EXTENSION NEWSLETTER

The Alabama Fish Farming Center stays busy serving farmers despite COVID-19

Luke Roy, Anita Kelly, Alabama Fish Farming Center

The Alabama Fish Farming Center is no stranger to providing diagnostic, Extension, and research support to west Alabama aquaculture producers and 2020 has been a very unorthodox yet still productive year. The COVID-19 pandemic resulted in the Fish Center closing its doors from April 11 – May 8 due to a closure mandated by Auburn University. However, Fish Center personnel were still available to farmers during this time and farm visits were made to provide assistance related to fish health and production related issues. To date, Fish Center personnel have collectively logged in excess of 500 farm visits in 2020 to provide assistance related to fish health, water quality, production related issues, or to work on various aquaculture research and extension demonstrations. Since May 8, the Fish Center has been operational during normal working hours (8:00 AM – 4:30 PM) behind locked doors in accordance with Auburn University's COVID-19 policy. Farmers needing assistance can call the Fish Center from the parking lot to drop off water or fish samples at the east side entrance of the building. Currently, the Fish Center conference room is still closed to the public until further notice. Research activities have continued for the most part as planned, however a few projects have been delayed until 2021 due to pandemic-related issues.

Dr. Anita Kelly has made in excess of 200 farm visits to provide catfish producers with assistance in diagnosing disease related issues and investigating fish kills. The Mobile Lab has been a tremendous asset during the COVID-19 pandemic and has allowed continued support of Alabama catfish farmers throughout the year even during the quarantine period when the Fish Center was closed. Bill Hemstreet is working part-time in a backup diagnostics support role and has been instrumental to the continued suc-

Proliferative gill disease (Hamburger Gill Disease)

Anita Kelly, Alabama Fish Farming Center

Fig. 1. The swollen gills of a channel catfish that was diagnosed with PGD. Note the hamburger like appearance. (Photo courtesy of the National Center for Veterinary Parasitology).

Proliferative gill disease (PGD) is the most significant parasite disease of farm-raised channel catfish and to some extent hybrid catfish. Blue catfish, *Ictalurus furcatus* are essentially immune to PGD and blue × channel catfish hybrids are partially immune and may prevent the PGD parasite from completing its life cycle. Therefore, channel catfish (and sometimes their hybrids with blue catfish) are the only species susceptible to PGD.

Proliferative gill disease is caused by a myxosporean parasite that results in severely swollen gills with broken gill cartilage. Most cases of PGD will occur between March and May when the ideal water temperatures for this disease occur (61 to 77 °F). Mortalities are often significant and can exceed 50 percent. The high mortality rate is due to severe gill swelling, making it difficult for the fish to extract enough dissolved oxygen from the water. This essentially suffocates the fish. The swelling and red hemorrhagic areas next to white dead gill tissue gives the gills a ground hamburger meat look (Fig. 1).

The parasite causing PGD is *Hennegya ictaluri,* a spore-forming parasite that alternates between two hosts, an annelid worm and channel catfish. The annelid worm *Dero digitate,* which lives in the pond mud, hosts the actinospore, *Aurantiactinomyxon ictaluri.* The actinospore develops in the worm, which then releases the actinospore stage into the water through its feces. This actinospore floats in the water with its three wing-like projections that act as buoyancy floats. The actinospore attaches to the fish's gills and releases its plasmodial sporoplasm (containing infectious cells) into the fish gills causing a severe inflammatory response leading to respiratory distress. This inflammatory response leads to swelling or ground hamburger appearance of gill. It occurs most often in younger fish, especially those stocked into new ponds, but older fish and established ponds are affected at times. Multicellular spores form within the plasmodia inside the fish gills. Some mature into *Henneguya ictaluri* spores, which are released into the pond environment and are ingested by the Dero

worms. This completes the life cycle (Fig. 2).

There is no treatment for PGD, but some methods have demonstrated anecdotal success. Since PGD is considered a "new pond disease," it has been recommended that new or renovated ponds be filled partially with water from adjacent, established ponds. Since the Dero worm is a host, stocking smallmouth buffalo, *Ictiobus bubalus,* that consume the worms could reduce the number of hosts for PGD. Prevention of PGD has been accomplished by applying hydrated lime to dry ponds prior to filling. The caustic nature of hydrated lime and the associated pH change in the pond soil significantly reduces the amount of Dero worms present in the mud prior to filling. As for treatment, catfish farmers have often pumped water from an established, healthy pond into a pond infected with PGD with some degree of success in reducing mortalities. Note that when PGD-infected catfish are removed from the infected pond, they recover quickly. Although no proven treatments

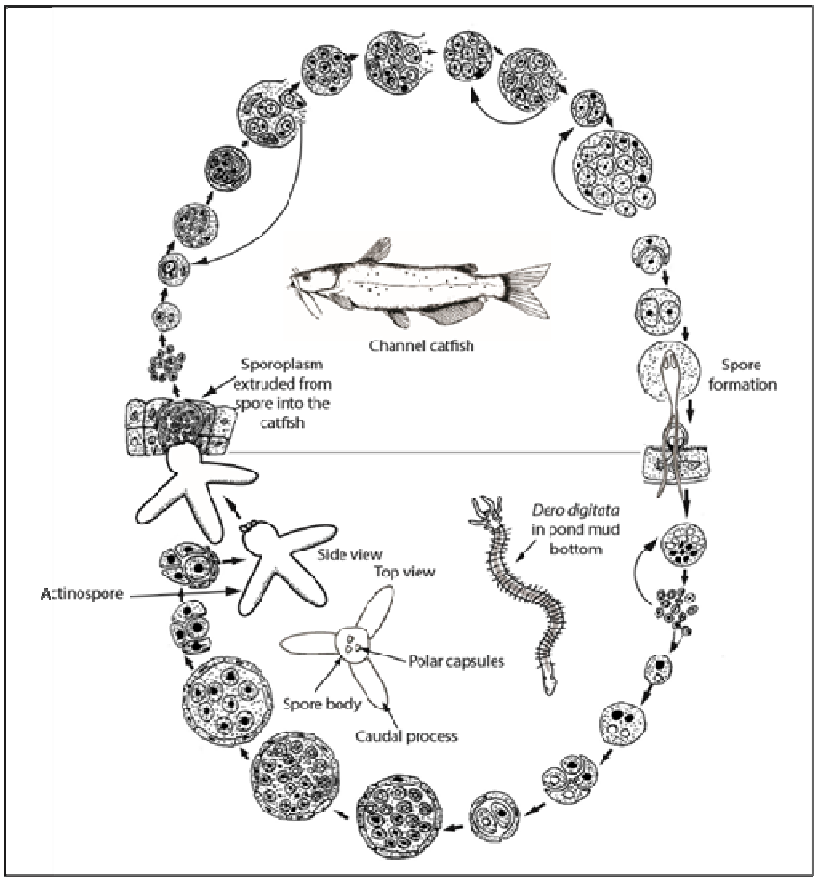

Fig. 2. Life cycle of *Henneguya ictaluri,* causative organism of PGD, showing the development of its myxospore stage in channel catfish and actinospore stage in *Dero digitata.* (Photo courtesy of Wyvette Williams, Kentucky State University)

Jesse James joins the Alabama Fish Farming Center as a Research Associate

Jesse James was recently hired as a Research Associate at the Alabama Fish Farming Center. Jesse grew up on a catfish and crawfish farm outside Newbern, Alabama. He attended Troy University where he received a B.S. in Marine Biology (2017) and was a member of the Troy University Bass Fishing Team. After completing his undergraduate studies at Troy, he was accepted into the graduate school at Auburn University and in 2019 received an M.S. in Fisheries, Aquaculture, and Aquatic Sciences. Jesse will be providing support to research, diagnostic, and Extension programs based out of the Fish Center. Jesse's background and expertise in catfish and crawfish farming is proving to

CFAP - Coronavirus Food Assistance Program

Terry Hanson, Luke Roy , Anita Kelly,
School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn University

The Coronavirus Aid, Relief, and Economic Security Act (CARES Act) provided $9.5 billion to the US Secretary of Agriculture to assist agricultural producers impacted by the effects of the COVID-19 outbreak. This amount was augmented by $6.5 billion from the Commodity Credit Corporation (CCC) to assist producers with issues of production and marketing of agricultural commodities, and the removal of surplus commodities from normal marketing channels.

With this CARES act, US farmers and ranchers whose operations were directly impacted by the coronavirus pandemic were provided financial relief through the Coronavirus Food Assistance Program (CFAP) and later through an additional CFAP-2 program.

Initial CFAP Program - On August 11, 2020, the USDA announced that catfish and other species such as crawfish, largemouth bass and carp sold live as foodfish, hybrid striped bass, red drum, salmon, sturgeon, tilapia, trout, ornamental-tropical fish, and recreational sportfish were eligible for a payment if they met one or two criteria.

CFAP payments were issued to farmers from two different funding sources. The CARES Act compensated farmers for losses resulting from a price decline between mid-January and mid-April 2020. The catfish industry did not meet this requirement. The second funding source used the Commodity Credit Corporation Charter Act (CCC) to compensate producers for losses due to on-going market disruptions over the same period. Catfish producers were eligible for the CCC payment because they faced an abrupt and significant drop in sales during the period. Payments to catfish farmers were calculated by multiplying the inventory that was not sold but was market size and available to be marketed between January 15 and April 15, 2020, by the payment rate of $0.07 per pound. The application process was administered through each county's Farm Service Agency office.

CFAP 2 Program - On September 18, the USDA announced a second Coronavirus Food Assistance Program 2 (CFAP 2) that provided an additional coronavirus aid package for farmers. The USDA allotted $14 billion from the Commodity Credit Corporation (CCC) Charter Act and CARES Act for the CFAP 2 program, with the aim of helping producers who continued to face market disruptions and associated costs due to the COVID-19 pandemic. **The sign-up for CFAP 2 program began on September 21, 2020 and continues until the sign-up deadline of December 11, 2020.** The USDA has provided several options for applying, including applying online or downloading forms to fill out and submit. Catfish producers are encouraged to contact their local FSA office to begin the application process. Go to www.farmers.gov/cfap/aquaculture for specific information on aquaculture commodities.

CFAP 2 payment calculations will use a sales-based approach, where producers are paid based on five payment ranges associated with their 2019 sales. Payments for CFAP 2 will be based on the catfish producer's 2019 sales of eligible commodities in a declining block format using the following

2019 Sales Range	Percent Payment Factor of Producer's 2019 Sales
$0 to $49,999	10.6%
$50,000 to $99,999	9.9%
$100,000 to $499,999	9.7%
$500,000 to $999,999	9.0%
>$1,000,000	8.8%

For example, a producer's 2019 eligible catfish sales totaled $75,000. The payment is calculated as ($49,999 times 10.6% = $5,300) plus ($25,001 times 9.9% = $2,475), which equals a total payment of $7,775. Payments for catfish producers who began farming in 2020 and had no sales in 2019 will be based on the producer's actual 2020 sales as of the producer's application date. Eligible sales only include sales of raw commodities grown by the producer. More examples of how payments will be broken down based on sales ranges are shown in the

Example Farmer	2019 Catfish Sales	Portion of farmers total payment falling into each sales range					Total Gross Payment
		<$50,000 in Sales (10.6%)	$50,000 to $99,999 in Sales (9.9%)	$100,000 to $499,999 in Sales (9.7%)	$500,000 to $999,000 in Sales (9.0%)	>$1 mill in Sales (8.8%)	
Farmer 1	$8,265	$876					$876
Farmer 2	$66,187	$5,300	$1,603				$6,903
Farmer 3	$220,737	$5,300	$4,950	$16,712			$21,962
Farmer 4	$686,650	$5,300	$4,950	$38,800	$16,798		$65,848

To complete the CFAP 2 application, producers will need to reference their sales, inventory, and other records. However, since CFAP 2 is a self-certification program, this documentation will not need to be submitted with the application. Because applications are subject to County Committee review and spot check, some producers will be required to provide documentation.

There is a payment limitation of $250,000 per person or entity for all commodities combined. Applicants who are corporations, limited liability companies, or limited partnerships may qualify for additional payment limits when members actively provide personal labor or personal management for the farming operation. In addition, this special payment limitation provision has been expanded to include trusts and estates for both CFAP 1 and 2. Producers will also have to certify they meet the Adjusted Gross Income limitation of $900,000 unless at least 75% or more of their income is derived from farming, ranching or forestry-related activities. Producers must also comply with Highly Erodible Land and Wetland Conservation provisions. Producers may be requested to provide documentation of their application and certification. Producers also must fill out forms to prove their eligibility for the program. Catfish producers who participated in the initial CFAP will likely have all eligibility forms on file.

Alabama Department of Agriculture & Industries State Supplemental CFAP Program - In August, Gov. Kay Ivey awarded $26 Million of CARES Act Funds to assist Alabama Agriculture impacted by COVID-19. Funding was used to establish the Alabama Agricultural Stabilization Program (AASP), see crf.alabama.gov for more details. The AASP supplemental CFAP Grant Program had $8 million allocated for producers that qualified for USDA's initial Coronavirus Food Assistance Program (CFAP). The exact percentage to be used for the state payment will be determined after all state supplemental CFAP applications have been received and USDA's CFAP data is finalized. For more details, go to https://alabama.submittable.com/

Managing algal populations and off-flavor in channel catfish ponds using weekly low dosages of copper sulfate

Anita Kelly, Luke Roy, Alabama Fish Farming Center

Several catfish farms in west Alabama have difficulty with heavy algal blooms in the summertime. These algal blooms often contain blue-green algae (or cyanobacteria), causing off-flavor in channel catfish. Off-flavors ultimately cost catfish producers as harvesting is delayed until the fish are on flavor. This requires more feed to maintain the fish's weight and potential losses due to disease outbreaks or predation. Annual economic losses due to off-flavor have been estimated as high as $47 million.

Copper sulfate is commonly used in the catfish industry to control the blue-green algal blooms. However, farmers typically treat once the bloom has taken over the pond or when fish are not eating as much. The major disadvantage of using copper sulfate is that it is affected by water quality including alkalinity, hardness and pH. Treating ponds occasionally with large quantities of copper sulfate can increase free copper to concentrations that are stressful or can kill fish, particularly in pond water with low alkalinity. By using frequent low doses of copper in catfish ponds producers can avoid stress, mortatity, or off-flavor.

Studies conducted on commercial farms in Mississippi indicated that using low doses of copper sulfate resulted in 50% fewer off-flavor cases in their fish, decreased blue-green algal populations, while beneficial green algal populations increased. In this study copper sulfate treatments began in late spring or early summer. It continued weekly until the water temperature was below 68 ^{0}F. These farms applied copper sulfate pentahydrate at 0.5 ppm or 5 lbs per acre. The copper sulfate pentahydrate crystals, placed in burlap bags, were hung either in front of or behind the aerator. The aerators were run until all the crystals had dissolved. The aerators enabled more even distribution of the copper around the

American White Pelicans

Brian Dorr, Research Wildlife Biologist, USDA/Wildlife Services/National Wildlife Research Center

You may have seen these large birds flying high above your farm. Slowly circling, rarely flapping, rising with thermal updrafts, their wings periodically flashing white as the sun catches them. Rising high in the air, they can set those wings in a low glide and travel incredible distances. What you are looking at is likely the American White Pelican (*Pelecanus erythrorhynchos*).

The American White Pelican is an unmistakable bird. With a wingspan of 8-9 feet and weights of 12

to 20 lbs, they are one of the largest birds in North America. They are an all-white bird except the outer edges of their wings which are black. Like all pelicans they have an enormous bill with a huge expandable yellow to orange pouch, called a 'gular pouch.' They are one of only two species of pelicans in N. America. The other is the much smaller and darker Brown Pelican (*Pelecanus occidentalis*), familiar along coastlines of the U.S.

The American White Pelican is quite different from the Brown Pelican in many ways. For one, they range far inland and breed in sometimes very large colonies (1,000's of individuals), primarily in the Great Lakes and Northern prairie regions of the US and Canada. Their breeding colonies are usually on remote islands, protected from predators. Brown Pelicans are coastal birds rarely venturing inland. American White pelicans will migrate along our Pacific, Central and Mississippi Flyways (rarely the Atlantic flyway) similarly to what we see with ducks and geese. They will winter along our warm southern coasts where they may mingle with Brown Pelicans and their more distantly related cousin, the Double-crested Cormorant (*Phalacrocorax auritus*).

In some ways, the American White Pelican shares more characteristics with its distant cousin, the Double-crested cormorant, than the more closely related Brown Pelican. The American White Pelican breeds and migrates in similar areas as the Double-crested Cormorant. However, the Double-crested Cormorant is more common and widely distributed. Both species had a large population increase with the limitation of pesticides like DDT, legal protections, and changes in habitats. As with other wildlife, their populations increased rapidly from lows in the 1970s. According to breeding bird survey data, both species' populations are continuing to grow, mainly east of the Rocky Mountains. They are now commonly found throughout the southeast, particularly Arkansas, Louisiana, Mississippi, Alabama and Florida.

The American White Pelican differs from both the Double-crested cormorant and the Brown Pelican in how it forages. The other two species are diving birds, but the American White Pelican swims along, usually in large flocks, dipping its long neck and bill into the water and scooping up prey. They do not dive. These birds will often work in unison to 'corral' and capture prey, like schools of fish. They then let the water drain from their pouch and swallow the remaining prey whole. Whereas the cormorant catches prey of a certain size (4-12 inches), pelicans will eat almost anything from small fish and crustaceans like shrimp (if there are large numbers) to fish well up to

2lbs or more in size.

American White Pelicans share another characteristic with their cousins the Double-crested Cormorant. They can often be found eating fish from aquaculture ponds, much to the consternation of farmers. Because of how pelicans forage and their large size, they can consume anything from fingerlings to foodfish. The only saving grace for producers is American White Pelicans are not as abundant as cormorants. Wintering populations in Mississippi averaged about 1/10th that of cormorants. However, they often move in large flocks, and when they do show up, they can cause a lot of damage quickly. American White Pelicans are estimated to consume about 2-3lbs of fish per day. If pelicans show up on your farm, the depredation issue is a serious one. But what may be more damaging is they are a host for the trematode parasite (*Bulbophorous damnificus*) that can infect catfish and cause substantial fish losses.

So, what can a producer do if pelicans arrive on their farm? The methods typically used to disperse cormorants also work on pelicans (pyrotechnics, propane cannons and harassment patrols). Permitted lethal take under a depredation permit can also help disperse birds and make non-lethal methods more effective. If you can get legal access, dispersing pelicans from nearby loafing areas (often flooded fields) can move them away from your farm as well. If you have trematodes, efforts like liming pond mar-

Greg Whitis Retires

Bill Hemstreet, Retired AFFC Staff

Greg Whitis, an Aquaculture Specialist with the Alabama Cooperative Extension Service (ACES), retired from his position at the Alabama Fish Farming Center (AFFC) on September 1st of this year. Greg accepted this position in 1987. He is a native of Iowa and came to Alabama via Auburn University, where he attended and received a Master of Aquaculture Degree in 1982.

He returned to Iowa to marry Karen, his wife now of 37 years. They have two sons, Jason and Andrew. In 1985 he returned to Alabama with Karen to be employed by Pearce Catfish as night-time manager of Alabama's largest catfish farm.

In 1987, Auburn University hired him to fill the Aquaculturist position at the Alabama Fish Farming Center in Greensboro. Greg is known for his hard-nosed, no-nonsense economic approach to aquaculture enterprises.

Among his accomplishments over the years, he has helped numerous catfish farms set up and run their own water-quality testing facilities. He has also helped set up and nurtured several aquaponic systems in Alabama secondary schools. Greg has been instrumental in developing the salt-water shrimp farms in west Alabama. He has been an effective liaison with Auburn's Fisheries researchers in developing Best Management Practices for Catfish Farms.

Also, Greg has served as Scoutmaster for local Boy Scout Troop 13 for many years, taking his scouts to Philmont twice, the Boundary Waters, and Sea Base expeditions. In his retirement, he is pursuing his aspirations to become an accomplished

USDA APHIS Wildlife Services Has Moved

Thomas Graeter, USDA APHIS Wildlife Services

As some of you may have heard, the USDA APHIS Wildlife Services office has recently left the great town of Greensboro. The decision to leave Greensboro, and the Fish Farming Center, was difficult for all involved. Still we believe it will ultimately prove to be a benefit to the fish farming community. The Fish Farming Center personnel has ambitiously undertaken plans to expand their facility and research capabilities to better serve the aquaculture producers of west Alabama. This expansion includes hiring additional staff members and, consequently, the need for extra office space. Therefore, it was mutually agreed that Wildlife Services would seek a space to call its own. The Wildlife Services office is now located in Northport beside the Alabama Department of Conservation and Natural Resources (ADCNR District 3) and the Alabama Forestry Commission offices (AFC Northwest Region) (Fig. 1). While the office has moved, I will remain in Greensboro and serve the aquaculture producers of west Alabama. I want to encourage you to contact me directly if/when you experience issues related to double-crested cormorants or any other species of fish-eating bird. I can be reached at (334) 200-5531 or at Thomas.Graeter@usda.gov.

Fig. 1. New location of USDA APHIS Wildlife Services in Northport, AL.

I would also like to take this opportunity to inform the aquaculture community that Mrs. Leah Moran has left her position with Wildlife Services to pursue a PhD at Louisiana State University. Leah was a valuable member of our team, and her contributions to Wildlife Services will be greatly missed. With that said, we expect great things from our new aquaculture technician, Mr. Daniel Creel. Daniel is a local from Linden, AL. He recently graduated from Auburn University, where he earned a Master of Science with a focus on Fisheries, Aquaculture, and Aquatic Science. Many of you will know Daniel from his work on “big fish” and the problems they cause to catfish producers. Since graduating, Daniel has been working at the Alabama Fish Center under the leadership of Dr. Luke Roy.

If you have any questions, issues, or require assistance, please reach out to me directly or stop by the new office:

USDA APHIS Wildlife Services
8115 McFarland Blvd.
Northport, AL 35476
office: (205) 632-3981
(205) 650-6084

The Auburn University Coastal Shellfish Lab Helps Producers

William Walton, Auburn University Shellfish Lab

The Auburn University Shellfish Lab (AUSL), located on the Dauphin Island Sea Lab campus on the Alabama coast, is part of Auburn University's School of Fisheries, Aquaculture & Aquatic Sciences. Built in 2003, AUSL is staffed by four biologists, a team of graduate students and post-doc(s), a couple Extension specialists and a professor, and serves as a base of operations for other Auburn faculty and their students (as well as other collaborating institutions). The overarching mission of AUSL is to ensure a thriving shellfish seafood community in the US, through globally relevant research, Extension and education.

This ambitious mission consists of three distinct elements: sufficient and sustainable shellfish production, capable individuals and engaged communities that support shellfish production, and increasing demand for shellfish produced in the US. Simply put, AUSL strives to increase biological production capacity while also increasing the social/economic capacity, ideally leading to increased production, which supplies a market with increasing demand.

How do we increase the industry's biological production capacity? To enable sufficient and sustainable shellfish production, AUSL seeks to better understand the value of natural environments and promote best practices that lead to sufficient and sustainable shellfish production which in turn supports harvesters, growers, producers, distributors and consumers of shellfish. Currently, AUSL conducts research in the following efforts in support of increased biological production capacity:

- Determine production practices that improve quantity, quality and safety;
- Use aquaculture breeding programs to develop better performing organisms;
- Improve hatchery production to increase the quantity and quality of seed (juvenile shellfish);
- Increase understanding of the effect of water quantity and quality on shellfish fisheries and aquaculture;
- Improve understanding of the ecosystem services from shellfish seafood production;
- Assess feasibility of new and alternative species; and
- Evaluate the role of aquaculture in restoration efforts.

Fig. 1. Scott Rikard checking the sex and ripeness of oysters for the SALT breeding program.

This type of work is the 'bread and butter' of most production-focused research facilities and this is where the bulk of AUSL's applied research is focused. As one example, AUSL is in the midst of a regional collaboration (led by the University of Southern Mississippi), Selection of Aqua-

culture Lines with Improved Traits or SALT, to select lines suited to the different salinity regimes experienced by oyster farmers along the Gulf Coast. The offspring of the initial spawn are being raised in nurseries currently for deployment at commercial farm sites from Florida to Louisiana.

But even if the challenges to biological production are met, production only succeeds if individuals are capable and supported by communities (given the permitting requirements for shellfish aquaculture), sometimes called 'social license'. To ensure the human capacity to produce shellfish through both capable, skilled individuals and supportive communities, AUSL seeks to develop an inclusive, capable workforce in shellfish seafood related fields with informed and engaged supportive communities. Currently, AUSL is leading the following initiatives in support of increased socio-economic capacity:

- Provide training for individuals interested in shellfish fisheries and aquaculture, with effort to enhance accessibility and opportunity for underrepresented groups;
- Create tools to help farmers increase efficiency and productivity;
- Address regulatory constraints and opportunities;
- Address fiscal constraints and opportunities;
- Address public perception constraints and opportunities; and
- Engage decision-makers and the interested public.

Much of this work is typically thought of as Extension work, with production of smartphone apps, fact sheets, and facilitating interactions between regulators and industry members. One less traditional example of this work at AUSL is the development of a small commercial oyster farm, Bonus Point Oyster Company, as a vocational platform for local high school students considering careers in shellfish aquaculture. The intent of the program is to produce highly skilled individuals who are pursued as potential employees, while also providing the industry at large a consistent qualified workforce. This program is developing, working with educational partners in both Alabama and Mississippi with hopes of becoming a regional and even national resource.

With both these efforts, the goal is to increase production. Of course, increased production can pose economic hardships for individuals through decreased sales volume and/or price. In an effort to anticipate and avoid this impact, AUSL strives to increase demand for shellfish produced in the US. These efforts are premised on the simple concept that an educated consumer will increase demand for seafood from the US, including (but not limited to) shellfish. At AUSL, there are several activities underway to help increase consumer demand for domestic shellfish, including:

- Identify hurdles and opportunities for sales of shellfish produced in the US;
- Provide training programs for seafood culinary professionals to learn about and connect to US shellfish production;
- Create tools to help seafood culinary

Fig. 2. Becky Wasden working with two high school students at the Bonus Point Oyster Company as part of vocational training with AUSL.

professionals understand and connect to US shellfish production; and
- Increase consumer awareness of shellfish produced in the US.

These efforts are maybe the least typical for a facility like AUSL, but the industry has been clear that this needs to be a priority. Of course, AUSL cannot and should not run marketing campaigns for individual businesses. That said, there are clear opportunities where education and training of seafood culinary professionals may help promote demand for shellfish produced in the US. One example of this work are the seafood server trainings offered to restaurant staff, *Know Thy Seafood*, to help give servers the information that

Fig. 3. Raw bar at Automatic Seafood in Birmingham, one of the restaurants that has hosted a *Know Thy Seafood* server training program, focused on oysters.

Catfish is One of Alabama's Top Agricultural Commodities

Terry Hanson, School of Fisheries, Aquaculture & Aquatic Sciences, Auburn University

The US Department of Agriculture National Agricultural Statistics Service (NASS) released an Alabama Agricultural Fact sheet in September 2020.

The 2019 Alabama Agriculture highlights include Alabama's Catfish industry being #2 in cash receipts within the US Catfish industry with $97.7 million, right after Mississippi. Alabama Catfish is preceded in cash receipts by Alabama Broilers (#4 in US, $3.03 billion), Cattle and Calves (#29 in US, $407 million), Chicken Eggs (#9 in US, $390 million), Cotton lint and seed (#6 in US, $357 million) and Peanuts (#4 in US, $109 million).

In terms of production, Alabama Catfish is ranked #2 in the US at 51.1 million foodsize fish in inventory and Alabama Broilers are ranked #2 in the US with 1.13 billion head! Peanuts are ranked #3 with 529 million pounds.

Other interesting facts about Alabama Agriculture can be found at: https://www.nass.usda.gov/Statistics_by_State/Alabama/Publications/

2020 Annual Catfish Conference Cancelled

This year the Annual Catfish Conference hosted by Auburn University and the Alabama Fish Farming Center will **not** be held due to COVID-19 restrictions. We will share our annual updates in the spring newsletter. Please note that the state committee elections will take place on February 1, 2021, at the

RESEARCH ROUND-UP

Gene Expression: The Key to Success for High-Hatch Hybrid Catfish Eggs

Jaelen N. Myers[a], Paul W. Dyce[b], Nagaraj G. Chatakondi[c,d], Sara A. Gorman[b], Sylvie M.A. Quiniou[c], Baofeng Su[a], Eric Peatman[a], Rex A. Dunham[a], Ian A. E. Butts[a]

[a] School of Fisheries, Aquaculture and Aquatic Sciences, Auburn University,[b] Department of Animal Sciences, Auburn University, [c] USDA-ARS Warmwater Aquaculture Research Unit, National Warmwater Aquaculture Center, Stoneville, MS, [d] Syndel USA, Ferndale, WA

The importance of egg quality (or egg competence), defined as the capacity for eggs to be fertilized and develop into viable offspring, is not to be underestimated in the hatchery environment. Nevertheless, challenges still remain in estimating egg quality prior to fertilization due to lack of clear biomarkers. Despite best efforts to optimize reproduction, egg incubation, and larval performance in captivity, inconsistencies in production are still created by high variations in egg quality from individual females. It is obvious that these maternal contributions are very influential in determining reproductive success, and most importantly, how many healthy fry develop from each egg batch. Egg quality has traditionally been assessed by the physical characteristics of the egg that can be seen with the eye or the aid of a microscope. Those eggs that pass visual inspection are then fertilized. It makes sense that the best looking eggs would come from the best quality broodfish. However, this method alone may not be the most reliable option because traits can vary widely and so do hatchery conditions.

Interestingly, recent discoveries on egg quality across other fish species have shown that up and down regulation of specific messenger RNA (mRNA) transcripts (which code for proteins) are linked to egg quality and larval success. Thus, lower or higher levels of products coded by these transcripts are the key to proper development during the embryonic stages of life. Initially, the building blocks for forming these gene products come straight from the female to the developing embryo, but then as development progresses the embryo become self-sustainable and makes its own. Therefore, some eggs could have an advantage from the start depending on the maternal contribution, which could lead to the drastic differences we observe in how many embryos complete neurulation and hatch. Studying what makes one egg batch better than another from the genetic perspective could shed light on some of the mysteries behind poor egg

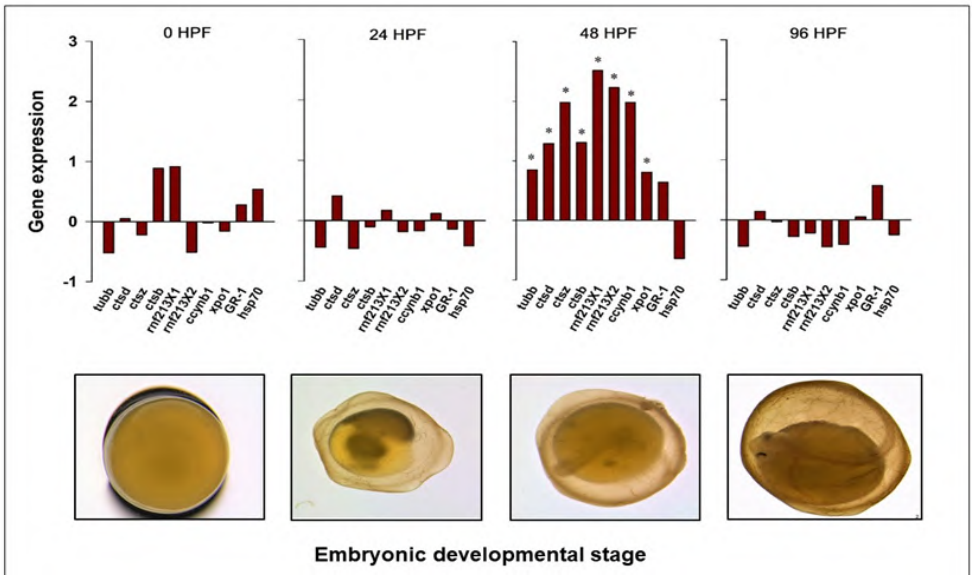

Fig. 1. Relative gene expression of high-hatch hybrid catfish eggs compared to a low-hatch control group for ten target mRNAs related to egg quality and embryonic development. Bars show expression levels for the high-hatch group and the baseline of each panel is the low-hatch control set to 0. Significant up or down-regulation for a gene are denoted by *. Hybrid catfish embryos are shown at each stage during embryonic devel-

quality.

The objectives of this research were to examine expression of specific genes linked to egg and embryo quality in other hatchery fishes and determine if there were differences between low-hatch and high-hatch egg batches through early development stages (0, 24, 48, and 96 hours post-fertilization; HPF). Total RNA was extracted from eggs/embryos of nine females that showed extreme variability in hatch success. Egg batches from each female were categorized into two experimental groups: high-hatch (>50% neurulation and >30% hatch, n = 4) and low-hatch (near or <50% neurulation and <20% hatch, n = 5). Real-Time PCR was used to quantify relative gene expression for each sample and time. The ten transcripts assessed in this study perform critical cellular functions, including Tubulin β (*tubb*), Cathepsin D (*ctsd*), Cathepsin Z (*ctsz*), Cathepsin B (*ctsb*), Cyclin B (*ccnb1*), Exportin-1 (*xpo1*), Ring finger protein 213 (*rnf213*), glucocorticoid receptor-1 (*GR-1*), and heat shock protein 70 (*hsp70*).

Results of this analysis showed that many of the target genes were related to hatch success, indicating their importance as genetic biomarkers of embryo viability. The female gift basket did not have an impact during the earliest developmental stages, and expression was low for each group. However, differential expression is important when the embryo transitions to transcription of its own resources at 48 HPF, commonly referred to as the neuralation stage. Relative gene expression of all transcripts except *GR -1* and *hsp70* were up-regulated in the high-hatch egg group and peaked at this time. We conclude that these genes must be expressed in higher levels at this threshold in order for normal progression to hatch, leading to eggs with higher hatch success (Fig. 1).

CONCLUSIONS - By pairing these markers with physical indicators of egg quality, embryo viability and potential hatch can be predicted more reliably, reducing problems associated with the incubation of poor quality eggs and embryos. Furthermore, using mRNA markers as a selection mechanism for hatchery broodstock may lead to more high-hatch egg

The Use of Acoustic Feeders in Shrimp Production Reduces Feed Usage and Increases Growth

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Figure 1. Pond setup with acoustic feeding technology.

For about a decade and a half, our lab has researched various aspects of shrimp nutrition at Claude Peteet Mariculture Center (CPMC, Gulf Shores, AL). Although we have tested very different things throughout this timespan, our focus was always finding solutions that would ultimately improve shrimp production efficiency. For the last five years, our focus has been on how feeding and environmental monitoring technologies can take our production efficiency to a much higher level. For years, our laboratory used handfeeding and timer-feeding protocols to feed shrimp. While these methods improved production efficiency, there is always room for improvement. Recently, all 16 research ponds at CPMC were equipped with solar-powered AQ1 pas-

Fig. 2. Hydrophones and digital recorders used to monitor feeding sounds in glass tanks (right) and acoustic chambers (left).

sive acoustic feeders with dissolved oxygen (DO) management (Fig.1). What is this, you say? Well, the AQ1 system not only monitors DO in real-time, but it also has a hydrophone (microphone in the water) that listens to the shrimp feed. Due to its hard exoskeleton, shrimp produce a very distinct clicking sound due to the crushing and shredding of food with their mandibles. The system automatically adjusts feed inputs into each pond based on the shrimp's response to feed being offered. Instead of feeding and assuming the shrimp are hungry, we can instead respond to their request for feed very accurately.

Yep, that's a dinner plate the fills on demand. The system has cut production time by 30 days and improved growth rates by around 50%. In short, we are raising more and bigger shrimp in a more nutritionally, environmentally and economically efficient way.

The noisy eating habits of shrimp allow us to listen to them not only in ponds but also in laboratory tanks (Fig. 2). Drs. Peixoto and Soares, visiting scientists from Brazil, have been using acoustic signals to evaluate which factors influence the noises produced by shrimp. Noises can be made by different diet textures, which is similar in some ways to testing the crispness and crunchiness sounds when we eat our favorite snack. They are also looking at how various attractants (krill oil, krill meal and fish hydrolysate) added in the diets affect their feeding behavior. In this case, their goal is to

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