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University of Arkansas at Pine Bluff

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Comparison of Sorghum and Corn Distillers Dried Grains with Solubles in Diets of Channel Catfish

Rebecca Lochmann, Professor-Fish Nutrition/Feeds, UAPB and Harold Phillips, Research Specialist-Fish Nutrition/Feeds, UAPB

By-products of the biofuels industry such as distillers dried grains with solubles (DDGS) can be effective ingredients in lower-cost diets for catfish. Corn DDGS come in different forms (such as regular or solvent-extracted), and appear to be palatable and to support catfish performance similarly to other plant proteins. However, the cost of corn DDGS products can be higher than those of DDGS from other sources such as sorghum. Like corn DDGS, the production of sorghum DDGS has increased with the growth of the biofuels industry. Sorghum DDGS has not been tested in diets for channel catfish, but has the potential to reduce diet cost if it performs similarly to corn DDGS as a feed ingredient.

We conducted a feeding trial with catfish fingerlings in tanks to determine the effects of diets with 32% protein and different protein sources ((soybean meal, sorghum DDGS, or solvent-extracted (SE) corn DDGS)) on growth, survival and feed conversion. Diets contained: 1) 0% DDGS (soy control); 2) 10% Sorghum DDGS; 3) 20% Sorghum DDGS; 4) 10% corn SE-DDGS; or 5) 20% corn SE-DDGS. Fish were fed the diets to satiation twice daily on weekdays and once daily on weekends for 7 weeks.

Weight gain was higher in catfish fed diets with 20% sorghum or 20% corn DDGS than those fed the soy control or diet with 10% sorghum DDGS (Table 1). Feed conversion was also better in fish fed diets with 20% DDGS (from sorghum or corn) than those fed the soy control, while the FCR was intermediate for fish fed the diets with 10% DDGS. Survival was 90% or higher in all treatments and did not differ among diets. Results indicate that sorghum and corn DDGS both enhanced fingerling performance compared to the control diet with no DDGS. Sorghum and corn DDGS are both cheaper than soybean meal, so partial substitution of DDGS for soy should reduce diet cost while maintaining or improving production. Sorghum DDGS is also lower in xanthophylls (yellow pigments) than corn DDGS, but the supply of corn DDGS exceeds that of sorghum DDGS currently. Possibly, a mixture of corn and sorghum DDGS could be used to enhance catfish performance while reducing xanthophyll content and cost of the diets. Further research is also needed to determine the effects of sorghum DDGS on larger catfish. However, there were no adverse effects on smaller fish, indicating that this is a safe and effective alternative ingredient for catfish.

Table 1. Performance of channel catfish fingerlings fed 32% protein diets with soybean meal, sorghum DDGS, or corn SE-DDGS for 7 weeks.

Indicator	No DDGS (soy control)	Sorghum (10%)	Corn (10%)	Sorghum (20%)	Corn (20%)
Mean weight gain (g)	9.4 C	10.4 C	11.6 BC	12.6 AB	13.0 AB
Feed Conversion (fed/gain)	1.6 C	1.5 BC	1.3 AB	1.3 A	1.4AB
Survival (%)	94.0	93.8	96.3	100.0	90.0

Means within rows with different letters were significantly different ($P<0.05$) based on 1-way ANOVA and Fisher's LSD tests.

Solvent-Extracted Distiller's Dried Grains with Solubles Show Promise in Channel Catfish Diets

Nilima Renukdas, Research Specialist, UAPB, Carole Engle, Professor, Economics/Marketing, UAPB, Brian Bosworth, Research Geneticist, USDA/ARS and Rebecca Lochmann, Professor, Fish Nutrition, UAPB

High feed prices continue to drive the search for new ingredients and formulations that have the potential to lower catfish feed costs. In 2011, a new ingredient, solvent-extracted distiller's dried grains with solubles (SE-DDGS) was tested as a feed ingredient to evaluate its effect on pond production performance of channel catfish. SE-DDGS is a new form of distiller's dried grains with solubles that has not been evaluated previously. Four diets were tested: 28% and 32% protein diets with and without SE-DDGS (Table 1). Feed costs (bagged feed) at the time feed was formulated as compared to the 32% protein traditional diet, were: $30/ton less for the 32% protein SE-DDGS diet, $18/ton less for the 28% protein traditional diet and $46/ton less for the 28% protein SE-DDGS diet (Table 2).

Channel catfish were stocked March 30, 2011 into twenty 0.25-acre earthen ponds at the UAPB Aquaculture Research Station. Each pond was stocked with 6,000 fingerlings/acre (mean weight 31 lb./1000, total length 5 inches) and 1,500 lb/acre of large, carryover fish (mean weight 0.5 lb) to simulate commercial farming conditions. Fish were fed once daily to satiation (quantity of feed consumed in 10-15 minutes). Ponds were harvested after 186 days of culture and all fish were counted and weighed. Twenty market-sized fish from each pond were transported to the USDA/ARS Catfish Genetics Research Unit where processed yields were determined. Results of the study showed that inclusion of SE-DDGS in the diet had little effect on carryover fish (Table 3). There were no statistically significant differences among the four diets in terms of gross and net yields, survival or growth of carryover fish. Results did show greater gross yield, net yield, survival and growth of fingerlings when fed the SE-DDGS diets, which resulted in greater total yield of fish on diets with 28% protein. A 2-way ANOVA showed that total yield was higher on 28% vs. 32% diets and on SE-DDGS vs. traditional diets. The fish fed the 28% protein SE-DDGS diet ate more feed but converted it as effectively (or better) than fish fed the other diets (Table 4). There were few differences in processing yields resulting from the different diets (data not shown).

Overall, fish fed the diets that included SE-DDGS performed at least as well as those fed the industry standard diets. No adverse effects were found to the use of SE-DDGS in diets for channel catfish. When prices of SE-DDGS result in reduced cost of the fish feed diets, inclusion of SE-DDGS appears feasible. Additional work is warranted on this new ingredient.

Table 1. Ingredient composition of experiment diets (%, as-fed).

Ingredients	32% protein		28% protein	
	Traditional diet	SEDDGS diet	Traditional diet	SEDDGS diet
Soybean meal (48%)	52.3	42.0	40.6	30.4
Cottonseed meal (41%)	10.0	10.0	10.0	10.0
SE-DDGS[a]	0	20.0	0	20.0
Corn	29.4	19.8	31.1	21.3
Wheat middlings	5.0	5.0	15.0	15.0
Lysine-HCl	0	0.15	0	0.25
Monocalcium phosphate	1.13	0.93	1.08	0.88
Vitamin premix w/Stay C[b]	0.1	0.1	0.1	0.1
Trace mineral premix[c]	0.1	0.1	0.1	0.1
Fat[d]	2.0	2.0	2.0	2.0

[a] Solvent-extracted distillers dried grains with solubles.
[b] Meet vitamin requirements of channel catfish.
[c] Meet trace mineral requirements of channel catfish.
[d] Menhaden oil: catfish oil (1:1); sprayed on finished diets.

Upcoming Events

2013 Arkansas Bait and Ornamental Fish Growers Meeting
Feb. 7, Lonoke Agriculture Center, Lonoke, Ark.
Annual educational meeting sponsored by Arkansas Bait and Ornamental Fish Growers Association. For information contact Sathya Kumaran at (501) 676-3124.

Catfish Farmers of America/ Catfish Farmers of Arkansas
February 14-16, Peabody Hotel, Little Rock, Ark.
For information contact Bo Collins at (870) 672-1716.

Aquaculture 2013
Feb, 21-25, Nashville, Tenn.
The International Triennial Meeting of the National Shellfisheries Association, American Fisheries Society Fish Culture Section and the World Aquaculture Society. For information contact the Conference Manager at (760) 751-5505.

Aquaculture Basics
Feb. 16, University of Kentucky Research and Education Center in Princeton, Ky.
Topics to be discussed include understanding the relationship among pond productivity, feeding and aeration, fee fishing or pay lake management, including regulations, fish care, stocking rates, pond construction, water quality and aquatic plant management. For information contact William Wurts at 270-365-7541, ext. 200, Email: wwurts@uky.edu or Forrest Wynne at 270-247-2334 Email: fwynne@uky.edu.

Aquaculture Production Systems
March 2, KSU Aquaculture Research Center in Frankfort, Ky.
Topics include the essentials of pond production, the use of airlift pumps, a basic overview of fish production in cages, net pens and flow-through raceway systems, facility site selection, water quality, fish species, diseases, and recirculating aquaculture systems. For information contact: William Wurts at 270-365-7541, ext. 200, Email: wwurts@uky.edu or Forrest Wynne at 270-247-2334 Email: fwynne@uky.edu.

Table 2. Feed prices of diets used for 2011 feed study.

Dietary Protein	Traits	Price of Bagged feed ($/ton, 2011)
32%	No SEDDGS*	482
32%	20% SEDDGS	452
28%	No SEDDGS*	464
28%	20% SEDDGS	436

* SE-DDGS = Solvent-extracted distiller's dried grains with solubles

Table 3. Yield, survival, growth rate and final weight at harvest of fingerling and carryover channel catfish.

		32% protein		28% protein		*P*-value		
Parameters	Unit	Traditional diet	SEDDGS diet	Traditional diet	SEDDGS diet	Protein	Quality	Interaction
Gross Yield								
Fingerling	lb/acre	2,291±277	2,599±113	2,545±416	3,290±441	0.013*	0.007*	0.213
Carryover	lb/acre	5,365±438	5,964±716	6,040±346	6,276±461	0.069	0.118	0.480
Total	lb/acre	7,656±460	8,563±635	8,585±432	9,566±508	0.002*	0.002*	0.886
Net Yield								
Fingerling	lb/acre	2,104±277	2,412±113	2,358±416	3,103±441	0.013*	0.007*	0.213
Carryover	lb/acre	3,865±438	4,464±716	4,540± 346	4,776±461	0.069	0.118	0.480
Total	lb/acre	5,969±460	6,876±635	6,898±432	7,879±508	0.002*	0.002*	0.886
Survival								
Fingerling	%	65±8	70±5	73±11	84±7	0.012*	0.046*	0.842
Carryover	%	92±8	97±8	98±6	99±9	0.320	0.430	0.646
Total	%	74±5	79±2	81±7	89±5	0.003*	0.019*	0.496
Growth rate								
Fingerling	lb/day	0.003±0.0	0.003±0.0	0.003±0.0	0.003±0.0	0.864	0.013*	0.781
Carryover	lb/day	0.008±0.0	0.008±0.0	0.008±0.0	0.008±0.0	0.653	0.936	0.015
Final weight								
Fingerling	lb	0.58±0.0	0.62±0.02	0.58±0.02	0.62±0.02	0.829	0.013*	0.820
Carryover	lb	1.91±0.02	2.02±0.09	2.03±0.07	1.93±0.08	0.657	0.956	0.016*

The columns, labeled "Protein," "Quality," and "Interaction," show results of two-way factorial analysis that separates and compares results of the 32%, 28% protein diets ("Protein") and 32% with 20% DDGS and 28% diets with 20% DDGS ("Quality"). The "Interaction" heading shows that the protein levels and diet ingredients did not combine to produce significant effects. Values (mean ± SD) across table with sign '*' show significant difference at $P<0.05$.

Table 4. Total feed fed, mean daily feed and feed conversion ratio at harvest of fingerling and carryover channel catfish.

		32% protein		28% protein		*P*-value		
Parameters	Unit	Traditional diet	SEDDGS diet	Traditional diet	SEDDGS diet	Protein	Quality	Interaction
Total feed	lb/acre	11,568±340	12,132±663	11,866±520	13,097±250	0.022*	0.003*	0.195
Mean daily feed	lb/acre/day	71±2	74±4	72±3	80±2	0.023*	0.002*	0.213
FCR[a]	Ratio	1.94±0.13	1.77±0.07	1.72±0.06	1.67±0.11	0.003*	0.025*	0.205

[a] Calculated by dividing the quantity of feed by the net yield.
Values (mean ± SD) across table with sign '*' show significant difference @ p<0.05.

Three Employees Join UAPB's Aquaculture/Fisheries Center of Excellence

Dr. Jeonghwan Park has joined the Aquaculture/Fisheries Center of Excellence at the University of Arkansas at Pine Bluff as an assistant professor of aquaculture and aquacultural engineering. Previously, Dr. Park worked as a research scholar in the aquaculture and engineering fields in the Department of Biology, North Carolina State University. He collaborated with many researchers and farmers on an effluent management study for hybrid striped bass ponds and developed techniques for over-wintering hybrid striped bass in tank-based culture systems. As a head designer, he also participated in engineering projects to building inland tank-based commercial fish farms for freshwater culture of southern flounder. In addition, he directed construction of sturgeon culture systems for caviar and meat production, and joined in several other engineering-related projects.

He spent 10 years at the Freshwater Fish Farming Research Station of Pukyong National University located in Busan, South Korea. During that time, he assisted with several diverse research projects in ponds and recirculating systems with freshwater fishes such as carps, koi, goldfish, tilapia, Asian sea bass, catfishes, rainbow trout, and eels. After that, he served for 6 years as an adjunct professor and a research associate with extension responsibilities at the Department of Marine Bio-Science, Gangwon Provincial College in South Korea. He taught various topics on aquaculture and participated in projects related to the development of aquaculture systems and management regimes for both freshwater and seawater species. As a result, he has hands-on knowledge and experience of aquaculture and engineering in various settings.

At UAPB, Dr. Park will be working on engineering designs with David Heikes, the engineering specialist, to refine the application of split-pond systems for catfish, baitfish and other species with potential to be commercially important in Arkansas. He will teach an undergraduate course in aquaculture, a graduate course in advanced aquaculture and two aquacultural engineering courses. You can contact Dr. Jeonghwan Park at jpark@uaex.edu or via phone at 870-575-8128.

Matt "Rex" Recsetar has been hired as an Aquaculture Extension Specialist at UAPB. He came to Arkansas from the University of Arizona, where he got his master's degree in fisheries science.

During his time in graduate school, Recsetar also completed the McGuire Entrepreneurship Program where he developed an urban entertainment fishing and aquaculture business. As a result of the program and through his graduate studies, he gained experience in business plan authoring, aquacultural engineering, fish diseases, recirculating aquaculture systems and working with a variety of aquatic species including channel catfish, tilapia, largemouth bass, crayfish and various trout species.

His master's research focused heavily on the thermal tolerance of fish at different life stages, and so he has a thorough understanding of fish physiology and morphology. In addition, Recsetar has a propensity for innovation and his creative thinking has allowed him to solve or improve many aquacultural dilemmas he has encountered. In his current role, he will be in charge of the research verification program. You can contact Rex at mrecsetar@uaex.edu or via phone 870-575-8139 or mobile 847-814-2741.

Dr. Jeonghwan Park

Matt "Rex" Recsetar

Scott Jones is the newest Extension specialist to join the Aquaculture/Fisheries Center of Excellence. Jones will be an instructor/Extension specialist-small

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Hot Temperatures Led to Warmer Pond Temperatures

Anita Kelly, Extension Fish Health Specialist, UAPB

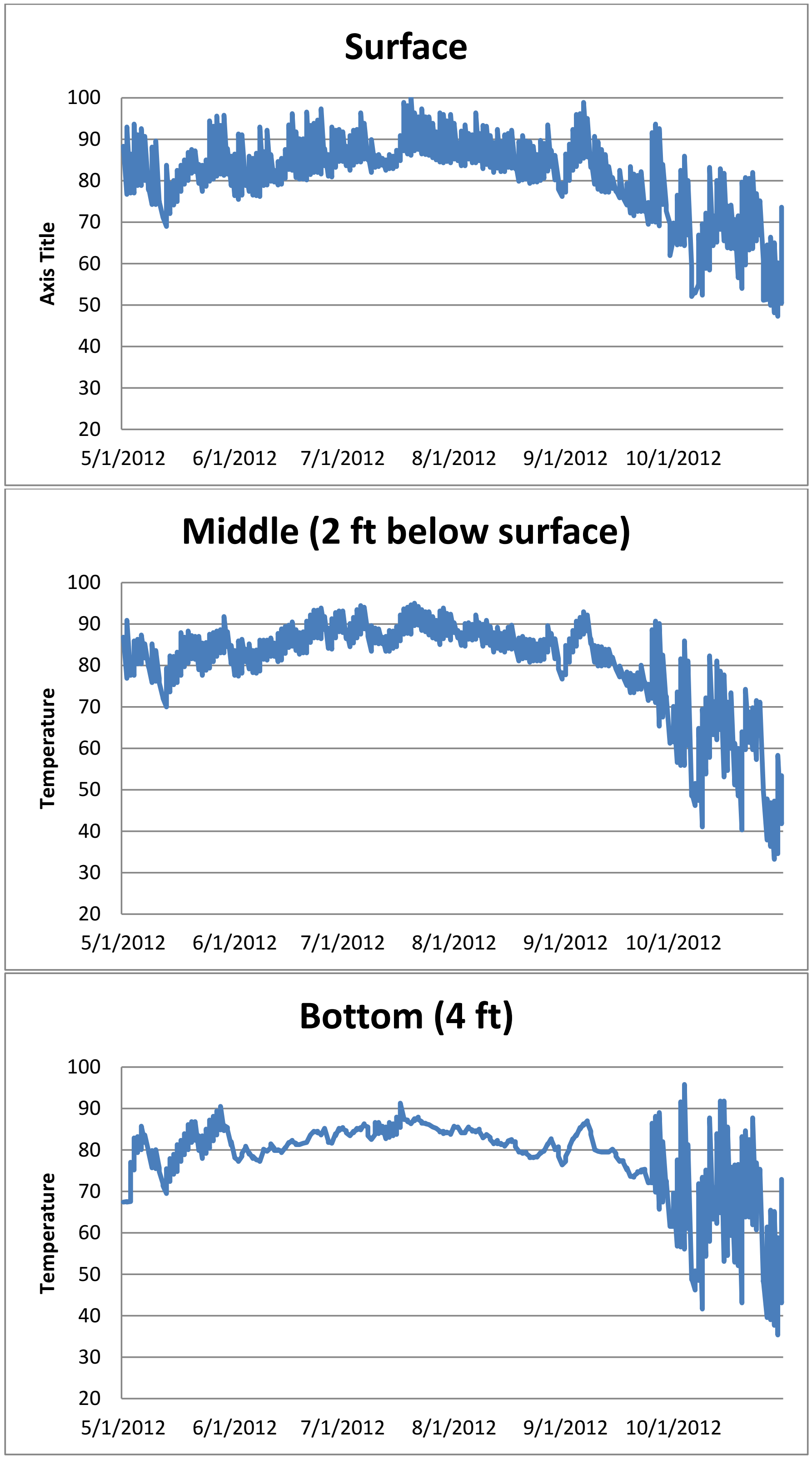
Hot temperatures throughout the spring and summer of 2012 brought warmer water temperatures in fish ponds. The Aquaculture/Fisheries Center has been recording water temperatures in catfish ponds in Arkansas since late 2010. Temperature recorders were placed at 0, 2 and 4 foot water depths in three ponds in Northern Arkansas, three ponds in Central Arkansas and three ponds in Southern Arkansas.

Figure 1 is a set of graphs showing water temperatures at the three depths in one pond in central Arkansas. Surface temperatures were often above 90 °F from mid-June through September and several times was nearly 100 °F.

During the same time period water temperatures in the middle, which was 2 ft below the water surface, was above 90 °F on numerous days. Even the temperatures 4 ft below the surface was consistently above 80 °F. High water temperatures for extended periods can cause significant problems for fish.

Warmer water contains less dissolved oxygen, fish metabolism is high so growth rates often slow down, fish are stressed and disease outbreaks often occur. To prevent water quality problems many producers will stop feeding when water temperatures get too high.

Figure 1. Daily catfish pond temperatures as recorded at the surface, middle (2 ft below the surface) and bottom of pond (4 ft below the surface). Temperatures were recorded at 6:00 am and 6:00 pm and are in °F.



Smallmouth Buffalo - A Potential Crop?

George Selden, Extension Aquaculture Specialist, UAPB

The smallmouth buffalo (*Ictiobus bubalus*) has received attention lately. With increasing interest in split-pond catfish production systems, the incidence of proliferative gill disease (PGD or "hamburger gill") in these systems can severely limit production, and the farmer's ability to fully utilize these systems. Smallmouth buffalo primarily feed on the bottom consuming insect larvae algae, detritus and Dero worms. It is this predation on Dero worms that recent research has indicated has the potential to reduce instances of PGD.

The smallmouth buffalo's native range includes the larger tributaries. Native to the Mississippi River, from Montana east to Pennsylvania and West Virginia, and it is also found in Gulf slope drainages from Alabama to the Rio Grande River drainage. This range includes areas where market-sized fish can be sold live, as food, in the ethnic markets were live Bighead Carp can no longer legally be sold.

This leads to some basic questions; how do you spawn and raise them, and once you've got food sized fish, can they be sold? It might be easier to address the second question first. While it is very difficult to obtain specific information the market demand for smallmouth buffalo, there is a demand for buffalo fish in general, which includes the largemouth buffalo and black buffalo. According to 2005 statistics, the slaughter markets processed 723 million pounds of fish, including smallmouth buffalo. A notation on the Texas Parks and Wildlife website states that smallmouth buffalo is the #1 species sold by commercial freshwater fishermen. A fact sheet from the Georgia Aquarium notes that "smallmouth buffalo, like the bigmouth buffalo, is of economic importance, contributing significantly to the commercial harvest of fish in the central states."

In 2006, surveys were conducted of ethnic markets and restaurants that sell live seafood in the Boston are through the Washington D.C. area, and also in-store surveys at retail markets in New Jersey, New York and Pennsylvania at the behest of Rutgers University, the New Jersey Department of Agriculture and Delaware Sea Grant. This survey data indicates that buffalo were a preferred fish 18% of the time, behind only tilapia, hybrid striped bass and crab/lobster, but above carp. The New Jersey Department of Agriculture also maintains a voluntary web listing of markets that sell live seafood. There are 45 markets listed from six eastern states (NY, NJ, PA, MA, VA, & MD). Of these 45 markets, 17 (38%), have buffalo as one of the species they sell. So, it can safely be said that buffalo fish, including smallmouth buffalo, are commercially harvested and are sold, and that there are customers who consider buffalo a fish of preference. What isn't known is the price they can command on the open market.

The life history of the smallmouth buffalo is not well understood and much of the existing information is from decades ago. In a 1922 article, mature fish were stocked into a pond at a rate of 12-20 fish/acre with a male to female ratio of 3:1 several weeks prior to spawning. The ponds were only ¼ full at the time of stocking and then gradually filled to simulate the spring flooding. Natural spawning activity was observed when the water temperatures were 56-58°F, but was very slow until the temperatures reached 60-62°F. This spawning temperature preference was confirmed in a 1952 study as well. In that study, after initial stocking of 7 males and 5 females in a 1.3 acre pond, the water temperatures dropped into the 40's. When a heavy rain raised the water level by one foot, spawning activity was observed the next day which coincided with water temperatures of 62°F. From data obtained using temperature loggers in northeast Arkansas catfish ponds, this time period coincides with the mid-late March to early April.

Smallmouth buffalo scatter adhesive eggs along the bottom and provide no parental care. They will scatter them along all bottom types, but seem to show a preference for spawning over vegetation and submerged objects when they are available. This pattern was repeated in the 1922 study were vegetation had been allowed to grow on the bottom, and in 1952 when hay was scattered throughout the pond. In the 1922 study, eggs were allowed to hatch in the pond and because of the vegetation, providing food was not necessary. After one year, the fish weighed from 4oz to 1 ½ lbs. The pond in 1951 was drained after 5-weeks and 15,000 fingerlings were harvested at 7.5lb/thousand (11,500 fish/acre).

Also in the 1951 study, mature fish were held in hoop nets and observed for spawning activity. After a heavy rain, this was observed. At that point, fish were strip-spawned, the eggs treated with cornstarch to prevent sticking, stirred with a feather until water hardened (about 1 hour) and hatched in jars. With water temperatures from 57-62°F, hatching started in 12 days and was completed within 2 days. During this time, eggs were treated for fungus and dead eggs removed. It took 2-4 days for the fry to become swim-up fry at which time they were transferred to a prepared pond at a rate of 700,000/acre. This was felt to be too heavy, so they were restocked into a bigger pond after 7 weeks. At this time, the fish average 3" and were at 10lb/thousand.

Fish become sexually mature at around 1lb, regardless of age. Females will lay 18,000-500,000 eggs/year. Spawning is stimulated by an increase in water coinciding with increasing water temperatures, with 60-64°F being optimal. They prefer a substrate, which indicates that spawning mats used for golden shiners or goldfish might be suitable. It is also quite possible that these mats could be then brought into hatcheries similar to golden shiners and goldfish.

In summary, it appears that successfully spawning and raising smallmouth buffalo is relatively easy. If the split-pond catfish production systems become more common, smallmouth buffalo could play an important role in reducing PGD outbreaks. This will naturally lead to fish that need to be sold and evidence indicates that there are markets where these fish can be sold. What isn't known is whether the costs of production will be met by the sale price. Further study on the economics of smallmouth buffalo culture will be required to answer this question.

New Markets for Largemouth Bass Open in New York

Anita M. Kelly, Extension Fish Health Specialist, UAPB

As of January 2, 1013, black bass can now be sold for human consumption in the state of New York. This will open a new market arena for largemouth bass producers in the state of Arkansas. The new regulations can be found in the New York Registry under I.D. No. ENV-18-12-00002-RP. Although the new legislation is under black bass, only largemouth bass can be sold as a food fish. A New York Department of Environmental Conservation (NYS DEC) permitted facility (in-state or out-of-state) will be allowed to sell largemouth bass as a food. You may obtain a hatchery permit application from the NYSDEC, Bureau of Fisheries, 625 Broadway, Albany, NY 12233-4753, which should be filled out and returned to the same address. Hatchery permits are valid on a calendar year basis.

The new law has specific criteria defining what constitutes a fish farm, along with an extensive paper trail tracking each largemouth bass sales transaction from the farm to the final customer. All licensed black bass hatcheries and persons engaged in the wholesale commerce of black bass must retain copies of any bill of sale and make such records readily available for inspection by the New York Department of Environmental Conservation for two years after each sale of black bass. To prevent wild fish stocks from being sold in the marketplace, sportsman and the public at large will not be able to sell any black bass whatsoever and will be severely prosecuted if attempting to do so. If you have additional questions regarding this new regulation please contact New York Department of Environmental Conservation's Bureau of Fisheries at 518-402-8890.

Aquaculture/Fisheries Center Hosts Events

The UAPB Aquaculture/Fisheries Center held its annual Aquatic Sciences Day on Sept. 20, 2012. A record number of 940 senior high school students, teachers and chaperones from 19 high schools participated. The students were given hands-on instructions for activities geared toward aquaculture and fisheries.

The Center hosted its biennial Aquaculture/ Fisheries Field Day October 4, 2012. Congressman Rick Crawford was the featured speaker. More than 200 participants were in attendance.


Aquatic Sciences Day


Aquaculture/Fisheries Field Day

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impoundments. The Texarkana, Texas native has a MS degree in aquaculture and fisheries from UAPB and a BS degree in range, wildlife and fisheries management from Texas Tech University in Lubbock, Texas.

Jones will develop an Extension and research program related to managing farm ponds and reservoirs, and teach an undergraduate course in recreational fishing. He will also develop a youth fishing education program and serve as coach of the UAPB Competitive Fishing Team.

He was president of the Texas Tech Bass Anglers prior to coming to UAPB where he founded the UAPB Bass Team in 2011. That same year, the team finished second in the Boat U.S. National Championship at Lake Lewisville in Texas. Later that year, UAPB won Team of the Year in the inaugural Arkansas Collegiate Series. He has been a featured guest on Americana Outdoors and Cabela's Fisherman's Handbook for winning the Berkley Conservation Institute presentation competition in 2011.

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Arkansas Aquafarming is published quarterly. Web address: www.uaex.edu/aqfi/newsletters
The purpose is to advance aquaculture production in Arkansas by providing reliable, practical, timely information.