Alabama Fish Farming Center *Fish Farming News, 2021(1):1-18*

EXTENSION NEWSLETTER

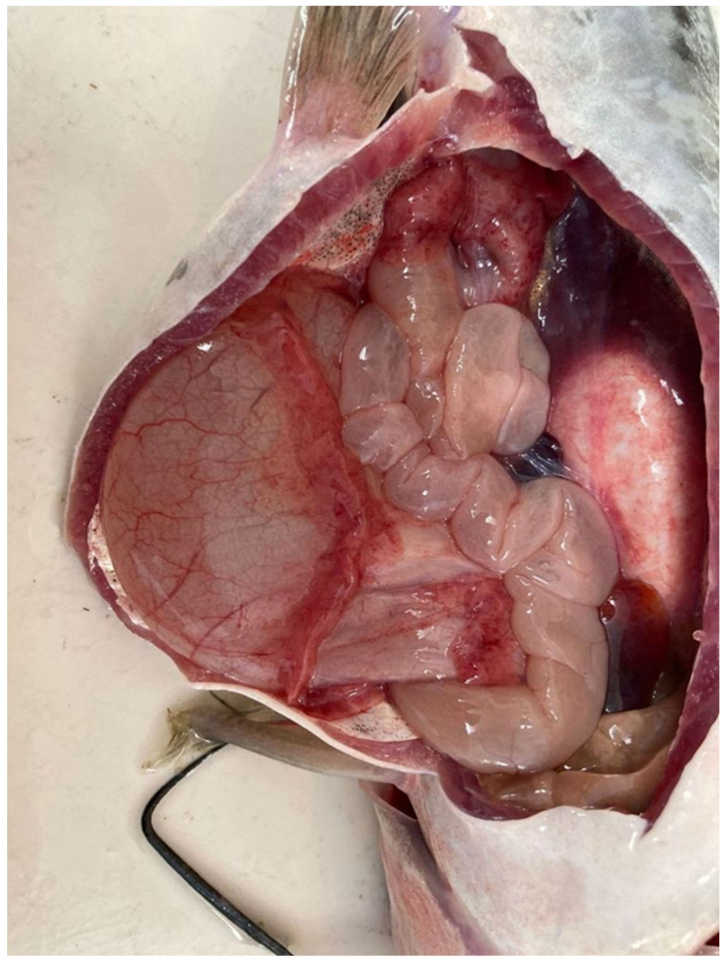
The 2020 Impact of Diseases in west Alabama

Anita Kelly, AFFC

Based on the annual Alabama Catfish Disease Survey, the 2020 catfish production season suffered several losses. The survey was responded to by 66 of the 67 producers in west Alabama representing a total of 16,146 acres of production of which 3,352 acres were used to raise hybrid catfish. The survey showed that there were 1,461 ponds under commercial production with an average stocking rate of 7,531 head per acre. The reported total poundage lost to the five primary disease agents (Aeromonas, Edwardsiella, Columnaris, PGD, and Toxic releases) was about the same between the two years with 5.26 million pounds of fish (2020) compared to 5.3 million lost in 2019 (Figure 1). The estimated monetary loss to the Alabama catfish industry was $13,698,501 in 2020, a 9% increase from 2019. This value includes lost pounds of fish, medicated feed costs, chemical treatments, and lost feeding days.

The primary cause of disease losses in Alabama continues to be from the bacterial diseases; *Aeromonas hydrophila* (2.7 million lbs) followed by Columnaris (2.1 million lbs) and Edwardsiella or ESC (0.4 million lbs). Losses due to unidentified toxins were 0.15 million lbs down significantly from 2019, which tallied 0.3 million pounds. Losses due to hamburger gill (PGD) were significantly higher in 2020 at 0.57 million pounds compared to 0.13 million lbs in 2019.

This year, the recorded losses of fish to columnaris was the second highest year since 2015, while losses due to virulent Aeromonas was the lowest. Although losses due to virulent Aeromonas decreased in 2020, the increase in Columnaris disease losses resulted in higher overall fish losses due to bacterial diseases. Losses due to ESC, which had been steadily declining since 2015, showed a slight



Channel catfish with clinical signs of virulent Aeromonas. Note the hemorrhage muscle and internal organs.

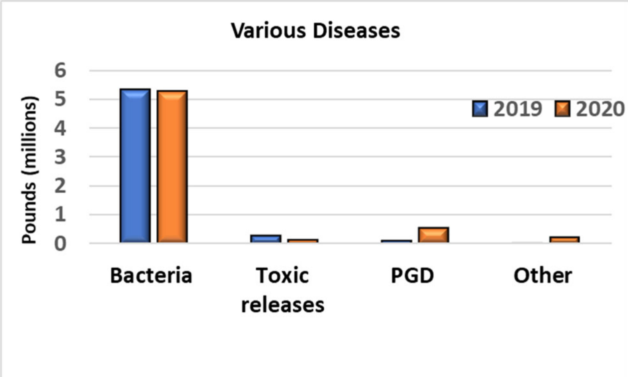


Fig. 1. Losses of channel and hybrid catfish in 2019 and 2020 by disease category.

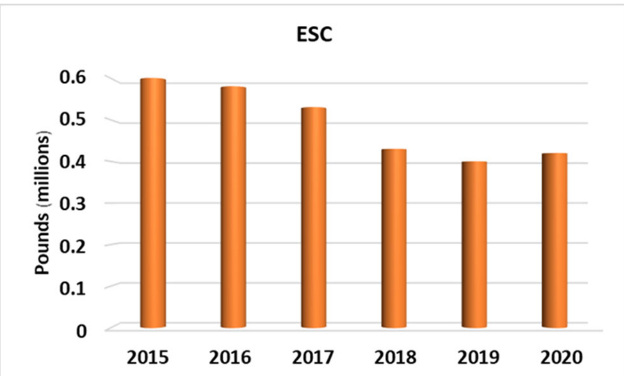


Fig. 2. Annual losses of channel catfish and hybrid catfish to ESC in Alabama (2015-2020).

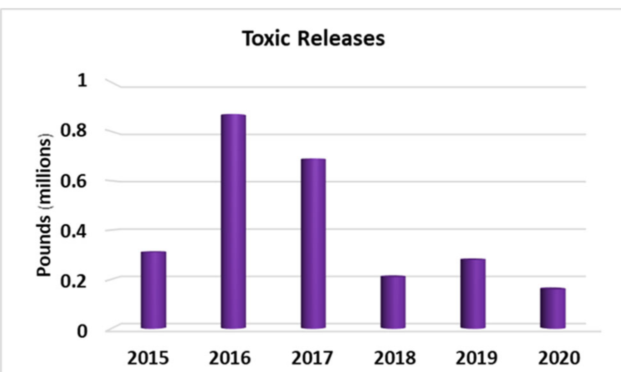


Fig. 3. Annual losses of channel catfish and hybrid catfish to toxic releases in Alabama (2015-2020).

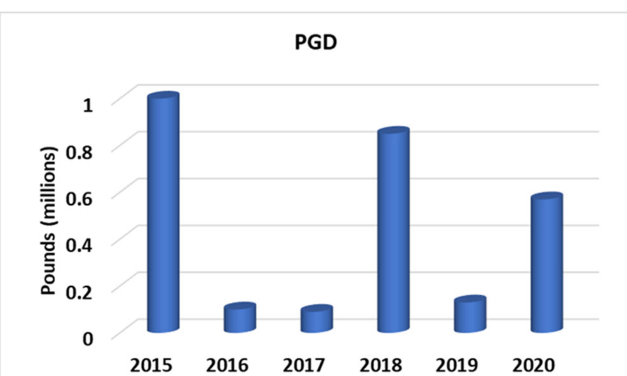


Fig. 4. Annual loses of channel catfish and hybrid catfish to PGD in Alabama (2015-2020).

increase in 2020 (Fig. 2). Toxic releases were significantly lower the last two years (Fig. 3) and PGD was higher in 2020 compared to 2019 (Fig. 4).

So far in 2021, a few cases of virulent Aeromonas were documented in Jan and Feb. Ich (Fig. 5) has been reported on several farms and caused massive mortalities. The AFFC has seen quite a few cases of hamburger gill (Fig. 6). If the gills of your fish look like raw hamburger, chances are the fish have it. Increased aeration will help alleviate the symptoms until the spores break open. As always, as the water warms up be on the look-out for Columnaris or cigar mouth. Remember early detection will prevent disease losses!

Fig. 5. Fish with Ich. Notice the appearance of white bumps that look like salt. (Photo: USDA, Cindy Ledbetter)

Fig. 6. Channel catfish with hamburger gill disease.

Renovation of commercial catfish ponds: Why is it important?

Luke Roy, Anita Kelly, Jesse James, Terry Hanson, AFFC/ SFAAS

Fig. 1. There is a lost opportunity cost associated with renovating a commercial catfish pond.

The topic of pond renovation on commercial catfish farms typically brings up a wide range of mixed feelings and opinions depending on the farmer. The majority of ponds in west Alabama and east Mississippi are watershed ponds instead of levee-style ponds, which are prevalent in the Mississippi Delta and Arkansas regions. While watershed ponds are typically deeper and produce more fish than levee-style ponds, they have several disadvantages. These include difficulties related to efficiently seining irregularly shaped deeper ponds and the inherent challenge and time associated with renovating a watershed pond. Farmers who choose to renovate a pond are faced with a situation in which it could be up to a year or more before the pond can be re-stocked with fingerlings. In addition to the actual cost of renovating a pond, there is a lost opportunity cost when that pond is not used to grow a crop of fish during a period of renovation. However, renovation has the potential of a long-term payoff due to smoother pond bottoms, better harvesting efficiency and decreased quantities of 'big fish.'

In west Alabama, pond renovation is typically not a routine practice for many of the previously mentioned reasons. While there are certainly very real costs associated with pond renovation, there is also a price to pay for not renovating ponds. It is widely accepted, both anecdotally and in the literature, that failure to renovate commercial aquaculture ponds can eventually lead to reduced yield over time. This is due to several different reasons that vary depending on each unique situation. Organic matter, fish waste, uneaten feed, and natural erosion of pond banks all contribute to the accumulation of excessive pond muck. The accumulation of pond bottom sediment can make it much more difficult to efficiently seine a pond as larger fish can often burrow into the muck and repeatedly avoid the seine. The accumulation of muck and sediment in large sections of the pond can eventually reduce pond depth. Over time, paddlewheel aerators can create indentations in the bottom of ponds that serve as safe havens for fish, most notably larger fish, when the pond is seined. A reduction in pond depth results in less water volume in which to both grow fish and effectively maintain adequate levels of dissolved oxygen via aeration. Pond bottom sediments can serve as reservoirs for the accumulation of certain pathogens, including the virulent *Aeromonas hydrophila*, which can affect fish survival and overall production in a pond.

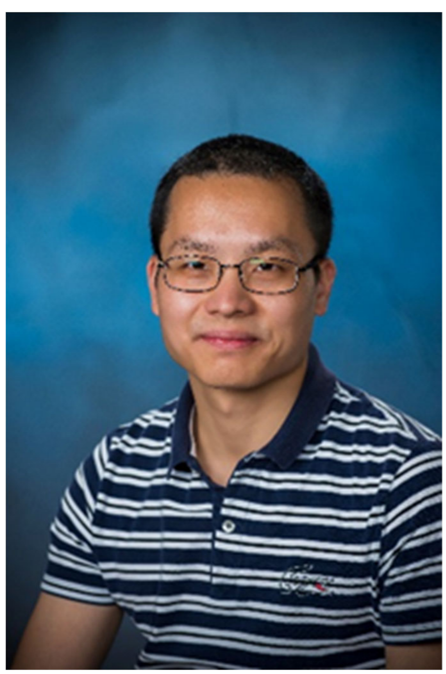
In 2021, the Fish Center is teaming up with Dr. Terry Hanson, an aquacultural economist at Auburn to develop partial enterprise budgets comparing net returns of catfish production from non-renovated ponds to those from renovated catfish ponds. This project is not grant-funded; however, there are many farms in west Alabama currently renovating or planning to renovate ponds. This presents an opportunity to capture some of this information while it is available and help the industry understand the benefits and costs of pond renovation. To collect this data, we plan to have Fish Center personnel meet one-on-one with 8-10 farmers to discuss pond renovation and collect cost and production data. Information gathered will be confidential, and the partial enterprise budget developed will be shared at the Alabama Catfish Conference in December 2021.


Fig. 2. Renovation of commercial catfish ponds can be a sizeable amount of time and money.

We are also interested in tracking fish production in ponds before and after renovation to document improvements in yield following renovation. With this information, we will be able to document current pond renovation costs and determine fish production levels needed to recoup the cost of renovating ponds. This information will help farmers make decisions on whether to renovate their ponds or not. If you are currently renovating ponds (or have renovated ponds in the last two years) and are interested in participating in this study, please contact Luke Roy at the Fish Center (334-624-4016; royluke@auburn.edu).

Wang Joins Auburn University

Dr. Dengjun (Kevin) Wang joined the School of Fisheries, Aquaculture and Aquatic Sciences in the College of Agriculture at Auburn University as an Assistant Professor in Jan 2021. Before landing in Auburn, Dr. Wang was a postdoctoral researcher associated with Oak Ridge Institute for Science and Education (ORISE) and National Research Council (NRC) in the Groundwater Characterization and Remediation Division (GCRD) at the U.S. EPA. He received his Ph.D. in Environmental Sciences from the Institute of Soil Science, Chinese Academy of Sciences.



Dr. Wang's principal research areas are on the fate and transport of particles, and remediation of contaminants in the aquatic environments. Specific research areas include: (1) transport and cotransport of colloids, nanomaterials, and plastics in porous media; (2) tracking sources and biogeochemical cycling of phosphorus in watershed using stable isotope techniques (phosphate oxygen isotope technique); (3) innovative technology for soil and groundwater remediation including PFAS remediation; and (4) nanotechnology for sustainable agriculture and aquaculture (e.g., nanopesticides, nanofertilizers, and nanosensors).

Reviewing the importance of total alkalinity before treating a pond with copper sulfate

Luke Roy, Anita Kelly, Jesse James, AFFC/ SFAAS

Copper sulfate pentahydrate (hereafter referred to as copper sulfate) is an important tool for the catfish producer. As an EPA-approved algicide, copper sulfate is often an effective treatment for controlling algae in catfish ponds. Copper sulfate has several advantages compared to other options, including a relatively secure legal standing, no accumulation in fish, more economical than other copper-related products, typically gets tied up in pond sediments so very little leaves the pond, and is often very effective.

To achieve control, farmers often have to use repeated small treatments to avoid toxicity issues with fish and the short persistence of copper in water. The effectiveness of copper sulfate and safety to fish are dependent on pond water quality. It can also be difficult to formulate a reliable treatment rate in ponds of unknown size and depth. Treatments are calculated in lbs/acre-foot, so the pond's exact size and average depth must be known to formulate a safe treatment for fish.

There are additional copper products that are commercially available, including Cutrine®, K-Tea®, and several others. These products consist of copper housed in an organic complex that is available in both liquid and granular formulations, has longer persistence in water, and can be used safely in soft water. However, the much lower cost of copper sulfate makes it more appealing for use in large commercial-sized catfish ponds.

As with any other chemical, the product label should be followed and it will provide instructions on the application of copper sulfate. One of the best methods to apply copper sulfate to a catfish pond is to weigh copper sulfate powder or crystals into burlap bags and then tow them behind a boat while the product dissolves. The product can also be weighed into cloth or burlap bags and placed 20-30 feet in front of paddlewheel aerators for a few hours until completely dissolved. The wave action generated by the aerators or when being pulled behind the boat are necessary to ensure the product is adequately dissolved to achieve an effective concentration in the pond water. Adding copper sulfate into the pond straight from the boat without allowing it time to dissolve will likely not adequately distribute the product throughout the entire pond.

Citric acid is often added to keep copper sulfate in solution longer. The ratio of copper sulfate to citric acid is 10:1, so if 50 lbs of copper sulfate is needed, 5 lbs of citric acid would be added. Most producers make a supersaturated solution of copper sulfate. Copper sulfate dissolves easily in water, but more copper sulfate can be dissolved if the water is heated. For example, at 32 °F, 0.33 lbs of copper sulfate can be dissolved in a gallon of water but heat the water to 212 °F and 6 lbs of copper sulfate can be dissolved! The easiest way to heat large volumes of water to the appropriate temperature is to use a water heater, like the ones used to heat the water in homes. These water heaters can be turned off when not in use to save energy.

Alkalinity (ppm)	Treatment Rate (lbs/acre-foot)
51	1.4
68	1.8
85	2.3
102	2.7
119	3.2
136	3.7
153	4.2
170	4.6
187	5.0
205	5.6

Table 1. Max dose copper (lbs/acre-foot) sulfate recommendations based on total alkalinity (ppm as $CaCO_3$). Note: As total alkalinity is increased so is the amount of copper that can be safely used in a pond.

Total alkalinity is defined as the sum of titratable bases in water, which for most pond water is mainly bicarbonate and carbonate. Total alkalinity is typically measured as ppm as $CaCO_3$. Total alkalinity can influence the toxicity of certain metals, such as copper, to fish. Calculating a pond treatment for copper sulfate is fairly simple. Table 1 provides a quick reference based on the widely known copper sulfate dose equation. From this table, it is easy to see that as total alkalinity is increased, so is the amount of copper sulfate that can be applied safely to the pond.

$$\text{Maximum dose of Copper Sulfate (ppm)} = \frac{\text{Total alkalinity (ppm)}}{100}$$

Example Calculation: How many pounds of copper sulfate would be needed to treat a 10-acre pond that is 5 feet deep with a total alkalinity of 95 ppm?

Maximum dose of copper sulfate (ppm) =

$$\frac{95}{100} = 0.95 \text{ ppm}$$

The total amount of acre-feet to be treated is 50 acre feet (10-acre pond * 5 feet depth = 50 acre feet)

1 ppm = 2.72 lbs/acre foot which is a conversion factor needed in the equation to change ppm to lbs/ acre foot.

Knowing this information we can now determine the amount of copper sulfate needed to treat the pond described in the example:

50 acre feet * 2.72 lbs/acre foot * 0.95 ppm = 129.2 lbs of copper sulfate

Copper sulfate is a valuable tool available to catfish farmers for treating problematic algae blooms in ponds. Taking the time to determine the total alkalinity of your pond, as well as the average depth, will help ensure you are using a copper sulfate treatment that is effective at treating algae and safe for your fish. Feel free to contact the Alabama Fish Farming Center to test pond water alkalinity or if assistance is needed to calculate a copper sulfate treatment for your pond.

Bruce joins SFAAS faculty

Dr. Timothy J. Bruce joined the SFAAS faculty in January 2021 as an Assistant Professor of Aquatic Animal Health. Dr. Bruce began his academic career at the University of Western Ontario, where he earned a Bachelor in Medical Sciences degree. He then went on to pursue his M.S. in Biology at Purdue University-Fort Wayne, and became interested in fish health and physiology while working in Dr. Ahmed Mustafa's laboratory. Tim completed his Ph.D. in Fisheries Sciences at South Dakota State University under the supervision of Dr. Michael Brown and also worked as a Research Scientist for Prairie AquaTech, a company that manufactures plant-based protein ingredients for aquaculture species. Following the completion of his Ph.D., he then relocated to the Lost Valley Hatchery (Warsaw, MO) and served as the Aquatic Animal Health Specialist/ Fish Pathologist for the Missouri Department of Conservation before transitioning to the University of Idaho, where he was a Postdoctoral Fellow in Dr. Ken Cain's Fish Health Lab.

Dr. Bruce's research agenda at Auburn includes the investigation of emerging diseases and co-infections in warmwater fish culture, warmwater vaccine development/strategy, and nutritional approaches to improving fish health. Dr. Bruce is looking forward to research collaborations both with many of the SFAAS researchers and commercial producers.

Weed control in recreational ponds: it's a process

Rusty Wright, SFAAS

In pond management, probably the most commonly asked question of Extension folks is, "How do I control this weed in my pond?" Pond owners often think the solution must be a chemical herbicide that they can buy to solve their problem, and in some cases, that is true. However, the best approach to weed control is to use a process that focuses on preventing weed problems or controlling them biologically before resorting to chemical herbicides. So, let's step through the basics in good pond weed control.

Prevention. The old saying "an ounce of prevention is worth a pound of cure" could not be truer than with weed control. Controlling weeds after they take over a pond is always more expensive than preventing them in the first place. Good pond design is the first step in preventing excess weeds. Ponds with edges that slope quickly to 3 ft and deeper provide little shallow water where many rooted plants and attached filamentous algae grow (Fig. 1). Combined with a good fertilization program or the application of pond dyes (only for ornamental ponds), light doesn't reach the bottom where plants first start growing. Never fertilize a pond with an existing weed problem. Those added nutrients will make the weeds grow out of control. Start fertilizing early in the year when water reaches about 60° F before the weeds are actively growing. Of course, not all ponds should be fertilized if that does not meet the pond owner's goals or if it is not possible to effectively fertilize a pond because of too much water flowing through the pond.

The next good prevention approach is not to bring weeds in. That may seem obvious, but plants are sometimes brought in as ornamentals or to provide habitat for fish and wildlife. If a pond owner decides they want plants, they should get them from a good nursery source. These plants will be less likely to have unwanted weeds that come in attached to leaves or roots or as seeds or spores in the soil. For ponds managed for aesthetics or fishing, only bring in plants that are relatively easy to control. Plants like water lilies and water willow grow above the surface so they can be easily monitored and, if they start to spread too much, easily controlled with relatively inexpensive herbicides. Submersed weeds like naiads, watermilfoil, or hydrilla, can be invasive and can grow across the pond's bottom before the pond owner realizes there is a problem.

Fig. 1. Yellow bog iris is an ornamental plant that sometimes can get out of control in recreational fishing ponds.

Weeds are sometimes introduced to the pond by accident on a boat brought in from a waterbody with the weed. Always check boat trailers after loading and hauling out a boat for weeds and mud. Ideally, the boat and trailer should be washed and preferably allowed to dry before launching in another lake, reservoir, or pond.

Identify the weed. Before starting a control effort with any established weed, identify the plant to determine which control method is the best choice. Contacting an Extension professional, fisheries biologist, or pond management consultant to confirm the identification of the plant and control method can result in better control, reduced cost, and potentially fewer negative effects to the fish. Often a few close-up digital pictures of the plant are sufficient for a professional to identify the weed. However, for some problems like filamentous algae, they will need to look at a sample.

Biological Control. Biological weed control in ponds can be effective and relatively inexpensive. The most common biological control is the use of grass carp or white Amur. These large carp are native to Asia and have caused biological problems in North America, where they established breeding populations. For this reason, most states have restrictive stocking regulations requiring permits and only allowing the stocking of sterile grass carp. In Alabama, fertile grass carp can be stocked without a permit. Grass carp eat primarily soft-stemmed weeds that grow beneath the surface like southern naiad or Potamogeton. Stiffer stemmed plants, those that grow above the surface, filamentous algae, and the tiny floating plant watermeal may not be controlled or only partially controlled by grass carp, depending on the plant. Between 3 and 5 grass carp per acre is a good stocking rate to help prevent weeds from establishing. Higher stocking rates are needed to control established weeds or species that grass carp do not prefer to eat.

A couple of less common biological controls are tilapia and alligator weed flea beetles. Tilapia are tropical fish that have been used for partial control of watermeal and, to a lesser degree, filamentous algae. Except in more southerly parts of the southeast, tilapia generally do not survive cold winter temperatures and must be restocked each spring. As with grass carp, tilapia can be invasive, and one should always check with their local natural resource agency before stocking them. Alligator weed flea beetles, as the name suggests, are a specific control for alligator weed. Alligator weed is a common invasive plant originally from South America. Alligator weed flea beetles are an excellent control for this weed. Unfortunately, this insect is not commercially available. They can sometimes be obtained from the U.S. Army Corps of Engineers or sometimes through local Extension offices that work with the Corps to make them available.

Herbicides. Chemical weed control may seem like the most obvious way to kill weeds. The problem is that herbicides may only provide limited short-term control, can be very expensive, and sometimes cause other problems such as oxygen depletion or direct toxic effects to fish or the person applying them. Before buying any herbicide, always identify the weed that is causing the problem. Different plants often require different herbicides or application approaches. The label on the herbicide container will have the most important information needed to use the product, such as if the product is approved for aquatic use, which weeds is it effective for, the application rate, and what safety precautions should be taken. Always follow label instructions. **The label is the law.**

Fig. 2. Spraying herbicides from a boat is one method of application used for aquatic weed control (Photo Credit: Bence Carter).

The choice of herbicide depends not only on what works to kill the problem plant but also on cost, ease of use, safety concerns for both the applicator and the fish. Suppose the weed is growing near sensitive plants that the pond owner does not want to kill such as shoreline trees, ornamentals, or the turf on the shoreline. In that case, the herbicide may need to be applied carefully or a selective herbicide chosen that will only kill the target weed (Fig. 2). Some herbicides only kill the parts of the plant they touch. These contact herbicides are fast-acting but often provide only short-term control because the plant can regrow from roots or undamaged stems. A rapid kill from contact herbicides can also cause oxygen depletions that can kill fish. When possible, select a more slow-acting systemic herbicide that moves through the entire plant killing it entirely to give a more complete, long-lasting control with less risk of oxygen depletion.

Chemicals that are used to kill algae, algicides, can cause several problems if used incorrectly. Most algicides contain copper, which can be toxic to fish, especially koi and trout, in water with low alkalinity. Also, algicides can kill the planktonic algae (the tiny algae that turn the water green) responsible for making most of the pond's oxygen, potentially causing an oxygen depletion and fish kill. It is always good to consult with a fisheries biologist or Extension professional before using these products.

Mechanical control. Cutting and raking weeds can remove them in a limited area. However, breaking the plants into small pieces can spread them to other parts of the pond. Landscape fabric covered with gravel can be used as well around piers and swimming areas. In general, mechanical control is very hard work with limited value.

Combining the approaches. These various approaches to control weeds in ponds can be used together to increase the control and prevent the weeds from coming back. For example, an existing weed problem can be treated with herbicide, grass carp stocked to control resprouting or prevent a new weed from replacing it, and a consistent fertilization program started as a long-term preventative. No matter what tool is used, catching the problem early before the weed covers the pond not only reduces the problems that weeds cause in the pond but also allows more and generally less expensive options for control. The key to consistent and cost-effective weed management in ponds is to use all the tools in the control toolbox, not just rely on herbicides.

For further information on pond management, including weed control, please visit the Alabama Cooperative Extension System website www.aces.edu under the topic Fish and Water / Fisheries (fisheries - Alabama Cooperative Extension System;aces.edu). To contact an Extension Professional, contact information for Agents and county offices can be found on the website for each state's Extension system or service. The ACES website has a directory with contact information for all the county Extension offices in Alabama.

New arrivals to the Alabama Fish Farming Center in 2021

James Tuttle (Fig. 1) and David Pardo (Fig. 2) have joined the team at the Fish Center to complete M.S. degrees. James Tuttle will be in Dr Ian Butts' lab while on campus and at the AFFC during the summer. He graduated from Rhode Island University in 2018, where he received his BS degree in Marine Biology and Minor in Aquaculture and Fisheries Science. James has experience conducting large pelagic fish surveys, raising marine algal cultures, designing and building hatcheries, and producing and culturing several aquatic species. His thesis will center on catfish health primarily focusing on disease longevity in production ponds. He will also be assisting AFFC personnel with various other production studies with fish, shrimp, and crawfish as well as disease studies.

David will be splitting time between the Fish Center and Dr. Allen Davis' lab at Auburn to carry out studies related to the production, nutrition, and physiology of shrimp raised in low salinity water of west Alabama. He will also be assisting Fish Center personnel with catfish related studies. David has a B.S.

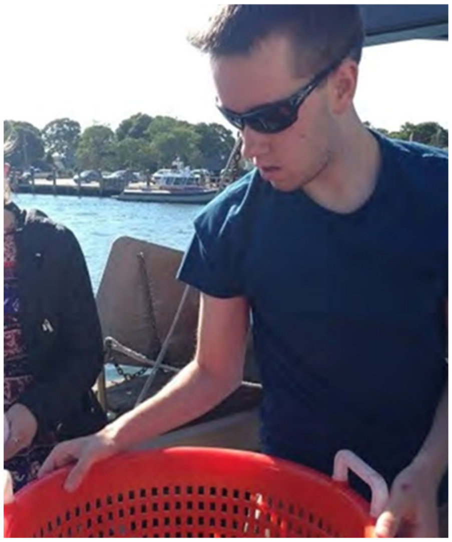


Fig. 1. James Tuttle.

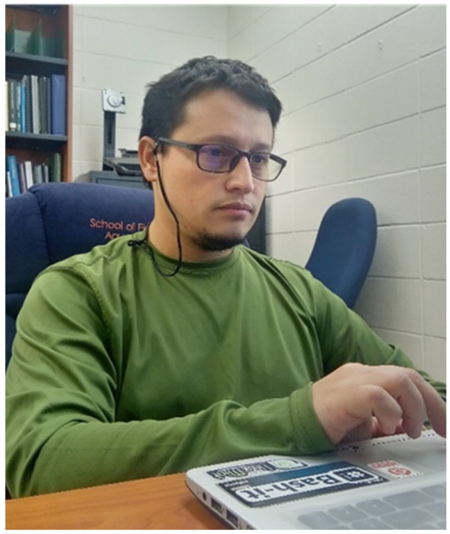


Fig. 2. David Pardo.

in Veterinary and Animal Husbandry Science from the University of Tolima in Colombia. He has a versatile background in commercial aquaculture (production, fish health, biosecurity) and has experience working with a number of different commercial fish species in South America. In addition to working in the aquaculture industry in Colombia, David spent time in Brazil at the National Institute of Amazonian Research working in a fish parasitology lab.

Managing Higher Catfish Feed Prices

Terry Hanson, SFFAS

Thirty-two percent catfish feed contains 30-44% soybean meal, 15-20% corn grain, and 0-20% corn gluten feed. So, as corn and soybean prices go, so goes catfish fish prices. Catfish feed prices were stable January through August 2020 but then increased 18% through the last four months 2020 (Fig. 1). Decreased supply in US corn and soybean production led to increased corn, soybean, and soybean meal prices. These crop supplies decreased due to several causes, including trade, drought, storm damage and yield decreases. The result was corn and soybean prices going up 70% and 65%, respectively (Fig. 2). Fortunately, the price producers receive for their catfish sold to processors has increased in 2020 and been over $1.09 / lb all year with a high price of $1.23 / lb in December (Fig. 3).

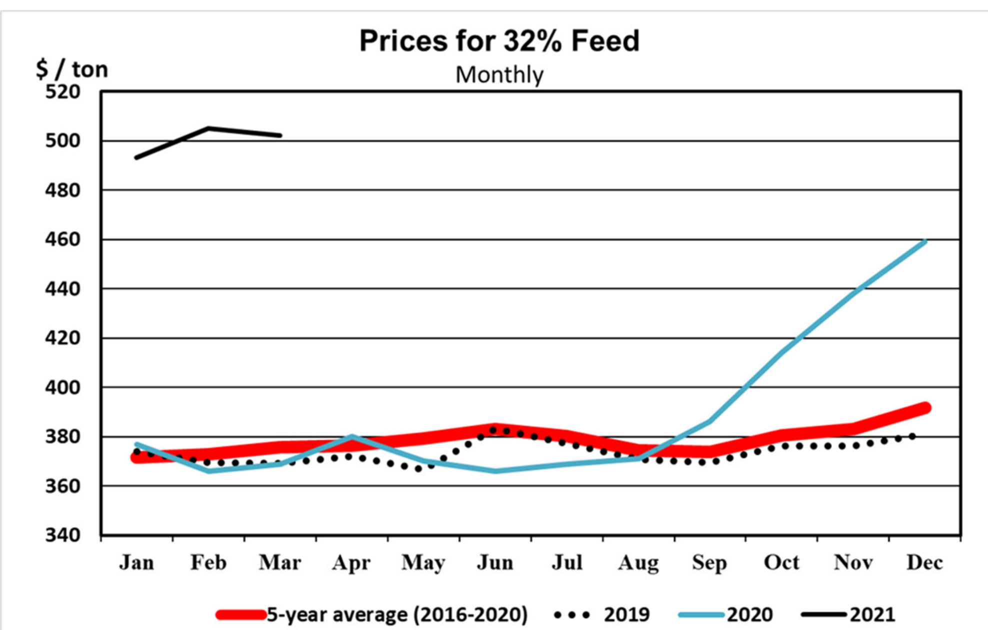
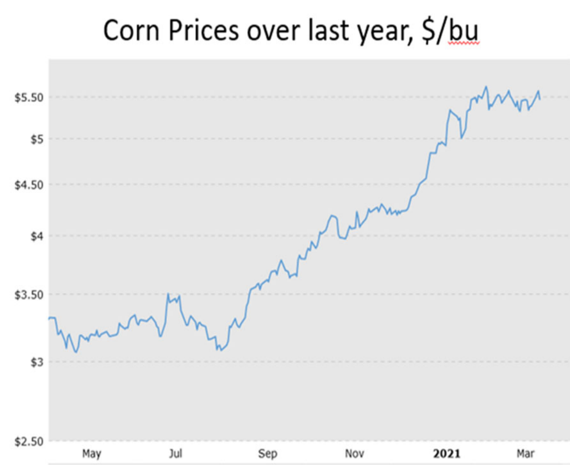


Fig. 1. Catfish feed prices for 32% protein feed in 2019, 2020, 2021, and the five-year average.

What can a catfish farmer do in this situation?

1) Keep an eye on the corn and soybean futures market prices. Future markets provide one source of price predictions. The primary crop ingredients in catfish feed are soybean meal and corn, at about 50% and 37%, respectively. One can check the future's market at the Chicago Board of Trade for futures contracts on corn, soybeans and soybean meal; see table below. The decisions of



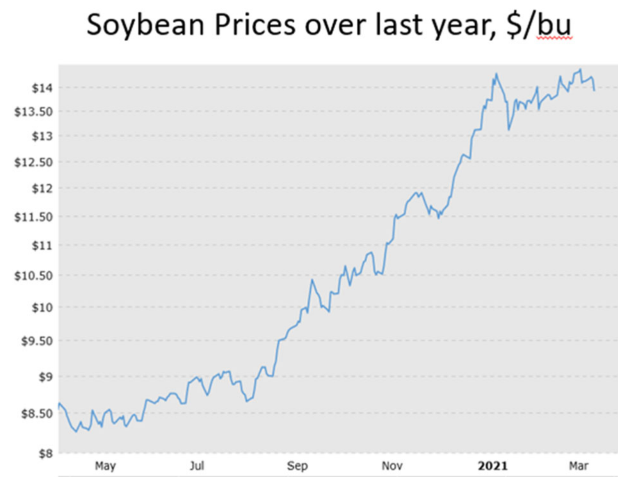


Fig. 2. Corn (+78% since July 2020) and Soybean (+66 % since July 2020) prices, 2020-2021. Source: Macrotrends

traders who are using all available information ultimately determine futures prices. To check on commodity future contract prices, go to these internet links:

Corn:
https://www.cmegroup.com/trading/agricultural/grain-and-oilseed/corn_quotes_globex.html
Soybean:
https://www.cmegroup.com/trading/agricultural/grain-and-oilseed/soybean_quotes_globex.html
Soybean Meal:
https://www.cmegroup.com/trading/agricultural/grain-and-oilseed/soybean-meal.html

Future's commodity prices are, therefore, a pretty good summary of factors likely to influence market prices. If you compare current commodity prices with future's contract prices 6 to 8 months later in the year, future's prices provide an idea of which way traders currently expect the commodity's price will go. You can see in the table below that the future's prices for each commodity are decreasing but slowly, over the next 2 to 8 months. However, conditions change quickly, and as new information about crop production becomes available, these future's prices are adjusted accordingly.

2) Booking catfish feeds is not an all-or-nothing proposition. It may be good to book some of your feed now and see how prices are in 1 to 2 months and reconsider if additional feed should be booked or not. However, check with your feed supplier to learn more about their booking requirements, such as minimum acceptable amounts, times for booking and delivery, payment method, etc. Given the potential for significant price volatility, producers might consider booking a portion of their feed needs. Remember, **it is not necessary and probably not advisable in most circumstances** to book 100% of anticipated feed needs. However, lining up some portion of those needs may have some advantages. If feed prices go up significantly, at least a portion of that increased feed price has been avoided. If feed prices decline, the producer can take advantage of that decline on the portion of feed purchases not made in advance. Also, having some feed booked may help a producer narrow down expected production expenditures and per-unit costs of production. This can help develop financial plans for the coming year and, if pre-paid, may help reduce taxes.

Chicago Board of Trade Commodity Grain Actual Price to Futures Price (CME)														
Corn					Soybean					Soybean Meal				
Actual	3/19/2021	$/bu	5.53		Actual	3/19/2021	$/bu	14.08		Actual	3/19/2021	$/ton	405.3	
Future	May-21	$/bu	5.51		Future	May-21	$/bu	14.05		Future	May-21	$/ton	404.2	
Future	Jul-21	$/bu	5.33		Future	Jul-21	$/bu	13.92		Future	Jul-21	$/ton	403.8	
Future	Sep-21	$/bu	4.86		Future	Aug-21	$/bu	13.48		Future	Aug-21	$/ton	396.6	
Future	Dec-21	$/bu	4.68		Future	Sep-21	$/bu	12.61		Future	Sep-21	$/ton	386.4	
					Future	Nov-21	$/bu	12.13		Future	Oct-21	$/ton	373.8	
										Future	Dec-21	$/ton	371.2	

3) Consider alternative feeding strategies for unfavorable economic conditions, like every other day, but be aware that this will decrease total fish produced. Many farmers will disagree with this strategy as they know more catfish pounds to sell is better than fewer pounds. Dr. Ganesh Kumar at the National Warmwater Aquaculture Center in Stoneville, MS, offers some ideas to help manage high feed prices.

- Monitor your feed budget and talk to your lender.
- Reduce the need for feeding by stocking less in 2021-2022 growing seasons.
- Stocking relatively larger fingerlings will provide a greater head start in production.
- Prioritize and feed ponds that have fish approaching market size.
- Feeding every day is the best strategy for production. However, every other day feeding becomes optimal when feed prices are approaching $500/ton.

Feeding strategies

- Feeding strategies on farms are sensitive to the levels of available capital, feed price, and fish price.
- At current feed and fish prices, feeding should be every day. Every other day feeding is optimal only when feed prices are very high. Every third day is not an optimal feeding strategy.
- Under higher feed prices or tighter credit, every other day feeding may become necessary.
- Reduce the cost of feed by using a 28% protein diet.

4) The bright spot is that catfish prices are high now (Fig. 3). The question is whether the higher fish price will offset the higher feed costs. You can do a quick estimate of whether you are making or losing money this year by:

- Estimate your feed costs by multiplying the feed quantity you expect to feed by the expected new higher feed price
- Multiply this by two as feed is approximately 50% of your total operating costs
- Subtract the feed plus other costs from your expected sales revenue to see your cash profit. Sales revenue is calculated by multiplying the quantity of fish you expect to sell by your expected fish price.
- There are a lot of unknowns here, but substituting in several feed/fish quantities and several expected fish/feed prices will give you a range of returns that can inform you about your chances for operational success this year.

5) Conclusions

The decision of whether or not to contract either input purchases or output sales can be a difficult one because there are seldom any right or wrong answers (without the benefit of hindsight, that is). Each producer must make an individual decision based on several factors. Perhaps the most important thing to consider is an individual's willingness and ability to stand the existing price risk. In this decision, it is important for the producer to determine whether or not the potential exists for a loss that would jeopardize the financial stability or survivability of the operation. If so, some type of contracting or forward purchase or sale would be an effective means of reducing that risk to an acceptable level.

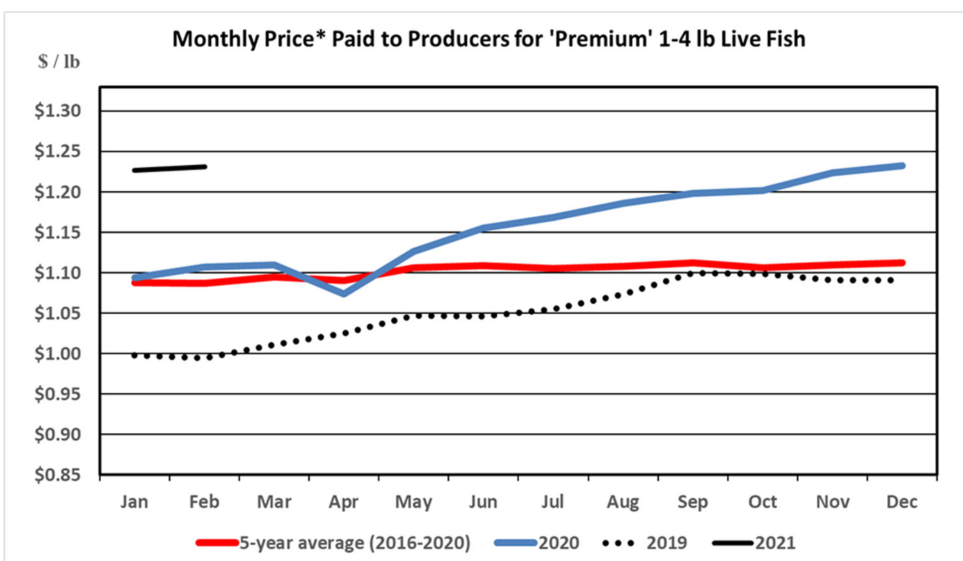


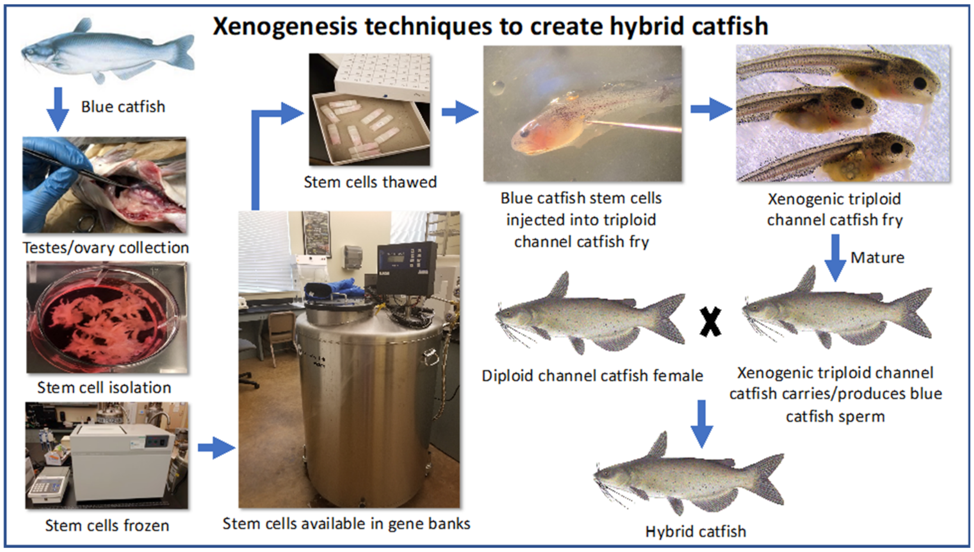
Fig. 3. Premium sized catfish (1-4 lb) price to producer, 2019, 2020, 2021, and 5-year average.

RESEARCH ROUND-UP

It's cold down here in Alabama: Freezing cells for optimizing hybrid catfish hatchery production

Jaelen N. Myers, Rex A. Dunham, Muyassar Abualreesh, Ian A. E. Butts, SFAAS

Cryopreservation is encroaching the world of aquaculture science. This technology has been popularized by movies such as Jurassic Park, in which deep-freezing chambers were used to incubate priceless dinosaur embryos. Although the implications for aquaculture are quite different, it is still an effective way to store various cell types and tissues without an expiration date. Cryopreservation of fish eggs and sperm is the next big step because it makes genetic material from valuable individuals available for selective breeding programs. The ability to pluck cells from cold storage could facilitate gamete transport between hatcheries and ensure that sperm is available when females are induced to spawn. Currently, cryopreservation protocols have been developed for testes, ovaries, and sperm for multiple freshwater and marine fish species.



There is a way to advance the technology to the next level by cryopreserving spermatogonial and oogonial stem cells (SSCs and OSCs, respectively). These cells are undifferentiated with the ability to develop into either testes or ovaries. The added benefit to having stem cells available in gene banks is that they are the secret weapon for xenogenesis (see Fig.). This process takes the stem cell tissues from a donor fish and transplants them into a host fish, in which the host develops the gonads and gametes of the donor. At first, it may not seem obvious why this is so interesting, but it has potential for improving hybrid catfish outputs if these cells are available for xenogenesis. Stem cells from blue catfish can be transplanted into channel catfish males, then the channel catfish male can produce blue catfish sperm. The next step would be to mate one of these males to a normal channel catfish female, resulting in all hybrid fry. This would be easier than the current hand stripping technique.

To make this approach more feasible, the aim of this research was to develop cryopreservation protocols for blue catfish testicular and ovarian tissues. Cryopreservation success is highly dependent on minimizing cell damage. Just like baking from a cookbook, there are specific ingredients that must be added, steps to be perfected, and one recipe does not work for all species or cell types. To find the perfect "recipe", we adapted methods from previous protocols by our research group. We analyzed different cryoprotectants (four permeating and two non-permeating) and concentrations that are common across cryopreservation studies. These cryoprotectants essentially act as shields against deepfreeze damage, but their efficacy may depend on their concentrations. Post-thaw viability of blue catfish SSCs and OSCs from the frozen tissues was compared for all combinations, using fresh cells as controls. The top performers from this stage of the analysis were then tested with multiple freezing rates ranging from low to high. Once optimizing the protocol to this point, the effects of four antioxidants and two antifreeze proteins (AFPs) (which acts as another layer of defense from cryodamage) were assessed for SSC post-thaw viability.

Our results showed that the choice of permeating or non-permeating cryoprotectant notably impacted cell survival of both cell types. For SSCs and OSCs, DMSO was a more effective permeating cryoprotectant than ethylene glycol, methanol, glycerol, or methanol. There were also significant differences in post-thaw viability due to the concentration. Since higher concentrations of these chemicals compromised viability, these cell types are likely sensitive to cytotoxicity when too much of them are added to the cells. Results were improved even more by adding the non-permeating cryoprotectant lactose to DMSO. Slower freezing rates (-0.5/-1 °C) were also less detrimental to the cells than more drastic rates (-5 and -10 °C). We also showed that individual antioxidants or AFPs improved post-thaw viability when added individually, but certain combinations of antioxidants and AFPs did yield better results.

Conclusions - Overall, our work shows that cryopreservation outcomes are influenced by steps taken at almost every step of the cryopreservation process, and optimization is key to cell survival. Although we used blue catfish tissues as our test species, we have shown which factors are important and must be optimized within any cryopreservation protocol. This knowledge can be applied to develop protocols for other important species. The next leg in this race is to use cryopreserved cells in transplantation research to prove that these frozen cells produce high numbers of xenogenic fry that can be raised to produce hybrid catfish fry.

EW Shell Fisheries Center: A Resource for Aquaculture Research in Alabama

Larry L. Lawson Jr., E. W. Shell Fisheries Center, SFAAS

Fig.1. The E.W. Shell Fisheries Center has a large number of ponds available for research.

The EW Shell Fisheries Center (the Center) sets Auburn University's School of Fisheries, Aquaculture, and Aquatic Sciences (SFAAS) apart from nearly all other public universities in the United States. This sprawling research center stretches more than three miles north to south encompassing over 1600 acres of land and almost 300 acres of freshwater ponds varying in size, type, and purpose (Fig. 1). In recent years, significant investment led to the construction of a 20,000 ft^2 administration and teaching building, a 17,000 ft^2 aquatic research laboratory building, the fish biodiversity research building, four-one acre raceway ponds, four "pole barn" flow-through systems, and substantial renovations to our existing structures. The Center's diverse and unique infrastructure supports a

Fig. 2. “Pole barn” flow-through system.

Fig. 3. Small-scale raceway ponds.

broad range of research, education, and outreach.

The heart of the Center is our faculty, staff, and students who call it home. As our facilities have progressed, so too has the footprint of our faculty. Currently utilizing the Center are at least 12 SFAAS faculty members and numerous associated graduate students whose labs cover the spectrum of aquatics research. Some of the current aquaculture-focused faculty specialize in fish nutrition, aquaculture outreach, fish reproductive physiology and cryobiology, aquaculture genetics, aquatic animal health, economics, and hatchery management. The Center is increasingly becoming a hub of interdisciplinary research with representatives from bio-systems engineering and horticulture (aquaponics research facility), entomology (honey bee research), biology, wildlife, and forestry, to name a few.

The extensive facilities available at the Center make it second to none in terms of warm-water aquaculture research capabilities. Beyond the many traditional aquaculture and watershed-type ponds, the newly constructed “pole barn” flow-through systems and small raceway ponds are unique additions over the past few years (Fig. 2 and Fig. 3). These production systems are designed specifically for conducting replicated aquaculture research experiments. Each of the four one-acre small raceway systems has 12 identical raceways allowing for great flexibility in treatment x replicate study designs. Similarly, the pole barn flow-through systems have 12-750 gallon tanks to suit the researchers’ needs. The new Aquatic Resource Laboratory building boasts ten small-scale recirculating aquaculture systems (RAS), seven independent wet lab rooms, a disease challenge lab, and three sophisticated chemistry labs. Other improvements include the renovation of the genetics research greenhouse, which now houses two new large-scale RAS; the recently completed aquaponics greenhouses; and plans for a new tilapia grow-out facility.

The Covid-19 pandemic greatly impacted our outreach and teaching activities the past year; however, this has given us time to reflect on the status of our outreach efforts at the Center. Traditionally, the Center hosts several public events, including an annual fishing tournament, biannual Open House Field Day, and business meetings for agency or industry stakeholders. Also, new classroom facilities have improved our teaching capabilities and are increasing the number of classes hosted at the Center. In the coming months, we plan to focus on extending our outreach to include greater public involvement at the Center and hope to bolster our interaction with the broader community. The Center is ideally situated to host relatively large groups in our multi-purpose meeting room in the new administration building. Our recently renovated pavilion area provides a scenic fishing lake, restroom facilities, concessions, and covered meeting space. If you need a location or have an idea for an aquaculture-related outreach event, please contact SFAAS.

More than ever, the aquaculture industry is adapting to new challenges, and the EW Shell Fisheries Center is doing the same. Many things have changed over the years, but, from faculty to facilities, we continue to be one of the leading aquaculture research facilities across the nation. Continued investment and involvement with industry partners will ensure we maintain our relevance in an ever-changing landscape. With all of these resources, the Center is as well-positioned as ever to fulfill our mission of Research, Teaching, and Extension to improve the aquaculture industry in Alabama.

Drones for monitoring "blue-greens" in catfish aquaculture ponds

Edna G. Fernandez-Figueroa, Angelea P. Belfiore, and Alan E. Wilson, SFAAS

Drones, unoccupied aerial vehicles, are commonly used in agriculture to determine the health of economically important crops, such as corn and wheat. Similar methods are currently being developed to measure the abundance of beneficial green algae and potentially toxic cyanobacteria, commonly called "blue-green algae", in aquaculture ponds. While currently in the developmental stages, these methods could be instrumental in informing important management decisions.

Blue-green algae thrive in aquaculture ponds throughout the southeastern US during much of the year, especially during the summer, due to the high nutrient inputs in the form of catfish feed. Blue-green algae blooms can lead to fish kills through the production of toxins (i.e., cyanotoxins) or when bacteria decompose dead organic matter leading to depleted dissolved oxygen levels. Off-flavor issues are also commonly associated with blue-green algae blooms, as some species produce compounds such as geosmin and 2-methylisoborneol (MIB) that affect the flavor and reduce the market value of catfish fillets. To mitigate the economic impacts associated with blue-green algae, aquaculture managers employ EPA-approved algaecides, such as copper sulfate, to reduce cyanobacterial abundance. While copper treatment is an effective tool for managing blue-green algae, it can also remove beneficial green algae and diatoms that make up the base of aquatic food webs, as well as other microbes, such as bacteria, that play a role in reducing ammonia and nitrite concentrations. Therefore, determining if blue-green algae concentrations are high enough to warrant chemical treatment is important for maintaining healthy pond ecosystems.

Estimating algal and blue-green algae abundance can be an expensive and time-consuming process, particularly in expansive aquaculture farms. Differentiating between harm-

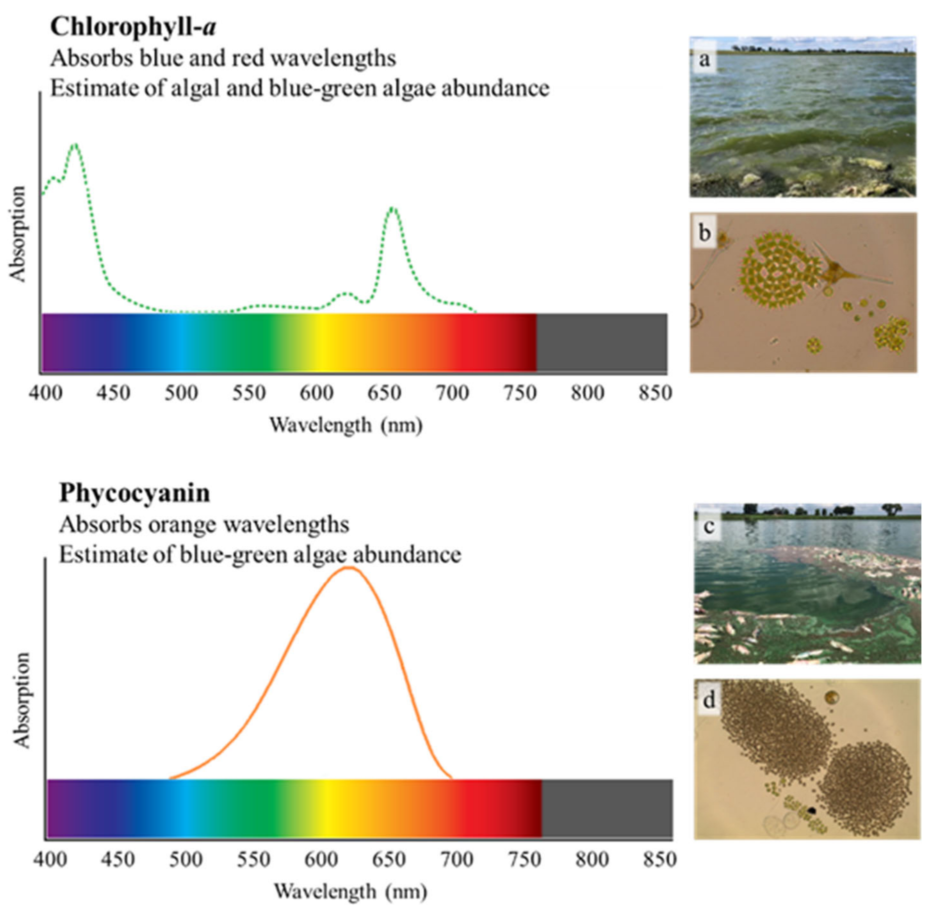


Fig. 1. Spectral absorbance of chlorophyll-*a* (top), the photosynthetic pigment found in all phytoplankton, and phycocyanin (bottom), an accessory pigment unique to cyanobacteria, commonly known as blue-green algae. High chlorophyll-*a* concentrations cause waterbodies to appear green (a) due to high concentrations of phytoplankton including green algae, diatoms, and cyanobacteria (b). High phycocyanin values are indicative of high cyanobacterial abundance, commonly associated with thick surface scums (c) and the release of cyanotoxins by cyanobacterial genera, such as *Microcystis aeruginosa* (d) that can cause fish kills (c).

less green algae and harmful blue-green algae typically requires cell enumeration or measuring photosynthetic pigments, such as chlorophyll-*a* and phycocyanin. Chlorophyll-*a* gives photosynthetic organisms, including green algae, blue-green algae, and terrestrial plants, their characteristic green color, as chlorophyll-*a* absorbs red and blue wavelengths and reflects green and near-infrared wavelengths (Fig.1). Scientists often measure chlorophyll-*a* to estimate the abundance of all the phytoplankton, including green algae and cyanobacteria. For estimating blue-green algae abundance, researchers often measure phycocyanin, which is present in blue-green algae. Phycocyanin absorbs orange and reflects blue and near-infrared wavelengths, causing the water to appear blue-green, hence the name “blue-green algae” (Fig.1). These differences in wavelength reflection can be detected with the naked eye with green algae dominated ponds having a “camouflage-green” hue and blue-green algae-dominated ponds having an almost neon “John Deere green” hue with visible surface scum (Fig.2). While these observations can be extremely helpful, they do not provide a quantitate measure of algal and blue-green algae abundance.

Drones equipped with sensors that measure blue, red, green, and near-infrared wavelengths can be used to estimate the abundance of chlorophyll-*a* in terrestrial and aquatic systems. However, there are still limitations for utilizing drones for monitoring aquaculture facilities, including the cost of drones and sensors, processing time, and a lack of standardized methods for estimating phycocyanin. To identify tools and methods for estimating phycocyanin (i.e., blue-green algae abundance), phycocyanin estimates based on aerial images of commercial aquaculture facilities in west Alabama are compared to *in situ* water samples. The goal of that research is to generate methods for collecting aerial data with drones of the entire catfish farm in a single flight and generate estimates of blue-green algae abundance of every pond within a short timeframe. Combined with automated dissolved oxygen and temperature meters, automated tools such as drones can be instrumental for optimizing aquaculture production and generating important data that can be used to better manage aquaculture facilities in a timely manner.

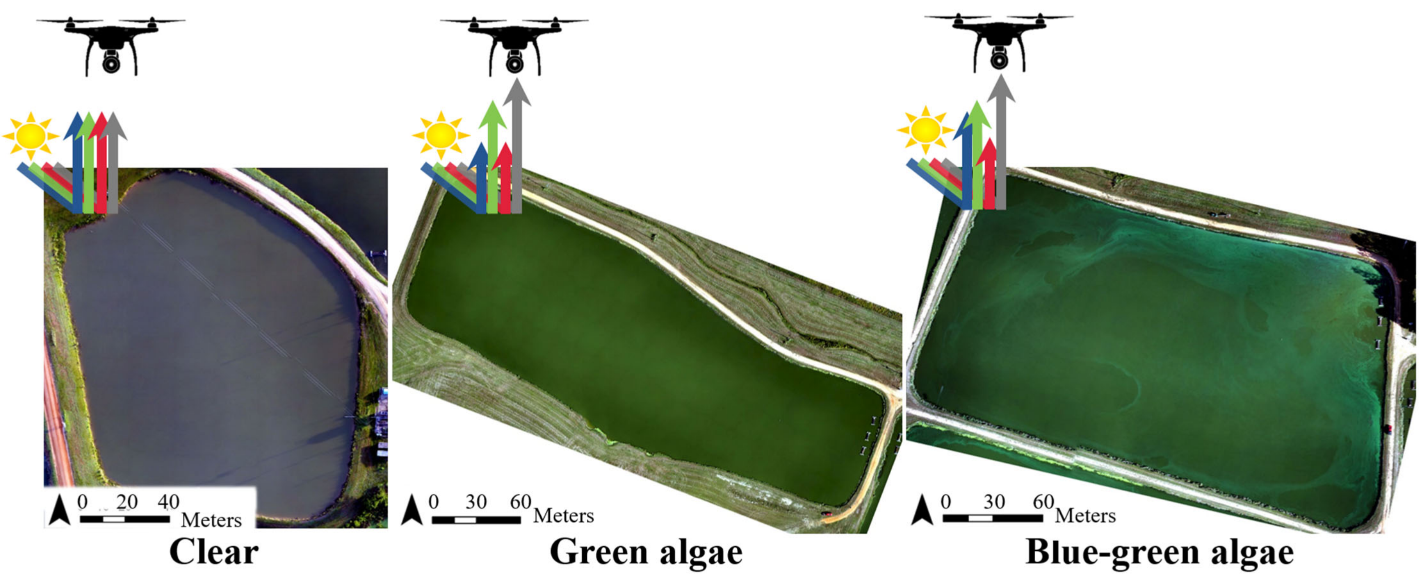


Figure 2. Typical spectral properties of a clear pond with low phytoplankton abundance, a pond with high green algal densities with high reflectance of green and near-infrared (NIR) wavelengths, and a pond with high cyanobacterial densities, with high reflectance of blue, green and NIR wavelengths, and characteristic cyanobacterial surface scum.

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