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Impacts of Stocking Size and Protein Content of Feed on Stocker Production

Lou D'Abramo, Terry Hanson, and Jim Steeby

Recently, an assessment of the critical fingerling-to-stocker phase of the three-phase (modular) system for production of channel catfish was completed. The three-phase system consists of three separate phases of batch culture: fry to fingerling, fingerling to stocker, and stocker to growout. This approach contrasts with the traditional multi-batch (multi-size) culture system based on continuous harvest of food fish combined with replenishment by stocking fingerlings into the same production pond.

Research efforts concerning the fingerling-to-stocker phase have focused on the evaluation of the effects of stocking size, stocking density, and protein content of feed. In 2004, 4.3 inch fingerlings (22.1 pounds/1,000) were stocked into 0.12-acre experimental ponds at three different initial densities (40,000, 50,000 and 60,000/acre). A 35% crude protein fingerling feed was fed daily to satiation over a growout of 6 months. A maximum feeding rate of 200 pounds/acre per day was established. Survival for the fingerling-to-stocker phase ranged from 63.7 to 72.6%, but the weight at harvest (0.21 pound) fell slightly below the desired weight of 0.25 pound (Table 1). The inability to achieve the size goal was assumed to be caused by small size at stocking, an unseasonably cool summer, and periods of "off feed" management in response to a disease outbreak.

The results obtained in 2004 led to a 2005 experiment that used a larger fingerling size at stocking (30.5 pounds/1,000) to try to achieve a 0.25 pound harvest weight. The average length of fingerlings stocked was 4.7 inches, representing a 38% increase in average stocking weight relative to the previous year. The relative effectiveness of fingerling feeds that contained either 32% or 35% crude protein (a difference of $60 per ton in cost) was also evaluated. The initial stocking density was 50,000/acre. There were five, 0.12-acre ponds (replicates) for each of the dietary treatments, and a maximum

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Impacts of Stocking Size and Protein Content of Feed on Stocker Production
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feeding rate of 200 pounds/acre per day during a growout period of six months.

The 2005 results demonstrate the impact of size of stocked fingerlings on the final harvest weight, as well as the effect of protein content of the feed on growth (Table 1). Mean survival (63.0% and 66.3%) was satisfactory and did not significantly differ between dietary treatments. Average weight of the stockers at harvest were much greater, 0.41 pound (35% crude protein) and 0.32 pound (32% crude protein), than the 0.21 pound weight achieved for the same period of culture during the previous year at the same initial stocking density and using a 35% crude protein diet. The harvest weight of the fish fed the 35% crude protein feed was significantly higher than that of those fed the 32% crude protein diet. The proportions of fish that were greater than the goal weight of 0.25 pound within the total harvested pond populations ranged from 72 to 77% for the 35% crude protein diet, and 47 to 56% for the 32% crude protein diet. Average stocker production for the 35% and 32% crude protein treatments was 12,931 pounds/acre and 10,440 pounds/acre, respectively. The economic analysis for 2005 revealed a $0.03 to $0.05/pound savings in cost of production, relative to the multi-batch system, whether a 32% or 35% crude protein feed was used in the fingerling-to-stocker phase.

All the reported 2004 and 2005 results concerning the fingerling to stocker phase have been obtained from small (0.12 acre) experimental ponds and therefore must be viewed with some caution. Greater growth rates may be realized in small experimental ponds relative to commercial size ponds but this limited approach is necessary to achieve the level of replication to establish confidence in the statistical evaluation of the data collected. A parallel verification study in 4-acre ponds is currently in progress.

The combined results of the 2004 and 2005 investigations underscore the flexibility afforded farmers to meet a specific management goal of this second of the three-phase production system. The farmer has an array of choices relative to initial stocking density, feed, and size of fingerling at stocking based upon costs/availability associated with the different options.

Table 1: Six-month post-stocking production results for the 2004 and 2005 fingerling to stocker research. Stocking density was 50,000/acre, and initial stocking weights were 22.1 pounds/1,000 and 30.5 pounds/1,000 for 2004 and 2005, respectively.

Diet (crude protein)	Mean Weight (g)	Survival (%)	Production (pounds/acre)
2004 (6 months)			
35%	0.21	72.6	7,516
2005 (6 months)			
35%	0.42	67.2	14,095
32%	0.32	65.3	10,126

Use of Smallmouth Buffalo (*Ictiobus bubalus*) to Reduce the Incidence of Proliferative Gill Disease

Jim Steeby, David Wise, Todd Byars, and Louie Thompson[1]

[1]Thompson Fisheries, Inc.

Proliferative gill disease (PGD) is found in 10 to 11% of all cases submitted to the NWAC Aquatic Diagnostic Lab and causes significant disease losses each year. The disease is caused by a parasite (*Aurantiactinomyxon* sp.) harbored by a mud-dwelling worm (*Dero digitata)*. Although several chemicals have been tested, there is no known control for either the worm or the disease. The smallmouth buffalo (*Ictiobus bubalus)* is native to the waters of the southeastern U.S. and is reported to consume a range of benthic macroinvertebrates. Recent research at the NWAC tested whether this bottom feeding fish could reduce the number of benthic worms thereby decreasing the incidence of PGD.

In the spring of 2002, smallmouth buffalo were obtained from a commercial fisherman and spawned in a commercial catfish hatchery. Eggs were pressure-shocked to produce triploid fry. The triploid fry were placed in ponds and grew to 6 inches by fall. In October 2002, smallmouth buffalo fingerlings were stocked (100 fish/acre) into 11 commercial channel catfish ponds (250 acres total) that had a history of severe PGD outbreaks. Examination of gills of sentinel channel catfish placed into treatment and control ponds indicated that the presence of buffalofish had no effect on PGD in spring 2003. However, buffalofish significantly reduced the incidence of PGD in the fall of 2003. Average percent of gills with damage was only 1.3 in ponds with buffalofish compared to 2.9 in control ponds.

Survival of buffalofish appeared good in all ponds with no reports of small-mouth buffalo eating catfish feed. The buffalo grew from 6 inches to 17 inches (2.5 to 3.5 pound) in 12 to 14 months. Unfortunately the lack of size differential between the buffalofish and foodsize catfish at fall harvest made sorting difficult. Some buffalo that were sorted by hand and retained in the ponds through their second summer reached 5 to 6 pounds. No reproduction was noted in any of the ponds suggesting that most of these fish were sterile.

It remains uncertain whether stocking smallmouth buffalo would have a significant impact on the number of PGD outbreaks but a decrease in the severity is indicated. Currently, there is only a limited supply of smallmouth buffalo available from commercial sources. If you wish to experiment with this biological control option, consider stocking larger smallmouth buffalo (0.5 to 1.0 pound/fish) into several growout catfish ponds while maintaining some ponds without buffalofish. This would make grading easier since the smallmouth buffalo could be as large as 4 to 5 pounds by fall harvest. In brood ponds and fry ponds, sorting would be less of an issue.

USDA Catfish Genetics Research Unit Names New Leader

Dr. Ken Davis was named Research Leader for the USDA Catfish Genetics Research Unit in Stoneville, Mississippi effective July 25, 2005. Dr. Davis is a research physiologist and comes to Stoneville after working at the USDA National Aquaculture Research Center in Stuttgart, Arkansas from 2000 to 2005. He has prior experience with the research staff at the Genetics Unit having collaborated on catfish research projects at the Stoneville laboratory for many years. Other than a brief assignment at the Southeastern Fish Cultural Laboratory in Marion, Alabama in the late 70s, the majority of Dr. Davis'career has been spent as a professor in the Department of Biology at University of Memphis.

Dr. Davis is a native of Arkansas, and received a bachelors degree in Natural Science and a masters degree in Zoology from the University of Arkansas. He received his doctorate in Physiology from Louisiana State University. His areas of expertise include stress physiology, reproductive physiology, and sex determination in channel catfish. In addition to his administrative duties, Dr. Davis will be investigating ways to breed mostly male populations of channel catfish because of the males' propensity to grow larger in size. He can be contacted at (662) 686-3597.

Economic Impact of Trematode Infections in Commercially Raised Channel Catfish

David Wise, Terry Hanson, and Todd Byars

The trematode identified as *Bolbophorus* sp. can cause significant production losses in commercially raised channel catfish. This disease has been associated with high mortality rates, decreased feed consumption, and poor production efficiency. To assess the economic impact of this disease, a disease monitoring and production efficiency study was conducted on a commercial catfish operation with reported trematode infestations. The farm contained approximately 452 acres (40 ponds) in food fish production and 200 acres (24 ponds) in fingerling production. Prior to sampling only a limited number of ponds were identified by the producers as having production related problems (high mortality and poor feeding activity) related to *Bolbophorus*. Fish (20 to 30 fish/pond) were examined for the presence of nodules containing the encysted trematode and each pond was placed into one of four categories based on the percentage of infected fish in the sample. Ponds with trematode-infected catfish were placed into categories of light, moderate, or severe when the percentage of trematode-infected fish in the sample ranged from 1% to 33%, 34% to 66%, or 67% to 100%, respectively. Ponds that did not contain trematode-infected fish were categorized as negative. Production records from ponds used for food fish production were grouped by infestation level for analysis.

Of the 40 ponds sampled, 17 were categorized as negative, 6 as light, 6 as moderate, and 11 as severe. Fish from trematode-positive ponds consumed significantly less feed compared to fish from ponds that were categorized as trematode-negative. Fish from ponds in the trematode-negative category consumed on average 73.4 pounds/acre per day, and fish from ponds categorized as light, moderate and severe consumed 62.2, 47.5, and 47.2 pounds/acre per day, respectively. Similarly, production decreased as severity of infection increased. Compared to trematode negative ponds, ponds in the light, moderate, and severe categories produced 16.8%, 36.4%, and 44.5% less fish weight per acre, respectively.

The weight of catfish produced and the quantity of feed fed were put into a generalized enterprise budget format (Table 1). The pounds of catfish produced was estimated based on the amount of feed fed assuming 2.25 to 1 feed conversion ratio. (The actual pounds of fish produced were not used in the enterprise analysis because production is a partial result of feed fed during the previous year and ponds were only assessed for trematodes in the following year). Revenue generated from the estimated production was based on a selling price of $0.70/pound. Variable and fixed costs to production were estimated from previous work by Terry Hanson to develop enterprise budgets for catfish farms in Mississippi. The feed variable cost, representing 50% of the total variable cost, was the major cost factor that varied in each category. All other costs were applied equally to each category. Net returns to land were calculated by subtracting the total costs (variable plus fixed) from the revenue generated by the estimated production. While errors in these estimations are likely, this analysis is considered a conservative estimate since the actual variable cost and feed conversions would likely be higher in populations of fish infested with trematodes.

Production was greatest in ponds that were negative for the trematode infection. In this model, trematode negative ponds produced 6,017 pounds/acre resulting in fish sales of $4,212/acre and net returns of $455/acre. Estimated production decreased with increasing level of infection. Compared to trematode negative ponds, ponds in light, moderate, and severe categories produced 13.8%, 36.0%, and 40.5% less pounds of fish per acre, respectively. Decreases in production were associated with significant decreases in net returns. Net returns from ponds in the light category were reduced by 80.8% ($87 net return/acre) and production from ponds in the moderate and severe categories were not shown to cover variable costs of production. Ponds in the moderate category produced a net loss of $506/acre and severe ponds produced a net loss of $631/acre.

This study was conducted in response to a producer's request for assistance

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in treating a limited number of ponds believed to be infested with trematodes. It is important to note that the extent of this disease on the farm level was not revealed until each pond was sampled and individual fish were carefully examined for the encysted trematode. While heavy infestations are usually recognized, low-grade and even moderate trematode infections can remain undetected for years, slowly decreasing production and profitability. In some ways, low-grade infections represent a greater risk to production in the long run because they can go undetected. A mild infestation usually does not cause immediately obvious production problems. On any given day feeding activity may appear normal and low infestation rates may not be associated with unusually high death rates. Over the course of the production year, however, it is common to see a substantial decrease in the total amount of feed fed. Because low-grade infections are difficult to detect by casual observation, 20 to 30 fish from each pond should be sampled at least once a year and examined for trematode infections. The encysted trematode is easily recognized and appears as small bumps under the skin. In addition, close attention to year-end feed and production records should be made to identify poor-producing ponds. At the very least, ponds with lower feed and production rates should be intensively sampled to rule out trematodes as a possible cause for poor production. This data demonstrates the devastating effect even mild trematode infections can have on production and points out the importance of developing a long-term management plan to control this disease.

Table 1. Returns to catfish operations with negative, light, moderate, or severe trematode infestations.

		Degree of Trematode Infestation		
Value or Cost	**Negative**	**Light**	**Moderate**	**Severe**
Number of Ponds	17	7	5	11
Pond Acreage	182	75	59	136
Revenue				
Fish produced, lb	6,017	5,185	3,849	3,578
Selling price, $/lb	$ 0.70	$ 0.70	$ 0.70	$ 0.70
Fish sales, $	**$ 4,212**	**$ 3,630**	**$ 2,694**	**$ 2,505**
Variable Costs				
Feed fed, ton	6.7696	5.8335	4.3302	4.0251
Feed price, $/ton	$ 230	$ 230	$ 230	$ 230
Feed cost*, $	$ 1,557	$ 1,342	$ 996	$ 926
Chemical cost				
Trematode treatment, $	$ 144	$ 144	$ 148	$ 153
Other Variable				
Costs**, $	$ 1,557	$ 1,557	$ 1,557	$ 1,557
Total Variable Costs	**$ 3,258**	**$ 3,043**	**$ 2,701**	**$ 2,636**
Income Above				
Variable Costs, $	**$ 955**	**$ 587**	**$ (6)**	**$ (131)**
Fixed Costs,$/acre	**$ 500**	**$ 500**	**$ 500**	**$ 500**
Net Return/Acre	**$ 455**	**$ 87**	**$ (506)**	**$ (631)**

*Feed costs are approximately 50% of all variable costs
**Other variable costs are estimated to be 50% of total variable costs

2005 CVM Aquatic Diagnostic Laboratory Summary

Al Camus, Pat Gaunt, and Michael Mauel

Diagnostics

In 2005, the Aquatic Diagnostic Laboratory (ADL) at Stoneville received a total of 607 diagnostic case submissions. Diagnostic cases were received from 77 farms, or approximately 20% of the Mississippi industry. In addition, 681 water quality samples from 186 farms were analyzed. Compared to 2004, the number of case submissions decreased from 778. In 2005, the total number of water quality samples processed decreased from 851, while the numbers of farms submitting samples increased significantly from 60. The ADL staff would like to stress that we are here to serve the industry and encourage producers to continue to take advantage of this valuable free service.

As in the past, individual case submissions represent a composite sample of fish collected from a single pond. The numbers reported are derived solely from submissions processed by the ADL and do not necessarily reflect actual disease incidence in the field. Routine diagnostic procedures include evaluation of gill clips and skin scrapes for parasites, external and internal inspection for signs of disease, bacterial and viral cultures, histopathology, and water quality evaluation. The ADL works closely with MAFES fish health professionals to offer treatment recommendations, monitor disease trends, provide surveillance for new and emerging diseases, provide field service investigation, and maintain a database of epidemiologic information on diseases of catfish. The ADL supports the research efforts of other NWAC units, including MAFES, MSU-Extension Service, College of Veterinary Medicine, and USDA Catfish Genetics Research Unit. Furthermore, the laboratory provides an outlet for the dissemination of information gained from research efforts back to producers.

As in previous years, the bacterial diseases enteric septicemia of catfish (ESC) and columnaris disease dominated the number of producer submitted cases. The seasonal incidence of the four major diseases is presented in Figure1. Examined as a single disease, ESC accounted for 14.3% of cases, but in combination with other agents it was diagnosed in 31.1% of cases (30.7% in 2004). Alone, columnaris accounted for 20.8% of cases, but in combination with other pathogens, columnaris was present in 49.4% of all cases (40.9% in 2004), making it the most common disease seen by the ADL. ESC and columnaris were diagnosed together in 15.1% of case submissions. The incidence of these two diseases have remained relatively consistent over the past 9 years, where on average ESC was diagnosed in 35.8% and columnaris in 44.3% of all cases. Table 1 contains a summary of disease trends from 1997 to the present.

Proliferative gill disease (PGD) remained the most commonly diagnosed parasitic disease, representing 8.4% of cases (10.7% in 2004). Saprolegnia, the cause of winter fungus, was present in 4.0% of cases, up from 3.7% in 2004. The number of channel catfish virus (CCV) disease cases decreased from 10.8% in 2004 to 9.1% in 2004 and remained above the 9-year average of 5.8%. The number of channel catfish anemia (CCA) cases rose from 2.1% in 2004 to 4.6% for 2005 and remained below

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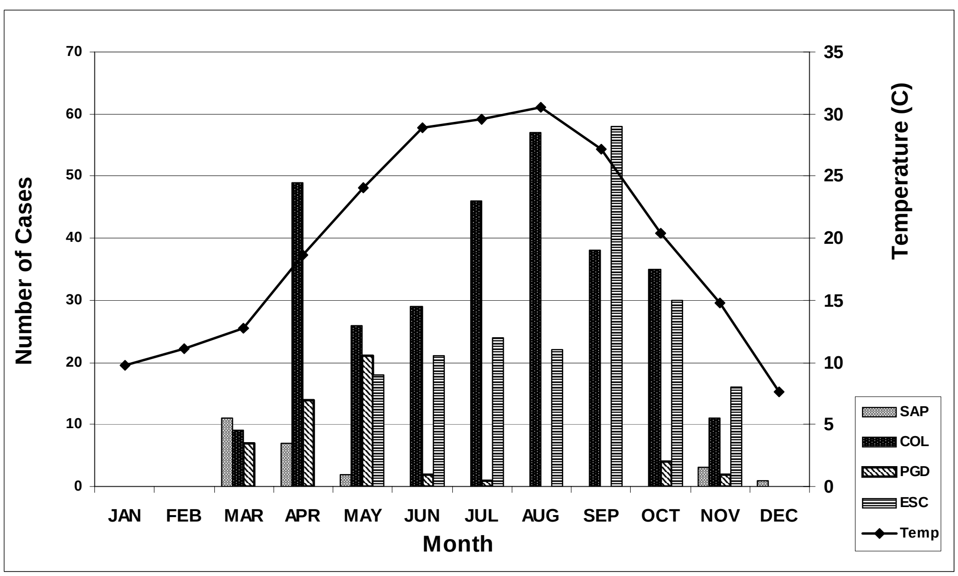

Figure 1. Seasonal incidence of major catfish diseases in 2005.

the 9-year average of 3.8%. *Ichthyophthirius multifiliis* (Ich) cases decreased from 5.0% last year to 1.3% in 2005, below the 9-year average of 1.8%. Cases of visceral toxicosis (VTC) decreased to 0.9% in 2005 from 3.2% in 2004.

The number of *Bolbophorus* trematode cases rose to 3.4% for 2005, but remained below the high of 5.6% seen in 2000. Farmers are encouraged to renew surveillance efforts and to control ram's horn snails (intermediate host of the parasite), particularly if pelicans are visiting their ponds. *Bolbophorus* trematodes are capable of killing fingerlings and increasing susceptibility to ESC, as well as decreasing feed consumption in larger fish. Control of the parasite can be accomplished through the use of copper sulfate or lime.

Highlights

The antibiotic florfenicol (Aquaflor®) was approved for use in catfish in October of 2005. Trials conducted at the ADL indicate the drug is highly efficacious against ESC when the drug is fed early in the course of an outbreak. Producers are encouraged to submit cases immediately if they suspect the disease is occurring in a pond. Currently, the drug is only approved for use in catfish against ESC and can only be obtained through the use of a veterinary feed directive order (VFD) signed by a licensed veterinarian. Before a VFD order can be written, diseased fish must be examined to confirm signs compatible with ESC. Medicated feed containing florfenical is fed for 10 days and a withdrawal time of 12 days must be observed prior to processing. Following the success of ESC trials, the Schering–Plough pharmaceutical company has funded new studies to evaluate the effectiveness of florfenicol against columnaris infections. The results of these trials will be submitted to the FDA as a component of the drug approval application process against this disease agent.

Continued research into the cause of visceral toxicosis of catfish (VTC) has focused on a naturally occurring biological toxin present in aquatic habitats under certain environmental conditions. Additional test results are pending and confirmation is expected during 2006.

Research continues into the cause of channel catfish anemia (CCA), a well-known but poorly understood cause of mortalities. Although researchers have suggested a number of possible causes in the past, including various vitamin deficiencies and toxin exposures, work at the ADL indicates that the disease is caused by iron deficiency. The role of hepcidin, a recently identified regulator of iron metabolism in animals, has been investigated and shown not to be involved in the development of the disease. Research into other potential causes for the development of iron deficiency anemia is ongoing.

A previously unknown streptococcal bacterial infection causing mortalities, spinal deformities, and reproductive failure in catfish broodstock was reported last year (NWAC News April 2005). Work conducted with the Centers for Disease Control in Atlanta has confirmed that this is a previously unknown species of bacteria and will be named *Streptococcus ictaluri*. To date, four outbreaks have been confirmed, but no additional cases were seen in 2005. At present the significance of this emerging disease is unclear. Producers noting emaciation, humped backs, and bloody sores along the jaw at the time of broodstock selection are encouraged to contact the ADL.

Table 1. Trends in disease diagnosis as a percentage of diagnostic case submission over time.

Disease	Average	2005	2004	2003	2002	2001	2000	1999	1998	1997
Columnaris	44.3%	49.4	40.9	44.7	44.5	37.2	42.6	45.5	44.8	49.1
ESC	35.8%	31.1	30.8	34.7	39.8	36.4	33.5	41.2	41.2	33.6
PGD	19.0%	8.4	10.7	10.8	16.3	20.1	29.8	30.0	16.3	28.6
Saprolegnia	7.5%	4.0	3.7	5.3	10.1	10.4	10.5	8.7	8.6	6.4
CCV	5.8%	9.1	10.8	8.9	5.8	7.3	2.3	1.8	3.1	3.0
Anemia	3.8%	4.6	2.1	5.2	5.3	5.0	4.9	2.8	3.0	1.7
Ich	1.7%	1.3	5.0	0.5	2.2	1.8	2.7	0.7	0.5	0.8
Bolbophorus	2.9%	3.4	2.6	1.1	2.0	4.4	5.6	1.5	-	-
VTC	2.5%	0.9	3.2	3.7	2.0	2.5	-	-	-	-
No Pathogens	15.8%	12.8	20.8	18.3	16.2	19.2	15.0	15.2	11.4	13.6
No. of Cases	1,283	607	778	832	1,057	1,602	2,189	2,007	1,647	831

Catfish Nutrition: Use of All-Plant Diets to Grow Food Fish

Ed Robinson and Menghe Li

Catfish feeds are predominantly plant based, but have traditionally contained a relatively small amount of feedstuff derived from animal sources, i.e., fish meal or by-product meals from animal processing industries. While animal feedstuffs are generally excellent sources of protein, minerals, and essential fats for catfish, animal feedstuffs are not needed in diets used to grow food fish. The main reason that animal feedstuffs continue to be used in feeds for food fish is based on the perception that they are indispensable either because of the contribution they make to the nutrient and energy nutrition of catfish or because they increase feed palatability. It is primarily a feed marketing issue because some producers perceive that feed that smells "fishy" is just somehow "better." However, nutrient and energy needs of catfish can be met without using animal feedstuffs, and an all-plant diet is just as palatable to catfish as a diet containing animal feedstuffs.

To demonstrate this we conducted six studies growing catfish from fingerlings to food fish using nutritionally-balanced, all-plant diets (Table 1). There were no differences in feed consumption, weight gain, feed conversion ratio, survival, visceral fat, dressed yield, or proximate composition of fillets regardless if animal feedstuffs were included in the diet or not. In addition to the studies reported herein, we fed all-plant diets to catfish in large production ponds without any noticeable differences in production from year to year. The primary reason that all-plant diets can be used to grow catfish today, where they might not have been effective in earlier studies, is that we have more nutritional data available that has been determined under conditions similar to those used to commercially culture catfish rather than in the laboratory. Thus we are able to formulate catfish diets using a variety of highly palatable and digestible feed mixtures that meet the fish's energy and nutrient requirements.

The advantages of excluding animal feedstuffs from food fish diets are related to economics and marketing. Depending on the cost of protein and the amount of animal feedstuff that is replaced, the annual savings in feed cost could be significant. It is difficult to give an actual number because the amount of animal feedstuffs used is not consistent over the industry. Another advantage is related to perception and marketing. Since consumers are health oriented and are exposed to negative media reports (whether factual or not) on issues that impact food animal industries, it seems prudent to distance oneself from these issues if possible. The main issue that comes to mind is "mad cow disease" associated with use of beef by-products in animal feeds. We know that farmed catfish are of the highest quality and we recognize that the health risk to humans that eat catfish fed these products is small, but again it's about perception. The elimination of beef products from the diet would help dispel any negative perception that might arise with this issue. The argument could also be made to remove all animal feedstuffs from the catfish diet because they are not needed and using nutritionally-balanced, all-plant diets would make farm-raised catfish unique among farmed fish in that it would be truly "grain" fed.

Table 1. Summary of six studies feeding catfish diets with or without animal protein (4% to 8% fish meal, meat and bone/blood meal, or a combination of the two) in earthen ponds for about 150 days in a single batch production system. Final weight of fish ranged from ¾ to 2.1 pound.

Diet	Feed consumption (pound/fish)	Weight gain (pound/fish)	Feed conversion (feed/gain)	Survival (%)
Animal protein	1.74	1.04	1.83	96.7
No animal protein	1.71	1.00	1.87	95.2

Diet	Visceral fat (%)	Carcass yield (%)	Fillet yield (%)	Fillet proximate composition: Fat (%)	Moisture (%)	Protein (%)
Animal protein	3.5	57.4	36.5	6.3	75.1	16.8
No animal protein	3.1	57.6	36.6	6.4	75.6	16.5

New Publications Produced by the Southern Regional Aquaculture Center

Craig Tucker and Sarah Harris
Southern Regional Aquaculture Center

In its 18 years of existence, the Southern Regional Aquaculture Center (SRAC) has distributed more than $10 million in funds to support aquaculture research and extension in the southeast. Research conducted with these funds has led to many innovations and improvements in aquaculture, but SRAC may be best known for the abundant literature produced through the "Publications, Videos, and Computer Software" project.

The SRAC "Publications" project is in its twelfth year of funding and is under the editorial direction of Dr. Michael Masser and staff at Texas A&M University. To date, the "Publications" project has generated more than 170 fact sheets with contributions from 158 authors from the southern region.

The effectiveness of the SRAC "Publications" project is rooted in the benefits of using a region-wide pool of experts to develop educational materials and then allowing SRAC to cover the costs of writing, editing, and initial publication. This process assures that each publication is written by the most knowledgeable person in the region and it prevents duplication of effort among states.

During the past year, research and extension scientists from the following institutions and agencies have contributed to SRAC publications: Auburn University, Clemson University, Kentucky State University, Louisiana State University, Mississippi State University, North Carolina State University, Texas A&M University, University of Arkansas at Pine Bluff, University of Florida, University of Virginia, Virginia Sea Grant, USDA-ARS (Stoneville) and USDA-APHIS (Wildlife Services, Starkville)

For information on 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 sites.

You will find information on just about any topic you can imagine from the list of 171 titles available from SRAC. To give you some idea of the variety of material available, here are some recent titles:

- Pond Aeration
- Managing Hatch Rate and Diseases in Catfish Eggs
- Controlling Bird Predation at Aquaculture Facilities: Frightening Techniques
- Managing Ammonia in Fish Ponds
- Biology and Culture of Hard Clams
- Channel Catfish Fingerling Production
- Species Profile: Cobia
- Species Profile: Koi and Goldfish
- Liming Ponds for Aquaculture
- Economics of Freshwater Prawn Culture in the United States

All SRAC Fact Sheets, as well as a variety of other printed materials, are readily available. If you have Internet access, the easiest way to obtain SRAC publications is to visit the SRAC website (see the box to the left) and browse the list of publications. When you find a 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 Jimmy Avery, Aquaculture Extension Specialist at the NWAC in Stoneville or your local Aquaculture Extension Specialist.

U.S. Farm-Raised Catfish Industry: 2005 Review and 2006 Outlook

Terry Hanson

The year 2005 could be described as a year that many catfish producers regained some of the equity lost during the 2001 to 2004 period of low prices and negative returns. There were higher producer prices, and moderate to lower catfish feed prices, tempered by increased fuel cost, which in balance, helped many producers catch up from four years of negative to minimal positive returns.

Production

The 2005 catfish production acreage was down 4,200 acres or -2.4%. The number of U.S. catfish operations was down 1% from 2004. In Mississippi, there were 20 fewer operations (-5%) from January 2005 to January 2006.

In 2005, round weight processing of catfish was 600 million pounds, down 5% from 2004's processed weight of 630 million pounds. This may be attributed to the continued adjustments stemming from the low prices seen from 2001 to 2003. Additionally, imported fish substituting for U.S. farm-raised catfish continues to increase. However, even with these events total producer's gross income in 2005 was approximately $435 million, only down 1% from 2004.

Price

In 2005 the average price received by producers was $0.73/pound, up $0.03/pound from 2004's average price of $0.70/pound. As of mid-April 2006, the pond bank price had increased to $0.78/pound. Low pond inventories of food size fish in early 2006 suggest catfish supply will continue to keep upward pressure on prices, with prices surpassing $0.80/pound in some periods.

Production inputs

The 32% protein catfish feed price in 2004 ranged from $230 to $310/ton and averaged $270/ton. In 2005 the price ranged from $224 to $247/ton and averaged $233/ton. In the first quarter of 2006 the feed price ranged from $243 to $253/ton. The two main catfish feed ingredients are looking to take divergent price paths in 2006. Corn prices have been rising and planted acreage is expected to decrease in 2006, while soybean prices have been falling and planted acreage is expected to increase. The rise in fertilizer price has affected the decision to plant more soybeans. The 2006 projected catfish feed price should stay in the $240 to $260/ton range.

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Table 1. Estimated off-road[1] gas and diesel costs for a 250-acre catfish operation in Mississippi.

	Sept. 03	Sept. 04	Sept. 05	Apr. 06
Gasoline Price[1], $/gallon	$ 1.34	$ 1.51	$ 2.29	$ 2.31
Farm Gasoline Cost[2]	$ 16,555	$ 18,662	$ 28,328	$ 28,575
Additional Gas Cost Compared to Sept. 2003	—-	$ 2,107	$ 11,772	$ 12,020
Diesel Price[1]	$ 1.08	$ 1.53	$ 2.28	$ 2.27
Farm Diesel Cost[2]	$ 24,186	$ 34,235	$ 50,984	$ 50,649
Additional Diesel Cost Compared to Sept. 2003	—-	$ 10,049	$ 26,798	$ 26,463
Combined Gas & Diesel Cost	$ 40,741	$ 52,897	$ 79,312	$ 79,224
Combined Additional Fuel Cost Compared to September 2003	—-	**$ 12,156**	**$ 38,571**	**$ 38,483**

[1] Farm use or "off-road" fuels are tax exempt, and the Federal and MS state taxes of $0.184 and $0.18/gallon for gasoline, respectively, and $0.244 and $0.18/gallon for diesel, respectively, have been subtracted from the retail fuel cost. In MS there is a $0.057/gallon dyed-diesel fuel tax that has been included in the off-road diesel fuel price.
[2] Fuel cost is based on 12,392 gallons of gasoline and 22,332 gallons of diesel fuel used annually.

Broodstock Trends in the Southeastern U.S. Catfish Industry

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The production of catfish eggs and fry is a vital component of the catfish industry. To provide better estimates on this segment of the catfish industry, USDA-APHIS and USDA-NASS surveyed producers in the four major catfish-production states (Alabama, Arkansas, Louisiana, and Mississippi).

Survey data revealed that a small percentage of catfish operations (14.2%) maintained broodstock while an even smaller percentage of operations (12.8%) operated hatcheries. The difference can be attributed to the fact that a few of the operations that bred catfish allowed eggs to hatch in ponds, and that a few of the operations that operated hatcheries did not breed catfish but purchased eggs. In 2002 there were an estimated 106 hatcheries producing an average of 17 million fry. Total estimated output for the industry would therefore be near 1.8 billion fry per year.

The majority of broodstock operations surveyed maintained some genetically-improved lines, such as Goldkist, NWAC103, or on-farm “mass-selected” lines. Only 34.8% of operations used “pond-run fish” or unimproved, large catfish for breeding. Most operations had regular feeding regimes and about a third supplemented feed with some type of forage fish such as fathead minnows or golden shiners.

Maintenance of non-reproductive broodstock utilizes resources that could be invested elsewhere. To minimize this inefficiency, producers typically sort broodfish by sex and cull inferior fish on an annual basis. In 2002, 16.3% of all broodstock (relative to the January 1, 2003 broodstock inventory) were culled. However, 54.5% did not cull any broodfish in 2002. This may be due in part to the fact that approximately 75% of broodfish were aged 4 years or less. Hatchery operators showed a preference for younger broodfish since only 3% of broodfish were more than 6 years of age. Producers also estimated that they lost approximately 14% of their broodfish annually, principally due to fighting among males. Consequently, the combination of losses and culling represented close to one-third of the turnover in broodstock inventory.

Hatchery managers generally prefer early spawning by broodstock. This allows more time for fingerling growth before temperatures cool below feeding thresholds. A commercial catfish facility in the Mississippi delta compared the age of catfish and their proportion of spawning activity from 1997 to 2002. Over these years a total of 282,500 pounds of broodfish were spawned resulting in 18,862 spawns. The percent of spawns collected by weekly intervals for 3-, 4-, and 5-year-old fish for 1997 to 2002 is presented in Figure 1 (courtesy of Harvest Select and Nagaraj Chatakondi). This demonstrates the variation in peak spawning activity of three age groups of channel catfish. As suspected, older broodfish typically spawn earliest, proceeding to smaller fish as the season progresses.

Given these facts, we would make the following recommendations to operations that are managing broodfish.

- Broodfish should be sorted by sex and inferior fish culled on an annual basis.
- Forage-fish supplementation helps ensure good egg quality and spawning success. Producers should be aware of the health status of the forage fish being introduced into their pond to avoid accidental disease introduction.
- Considering the time and capital investment represented by broodfish—and the fact that good egg output is expected from fish 3 years and older—producers should normally keep broodstock until the fish are at least 5 years old. It may be necessary to sell these extremely large fish to live-haulers or at a low price but the value of early spawning cannot be overstated in most years.

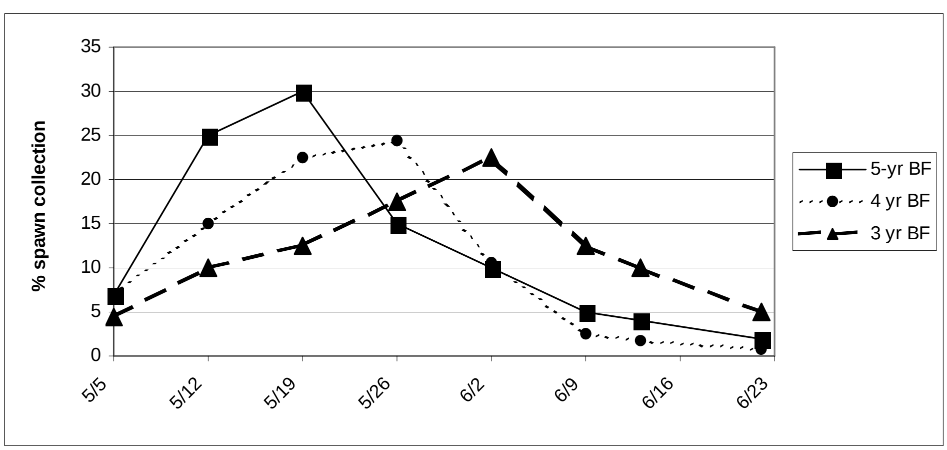

Figure 1. Broodstock spawning percentage by date.

Diuron-Based Herbicides Obtain Emergency Exemption

The United States Environmental Protection Agency (EPA) has announced approval of an emergency exemption on three diuron-based herbicides that will aid Mississippi producers in controlling blue-green algae in catfish ponds this year. Blue-green algae release MIB (2-methylisoborneol) into the water and is absorbed by catfish. The compound is eventually deposited in the flesh imparting a musty or muddy off-flavor. This off-flavor hinders the marketability of fish to processors and costs the industry millions of dollars in increased costs.

The three diuron-based products registered in Mississippi are **Direx 4L**, **Karmex XP**, and **Karmex DF**. All three products are manufactured by Griffin LLC. As progress continues toward a permanent registration (24[c]) for these products, it is vital that producers continue to purchase only these three registered products. The emergency exemption will expire on November 1, 2006.

Application rate for the liquid formulation (**Direx 4L**) is 0.8 ounces/acre-foot every seven days. Application rate for the dry flowable formulations (**Karmex XP and Karmex DF**) is 0.5 ounces/acre-foot every seven days. Based on label restrictions, diuron-based herbicides can only be applied to a pond (or group of fish) nine times per calendar year. If you need additional information concerning application of these products, please contact Extension Specialists Jimmy Avery, Jim Steeby, or Charlie Hogue.

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Fuel costs are up and the price of oil continues to rise, topping $71/barrel in mid-April 2006. At the mid-April point, regular gasoline cost was $2.67/gallon ($2.31/gallon tax exempt) and diesel cost $2.64/gallon ($2.27/gallon tax exempt). The impacts of these increases can be seen in Table 1 (on page 10). The continued upward direction of fuel prices will affect direct fuel costs required in the catfish production process as well as increase costs of other production inputs using oil-based products in their manufacture or transportation.

Outlook for 2006

Imports of "basa" were up by 191% in January 2006 over January 2005; this will be a continued concern for the industry, even with tariffs in place. The 2006 production year should be marked by a stable price for producers of around $0.75/pound for the first half of the year and probably not go below $0.70/pound in the second half of 2006. Catfish feed (32% protein) should remain in the $240 to $260/ton range. The remaining wild card is how high fuel prices will go. This will affect catfish farms directly and indirectly and cut into operators' net returns.