American Fisheries Society
Louisiana Chapter

ABSTRACTS OF THE 38TH ANNUAL MEETING OF THE LOUISIANA CHAPTER OF THE AMERICAN FISHERIES SOCIETY

"BEYOND THE BAYOU: DIVERSITY OF LOUISIANA'S AQUASCAPES"

AYO HALL
NICHOLLS STATE UNIVERSITY
THIBODAUX, LOUISIANA
MAY 25-26, 2017

ACKNOWLEDGEMENTS

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ACKNOWLEDGEMENTS BY STUDENT CLUBS

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Cutco Cultery EBR, Louisiana Sea Grant, Southeast Coast Division, Andrew Smith at Iron Creek Forge, Dr. Chris Bonvillain, Dr. Chris Green, and others who donated after press

Cover photos courtesy:

Christopher Bonvillain, Quenton Fontenot, and Christopher Green

Louisiana Chapter of the American Fisheries Society
Thursday, 25 May 2017 (Day 1)

Presenting author is denoted by an asterisk (*). Student presenters are underlined. Abstract page is listed in parentheses.

8:00 AM	Registration – 152 Ayo Hall
8:50 AM	**Welcome and Keynote Speaker Introduction**
9:00 AM	**Keynote Presentation: Invasive species – do we have to fight all of them?** **Michael Massimi**, Environmental Scientist, Invasive Species Coordinator, Barataria-Terrebonne National Estuary Program
9:30 AM	**Break 1**: Thirty minutes
10:00 AM	**Population characteristics of red swamp crayfish *Procambarus clarkii* from hydrologically impaired areas in the Atchafalaya River Basin.** Lauren M. Kong* and Christopher P. Bonvillain (25)
10:15 AM	**Quantitative and qualitative assessment of crayfish harvesting practices in the southern Atchafalaya River Basin.** Ivan Vargas-Lopez*, Michael D. Kaller, and William E. Kelso (32)
10:30 AM	**Identifying scale-dependent environmental drivers of crayfish community diversity in Louisiana streams.** William R. Budnick*, Sophia I. Passy, and Michael D. Kaller (12)
10:45 AM	**Low water during spawning season can lead to a population wide skipped spawning event for bowfin in floodplain systems.** Quenton Fontenot*, Johnathan Davis, Chris Haynes, Alexis Rixner, and Allyse Ferrara (19)
11:00 AM	**Lunch on your own** (two hours)
1:00 PM	**Molecular regulation of shell development in eastern oysters (*Crassostrea virginica*) in response to CO_2-related ocean acidification.** Mackenzie L. Richards*, Courtney H. Healy, Amy J. Mallozii, Sandra Casas Liste, Jerome F. La Peyre, John Supan, Reagan M. Errera and Wei Xu (36)
1:15 PM	**Chicken or the egg? How bird hormones could improve hatchery production.** Eric Falls*, Christopher Green, and Sylvie Quiniou (17)
1:30 PM	**Germplasm repositories can provide a necessary tool for recovery programs of imperiled fishes.** Yue Liu* and Terrence R. Tiersch (29)

1:45 PM	**Translating high-gradient stream paradigms to the coastal plains streams of Louisiana.** Erin E. Thayer* and Michael D. Kaller (41)
2:00 PM	**Three-dimensional printing: What is all the fuss about?** William M. Childress*, and Terrence R. Tiersch (15)
2:15 PM	**Fishes around small oil and gas platforms in the northern Gulf of Mexico's hypoxic zone: changes in relative abundances and depth distributions.** David B. Reeves*, Edward J. Chesney, Ryan T. Munnelly, Donald M. Baltz and Brian D. Marx (35)
2:30 PM	**Break 2**: Thirty minutes
3:00 PM	**Impacts of ocean acidification on bacterial communities in coastal microbial biofilms.** Greer Darden, Wei Xu, Mackenzie Richards*, Amy Mallozzi, Reagan Errera, Illya Tietzel, and John Supan (16)
3:15 PM	**Salinity tolerance in hatchlings of the Apple Snail (*Pomacea maculata)* collected from the Barataria-Terrebonne National Estuary.** Ashleigh N. Lambiotte* and Gary LaFleur (27)
3:30 PM	**The apple snail invasion in Louisiana: what we know and what we don't know.** Sean Kinney* (24)
3:45 PM	**An evaluation of tournament sampling and continuation of red snapper life history metrics.** Erik T. Lang* (28)
4:00 PM	**The use of dietary additives as a means of counteracting elevated temperature in rainbow trout: growth, efficiency and physiological performance.** Abigail B. Bockus*, T. Gibson Gaylord, Wendy M. Sealey, Carl J. Yeoman, and Daniel W. Bearden (10)
4:15 PM	**Interaction of temperature and salinity on the growth and mortality of Louisiana oysters and incorporation into a sustainable harvest model.** Troy L. Sehlinger*, Michael R. Lowe, Thomas M. Soniat, and Megan K. La Peyre (38)
4:30-5:30 PM	Poster Session – Ayo vestibule
	Crayfish population characteristics in two hydrologically different Louisiana river-floodplain systems. Alexa Ballinger* and Christopher Bonvillain (9)
	Developing methods to monitor reproductive health in frogs of the B-T National Estuary. Justin R. Brockmann* and Gary LaFleur Jr. (11)
	Status, abundance, and distribution of the saltmarsh topminnow, and two other SGCN fish in the Barataria Basin. Joel R. Caldwell* and Bonnie Slaton (13)

	Multigenerational effects of chronic exposure to the polycyclic aromatic hydrocarbon naphthalene in Gulf killifish *Fundulus grandis*. Andrea Yammine*, Charles Rice, and Christopher Green (45)
5:30-9:00 PM	Social, student raffle and auction – Nicholls State University Soccer Pavilion (Across the street from John L. Guidry football stadium.)

Louisiana Chapter of the American Fisheries Society
Friday, 26 May 2017 (Day 2)

Presenting author is denoted by an asterisk (*****). Abstract page is listed in parentheses.

9:00 AM	Registration – 152 Ayo Hall
9:15 AM	**Enhancing fishing opportunities in Louisiana through the Get Out and Fish! community fishing program.** Megan E. MacMenamin* (33)
9:30 AM	**LDWF's Aquatic Volunteer Instructor Program.** Alayna S. McGarry* (34)
9:45 AM	**Lessons learned and involvement in Louisiana Department of Wildlife and Fisheries' Derelict Crab Trap Removal Program.** Patrick W. Smith* and John A. Lopez (40)
10:00 AM	**SCIENCE tools and assessments to support aquatic conservation in the Gulf Coast and beyond.** Benjamin M. Kahler* and Blair E. Tirpak (21)
10:15 AM	**Break 1.** Fifteen minutes
10:30 AM	Business Meeting and Awards Presentations

ABSTRACTS

Presenting author is denoted by an asterisk (*****). Student presenters are underlined.

Crayfish population characteristics in two hydrologically different Louisiana river-floodplain systems

Alexa Ballinger* and Christopher P. Bonvillain
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Anthropogenic modifications to large river-floodplain systems can sever natural water sources, alter annual flood pulse characteristics, and disrupt population dynamics of local aquatic biota. Currently, there is little empirical information on the effects of these modifications on aquatic biota in bottomland-hardwood floodplain systems in southeast Louisiana. The Atchafalaya River Basin (ARB) receives an annual flood pulse from the Mississippi River that typically inundates floodplain habitats in the spring and dewaters in summer, allowing nutrient transfer between the main river channel and adjacent back swamps. In contrast, anthropogenic modifications to the upper Barataria Estuary (UBE) have eliminated an annual riverine flood pulse from the Mississippi River and large precipitation events are now the only drivers of floodplain inundation. This project aims to compare population characteristics of red swamp crayfish *Procambarus clarkii* between these two hydrologically different large river-floodplain ecosystems that are separated by less than 25 km. *P. clarkii* rely on floodplain inundation for access to habitat for foraging and reproduction, and survival of offspring and rate of individual development can be constrained if floodplain inundation area and duration decreases or diminishes completely. *P. clarkii* sampling will occur every two weeks at 12 sample sites in the UBE and 14 sample sites in the eastern ARB during the 2017 and 2018 crayfish seasons. Catch per unit effort (CPUE) and water quality will be recorded for all sites on every sample date and all captured crayfish will be identified to species, sexed, measured, and reproductive form determined (males only). Hemolymph protein concentration is indicative of overall health in *P. clarkii* populations and will be collected from 10 adult intermolt *P. clarkii* at each site on every sample date. Examining the extent to which a modified floodplain system affects *P. clarkii* population characteristics may provide better understanding of how the UBE, and other floodplain systems, should be managed in the future.

The use of dietary additives as a means of counteracting elevated temperature in rainbow trout: growth, efficiency and physiological performance

Abigail B. Bockus*[,1,4], T. Gibson Gaylord[1], Wendy M. Sealey[1], Carl J. Yeoman[2], and Daniel W. Bearden[3]
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Global surface temperatures are projected to rise 2-4°C by the year 2100. The consequences of this environmental change on physiological function will alter production efficiency in the rainbow trout (*Oncorhynchus mykiss*) industry with concomitant regional and economic impacts. Here, we examine the effects of warming on growth, feed efficiency, and performance, and whether dietary additives can ameliorate the metabolic costs associated with elevated temperature.

Rainbow trout (44 g) were stocked into recirculating systems maintained near trout's thermal optima of 15°C or at an elevated temperature of 18°C. Each treatment was stocked into 440 L tanks at 15 fish per tank. Individuals were fed a control fishmeal-based diet or one of three treatment diets including either a metabolic modifier (Thermal Care) or prebiotic (Biomos and Grobiotic A). Diets were randomly assigned to triplicate tanks and fed twice daily to apparent satiation for 12 weeks. Fish were weighed every three weeks to assess growth and feed efficiency. At termination of the trial, three fish per tank were collected for whole-body proximate analysis and nutrient retention efficiencies. Blood from an additional three individuals was analyzed for acid-base balance and various metabolites. Five individuals per treatment were used to determine changes in maximum swimming speed. Data were compared using two-way ANOVA. When a significance level of $p<0.05$ was found, Dunnet's contrast was applied.

Elevated temperature had a significant effect on survival. Further, there was an interactive effect of temperature and diet on growth. Feed efficiency was higher (Fig. 1) and feed intake lower for individuals at 15°C than 18°C. Further, there was a drop in plasma HCO_3^- from 15°C to 18°C and this effect was suppressed in fish fed Thermal Care but not the other dietary additives. Other plasma metabolites also showed changes with temperature and diet. There was no change in maximum swimming speed between treatments; however, plasma pCO_2 was lower at exhaustion in 18°C fish fed a control diet than those at 15°C and this drop was suppressed in fish fed a dietary additive. Efficacy of these dietary constituents for physiological enhancement and implications for future productivity will be discussed.

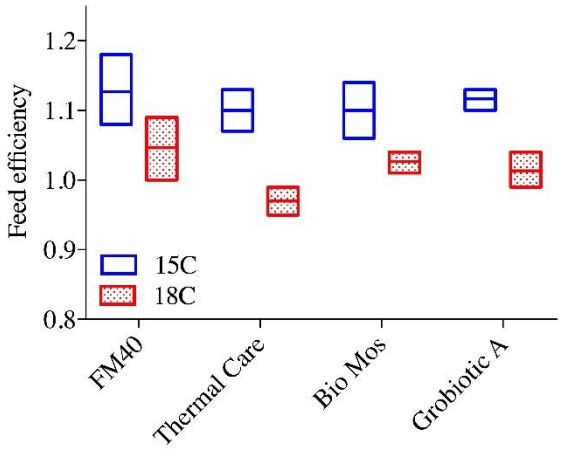

Figure 1: Feed efficiency was lower in rainbow trout held at 18°C than those at 15°C regardless of the addition of feed additives.

Developing methods to monitor reproductive health in frogs of the B-T National Estuary

Justin R. Brockmann* and Gary LaFleur Jr.
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Since 2005, our lab has conducted studies to monitor the ecology of several estuarine sites, using amphibian surveys as an indication of environmental health. Here we describe long term data on behavioral surveys that have documented frog call densities and diversity since 2005, as well as more frequent studies that seek to document the reproductive health of frogs. Frog call surveys were conducted at four primary sites within the Barataria-Terrebonne National Estuary (BTNE) following guidelines set by the LA Amphibian Monitoring Program coordinated by the Dept. of Wildlife and Fisheries, in coordination with the U.S. Geological Survey. Each year we conduct frog call surveys at four sites including an impounded willow wetland at the Nicholls Farm used for protocol training, a route through extensive cypress swamp in Choctaw, a route adjacent to brackish marshes along LA Hwy 55 in Montegut, and another route near the brackish marshes along Falgout Canal. The lower sites contain wetlands that once supported cypress trees, but recently transitioned to brackish marsh. Comparing the number of species encountered over the last six years, we found that the Choctaw Route yielded an average of 10.3 +/- 0.5 different species, the Falgout Canal Route yielded 6.8 +/- 1.1 species and the Montegut Route yielded 4.4 +/- 1.3 species (**Figure 1**). These surveys also allow us to designate a group of anurans that consistently tolerate brackish salinities including the Eastern Cricket Frog, Green Treefrog, Southern Leopard Frog, Pig Frog, and American Bull Frog. Since the lower sites are adjacent to coastal restoration projects, these data will allow us to use the number of frog species as an indicator of restoration success. If the marsh becomes more saline, we expect amphibian species to decline, whereas if the marsh becomes fresher, we can expect the number of amphibian species to increase.

We have also recently embarked on a project seeking to compare the reproductive health of Eastern Cricket Frogs that inhabit wetlands affected by sugar mill effluent with frogs that inhabit wetlands without mill effluent. So far, frogs have been collected from our control site at the Nicholls Farm in order to develop a set of indicators for reproductive health. In our sample we found a 1:1 sex ratio. Gonads were dissected and weighed to calculate average gonadal-somatic indexes (GSI) for males and females, showing of 2.05% for males and 6% for females. We are also developing methods to compare the pitch and frequency of frog calls using spectrogram analysis. This work has been supported by The Center for Bayou Studies, USGS, LDWF, NOAA, and BTNEP.

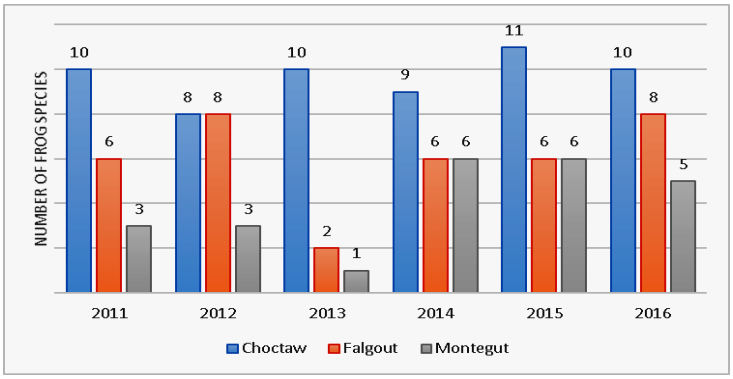

Figure 1. Number of species encountered at each of three frog call survey routes from 2011 to 2016. The Freshwater cypress swamps of Choctaw consistently support a greater number of frogs encountered.

Identifying scale-dependent environmental drivers of crayfish community diversity in Louisiana streams

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Louisiana crayfish communities have generally low local richness (alpha diversity) and great compositional turnover among streams (beta diversity). Although previous work has shown that beta diversity is partly driven by relative abundances of 4 broadly distributed crayfish species, environmental drivers of turnover have not been characterized. Furthermore, crayfish community responses to environmental conditions are likely scale specific, which can challenge conservation plans that only consider a single spatial scale. Herein we use variance partitioning and distance-based Moran eigenvector maps (dbMEM) to determine at what spatial scales environmental factors structure crayfish communities and distributions. We analyzed crayfish community data from 47 streams in 5 major Louisiana river drainages between 2013-2014. We calculated spatial variables with dbMEM that corresponded to spatial scales among drainages (broad scale), within drainages (intermediate scale) and at the stream level (small scale). These variables were then used in a variance partitioning model to estimate fractions of community variance driven by purely environmental factors, spatial variables, geographic distances, and their covariances. We then elucidated scales where environmental variables constrained community composition after analyzing their relationships with each spatial variable. Our results showed that not only did model fits improve after including spatial variables, we also found that presence of sand, specific conductance, and stream depth were important community drivers across scales, but presence of clay and grassy banks were locally important. Temperature, a climatic factor, was important at broad scales. Our results provided valuable insight as to what scales environmental variables were biologically relevant for Louisiana crayfish. Future work will aim to expand our dataset to include a greater spatial extent and sample size to use for these models, with the goal of ultimately developing management recommendations for crayfish conservation in the state.

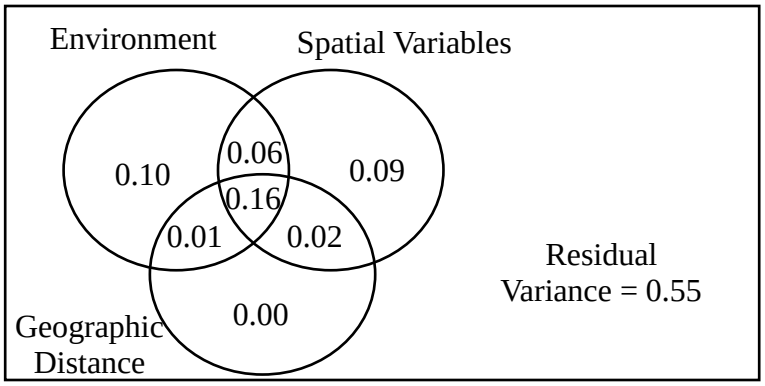

Figure: Venn Diagram showing results of the variance partitioning model. Circles show fractions of community variability explained by pure environment and spatial variables and geographic distances and overlaps shows fractions due to covariance. Residual variance refers to variability not captured by the model.

Status, abundance, and distribution of the saltmarsh topminnow, and two other SGCN fish in the Barataria Basin

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The saltmarsh topminnow *(Fundulus jenkinsi)* is found in low to moderately saline tidal estuaries from Galveston Bay, Texas to Escambia Bay in the Florida panhandle, within dendritic creeks and marsh edge consisting primarily of smooth cordgrass *(Spartina alterniflora)* and black needlerush *(Juncus roemerianus)* (Thompson 1980; Tiner 1993; Peterson et al., 2003). The saltmarsh topminnow was a federally listed species of special concern by the National Oceanographic and Atmospheric Administration (NOAA) until the year 2011 (Federal Register 2011; Crabtree 2011), and is currently listed as a species of greatest conservation need (SGCN) by Louisiana, Mississippi, and Florida. In September 2010, environmental group Wild Earth Guardians petitioned the US Fish and Wildlife Service (USFWS) to include the species as threatened or endangered under the emergency listing provision of the Endangered Species Act (ESA) due to habitat degradation and loss resulting from the BP oil spill (Felson 2010). Jurisdiction was subsequently transferred to USFWS for ESA listing status review (Crabtree 2011). Current baseline ecological data derived using active sampling gear such as seines and trawls, may introduce bias in assemblages preferring complex intertidal marsh edge environments (Hindell and Jenkins 2004; Warry et al., 2013). Peterson (2003) suggests that increase in coastal population leading to further development, patchy distribution, low relative abundance, as well as erosion of brackish marsh habitat perpetuates continued impacts; therefore, a need is warranted for spatial and temporal quantification (Lopez 2011). We hypothesize that our standard sampling method, the 50 foot bag seine, under-represents structure oriented guilds, specifically intertidal drainages dominated by smooth cordgrass and black needlerush. Beginning in October 2016, Louisiana Department of Wildlife and Fisheries (LDWF) Marine Fisheries and Inland Fisheries divisions initiated comprehensive population density and abundance data collection of brackish marsh edge, implementing standardized quantitative electrofishing gear capable of operating in brackish waters (Mazzoni et al., 2000; Bayley and Austen 2002; Meador 2005; Warry 2013). Data collection includes, however is not limited to three SGCN designated fish; the saltmarsh topminnow, bayou killifish *(Fundulus pulvereus),* and diamond killifish *(Adinia xenica).* Five seine monitoring stations where saltmarsh topminnows were present since the year 2013 or later were chosen as electrofishing sites. Initial preferred habitat quantification using a 1 meter quadrant randomly placed at 3 locations within the 5 respective sampling sites (Peterson and Turner 1994; Lopez et al. 2010) will be completed by October 30, 2017. Once suitable habitat is established, at least 5 additional preferred sites will be included. Following year two of sampling a population estimate will be established for the Barataria basin. Population density calculations using Catch Per Unit Effort (CPUE) values will be completed by October 30, 2018. Baseline population density and abundance are to be developed by utilization of standardized quantitative electrofishing within preferred habitat. A Geographical Information System (GIS) "preferred habitat model" will be developed and integrated for sampling of Louisiana's coastal study areas, achieving a state-wide population estimate, and will be included in the State Action Plan for distribution, habitat use, and status.

Variation in soil shear strength and belowground biomass across wetland types in Louisiana

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Louisiana's coastal wetlands are environmentally and economically important ecosystems that have been subject to rampant loss during the last century. Wetland loss caused by erosion, subsidence, and conversion to other uses, among other factors, negatively impacts numerous important ecosystem services, such as flood and storm protection, water quality improvement, and climate mitigation, among numerous others. However, some wetland types may be more resistant to deterioration than others, and therefore provide ecosystem services more effectively than less resistive wetland types. Louisiana's wetlands can be broadly divided into five different types based on salinity and vegetation, which include salt marsh, brackish marsh, intermediate marsh, fresh marsh, and forested wetlands. This research examined relationships between belowground biomass and soil shear strength at forty-two wetland sites across Louisiana, representing all five wetland types. We measured soil shear strength as an indicator of soil integrity, and belowground biomass as an important ecosystem function expected to directly influence soil strength, and thereby, wetland stability. The results of this study will reveal whether belowground biomass is positively correlated with soil shear strength, and how these factors vary across different wetland types. These results will also provide an indicator of the ability of these valuable ecosystems to resist erosive forces and continue to provide important ecosystem services.

Three-dimensional printing: What is all the fuss about?

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Over the past 5 years, fused deposition modeling (FDM) printers, also popularly known as desktop 3-dimensional (3-D) printers, have become convenient and affordable for average consumer. These printers have an extruder that feeds plastic filament into a heater block and nozzle called the "hotend". The filament melts inside the heater block, is pushed through the nozzle, and the molten material is laid down at specified layer heights along a programmed X-Y-Z coordinate system. The price of FDM printers can range from $200 to $1,000 for small-volume and kit printers, to $2,000 to $10,000 for more professional printers. There are currently more than 30 different types of filaments on the market that vary in strength, temperature response, and material composition. The two most commonly used filaments are polylactic acid (PLA) and acrylonitrile butadiene styrene (ABS). These filaments work with most entry-level printers and are suitable for a broad range of applications. When working with other filaments, (such as flexible or high melting temperature) an upgraded extruder and hotend are needed to create high quality prints. In the past, injection molding has been used to fabricate plastic objects in large volumes. This is sufficient for final designs, but is a costly and time-consuming process for design and prototyping of new devices. In the laboratory, scientists often find themselves improvising or constructing one-off objects for day-to-day or experimental use because nothing suitable is commercially available to meet their needs; or is too expensive. The use of 3-D printing allows for rapid prototyping of devices and objects at a low cost, and allows for others to print the same object through open-source file sharing. This can improve the reproducibility of results among laboratories and help establish user-group communities around those objects.

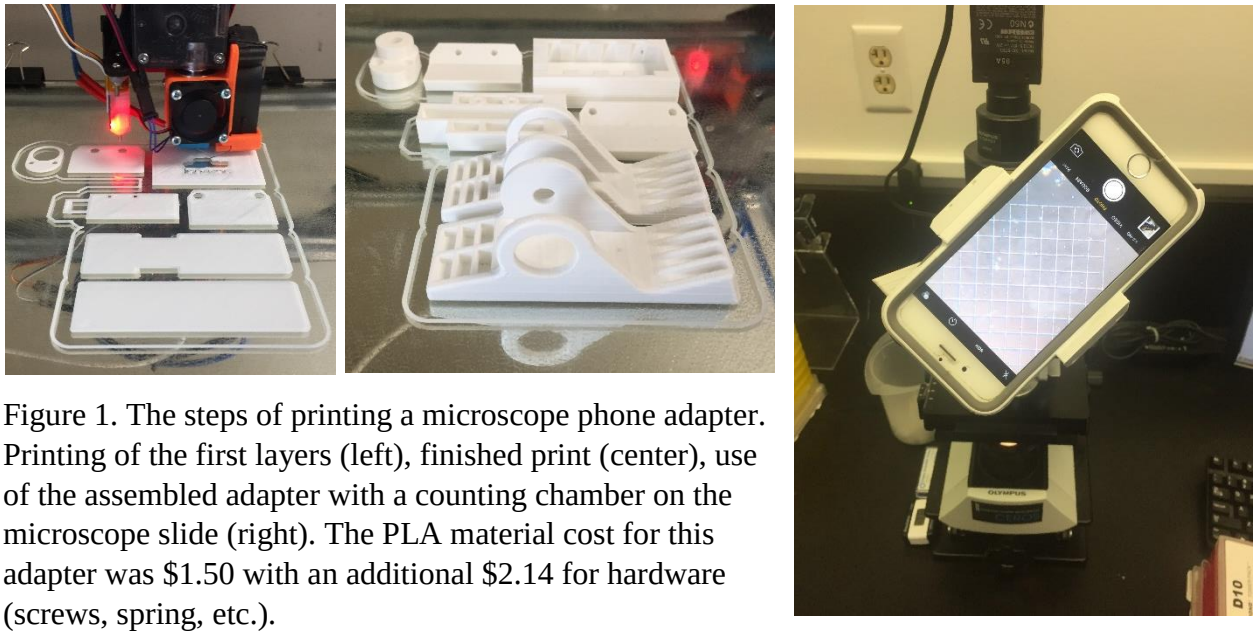

Figure 1. The steps of printing a microscope phone adapter. Printing of the first layers (left), finished print (center), use of the assembled adapter with a counting chamber on the microscope slide (right). The PLA material cost for this adapter was $1.50 with an additional $2.14 for hardware (screws, spring, etc.).

Impacts of ocean acidification on bacterial communities in coastal microbial biofilms

Greer Darden[1], Wei Xu[1], Mackenzie Richards*[,1], Amy Mallozzi[2], Reagan Errera[2], Illya Tietzel[3], and John Supan[1]
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The Eastern Oyster (*Crassostrea virginica*) is an important and valuable aquaculture species, especially in the Gulf Coast. However, annual statistical data shows that Gulf oyster production significantly decreased from 25.8 million pounds in 2000 to 19.2 million pounds in 2013. Due to lack of mobility during most of their life cycle, oysters employ a rapid acclimation mechanism to adapt to highly dynamic and stressful environments (Bartol *et al.*, 1999), which makes them an excellent model in the study of stress response and adaptation (Heilmayer *et al.*, 2008). The local microbial communities here are heavily affected by climate and inland inputs. Disturbance of the structure of a local microbial community may lead to an interruption of local ecosystem, including the development of bivalve species. Bacterial communities in biofilms tend to be more diverse than those in the overlying water column. Instead of seasonal cycling, the shifts in biofilm bacterial communities often correlate with environmental factors, such as wave energy (Hewson & Fuhrman, 2006), organic carbon (Polymenakou *et al.*, 2005), and primary productivities (Gobet *et al.*, 2012). We interested in how the biofilm microbial communities in the Coast of Gulf Mexico influence the development of larval Eastern Oysters, as well as identify changes in the bacterial community structure and function with increasing pCO2 stress, in order to further assess the regulation of ocean acidification on the ecosystems of aquaculture and fisheries.

Chicken or the egg? How bird hormones could improve hatchery production

Eric Falls*[,1], Christopher Green[1], and Sylvie Quiniou[2]
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Gonadotropin Releasing Hormone (GnRH) is a neuropeptide hormone comprised of 10 amino acids. It is produced and secreted from the hypothalamus in waves that act on the pituitary gland to stimulate the release of Luteinizing Hormone (LH) and Follicle-stimulating Hormone (FSH). LH and FSH act on the testes or ovaries making GnRH a vital hormone for gonad maturation and reproduction, because of its role within the hypothalamic-pituitary-gonadal (HPG) axis. The release of GnRH within later stages of oocyte maturation stimulates ovulation and the release of eggs for fertilization. In the mature male, the release of GnRH stimulates the beginning of spermatogenesis and the development of secondary sex characteristics.

GnRH is found in three different variants. Most vertebrates only have GNRH1 and GnRH2, while teleosts have GnRH1, 2, and 3. While all three types act mainly to regulate reproduction, they all have specific physiological roles within their respective taxa. From an evolutionary perspective, it is beneficial for an animal to have more variants of GnRH as they can help partition the physiological roles related to gonadal maturation and behavior. First identified within mammals, mGnRH1 variants have proven to increase the rate of secretion of LH and FSH. The GnRH variant first identified within chickens, cGnRH2, is believed to affect sexual behavior more than stimulate the release of the gonadotropic hormones within specific taxa. While it is believed that sGnRH3, first identified within salmon, combines both qualities of GnRH1 and GnRH2.

Hatchery production of fishes relies on captive reproduction from broodfish. A popular technique is to inject sexually mature female fish with GnRHa to induce ovulation for volitional spawning or artificial fertilization after striping the eggs. Because of its reliability, GnRH1a is a very popular hormone used to induce spawning. In the catfish industry, mGnRH1 and sGnRH3 have been successfully used to induce ovulation in channel catfish for the foodfish production of a hybrid catfish. This research project is being carried out in conjunction with USDA-ARS, Warmwater Aquaculture Research Unit to investigate the use of cGnRH2a as a spawning aid for channel catfish. The goal of this study is to investigate if cGnRH2a is an effective spawning aid for channel catfish, in comparison to mGnRH1a and sGnRH3a. We believe that cGnRH2a will be effective based on the results of previous spawning studies. Our work will investigate specific actions of these hormones on the HPG axis via biochemical and molecular analysis.

Age and growth of Louisiana marine catfishes

Shane Flinn, Stephen Midway, Brandy Malbrough, Lindsey Dey, and Matthew Robertson*
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Little information exists regarding the biology and life history of hardhead catfish (*Ariopsis felis*) and gafftopsail catfish (*Bagre marinus*) in the Gulf of Mexico and throughout their ranges. Marine catfishes are not recreationally or commercially targeted, and in many cases are even avoided. Yet their ubiquity suggests an importance to the ecosystem, and preliminary evaluation of flesh by Louisiana Sea Grant has suggested the possibility of a future market. A better understanding of all biological parameters of Gulf of Mexico marine catfishes will improve our basic knowledge of their importance to coastal ecosystems and prepare us with information in the event of increased management. We obtained hardhead and gafftopsail catfish from routine fishery-independent collections by the Louisiana Department of Wildlife and Fisheries, in coastal Louisiana beginning in 2016. Samples were from two coastal regions. We recorded basic biological information, including length, weight, sex, and collected liver, stomach, gonad, and otolith tissues. To date, we have processed around 350 fish and have fit von Bertalanffy growth models and Fulton's condition factors to the data. Ages were estimated from lapillar otoliths as the more common sagittal otoliths were not recovered. Estimated growth parameters of hardhead catfish were, L_∞= 391.67, k = 0.36, and t_0 = 0.03; gafftopsail catfish samples are still being aged and growth parameters will be available soon. Our preliminary modeling suggests that marine catfish growth may be species-specific, which is contrary to previous studies.

Low water during spawning season can lead to a population wide skipped spawning event for bowfin in floodplain systems

Quenton Fontenot*[,1], Johnathan Davis[2], Chris Haynes[3], Alexis Rixner[1], and Allyse Ferrara[1]
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The hydrologic regime of historic Mississippi deltaic floodplains is characterized by a spring flood pulse that inundates low-lying terrestrial areas. Regular hydrology of the Mississippi River includes dewatering of the floodplains following springtime peaks in water levels so that water levels are typically at their lowest level in the fall. The upper Barataria Estuary has been cut off from the Mississippi River due to flood protection measures and modern water level is dependent on local rainfall. Many organisms endemic to the Mississippi River deltaic plain have adopted a life history strategy that takes advantage of newly inundated floodplains for spawning and feeding. Bowfin (*Amia calva*) are nest builders that prefer to nest in vegetation and male bowfin aggressively protect their nest site and developing offspring. In Louisiana, bowfin typically spawn in February and March. Because the Atchafalaya River is a distributary of the Mississippi River, water levels in the Atchafalaya River Basin follow the Mississippi River pattern and are usually above bank full level during February and March. However, in the upper Barataria Estuary water level is dependent on local rainfall and is not usually above bank full level during the normal bowfin spawning period. Based on data collected in the upper Barataria Estuary in 2006, 2007, 2015, 2016, and 2017 it appears that the majority of female bowfin do not spawn when water levels are below bank full in February and March (2006, 2015, 2017), but the majority do spawn when water levels are above bank full during the spawning period (2007, 2016). Water level in the Atchafalaya River Basin was above bank full level in 2015, 2016, and 2017 and the majority of female bowfin spawned each year. Therefore, it appears that population wide bowfin reproduction can be impacted by low water levels during their spawning period.

Seasonal diversity and abundance of larval and juvenile fishes in the lower Barataria Estuary

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The Barataria Estuary is comprised of diverse habitats that transform along a salinity and elevation gradient from cypress-tupleo freshwater swamps in the north to *Spartina alterniflora* dominated salt marshes in the south. Many recreationally and commercially important species of fish, such as Gulf menhaden *Brevoortia patronus* and Red drum *Sciaenops ocellatus*, as well as invertebrates such as Blue crab *Callinectes sapidus* rely on the estuary for one or more stages of their life cycle (Conner and Day Jr. 1987).

Larval fish and water quality were sampled monthly at four stations throughout the lower Barataria Estuary from January 2014 through December 2015. Larval fish were sampled with a .5m diameter .5mm mesh plankton net towed 10 minutes once per station. All stations are located in salt marsh zone of the estuary with a site located near Four Bayou Pass, a site in Grand Bayou (near the future site of the Mid-Barataria Diversion), a site in Bayou Wilkinson, and a site in Snail Bay. These salt marsh habitats are characterized by a salinity range of 6 – 20 ppt (parts per thousand) and *Spartina alterniflora* as the major vegetation (Conner and Day Jr. 1987).

There are two main goals of this project. First is to characterize the utilization of the lower Barataria Estuary by larval and juvenile fish and to set a baseline for further study. Second is to look at recruitment versus retention of larval and juvenile fishes by comparing samples collected with other gear (trawl, seine, gillnet, etc).

SCIENCE tools and assessments to support aquatic conservation in the Gulf Coast and beyond

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Maintaining and enhancing populations of a diverse suite of aquatic species requires long-term, strategic collaboration among organizations at broad geographic scales. The Gulf Coast Prairie Landscape Conservation Cooperative (GCP LCC) is a collaborative science support partnership of state, federal, and non-government conservation organizations working to deliver sustainable natural and cultural resource conservation across portions of Louisiana, Texas, and Oklahoma by sharing scientific knowledge, leveraging resources, and working toward common landscape goals. The GCP LCC is working across administrative boundaries to define and design long-term landscape conservation by focusing efforts on 28 terrestrial and aquatic species that represent 17 broadly-defined habitats. Several ecologically and culturally important aquatic focal species such as Alligator gar (*Atractosteus spatula*), American oyster (*Crassostrea virginica*), shrimp (*Penaeidae*; brown, white, and pink shrimp), and Blue crab (*Callinectes sapidus*) represent the diversity of aquatic habitats between the deep waters of the Gulf of Mexico and the inland headwaters and streams. The presentation will showcase some of the science development and delivery activities for aquatic species funded by the GCP LCC such as the Gulf Coast Vulnerability Assessment, Gulf-wide sea level rise models, potential inland migration of tidal marshes, and efforts to map intertidal oyster reefs using aerial drones and side-scanning sonar. Strategic science needs for aquatic focal species and systems identified by GCP LCC partners will be presented. Finally, we will demonstrate how our previous work and future efforts can add value to the many other conservation efforts across the Gulf Coast region of Louisiana.

Review of the 2016 Michael C. Voisin oyster hatchery season and implementation of improved standard operating procedures

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The Michael C. Voisin Oyster Hatchery in Grand Isle, Louisiana is capable of producing one billion pediveliger larvae to support the state's oyster reef rehabilitation efforts. The first full hatchery season in this facility took place in 2016, producing over 180 million *Crassostrea virginica* larvae and 60,000 oyster seed for different research, industry or Louisiana Department of Wildlife and Fisheries restoration efforts. Although improvements were made from the previous 2015 season, we are constantly seeking to improve the overall success of conditioning and spawning broodstock, as well as raising viable larvae. These improvements include adjustments to standard operating procedures for water quality management, use of additional filtration systems, more thorough cleaning and maintenance protocols, and installation of a platform to better support the seawater intake line. These enhancements were implemented at the start of the 2017 hatchery season. Additionally, increasing water quality testing and data collection protocols, and improving documentation of oyster rearing, will allow us to better analyze and identify trends in broodstock conditioning and larval survival. Complete and robust data are necessary for researchers to better understand factors contributing to overall hatchery production, improve operations for oyster success, and collaborate with other state management programs.

Effects of chemicals and antibiotics on quality degradation in shrimp

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Quality problem associated with both wild and farmed shrimp are a global food safety concern. We researched quality degradation in shrimp from Louisiana (*Farfantepenaeus aztecus* and *Litopenaeus setiforus*) due to the application of chemicals and antibiotics. We researched the effect of Sulfite, Everfresh (sulfite-free) and Prawnfresh (sulfite-free) on proximate composition (moisture, ash, protein, and lipid), color (L*a*b*), texture (hardness, resilience, springiness, and chewiness) and bacterial condition (total plate count) by chemical, instrumental and microbiological analysis. We identified the amount of sulfite residue in shrimp collected from a variety of sources, and we tested for the presence of harmful bacteria (*Salmonella, Listeria monocytogenes, Vibrio cholerae, Vibrio vulnificus* and *E. coli*) in shrimp. We found there is no effect of sulfite, Everfresh and Prawnfresh on proximate composition, color and texture of shrimp (both white and brown shrimp) compared with control shrimp. For white shrimp, the bacterial count was lower in treated shrimp. The sulfite residue in shrimp were within the FDA limit (less than 100 ppm). *Salmonella, E. coli*, total coliforms and *Listeria monocytogenes* were not found in wild caught white and brown shrimp. Research on *Vibrio cholera* and *Vibrio vulnificus* are ongoing. Results indicate that chemical used for black spot treatment has no effect on shrimp composition, color and texture. Results of our study will provide information about how grow out and postharvest treatment of shrimp affects quality and food safety.

The apple snail invasion in Louisiana: what we know and what we don't know

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Apples snails (*Pomacea* spp.) were found in Louisiana in 2006 near Gretna following Hurricane Katrina. Since the first sighting in the wild, their range has expanded to include 22 southern parishes. Currently, little biological information is known concerning these species in Louisiana, including how far they are likely to expand and what environmental conditions, if any, will limit them. Populations of these species can lead to reduced aquatic vegetation and altered habitat. Apple snails can also be a carrier of rat lung disease. Potential vectors of new infestations and movement of current populations will highlight the problems associated with controlling this aquatic snail. Habitat requirements, food preferences, and potential agriculture impacts will be presented to illustrate the need for additional attention and research on this species.

Population characteristics of red swamp crayfish *Procambarus clarkii* from hydrologically impaired areas in the Atchafalaya River Basin

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Crayfish harvested from the Atchafalaya River Basin (ARB) comprise the majority of Louisiana wild crayfish landings. However, spatial and temporal heterogeneity in ARB physicochemistry results in extensive areas of the ARB that experience environmental hypoxia (dissolved oxygen [DO] < 2.0 mg/L) for several weeks to months during the annual flood pulse. Although red swamp crayfish *Procambarus clarkii* can tolerate environmental hypoxia, prolonged exposure can negatively affect crayfish population vigor. The Nature Conservancy (TNC) and the state of Louisiana have plans to implement hydrologic restoration projects in the ARB that are aimed to improve water flow patterns and water quality that will reduce the severity, extent, and duration of hypoxia. The purpose of this research is to evaluate population characteristics of *P. clarkii* from hydrologically impaired areas in the ARB before implementation of the hydrologic restoration activities. *P. clarkii* were sampled at 14 sites within the ARB every two weeks during the 2016 crayfish season. All captured crayfish were identified to species and numerated, and sex, carapace length, and reproductive form (males only) were recorded. Catch per unit effort (CPUE) was determined as the number of crayfish caught per trap. Additionally, hemolymph samples were collected from ten *P. clarkii* at all sample locations on every sample date to determine hemolymph protein concentrations. *P. clarkii* from normoxic locations had significantly higher mean hemolymph protein concentrations ($F_{1,14.3} = 6.89$, $P = 0.0196$) compared to individuals from chronically hypoxic sites. Although significant differences were not found in *P. clarkii* carapace length ($F_{1,38.2} = 0.13$, $P = 0.7211$) and CPUE ($F_{1,10.8} = 4.02$, $P = 0.0709$) between normoxic and hypoxic locations, normoxic sites produced higher CPUE values on every sample date and larger individuals during the majority of the crayfish season. The results of this project will determine if ARB hydrologic restoration activities can provide an important ecological and economic ecosystem service, improved crayfish stocks that produce individuals with higher hemolymph protein concentrations, larger crayfish, and higher CPUE values.

Long-term impacts of *Deepwater Horizon* oil exposure on marsh-stabilizing mutualism between smooth cordgrass (*Spartina alterniflora*) and the southern ribbed mussel (*Geukensia demissa granosissma*)

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Coastal wetlands are among the most biologically productive environments in the world. Included in the top tier is the Mississippi River Delta, the largest and most valuable coastal wetland complex in the contiguous United States, which provides myriad ecosystem services to the region and the nation. However, the provision of one service, oil and gas extraction, critically altered the structure and function of this ecologically and economically important ecosystem when the *Deepwater Horizon* (*DWH*) offshore drilling rig exploded in 2010. The ensuing oil spill that released approximately 5 million barrels (~800 million L) of crude oil into the northern Gulf of Mexico was the largest marine oil discharge in U.S. history. Barataria Bay, located in the central portion of the Delta, was among the most severely impacted areas, with approximately 120 km of oiled coastline, including documented effects on wetland ecosystems, estuarine dependent species, and coastal human settlements. This study will further investigate the long-term effects of hydrocarbon stress on interacting salt marsh communities by and (1) comparing mutualistic relationships between *Spartina alterniflora* (smooth cordgrass) and *Geukensia demissa granosissma* (southern ribbed mussels) in heavily oiled and unoiled marshes, and (2) conducting mussel density surveys across heavily, moderately, and unoiled salt marsh sites. The primary goals of this study are to determine if *DWH* oiling reduced marsh function and stability via long-term impacts to mussel population dynamics and plant-invertebrate mutualism. This study will additionally assess the feasibility of mussel transplantation as a possible salt marsh restoration method.

Salinity tolerance in hatchlings of the Apple Snail (*Pomacea maculata)* collected from the Barataria-Terrebonne National Estuary

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Over the past decade the invasive apple snail *Pomacea maculata* has been increasing its range in Louisiana waterways. The species poses the threat of denuding flooded ponds containing aquatic crops and altering wetland structure wherever it colonizes. In this experiment, the salinity tolerance of *Pomacea maculata* was analyzed to develop a predictor of the snail's possible range. Snails were collected from sites above and below the Gulf Intracoastal Water Way (GIWW) and exposed to a range of salinities. This was done by conducting two parallel trials, one with a 0 ppt control and another with a 5 ppt control. Every 72 hours, snails were observed under a dissecting microscope to score survival. All surviving snails from a salinity treatment bowl would then be moved into a new bowl with a 5 ppt higher salinity. Live control snails would be returned to a fresh container with the same control salinity. This procedure was repeated until there was no survival in salinity treatment bowls. A significantly higher survival was found in snails collected above the GIWW and hatched into 0 ppt, compared to snails collected below the GIWW and hatched into 0 ppt, demonstrating that snails from above the GIWW were better able to survive an increase in salinity when hatched into 0 ppt. In contrast, a significantly higher survival was found with snails collected from below the GIWW when hatched into 5 ppt, compared to snails collected above the GIWW and hatched into 5 ppt. When comparing the two trials to each other, it was found that at lower salinities, such as 5 ppt, snail survival is not significantly different between groups hatched in 0 ppt or 5 ppt. However, at higher salinities, such as 10 ppt, snail survival was significantly higher in groups collected below the GIWW. No snails survived the 72 hour testing period at 15 ppt. On the other hand, 65% survival was measured in snails at 10 ppt. In summary, our results allow us to speculate that the Maculata Apple Snail may increase its range into southern parts of the estuary characterized by intermediate salinities, but they would not be expected to extend all the way to high salinity barrier island habitats.

An evaluation of tournament sampling and continuation of red snapper life history metrics

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Although red snapper (*Lutjanus campechanus*) is the most assessed fish in the Gulf of Mexico with a plethora of data in accompaniment, biological data on fish greater than age 15 is sparse (SEDAR 31). Fishing tournament sampling gives access to older fish but presents concerns of bias considering that fishing tournaments target bigger, older fish (Patterson et al. 2001). This bias for growth parameters proved to be true with tournament sampling and standard recreational sampling proving to be significantly different according to a likelihood ratio test ($\chi^2 = 39.393$, $P < 0.0001$; Ogle 2015). However, the larger older fish collected from fishing tournaments allow for fecundity metrics that can be inserted into a fecundity at age curve for egg production estimates. Red snapper batch fecundity, relative fecundity and annual fecundity increased with age as observed in the past. Fish over age 15 show a sharp increase in annual fecundity. However, when total egg production is taken into account, age seven red snapper seem to account for most of the egg biomass. This could be indicative that red snapper's full reproductive potential is not being utilized due to the low numbers of fish over the age of 15 years.

Germplasm repositories can provide a necessary tool for recovery programs of imperiled fishes

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Recovery programs for endangered or threatened species require a combination of various conservation tools such as status assessment, legislation, habitat restoration and management, translocation, and captive breeding. However, limitations of certain tools challenge implementation of such programs. For example, long-term efforts such as habitat restoration can take decades, but population sizes and genetic diversity of concerned species can continue to decline in nature before full restoration. Shorter-term efforts such as captive breeding are at risk due to disease outbreaks, administrative discontinuity, high costs, and inbreeding depression. Repositories of cryopreserved germplasm can become a necessary addition to the conservation toolbox to address these challenges by preserving germplasm for future use at a relatively low cost, ensuring integrity of genetic diversity, enabling genetic assessment, and enhancing captive breeding. This tool has been used to improve diversity in recovery of endangered mammals such as black-footed ferret. However, it has been neglected in conservation programs of imperiled fishes. For example, in 86 current recovery plans of endangered or threatened fishes developed by U.S. Fish & Wildlife Service, only 2 have mention of cryopreservation, and that was for research purposes. We have developed a recovery plan using Redtail Splitfin (*Xenotoca eiseni*) as a model to demonstrate a comprehensive strategy to couple germplasm (sperm) repositories with conventional conservation tools. Sperm from *X. eiseni* from wild populations can be cryopreserved on-site in French straws, and the straws shipped to a central repository (Fig. 1). When wild populations are brought to hatcheries, sperm from these stocks can be cryopreserved from successive generations and be used when necessary to maintain desired levels of genetic diversity and reduce inbreeding of broodstocks. When historic or translocation habitats are ready, germplasm can be incorporated into live populations in hatcheries for introduction to the habitats. Successful recovery requires a practical conservation plan as well as strong collaborations among people and agencies with specialized expertise and function. A calculator model was developed to assist linkage of expertise with germplasm repositories. Based on desired retention of heterozygosity, inbreeding, and effective population size, the brood sizes from cryopreserved germplasm to be incorporated into captive stocks can be calculated. For example, if 500 offspring from germplasm repositories are desired per year for 50 years, sperm of 174 males from wild population need to be cryopreserved into 156 straws, and 6 straws need to be thawed and used to inseminate 125 females per year (if 20% of females are able to produce 20 offspring). Protection and characterization of genetic resources can be integrated into conservation programs through development of interaction with germplasm repositories, and expanded strategies for genetic management.

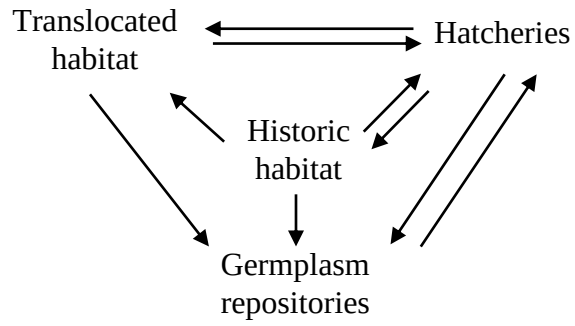

Fig. 1. A strategy to use germplasm repositories in a comprehensive recovery program.

Louisiana Fisheries Forward: advancing our seafood industry

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Commercial fishing is a crucial part of the heritage, culture and commerce along Louisiana's coast. Our state is home to the most productive seafood industry in the lower 48—about 1 billion pounds of seafood, on average, is landed commercially in Louisiana each year, with an estimated dockside value of $300 million. Louisiana seafood fuels our economy and feeds a global population. Louisiana Fisheries Forward (LFF) is a voluntary education program that aims to further raise the bar on the quality and sustainability of Louisiana seafood. A collaboration of the Louisiana Department of Wildlife and Fisheries and Louisiana Sea Grant College Program at LSU, LFF was established to help improve the economic success of the State's commercial fishing industry. LFF provides a structured mechanism to develop and deliver relevant and timely information to the seafood industry. Content is presented via the Internet, using training videos and fact sheets, and directly to communities with hands-on workshops, training days and demonstration projects that showcase new technology and best practice methods. Our goal, through Louisiana Fisheries Forward, is to help fishermen understand the 'science' of fishing—the business trends, new technologies and equipment, and regulatory rules and policies that lead to financial success and resource preservation.

Fig. 1. Louisiana Fisheries Forward logo.

Physical and physiological thermal stress responses of two sympatric crayfishes in Louisiana, *Procambarus clarkii* and *P. zonangulus*

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Water temperature is an important abiotic component in farmed and wild crayfish habitats as it influences individual and population characteristics including growth, metabolic activity, and overall population vigor. However, thermal limits have not been established for the two commercially important crayfishes in Louisiana, the red swamp crayfish *Procambarus clarkii* and the southern white river crayfish *P. zonangulus*. The purpose of this study was to determine the physical and physiological thermal maxima for *P. clarkii* and *P. zonangulus*. Physical thermal stress was examined by the critical thermal maxima (CTMax) using a righting response method for crayfish acclimated to 24, 27, or 30°C for two weeks prior to experimentation. Water temperature in all acclimation trials was increased 1°C h^{-1} and the end-point temperature for an individual was determined by the failure of righting response within 30 seconds. CTMax values for *P. clarkii* acclimated at 24, 27, and 30°C were 39.5 ± 0.2, 39.0 ± 0.0, and 39.4 ± 0.2°C respectively, and 39.8 ± 0.2, 38.8 ± 0.2, and 39.0 ± 0.2°C for *P. zonangulus*. There was no significant difference in CTMax values between species in any of the acclimation trials. Physiological thermal stress was determined by measuring hemolymph glucose concentrations every two hours for crayfish acclimated at 26°C for two weeks and water temperature increased 1°C h^{-1}. Hemolymph glucose concentrations in both species began to slightly increase at 36°C with highly elevated concentrations at 40°C. The physiological and physical thermal stress experiments for *P. clarkii* and *P. zonangulus* showed similar results and provides evidence that these species can survive in extremely high water temperatures. Although *P. zonangulus* prefer cooler water temperatures compared to *P. clarkii*, both species displayed similar CTMax values. The large CTMax values for *P. clarkii* and *P. zonangulus* obtained in this study help explain how these species are able to thrive in warm lentic habitats throughout Louisiana and why they are a prolific invasive species around the world.

Quantitative and qualitative assessment of crayfish harvesting practices in the southern Atchafalaya River Basin

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Although wild harvested crawfish represent only 8% of the economic value of the Louisiana crawfish industry, wild harvested crawfish are highly desired by some consumers and have a strong socio-cultural importance in Louisiana. Despite many decades of assessing the fishery in terms of landings and value, the practices of the individual harvester are not well documented. Resources have been made available to harvesters, such as the Atchafalaya Basin Program's Natural Resource Inventory and Assessment System. However, it is unclear whether harvesters use this information or what information is used in selection of trapping sites. This project evaluated harvesting practices by: 1) field observation and mapping of harvest sites in southwestern Atchafalaya River Basin; and 2) directed interviews with individual harvesters. Field observations included trap locations, water quality, habitat components, and fishery independent sampling. Field observations were conducted along four transects across a gradient of water quality over two seasons (2015 and 2016) weekly during the active harvest period. We also assessed connectivity with floodplain and river water sources by conservative tracers (isotopes) sampled at each water quality site biweekly during 2016. Directed interviews of 25 harvesters asked about frequency and intensity of effort, factors in deciding where to trap, and their experiences. Trap location and water quality data were first assessed for spatial autocorrelation by X^2 and Nearest Neighbor Tests and then by generalized linear mixed models including water quality, habitat, and conservative tracers. Trap locations were not random; therefore, generalized linear mixed models included a random variable to account for spatial autocorrelation. Analyses demonstrated that most traps were set in shallower (1-2 m) and relatively clear water (< 69.4 NTU) or in deeper (~3m) and relatively clear water. Very few traps were set in shallow and muddy water. Trap intensity also was associated with river water versus swamp water, based on tracer data. Harvester interviews corroborated the importance of depth (46%) and water color (41%) when setting traps, and river stages (75%) when starting harvesting. Therefore, although the harvesters may not be using water quality and chemistry data, their harvesting practices do follow water movements, likely based on accumulated experience with depth and water color.

Enhancing fishing opportunities in Louisiana through the Get Out and Fish! community fishing program

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The Louisiana Department of Wildlife and Fisheries has launched a community fishing program called Get Out and Fish!. Through this program LDWF strives to recruit, retain and reactivate anglers to the sport of fishing. The creation of a quality fishery provides residents of all ages and abilities easy access to a fun fishing experience. The Get Out and Fish! program promotes family and community interactions and provides educational opportunities to teach children and adults how to fish.

LDWF biologists select a community pond that is located in close proximity to a city, town, or village and is accessible to the general public. LDWF then partners with the local government or community organization to provide quality fishing with great odds of catching fish by stocking adult size channel catfish in the spring and fall and rainbow trout in the winter. LDWF assists with scheduling the fish stocking and provides technical assistance and advice on pond management. In addition, LDWF staff and volunteers assist the local organization in hosting a Get Out and Fish! event in conjunction with the initial stocking of fish. These events have both a family friendly fishing competition as well as educational fishing activities. For those anglers who are less experienced we provide instruction on casting, bait selection, knot tying, fish identification and more. In addition, LDWF provides training to volunteers and coordinates partnerships with local organizations in order to offer and enhance further aquatic education opportunities at LDWF Get Out & Fish sites.

LDWF's Aquatic Volunteer Instructor Program

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The Louisiana Department of Wildlife and Fisheries has expanded on its aquatic education instructor program. Since the Fisheries Outreach team has dwindled in numbers, it has been difficult to reach the public across the entire state. We still receive event requests on a regular basis but haven't had the employees to send to them. That's where these newly trained aquatic volunteer instructors come into play and help us in these vital situations. Now known as the Aquatic Volunteer Instructor Program (Aquatic VIP), we have trained 149 volunteers since the creation in 2015. After going through an eight-hour hands-on workshop, these certified volunteer instructors are ready to teach the public about Louisiana's fisheries. Whether it's as simple of an activity like casting practice with backyard bass or as in-depth of a lesson like fish anatomy, this Program covers it all. Aquatic VIP supplies the volunteers with lesson plans, activity guides, educational material and loaner kits to be utilized at events. They also receive training on how to host their own aquatic education program if they want to do more than volunteer at LDWF events. With Aquatic VIP expanding and reaching more parts of Louisiana, the future of this program is bright. Thanks to these volunteers, the public will continue to be taught about their role in conserving Louisiana's aquatic resources.

Fishes around small oil and gas platforms in the northern Gulf of Mexico's hypoxic zone: changes in relative abundances and depth distributions

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Oil platforms (platforms) provide hard bottom habitat in the northern Gulf of Mexico's hypoxic zone that attracts a wide variety of fishes. Hypoxia occurs near the bottom and reef-associated fishes utilize platform habitat in the well-oxygenated waters overlaying hypoxia. A camera array was used to estimate relative abundances and depth distributions of fishes before, during, and after hypoxia at platforms experiencing intense (seaward) and mild hypoxia (shoal). Gray Snapper abundances were stable at seaward platforms, but abundances at shoal platforms were ten times higher after hypoxia than they were before (P<0.01). There were similar trends of abundances for Sheepshead, Atlantic Spadefish, Blue Runner, and Atlantic Bumper in the two areas, and there was no effect of hypoxia. Depth distributions were similar at shoal platforms throughout the study period (P>0.55), but shifted 3m shallower at seaward platforms when hypoxia was present (P<0.01; Figure 1). Hypoxia may have contributed to different recruitment rates of Gray Snapper at seaward and shoal platforms, but fishes appeared to maintain their abundances at seaward platforms by vertically migrating to the waters above hypoxia. Our findings suggest that the vertical dimension of platforms is key to their ecological role in the hypoxic zone and should be considered for artificial reef management.

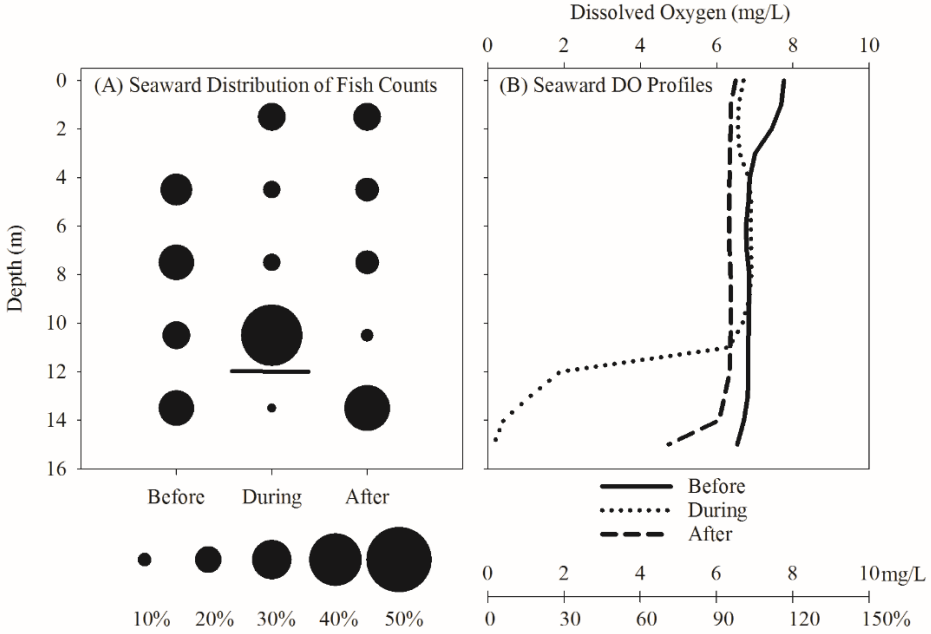

Figure 1: Depth distribution of fish counts at seaward platforms (A) and dissolved oxygen profiles (B) platforms before, during, and after hypoxia. Black circles represent 3 m depth bins, and are scaled to the proportion of fish counts occurring within a bin. The horizontal bar in plot A demarks the vertical extent of hypoxia (DO of 2 mg/L).

Molecular regulation of shell development in eastern oysters (*Crassostrea virginica*) in response to CO_2-related ocean acidification

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Indigenous to the Gulf of Mexico, Eastern oysters (*Crassostrea virginica*) are critical species within estuarine ecosystems and are economically valuable aquaculture bivalves along the coasts of the United States. Previous studies suggest that early growth and development of the eastern oyster are affected by the fluctuation of environmental factors including temperature, salinity, pH, pollution, and increases in CO_2. Over the past decades, the global atmospheric concentration of CO_2 has drastically increased due to anthropogenic inputs. As a result, dissolved CO_2 levels in surface seawaters are rising, contributing to ocean acidification. While there is indication that increasing acidification of oceans could negatively impact the development of larval oysters, specifically their shell development, the genomic response of oysters to this impact remains largely unknown.

To better understand the impact of CO_2- related ocean acidification on the molecular regulation of shell formation in eastern oysters, six previously identified bivalve shell development related gene-encoding proteins, calreticulin (*crt*), calnexin (*cnx*), caltractin (*calt*), calmodulin (*CaM*), dominin (*dominin*) and segon (*segon*), were investigated in response to increased CO_2 concentrations. The full length of gene crt, cnx, calt, and cam were cloned and sequenced. The three dimensional structures and the calcium binding sites of the proteins encoded by these four genes were simulated. Expression profiles of the six genes were analyzed utilizing quantitative PCR (qPCR). Expression patterns of the six selected genes under high CO_2 exposure were observed in primarily cultured mantle cells incubated in various percentages of atmospheric CO_2 (0-10%) and associated pH values of cell culture medium (7.4-.7.0). These profiles were also detected in oyster larvae reared in both ambient pCO_2 (400 ppm) and increased pCO_2 (1000 ppm) concentrations. In mantle cells, our results revealed differential expression between each of the six target genes in response to increased CO_2 concentrations. Understanding the molecular regulation of shell development in eastern oysters in response to ocean acidification will aid in conserving and sustaining both cultured and wild populations of oysters facing environmental stress.

Nicholls Honors Program creates a service learning project to conserve Outsider Sculpture Site in the traditional fishing community of Chauvin, LA

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The Chauvin Sculpture Garden was created by visionary artist Kenny Hill over a thirteen-year period in the late 1980s on the banks of Bayou Petit Caillou in Chauvin, LA. After Hill abruptly walked away from the site in 2000, Kohler Foundation purchased the land, restored the garden, and entrusted the site to Nicholls State University to maintain. Since then Nicholls has sought ways to integrate the garden into its educational initiatives. Here we describe a relationship created between the Nicholls Honors Program and the Chauvin Sculpture Garden that highlights service learning as a vehicle for student engagement and lasting community stewardship. Since 2015, the Honors Program has logged nearly 200 person-hours in its efforts to provide labor and public awareness to the unique art installment. The project offers an opportunity for students to immerse themselves in the traditional Cajun community of Chauvin and expose themselves to unique folk art. Through the project, students are able to observe firsthand a geographical area impacted by climate change, creating a new generation of educated citizens able to work towards coastal protection and restoration. It also provides training in art conservation, using the work of Kenny Hill as a rare example of visionary art requiring interaction with conservators for its survival. As a result, we have found that the project nurtures a strong sense of connection to the Louisiana Coast as well as an opportunity to actively participate in the visionary work of Kenny Hill.

Figure 1. Two Nicholls students repaint sculptured pathways created by Kenny Hill at the Chauvin Sculpture Garden in April, 2017.

Interaction of temperature and salinity on the growth and mortality of Louisiana oysters and incorporation into a sustainable harvest model

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Eastern oysters (*Crassostrea virginica*) in Louisiana deliver a suite of important ecosystem services and support the largest commercial oyster fishery in the United States. Current management and restoration decisions are supported by a shell-budget model that estimates sustainable harvest of oysters based on a no-net-loss of surficial reef (e.g., dead shell). The inputs to the model, derived from an annual stock assessment, are oyster density, oyster size, reef area, and surficial cultch mass. The model theoretically simulates oyster growth and mortality, and if possible, provides a level of oyster harvest that would result in no net loss of reef material. In the absence of suitable parameterization of the effects of temperature and salinity on the growth and mortality of local populations, generalized assumptions based on work performed outside the region were applied. However, Louisiana oyster reefs experience lower salinities (< 15), shorter overwintering periods, and prolonged exposure to high summer temperatures as compared to Atlantic populations. Our research aims to update environmentally-driven mortality and growth assumptions for Louisiana oysters, with particular emphasis on the combined effects of temperature and salinity on growth and mortality. To meet this goal, we synthesized data derived from two long-term (1988-2013) reef monitoring projects conducted by Louisiana Department of Wildlife and Fisheries on public oyster reefs. We combined finite distribution mixture modeling of monthly dredge samples with directed tray studies to quantify growth and mortality rates across spat (≤ 25 mm), seed (25-75 mm) and sack (> 75 mm) oyster size classes. We then used Generalized Additive Model and response surface-model frameworks to examine the non-linear interactions between growth and mortality estimates and long-term trends in salinity and temperature. I will conclude the talk by briefly detailing my current thesis research focusing on the spatial and temporal differences of environmental factors and the effect they have on oyster growth and mortality in the Barataria Estuary. Our coast-wide work highlights the complex relationships between oyster ontogeny and the environmental controls on mortality and growth; providing improved model parameterization for more accurate estimates of sustainable harvest.

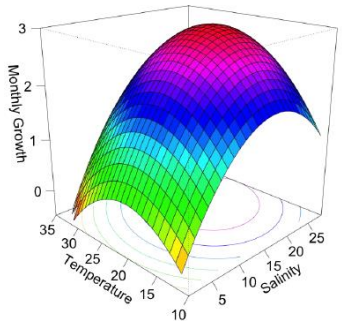

Figure 1: Sack oyster (> 75 mm shell height) growth.

Changes in fish assemblage in Breton Sound Louisiana

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A central challenge to assessing effects of major environmental changes is the lack of historic quantitative distribution and abundance data. Quantitative abundance and distribution data for nekton have been collected over a long period of time by the Louisiana Department of Wildlife and Fisheries as part of an effort to manage and conserve the state's fishery resources. To assess the ecological response of nekton to historic disturbances and hydrological changes, nekton were sampled monthly using 228 meter monofilament gillnets at historic sampling stations. Twelve years of data from four sites (N=495) along the Mississippi River Gulf Outlet (MRGO) in Breton Sound Louisiana were analyzed using nonparametric multivariate statistics to test hypotheses that nekton assemblages in Breton Sound have shifted over time as the result of changes in hydrology and several major natural disturbances. The results of this study indicate that while an overall shift in nekton assemblage structure seems to have occurred, nekton abundance in Breton Sound Louisiana following several major storms and the closure of the MRGO is comparable to historical norms. However, it is clear that the abundance of recreationally important species such as the spotted sea trout (*Cynoscion nebulosus*) seem to depend on salinity which may have been affected by the closure of the MRGO. Despite fluctuations in nekton assemblages over twelve years, these results suggest that nekton are resilient to significant and repeated natural and anthropogenic disturbances. However, it is crucial that long term monitoring of Louisiana fisheries continue in order to protect against possible future declines.

Lessons learned and involvement in Louisiana Department of Wildlife and Fisheries' Derelict Crab Trap Removal Program

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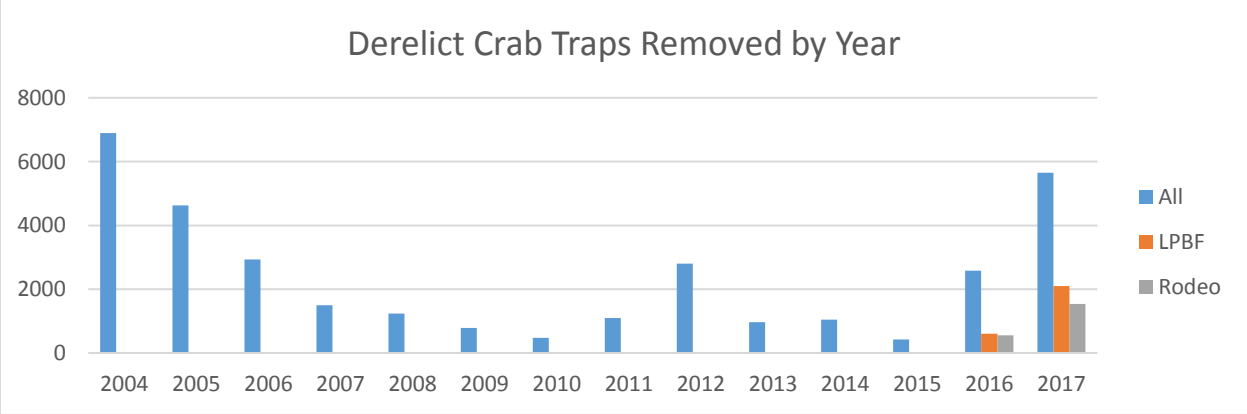
The Lake Pontchartrain Basin Foundation (LPBF) has partnered with the Louisiana Department of Wildlife and Fisheries (LDWF) and others to remove derelict crab traps from coastal Louisiana in 2016 and 2017. Derelict crab traps are abandoned or lost passive fishing gear that have environmental and other costs. These box shaped traps, often made of vinyl coated wire mesh, can continue to "ghost fish", attracting and killing aquatic organisms from many taxa. In order to remediate the effects of derelict crab traps, LDWF instituted the Derelict Crab Trap Removal (DCTR) Program in 2004, resulting in the removal of 32,040 traps, from 2004 through 2017. This involves the physical removal, destruction, and disposal of derelict crab traps during a commercial crab fishery closure. From 2004 – 2016, a portion of the Louisiana coast for up to 16 days was closed to commercial crabbing for derelict crab trap removal. Recent legislation called for a statewide 30-day commercial fishery closure each year from 2017 -2019. The nine day 2016 eastern Lake Pontchartrain DCTR removed 1,386 crab traps. The 2017 eastern Louisiana DCTR resulted in the removal of 3,822 traps in the Pontchartrain Basin. The majority, 3,664, of these traps came from the waterscape surrounding Delacroix Island, LA. Using data from the 2016 closure, we estimated the total number of findable (crab traps that are in part or have a float attached above the water line) crab traps within the Pontchartrain Basin to be over 25,000. Using data from 2016 and 2017, we compared the cost efficiency of different boat and crews, and found contracting a commercial boat operator with a boat specifically designed to carry crab traps to be more cost effective than more common center console vessels ($8.84 vs $19.77 per trap). We are planning to use these and other lessons learned for the 2018 and 2019 DCTRs.



Number of derelict crab traps removed in coastal Louisiana by year. For 2016 and 2017, the proportion collected by LPBF personnel (orange bars) and during the volunteer based derelict crab trap rodeos (grey bars) from the Pontchartrain Basin, is shown.

Translating high-gradient stream paradigms to the coastal plains streams of Louisiana

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Ecological paradigms associated with energy acquisition within high gradient streams are well established; however, translating these ideas to low-gradient coastal streams may not be simple. For instance, brook trout (*Salvelinus fontinalis*) in the Appalachian Mountains rely heavily on terrestrial insects falling into headwater streams. This is especially important when benthic macroinvertebrates are depleted mid-summer. The River Continuum Concept, which states that autochthonous production is low in headwater streams, is a standard explanation for this phenomenon. Low-gradient coastal streams of Louisiana may follow a similar paradigm with the connection to the riparian corridor and adjacent floodplain, but are vastly understudied. Outside of the tropics, the flood-pulse concept is a less-supported paradigm that describes a river or stream's connectivity to the floodplain. In this paradigm, the exchange of biological materials between these two ecosystems increases overall productivity. Louisiana offers the opportunity to investigate primary and secondary productivity in the coastal stream communities as well as providing insight into the biogeographical distribution of fishes. Herein, we describe a study involving terrestrial subsidies and its applicability to Louisiana coastal streams with the goals of continuing research into relationships between coastal stream and river productivity with biodiversity along a larger gradient of biogeographical change.

The ecological importance of dragonflies and damselflies

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Dragonflies and damselflies (Odonata: Anisoptera and Odonata: Zygoptera) are ecologically important not only because of their role as both predator and prey in an ecosystem, but also because of their use as a bioindicator of habitat quality. Because Odonates utilize both aquatic and terrestrial habitat for parts of their life cycle and are sensitive to changes in both environments, their presence is often a good indicator of the quality of the entire ecosystem. Dragonflies generally rely little on specific plants for habitat recognition, but rather on the structural complexity of the vegetation. Human activity such as urban development has been shown to simplify the vegetation structure in many riparian (shoreline) areas by facilitating the movement of invasive plants, which often overtake native vegetation. These habitat changes have been shown to influence the diversity and distribution of Odonate communities. This project focuses on exploring the impact of these habitat changes on the composition of Odonate communities in urban, suburban, and rural aquatic ecosystems in Louisiana. To test this, we have been sampling both the Odonate larvae and the vegetation composition in several aquatic ecosystems in Louisiana. By identifying the larvae down to the family level and comparing the Odonate composition to the ratio of invasive and native plant species at the sampling site, a "curriculum" of sorts can be developed to estimate the quality of an ecosystem using the families of Odonates observed in an area.

Standardization of vitrification for aquatic species with three-dimensionally printed devices

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Vitrification is a method of cryopreservation that rapidly freezes samples in thin films to form amorphous ice ("glass"). Although vitrification offers an effective method of preserving gametes, there are a number of major technical drawbacks impeding its application to germplasm of aquatic species. These drawbacks include the lack of devices intended to freeze fish sperm, which forces user groups to struggle with improperly suited devices. This diminishes the quality of data and results, and impedes the community's ability to reconstruct experimentation and standardize approaches. Our goal was to develop methods and devices essential for rapid assessment of vitrification with the application of 3-D printing. Our objectives were to: 1) design and prototype a 3-D printed assessment pedestal and a range of vitrification loop configurations; 2) establish categorization criteria based upon the clarity of frozen films, and 3) conduct tests to observe the effects of vitrification capabilities with varied loop configurations. Assessment of frozen films was rapid (Figure 1) and in combination with 3-D printing offers opportunities for standardization and improved results for vitrification of sperm, and potentially of eggs and embryos. This would be especially valuable for small-bodied fishes including imperiled species and biomedical models such as zebrafish and members of the genus *Xiphophorus*.

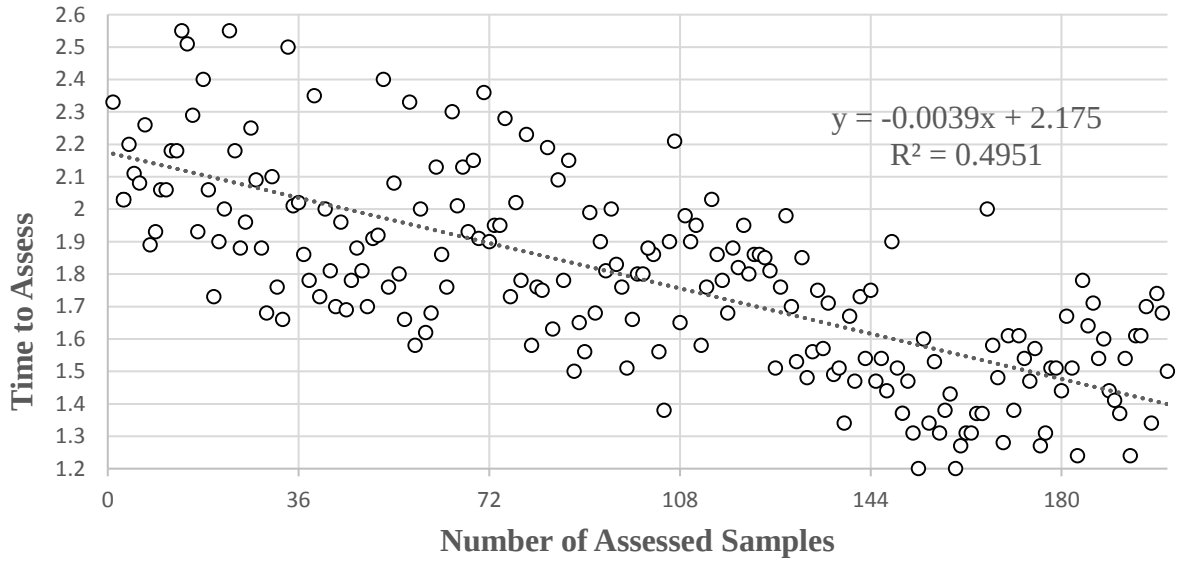

Figure 1. The time required to individually assess the vitrification quality of frozen thin films declined with practice, representing a learning curve. Rapid classification was necessary because the vitrified samples thawed rapidly (requiring routine assessment within 5 sec). A total of 216 vitrified samples were assessed and three exceeded the conservative target maximum assessment time (set at <2.5 sec), all of which were recorded within the initial 50 samples.

Development of an aquatic germplasm and genetic resources center

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Cryopreservation of sperm was developed at the same time (late 1940s) for bulls and fishes. Livestock operations quickly adopted this technology because it greatly simplified a long-standing need to distribute improved genetics throughout herds with thawed sperm to replace the cost and effort of transporting and maintaining live bulls. Fish hatcheries did not immediately recognize such needs, and for this and other reasons, such as a lack of commercial-scale processing, cryopreservation has not yet been generally employed for aquatic species to develop, maintain, and distribute genetic resources. The Aquatic Germplasm and Genetic Resources Center (AGGRC) was initiated to convert the LSU Dairy Improvement Center (DIC) into an all-inclusive, stand-alone facility for research, technology development, teaching, outreach, training, cooperation, commercial-scale processing, and programmatic assistance for development of comprehensive repositories in aquatic species (Figure 1).

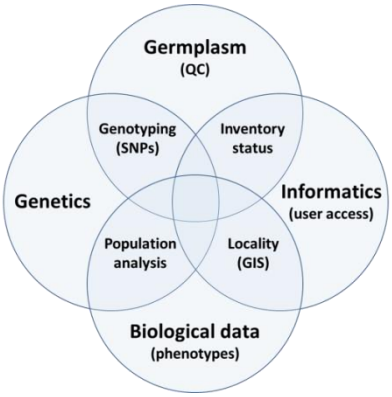

Figure 1. Components and interactions necessary for realization of comprehensive repositories that can be used to develop, maintain, and distribute genetic resources. The value of information (e.g., genotyping) and samples (e.g., germplasm) is magnified as additional components are integrated for specific genotypes, individuals, populations, and species. Collections can include a variety of tissues, and genotyping can be used to facilitate marker-assisted selection, specify collection needs, or identify genotype x environment interactions. User groups would include conservation programs, commercial fisheries, aquaculture, and biomedical research.

The DIC was created in 1947 as a university-private sector cooperative and has provided services including custom cryopreservation of bull semen for 70 years. Tiersch and co-workers collaborated with scientists at the DIC since the 1990's to develop commercial-scale cryopreservation for fish and shellfish. In 2015 the commercial cooperator (Genex, Inc.) moved its operations, and the DIC facility became available for transition into dedicated use with aquatic species. The AGGRC comprises 23,000 ft^2 of laboratory, office, cold-room, and barn space including a conference room and areas specifically designed as a cryopreservation center. In addition there are several outbuildings (an additional 5,500 ft^2) to be converted into fish holding space. The AGGRC combines 25 years of experience with hundreds of aquatic species in cryopreservation and repository development with facilities suitable for research and commercial-scale activities. Staffing includes biological and engineering expertise, and projects emphasize standardization and community development by production of devices for specific activities in cryopreservation. Prototyping and testing are performed with 3-D printing and microfabrication. The facility is located adjacent to the LSU campus which facilitates collaboration, including teaching of classes. In addition to separate research and commercial-scale laboratories, a self-contained mobile laboratory has been developed to perform high-throughput cryopreservation on-site at cooperating facilities.

Multigenerational effects of chronic exposure to the polycyclic aromatic hydrocarbon naphthalene in Gulf killifish *Fundulus grandis*

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Sublethal effects of the Deepwater Horizon oil spill in the Gulf of Mexico have been studied extensively, however potential multigenerational, immune system, and endocrine effects following exposure to polycyclic aromatic hydrocarbons (PAH) are poorly understood. The goal of this study is to examine potential adaptation within two generations of Gulf killifish exposed to PAHs. Multiple biomarkers will be used to assess adaptation within these fish, such as lysozyme (enzyme critical in innate immunity), and 11-ketotestosterone and vitellogenin (endocrine hormones often affected by PAHs).

In a previous experiment, a population of Gulf killifish, parents (F1), were exposed to a water accommodated fraction of crude during spawning over a 40 day period giving rise to offspring (F2). The current study details the F2 individuals, who after reaching maturity were chronically exposed to 100 µg/L of aqueous naphthalene for 40 days, and observed an additional 40 days after naphthalene treatments. Gill and liver tissues were collected and assessed for Ethoxyresorufin-0-deethylase (EROD) and CYP1A enzyme activity as a marker of PAH metabolism during the exposure period. Surface mucus and blood plasma were collected for the determination of hormone concentrations and lysozyme activity.

Lysozyme was detected in surface mucus of Gulf killifish and naphthalene exposure significantly decreased the relative concentration of lysozyme in fish exposed to naphthalene regardless of parental history (Fig 1). Changes in concentrations of lysozyme were also significant with the linear relationship of time, treatment and parental history with individuals from exposed parents showing overall higher concentrations than individuals from control parents. Both surface mucus and plasma concentrations of 11-ketotestosterone and vitellogenin were too low to be detected and show any differences between exposure groups. Preliminary results indicate increased EROD activity in individuals exposed to naphthalene, and laboratory analysis for these biochemical markers are ongoing. Initial results show potential adaptation to PAH metabolism and immunology within two generations in Gulf killifish.

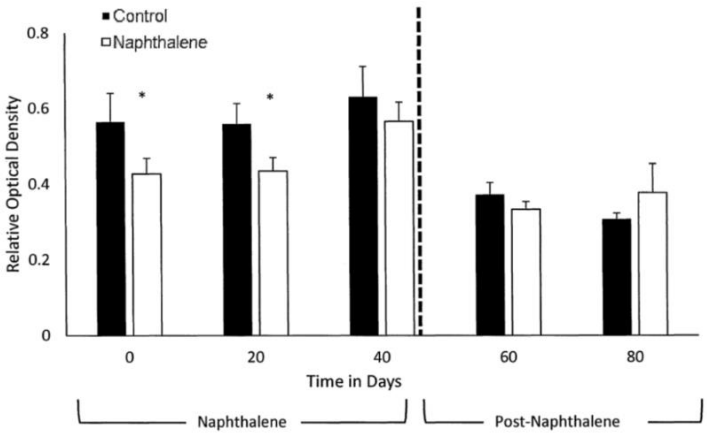

Figure 1: Mean (±SE) mucus lysozyme in relative optical density from parental exposed naphthalene and control individuals of Gulf killifish exposed to aqueous naphthalene for 40 days. Asterisks indicate significant differences between exposure groups (ANOVA, two way, $p < 0.05$)