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Inside this Issue:

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Handling Catfish Egg Masses

James Steeby

Catfish egg masses are subject to irreparable damage or mortality if handled improperly. Unfortunately this egg failure or mortality does not show up until much later in the hatching cycle. Currently no standard set of egg collection and handling practices exists.

A review of the egg handling practices at many hatcheries has revealed three critical areas where the quality of egg masses can be compromised. The recommendations contained in this article are based upon a review of available equipment and input from hatchery managers.

Collection

Gently separate adhered egg masses from the bottom of the spawning container. Place the egg masses in plastic commercial fish baskets equipped with liners made of knot-less 1/4-inch mesh netting. This lined basket can be made to float by placing a lightly inflated bicycle inner tube just under the rim of the basket. This allows a constant flow of water through the basket and a slight movement of the egg masses as personnel move through the pond. Eggs can be lifted from the basket and placed in transport containers using the liner only if desired. When tubs or coolers are used to collect egg masses, the container water must be exchanged with fresh pond water every ten minutes to maintain proper oxygen in and around the egg masses. Only 10-15 egg masses should be placed in the lined basket, tub, or cooler prior to being moved directly to the hatchery or being placed in a transport tank. Dissolved oxygen should always be maintained near 5 ppm with some intermittent motion to keep from suffocating eggs at the center of the mass.

Transport

If eggs are to be retained for more than 30 minutes at pond side, consider using large (100-quart) insulated coolers to keep water temperatures from increasing. These coolers can also serve as the transport device. A cooler of this type should have a pure oxygen supply equipped with a diffuser stone and a small submersible 12-volt water pump (rated at 360 gallons per hour) attached to a spray outlet. Place the pump in a small mesh bag to avoid the intake of eggs. This type of pump can be purchased at aquaculture supply outlets and large discount stores. The spray outlet should be fixed near the top of the cooler rim with conduit clamps and run along one length of the long

continued on page 5

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

NWAC Coordinator's Comments

Marty J. Fuller, Interim Coordinator

I want to take this opportunity to publicly thank Dr. Ed Robinson for his dedicated support and leadership as Coordinator of the Thad Cochran National Warmwater Aquaculture Center. As many of you know, Dr. Robinson has decided to step down from his administrative duties and devote his full-time energies to the research and extension programs in nutrition and harvest technology. Ed has led the Center through a time of major expansion of the facilities and research and outreach programs.

Dr. Robinson played a major role in overseeing the construction of the 32,000 square-foot state-of-the-art research facility which was opened in November 1997. At that time personnel consisted of 17 scientific staff and 30 support personnel. Today, the scientific staff is 27 with over 60 support staff. A new wet lab facility has been constructed, adding 1,200 square feet for fish health research. In addition, new research ponds have been built or are under construction that will bring the total number of ponds at the Stoneville facility to 291.

Because of Ed's valuable leadership, the statewide coordination of the aquaculture program was transferred to the Center. The move ensured that clientele would have a single point of contact to address their needs and allow the highest and best use of aquaculture research and extension funds.

Obviously, the catfish industry has faced many challenges and opportunities during Dr. Robinson's tenure as Coordinator. He has been extremely responsive to industry needs and worked closely with all necessary groups for the ultimate benefit of the catfish producer. Although, these issues required a significant time commitment, Ed was somehow able to maintain a very productive nutrition research program.

Ed Robinson's dedicated efforts to the catfish industry are highly appreciated. He has led your Center to a level of international prominence. I know you will join me in thanking Ed for his vision, leadership and devotion as Coordinator of the NWAC.

Drought Impacts East Mississippi Catfish Farms

Charlie Hogue

Typically one would think of a drought affecting only row-crop farms. But in the Black Belt area of east Mississippi, it has also had a dramatic effect on area catfish farms. Most of these catfish operations rely on rainfall as their only source of water. The year-to-date rainfall amount in this area (as of November 24, 2000) was 15 to 16 inches below normal. Some ponds built during fall 1999 and spring 2000 did not receive sufficient rainfall to stock with catfish. Those ponds that were stocked were filled by pumping water from adjacent creeks. Most production ponds are currently 30 to 36 inches below normal water levels.

In some ponds, the pond bottom in the shallow end has been exposed since August. This has lead to many fish being placed on restricted diets. When water temperatures reached the upper 90's F, some farmers initiated a maintenance schedule of every other day feeding. In some cases, farmers quit feeding altogether. This has delayed harvest, requiring fish to be held through the winter and fed next spring to reach harvest size. This delay creates an opportunity for increased disease outbreaks and bird depredation.

The drought has also had an impact on the incidence and timing of disease outbreaks. Columnaris was the most prevalent disease this fall. Since this is a stress-related disease, the amount of heat and poor water quality caused by the low volume of water were contributing factors. Anemia, which usually occurs in cooler water temperatures, has taken a toll on several ponds. There is also the possibility of increased "winter kill" syndrome.

There are many positive aspects of the catfish industry in east Mississippi. The industry has been a positive diversification for many of the row-crop farmers in the area, similar to the impact catfish made in the Delta in the early 1980's. If "mother nature" provides a wet winter to get ponds back in production, farmers will make it through this year and catfish farming will continue to prosper in the Black Belt area of the state.

Feeding Catfish

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

There has been more research conducted on the nutrition of catfish than any other area of catfish research and more is known about the nutrient needs of catfish than any other fish. Yet there is debate, particularly among catfish producers, as to what is the best feed and how best to feed. Although there is considerable scientific information available on feeding catfish, feeding is still as much an art as it is a science. There are no standard feeding practices in the industry, partly because so many factors affect feeding and every pond of fish behaves differently on a given day. As a result, feeding catfish is highly subjective and feed allowance is based upon the discretion of the feeder. This is unlike other farmed animals which are typically fed *ad libitum* allowing the animal to feed at will. Research has shown that when catfish are allowed access to feed on an *ad libitum* basis, they eat more feed and grow faster compared to fish fed once daily to apparent satiation. However, the logistics associated with *ad libitum* feeding prohibit the practice on large-scale commercial catfish farms.

Given that management strategies vary greatly within the catfish industry and that every pond is different, there may be no one single feeding method or feed that is optimum for use in feeding catfish. But there are some conclusions related to feeding and to feeds that are drawn from the results of sound scientific research that should be considered when developing feeding strategies. Some of this information is presented in brief below. These should be considered as guidelines, since each catfish producer must make the final decision on what feeding strategies best meet his/her management program. **The following information has been derived from feeding healthy catfish and the guidelines do not necessarily apply to diseased fish.**

Feed Quality

There are no major nutritional differences among catfish feeds manufactured by the various feed mills. All of the feeds are of high quality. They are highly palatable, digestible, and meet all the nutritional requirements of the catfish. A general misconception is that high-protein, high-animal protein feeds are "better" for catfish. This is not the case for food fish. A feed containing 28% and no more than 3% animal protein is more than adequate for growing food fish, even when feeding rates do not exceed 100 pounds per acre per day. Fingerling feeds generally contain a higher level of animal protein and total protein than do feeds used for growing food fish. However, there are research data that indicate that a 28% protein feed containing animal protein is just as effective in growing 20 pounds per 1000 fingerlings to 100 pounds per 1000 fingerlings (stocked at 100,000 fish per acre) as is a 41% protein feed.

Feed Intake

There are numerous factors that affect feed intake, but temperature appears to be the dominant factor that regulates feed intake. Often, particularly in early spring when pond water temperatures are just beginning to warm, one will hear that fish are feeding poorly and the question of the feed being the culprit always arises. In all the years we have been conducting feeding research, we have found no significant differences in the amount of feed consumed regardless of the ingredient or nutrient content of an experimental feed. Even feeds that one would expect the fish to consume poorly are generally readily eaten. Further, attempts to increase feed consumption by catfish during times of temperature stress (cold or hot) by modifying the diet have been unsuccessful. It is highly unlikely that the feed is at fault when fish are feeding poorly. Poor feed consumption is more likely to be related to environmental factors or to disease than to feed related problems. Feed consumption by catfish is likely to be highly erratic until water temperatures reach the mid 70's F, which is generally around the first week in May in Mississippi.

Feed Allowance

As a general rule, it is best to feed basically what the fish will consume on days fed. We realize that it is truly difficult to satiate catfish, it is easier to waste feed when feeding to satiation, and that one must consider the effect of heavy feed input on pond water quality. However, restricting feed intake appears to promote establishment of dominance hierarchies in animals. This may result in the majority of the feed being consumed by the more aggressive animals, leaving other animals underfed. There is evidence in other animals that this increases the incidence of cannibalism. This cause of cannibalism in catfish has not been verified.

It is also best to feed on a daily basis. Feeding every other day or every third

continued on page 4

Feeding Catfish
continued from page 3

day may be called for under certain conditions, but is generally not recommended for routine feeding. Under this type of feeding regime, the fish cannot consume enough feed on days fed to compensate for the missed feed on days when they are not fed. As a general rule, fish fed every other day or every third day will consume 50% and 65% more feed on days fed, respectively, as compared to fish fed once daily to apparent satiation.

If one is restricting feed by feeding less than daily, using a high protein feed would appear to be logical, but in reality it may be less beneficial than thought. It is true that when fish are underfed they usually respond to higher amounts of dietary protein, but only if the energy content of the feed is increased to ensure that adequate non-protein energy is available to prevent the more expensive protein from being used for energy. Another problem with this type of feeding scenario is that the larger more aggressive fish will consume most of the feed, and they do not need a higher protein feed, but rather a lower protein would suffice. Also, since the time between feedings is increased, the fish will have more time to empty gut contents and be ready to eat again. Thus the larger fish will continue to consume most of the feed at the expense of the smaller understocked fish and waste protein since they are consuming more than they need for maximal growth.

Frequency of Feeding

Generally feeding catfish once daily is satisfactory. However, there is some evidence that feeding twice a day is beneficial. This may be particularly true with fingerlings. Fish fed twice a day generally consume more food and convert about the same as fish fed once daily. However, there are logistics to consider when feeding twice a day, and if the feeder is not careful, feed can easily be wasted by over-feeding. We don't recommend feeding all ponds twice daily, but if a pond of fish feeds particularly well in the morning you should consider feeding that pond again in the afternoon.

Time of Day to Feed

We realize that on large commercial farms the time of day fish are fed is largely dictated by the logistics required to feed many acres of ponds in a limited time period. As a result, many catfish producers start feeding in early morning

as soon as dissolved oxygen levels begin to increase. This practice is fine, but research has shown that there are no significant differences in weight gain, feed consumption, feed conversion, and survival among catfish fed to satiation at 8 a.m., 4 p.m., or 8 p.m. There were also no differences in emergency aeration time among treatments. However, feeding near dark is not recommended unless sufficient aeration is available if needed, since peak oxygen demand by the fish occurs 6-12 hours after feeding when dissolved oxygen levels are low. Generally, it appears that in warm weather it is most practical to begin feeding in the morning as the dissolved oxygen begins to increase. In cool weather (fall, winter, and spring), water temperature is usually higher in the afternoon and the fish will feed better.

Distribution of Feed

Research using sonar to study the behavior of catfish in ponds has demonstrated that 40 to 50% of catfish may not respond to feeding at a given time. Many of the fish remained on the opposite side of the pond from which the fish were fed. Feed should be scattered over a large area to provide feeding opportunities for as many fish as possible. It is desirable to feed on all sides of the pond, but this is generally not practical because prevailing winds dictate that feed must be distributed along the upwind side to prevent it from washing ashore.

Compensatory Growth

Catfish exhibit compensatory growth. That is, fish that are not fed or fish in which feed intake is restricted for a period of time can make up the gain lost during the period of feed deprivation and catch up with fish that were fed for the entire time once feeding is resumed. Even so, using compensatory growth as a feeding strategy is not recommended as a routine practice. For one thing, considerably more feed must be fed daily for an extended period once feeding is resumed if the lost growth is to be made up. This increased feed input may tax the capacity of the pond to metabolize the nutrient load. Another consideration is that compensatory growth may work well with fish of similar size, but in a commercial catfish pond containing various sizes of fish the larger more aggressive fish are going to consume the bulk of the feed and the smaller fish will be unable to consume enough feed to catch up. Also, it should not be assumed that se-

continued on next page

verely restricting feed input or not feeding will always be compensated once feeding resumes.

Winter Feeding

We realize that many catfish producers choose not to feed during winter months for a variety of reasons, and we would not disagree that it may be difficult to see positive results from a winter feeding program. However, there are enough research data to conclude that winter feeding is beneficial. The magnitude of the benefit is dependent on the severity of the winter. Obviously if winter temperatures are particularly severe, the benefits of feeding will be much less than if the temperatures are relatively warm. Research conducted at Auburn University has shown that catfish weighing one pound held over winter without feed lost 9% body weight; whereas, those that were fed 1% body weight on days when the water temperature exceeded about 55º F increased in body weight by 18%. Winter feeding may be even more important in fingerlings, where gains may be as high as 20 to 25%. Winter feeding schedules for catfish are available, but since feeding will be highly variable they should be used as guidelines. Generally the rule is if it is warm and the fish will feed, it is beneficial to feed.

There is no best winter feed. Low protein feeds are just as effective as high protein feeds. Although it may appear to be logical to add special additives to winter feeds for catfish, current research shows no benefit in doing so. It may be preferable that the feed sink during the winter, but this has not been verified by research. If a sinking feed is used, make sure that it is an extruded feed and not a feed manufactured via a pellet mill. Extruded feeds are highly water stable and will remain intact longer than a feed prepared in a pellet mill.

Handling Catfish Egg Masses

continued from page 1

side. The water spray outlet should be made from 3/4-inch PVC pipe drilled with 1/8-inch holes on 1-inch spacing. A 100-quart size cooler can maintain 25-30 pounds of egg masses (20-40 spawns) for extended periods.

Larger transport containers such as 200-gallon fry transport tanks should have pure oxygen supplied by a center line of stones running the length of the tank. This type of tank is usually moved to the hatchery as soon as 50-75 egg masses have accumulated. Addition of a small submersible twelve-volt pump (rated at 1,000 gallons per hour), placed in a mesh bag, to circulate water is recommended at the higher loading rates. Filling the transport tank with pond water will avoid temperature shock to the eggs. Remember that most of these tanks are not insulated and will warm up rapidly if allowed to stand in full sunlight.

Treatments

On arrival at the hatchery, egg masses should be tempered by flowing hatchery water through the transport container for 15-20 minutes at a rate that will replace about half the water in this period (usually 3-5 gallons per minute). Once tempered, egg masses should be placed directly in hatching vats and iodine or other treatments applied. Application of chemical treatment to eggs in the hatching vats eliminates the possibility of eggs standing for long periods in washtubs where dissolved oxygen may deteriorate. Egg masses should not overlap each other in hatching baskets. Thick spawns should be divided into 2-3 pieces.

REMEMBER:

Eggs should be treated as well in the field as they are in the hatchery. Egg masses brought into the hatchery in poor condition will result in decreased hatching percentage, lower fry survival, and possible fry deformities. Dead eggs become open to attack by both bacteria and fungus as soon as treatments are discontinued, usually about the time some eggs begin to hatch. These dead eggs fall through the hatching baskets and come in direct contact with recently hatched fry causing large losses. These losses cannot be mitigated by increasing the number of egg treatments or simply increasing water flow to the troughs.

All hatchery managers should review these egg mass handling procedures with personnel at the beginning of the hatching season regardless of prior experience. At higher densities and during busy times of the season, problems often develop rapidly in hatcheries. If you begin to have poor hatching results as seasonal egg numbers increase, review all standard hatchery practices with personnel as soon as possible.

Chemical Control of *Dero* Worms to Prevent PGD

Charles C. Mischke, Jeff Terhune and David Wise

Proliferative gill disease (PGD), commonly referred to as hamburger gill disease, is a serious problem in catfish farming. PGD is one of the most commonly diagnosed diseases of catfish in the southeastern United States, representing approximately 30% of the total cases submitted to the NWAC fish diagnostic laboratory in 1999. The disease causes severe gill damage leading to suffocation of the fish, with severe outbreaks resulting in mortalities in excess of 50%.

The cause of PGD is believed to be a myxozoan parasite (*Aurantiactinomyxon ictaluri*). This parasite requires an oligochaete worm (*Dero digitata*) as a host for part of its life cycle. One approach for preventing PGD would be to break the life cycle of the parasite by eliminating *Dero* worms from the ponds.

In an effort to control PGD, catfish farmers have tried several tactics including chemical treatments to kill *Dero* worms. Some treatments are believed to reduce PGD incidence, but have not been experimentally validated. Several chemicals that either have U. S. Food and Drug Administration (FDA) or U. S. Environmental Protection Agency (EPA) approval or are being developed for use in commercial catfish ponds may have the potential for controlling *Dero* populations.

Several chemicals have been screened for their toxicity to *Dero* worms. Standard acute toxicity tests were used to calculate 24- and 48-hour LC50 values (the concentration of chemical needed to kill 50% of the *Dero* in 24 and 48 hours, respectively). The chemicals tested were: sodium chloride (certified A.C.S., Fisher Scientific, Fair Lawn, New Jersey), hydrogen peroxide (HUMCO, Texarkana, Texas), formalin (Sigma Chemical Co., St. Louis, Missouri), potassium permanganate (Aquatic Ecosystems, Inc., Apopka, Florida), chelated copper (EarthTec®, Earth Science Laboratories, Inc., Holdrege, Nebraska), Chloramine-T (Halamid, H&S Chemical Co., Covington, Kentucky), rotenone (Prentiss, Inc., Sandersville, Georgia), and Bayluscide® (Bayer Chemical Co., Kansas City, Missouri).

Sodium chloride and hydrogen peroxide are both considered low regulatory priority drugs by the FDA. Sodium chloride is commonly used to protect catfish from nitrite toxicosis by maintaining a 10:1 chloride to nitrite ratio; that equates to a chloride concentration that in general rarely exceeds 250 ppm sodium chloride. Our calculated LC50 for *Dero* is 6,800 ppm; the amount of salt needed to kill *Dero* populations in this study would probably not be practical in the industry.

Hydrogen peroxide may be a potential chemical for *Dero* control. The hydrogen peroxide tested in this study was only 3% active, so based on active ingredient the LC50 value would be 13.2 ppm. However, little work has been done on safe treatment concentrations of hydrogen peroxide for channel catfish.

Formalin (under the trade names: Formalin-F, Paracide-F and Parasite-S) is an FDA approved drug and may have potential as a pond treatment to control *Dero* populations. Formalin is effective in treating fungus. The LC50 values for *Dero* worms were slightly below formalin concentrations typically used for general pond treatments (25 ppm). However, organic material in the water decreases the effectiveness of formalin, so higher concentrations may be required to kill *Dero* in pond situations.

Potassium permanganate and copper sulfate are both registered for use in catfish production ponds by the EPA as an oxidizer and algaecide, respectively. Both compounds have historically been used to control external protozoan parasite infections in fish. Treatment rates for these compounds are determined by various water quality factors (e.g., organic matter load for potassium and alkalinity and hardness for copper) specific for individual ponds. With the water used in this experiment, the LC50 of both chemicals for controlling *Dero* worms were much higher than concentrations that would be considered a safe treatment for a pond with fish.

Chloramine-T is not approved for use in the catfish industry, but has been used to treat parasites of rainbow trout. For trout, chloramine-T is typically used as a short (1 hour) bath treatment at a rate of 10 ppm. The 24-hour LC50 value for *Dero* worms was much higher (29.5 ppm) than even the 1 hour bath treatments used in the trout industry. Tests in our laboratory show the 24-hour

continued on next page

LC50 value of chloramine-T products to catfish is from 24-34 ppm; chloramine-T would not be an effective way to control *Dero* worms in ponds with fish.

Rotenone and Bayluscide® were tested with the premise being that it would not be used to treat ponds with fish, but rather as pond sterilization treatments. Rotenone, however, would not be effective in eliminating *Dero* during sterilization, as the 24-hour LC50 for *Dero* (5.3 ppm) is 3 – 5 times higher than the concentration typically used for pond sterilization (1-2 ppm). Bayluscide®, however, may be a better choice for pond sterilization; *Dero* are highly sensitive to Bayluscide® (24-hour LC50 = 0.346 ppm). Bayluscide® is currently being looked at for a Section 18 Emergency Use Exemption in Mississippi for controlling snail populations in ponds.

Chemical control of *Dero* in grow-out ponds with fish may not be an option because of the narrow margin of safety between the effective concentration that kills *Dero* and the safe concentration for fish. PGD severity and associated mortalities may occur for extended periods of time, up to 8 weeks in severe circumstances, and is dependant on the number of parasite spores in the water column. Observations from methods used in this study to culture *Dero* worms for these tests suggest that their population size doubles every 3-4 days. Multiple chemical treatments would therefore be necessary to keep *Dero* numbers down and limit the number of parasite spores released. Repeated treatments would have consequences on affected fish by adding additional stress from both the direct and indirect effects of the chemical being used. In addition, most chemical treatments at levels required to affect *Dero* populations and the need for multiple treatments may be cost prohibitive.

Because fingerling producers drain production ponds yearly, some of the chemicals may be useful for treating ponds prior to fish stocking each year as a pond sterilization strategy. Bayluscide®, chloramine-T, formalin, and potassium permanganate may all have potential for this type of treatment. A lower volume of water could be present in the ponds during treatment which would reduce the total amount of chemical needed and fish would not be a concern for the high chemical concentrations required to kill *Dero* worms. This type of strategy needs further evaluation to determine field efficacy, procedures for use, and cost to production.

Table 1. Acute toxicity (24- and 48-hour LC50 and 95% confidence intervals) of eight chemicals tested on *Dero* worms.

Chemical	**24-hour LC50 (95% CI)**	**48-hour LC50 (95% CI)**
Sodium Chloride	6,800 ppm (6,600-7,000)	6,700 ppm (6,500-7,000)
Hydrogen Peroxide (3% active)	438.5 ppm (402.1-474.9)	438.5 ppm (402.1-474.9)
Formalin (37% Solution)	23.3 ppm (21.8-24.7)	22.4 ppm (21.1-23.8)
Potassium Permanganate	5.7 ppm (5.3-6.2)	5.7 ppm (5.3-6.2)
Copper Sulfate (5% metallic copper)	127.6 ppm (106.7-148.4)	29.9 ppm (26.1-33.7)
Chloramine-T	29.5 ppm (26.9-32.0)	28.1 ppm (nd)
Rotenone (5% solution)	5.3 ppm (5.0-5.6)	4.2 ppm (3.8-4.6)
Bayluscide® (70% wettable powder)	0.346 ppm (0.324-0.368)	0.342 ppm (0.320-0.363)

Publications and Videos Produced by the Southern Regional Aquaculture Center

Craig Tucker and Sarah Harris

In this issue of the NWAC News, we continue our series of articles describing the research and extension activities of the Southern Regional Aquaculture Center (SRAC), which is housed at the NWAC in Stoneville. We outlined the organization of SRAC in the first issue of the NWAC News (December 1998) and summarized SRAC-supported nutrition research in the last issue (June 2000). In this issue, we describe the most visible activity supported by SRAC — the development and production of printed publications and other educational materials.

When the Regional Aquaculture Center (RAC) program was established by Congress in the late 1980s, one of the mandates was to develop and disseminate information needed to solve problems in the aquaculture industry. The five Regional Aquaculture Centers in the U.S. are effective at meeting that goal because they provide a unique mechanism for assessing regional needs and establishing priorities.

The concept of using the RAC program as a vehicle for producing educational materials is based upon the benefits of using a region-wide pool of experts to develop materials in specific subject areas and allowing the Regional Centers to bear the cost of development and initial publication. The materials developed through the RAC program are then made available to U.S. citizens through the network of State Extension aquaculture contacts and over the Internet. In theory, this process avoids duplication of effort among states, makes efficient use of personnel and funds at the State level, and results in high-quality educational materials that are readily available to anyone.

To facilitate development of educational materials for the Southern Region, SRAC established the "Publications, Videos and Computer Software" project to assess and prioritize publication needs and develop appropriate publications to meet those needs. This has become one of our most successful projects.

For more information on this and other SRAC projects, visit our website at :

http://www.msstate.edu/dept/srac

In addition to the wide variety of information offered, you can print copies of all SRAC publications, obtain the address of your State Aquaculture Extension Specialist and link to many other useful aquaculture sites.

Although it has operated under several different titles, the SRAC publications project has actually been a continuing annual project since 1988. Dr. Jim Davis at Texas A&M was the first Project Leader, and after his retirement this project has been continued under the leadership of Dr. Michael Masser at Texas A&M. By making use of the diverse expertise available in our region, high-quality information on a wide variety of topics is produced.

Several different types of publications, including research-based fact sheets, videos, project summary reports, and other educational materials are prepared by SRAC through this project. The most well-known publications are the "SRAC Fact Sheets." With over 150 Fact Sheets now in print, these materials are used extensively in the United States and internationally by producers, consumers, researchers, and educators. Subjects include culture techniques and systems, nutrition, water quality and waste management, disease treatment, off-flavor management, consumer education, marketing, and much more.

A new series of publications, "Species Profiles", is also proving to be very popular. Each profile provides in-depth information on the biology and culture of a particular aquatic animal. The "Species Profiles", together with other "SRAC Fact Sheets", cover not only the common aquaculture species such as catfish, baitfish, hybrid striped bass, crawfish, and trout, but also other animals with aquaculture potential, such as grouper, largemouth bass, turtles, frogs, and others.

Since the initiation of this project, more than 75 scientists in all 13 states and two territories of the Southern Region have contributed to SRAC publications and videos. Each publication is thoroughly reviewed by producers, administrators and scientists for accuracy and style before publication.

During the past year, research and extension scientists from the following

continued on next page

institutions and agencies have contributed to SRAC publications:

- Harbor Branch Oceanographic Institute
- Kentucky State University
- Langston University
- Louisiana State University
- Mississippi State University
- North Carolina State University
- Oklahoma State University
- Texas A&M University
- University of Arkansas at Pine Bluff
- University of Kentucky
- University of North Carolina at Wilmington
- University of the Virgin Islands
- USDA/ARS, Pine Bluff, Arkansas

All SRAC Fact Sheets, as well as a variety of other printed materials, are readily available from several sources. For people with Internet access, the easiest way to obtain SRAC publications is to visit the SRAC website (see the box on the previous page) and browse the list of publications. When you find the publication of interest, simply click on the title and print. If you do not have access to the Internet, copies of SRAC publications can be obtained from Dr. Jimmy Avery, Aquaculture Extension Specialist at the NWAC in Stoneville or your local Aquaculture Extension Specialist.

A Practical Program to Compare Catfish Farm Operations, Management, and Costs of Production

Terry Hanson and Harry Simmons[1]

[1]Simmons' Farm-Raised Catfish, Yazoo City, Mississippi

At last year's Catfish Farmers of America meeting in Albuquerque, New Mexico, Harry Simmons related that farmers attending these meetings get a lot of information and new ideas by discussing their operations with one another. We discussed possible ways to extend this informal discussion to a level where many farmers could participate and benefit by increasing production and lowering costs. Simmons has used comparative management and cost of production information to help improve his catfish farm management and profitability. Since that meeting we have discussed broadening this comparative analysis program. A preliminary survey has been drafted and we are currently seeking to increase the number of participating farmers to improve the accuracy of the results and to assist more farmers.

The program will refine the survey based on producers' interests such as feeding rates, labor rates, yields, causes of mortality, etc. The goal is to provide participants with survey results containing year-by-year and 3-year period average values for each survey question. This would allow producers to compare their farms' specific values to the annual averages. Knowing that the farm operation value is above, equal to, or below the average for feed conversion, for example, would allow the producer to focus on improving aspects concerning feed and feeding practices. Depending on the number of participants, size of farms, and farm location, analyses can also be conducted according to farm size categories and region.

After preliminary discussions, the following points form the basis for this project. First, a minimum of three years of production yields, inputs, management, and costs would be required to overcome annual changes in inventory numbers and to smooth out high and low production years. To reduce additional paperwork, the survey will be developed using production and financial records currently on-hand. Results would be averaged on a per year and per 3-year basis and returned to participants on a per acre basis to keep answers anonymous and confidential. These results will be provided to participating producers only and all answers will be used in strict confidentiality.

The time frame for this project is as follows:

- Early December 2000: meet with interested producers to discuss and finalize survey;
- Mid-January 2001: send out the survey;
- March 1, 2001: deadline for return of the survey; and
- April 1, 2001: return analyzed results to participants.

You may choose to participate in a discussion of subject areas to be covered in the survey and analysis or choose only to respond to the survey. By participating in the survey development you would be able to ensure your items of interest are being addressed in a way that results would be most helpful to you.

If you are interested in participating in such a program, contact either Terry Hanson (662) 325-7988 or Harry Simmons (662) 746-5687 as we are developing a list of interested producers. There is NO charge for participation in this program.

Development and Evaluation of USDA 103 Line Channel Catfish

Bill Wolters

Over the last 14 years, the USDA/ARS Catfish Genetics Research Unit in Stoneville, Mississippi has conducted research with the goal of enhancing the genetic potential of channel catfish. An important product of this research program has been the development and evaluation of the USDA 103 line of channel catfish, which has excellent growth compared to other catfish currently being used by producers and is recommended for foodfish production. The November 2000 issue of the Catfish Journal published an article announcing the joint release of the new catfish line which has the experimental name USDA 103 in February 2001 by the USDA and Mississippi Agricultural and Forestry Experiment Station (MAFES). This article summarizes the performance data gathered over 6 years of study. This information should be of interest to anyone considering using the fish in commercial production.

Origin of the USDA 103 Catfish. The original stock of USDA 103 catfish was obtained from the U.S. Fish and Wildlife Service National Fish Hatchery system. Sub-adult fish (1992 year class - F_0 generation) were obtained in 1993 and reproduced in 1994 as 2-year old broodfish. Subsequent generations developed for joint release were produced and selected from the offspring of 2-year old spawners. Full-sibling families (F_1 generation) obtained in 1994 were selected for resistance to Enteric Septicemia of Catfish (ESC) and fish selected within families for growth rate were saved as future broodfish. These offspring (F_2 generation - 1998 and 1999 year classes) are being cultured in earthen ponds at the NWAC prior to release.

Distinguishing Genetic Information. In order to identify and maintain the genetic integrity of USDA 103 channel catfish, a DNA fingerprinting system was developed. DNA can be quickly isolated from a blood sample or a small tissue sample and used to distinguish USDA 103 catfish from non-USDA 103 catfish. DNA markers have been characterized in 3 generations of catfish from the USDA 103 line and compared to fry from 20 commercial fingerling operations in Mississippi, Alabama, Arkansas, and Louisiana, and wild fish from the Mississippi River. Based on information obtained from these markers on a random sample of 96 fish from a fingerling pond, the chance of any two contaminant fish being classified as a USDA 103 catfish is 1 in 59 million. There is even a smaller chance, 1 in 100 million fish, that USDA 103 fish would undergo mutation and become classified as non-103 fish.

Growth and Performance in Tank Studies. Seven different studies were conducted to compare growth performance, carcass composition, and serum hormone levels of USDA 103 catfish versus other catfish. In one or more of the studies, five other catfish stocks, five dietary protein levels, and effect of two culture temperatures were evaluated. These studies were carefully controlled with large numbers of replicated tanks and primarily utilized juvenile fish, however, one tank study cultured juvenile fish to marketable size. In all seven tank studies, the USDA 103 catfish demonstrated significantly faster growth than other catfish (Figure 1). In six of seven tank studies, USDA 103 catfish consumed significantly more feed. No significant differences were found for survival and carcass composition. Serum levels of insulin-like growth factor-1 (IGF-1), a hormone regulating growth, were significantly higher and correlated with faster growth at both 71º and 79º F in USDA 103 catfish compared to one commercial catfish line. Serum estrogen levels in sub-adult USDA 103 female fish were higher than females from one commercial catfish line

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Figure 1. Comparitive growth of USDA 103 and Kansas Strain channel catfish juveniles to marketable size in a 210-day study.

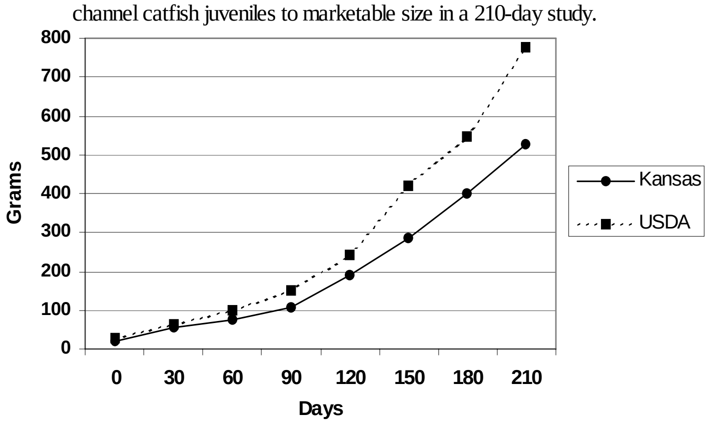
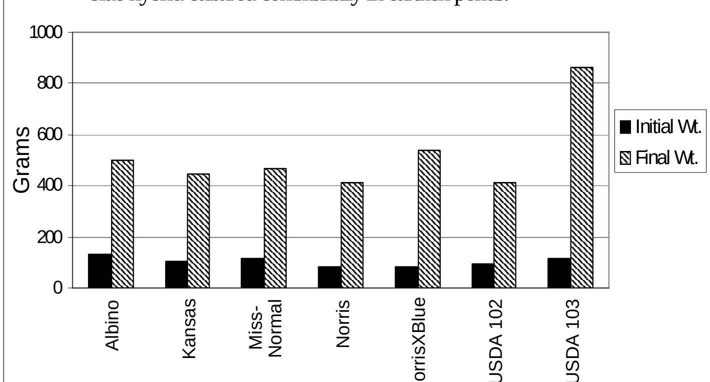


Figure 2. Growth of six channel catfish lines and one channel X blue hybrid cultured communally in earthen ponds.



and, as indicated above, may be an indication of earlier sexual maturity in USDA 103 catfish. USDA 103 catfish were found to be susceptible to enteric septicemia infection, a trait in common with all channel catfish. USDA 103 catfish were less susceptible to ESC than Norris catfish in one study and more susceptible in another study.

Growth and Performance in Pond Studies. Growth performance, carcass composition, and fillet yield of USDA 103 catfish versus eight other catfish lines were compared at three research locations. Three studies were conducted with USDA 103 catfish cultured communally with other lines stocked into the same replicated ponds. Eight pond studies cultured each catfish line in separate ponds. All pond studies comparing USDA 103 catfish to other catfish were for one growing season in batch culture. In one or more of the studies, six other catfish lines and three dietary protein levels were evaluated at three research locations.

Communal Stocking Studies. The earliest studies evaluating growth characteristics were conducted by stocking all catfish groups communally because of lack of replicated ponds. These early studies provided information that showed the potential of this line and the need for further evaluations stocking the catfish groups into separate ponds. The USDA 103 catfish line was evaluated in three communal stocking studies in which fish were grown from fingerlings to marketable size. Harvest weight was significantly larger in USDA 103 catfish than other catfish in all three communal studies (Figure 2). Specific growth rate (% increase in weight per day) was greater than all other catfish in two out of three studies. The large difference in harvest weight between USDA 103 catfish and other catfish apparent in these studies is likely the result of a competitive advantage from vigorous feeding activity in USDA 103 catfish and higher food consumption, a characteristic also found in tank studies. As a result of the aggressive feeding of USDA 103 fish, less feed was available to other catfish present. Survival and fillet yield of USDA 103 catfish did not differ from that for other catfish in the communal stocking studies.

Separate Stocking Studies. As stated earlier, later and more recent studies evaluated growth characteristics by stocking the different catfish groups into separate ponds. Eight pond studies were conducted in which USDA103 catfish were compared to other catfish lines stocked in separate ponds. In one study, fry were grown to fingerlings (Figure 3) and in the other seven studies, fingerlings were grown to marketable size (Figure 4). Higher harvest weight and feed consumption were found for USDA 103 catfish fry cultured to fingerlings, but no differences were found in yield, feed conversion or survival. In all other pond studies, USDA103 catfish had significantly higher harvest weight and gain. Yield was higher in five studies, not different in one study and lower in another as a result of overwinter mortality. Survival was not different in three studies, but lower in three studies. Cause of mortality usually could not be identified, although in two instances, losses may have been related in some way to very low levels of chlorides, because fish losses ceased after salt (sodium chloride) was added to ponds to increase chloride levels to 100 ppm. Feed conversion was not different in four studies, but was lower in the three studies where survival was lower. No differences were found for fillet yield compared to other channel catfish. Fillet yield for blue x channel hybrids was significant greater (~2%) than channel catfish.

Reproductive Performance. Reproductive performance, particularly spawning success, is an important characteristic to consider in a genetic improvement program, especially for fingerling producers. One characteristic noted in USDA 103 catfish compared to other catfish is the higher concentrations of sex hormones. These higher levels appear to be related to early

continued on page 12

Figure 3. Growth of three lines of channel catfish fry cultured to fingerlings in earthen ponds.

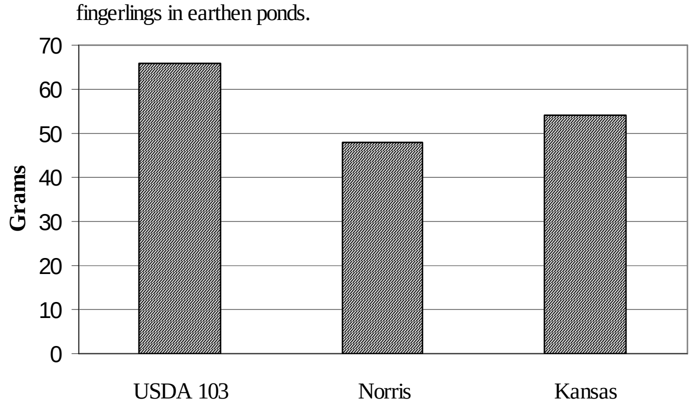
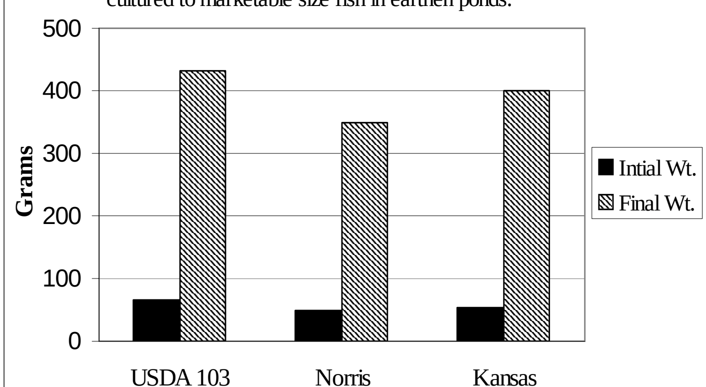


Figure 4. Growth of three lines of channel catfish fingerlings cultured to marketable size fish in earthen ponds.



USDA 103 Line
continued from page 11

sexual maturity and have not been correlated with higher spawning success. Some USDA 103 females spawned at an early age (2 years), and overall demonstrated good spawning success (percentage of females spawning in a given year) and fecundity (number of eggs produced per pound of female).

Summary of Performance Trials. Results of experimental trials have shown the USDA 103 line catfish has excellent growth characteristics compared to other catfish currently being used by producers. The growth advantage of USDA 103 catfish appears to be due to aggressive feeding behavior and higher feed consumption, and USDA 103 fish should reach market weight faster than fish currently cultured under commercial conditions. Actual performance in commercial production may vary from experimental results due to differences in management strategies, and, as with any animal bred for improved performance, realization of the full potential of the fish depends on using good cultural practices and maintaining optimum environmental conditions.

Acknowledgements. USDA 103 line catfish were developed at the USDA/ARS Catfish Genetics Research Unit, NWAC, Stoneville, MS. Experimental studies to evaluate the USDA 103 catfish were conducted and summarized by W.R. Wolters, G.C. Waldbeiser, J. Silverstein, B. Bosworth and T.D. Bates, USDA/ARS Catfish Genetics Research Unit; E.H. Robinson, M. Li, D. Wise, and S.L. Jackson, Mississippi Agricultural and Forestry Experiment Station, Delta Research and Extension Center; D. Freeman, USDA/ARS Aquaculture Systems Research Unit, Pine Bluff, AR; P. Klesius, USDA/ARS Aquatic Animal Health Research Unit, Auburn, AL; M. Holland, College of Veterinary Medicine, MSU; J. Silva, S. Park, and R. Chamul, Department of Food Science, MSU; and K. Davis, Department of Biology, University of Memphis. The guidelines, "Policy and Procedures for Release and Distribution of Newly Developed Catfish Lines from Cooperative Research Programs developed by the USDA/ARS and Mississippi State University Agricultural and Forestry Experiment Station detail the procedures for distribution of catfish to interested commercial producers. Drs. Craig Tucker, Les Torrans, Jim Steeby, and Jimmy Avery provided editorial review.

USDA 103 Release Planned for February

Vance H. Watson, Director, Mississippi Agricultural and Forestry Experiment Station

USDA/ARS and MAFES are pleased with the significant interest shown by fingerling producers in the NWAC broodstock release since the announcement was made in the November issue of the Catfish Journal. The line of fish, selected by Dr. Bill Wolters, USDA/ARS geneticist and tested under the experimental name, USDA 103, have shown superior growth rates in both tank and pond studies. Genetic markers, identified by USDA/ARS scientists, allow for the rapid identification and certification of the catfish. This novel advancement is the first of its kind in catfish and has the promise to provide increased efficiency to the catfish industry.

The Experiment Station is fortunate to have such a positive partnership with USDA's Agricultural Research Service. Both agencies look forward to a rapid multiplication and dissemination of the offspring of this fish to the food fish sector as soon as feasible. An industry release committee will meet in mid-December to establish the guidelines for the national distribution of the broodstock. In general, bonafide fingerling producers that meet minimum criteria and agree to produce the fish as a certified class will be eligible. It is anticipated that a lottery drawing will be conducted to establish loading order.

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