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Comparison of Different Pond Production Systems for Raising Largemouth Bass

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The Largemouth Bass (LMB), *Micropterus salmoides* is a centrarchid freshwater species native to North America and the most sought-after sport fish in the U.S. In addition to being a prized sport fish, the demand for LMB in the food fish market, particularly fresh Asian markets, has increased dramatically in recent years. Arkansas is the leading producer of food size LMB in the U.S. and provides a large percentage of LMB sold to Canada.

While the outlook for LMB as fresh products appears promising, farmers raising LMB in traditional levee ponds have reported variable survival, growth and food conversion ratios (FCRs). Because of the variable efficiency and results achieved using traditional production methods, several Arkansas farmers have expressed interest in alternative production technologies such as split-pond production systems and intensively aerated ponds. While these systems have been recently tested in the catfish industry, to our knowledge, there is no data on the suitability of some of these alternative production systems for LMB.

Hence, the aim of this study was to compare four different production systems for raising LMB for the food fish market to assess the possibility of increasing production with alternative rearing techniques. In addition to alternative production systems, farmers raising LMB have reported issues with hydrogen sulfide in their ponds. PondDtox®, a bacterial product which is comprised of *Paracoccus pantotrophus*, has been used by several Arkansas baitfish farmers as a means to reduce hydrogen sulfide and improve overall pond water quality. While this product has been tested in a limited number of LMB ponds in which fish are being raised for the sport fish market, it has not yet been evaluated in food fish production ponds which receive higher feed inputs and theoretically could have more issues with hydrogen sulfide.

In the summer and fall of 2015, a study was conducted in twelve 0.1 acre ponds at the Aquaculture Research Station at the University of Arkansas at Pine Bluff. The treatments (three replicates per treatment) consisted of traditional ponds, traditional ponds with addition of PondDtox®, high aeration (10 HP/acre) ponds and split ponds. All treatments, except the high aeration treatment, had 5 HP/acre of aeration. The first two production systems (traditional, traditional + PondDtox®) were stocked at 3,000 fish per acre which is the typical stocking density used by commercial producers for LMB raised as food fish. The other two production systems (high aeration, split pond) were stocked at higher rates (5,000 fish per acre). Ponds were stocked with feed-trained LMB fingerlings (average individual weight of 128±47.6 g). Initial lengths and weights were determined for 113 individual fish (Figure 1). Fish were fed four times per day to satiation with a formulated feed (Skretting) that was 48% protein and 18% lipid. Sampling of one pond per treatment was performed bi-weekly. Mortality was checked twice daily. Water temperature and dissolved oxygen were measured twice per day. Pond water was sampled weekly and analyzed for total ammonia nitrogen, nitrite nitrogen and nitrate nitrogen.

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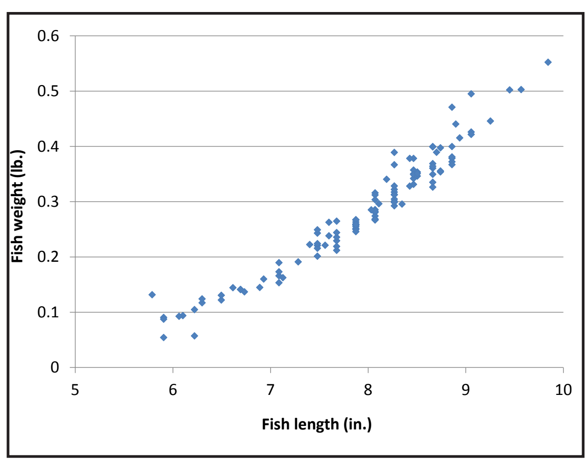

Figure 1.

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Following 157 days the ponds were harvested by seine. Each individual pond was also drained so all fish could be recovered. During harvest LMB were group weighed. Individual total lengths and total weights were measured on 75 fish from each pond to determine condition factor and length/weight distribution. Survival, final weight, biomass gained, FCR, specific growth rate (SGR) and weight gain rate (WGR) were also determined.

There was a low dissolved oxygen event in one pond that had an aerator failure which resulted in a few mortalities. Besides that one event, water quality remained acceptable in all ponds throughout the experimental trials. During the peak of summer, pond water temperatures exceeded 90°F on many occasions and remained hot for several weeks, resulting in a period in which none of the fish fed well in any of the treatments. However, when water temperatures began to cool in September fish began feeding normally again.

There were significant differences in final weight, condition factor, biomass gained, SGR and WGR. Performance was similar (no significant differences) between the traditional and traditional pond + PondDtox® treatment. But, LMB from the split pond and high aeration treatment had lower final weights than the traditional pond and traditional pond + PondDtox® treatments (Figure 2). Condition factor, SGR and WGR were lower in the split pond treatment. The split pond and high aeration treatment had approximately 50% higher biomass gain than traditional and traditional + PondDtox® treatments. There were no differences in survival or FCR among treatments. Relative frequency distribution at harvest suggests a better performance for fish reared in traditional ponds with 88.4% of the population reaching 0.88 to 1.76 lbs, followed by the traditional + PondDtox (84.9%), high aeration (80.9%) and the split-pond system with 77.8% of the fish falling in that weight range (Figure 3).

While the split pond and high aeration treatments had lower final weights compared to the two traditional pond treatments, these technologies are still promising given the much higher stocking rates that were utilized (5,000 fish per acre compared to 3,000 fish per acre) and the significantly higher biomass produced under those culture conditions. Presently, there is one commercial LMB producer in Arkansas experimenting with split ponds and there are several others that are interested. The typical level of aeration used by producers for commercial ponds is 2-3 HP/acre of aeration, and to our knowledge, increased aeration levels (such as 10 HP/acre) have not been tested on commercial LMB farms. Additional data is needed in research and commercial settings to further understand the benefit of these alternative productions systems for LMB and whether their implementation at the commercial level is economically feasible.

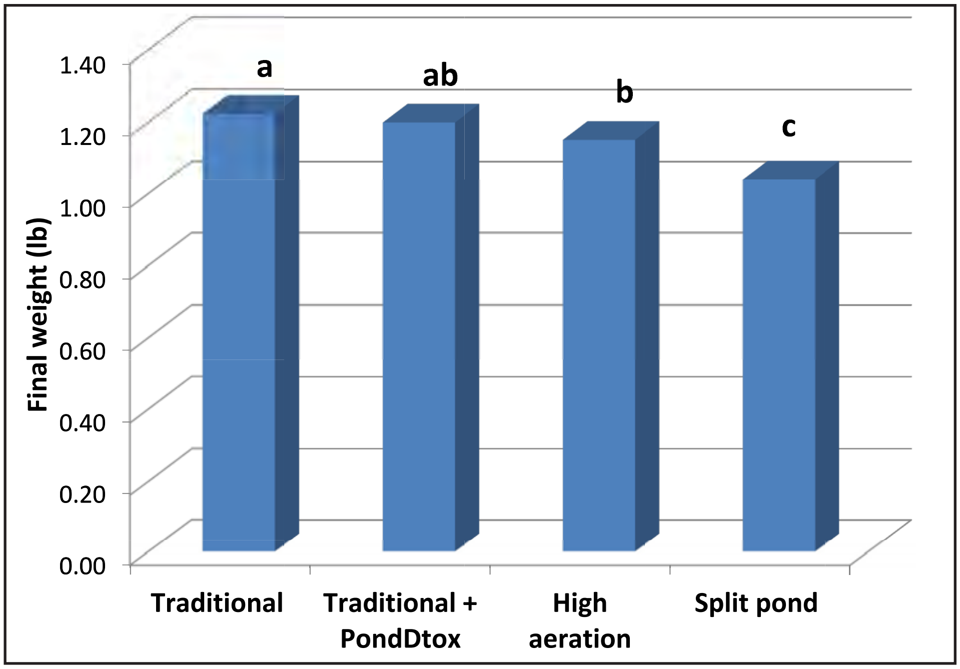

Figure 2.

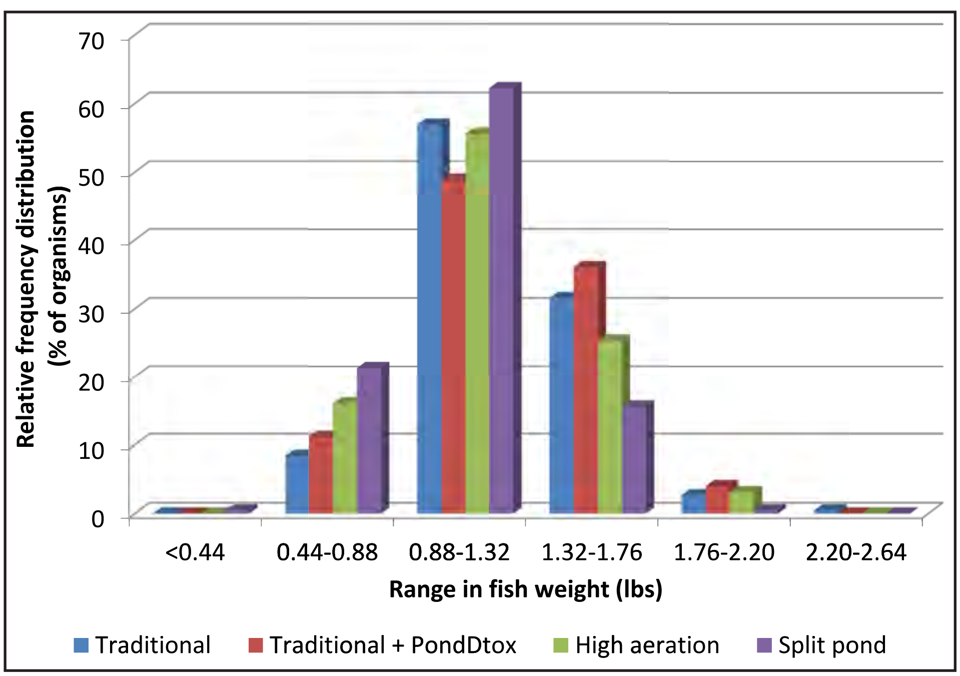

Figure 3.

Growing Largemouth Bass for Food

Matthew A. Smith, Extension Aquaculture Specialist, Ohio State University; Luke A. Roy, Extension Aquaculture Specialist, Auburn University

State agencies and private farms have cultured largemouth bass *Micropterus salmoides* (LMB) for stock enhancement in lakes, ponds and reservoirs across the United States for many decades. Anglers find this fish highly desirable because of its ferocious behavior and large adult size. To reduce hatchery costs, most LMB are stocked as fingerlings. For this reason, research has historically focused on pond spawning, fingerling culture and LMB life history in public waterways. In the last 15 years or so, there has been an increased interest in growing LMB for a food-fish sized market (1-1.5 lbs).

Arkansas is the largest producer of sportfish and food-fish LMB in the U.S., with food-fish almost exclusively sold live to Asian markets. Putting a dollar amount on the total amount of LMB sold as a food-fish is difficult since USDA-NASS census data currently only lists LMB as a sportfish. The census lists food-size LMB under sportfish, which potentially includes LMB grown to large sizes for both stocking and food purposes. Those sold and listed as food-size were enumerated at over 2.1 million pounds (>$11.4 million farm-gate) in 2013; an increase of approximately $3 million since 2005. The number of farms producing LMB has remained stable since 2005, while the USDA-NASS census data revealed average farm-gate price per pound of food-size LMB increased from $1.99 to $5.23. Some farms in the south and the mid-west are culturing LMB and interest is continuing to grow, although currently most feed trained fingerlings are purchased from Arkansas.

Competition between the sportfish markets and food-fish markets have likely helped keep the price of LMB higher compared to other species commonly cultured in the U.S. Developing a filet market for pond cultured LMB has been considered, but is not currently economically feasible. This may change in the future if the cost of producing fingerlings (43% of total costs) and feed (38% of total costs) can be lowered in pond culture. Processing fish also requires the addition of a Hazard Analysis Critical Control Points (HACCP) plan, which is used by the Food and Drug Administration (FDA) in determining a facility's capacity to limit human health hazards that are "reasonably likely to occur."

There are currently >15 million U.S. citizens with Asian heritage, and the U.S. Census Bureau reported in 2013 that almost half of all new immigrants were from Asia. Additionally, it is projected that the Asian population in the U.S. will reach almost 40 million by the year 2060 (estimated at 9.3% of the total population). Although certainly not the only fish in the store's aquarium, LMB are currently frequently chosen over other popular freshwater fish in live Asian markets. The filet is white and mild in flavor. Due to these desirable traits it is reasonable to assume that interest in culturing LMB will continue to rise. However, as with all markets and commodities, corresponding competition will rise as interest in a product increases. Also, as many immigrants assimilate into this country, it is possible that future generations will be less likely to purchase a live fish since it is becoming less customary to do so in the U.S.

Culturing LMB requires extra steps since they will not automatically consume a commercial diet. Spawning activities of LMB begin when water temperature stabilizes at 60°F, although some farmers find the best egg quantity and quality to come when temperatures fall within the 70-72°F range.

There are several methods commonly used in spawning LMB. One of the less intensive practices is to stock brood pairs (1:1 or 2:1 male:female ratio) in a recently filled pond to limit predatory aquatic animals. The eggs are deposited in a saucer shaped nest in the pond bottom, fertilized by males, and allowed to hatch in the ponds. A large-mesh soft seine should be used to remove the adults to avoid predation, leaving behind the yolk-sac fry. Spawning mats can also be placed in broodstock ponds, although there is no guarantee that eggs will be laid on the mats instead of the pond bottom. Once the egg sac is absorbed, the fry will begin feeding on zooplankton, aquatic insects and each other. At 1.5-2 inches, LMB are seined with a soft-mesh net and transferred inside where they can be feed trained to commercial diets. Once feed trained, fingerlings are transported from the indoor tanks to grow-out ponds where they are fed commercial diets containing at least 44% crude protein and 14% crude lipid (typically 45-48% protein and 16-18% lipid). Higher nutritional requirements means that feed costs are three to seven times more expensive than catfish diets (28-32% protein).

The second, more intensive, practice is to bring brood fish indoors and add artificial spawning substrate to raceways. The mats can be transferred to spawning tanks once eggs are deposited on the mats and fertilized by males. After hatching, fry can then be transferred to nursery ponds at a more precise density. The fertilized egg mats can also be transferred outdoors to allow hatching in ponds, although risk of aquatic insect predation, fungus and low dissolved oxygen concentration can limit hatching rates and survival. After reaching 1.5-2 inches, they are seined and brought indoors for feed habituation in the

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same manner as previously mentioned. Hormone injection has been moderately successful, although the cost of hormones, intense labor needed and a desire to allow fish to spawn naturally has hindered the adoption of this technique by most farmers.

Although the beginning life stages of LMB have been documented considerably, further research is needed on the fish after the early fingerling stage, particularly in this region of the country. Fingerlings for the sportfish market are rarely feed trained since it is an added cost. This adds an additional dynamic as LMB are grown in high density culture ponds for a longer period of time and at more extreme temperatures (high summer and low winter temperatures). With pond-raised LMB taking two years or more to reach food-size, their ability to tolerate poor water quality and extended periods of high density culture is being investigated. Other recent research has focused on raising advanced fingerlings indoors to attempt to raise LMB to market size in a shorter period. Although LMB are currently sold live, studies have shown whole filet dress out to be similar to catfish (61-62%). Developing lower cost feeds, improving feed conversion ratio (FCR), and disease management are also key research areas.

Optimal water temperatures for feed consumption and growth are between 80-85°F. Preliminary data suggests that as water temperature approaches the summer zenith (>100°F) in Arkansas, growth actually slows and could potential decline. In Midwestern states such as Ohio or Iowa, the growing season is shorter in comparison to Arkansas, and water temperatures do not reach such extremes. Oxygen concentrations should be maintained above 5 mg/L to avoid stress. Supplemental aeration is necessary, especially during summer months when feeding rates are high. However, unlike catfish, LMB are tolerant to high nitrite-nitrogen levels.

As aquaponics interest grows in the U.S., people are often wondering what freshwater species other than tilapia can be cultured in this type of system. LMB are a potential candidate, although they are considerably more difficult to culture compared to tilapia. A positive, and potential negative, is that their high protein and lipid diet would result in high nutrient loads. The positive is that plants should receive those nutrients and hopefully utilize them well. The negative is that the system would need to be designed to handle (remove or crop off) larger quantities of solids before entering the plant growbeds. Additionally, since LMB are nest spawners, the risk of undesirable spawning in tanks is minimal. Largemouth bass are able to survive in much colder water than tilapia. This is a key consideration when factoring in the potential catastrophic risk of power failure during winter months.

Growing fish has its share of difficulties, but the first task to overcome is the market. Every market has a saturation point. As with any product, it is first necessary to find out if a market even exists, where it is located, and what permits are needed for transportation to that state. Like most fish species in the U.S., regulations regarding live transportations of LMB across state (and country) lines can be confusing. Until 2013, the state of New York refused to allow the importation of LMB for live markets while readily accepting them for sportfish stocking. Failure to follow these laws could result in large fines and possibly prison. However, when New York lifted this ban, it opened up a previously untapped market in the U.S. Although LMB are not without their difficulties, they are worth consideration as a cultured species.

Upcoming Events

Seafood Expo North America
March 19-21, 2017
Boston, Massachusetts
Attending buyers represent importers, exporters, wholesalers, restaurants, supermarkets, hotels and other retail and foodservice companies. Exhibiting suppliers offer the newest seafood products, processing and packaging equipment and services available in the seafood market. For more information go to: http://www.seafoodexpo.com/north-america/

World Aquaculture 2017
June 26-30, 2017
Cape Town, South Africa
The Annual International Conference & Exposition of World Aquaculture Society. For information contact the Conference Manager at (760) 751-5505.

147th Annual meeting of the American Fisheries Society
August 20-24, 2017
Tampa, Florida
The Florida Chapter of the American Fisheries Society is hosting the meeting. For more information see http://afsannualmeeting.fisheries.org.

NEED A COUPLE MORE EVENTS TO FILL SPACE HERE, PLEASE

Improving Soybean Meals for Diets of Largemouth Bass

Michele Thompson, Research Associate, UAPB; Rebecca Lochmann, Professor of Aquaculture Nutrition, UAPB

Largemouth Bass is a popular sportfish in Arkansas, and a food fish in many markets. It is a predator that usually requires large amounts of animal protein in the diet. Marine fish meal is the animal protein used most often in bass diets. Fish meal is expensive and supplies are limited, so other protein sources are being studied. Soybean meal often is used as an alternative protein source in fish feeds. Soybeans are widely cultivated in the United States. In Arkansas, there are approximately 3.3 million acres in soybean production. Soybean meal is a more sustainable feed ingredient than fish meal. However, soy is not a perfect substitute. It contains anti-nutritional factors that can have negative effects on the growth and performance of fish. Some of the anti-nutritional factors can be eliminated through processing. Largemouth Bass is a carnivorous fish that eats various animals in nature. One concern of using plant proteins in bass diets is a potential increase in cannibalism when fish are reared in close quarters.

In a recent study, five different soybean meals were compared to fish meal as the main source of protein in a Largemouth Bass diet. The soybean meals included a standard soybean meal (dehulled, solvent-extracted 48% protein), an acid-hydrolyzed meal, a hot-water-treated meal, and two fermented soybean meals (Fermented Soy 2 and Pepsoygen™). The diets contained 45.5% crude protein and 14.2% total lipid. For 12 weeks, the fish were fed twice daily to satiation and mortality was recorded daily. Fish survival was high for all of the diets. There was no cannibalism despite the lack of animal protein in most of the diets. The fish appeared healthy, with no deficiency signs or negative effects from anti-nutritional factors.

The fish fed the diets with the standard soybean meal, acid hydrolyzed meal, hot-water treated meal, and Fermented Soy 2 had very similar growth (Figure 1). The feed conversion ratio (FCR) was higher than anticipated (2.6-4.3) for diets with soy products. This may indicate that the fish had a difficult time digesting and utilizing the diets.

The control diet with fish meal was the top performer, resulting in the highest weight gain and lowest FCR. However, fish fed the Pepsoygen™ diet also performed well - they had the second highest weight gain and similar FCR to fish fed the fish-meal diet. Pepsoygen™ appears to be a promising protein source for bass - at least as a partial substitute for fish meal.

Inefficiency Factors and Economic Impact of Baitfish and Sportfish Production

Jonathan van Senten, Post-doctoral Research Associate, Virginia Polytechnic and State University; Carole R. Engle, Engle-Stone Aquatic$ LLC; Madan M. Dey, Chair, Department of Agriculture, Texas State University; Luke A. Roy, Extension Aquaculture Specialist, Auburn University; Anita M. Kelly, Extension Aquaculture Specialist, UAPB

The 2014-2015 survey on the cost and impact of regulations for baitfish and sportfish producers in the U.S. has produced interesting insights about some of the challenges facing the industry. The various analyses performed with the data included a technical efficiency analysis and an economic impact assessment for the state of Arkansas. The technical efficiency analyses looked specifically at which factors of cost and regulations were contributing to inefficiency on farms. The economic impact assessment developed estimates for the contribution baitfish and sportfish aquaculture activities have had on the Arkansas state economy and the economies of Greene, Lonoke and Prairie Counties.

Efficiency estimates were developed that allowed for the identification of specific factors contributing to inefficiency on farms. Factors that were found to significantly impact inefficiency were: lost or foregone sales, the cost of changes due to regulations, cost of manpower to comply with regulations, insurance costs on the farm and permit and license renewals. These findings are not entirely surprising, given that many of those factors do not translate into increased production on the farm. In other words, when farms are forced to allocate money for these activities it reduces the money available to invest in production activities that would result in higher yields. It should be noted that fish health costs were not found to be a significant factor contributing to inefficiency, and neither was the number of states a farm was shipping fish to (although this could have an effect on the number of licenses and permit they may be required to renew annually). The regional area in which farms were located (Southeast, South Central or Great Lakes) also did not demonstrate a significant impact on inefficiency.

Using an average production budget for the state of Arkansas, and for the three major production counties (Greene, Lonoke and Prairie), estimates were developed for the impact of the aquaculture activities in those areas. The total economic output for baitfish and sportfish production in the state of Arkansas was estimated at $72 million; the direct effect was $36 million, indirect effect was $12 million and an induced effect of $23 million. The primary industries affected by baitfish and sportfish production were the automotive repair and maintenance industry, commercial and industrial machinery and equipment repair, couriers and messengers, construction and repair of roads, bridges, and tunnels, and owner-occupied dwellings. In terms of employment, the Arkansas industry had an estimated total impact of 559 jobs; with 294 jobs as a direct effect, 80 jobs as an indirect effect and 185 jobs as an induced effect. However, because not all goods and services utilized by the industry are produced within the state, the research team elected to run an additional model factoring in the nation as a

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whole. Doing so would capture the effect of purchases and expenditures that are linked to industries outside the state of Arkansas as well. The total economic output effect under this scenario was $158 million, with a total employment effect of 884 jobs. It is important to note that this analysis includes only farm-level expenditure effects and does not include the substantial economic impact that occurs from end user expenditures. In other words, this analysis does not include the economic impact from expenditures by anglers on their fishing trips using Arkansas baitfish and the contributions of those expenditures to the economies where they fish.

Breaking the economic impacts down to the three respective counties demonstrated that baitfish and sportfish culture had the largest total output effect in Lonoke County ($31 million), followed by Prairie County ($11 million), and Greene County ($8.6 million). This pattern was maintained when looking at employment effects, with producers in Lonoke County having an estimated total impact of 316 jobs, Prairie County 104 jobs, and Greene County 76 jobs. It should be noted that Lonoke County was home to 64% of the Arkansas producers who participated in our study.

It is a fact that Arkansas has been the leading producer of baitfish and sportfish in the U.S. for some time now; home to about 60% of all baitfish and sportfish production (USDA, 2014). Thanks to the participation and support from the Arkansas industry, we have successfully been able to estimate the economic impact of their production activities within the state and counties. For a more in-depth discussion of methods and results, we would encourage you to review the two manuscripts, currently in press, discussing the technical efficiency and economic impact assessment. Any questions or comments may be directed to the contact individuals designated below.

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Solve Problems Before They Happen with Winter-Time Pond Management Tips

Scott Jones, Small Impoundment Extension Specialist, UAPB

While fishing certainly takes a step back in the winter for the typical Arkansas pond, there are still many things you can do during the "off season" to keep your pond producing healthy fish while also combating problematic weeds.

The number one issue the typical Arkansas pond owner has to deal with on an annual basis is aquatic plant growth. I deliberately did not call them "weeds" at first because a "weed" is a plant that is growing where it is not wanted. There are many aquatic plants that are quite beautiful and provide tangible benefits for your pond. For example, plants like Arrowhead, Lizard's tail and Pickerelweed grow around the margins of the pond out to about 2 feet of water while stabilizing erodible shorelines, providing habitat for insects (baby fish food) and small fish (big fish food), and they spread slowly enough that they are relatively easy to control. Additionally, plants like Pickerelweed have beautiful flowers that can add to the aesthetics of the pond. However, when plants begin growing uncontrollably, even the nice beneficial plants can be considered weeds.

One of the characteristics of pond weeds that make them a nuisance, can also actually be convenient for the owner who decides that they are ready to take a proactive approach; the weeds you had trouble with last year are almost certainly going to cause you trouble again this year. That means that if you correctly identified the plant species that were causing trouble in your pond last season, you can shop around now for the best prices on the appropriate herbicides and be ready for those jerks as soon as they emerge again this year! Herbicide applications are almost always more effective while the plants are rapidly growing (early in the growing season) and when the plant density is at its lowest (early in the growing season). While it still may require multiple herbicide applications to keep the pesky plants away during the growing season, you will not have to use as much (which saves you $$$) and the pond will look better and fish

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more easily throughout the year. Check out the Aquatics Section of the MP44 – *Recommended Chemicals for Weed and Brush Control* at https://www.uaex.edu/publications/pdf/mp44/mp44.pdf for guidance on what herbicides to use for your situation.

The second most common issue facing ponds in Arkansas, especially those in the central and southern parts of the state, is acidic water. This is somewhat misleading because it's not so much the water as it is the soil causing the problem. Most of Arkansas, except for some northern parts of the state, lacks natural limestone deposits. Limestone is an excellent buffer of pH because it neutralizes acids that it contacts. Areas that lack limestone tend to have acidic soil, which in addition to naturally acidic rain, lead to acidic pond water. Symptoms of acidic water include but are not limited to, very clear water during the summer (3 to 4 feet or more of visibility), poor reproduction and growth in various fish species, fish kills in the mid to late winter with fish exhibiting sunken eyes and open lesions on their bodies. While the solution to this issue is simple and relatively inexpensive, applying agricultural limestone directly into the pond, the application can be a hassle. The best time to apply agricultural lime is before the pond is filled with water by spreading it evenly across the pond bed and tilling it into the soil. The next best option, after the pond is filled with water, is loading the lime onto a floating barge, or even a jon boat with a flat platform installed on it, and then spraying the lime into the pond with a high pressure water hose. Spread the lime evenly, and be sure to well-cover the deepest sections of the pond as they usually need lime more than the shallower areas. Applying lime to only the shallow areas (like dumping from the truck directly into the pond) is usually ineffective because much of the pond bottom away from the bank will remain acidic and continue affecting the water. Over several years of sampling ponds in Arkansas, two-tons per acre of finely crushed agricultural limestone is usually necessary to treat acidic ponds. It is also commonly necessary to reapply agricultural limestone every few years. Do not use hydrated or fast-acting limes in ponds that already have fish in them because they can cause rapid pH changes that can potentially kill fish.

The best time of year to apply lime is the winter so that it has time to incorporate into the soil before the growing season begins. Also, it can be risky to apply lime during the summer as it will temporarily bind to and remove critical nutrients from the water which can cause phytoplankton blooms to collapse (which can lead to oxygen depletion and potentially fish kills), and the clearer water may allow for nuisance aquatic plants to grow. Finally, do not apply fertilizer and lime at the same time because lime will bind to and remove the fertilizer from the water, totally defeating the purpose of the fertilizer and wasting your money.

Take some time this winter to get proactive in your pond management activities. A little work and planning while it's cold will make the pond more successful and more enjoyable when the weather is nice!

Winter is a Great Time to Apply Aquatic Dyes

George Selden, Extension Aquaculture Specialist, UAPB

Aquatic dyes are made from EPA registered, non-toxic food dyes (typically blue), and can be used to help control unwanted filamentous algae and submersed aquatic plants in ponds and lakes. They do not kill plants, but rather work by restricting the amount of light in the water. When low light conditions exist, plant growth is limited due to reduced photosynthesis. Dyes are less effective in water where the depth is less than three feet. In these shallow areas, enough light can still penetrate to allow photosynthesis.

Treatment should occur before weed growth begins, or when weeds first begin to emerge from the bottom of the pond. Dyes are effective if the plant height is below 2 ½-3'. A good time to treat the pond with dye is late winter before water temperatures have increased to the preferred range for plant growth. If you have a frozen pond in late winter, you can still treat the pond. When the dye is applied to ice, it will melt a hole and disperse underneath. Additional applications will be necessary throughout the year to maintain an acceptable level of dye in the water. These dyes may be used at any time of the year.

There are various formulations of aquatic dyes that include AquaShade, Admiral Liquid and WSP, SePro Blue and Lake Colorant Liquid and WSP, though this list is undoubtedly incomplete. The purchase and use of these dyes is unrestricted, so they can be shopped for on-line as well as from local retailers. Use rates vary, but many liquid formulations can be applied at a rate of one gallon/acre-foot of water. Some plants can grow at very low light levels, for example Hydrilla. For these types of plants, the rate should be doubled. The label should always be consulted prior to use.

Aquatic dyes should only be used in water bodies that are entirely within the control of the applicator. Treated ponds/lakes should also have little or no outflow. If water is continuously released from the pond/lake then the dye becomes diluted, product is wasted, and effectiveness is reduced. The effects of an aquatic dye typically last for 6-12 weeks.

The restrictions on dye use are minimal. They should not be applied to water bodies where water is used for human consumption. A pond/lake used for swimming can be treated, but the dye should be completely dispersed prior to permitting swimming. Aquatic dyes are also non-toxic to livestock.

Note: Mention of tradenames or commercial products does not constitute endorsement or recommendation for use by the University of Arkansas at Pine Bluff or the Cooperative Extension Service.

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OFFICIAL BUSINESS

Dr. Uttam Deb Joins UAPB Faculty as Assistant Professor

Luke A. Roy, Former Extension Aquaculture Specialist, UAPB

Dr. Uttam Deb has joined the University of Arkansas at Pine Bluff as an assistant professor of aquaculture and fisheries economics. Dr. Deb received his education and training in Bangladesh, Philippines and Canada. He received his bachelor's and master's degrees in agricultural economics from Bangladesh Agricultural University. He obtained a Ph.D. in agricultural economics from the University of the Philippines Los Baños. Following his doctoral work, he completed a post-graduate certificate program in trade policy and commercial diplomacy at Carleton University, Canada.

Dr. Deb has over 20 years of experience working in international agriculture and aquaculture development. He has published extensively throughout his career. Dr. Deb has expertise in econometric tools, mathematical modeling, Geographical Information Systems and participatory rapid appraisal techniques. In this position at UAPB, Dr. Deb plans to develop a productive research program to improve economic management of aquaculture and natural fisheries systems. He will teach graduate and undergraduate courses in economic management of aquaculture, fisheries and related subject areas.

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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.