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The Economic Impact of the Catfish Industry in Chicot County, Arkansas

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Carole R. Engle, Director

Chicot County, Arkansas, is predominantly rural, sparsely populated and located in the Mississippi Delta. This region of the United States is generally characterized by low income, high poverty and high unemployment. The economy of Chicot County is based primarily on agricultural production. Textile and catfish processing constitute the major manufacturing industries.

The civilian labor force in 2001 included 6,125 individuals with an unemployment rate of 10 percent. Per capita personal income was $18,072 in 2000, 18 percent lower than the state average and 39 percent lower than the national average, ranking Chicot County 50th out of 75 counties in Arkansas. The poverty rate in Chicot County was 29 percent, nearly double the statewide average of 16 percent.

The economic impact of the catfish industry on the Chicot County economy was analyzed using the IMPLAN system. The IMPLAN computerized database and modeling software is used to construct regional input-output tables based on a Bureau of Economic Analysis national database. Three types of economic effects were measured—direct, indirect and induced. *Direct effects* represent direct production and employment by catfish farms and catfish processing plants. *Indirect effects* are measured as changes in sales by supporting businesses that result from the sale of inputs and services to catfish farms and processing plants. *Induced economic effects* result from purchases of consumer goods and services by employees of catfish farms, processing plants and supporting businesses. Restaurant and grocery sales fall in this last category.

Three economic indicators were compared. *Economic output* is the total value of production (sales plus or minus inventory). *Value added* is the amount of money available for employee salaries and wages, returns to business owners and indirect federal and local

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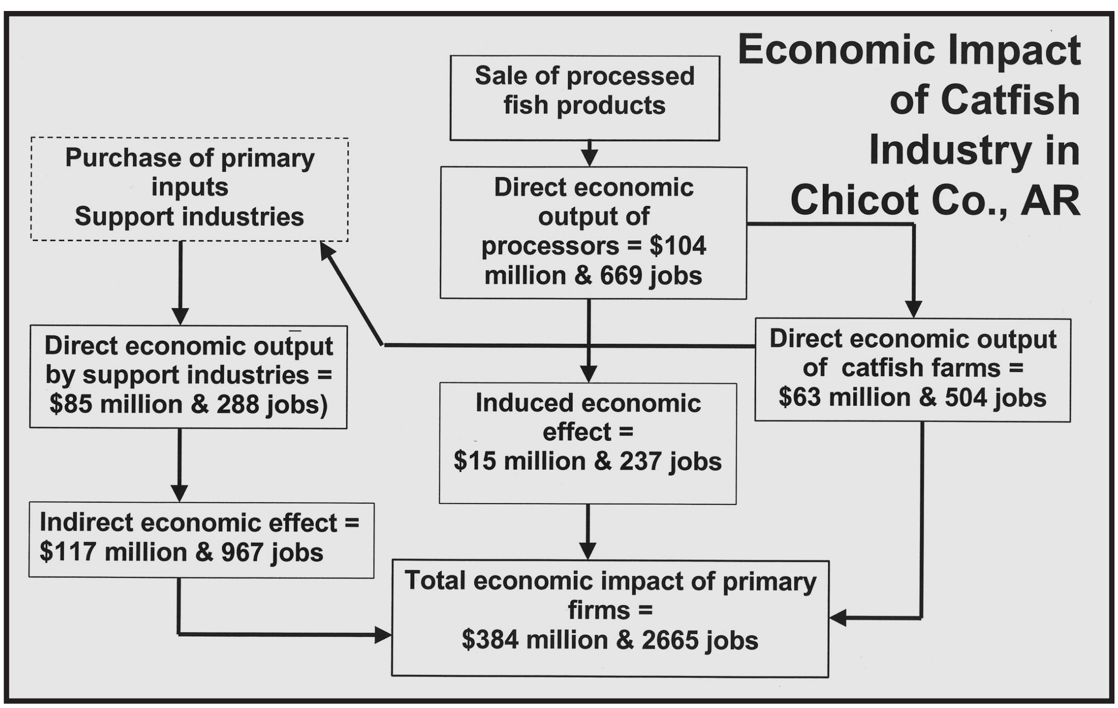

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taxes. *Employment* measures the number of full-time and part-time jobs created through direct, indirect and induced economic effects.

Economic multipliers were calculated. An economic multiplier summarizes the total economic benefits resulting from a change in the local economy or change in economic output. It is calculated as the sum of direct, indirect and induced economic effects divided by the direct economic effect. For example, a catfish farming output multiplier estimates the total change in local economic output that results directly from an increase in output of catfish farms. Similarly, a catfish farming employment multiplier measures the change in total employment that results from a change in employment on catfish farms.

Three questionnaires were developed to collect 2001 information from all catfish farmers, processors and businesses that support catfish production and processing. The catfish farm survey included both a mail survey and personal interviews. Out of 85 farmers in the county, 44 farmers completed the survey with usable responses, yielding a response rate of 52 percent. The catfish processor questionnaire was mailed to both processors in Chicot County. Data requested from catfish processors included employment, production costs and sales. Personal interviews were conducted at 59 businesses in Chicot County that depend directly or indirectly on the catfish industry. Information was collected from these support businesses on employment, sales and the percentage of sales that came from catfish.

The catfish industry and corresponding support services in Chicot County produced economic output valued at $384 million in 2001. The catfish farming and processing sectors contributed 39 percent and 28 percent, respectively, to the total economic output of the catfish industry. About $252 million (66 percent), $117 million (30 percent) and $15 million (4 percent) were generated through direct, indirect and induced effects, respectively.

Note that the indirect effects of catfish farming were higher than those of processing because most of the inputs and services used in catfish farming were purchased locally. In addition, other secondary industries related to the catfish industry through indirect and induced effects contributed 8 percent of the catfish industry total economic output. Indirect economic effects from these industries were mainly from wholesale trade ($7 million) and motor freight transport and warehousing ($2 million). The induced economic effect was mainly from housing ($3 million), doctors and dentists ($2 million) and miscellaneous retail business ($1 million).

Catfish farms and processing plants, including both direct and indirect employment, created more jobs in Chicot County than any other economic sector with the exception of state and local government. The catfish industry generated 2,665 jobs in the Chicot County economy through direct (1,461 jobs), indirect (967 jobs) and induced effects (237 jobs). Catfish processing generated the greatest direct employment at 669 jobs. This was followed by 504 jobs in catfish farming.

Catfish farming produced the highest number of jobs in the indirect effects category (679), almost equal to the number of employees hired directly by catfish farms. This analysis demonstrates that catfish farming creates large numbers of jobs in backwardly-linked businesses such as aquaculture supply companies, equipment dealerships and hatcheries. Examples of indirect and induced effects, respectively, are jobs created in the maintenance and repair of buildings and facilities, and jobs in the health sector due to increased income and demand for services. Most of the jobs created through indirect and induced effects in the secondary industries were in wholesale trading (106 jobs) and restaurants (49 jobs).Overall, catfish and related businesses accounted for more than 49 percent of all jobs available in the county in 2001.

The catfish industry and the service sector generated $77 million of value added, paid in the form of labor income to employees and business owners and indirect business taxes in 2001. The catfish industry in Chicot County generated $22 million federal, state and local tax revenue in 2001.

The output multiplier calculated for catfish farming was 6.1. Thus, each $1 of earnings by catfish farms generated $6.10 total economic activity in the Chicot County economy. Of this, catfish farms received $1 and the remaining $5.1 "leaked" into the economy. The employment multipliers were 5.3 for catfish farming, 4.0 for catfish processing and 9.3 for support businesses. In other words, for every person employed on catfish farms, more than four jobs were created in other sectors of the county's economy. The value-added multiplier provides an estimate of the additional value added to the product as a result of the economic activity under study. For every $1 paid by catfish farmers, another $7.6 was paid as value added to the Chicot County economy. At the industry level, for every $1 received by the catfish industry, $0.8 is received by the county economy. The corresponding employment and value added multipliers were both 1.8.

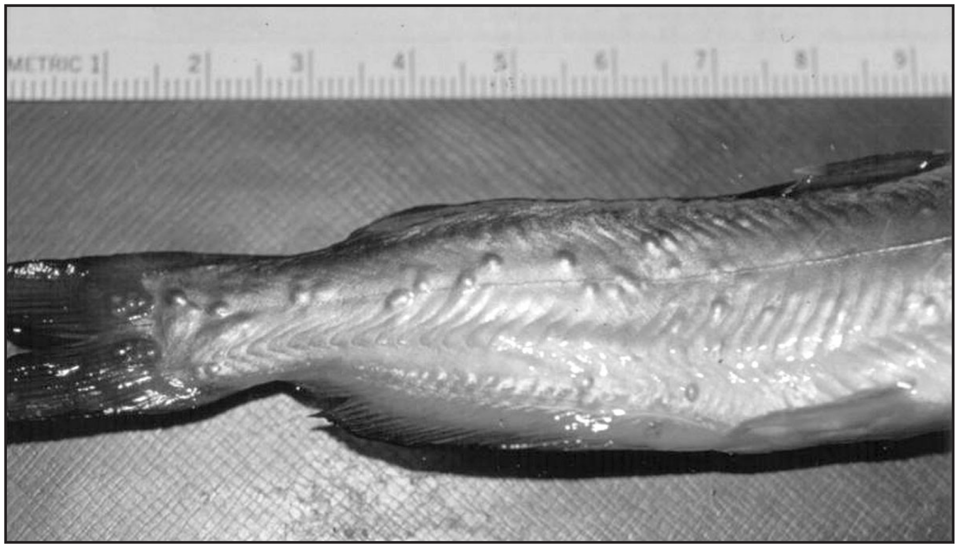
Encouraging the growth of backward-linked industries is one of the strategies used for rural poverty alleviation. As demonstrated in this study, the catfish industry directly and indirectly affects the production and employment of most industries in Chicot County. The catfish industry is an important job-creator in the county and thus an important source of tax revenue for local governments. Its importance to the local economy arises from the industry's demand for various support services that must be supplied locally. The existence of strong backward linkages is important in stimulating the local economy and diversification of local economic activities.

Catfish processing plants have a substantial direct impact on economic output and employment. Catfish farms also have an important effect on economic output and employment, but catfish farming has a much greater effect on economic value added and employment in support sectors. Catfish farming has resulted in substantial development and expansion of support businesses which, in turn, create additional jobs, economic activity and tax revenue.

For a copy of the complete study, contact Cassandra Byrd-Hawkins at 870-575-8123.

Trematodes on Catfish in Southeast Arkansas

Larry Dorman
Extension Fisheries Specialist



Most catfish producers across the nation are aware of the presence of the catfish trematode, (*Bolbophorus sp*.) This parasite was originally discovered in Montana about 40 years ago in trout. In the mid 1990s the trematode was discovered on catfish farms in southern Louisiana. The impact of the trematode has been devastating, and even forced one farm out of business.

In the delta regions of Mississippi and Arkansas, the parasite was reported in the summer of 1999. Originally, the parasite appeared to be more widespread in Mississippi than in Arkansas. Lab reports from Arkansas showed the parasite to occur only on a few farms, those farms closer to the Mississippi River or farms adjacent to large irrigation reservoirs. Now the situation has changed. Fall 2003 reports show the presence of the trematode on farms in the central part of Chicot County. It is likely that the trematode is now widespread in southeast Arkansas.

Understanding the Problem

To understand the trematode problem, one must recognize that a complex life cycle exists involving two intermediate hosts and one final host. *Bolbophorus* life cycle involves these specific hosts: American white pelicans, ram's horn snails and catfish.

The life cycle begins when the adult trematode, living in the digestive tract of the American white pelican, releases eggs that are deposited into the pond when the birds defecate. The eggs hatch into a form called miracidia, which infest the first intermediate host, the ram's horn snail. The miracidia mature in the snail and release larval trematodes called cercariae, which in turn infect catfish. Within the catfish, trematode larvae develop and encyst in the flesh of the fish. The trematode completes its life cycle when a pelican eats the infected catfish.

The only way for a catfish to become infested with the trematode is through this complex life cycle. Fish to fish infestation is *not* possible. Therefore moving fish and equipment from infested ponds will not cause infection of fish in a "clean" recipient pond.

Recognizing Infected Fish

Look for *Bolbophorus* infestations in and around the tail of a catfish. *Bolbophorus* may form small cysts anywhere in the body. They are most commonly found in and around the tail. The cysts are approximately 1/32 to 1/16 inch in diameter and appear as red or white raised bumps just under the skin or anywhere in muscle tissue.

The severity of the infestation may vary. An infestation may have no apparent effect on production. On smaller fish, however, there may be organ trauma and massive mortalities. Larger fish seem to be less susceptible, with lesions generally limited to skin and fins. However, some larger fish are severely infested, feed poorly and are extremely thin.

Preventative Measures

Any pond in southeast Arkansas may be infected, or may become infected with the trematode. Chemical and biological control methods are known to reduce snail populations. For biological control, stock 10 to 20 black carp per acre for snail control, plus 10 to 20 grass carp per acre to control aquatic vegetation on which the snails can thrive.

Some farmers have spent a lot of time trying to control bird activities around ponds as a means of preventing the spread of the trematode. But the white pelican population is ever increasing, as the number and size of protected areas increase. Additionally, many acres of private land are enrolled in the wetland reserve programs, and this increases local pelican populations. Finally, with lower fish prices, farmers do not have the resources, in terms of finance and personnel, to mount aggressive bird control programs.

Scout ponds for the presence of the ram's horn snail. These snails prefer shallow areas of water with abundant quantities of aquatic vegetation. Inspect clumps of vegetation closely for the presence of the snail.

Note fish feeding behavior. If the fish's appetite is reduced, then investigate the reason. If water quality and disease variables are eliminated, then trematodes may be a cause for the behavioral change. Examine fish for the presence of the trematode. This can be accomplished by baiting fish into the corner of a pond and pulling a cutting seine around the fish. Examine 20 to 30 fish and if the trematode is present, then notify a diagnostic laboratory for confirmation.

Chemical Treatments

Promising chemical treatments for the control of the ram's horn snail involve the use of either copper sulfate or hydrated lime.

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Apply copper sulfate at 10 pounds per 250 linear feet of pond levee. Mix dry copper sulfate with 70 gallons of water per 250 feet of pond margin treated. Apply the liquid formulation along the pond bank, in a 6-foot wide band around the pond perimeter.

Copper sulfate is toxic to fish, so check total alkalinity in your pond just before using this chemical. You risk killing fish if you use more than allowed, per acre, based on alkalinity and pond volume. Apply the copper, at a reduced rate if necessary, according to the pond alkalinity at the time of treatment.

Do not treat ponds smaller than 7 acres by this method because the amount of copper sulfate needed around the banks will exceed the amount that can be safely applied to the whole pond. Take care when treating ponds with heavy algal blooms due to potential dissolved oxygen problems. To minimize the impact on algal populations, treat half the pond margin one day and the remainder of the pond several days later.

If you choose hydrated lime, apply it in the dry form at 50 to 75 pounds per 100 linear feet, along the pond levee. Apply the lime along the pond perimeter, up to 4 feet from the bank, 1 to 2 feet beyond any vegetation that extends into the pond. The pH level will increase briefly in the application zone but will not affect fish, as long as total alkalinity is greater than 50 ppm.

Hydrated lime can also be mixed with water and applied as a slurry. This form is usually made by commercial lime venders and delivered to commercial applicators or individual farmers. Formulation rates are 4.0 to 4.7 pounds of hydrated lime per gallon of water. At this concentration, apply 20 gallons of slurry per 100 linear feet of levee.

Unfortunately, the catfish trematode is here to stay. However, with some effort, the impact of the parasite will be minimal.

Upcoming Events

Arkansas Aquaculture 2004
January 15-17, 2004
Annual educational meetings, jointly sponsored by the Catfish Farmers of Arkansas and the Arkansas Bait and Ornamental Fish Growers Association. Austin Hotel, Hot Springs, Arkansas. For registration information contact Bo Collins at (870) 672-1716 or Margie Saul at (870) 998-2585.

Fish Farming Trade Show
February 5-6, 2004
The largest fish farming equipment exposition in the United States will be held at the Washington County Convention Center in Greenville, Mississippi. The event is sponsored by the Catfish Farmers of Arkansas as well as Catfish Farmers of Mississippi, Alabama Catfish Producers and Louisiana Catfish Farmers Association. Before February 3 registration is $15. Mail pre-registration to The Fish Farming Trade Show, 1100 Highway 82 East, Suite 202, Indianola, MS 38751. On-site registration is $20. For more information call (601) 714-5327.

Deadline for Catfish Producer Financial Assistance Applications
February 17, 2004
Catfish producers may obtain an application for the USDA Trade Adjustment Assistance Program (FSA-229) from http://forms.sc.egov.usda.gov/eforms/Forms/FSA0229_030923V01.pdf or from your local Farm Service Agency. Application deadline is February 17. If you choose to participate, plan to attend one of the trainings on March 23 or 24.

Catfish Farmers of America Annual Convention
February 26-28, 2004
The Catfish Farmers of America Annual Convention will be at the Sheraton Hotel in New Orleans. The event will include presentations on industry topics, the annual awards luncheon and business meeting. Call (601) 714-5327 for information.

Aquaculture America 2003
March 1-5, 2004
This annual gathering of U.S. and world producers and researchers will take place in Honolulu, Hawaii. The event includes a trade show and meetings of affiliated aquaculture organizations. See http://www.aquacultureamerica.org/ for more information or call 760-432-4270.

Catfish Producer Technical Assistance
March 23, 2004 - Lake Village
March 25, 2004 -Newport
To be eligible for benefits under the USDA Trade Adjustment Assistance Program, catfish producers must apply by February 17, and then must receive technical assistance through Cooperative Extension. Plan to attend one of the following workshops: in Lake Village, 9:30 a.m., at the Chicot County Extension Service, Conference Room, or in Newport, 9:30 a.m., at ASU-Newport, Center for the Arts. More information on these meetings will be distributed later.

Dr. J. Wesley Neal Joins Aquaculture/Fisheries Center

Dr. J. Wesley Neal has joined the UAPB Aquaculture/Fisheries Center as assistant professor (small impoundments). Dr. Neal holds a Ph.D. degree in zoology and a master's degree in fisheries and wildlife from North Carolina State University.

Dr. Neal's dissertation research involved the use of hybrid striped bass in farm ponds and reservoirs. At UAPB, his responsibilities will include research and Extension programs in community fishing, farm pond management and management of irrigation reservoirs for sport-fishing.

Dr. Neal can be reached at (870) 575-8136 or wneal@uaex.edu.

Dr. J. Wesley Neal

Last Opportunity to Comment on EPA's Proposed Effluent Guidelines for Aquaculture

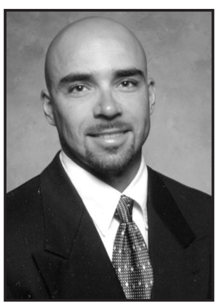
Carole R. Engle, Director

The public has until February 12, 2004 to send comments to EPA regarding the Notice of Data Availability published in the Federal Register on December 29, 2003. This is the last opportunity to review and comment on the accuracy and completeness of the EPA proposed ruling regarding aquaculture effluents. Carole Engle, Nathan Stone, and Hugh Thomforde are members of the Joint Subcommittee on Aquaculture, Aquaculture Effluents Task Force, and can provide more details.

Following the public comment period, additional analyses may be conducted by EPA. Several internal reviews will take place, first within EPA, then by OMB, and then by an interagency panel, before submission to the EPA Administrator for signature and publication in the Federal Register as the Final Rule. The final EPA ruling on aquaculture effluents is scheduled to be signed June 30, 2004. The focus of the Rule is on raceway, net pen and recirculating aquaculture systems that produce more than 100,000 pounds per year. Static pond production systems are *not* being considered in the proposed rule. EPA is expected to release Best Management Practice guidelines for aquaculture.

New Staff for the Aquaculture Verification Programs

Steeve Pomerleau, Research Associate (Aquaculture Verification)



Steeve Pomerleau

Who is this quiet bald-headed guy with the funny accent? Let me introduce myself: I am Steeve "Frenchy" Pomerleau from Quebec, Canada. After completing a degree in biology from Laval University, I conducted research on sea urchin culture for the Canadian Department of Fisheries and Oceans. I moved to Arkansas in 1999 to complete my master's degree in aquaculture at UAPB, where I conducted studies on stocker catfish production.

In the past four years I have gained significant experience in catfish production and aquaculture in general. I am now responsible for the Aquaculture Research Verification Programs, under the supervision of David Heikes. I am very happy about this new position and will do my best to serve the Arkansas catfish and baitfish industries. You may reach me on my mobile phone, (870) 692-3709, or by email at spomerleau@uaex.edu.

A New Start for Aquaculture Research Verification Programs

Steeve Pomerleau, Research Associate (Aquaculture Verification)

A new Catfish Research Verification Program and the first Baitfish Research Verification Program are scheduled to start in the spring of 2004. The catfish program will focus on catfish growout in multiple-batch ponds. The baitfish program will focus on reliable production of juvenile, or "peewee" golden shiners. High yields, and low mortalities are expected. If you would like to be a cooperator or learn more about the programs contact Steeve Pomerleau at (870) 692-3709. You can also browse our Aquaculture Research Verification web site at www.uaex.edu/aquaculture.

The essence of aquaculture research verification is to provide intensive monitoring of commercial ponds in which research-based management protocols are implemented. Program cooperators agree to manage a section of their farm according to Extension recommendations for a period of one or more years. Cooperating producers keep records on production inputs and outputs. Extension personnel collect data at stocking and harvesting events, and visit cooperators on a weekly basis to collect water samples and farm records. This results in a comprehensive database of water quality, input use, stocking and harvesting data from commercial ponds that greatly exceeds the data available from normal farm production records.

The comprehensive quality of the data provides for more accurate estimates of survival, yield and feed conversion ratios than data obtained from normal farm records. The principal benefit of aquaculture research verification is to determine if the total set of research-based Extension recommendations applied on a commercial farm produces yields, feed conversions and costs consistent with results from research trials.

In the fall of 2003, new interdisciplinary verification committees consisting of researchers and Extension specialists were formed to develop revised sets of recommended management practices for commercial catfish and baitfish culture. Recommendations are based on current research, practical experience and previous yield verification trials. Details on the programs and the recommended management practices are available on our Aquaculture Research Verification web site at www.uaex.edu/aquaculture. You may also visit the web site to follow trends in the data from verification ponds. Summaries will also be published regularly in *Arkansas Aquafarming*.

Crude Protein in Commercial Catfish Diets

George Selden
Extension Aquaculture Specialist

Commercial catfish feed comes in a variety of pellet sizes--floating or sinking pellets--and a variety of crude protein levels. The two most common levels are 28 percent and 32 percent crude protein. Farmers choose a particular formulation based upon growth and profitability. Of course, there has been considerable debate on which protein level leads to maximum growth.

Why would it be desirable to limit the total crude protein in practical diets? There are three nutrient groups that can provide energy—fat, carbohydrate and protein. Of these, protein is the most expensive. Reductions in protein content, without a reduction in growth, reduce feed costs. Excess dietary protein is catabolized preferentially over fats and carbohydrates for energy, so it is not available for growth. In addition, excess protein in the diets will lead to greater total nitrogen levels in the pond, fostering troublesome algae growth.

Since it is desirable to limit total dietary crude protein, which level is best? Current research seems to indicate that maximum growth of catfish can be achieved with practical diets containing a crude protein level of 28 percent. The following are representative examples.

In 1999, Robinson and Li fed fish diets containing 24, 28 or 32 percent crude protein, at rates of 80, 100, or 120 lbs/acre/day or to satiation. Results indicated that there were no differences in weight gain based upon the crude protein level. Fish fed at rates below satiation or below 120 lbs/acre/day experienced reduced growth. Visceral fat increased with the amount of feed fed, and higher visceral fat and lower dress-out occurred in those fish fed diets with a 28 percent crude protein. Dietary crude protein had no effect on fillet composition.

In 2002, Ruebush and Engle fed fish to satiation every other day—diets containing 28 or 36 percent crude protein. The results indicated no significant differences in feed conversion ratio, and mean harvested weight and growth of fingerlings and carry-over fish. There were also no significant differences in gross and net yield of carry-over fish.

These types of results correspond with those of one of the first channel catfish nutrition studies, conducted more than 40 years ago. In 1962, Nail and Shell fed fish at a restricted rate, diets with crude protein levels of 6.3, 15.8, 25.3 or 34.8 percent. Weight gain of fish fed 25.3 percent crude protein was higher than those fed 6.3 or 15.8 percent crude protein, but not significantly different than those fed diets with 34.8 percent crude protein.

Some studies show that fish will grow better when fed diets containing a 32 percent or higher crude protein, but these studies involved feeding at a restricted rate. This is not desirable for several reasons.

First, if the farmer is not feeding to satiation, maximum growth is not obtained. Numerous studies have shown that fish fed at restricted rates do not grow as fast as those fed to satiation. They simply do not receive as much food as they can convert into flesh.

A second reason has to do with the under-stocked fish. Most catfish ponds are kept in continual production until the pond needs to be rebuilt. Market sized fish are harvested several times a year, and then the ponds are partially restocked with smaller fish. In these ponds, the smaller stockers are out-competed for food by the bigger fish. Where the fish are fed at a restricted rate, the under-stocked fish do not receive as much feed and therefore take longer to reach a market size.

Finally, protein is the most expensive feed ingredient. Thirty-two percent crude protein feed is typically $8-12 more expensive per ton than 28 percent crude protein feed. Over the course of a summer of feeding, this price difference adds up.

Other variables are considered during diet formulation. These include digestibility of different crude protein sources, essential amino acid profiles of different feedstuffs, and the essential amino acid requirements of channel catfish.

Selection of Air Flow Meters for Compressed Oxygen on Live Bait Haul Vehicles

Hugh Thomforde, Extension Aquaculture Specialist

Excessive oxygen, up to 150 percent saturation, is a common problem on live bait hauling vehicles used for long distance transport. The two main reasons for excess oxygen are lack of oxygen monitoring equipment on the vehicle, and use of flow meters that are out of range for the purpose.

Sturdy industrial flow meters, which read from 0.5 to 15 lpm (liters per minute), are typically mounted on hauling trucks. But flow meters work best in the mid-range, so this unit provides a steady flow of oxygen only in the range from about 5 to 10 lpm. Most 100 gallon hauling boxes require lower flow, of only 2 or 3 lpm. A flow meter that is rated up to 6 lpm would be much better suited for the job. But most flow meters that are designed for these lower flow rates are for hospital use, and not built to withstand moderately harsh field conditions. On the other hand, most of the more durable, industrial, flow meters are not designed for low-flow conditions. Careful selection of the most appropriate flow meters for fish trucks will contribute to years of trouble-free operation, and improved oxygen levels for fish hauling.

High Fat Feeds for Baitfish?

Rebecca Lochmann, Associate Professor
Nathan Stone, Extension Fisheries Specialist

High fat feeds provide advantages in baitfish production, especially with the increasing cost of soybean meal. After all, no consumer of baitfish will ever complain about a fatty taste. Adding extra fat provides inexpensive energy, and spares available protein in the feed and natural foods for growth. High fat diets increase the body fat content of baitfish, which in turn increases their hardiness during production, transport and marketing. Some studies also show that high fat diets increase fish survival. Diets high in both protein and fat may be useful in special cases, such as in feeds for broodfish or for production of "jumbos."

UAPB conducted studies in 2002 and 2003 to determine the effects of high fat feeds on golden shiners. The 2002 study was conducted in outdoor pools that were fertilized before stocking to stimulate plankton production. Small golden shiners weighing 0.73 grams initially (1.6 lb/1000) were stocked at 500 fish/pool. They were fed one of three diets: Diet 1) A standard 28 percent protein commercial baitfish feed containing 5 percent fat; Diet 2) Diet 1 top-dressed with 9 percent poultry fat; and Diet 3) Diet 1 top-dressed with 9 percent menhaden fish oil. The feeding rate was 5-6 percent of body weight daily, divided into two feedings. After three months the pools were harvested. Growth curves showing average weights over time are shown in Figure 1a. Final average weight gain was highest on the commercial diet and the high fat diet with menhaden fish oil. Weight gain of fish fed the high fat poultry diet was lower than fish fed the other diets (P=0.08). Survival was significantly higher in fish fed either of the two high fat diets (P=0.06) than on the regular commercial diet. There was no difference in condition (Fulton's K) of fish due to diet. Feed conversion ranged from 3.9-4.2 and did not differ by diet.

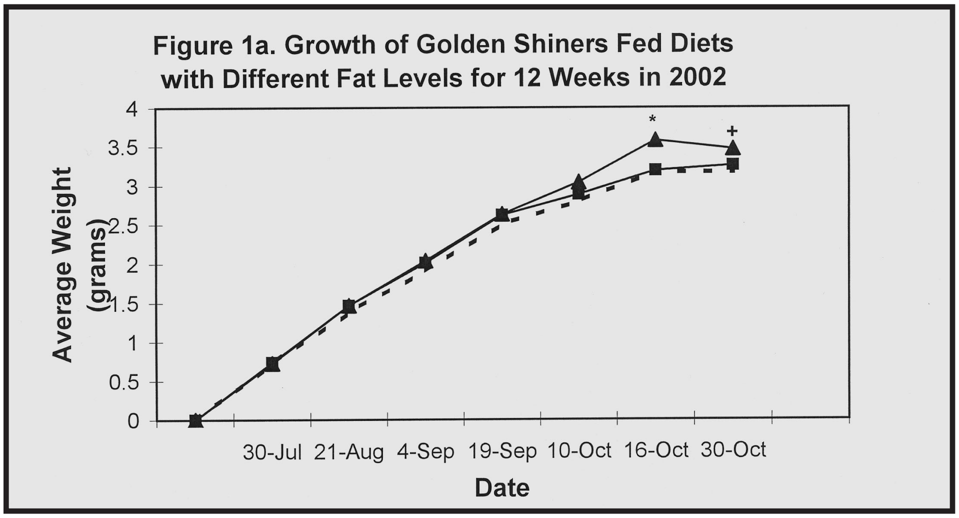


Figure 1a. Average individual weights of golden shiners fed a standard commercial feed (triangles), the commercial feed top-dressed with 9 percent poultry fat (dotted line), or the commercial feed top-dressed with 9% menhaden fish oil (squares). An asterisk (*) denotes significant differences in treatment means at P<0.05); a plus symbol (+) denotes a significance level of P<0.10. Fish size range of 0.7-3.5 grams is approximately equal to commercial baitfish size categories of 1.6-7.7 lbs/1000.

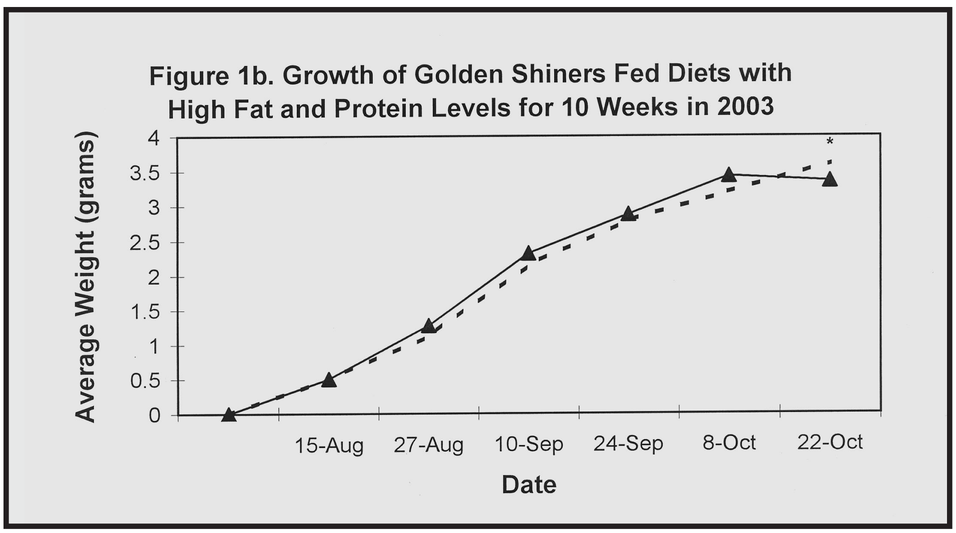


Figure 1b. Average individual weights of golden shiners fed feeds with soy proteins, meat and bone meal, and poultry fat. Both diets were higher in protein and lipid than standard commercial feeds for baitfish but contained no fish meal. Diet 1 (dotted line) contained 44 percent protein and 14 percent lipid and Diet 2 (triangles) contained 47 percent protein and 15 percent lipid. An asterisk (*) denotes significant differences in treatment means at P<0.05). Fish size range of 0.5-3.6 grams is approximately equal to commercial baitfish size categories of 1.1-8.0 lbs/1000.

Fish fed the diet with menhaden fish oil had the lowest mortality when exposed to heat stress (34-35 degrees C) (P=0.03). So compared to the basic commercial 28 percent protein diet, adding extra fish oil improved survival, but not growth. Adding extra poultry fat reduced growth, but also improved survival.

In the 2003 study, diets containing high protein and fat levels were tested in 0.1-acre earthen ponds. Poultry fat was used in both feeds. These diets are of most interest for production of valuable "jumbo" golden shiners, if the fish can be reared to market size in one year. Currently this takes two years. It is expected that late-season grow-out of shiners will benefit from this diet. The rapid growth and accumulation of body fat seen in this study resulted in larger

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fish, better suited to maintain a healthy condition over winter. Fish averaging 0.5 gram initially or 1.1 lb/1000, were stocked at 193 lb/acre and fed 6 percent body weight daily, divided into two feedings, for 10 weeks. The initial feeding rate was 12 lb/acre. One diet contained 44 percent protein and 14 percent fat, while the other contained 47 percent protein and 15 percent fat. Growth curves showing average weights over time are shown in Figure 1b. Fish fed the higher protein and fat diet had higher average final weight, Fulton's K condition index, and relative weight condition index ($P<0.05$) than those fed the diet with slightly lower protein and fat levels. At harvest, total yield was 879 – 928 lb/acre and feed conversion ratio was 1.1-1.2, but with no significant differences between diets. On average, fish weighed 3.5 g, (equivalent to 7.7 lb/1000, or 131 fish/lb). Feeding either of these high-protein feeds for 10 weeks resulted in a net increase in fish standing crop of about 700 lb per acre.

More study is needed to decide if these alternative diets will improve the economics of baitfish production, depending on variations in feed prices and other factors. More work is also needed to evaluate the potential effects of high fat feeds on fish health and survival through the marketing process.

Hugh Thomforde
Dr. Hugh Thomforde
Extension Aquaculture Specialist
Technical Editor

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