulting in extreme fluctuations in temperature and dissolved oxygen levels. A commer-

continued on page 7

Feed Intake of Large and Small Fish in Mixed Size Populations

Jeffrey T. Silverstein and Don W. Freeman[1]

[1] Stuttgart National Aquaculture Center, Stuttgart, AR

Sample size, weight of fish and feed consumption (as a % of body weight) and percent of the total feed consumed by each size group for each of the sample dates.

Date	Size	n	Weight (lbs)	% BW consumed	% of Total consumed
June 21, 1999	Small	289	0.69 ± 0.02	0.96 ± 0.06	46.0 ± 4.5
	Large	274	2.04 ± 0.03	0.40 ± 0.02	54.0 ± 4.5
Sept. 2, 1999	Small	199	0.87 ± 0.03	0.83 ± 0.07	39.2 ± 3.2
	Large	254	2.73 ± 0.04	0.42 ± 0.03	60.8 ± 3.2

In the Mississippi Delta catfish production generally follows a multiple batch cropping strategy where market-size fish are graded off for harvest and fingerlings are stocked back into the pond. It is therefore common to have ponds with a wide range of fish sizes. During cooler months, April and May, fish may be fed to satiation, but as temperatures rise in July and August, feeding is often restricted because of water quality concerns. The efficiency of feeding and growth in this multiple batch system has been questioned because of the potential for competition between larger near-harvest size catfish and smaller fingerlings. To determine if feed intake was affected by fish size, we conducted a study using labeled feed.

Two size classes of fish, small (average weight, 0.44 pounds) and large (average weight, 1.5 pounds) were stocked 1:1 into three replicate ¼ acre ponds at the rate of 8000 fish per acre at the Agriculture Research Service catfish facility in Pine Bluff, Arkansas. Fish were fed daily with a 28% protein floating feed. On the two sampling days fish were fed an experimental 28% protein floating feed prepared with glass beads containing lead-oxide. The beads were mixed in at a low concentration (1%) of the feed prior to extrusion. The glass beads show up well on x-rays. The number of beads per unit feed weight was determined in a standard curve.

On June 21, 1999, approximately 3 weeks after the ponds had been stocked, the fish were fed to satiation (20.9 pounds per pond) with the labeled feed. At least 1 hour after the fish had been fed, the ponds were seined to capture the fish and a large scoop net ("super scoop") was used to catch a random sample of fish from the seine. The fish were anesthetized and then weighed and x-rayed with a small portable x-ray unit. Over 150 fish from each pond were measured. The number of beads in each fish's stomach was counted and converted to weight of feed consumed, and then feed consumption was expressed as feed consumed (pounds) per 0.22 pounds body weight (percent consumption).

A similar protocol was followed on September 2, 1999. Labeled feed was delivered to each pond, and limited to 121 pounds per acre (31 pounds per pond). The fish appeared satiated with this amount of feed. Fish were individually weighed and x-rayed.

The size distribution of the fish sampled in June was bimodal and showed that a good random sample of fish had been caught with the "super scoop". Feed intake (percent consumption) was more than twice as high, 0.96 ± 0.06 vs. 0.40 ± 0.02, in smaller fish (weight range 0.07 to 1.36 pounds) than in large fish (weight range 1.37 to 4.51 pounds).

The September sample also showed a clear bimodal size distribution (small fish 0.02 to 1.68 pounds; large fish 1.69 to 4.41 pounds) and the percent consumption was again nearly twice as high in the smaller size group than the larger size group (0.83 ± 0.07 vs. 0.42 ± 0.03).

These results suggest that smaller fish introduced to multiple batch systems are able to eat and grow. Nevertheless, such studies have not yet been done in large ponds, and in this study feed was not restricted. The fish behavior and interactions in a larger area, and under feed restrictions may be different.

Annual Fish Diagnostic Laboratory Report for 1999

Lester Khoo

It was another busy year for the Fish Diagnostic Laboratory at Stoneville. We appreciate those who have utilized our facilities and hope that we can continue to provide the services you need. The staff of research assistants and interns performs a large portion of the work of this laboratory and this report is no exception. Ms. Cyndi Ware has diligently reviewed the case submissions in the preparation of this report. This was an arduous task as there were 2225 cases submitted to the laboratory (an increase from 1920 cases in 1998).

Definitions for cases and disease entities are similar to previous summaries. Routine diagnostics include gill clips, fin and skin scrapes, examination of the external and internal lesions, touch impressions of internal organs (when indicated), as well as bacterial cultures of the brain and posterior kidney, viral cultures of the spleen, posterior and anterior kidney, and histopathology. Each case represents the fish submitted from one pond for that day. The following criteria are used in arriving at the diagnosis for each case.

- Enteric septicemia of catfish (ESC) – the isolation of *Edwardsiella ictaluri* on blood agar from brain and posterior kidney cultures.

- Columnaris – isolation of *Flavobacterium columnare* on dilute Mueller Hinton agar or upon microscopic identification of the typical slender filamentous bacteria on skin, fin or mouth scrapes or gill clips of fish with the characteristic necrotic lesions. The latter is reported as external columnaris in our client reports but have been grouped together with the positive cases for this report.

- Proliferative gill disease (PGD) or Hamburger gill – microscopic identification of breaks in the gill cartilage of wet mount or on histopathology sections.

- Channel catfish virus disease (CCV) – the presence of cytopathic effects in channel catfish ovary cell cultures inoculated with suspensions of spleen, posterior and anterior kidney.

- Channel catfish anemia (CCA) – condition where packed cell volume (PCV) is less than 10% in stocker and food-sized fish.

- Saprolegnia (winter fungus) – microscopic identification of typical fungal hyphae from gill clips or fin/skin scrapes.

- Branchiomyces (gill fungus) – microscopic identification of typical fungal hyphae that are usually deep within the gill tissue (especially blood vessels).

- Trematode – microscopic identification of metacecariae from subdermal nodules or nodules on internal organs. These cases only reflect the trematode, *Bulbophorus confusus* and do not take into account the other species of trematodes such as *Clinostomum* (yellow grub).

As a whole, similar trends were seen last year when compared to the previous years. Bacterial diseases were the predominant diagnoses among the case submissions. There were 913 cases of columnaris out of the 2007 farm cases (45.5%) which is fairly similar to 1998 where 44.8% of the cases were columnaris. There were 826 cases of ESC, which represents exactly the same percentage (41.2%) as in 1998. PGD was the third most common diagnosis with 602 cases or 30 % of all farm cases. This is an increase from 1998 (16.3%) but is similar to 1997 (28.6% of all farm cases). Saprolegnia was the fourth most common diagnosis with 175 cases (8.7 %). Although weather (water temperature) plays a major role in the incidence of diseases in catfish ponds, some of the observed diseases did not correlate well with the fairly warm and extended summer we experienced last year. (As in previous years, the water temperatures used in the graphs were mid-morning values collected from 35 ponds at 4 different locations in Humphreys, Sunflower and Washington counties). There were only 36 cases of CCV (a disease that is associated with high water temperatures) compared to 51 cases in the previous year. There was a slight increase in anemia cases (53 compared to 49 in 1998) and Branchiomyces cases (12 compared to 7 in 1998).

An emerging disease entity recognized at our laboratory last year was caused by the trematode tentatively identified as *Bulbophorus confusus*. There were a

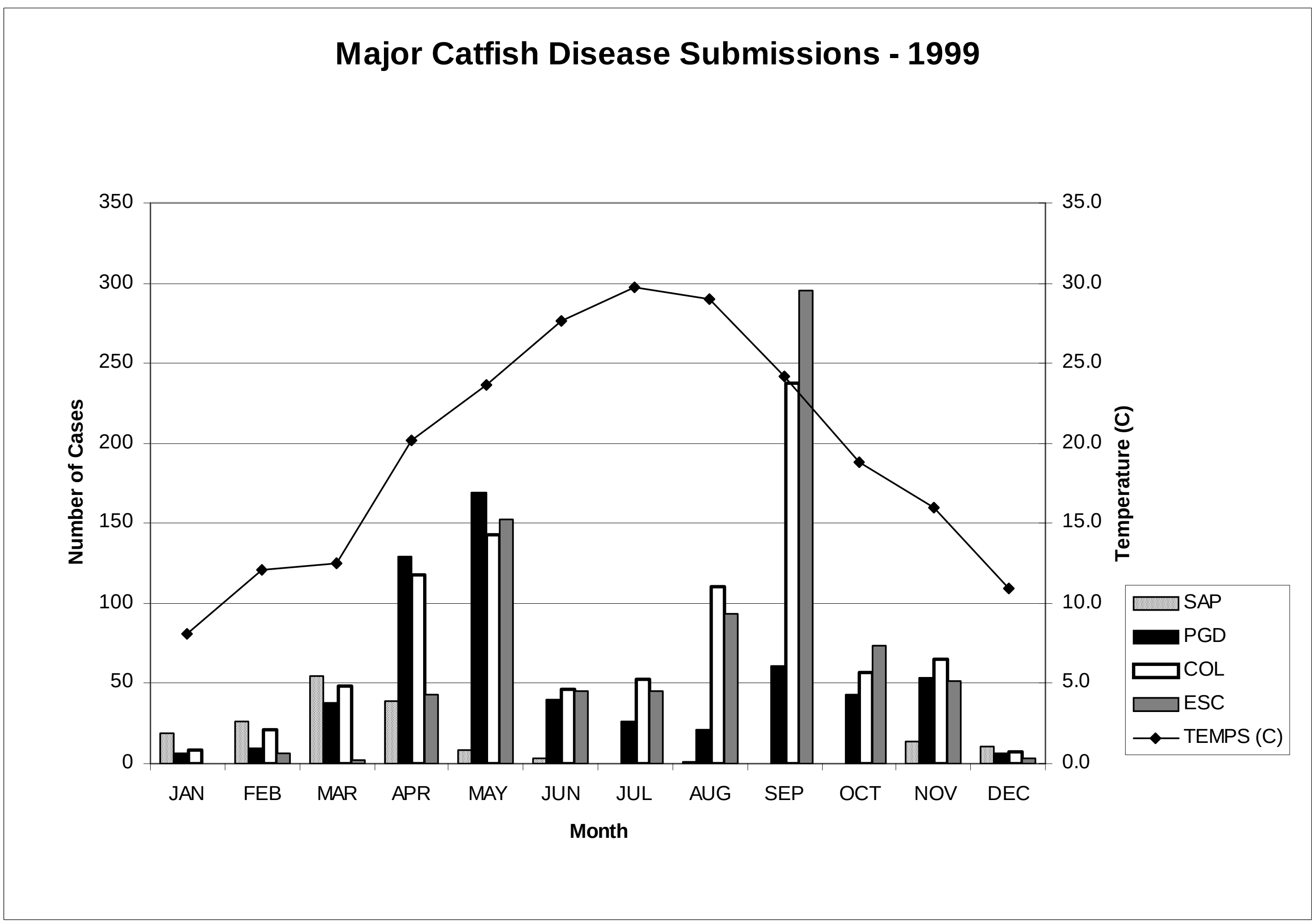
continued on next page

total of 34 trematode cases diagnosed with almost all submitted during the month of August. One disease entity that we recognized last year, which may not be captured in the disease summary, is Visceral Toxicosis of Catfish (see article in this issue). There were approximately 122 cases based on internal lesions (these fish usually do not have any external lesions). The first cases of this disease were submitted in early February and extended to April. Additional cases were submitted in November and December. These cases are part of the 305 cases referred to as disease checks, where we were unable to identify an infectious agent. Currently, based on negative viral and bacterial cultures and some laboratory experiments, the etiology of this syndrome is thought of non-infectious origin (i.e. most likely a toxin).

The numbers of water quality submissions were comparable with the previous year (823 from 345 farms versus 849 from 367 farms). Typically, total ammonia, nitrite, chloride, alkalinity, pH and hardness were the tests performed on these samples.

Despite the increase in case submissions, the numbers of bacterial cultures that were resistant to Terramycin and Romet remained low and similar to the previous years. In most cases, there was a slight decrease except for the two columnaris cultures that were resistant to Romet. There was a culture of *Pseudomonas* and one of *Aeromonas* that were resistant to Terramycin. (We do not typically report these infections as they usually occur in fish that are in fair to poor post-mortem condition and usually mixed in with *Edwardsiella ictaluri*). In both these cultures, *Pseudomonas* and *Aeromonas* were the predominant bacteria.

We hope that some of the explanations in this summary might provide an explanation to some of the questions that might arise from the report. However, should you have further questions that need clarification, please do not hesitate to contact us.



Management of Off-Flavor with Copper Sulfate

Craig Tucker and Terry Hanson

Off-flavor has been a major problem in catfish farming for more than 30 years, which points out what most catfish farmers already know: progress in off-flavor management has been painfully slow. Off-flavors can come from many different sources in ponds, so we may never eliminate all flavor problems in pond-raised fish. However, the most common off-flavors in catfish farming are caused by certain species of blue-green algae, and considerable control of flavor quality may be possible by focusing management efforts on that group of organisms.

In 1995 a Mississippi catfish farmer told us of his success at managing blue-green algae using frequent, low doses of copper sulfate. Later that year, we initiated a controlled study to determine the effectiveness of this practice. The study was funded by the USDA Southern Regional Aquaculture Center.

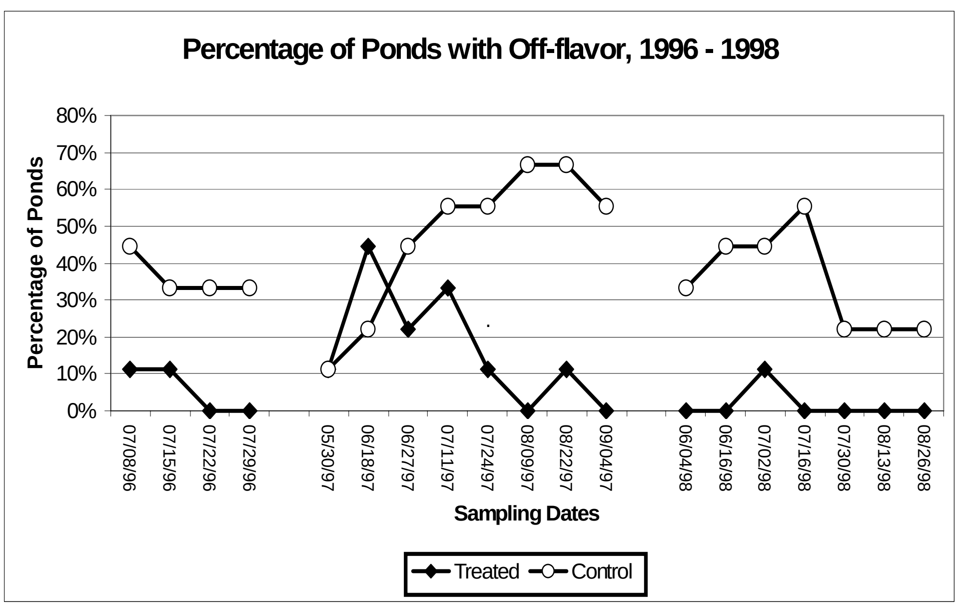
The study was conducted in eighteen, 1-acre ponds at the NWAC in Stoneville, Mississippi. The ponds were supplied with water from a well, and pond waters had moderately high concentrations of total alkalinity and hardness (100-200 ppm as calcium carbonate). Ponds were stocked with 10,000 channel catfish per acre in February 1996, and managed using common farming practices. Each spring when water temperatures increased above 70° F, half the ponds were treated weekly with 5 pounds of copper sulfate per acre. Treatment was made by placing the copper sulfate crystals in a double burlap bag and then suspending the bagged copper about 20 feet in front of a paddlewheel aerator. The water current produced by the aerator dissolved the chemical and distributed it throughout the pond. The aerator was operated until all the copper dissolved, which usually required about two hours. Treatments were made at about 11 a.m. every Monday until water temperatures fell below 70° F in the fall.

Over the 3-year duration of the study, copper treatment reduced the number of ponds with off-flavored fish by 80% compared to untreated ponds, although success varied from year-to-year and from one sampling date to another (see chart). Not only were there fewer off-flavor events in the copper-treated ponds, the events, when they did occur, tended to be of shorter duration than in untreated ponds. Because off-flavor events in copper-treated ponds were relatively rare and brief, fish harvest was never delayed in copper-treated ponds. Off-flavor episodes in untreated ponds were of highly variable duration. For example, off-flavors were never detected in fish from one pond while fish in another pond were off-flavor for nearly a year. Off-flavors delayed fish harvest on 10 occasions in untreated ponds.

While copper treatment had a positive effect on fish flavor quality, it had a negative effect on certain water quality variables. For example, average concentrations of nitrite were often higher in copper-treated ponds, but nitrite toxicosis (brown-blood disease) was prevented by adding salt to maintain chloride concentrations at approximately 100 ppm in all ponds. Copper-treated ponds also required about 20% more aeration during the summer. But, as indicated below, increased aeration costs were more than offset by increased receipts obtained by the higher production yields from the treated ponds.

Average annual fish harvest was 4,620 pounds per acre in untreated ponds and 5,260 pounds per acre in copper-treated ponds. The 12% reduction in fish harvest from untreated ponds was not caused by a systematic reduction in harvest from untreated ponds, but was due to infectious disease outbreaks in one or two ponds each year when harvest was delayed due to off-flavor. In other words, the occasional inability to harvest fish in a timely fashion exposed fish to a greater risk of loss to diseases and other causes.

continued on next page



Enterprise budgets showed that average annual net returns above variable costs were $569 per acre for untreated ponds and $848 per acre for the copper-treated ponds. Variation in net returns was twice as great for untreated ponds as for treated ponds, indicating increased stability in production and returns when using copper sulfate. High variation in annual performance of untreated ponds resulted from one or more ponds having very good net returns while one or more ponds had extremely poor returns due to protracted episodes of off-flavor. Stability in production and costs reduces risk and is a positive factor farmers can use to better plan their cash flow needs throughout the production season and in the longer term.

The results of this study were surprisingly good and indicate that periodic treatments with low doses of copper sulfate may be a useful management practice for catfish farmers. Keep in mind, however, that our study was conducted in relatively small ponds and observations were collected from only 18 ponds for three years. Similar results may not be consistently achievable in large ponds and results may not have been quite so spectacular if a large number of replicate ponds were studied over a longer time. Also remember that copper sulfate treatments will affect water quality and more aeration will be required in copper-treated ponds than in untreated ponds. Therefore, use copper sulfate only if you plan to harvest fish before fall and only if there is good reason to believe that fish will be tainted with blue-green off-flavors if no treatment were undertaken. Do not make routine copper sulfate treatments for algae control in fingerling ponds or in broodfish ponds (off-flavors are not a problem in those fish). And finally, do not use this treatment regimen in waters of low hardness and alkalinity (generally considered to be less than 50 ppm as calcium carbonate) because application of copper sulfate may stress or kill fish.

Crayfish

continued from page 2

cially manufactured diet replaces the food derived from the decomposition of the planted forage (a 32% crude protein, sinking catfish feed works well). Harvest is by trapping but the elimination of planted forage provides the added opportunity for a more active harvest by seine.

Results derived from research during the past ten years have identified best management practices that include type of feed, feeding rates, and harvesting strategies. Over the past four years, a mean annual production of 2,230 pounds/acre has been achieved and production in some ponds has exceeded 3,000 pounds/acre. (Annual production in Louisiana generally does not exceed 900 pounds/acre.) Part of the increase results from eliminating restrictions on harvesting caused by the draining, planting and flooding procedures. With a continuously flooded pond, an extended time for harvest becomes available. The higher annual yield compared to that obtained in Louisiana systems can also be attributed to a predictable supply of food. In many crayfish farming ponds in Louisiana, decomposition of the forage is generally complete by early spring and food resources are insufficient to continue to sustain the resident crayfish populations. In response to the lack of sufficient food, many crayfish cease to grow; therefore, the full production potential of a pond cannot be realized.

Last year, artificial substrate consisting of inexpensive plastic barrier netting, the type generally used around construction sites, was vertically orientated below the water surface throughout the water column. The total area of substrate introduced was equivalent to 50 % of the bottom surface area of the ponds. Annual yield increased by 36%, to 2,830 pounds/acre, compared to ponds with no substrate. Most of the yield can be attributed to a 24% increase in the number of harvested crayfish. This increase is probably due to lower occurrences of cannibalism as well as a decrease in the number of crayfish-to-crayfish encounters made possible by the presence by the substrate. The netting not only provides for crayfish dispersal in a vertical dimension but also serves as a substrate for the growth of different organisms that are food for the crayfish. As a result, the food conversion ratio in ponds with substrate is lower (approximately 1.5 pounds of feed to produce one pound of gain). Preliminary economic analysis indicates that the use of such substrate is cost-effective.

The market for crayfish has been principally located in Louisiana. From 1991-1995, Louisiana provided 90% of the national supply of crayfish, approximately 100 million tons annually. Between 70 and 90% of that production is consumed annually in Louisiana. However, consumer interest in Cajun cuisine and demand continues to increase in other regions of the United States. The continuous flood method of farming ensures crayfish availability from March through November and there is little overlap with Louisiana production that occurs from December through May.

This year, crayfish harvested from both the culture and capture fisheries in Louisiana is scarce. It is believed that last year's drought in Louisiana contributed to the death or stress of many female crayfish. At the time, these crayfish were in burrows where they had retreated in response to the routine draining of the ponds to prepare the pond bottom for planting of forage. As a result, crayfish are selling for at least $1.25/pound wholesale, considerably higher than the normal $ 0.40- 0.60/pound. Crayfish would not have been scarce if the continuous flood system without planted forage was being used.

continued on page 12

Nutrition Research Supported by the Southern Regional Aquaculture Center

Craig Tucker and Sarah Harris

In the first issue of the NWAC News (Volume 1, Number1, December 1998), we described the structure and function of the Southern Regional Aquaculture Center (SRAC). The SRAC is one of five USDA-funded regional aquaculture centers established to provide a mechanism for developing regional research and extension projects to solve industry problems. Mississippi State University is the host institution for SRAC, and the program is housed in the NWAC in Stoneville.

In this issue of the NWAC News, we will describe one of the many projects funded through SRAC. In future issues, we will provide summaries of other SRAC projects. You can also review SRAC activities through our website at http://www.msstate.edu/dept/srac. The website contains a variety of interesting items, including reports of all current SRAC projects and a list of all SRAC publications (which can be downloaded and printed).

Since the initiation of SRAC in 1987, three major research and extension projects in the area of aquatic animal nutrition have been supported by the Center. The first was a three-year project (1990-92) which studied the "Effect of Nutrition on Body Composition and Subsequent Storage Quality of Farm-Raised Channel Catfish." The project was conducted by participants from six universities in the southern region and was funded at $822,000. From 1994-1996, SRAC funded the project "Improving Production Efficiency of Warmwater Aquaculture Species Through Nutrition" which involved researchers at nine universities. This project was funded at $760,000.

Currently, SRAC is funding the three-year, $733,000 project "Optimizing Nutrient Utilization and Reducing Waste through Diet Composition and Feeding Strategies." The following is a brief summary of the work conducted to date on the project, which is nearing completion of its third and final year.

CHALLENGE

Nutrition and feeding costs are the largest operating expense in fish farming. Expenses include not only the cost of the feed but also the manpower and equipment needed to deliver the food. Another, less obvious, cost associated with feeding is the cost of dealing with water quality problems that are indirectly related to feeding practices. Protein is a major component of the costs of feed ingredients and the component which contributes nitrogen to the water either from uneaten food or fish wastes. Two areas that offer the great potential for improvement in production efficiency and waste minimization involve manipulation of diet composition and refinement of feeding strategies.

RESPONSE

This project was developed to provide a scientific base for optimizing feed composition, feeding frequency, and amount of feed to provide efficient production and reduce wastes in channel catfish, hybrid striped bass, baitfish, and crawfish culture. Nineteen scientists are participating in this 3-year project, which began December 1, 1997. The following institutions are involved:

- The University of Memphis
- Auburn University
- Louisiana State University, Baton Rouge
- Louisiana State University, Rice Research Station
- Missississippi State University, Starkville
- Missississippi State University, Stoneville
- North Carolina State University
- Texas A & M University
- University of Arkansas at Pine Bluff
- University of Georgia

The project was drafted to: 1) determine the effects of diet composition on fish production, nutrient utilization, and excretion of organic and nitrogenous wastes for catfish and hybrid striped bass; 2) assess the effects of various feeding strategies and techniques on fish production, nutrient utilization, and waste reduction for channel catfish, baitfish, and hybrid striped bass; and 3) develop and refine feeding strategies for crawfish that effectively enhance production by augmenting the forage-based system.

ACCOMPLISHMENTS

Channel Catfish — Several promising approaches to improving protein use in catfish feeds have been identified. For example, catfish production was not affected when the crude protein level in the diet was reduced from 30 to 25%, even if supplemental lysine was not provided in the reduced-protein diet. Another study showed that channel catfish production and feeding efficiency were

continued on next page

the same when fed diets with all-plant ingredients or with 4% menhaden fish meal, yet the all-plant diet costs 5% less, which would reduce cost of production for U.S. catfish by as much as $6,000,000 a year. In yet another study, feeding 12.5% less of a 32% protein feed to catfish in production ponds produced the same yield of fish as feeding a 28% protein to satiation. Feed efficiency and economics were improved by feeding the 32% protein feed with no difference in nitrogen or phosphorous wastes or phytoplankton production. Feeding 22.5% less of a 36% protein feed did reduce fish production.

Changing feed strategies according to water temperature or quality appears to have a minimal impact on fish production. Fish production, feed consumption, feed conversion ratio, visceral fat, and total ammonia nitrogen were positively correlated to feed consumption or feed input. Fish fed every day throughout the growing season consumed the most feed and had the highest net production. These studies suggest that catfish should be fed to satiation daily for maximum production.

Reduction of the protein concentration of the feed and marginal reductions in feeding rate have not been found to have measurable effects on nitrogen concentrations. Further, different phosphorus concentrations in feed had no effects on soluble reactive phosphorus, total phosphorus, or algal biomass, although using low phosphorus diets may be beneficial by reducing the phosphorus load to bottom soils by conserving their ability to adsorb phosphorus.

***Hybrid Striped Bass* —** A significant finding of this project was that reducing daily feeding frequency from three to four times a day to two times per day had no effect on total production or size distribution of hybrid striped bass fingerlings. Also, adult fish fed once a day either in the early morning or late afternoon had higher production, average weight, and were more uniform in size than fish that were fed either during the mid-morning or mid-afternoon. Reduction of feeding times during the day will reduce production costs by decreasing labor requirements and reducing wear on feeding equipment.

Studies also investigated the effect of dietary lipid and water temperature on growth. Results showed that diets with intermediate (10-15%) levels of dietary lipids enhanced growth of hybrid striped bass when compared with fish fed a 5% or 20% lipid diet. Fat accumulation increased with increased dietary lipid levels. Other studies showed that growth and nutrient utilization were significantly higher for fingerling fish at a moderate water temperature (80^{o} F) than at a higher temperature (90^{o} F), regardless of dietary energy to protein (E/P) ratios. The reduced growth at the higher temperature may be due to increased energy requirements at this temperature. Feed consumption decreased with increasing dietary E/P ratios. Feed efficiency, protein efficiency and protein conversion efficiency were highest at a dietary E/P ratio of 9 kcal per gram protein.

***Golden Shiners* —** Diets with oils from soybean, cod liver, canola, or olive, and various combinations were evaluated in feeding trials. Soybean oil appears to be the best lipid source for promoting growth. A comparison of the performance of diets with 4 or 13% lipid from poultry fat or menhaden fish oil is in progress and a stress test of fish fed the vegetable oil source diets has been completed and the analysis of plasma cortisol is underway.

***Crawfish* —** Identification of inexpensive locally available feedstuffs for supplementing feeding of crawfish has shown that rough rice seed and whole raw soybeans increased growth over crawfish fed by the cultivated rice forage system alone. Growth was similar to that obtained by feeding a formulated 25% crude protein feed. However, feeding supplemental feed decreased the effectiveness of baited traps used in harvesting in ponds. Limiting the supplemental feeding to only one day a week failed to generate larger crawfish than those in the forage system alone. Supplemental feeding with rice seed had a significant effect on sparing rice forage, but feeding too often reduces the effectiveness of baited traps when harvesting.

Diuron Approved for Use in Mississippi

Jimmy Avery

The Environmental Protection Agency has granted a specific exemption (Section 18) to the Mississippi Department of Agriculture & Commerce for the use of diuron in catfish ponds to control blue-green algae. Diuron, sold under the trade names of Diuron 80W and Nautilus Aquatic Herbicide, may be applied in or on commercial levee contained catfish ponds in Mississipppi until November 30, 2000. The product may be applied at a rate of 0.5 ounces per acre foot (0.4 ounces a.i.), every seven (7) days but not to exceed nine (9) applications per year. Applications are still pending in Alabama, Arkansas, and Louisiana.

Identification of Channel Catfish Strains using DNA Fingerprinting

Geoffrey C. Waldbieser and William R. Wolters

Genetic improvement through selective breeding has increased yield and production efficiency in many livestock and crop species. Identification, maintenance, and management of genetically improved broodstock is essential to ensure the genetic gains developed by the breeder are realized by the industry.

Identification of genetically improved strains of channel catfish is important to maintain the purity of the strain. Accidental introduction of other fish into the breeding population can diminish the genetic gains made in the selection process. Therefore it is essential to determine whether the selected population of catfish is "true to type". This is difficult because different strains or lines of channel catfish do not differ significantly in appearance. Physical tagging systems are problematic due to labor costs, potential injury to the animals, and the large numbers of catfish involved in commercial operations. An alternative is to use the variation in DNA sequences that already exists in the catfish populations as an identification system.

Detection of DNA sequence variation, or DNA fingerprinting, is becoming a commonly used identification system for many species, including humans. DNA, the molecule that contains the genetic information in each cell, is composed of a chain of the nucleic acids adenine, cytosine, guanine, and thymidine (A, C, G, and T). The nucleic acids are aligned in a specific sequence, and that sequence is "read" by the cell to make proteins. The total collection of DNA molecules in the cell is called the genome, so the catfish genome contains the genetic information specific to a channel catfish. One can think of the catfish genome as an instruction manual for making all the proteins necessary for building and maintaining a catfish. The catfish instruction manual (genome) would consist of 29 chapters (DNA molecules) containing a total of 1 billion letters (nucleic acids).

No two genomes are completely identical. Very small changes in the DNA sequence, like typographical errors in the manual, are inherited from each parent. This is the actual basis for genetic differences between catfish. NWAC scientists have used molecular biological techniques to identify many regions in the catfish genome that contain DNA sequence variation between individuals.

The specific regions in the catfish genome that exhibit DNA sequence variation in catfish populations are termed DNA markers. One can use a combination of markers to identify a "fingerprint" of DNA marker patterns common to related groups of fish, because individuals that are more closely related have fewer differences in DNA markers than unrelated individuals. Therefore, the DNA marker information can be used to identify which catfish belong to a certain genetic group or strain. The USDA103 catfish line, scheduled for release to the industry in winter 2000, has good growth and reproductive characteristics. After comparing DNA fingerprint patterns between catfish of the USDA103 line and catfish from 20 fingerling operations in Mississippi, Arkansas, Alabama, and Louisiana, we have chosen 11 DNA markers that help identify USDA103's from non-USDA103's. Even with these markers, there is a probability that about 1 out of every 10,000 commercial fish will have a fingerprint that looks like a USDA103 line catfish. However, the probability of falsely recording two fish in a pond as USDA103 line catfish is 1 in 59 million.

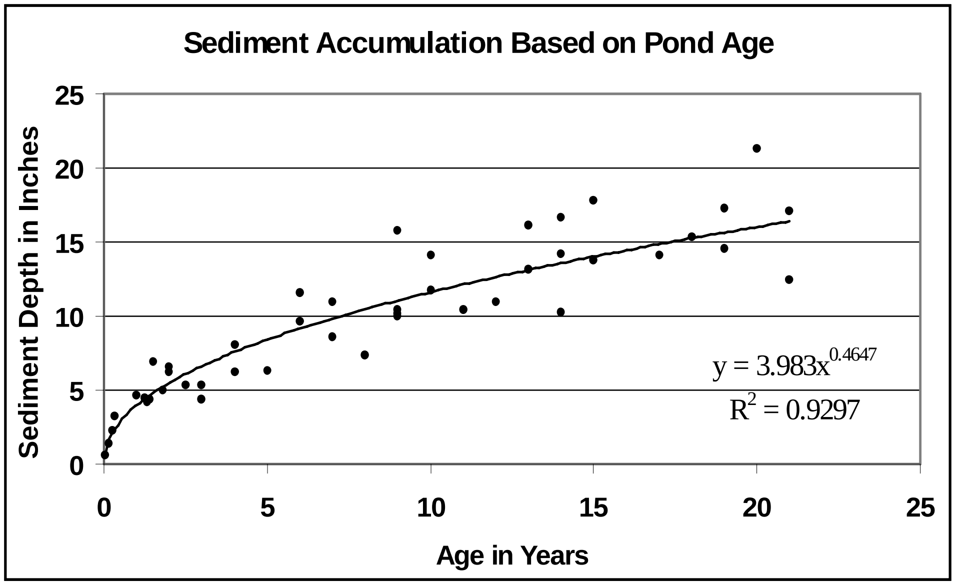
In an initial test, a piece of a barbel was clipped from thirty unknown catfish and provided to NWAC scientists to determine which fish were from the USDA103 line. Twenty-four catfish were excluded because they contained DNA marker variants that were not seen in USDA103 line catfish. The remaining six catfish were correctly identified as the USDA103's in the test sample.

In summary, DNA fingerprinting can be used in the certification of catfish strains. A DNA fingerprint system has been developed to identify contaminating fish within USDA103 strain populations. This will help maintain the purity of genetically improved strains to help increase production efficiency and aid in the sustainability of U.S. catfish production.

Sediment Accumulation and Oxygen Dynamics in Channel Catfish Production Ponds

Jim Steeby, Sue Kingsbury, Craig Tucker, John Hargreaves, Tom Cathcart[1], and Paul Zimba
[1] Mississippi State University, Starkville

Over the past three years, studies have been conducted on sediment accumulation and use of oxygen by sediments during the production season. A total of 45 commercial catfish ponds were sampled in the Mississippi Delta. Ponds ranged in age from two weeks to twenty-one years. Each pond had a history of continuous use for producing food-size catfish. In the initial year of use approximately 5 inches of sediment is established followed by an average yearly increase of 0.6 inches per year (see chart). After 15 years of continuous use over 1 foot of pond volume can be occupied by sediment. The accumulation of sediment combined with the erosion of the levee slopes leaves many older ponds with only 18-24 inches of usable pond volume. When observed from the bank these ponds may not appear shallow but wading to the center of the pond will quickly illustrate the point. These shallow ponds are susceptible to rapid declines in oxygen. At typical rates of oxygen use by plankton and sediments in mid-summer, these shallow ponds will reach low oxygen levels three hours faster than ponds with a full depth of 4 feet of depth.



On the basis of these findings it is recommended that, where possible, ponds be built to contain 5-7 feet of water. This will allow more capture of rainfall and allow space for sediment accumulation as the pond ages. Shallow ponds should be drained frequently allowing sediments to compact and dry to avoid the loss of pond volume. Using shallower ponds for fingerling production may be one option as they tend to be more frequently drained. The use of bermudagrass for control in levee erosion and to maintain soil moisture is recommended especially where new levees are being constructed. The MAFES Bulletin 1088 "Performance of Seeded Bermudagrass (1999) " is an excellent source of information on the selection of bermudagrass varieties.

It was also found during these studies that floating catfish feed which descends to the mud does not penetrate the sediment surface and is readily available to feeding fish. Sinking feeds however were easily buried if the surface of the mud was disturbed in any fashion.

Trematode

continued from page 1

The redear sunfish or "shell-cracker" got its name from its preferential diet of snails. Redear are extremely difficult to train to take fish feed and will not readily consume catfish feeds as the other species being tested. Freshwater prawns also eat snails. MSU has done considerable research with this species and as a result a fledgling freshwater prawn industry has been established in Mississippi. Freshwater prawn and redear sunfish could also provide the catfish farmer with the opportunity to diversify while controlling snail populations.

Visceral Toxicosis of Catfish

University of Arkansas at Pine Bluff and NWAC Scientists

During the early spring of 1999, several commercial catfish producers experienced sudden losses of foodfish and broodfish. These losses were most severe from mid February until early May. What was particularly unique was the loss of large numbers of broodfish. Unfortunately, commercial catfish producers reported the problem again during the fall of 1999 and also reported losses this spring. Previous laboratory reports and publications describe a disease of this type but occurrences were rare and did not allow further study. Researchers, diagnosticians, and Extension personnel at both the NWAC and at the University of Arkansas at Pine Bluff (UAPB) generally referred to the phenomenon as "Spring Losses of Foodfish and Broodfish" (see Nov.1999 NWAC Newsletter). Scientists at the NWAC and UAPB have spent considerable effort since the spring of 1999 trying to identify the causative agent. Based on the clinical signs, the syndrome is currently being referred to as Visceral Toxicosis of Catfish (VTC). The affected fish show very few clinical signs. Externally, the fish appear normal with no eroded areas or fungal patches. However, depending on the time of year, it could be possible for fish with VTC to exhibit winter kill type lesions. Some fish have their stomach protruding into their mouth. Exophthalmia or "pop-eye" was more apparent in stocker-size fish.

Behavioral signs may include "porpoising" or swimming rapidly at the surface for short periods of time or fish may appear lethargic while at the pond bank. Internally, some fish exhibited an intussuception or "telescoping" intestine, milky white fluid in the body cavity, a dark congested spleen, and the anterior gut had a white, opaque appearance, with prominent blood vessels. In ponds with mixed sizes of catfish, larger fish are usually the first to die.

Although researchers have narrowed the possibilities, the exact cause of this syndrome still remains unknown. To date, all diagnostic submissions have been negative for bacterial and viral pathogens. The causative agent appears to be non-infective and has only occurred during water temperatures of 54° to 68° F. Researchers can now confirm the diagnosis by using a bioassay using the blood of affected fish. Transferring serum from sick fish to healthy fish by IP or IV injection can reproduce lesions and mortality.

Producers can play a significant role in assisting UAPB and NWAC in their attempt to understand the cause of these losses. If your farm experiences these types of losses, please submit fish to your diagnostics laboratory. This will help us to document the distribution and prevalence of losses and provide researchers the material on which to conduct further experiments.

Crayfish

continued from page 7

After 10 years of research concerning population dynamics and best management practices, the next step is a verification study. This is essential for determining whether the practices developed in small experimental ponds will successfully transfer to larger ponds (2-5 acres). Smaller ponds have a higher surface area to volume ratio and the impact of certain management practices may not apply to larger ponds of similar design. In addition, a complementary economic analysis of the new system of crayfish farming is needed and is currently in process.

Diversification will be the key to success for aquaculture farmers in the future and the farming of crayfish appears to be a viable option. With the ever-expanding market in the United States and even internationally, farmers in Mississippi and other regions of the country do not have to compete with production in Louisiana or worry about the potential glut of wild caught (capture fisheries) crayfish and the adverse effect of that harvest on prices. These new approaches to crayfish farming should lead to new horizons.