Gulf Scholars Summer Showcase

August 9th, 2023
LSU Center for River Studies

LSU

Gulf Scholars Program

The National Academies of SCIENCES ENGINEERING MEDICINE
GULF RESEARCH PROGRAM

LSU
Discover Undergraduate Research Program

About the Gulf Scholars Program

The mission of the National Academy of Sciences Gulf Scholars Program (GSP) is to build the capacity of the Gulf region's colleges and universities to prepare and inspire undergraduate students to address critical challenges facing the region at the intersections of human, environmental, and energy systems.

LSU's Gulf Scholars Program launched in the spring of 2023. Our plans were to create a summer research and creative endeavor program (Gulf Impact Project), utilize and build off of existing LSU Discover Undergraduate Research Program infrastructure to support the program, and design the complementary curriculum offerings. For the summer Gulf Impact program, applicants could either apply to existing faculty projects or develop their own proposals for projects. After a competitive application process, we were able to fund 18 students out of the 40 who applied. Those Gulf Renaissance Scholars represent 13 different majors and worked with 10 different departments under the mentorship of a faculty member. We are proud to have those students presenting their research to you today.

Figure 1. Cast net fishing at Wampold Park in Baton Rouge.

Figure 2. Excursion to the Gulf of Mexico, July 21 - 22. Scholars standing on newly built land in both photos.

Acknowledgements

Getting the LSU Gulf Scholars Program off the ground and all the way to the Summer Showcase today would not have been possible without the help of many partners. Thank you to everyone that has played a role in the program thus far.

Special Thanks:

The staff of the LSU Center for River Studies
LSU Gulf Scholars Program Leadership and Steering Committee
Sarah Ferstel and Tori Clement, LSU Discover Undergraduate Research Program
Dr. Jacqueline Bach, LSU Discover and Academic Programs & Support Services
Dr. Clint Willson, LSU College of the Coast & Environment
Daena Carrillo, LSU Gulf Scholars Graduate Assistant

Figure 3. Members of the Leadership and Steering Committee at the Breton Sound marsh and Tulane Fish Collection, January 2023.

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Gulf Impact Projects

Joseph Brooks - No Place Like LaPlace: A Green Infrastructure Network for Stormwater Management
Major: Landscape Architecture
Mentor: Dr. Nicholas Serrano
Research Department: Landscape Architecture

St. John the Baptist Parish is located between the cities of New Orleans and Baton Rouge and is influenced by a wide range of anthropogenic and biologic processes. From Maurepas Swamp to Lac des Allemands, the diversity of the landscape is mirrored in the varied interests in Parish development and protection. Efforts to reduce the parish's vulnerability to storm surge received funding in 2018 with the introduction of the US Army Corps of Engineers' West Shore Lake Pontchartrain project, which proposes the construction of a new levee north of the communities of LaPlace and Reserve. In 2021, Hurricane Ida struck LaPlace, the Parish's largest urban center, highlighting the need for improved stormwater management for industrial, residential, and commercial partners. Through spatial analysis and map development, our project considers natural and nature-based solutions and ecosystem services for stormwater management. This project also considers obstacles to community resilience, such as the lack of bikeability, walkability, and public green spaces. These are informed by spatial analysis, with particular attention to hydrology, surface permeability, drainage, and vegetation. Sites representative of typical conditions were identified in partnership with the St. John the Baptist Parish Planning and Zoning Department and evaluated within the spatial framework to inform the design of scalable, implementable, and transferrable interventions. These interventions include "blue ways", sustainable residential development, and retrofitted streetscapes. Site designs were developed with the primary aim of proposing a green infrastructure network that can reduce flood hazard, improve water quality, provide habitat, connect the community, and provide a sense of place.

Jennifer Cagnolatti - Evaluation of Altered Nutrient Conditions on Algal Growth During Dynamic Co-Culture
Major: Biological Sciences
Mentor: Dr. Sibel Bartu-Ates
Research Department: Oceanography and Coastal Sciences

Phytoplankton, also called microalgae, are important primary producers in marine and freshwater systems. Factors like nutrient levels due to human-related modifications of marine and freshwater systems can cause a shift in growth and abundance of different types of phytoplankton like cyanobacteria, which can lead to numerous negative consequences. Cyanobacteria can create harmful algal blooms, which can increase turbidity, bacterial decomposition, and the production of toxins, mainly the hepatotoxin microcystin, as well as allelopathic chemicals used to outcompete other phytoplankton species. Due to the lack of available technology capable of co-culturing two different algal species' communication, little is known about allelochemicals. The goal of this work is to optimize a novel co-culture system to identify these chemicals through the use of a 3D-printed insert for 6 well plates where two different algal species can be physically separated but chemically connected. Before allelopathic chemicals could be identified, the insert system, which had been previously developed for mammalian cell co-culture, had to be validated for algal studies. In this study, *Chlorella* and *Chlamydomonas reinhardtii* were the two algal species used to see how changes in nutrient compositions (e.g., native or bloom-like) affected their growth during co-culture. This preliminary study is important in showing what conditions promote the growth of harmful algal blooms to gain a better understanding of how different species outcompete each other. In the future, the insert system can be used to identify allelopathic chemicals produced during co-culture to understand conditions that promote phytoplankton species succession in algal bloom dynamics.

Gulf Impact Projects

Emma Carlo, Alcina Costa, Neil Tepper - Callin' Baton Rouge: 311 Calls, Flooding, and Environmental Justice
Majors: Sociology, Computer Engineering, Political Science
Mentor: Dr. Kevin Smiley
Research Department: Sociology

Baton Rouge is experiencing unprecedented flooding, and for decades our only concern was the floodplain and flood-prone areas. However, climate change increasingly affects the severity of major natural events that our infrastructure may not be equipped for even for areas that did not flood. This project sought to determine a relationship between environmental injustice and the residents of East Baton Rouge Parish who reported issues to the 311 resource, a phone number which residents call to report non-emergencies. This city resource allows for an analysis of which areas are impacted the most to then identify trends that could possibly expose disproportionate environmental impacts.

All 5,000 calls made during 2021 were qualitatively coded for various flood causes amongst other variables to be used in geospatial and statistical analysis. This analysis allowed us to test the relationship between an area's flood risk score and the frequency of which they report an issue, compare census variables such as race and income between tracts to determine whether a specific type of area is impacted more, and the overall frequency of flood causes.

Our results indicate the more common causes of flooding includes a catch basin needing to be cleaned due to vegetation or trash, a ditch needing to be mowed, or the presence of a sinkhole. These findings represent a key issue for infrastructure in East Baton Rouge, based on more areas flooding despite having a low flood risk score as well as a mostly even distribution of residents among all races experiencing such issues.

Brooke Chouest - Blood in the Water, Water in the Lungs
Major: Stuido Art
Mentor: Dr. Johanna Warwick
Research Department: Art

The heat sticks to your skin. Humidity weighs you down. You lick your lips and consume the salt air. Landscapes. Erosion. Main channels, dams. The dance of the cast net thrower, the coastal master plan. Bless the fleet, feed the fleet. Tempête. Water over the bridge. Sun-scarred skin. Shucking oysters. Will it breach the levee? Vanishing soil. Welcome to nowhere.

Guidry, Cheramie, Breaux, Alario. Memory, history, pride. Mosquitos buzzing. "We will rise again." The hum of a crawfish boil. Boat motors cranking in the morning. Noah died and we buried him in the backyard. Cajun. That's coonass. Do you think he will swim? Desperation. Trawling. Oil. Do you think he can drown?

The land that is impacted by the water and the water that is impacted by the land. La perte, la déperdition. Toups, Pierce, Orgeron, Lefort. Ecological value vs. cultural value. Loss, shrinkage, defect. Have you been to Grand Isle? Cocodrie? Buras? Delcambre? Dying communities. A dying community. Consequences of deliberate actions. Thirty football fields of land a day. Boudreaux, Thibodaux, Lombas, Lagarde. Regarde ça. Alors et maintenant.

Rising, sinking, drowning, mon Dieu. The birds are still singing, but the culture is dying.

Gulf Impact Projects

Nonnie “Betsy” Cook - Enabling Predictive Toxicology Assessments to Determine Whether Pollution is Contributing to the Decline of Sharks in the Gulf of Mexico and Beyond
Major: Coastal Environmental Science
Mentor: Dr. Jon Doering
Research Department: Environmental Sciences

Decreases in the abundance of pelagic sharks have been documented around the globe, including in the Gulf of Mexico. Overexploitation has been blamed, but nothing is known about whether pollution could be a contributing factor or impairing recovery. Performing traditional toxicity testing with sharks is difficult because of their rarity, large size, and other factors. However, predictive toxicology focuses on the interaction of chemicals with specific biomolecule targets leading to impacts on a physiological pathway and can be measured using *in vitro* cell-based assays using genetic samples collected from the species of interest making this approach amenable to sharks. Therefore, the present study will use predictive toxicology to assess the potential impacts of pollution on sharks. Specifically, the sensitivity to activation of the aryl hydrocarbon receptor (AHR) by chemicals associated with fossil fuels and other industry will be measured for grey smooth hound shark, horn shark, shovelnose shark, Atlantic stingray, and electric ray. Over ten weeks, mRNA was extracted from the livers from each species and converted to cDNA. Primers were designed using known sequences of closely related species. Polymerase chain reaction (PCR) was performed to isolate AHRs from each species. Once isolated, AHRs will be cloned into expression vectors and transfected into COS-7 cells alongside a luciferase reporter. Cells will be exposed to serial concentrations of chemicals and luciferase response read on a plate reader. This response will be used to predict the sensitivity of each species to chemical toxicities to enable objective assessments of risk posed by pollution.

Carlie Dutile - Synthesis and Characterization of Cobalt Complexes for the Electrochemical Reduction of Nitrite in Water
Major: Biological Engineering
Mentor: Dr. Noemie Elgrishi
Research Department: Chemistry

Agricultural runoff causes high nitrate and nitrite levels that are harmful to wildlife in water systems. This runoff contributes to “dead zones” around the world, particularly in the Gulf of Mexico off the Louisiana coast. Several techniques are being developed to remove, recover, or degrade these contaminants. For nitrite in particular, electrochemical reduction is a promising technique which has increased in popularity as it would avoid the generation of secondary waste. The development of catalysts is required to aid in this electrochemical reduction of nitrite. Of these catalysts, copper complexes have been synthesized to reduce nitrite to gaseous products including N_2O, NO, and N_2. Cobalt catalysts have also been synthesized for the reduction of nitrite in water and the production of ammonia/ammonium. This is desirable because ammonia/ammonium are valuable, usable products that require a lot of energy to produce using conventional methods such as the Haber-Bosch process. Using cobalt electrocatalysts could decrease the energy required for ammonia/ammonium production and removes a problematic contaminant, nitrite. This project aims to synthesize cobalt complexes for the electrochemical reduction of nitrite in water. Previous work in this area has shown that interactions between the ligand and the metal center affect the reduction products. The ligands studied in this work include tris 2-(dimethylamino)ethyl amine (Me_6Tren) and tris(2-aminoethyl) amine (Tren). The work done thus far includes the synthesis and characterization of the following complexes: [Co(II)Me_6Tren(Cl)] [Cl], [Co(II)Tren(Cl)][Cl], and [Co(II)Tren($C_2H_3O_2$)][$C_2H_3O_2$]. Future work will focus on electrochemical characterization of these complexes.

Gulf Impact Projects

Victor Gischler - Louisiana: Sounds of the Coast
Major: Music
Mentor: Dr. Brian Nabors
Research Department: Music

Last June I traveled to Louisiana's gulf coast to record audio and gather materials with the purpose of creating music using only these findings. I had confidence that the materials and audio I found from Louisiana's wildlife and community could be used to create a unique soundscape. Similar compositional ideas have been experimented within the past century, such as John Cage's piece "Child of Tree," using objects such as dried leafs as instruments, and the musique concréte movement during the mid 20th century using edited recordings to make music. Audio sampling is also used frequently in popular music, such as Pink Floyd's album "Animals". Over the summer I was able to write 6 pieces, each of which having its own distinct sound. 5 of the pieces are fully electronic while the last one is a combination of electronic and live found percussion. Some examples of samples I recorded are of birds, insects, water flowing, restaurant ambience, seashells and more. I also commissioned a colleague, Joseph Brooks, to write his own piece using the recordings. In conclusion the research project was a success, as I was able to create sounds and musical textures that would have been impossible if I had not recorded sounds from the coast.

Jamarion Johnson - Vulnerability of *Spartina patens* Marshes to Sea-Level Rise
Major: Coastal Environmental Science
Mentor: Dr. Tracy Quirk
Research Department: Oceanography & Coastal Sciences

Coastal marshes are important ecosystems that support fish and wildlife, cycling nutrients and pollutants and sequester carbon dioxide. *Spartina patens* (salt meadow cordgrass) is a native grass that dominates the brackish and upper elevation saline marshes of the Atlantic and Gulf coasts of the United States. *Spartina patens* is a dominant species in the brackish marshes of Louisiana where it serves as an ecosystem engineer, stabilizing the shoreline against erosion, filtering pollution, and providing important breeding habitat for marsh birds. However, areas dominated by *S. patens* have been experiencing habitat loss across its range. We hypothesize that *S. patens* is vulnerable to loss due to excessive inundation. In Louisiana, marshes of the Mississippi River Delta are currently experiencing one of the highest rates of relative sea level rise globally. To investigate the potential for *S. patens* vulnerability to flooding, we are using two approaches. First, we are using the Louisiana Coastwide Reference Monitoring Station system (CRMS) to examine changes in cover over the last 15 years (2007) in relation to changes in flooding and salinity. Second, we are testing differences in *S. patens* above- and belowground biomass in three soil types (organic, mineral and sandy) with the prediction that live belowground biomass will be lowest in organic soils. Overall, this study will contribute new information on the effects of sea-level rise on coastal marshes, as well as potential conditions necessary for restoration of an important marsh plant species.

Gulf Impact Projects

Jonathan Russell - Are Increasing Global Sea Temperatures Linked to Changing Tropical Cyclone Induced Tornadic Distribution along the U.S. Gulf of Mexico Coast?
Major: Coastal Environmental Science
Mentor: Dr. Robert Rohli
Research Department: Oceanography & Coastal Sciences

Tropical systems have been understood to produce tornadoes (undergo tornadogenesis) within the northeast quadrant. However, observable shifts within increased tornadogenesis in the southeast quadrant over the past decade counter this past logic. Given the uncertainty into how and where tornadogenesis occurs, given the dynamic environment present, this study seeks to identify shifting trends in tornadogenesis from 1995-2020, but also into the relationships between changing atmospheric variables and the direct effect upon the process/location of tornadogenesis. Through obtaining data through various re-analysis methods, statistical analysis was completed to determine the relationship between the strength of tropical systems in the Gulf of Mexico at landfall and the location of tornadogenesis (bearing from center). The study produced multiple conclusions/results: First, the study proved when SST and PW readings are increased in tornado specific environments, there was a subsequent increase in the strength of the tropical system - proving the direct effect climate change has upon tropical storm formation/intensity. Second, the study proved there is statistical significance along with noticeable trends within the strength of a tornado, as it relates to the bearing from center. In most cases, EF-1 or greater, these tornadoes were generated with stronger storms at landfall and occurred outside the typical 0 to 90 degree range - occurring more often in the 270 to 360 degree range. Lastly, the study highlighted a noticeable variation in tornadogenesis within weak EF-0 tornadoes in category 1 hurricanes; suggesting an optimal balance of a tropical cyclones organization vs disorganization within the band distribution.

Dakota Sievers - Regenerating or Ghost Forest? A.E. LeBlanc Woods Natural Area
Major: Coastal Environmental Science
Mentor: Dr. Linda Hooper-Bui
Research Department: Environmental Sciences

Baldcypress trees are important in wetland areas, particularly on the Louisiana gulf coast. The trees provide vital ecosystem services such as dampening winds, suppressing storm surges, cycling excess nutrients, and providing shade and habitats. The health of baldcypress forests is paramount for the state of coastal areas. In past years, many forests are not regenerating, which means they are emerging ghost forests. Ghost forests occur when there is little to no regeneration happening or the forest is actively dying. Saltwater intrusion, urbanization, overharvesting, and climate change lead to the death of baldcypress forests. The A.E. LeBlanc Natural Woods Area located in a crook of the Mississippi River in Iberville Parish is home to old-growth baldcypress trees. More than 12 trees are greater than 100 years old with some alive in 1803 during the Louisiana Purchase. The preferred route for the new Mississippi River bridge bisects the LeBlanc Forest. This research seeks to determine if this old-growth forest is regenerating or an emerging ghost forest through observing tree age distribution. To achieve these objectives, baldcypress trees were mapped using ArcGIS, the circumference and diameter were measured, and we determined whether the forest is healthy or an emerging ghost forest. The proxy for age is the diameter. Trees with larger diameters are assumed to be older, provided they had the right nutrients. Findings from this study will provide landowners with information they could potentially use to combat the building of a bridge over the forest.

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Patricia Thibodeaux - Comparing Arthropod and Plant Communities Across Natural and Man-Made Brackish Marshes in Coastal Louisiana
Major: Animal Sciences
Mentor: Dr. Michael Polito
Research Department: Oceanography & Coastal Sciences

Coastal land loss in Louisiana is occurring due to a combinaton of factors including man-made levees along the Mississippi River which prevents natural depositon of sediment into the surrounding marshes. In order to combat this issue, marsh creaton and river diversion projects that build up newly created land and restore connectons between the Mississippi river and coastal wetlands have been implemented. Once this new land is formed, it is vital to ensure that these created marshes share the same ecological characteristcs and natural (i.e., "reference") marshes. Here we compared plant communites and arthropod food webs between created and reference sites. This was done by comparing plant biomass, arthropod abundance, and arthropod stable isotope values collected from created and reference sites. Plant biomass did not differ between created and reference marshes, but it did differ among taxa. *Spartina alterniflora* had a higher biomass than any other plant species. Arthropod abundance did not differ among feeding types (herbivore, carnivore, omnivore, detritivore) or between created and reference marshes. The δ^{13}C and δ^{15}N values of arthropods were significantly higher at reference vs created sites. δ^{15}N significantly differed among feeding types with omnivores and predators having higher values. δ^{13}C did not significantly differ among feeding types. Overall, we observed similar plant and arthropod communites at created and reference sites. However, differences in arthropod isotope values may imply food web differences between these sites. Going forward, I will analyze plant stable isotope values to clarify created and reference site food web pathways.

Landry Tucker - Sediment Core Analysis of a Well-Preserved Underwater Baldcypress Forest in The Northern Gulf of Mexico
Major: Chemistry
Mentor: Dr. Kristine DeLong
Research Department: Geography & Anthropology

In the Gulf of Mexico, 13 kilometers off the shoreline of Alabama, deep-sea divers discovered a large underwater forest of baldcypress tree (Taxodium distichum) stumps that once made up a marsh ecosystem from at least 56,000 years ago. Hurricane Ivan uncovered these preserved baldcypress stumps in 2004 and in 2020 Hurricane Sally did the same thing. The stumps were layered under 10 ft of mud, sand, and silt, and very well-preserved. Finding wood like this is rare since wood decomposes very easily in marine environments. Phase 1 of the Underwater Alabama Forest Project began in 2012 and Phase 2 is concluding as many more stumps sights are being found. Sedimentation rates of 6.25mm/century of the cores collected of wood and sediment samples that are older than 56,000-76,000 years old. These bald cypresses lived in anoxic conditions 60 m above sea level. Swamp and marsh environments usually contain euxinic sulfur-rich conditions. Baldcypresses are found in coast and river habitats, but the uncovered baldcypress tree stumps found in the Gulf of Mexico once resided 100 ft below sea level of what it is today. The research that we are doing today consists of mapping surveys, coring the sea floor, and understanding the climate and landscape that these ancient trees once lived in. This site yields valuable information on coastal geomorphology and sediment preservation of macro botanicals. We are understanding more about glacial forests, coastal land change, and many other scientific inquiries.

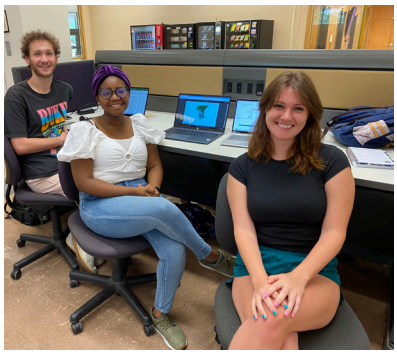
Gulf Impact Projects

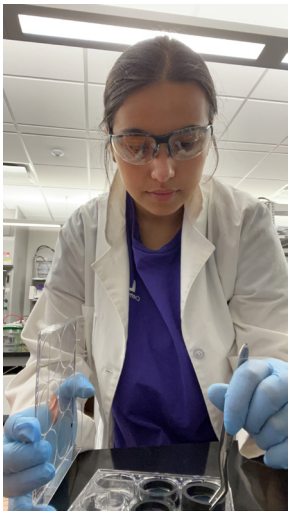
Treasure Wells - The Louisiana Early Childhood Teachers Oral History Project
Major: Psychology
Mentor: Dr. Jennifer Baumgartner
Research Department: Education

Oral history is a field of study and method of gathering, preserving and interpreting the voices and memories of people, communities, and people in past events. It is our oldest tool used for learning and passing on stories from generation to generation. However, as a means for preserving information, oral history is more often than not a forgotten medium in the wake of written word and other technological advancements. The stories of our elders and experts still deserve to be preserved in their primary form: word of mouth. Equally important to preserve are the stories our educators have to tell, whose livelihoods and stories are also often taken for granted. Teachers are integral members of our society. They set children up as citizens of the world, and guide them towards success. The children of today are the leaders of tomorrow, and teachers play a key developmental role that makes a child ready for their future. The stories and lievelihoods of teachers are often left untold. Word of mouth is easily lost over time and taken for granted. Therefore, the The Louisiana Early Childhood Teachers Oral History Project is taking initiative to preserve the voices of this population directly from the teachers themselves. We are working to interview career early childhood educators for their stories and experiences as teachers. We are also centering teachers from the coastal region to highlight the unique perspectives they have to share. The aim is to keep the art of oral history and the stories of our educators alive to preserve them for the next generations to come.

Jameson Woodall - Sedimentary History of the Mississippi River Pass-a-Loutre Outlet
Major: Coastal Environmental Science
Mentor: Dr. Sam Bentley
Research Department: Geography & Geophysics

Recent research on the Mississippi River Delta suggests that both regions offshore and within the Mississippi River are receiving sediment loads insufficient to maintain the either the subaerial or subaqueous Birdsfoot Delta of the Mississippi to its present extent. However, no studies have been undertaken to explore and document seabed changes immediately offshore of any Mississippi River outlets. To address this knowledge gap, we have begun geological and geochronological analyses of piston core PS17-91 (870 cm length) collected seaward of the Mississippi River Pass a Loutre in 2017. The core has been analyzed for Cesium-137 radionuclide activity (^{137}Cs), grain size, bulk density, and fabric (X-radiography). ^{137}Cs is widely used as a time marker for sedimentary processes, because it adheres to sediment particles, and was released into the atmosphere by nuclear testing 1954-1973. We hypothesize that core-derived long-term sediment-accumulation rates will exhibit historical declines due to decreased sediment discharge over the last ~100 years, concordant with documented declines in sediment delivered to the delta, and with observed retreat of the subaqueous delta. Preliminary ^{137}Cs analysis suggests that sediments at the base of the core were deposited ca. 1958, and resulting sediment accumulation rate is >14.7 cm/y, higher than recently measured sediment accumulation rates near other Mississippi outlets, but less than historically measured rates > 100 cm/y. Our next analyses will focus identifying changes in sediment accumulation over the last several decades associated with human changes to the Mississippi River system and possible retreat of both the subaqueous and subaerial delta.






THE GOLDEN BAND
TIGERLAND