U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services

U.S. Government Publication

Arkansas AQUAFARMING
Cooperative Extension Program
UAPB UNIVERSITY of ARKANSAS AT PINE BLUFF
School of Agriculture, Fisheries and Human Sciences
Vol. 33, No. 3, October 2016

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The Cost and Impact of Regulations on Baitfish and Sportfish Aquaculture

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Data from the 2014-2015 survey on the cost and impact of regulations for baitfish and sportfish producers in the U.S. have been analyzed and the results are in. Thanks to excellent participation by Arkansas producers, the response rate for the survey in Arkansas was 89%. While detailed manuscripts continue to make their way through the publication process, here are some Arkansas specific numbers producers need to know:

- Estimated $7.3 million per year for Arkansas industry in regulatory costs
- Average regulatory cost of $260,000 per farm or $420 per acre
- Direct costs of regulations only account for about 2% of total regulatory costs
- Lost and foregone sales have a dual impact; make up 55% of regulatory costs
- Regulatory burden is relatively higher on farms under 50 acres ($14,000 per acre)

Initial analysis of the data showed that there were several key differences between Arkansas and the 12 other states in the study; namely, Arkansas farms were larger on average (857 acres), shipped live fish to more states (an average of 18 states), and were the only producers participating in a state supervised fish health inspection program. These differences had implications for the overall makeup of regulatory costs in Arkansas; which were found to be on average 18% of total farm costs. Arkansas producers reported a total of 305 regulations with which they had to contend, and between one and 182 annual permit and license renewals (average 20 per farm). The number of federal permits per farm ranged between one and six, while the number of state permits per farm was between one and 34. Tabulating the average regulatory cost for Arkansas, revealed an average regulatory cost per farm of $260,000 ($150,000 average national) and $420 per acre ($3,000 average national).

Breaking down regulatory costs further into the various cost components revealed that lost and foregone sales accounted for the largest portion of indirect costs (55%) for Arkansas producers (top pie graph). This was followed by the costs of changes in management or infrastructure to comply with regulations (26%). The third largest indirect cost category was manpower (11%); which was likely underestimated in the study. Fish health costs accounted for 6% of regulatory costs for Arkansas producers; with the direct costs of licenses and permits only accounting for 2% of the costs.

The impact of lost and foregone sales limits the volume of fish that producers can sell. This also means that producers lose the ability to spread

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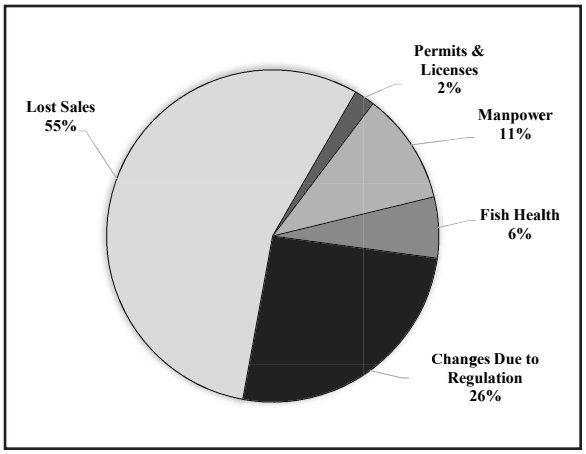

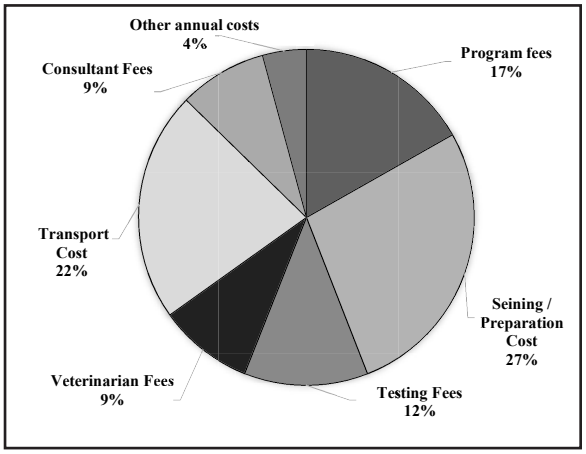

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regulatory costs over an increased production volume. Therefore, regulations resulting in lost and foregone sales have a dual impact of increasing regulatory costs, while simultaneously reducing the ability of producers to spread the increased costs by restricting sales volume.

Given that Arkansas producers were the only ones with a state-supervised fish inspection program, we also took a closer look at the breakdown of certified fish health testing costs. Of the farms who participated in Arkansas, 88% were also participants in the fish health certification program. The average annual cost of fish health testing for producers in Arkansas was $14,500 per farm, with an average cost per test of $4,400. The largest cost component of the certified fish health testing activities (bottom pie graph, previous page) was the seining and preparation for testing (27%), followed by the cost of transporting samples (22%). These were followed by the program fee (17%) and the actual testing fees (12%).

Regulatory costs were also assessed by farm size. Small farms (under 50 acres) had a relatively higher regulatory cost. By farm size, 60% of Arkansas producers were large farms (over 500 acres), 32% were medium (between 50 and 500 acres), and 8% were small farms (less than 50 acres). This was very different from other states, where there were only medium and small farms. Due to the fact that many of the regulatory costs captured by the survey were fixed costs, small farms spent on average more per acre on regulatory compliance; while large farms were better able to spread regulatory costs across a larger acreage and production volume.

We would like to thank the Arkansas producers and all the Extension and research personnel who helped make this project possible.

New Study Underway to Estimate the Impact of Lesser Scaup on Arkansas' Baitfish Industry

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The baitfish industry is an important economic enterprise for many aquaculture producers in Arkansas. The industry generates approximately $30 million annually in farm-gate sales of these small fish that include fathead minnows, goldfish and golden shiners. Diving ducks known as scaup, or "Bluebills," spend late fall through early spring in Arkansas and Mississippi on deep water wetlands, rivers, and aquaculture ponds. The notion that scaup are consuming an abundance of baitfish in Arkansas ponds has concerned commercial growers for several years.

During the fall-winters of 2016-2018, the University of Arkansas at Pine Bluff is teaming with bird researchers from Mississippi State University and the USDA's National Wildlife Research Center (at Mississippi State) to study impacts of scaup on baitfish in Arkansas. Scaup traditionally feed on small prey such as insect larvae, tiny crustaceans or hard-shelled insects like freshwater shrimp, and submerged aquatic plants, such as pondweeds. Fish, historically, were not an important part of scaup diets. Recent observations by Arkansas baitfish producers suggest that scaup are foraging significantly on Arkansas baitfish and cutting into producer profits. Because of this concern by growers, USDA Wildlife Services and UAPB Extension personnel collected foraging scaup from baitfish ponds in winters 2014-2015 and found that scaup were in fact eating baitfish. Our new study is designed to investigate this in more detail and will focus on: 1) assessing the abundance and distribution of scaup using baitfish farms, 2) quantifying the amount of prey (baitfish) available in ponds and the amount of fish and other prey consumed by the scaup, and 3) estimating the total economic impact of scaup foraging on baitfish on Arkansas' baitfish farms. All of these factors weigh heavily on the minds of Arkansas producers so this research is designed to answer these questions and identify potential solutions for the industry.

Researchers will sample baitfish ponds every two weeks from November through March, winters 2016-2018. Each day afield, we will count scaup and other waterbirds from vehicles or blinds on a pre-selected set of ponds that will be chosen from 15-20 farms participating in the study. We will count scaup and other birds, such as cormorants, great blue herons and white egrets, using the ponds and potentially consuming baitfish. Similar efforts to study scaup foraging on baitfish were conducted in 2004-2005, so our newer study results will be compared with the prior results.

In addition to surveys, we will collect scaup by directly shooting actively feeding individuals after they have been observed feeding for approximately 10 minutes. Once birds are collected in the field, various procedures will be used to preserve food consumed by the birds, as well as various data collected from the birds themselves, such as their sex, weight, etc. Ultimately, our goal is to estimate the species and abundance of fish consumed by scaup.

Once all of our data is collected, we can estimate numbers of scaup present over the two winters, amount and types of fish and other organisms eaten by the birds, and finally an economic analysis of the cost to growers related to fish consumed by scaup. The economic analysis will be led by Dr. Carole Engle. Dr. Engle has valuable previous experience working with aquaculture producers in estimating costs of their farming operations and the economic losses due to depredating birds.

We are eager for this collaboration between researchers and aquaculture producers, and are especially thankful for funding and other support from USDA's Southern Regional Aquaculture Center. As the aquaculture industry changes and migrating and wintering birds discover "profitable" food sources, research such as this is necessary to continue to understand relationships between wild waterbirds and their food and other habitat needs, particularly when it involves potential depredation of an important economic enterprise such as baitfish. These results will enhance our knowledge of this human-wildlife conflict and we will strive to provide conservation solutions for growers.

For more information on the study contact Dr. Brian Davis at 662-325-4790 or brian.davis@msstate.edu.

Treatment Considerations for Ponds with the Catfish Trematode (*Bolbophorus sp.*)

Larry W. Dorman, Extension Aquaculture Specialist

A Brief History of the Catfish Trematode in Arkansas

During the summers of 2007 and 2008 University of Arkansas Pine Bluff aquaculture/fisheries program personnel surveyed the Arkansas catfish industry for the presence of the catfish trematode (*Bolbophorus sp.*) For the study, some 325 ponds across the state were seined noting the presence and severity of trematode infestations. Survey results revealed the absence of the trematode in Northeast Arkansas (0% incidence in 34 ponds sampled) and Southwest Arkansas (0% incidence in 15 ponds surveyed). The trematode was present in 62 of 276 ponds surveyed in Southeast Arkansas.

Within the past two years, the trematode was confirmed on several farms in Southwest Arkansas. A large pelican population has taken up residence in large irrigation reservoirs in the area, so the trematode infestation was expected. Producers are reporting diminished feeding response from the catfish.

Trematode Life Cycle

Before discussing treatment options for the trematode, one needs to understand the life cycle of that organism.

- Adult fluke lives in digestive tract of the pelican
- Pelican defecates in pond; feces containing eggs from the adult fluke are released; Eggs hatch into an infective form known as miricidia
- Miricidia infects the ram's horn snail
- Within the snail, many reproductions occur
- Infective units known as cercariae are released from the snail
- Cercariae are free swimming and seek out catfish to infect
- Cercariae infect catfish by penetrating organs or muscle and change to a form known as metacercariae
- Catfish is eaten by a pelican; metacercariae matures into adult fluke

Treatment Options

There are no chemicals that can treat the infected catfish. Efforts to control the trematode are directed at controlling the ram's horn snail population. In previous years there were three treatment options. These options include the following: Shoreline treatment with hydrated lime or hydrated lime slurry, shoreline treatment with copper sulfate solution, and stocking black carp (legal in Arkansas) at a rate of 20 per acre into the infected pond or a combination of these strategies. Black carp may no longer be an option. There are no black carp fingerlings available at present for stocking.

Hydrated lime is applied as a dry powder or in a slurry along the edge of the pond, extending about 4-6 feet out into the pond. Dry lime is dispensed at a rate of 50 pounds per 75-100 feet of levee. An auger equipped hopper mounted on a tractor is useful for this purpose. The lime slurry treatment is usually performed by a commercial service. Four to 4.7 pounds of hydrated lime is dissolved per gallon of water. A 20 gallon slurry of the concentration will treat 100 feet of shoreline.

The copper sulfate treatment rate is 10 pounds of copper sulfate dissolved in 70 gallons of water. This amount treats about 250 feet of shoreline. This solution is sprayed into the pond from a large aerated tank which is usually drawn by a tractor. Regardless of the treatment option one uses, do not overlook the importance of a bird scaring program. Also remember that a bird depredation permit is also required. For any concerns about the catfish trematode presence on your farm, contact your Extension specialists at the following numbers:

George Selden at 870-540-7805
Luke Roy or Anita Kelly at 501-676-3124
Larry Dorman at 870-265-5440

Upcoming Events

Second International Congress of Macrobrachium
Nov. 9-11, 2016
Puerto Vallarta, Jalisco, México
The purpose of this conference is to improve the knowledge of the biology and taxonomy, ecological aspects, genetics, aquaculture and fisheries of the freshwater prawns of genus Macrobrachium. The meeting covers several aspects of the Macrobrachium and oral, poster presentations are available.Submit abstracts at: iicongresomacrobrachium@gmail.com

4th International Conference on Fisheries and Aquaculture
Nov 28-30, 2016
San Antonio, Texas
Fisheries 2016 will lay a platform for the interaction between experts around the world and aims to signify scientific discoveries, ideas and major milestones in the field of aquaculture technology and fisheries science. The conference will focus on the theme "Blue Revolution," and include workshops, symposiums, poster presentations and exhibitions.

Catfish Farmers of Arkansas
January 12-13, 2017
Hot Springs, AR
For more information contact Bo Collins: cfarkansas@sbcglobal.net

Arkansas Bait and Ornamental Fish Growers Association Annual Meeting
February 9, 2017
Lonoke, Arkansas
For more information contact Anita Kelly - kellya@uapb.edu.

Aquaculture America 2017
February 19-22, 2017
San Antonio, Texas
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.

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.

Herbicide Treatments for Submersed Aquatic Plants

George Selden, Extension Aquaculture Specialist

Arkansas has over 300,000 ponds, so it is not surprising that many ponds will annually experience problems with nuisance aquatic vegetation. Unlike terrestrial weed control, in aquatic situations, the plants can be growing emersed out of the water, floating on the water or submersed under the water.

Treating emersed plants is somewhat similar to treating weeds in your yard. Treatment most often consists of spraying the plants foliage with an appropriate herbicide, and trying to ensure that the herbicide "sticks" to the stems and leaves. Treating floating plants can be by either spraying the vegetation above the water, or by injecting the herbicide into the water in the hope that enough is absorbed by the plant parts underwater to kill the plant. But submersed plant treatment differs in some significant ways.

Treating plants that grow out of the water is essentially a two-dimensional activity. When you calculate the treatment, your rate will be listed in terms of ounces of product per acre, or per square foot. When calculating a treatment for a pond with submersed weeds, you typically need to calculate the pond's volume. For herbicides that require long contact times, you are actually treating the whole pond, not the plants. This situation can lead to less than satisfactory results.

When treating nuisance plants with herbicides, the single biggest cause for a treatment failure is insufficient concentration (over dilution) of the active ingredient. This principle applies to both terrestrial and aquatic weeds. If treating crabgrass and only a small part of the plant is sprayed or a sudden rainstorm washes the product off the leaves, the concentration of active ingredient is too low to kill the plant. For submersed plant treatment, the dilution can occur because the pond volume was underestimated, water conditions for the active ingredient were unfavorable (because of binding or chemical degradation), or the herbicide washed out due to pond outflow. What is the best way to treat submersed plants?

An essential step in preparation for any herbicide treatment is to accurately determine the pond volume (pond area x average depth). For an active ingredient, such as fluridone, the required contact leaves you no option but to treat the whole pond. Pond area can be easily calculated using an online tool like Google Earth. Determining the average pond depth can be accomplished by taking depth measurements at many locations and calculating the average. There are pond calculators online and a good fact sheet with more information is SRAC 103 *Calculating Area and Volume of Ponds and Tanks*.

After calculating pond volume, it would be possible to just drive around in a boat and "dump" the herbicide tank mix into the water. Undoubtedly, some of the active ingredient will find its way to down the water column and come into contact with the target plant. While this is possible, it may be wasteful.

A far better approeach is to actually deliver the herbicide into, or at minimum just above, the target plants. This will require some specialized equipment in the form of weighted trailing hoses. Without getting into too much detail, a tank with pump is connected to a horizontal boom with weighted hoses coming off at intervals (photo below). The hose length should be a little shorter than the pond depth so that as the boat moves, they move just over or within the submersed weeds. More detailed instructions can be downloaded from the University of Florida IFAS Extension at http://edis.ifas.ufl.edu/pdffiles/AG/AG36000.pdf .

A big advantage of using weighted trailing hoses is the ability to potentially use less herbicide by only treating the bottom foot or so of the pond. At this point you are back to treating weeds instead of treating the whole pond.

For larger bodies of water, often the nuisance plants will only grow around the edge because the water there is shallow enough to allow light penetration. Weighted trailing hoses give you the ability to treat only the band of submersed plants. Using specialized equipment also provides the opportunity to "spot treat" patches of weeds.

Some of the current active ingredients that are legal for aquatic use have a granular formulation. When granular herbicides are applied they fall to the bottom and begin to release the herbicide. How quickly the active ingredient is released depends on the formulation.

While some of the herbicide will be in the sediment, unlike terrestrial plants which absorb nutrients and water from the soil, the root systems of submersed plants are not the main source of nutrients, water and dissolved gases. These materials are absorbed from the foliage.

If the application has been accurate, the pellets have landed within the weeds you're trying to control, and the released herbicide is in the proper place to be absorbed by the plants. As a result, granular herbicides also provide you with the ability to treat smaller areas.

The methods of treating submersed weeds are different than those used to treat emersed or floating aquatic vegetation. To be successful more information and equipment is necessary. Knowledge about the pond size and average depth is essential to correctly calculate the treatment rate.

Depending upon the herbicide you select, water quality information or knowledge about current and flow are essential. If you need to use a liquid formulation, a boat equipped with weighted trailing hoses will make treatments more effective and less expensive by requiring less chemical. And finally, granular formulations can allow the pond owner to spot treat small patches of submersed aquatic plants.

A boat equipped with weighted trailing hoses.

UAPB Hires New Assistant Professor of Water Quality

Luke A. Roy, Extension Aquaculture Specialist

Dr. Amit Kumar Sinha joined the faculty at UAPB in August 2016. Dr. Sinha is originally from India where he completed a bachelor's degree in fisheries science. He then continued his education in Belgium, obtaining a master of science from Gent University with a specialization in aquaculture. Dr. Sinha earned a Ph.D. in Aquatic Toxicology/Water Monitoring from the University of Antwerpen, also in Belgium. Following the completion of his graduate work he worked three years as a postdoctoral research associate in collaboration with three different institutions in Canada (McMaster University, University of Alberta and Bamfield Marine Sciences Centre). Dr. Sinha is a seasoned researcher with an exemplary publication record.

Dr. Sinha's research is focused on investigating the effect of water pollutants and environmental stressors on fish in both natural systems and aquaculture operations. Most recently, his research has targeted molecular approaches to explore the interactive effect of feeding intensity and water quality on commercially important freshwater and marine species. In addition to research activities, Dr. Sinha has also dedicated time to offer applied training to farmers and ecologists on biomonitoring techniques in natural systems and aquaculture.

Dr. Amit Kumar Sinha

Aquaculture Producers Handbook App

George Selden, Extension Aquaculture Specialist, UAPB

In 2007, the Cooperative Extension Program published MP435 *Aquaculture Producer's Quick Reference Handbook* written by UAPB Extension Specialist Larry Dorman. Inside is information needed to calculate pond treatments; vat, pond and tank volumes; and information and tables that might be helpful to fish farmers.

For those with an android smart phone, this information is now available as an App. Google requires a payment to put things up at their Play Store where Apps normally can be downloaded. If you are interested in this App, please email Extension Specialist George Selden at seldeng@uapb.edu. The App and instructions on how to install it will be sent to you.

Lightning Safety In and Around Ponds

Larry W. Dorman, Extension Aquaculture Specialist

Statistics tell us that annually there are 22 million cloud-to-ground lightning strikes in the USA. Lightning travel is incredibly fast, estimated at 1,000 feet per one-millionth second. The typical lightning flash is about the thickness of one's thumb. Lightning currents average nearly 25,000 amps with voltages in the hundreds of millions. As we have been told, lightning, like any electrical current follows the path of least resistance to the ground. Don't let your body be part of that path. Practice safety during electrical storms.

When working in or around fish ponds there are some do's and don'ts to consider:

- If one is harvesting fish, immediately motor the aluminum boat to the pond's levee so all workers can get out.
- To avoid shock, don't stand by electrical conductors such as electric aeration equipment, electric panel boxes, electric wells, or back-up generators.
- Even though some protection is offered, do not stand under feed storage bins as they are metallic, quite tall and excellent conductors of electricity.
- Don't stand under the base of a tree.
- It is not safe to stand or lie on a concrete pad, the rebar inside of the concrete is a good conductor of electricity.
- If available, it is best for workers to go to a secure farm shop and wait out the storm.
- If a secure building is not available, the inside of a vehicle offers good protection. The fish loading truck can also be safe, but remember to lift the outriggers off the ground. When on the ground, the outriggers offer a path for the electricity to the ground.
- If one is caught with no safe structure or no vehicle is available, crouch in a balled-up position. Individuals need to separate and keep some distance between them because a lightning strike can travel across the ground.

Don't resume the work activity too soon. Wait at least 30 minutes after the last bit of thunder to be on the safe side. Remember, that life you save may be your own.

In-pond Raceway Systems: Are They Really a Good Alternative for U.S. Catfish Farmers?

Luke A. Roy, Extension Aquaculture Specialist, UAPB, Lonoke, AR
Travis W. Brown, Director of Aquaculture Technology, Brunswick Community College, Supply, NC

The authors of this article receive many calls each year from catfish farmers seeking to adopt alternative production technologies to increase production, profitability and sustainability of their farming operations. Questions often arise as to which system is most appropriate and the answer is often difficult, as each farm's situation is unique. Farming operations vary from a financial standpoint, physical layouts are different and technical expertise may be required depending on which intensive, pond-based system is used.

There are three basic alternative production systems that have been utilized recently by catfish farmers. In general, all three of these systems perform better with hybrid catfish than channel catfish. Intensively aerated ponds are traditional ponds (preferably of smaller acreage) that have higher levels of aeration installed (typically 6-10 hp per acre) and are normally stocked at higher rates (8,000-15,000 head per acre) than traditional catfish ponds. Split ponds divide a traditional pond into two sections, typically a fish-culture basin (15-20% of the pond area) and a waste-treatment lagoon (80-85% of the pond area). Farmers can then circulate water between the two sections using a number of different options for pumping large volumes of water (high-speed screw pump, slow-rotating paddlewheel, axial-flow pump or paddlewheel aerator). This confines management of catfish to a smaller area and allows for more efficient feeding, aeration, harvest, disease/parasite treatment, off-flavor treatment and general fish monitoring. In-pond raceway systems confine fish to a number of raceways or production cells within a larger pond where water is circulated through each raceway with slow-rotating paddlewheels or large-scale airlift pumps. With an IPRS, fish are held at much higher densities than split-pond systems and intensively aerated ponds.

Two of these production systems, split ponds and intensively aerated ponds, have been readily adopted by commercial catfish farmers in the southeast, while growth of IPRS has been confined to a small number of farms and seemingly reached a plateau. There will be more than 2,000 acres of split ponds in production for catfish in Mississippi, Arkansas and Alabama next year and this number will more than likely continue to grow. Currently, there are less than 100 acres of catfish production in IPRS in the southeast, most of which is limited to Alabama. Even though the IPRS has not been widely adopted by the U.S. catfish industry there are still a number of farmers that have been contacting Extension and research personnel that are interested in these systems.

Several of the catfish farms that originally adopted IPRS are no longer using these systems and some are using them to successfully grow fish for niche markets (fresh live markets or pay out lakes) or to grow fingerlings temporarily before stocking a larger stocker into production ponds on their farm. One farm in Arkansas built an IPRS exclusively for catfish production, but is no longer in business. However, this was not necessarily due to poor performance of the IPRS, but rather a management decision related to low fish prices and high feed prices. Some farmers are using their IPRS to grow tilapia. While there has been some marginal success by farmers raising hybrid catfish in these systems, farmers have struggled to consistently produce enough food fish in these systems to offset initial startup costs. Most commercial catfish farmers who have invested in these systems have had their fair share of problems, particularly with disease, slow growth and poor survival. In most cases, production of hybrid catfish in in-pond raceways has not consistently achieved levels as high as intensive aeration and split ponds outside of farm level research demonstrations in cooperation with universities, namely Auburn University in Alabama. The poor performance that has been observed with these systems can be attributed to lack of technical expertise and understating of different management practices that need to be incorporated. The point being, an IPRS is very different than an intensively aerated pond or split pond, and needs to be treated and managed as a raceway rather than a pond.

One advantage that IPRS does have over split ponds and intensively aerated ponds is they are much cheaper to treat with chemicals, such as potassium permanganate or formalin, should a disease or parasite issue occur. There is also considerably less time and labor associated with treating fish in an IPRS. It is also easier to track mortality in an IPRS as many fish (but not all) float to the surface and can be counted when removed. Delivery of feed is also facilitated in these systems, if an automated feed delivery system is utilized, and the fish response to feed during a feeding event can be better observed. If multiple raceways are available, it is feasible to maintain multiple crops (of different sizes) separate in the same pond which reduces cannibalism and also promotes more efficient feeding. Finally, it is also possible to culture addi-

Fish sampling at an in-pond raceway system in Alabama.

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tional species of fish (fathead minnows, paddlefish, redear sunfish, tilapia, etc.) in the rest of the pond if a market is available for an additional product. On paper, this production system appears to be an excellent option for catfish farmers, but there are other factors to consider.

The high stocking densities of IPRS often result in a unique set of problems specific to this production system. One of the biggest issues reported by commercial farmers are the occurrence of disease and mortality related to holding harvest-size fish due to off-flavor. Holding fish in a traditional pond or split-pond until off-flavor is controlled is an inconvenience, but typically manageable. In an IPRS, when fish reach harvest size they are often at maximum density within the raceway or production cell. It may take weeks or even months for fish to be deemed acceptable by the processing plant and this has resulted in disease issues which lead to high incidences of mortality and loss of profits. While off-flavor can be an issue in split ponds and intensively aerated ponds, it is much easier to manage. Another issue with IPRS has been catastrophic fish kills which occurred due to power failures (and generator failure) which can happen within any fish culture system. Since the volume of water in which fish are grown in an IPRS is less than a traditional earthen pond, the response time during an emergency is less. In addition, the response time is greater in split ponds and intensively aerated ponds since there is a higher water volume to fish ratio compared to an IPRS.

A study in Alabama which tracked incidences of disease in a number of IPRS from 2008-2013 revealed a high incidence of disease in these systems (farmers raising fish in these systems were routine returning customers to the diagnostic lab) with many reported cases of Columnaris, *Edwardsiella ictaluri* (ESC), and other common catfish diseases (Roy et al. 2013). In addition to production issues, recent research has revealed that often the startup costs for an IPRS can be higher than for split ponds and intensively aerated ponds. While cheaper versions of the IPRS that use a modular design and airlift pump technology instead of slow-rotating paddlewheels have been tested, commercial farmers have reported less water movement using airlifts compared to slow-rotating paddlewheels. Researchers have verified these observations, namely that large-scale shallow-water airlift pumps are less efficient than slow-rotating paddlewheels when it comes to moving large volumes of water. Of course, these airlifts are simpler in design and less expensive than slow-rotating paddlewheels. Another disadvantage that is not talked about much, but is very important to point out, is that IPRS typically perform better if fed a minimum of three to four times per day. With split ponds and intensively aerated systems, farmers can feed once per day as they are accustomed to with traditional pond production systems and achieve excellent results.

Stocking fingerlings in an in-pond raceway system in Alabama.

Split ponds and intensively aerated ponds are likely to continue to expand in the catfish industry for the foreseeable future. There are many reasons for this, but the primary one is that the management paradigm of these two alternative production systems is similar to what most U.S. catfish farmers are already accustomed to after years of managing traditional production ponds. Farmers can achieve high yields in these two systems, and in the case of intensively aerated ponds, with a much smaller initial investment by simply adding aerators to existing ponds and stocking at higher rates. The management of an IPRS is much more intensive, and there is simply higher risk associated with this production system. There is also more maintenance and supervision required. While IPRS has some promise for catfish production, additional research, particularly in the areas of disease, engineering and general husbandry, needs to be performed to address some of the mortality and poor growth issues that are being observed by the few commercial catfish farmers that have opted to invest in these systems.

IPRS have the potential for raising many different fish species and have reportedly had success in northern U.S. for growing yellow perch, and various carp and catfish species in Asia. In the southern U.S., several farms have been successful using these systems to produce fingerling and stocker-size centrarchids as well as tilapia and hybrid striped bass. However, when it comes to raising hybrid catfish for the food fish market, split ponds and intensively aerated ponds at this point in time appear to be a better fit for the U.S. catfish industry. U.S. catfish farmers have seemingly made their choice, and the vast majority of catfish farmers seeking to diversify their management schemes with alternative pond production systems are opting to invest in these two production systems over IPRS. This does not mean that IPRS do not have a place in aquaculture. IPRS were originally designed for use in water bodies that would normally be unsuitable for pond aquaculture (large, deep, uneven ponds and lakes). Research in the past proved that, if managed correctly, production performance of channel catfish was better using IPRS compared to cages in the same water body. In addition, IPRS demonstrated higher yields per acre than traditional catfish ponds at that time in many studies. The bottom line is that a thorough understanding of this production system is needed by the catfish producer to correctly and effectively culture fish in an IPRS. This knowledge is unfortunately lacking in the industry, and to some extent, the research community.

Further Reading

Luke Roy, William Hemstreet, and Travis Brown. 2013. Catfish disease cases in in-pond raceway systems in Alabama: 2008-2013. The Catfish Journal. 27(4):17,21.

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OFFICIAL BUSINESS

EPA Update

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At a recent meeting of the Aquatic Plant Management Society, there was a presentation titled "Washington Update." It reviewed actions within the federal government that might impact aquatic plant control. By far the biggest item involved the registration of a Dicamba formulation labeled for use on Dicamba tolerant soybeans and cotton. So, why would a terrestrial herbicide label impact aquatic plant control or even Arkansas fish farmers?

Dicamba is a herbicide with a mode of action similar to 2,4-D and triclopyr. Auxin mimics can be particularly toxic to broad leaf plants. As a result, Dicamba is not registered for use over cotton or soybeans. Strains of cotton and soybean that have been genetically modified to be resistant to Dicamba have become available, and Monsanto began the process to register a Dicamba product named M1691 for legal use over these new strains. This seemed a routine process, and had no broader implications for weed control on the farm or elsewhere. However, in March, the EPA released the proposed new label, and as part of the new label there was a prohibition against tank mixing any other herbicide.

Why do applicators tank mix herbicides prior to use? Two reasons have to do with resistance and synergy. Synergy is where the combination of two herbicides together provides better results than using each individually. While antagonism among herbicides is more common, where synergy exists there is the potential to use less chemicals and achieve better control. Herbicide resistant plants are a problem that seems to grow each year. Numerous publications have established that including two or more effective herbicides, with different mechanisms of action, in a simultaneous application is one of the most effective strategies for delaying the evolution of herbicide resistance. So, tank mixing is a practice that has real benefits to both the farmer and the environment.

However, in the document *Proposed Registration of Dicamba on Dicamba-Tolerant Cotton and Soybean* the EPA states that they are "…aware that a common agricultural practice involves tank mixing pesticides, resulting in the co-occurrence of chemical stressor to non-target plants including endangered species" and also stated "…the topic of synergy and multiple stressors is an uncertainty in assessing risk to non-target plants including endangered species."

When a pesticide undergoes registration, the EPA is required to, among other things, evaluate potential environmental effects. Since the 1960s, there have been hundreds of products patented and labeled that use herbicide synergy. Opening the University of Arkansas Extension publication MP44, *Recommended Chemicals for Weed and Brush Control* to a random page can yield pre-mixed products like Cimarron Max, which is a combo of metsulfuron + 2,4-D + dicamba. In the 2013 National Research Council (NRC) document, *Assessing Risks to Endangered and Threatened Species from Pesticides* the authors wrote: "The toxicity of a chemical mixture probably will not be known, and it is not feasible to measure the toxicity of all pesticide formulations, tank mixtures and environmental mixtures. Therefore, combined effects must be predicted on the basis of models that reflect known principles of combined toxic action of chemicals." In this proposed label, while the EPA recognizes the benefits of tank mixes, it is afraid of the "uncertainty" and therefore will not permit tank mixing.

So what are the implications and why should fish farmers care? As stated earlier, tank mixing potentially uses less chemical and saves money by enhanced effectiveness, fewer treatments and preventing/delaying resistant plants. If the EPA prevents tank mixes in future registrations, using herbicides could become more difficult and more expensive for farmers and aquatic herbicide applicators.

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