STATE OF THE COAST

BOOK OF ABSTRACTS

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THE BUSINESS OF RECYCLING OYSTER SHELL IN LOUISIANA

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The Coalition to Restore Coastal Louisiana's (CRCL) Oyster Shell Recycling Program (OSRP) recycles oyster shell from New Orleans-area restaurants and uses it to restore oyster reefs that help protect Louisiana's eroding coastline. From its beginning in June 2014 through the end of 2017, the program has realized great success: we collected over 3,100 tons of shell, engaged over 540 volunteers, and installed our first living shoreline, a 0.5-mile long reef, in 2016. Nevertheless, the OSRP faces its share of challenges, including time and costs associated with moving heavy shell, securing steady funding, and a long distance to the curing/volunteer site. Here, we focus on the shell-collection aspect of the program and present a program model validation, financial and market analyses, strategic plan, and results from implementation of the improved business model.

Over the past three-and-a-half years, the OSRP shifted from being entirely grant-funded to a partially grant-funded, part fee-based system. During the program's first two years, CRCL secured pilot funding and validated the OSRP's model, establishing oyster shell recycling as a viable and beneficial system for Louisiana. To determine the likelihood of a successful fee-based model, we next conducted a market analysis and used it to develop a plan to increase return on investment for restaurant partners. We then completed a financial analysis and used it to advise pricing and to strategize other cost-efficiency improvements in order to shift the program toward financial self-sustainability. Finally, we formalized a fund development plan to supplement fees as necessary at this stage of the program.

Thus far, implementation of the new model has allowed the program to continue, although at a smaller capacity—we now collect 37 bins per month from 16 restaurants, whereas at our largest we collected 120 bins per month from 26 restaurants. Implementation of our new promotional and marketing strategies is underway and we expect these activities to attract new participants and to increase the overall volume of recycled shell. We determined that using a closer location for most of the shell storage/curing and volunteer events could substantially increase efficiency. However, our first attempt to relocate the shell pile was unsuccessful. We have now identified another suitable location and partner that could meet our needs and are currently pursuing this opportunity.

PRESENTER BIO: Dr. Abibou leads CRCL's Habitat Restoration and Oyster Shell Recycling Programs. She earned a PhD from Tulane University in 2015 where she studied avian ecology in tropical forest fragments. She received her BS in Environmental Biology from SUNY College of Environmental Science and Forestry in 2006.

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CALCASIEU SALINITY CONTROL MEASURES: HYDRODYNAMIC MODELING TO SUPPORT DESIGN OF SALINITY BARRIERS

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The Calcasieu Ship Channel (CSC) Salinity Control Measures Project is a set of proposed measures intended to prevent saltwater from entering Calcasieu Basin through the Calcasieu Ship Channel. The project is part of Louisiana's Comprehensive Master Plan for a Sustainable Coast (Restoration Authority of Louisiana, 2012) to contribute to the restoration of a portion of the Chenier Plain region. To design salinity control measures in this unique coastal environment, numerical modeling was undertaken to establish an understanding of the coastal processes. Modeling was also conducted to evaluate the navigability through the proposed features. This presentation describes the modeling approach, the numerical modeling and results, and discusses how the model results informed the design of the project features.

The modeling of coastal processes included simulation of circulation, waves, vessel hydrodynamics, and hurricane conditions. Circulation modeling determined statistics on velocity and water levels at the structures using a combination of river conditions, water levels, and wind speeds. Wave modeling was performed to establish the wave climate within the project area for design guidance and to determine structure design elevations based on the saline water intrusion due to wave overtopping at the structures. To determine the impact of hurricanes on the structures, storm surge modeling was conducted to determine velocities at the sill openings and the tie-in for each structure as well as the water level difference (head) across the structures. Vessel hydrodynamic modeling was completed to determine the impact of deep draft passing vessels on the structures along the CSC.

Design events were established and evaluated for the usual, unusual, and extreme conditions. Usual conditions are described as a combination of conditions experienced at the project site on a regular (at least once every year) basis including the spring tide range, river flow rates, and 1-year storm conditions. Unusual and extreme conditions are described as a 50-year and 100-year storm conditions, respectively. Both present day conditions and future conditions, which include the relative sea-level rise, were considered when conducting the modeling to ensure the design criteria are relevant for the design life of the structures.

The results of the numerical models of all the coastal processes were evaluated to select the governing environmental forcing conditions for each feature element. The design included the determination of the stable stone size for various project features, berm and sill geometry, and scour pad design at the sill openings and structure-land tie-in. The results of the numerical models were also used to optimize the design for some features, to reduce impacts caused by the implementation of the structures. For example, creation of some features may result in increased morphologic response at the connection between the Calcasieu Lake and the Calcasieu Ship Channel, which, if not protected, could reduce project performance.

PRESENTER BIO: Mr. Agarwal has over 12 years of experience as a Project Manager and Senior Coastal Engineer in planning and data collection efforts, alternatives analyses, numerical modeling and design for a variety of coastal work including ports, marinas, and shoreline stabilization projects.

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FILLING A KNOWLEDGE GAP: USING OYSTER LADDERS TO UNDERSTAND THE IMPORTANCE OF INUNDATION DURATION IN SUCCESSFUL LIVING SHORELINES

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Living shorelines are becoming widely recognized as an effective way to slow coastal erosion in Louisiana, which is rapidly increasing due to the effects of climate change (i.e. rising sea levels, flooding) and subsidence. Specifically, living shorelines which use oyster barrier reefs as a natural infrastructure offer shoreline protection and stabilization, habitat for nekton and benthic organisms, and increased water quality. Oyster barrier reefs can be built from various types of materials (e.g. oyster shell, concrete, limestone, etc.) and in vastly different configurations (e.g. OysterBreak, Reef Ball), but their ultimate success depends on the development of an oyster population. Analysis of multiple project outcome data provides critical insight into drivers of reef success.

Previous studies have found that oyster barrier reefs can be sustainable and provide significant coastal protection if built in favorable conditions, which includes appropriate substrates, water quality and energy exposure. Here we present a meta-analysis of living shoreline projects across Louisiana (Terrebonne, Sister Lake, Grand Isle, Vermilion Cove, Lake Eloi, Lake Fortuna, Lake Athanasio). Overall, success was found to be related to salinity and energy exposure. Specifically, oyster populations were more sustainable in mid-salinity waters, and the barrier reefs within moderate to higher energy exposures shorelines provide the most significant reduction in shoreline retreat. However, it was also noted that significant zonation occurred on the reefs, which may be related to direct and indirect effects of inundation times. With changing water levels, and variation in reef elevations, understanding how inundation time might affect oyster growth, survival and reef sustainability is critical.

While the effects of salinity on oysters and oyster reef restoration have been studied extensively, less is known about the relationship between inundation duration and oyster growth and survival, and reef sustainability. Oyster ladders can be an effective way to monitor the effects of inundation duration on oyster growth and recruitment, with trays of oyster substrate placed at incrementally increasing heights to capture varying inundation exposures. Oyster ladders deployed at replicate sites will help to fill this knowledge gap. Understanding ideal inundation exposures will aid in designing and implementing successful living shorelines, as well as allow scientists and restoration ecologists to predict how oyster barrier reefs will fare under anticipated rising sea levels.

PRESENTER BIO: Danielle Aguilar is a Research Associate with the LSU School of Renewable Natural Resources under Dr. Megan La Peyre. Her current research efforts (and past graduate research study) revolves around coastal conservation and oyster reef restoration efforts on the Gulf coast.

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FAULT ACTIVITY IN THE TERREBONNE TROUGH, SOUTHEASTERN LOUISIANA: IMPLICATION FOR SUBSIDENCE HOT-SPOTS

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The observed displacement along faults in southeastern Louisiana has raised questions about the kinematic history of faults during the Quaternary. The Terrebonne Trough, a Miocene salt withdrawal basin, is bounded by the Golden Meadow fault zone on its northern boundary; north dipping, so-called counter-regional faults, together with a subsurface salt ridge, define its southern boundary. To date, there are relatively few published studies on fault architecture and kinematics in the onshore area of southeastern Louisiana. The only publically accessible studies, based on 2d seismic reflection profiles, interpreted faults as mainly striking east-west. Our interpretation of a 3-D seismic reflection volume, located in the northwestern Terrebonne Trough, as well as industry well log correlations define a more complex and highly-segmented fault architecture. The northwest striking Lake Boudreaux fault bounds a marsh on the upthrown block from Lake Boudreaux on the downthrown block. To the east, east-west striking faults are located at the Montegut marsh break and north of Isle de Jean Charles. Portions of the Lake Boudreaux and Isle de Jean Charles faults serve as the northern boundary of the Madison Bay subsidence hot-spot. All three major faults extend to the top of the 3d seismic volume, which is inferred to image latest Pleistocene stratigraphy. Well log correlation using 11+ shallow markers across these faults and kinematic techniques such as stratigraphic expansion indices indicate that all three faults were active in the middle (?) and late Pleistocene. Based on expansion indices, both the Montegut and Isle de Jean Charles faults were active simultaneously at various times, but with different slip rates. There are also time intervals when the Lake Boudreaux fault was slipping at a faster rate compared to the east-west striking faults. Smaller faults near the margins of the 3d volume appear to relate to nearby salt stocks, Bully Camp and Lake Barre. Our work to date suggests both salt and fault activity continued at least into the latest Pleistocene.

PRESENTER BIO: Akinbobola Akintomide is a Ph.D. candidate at Tulane University. He received an M.S. in Geosciences from the University of Tulsa and Bachelors of Technology in Applied Geology from the Federal University of Technology Akure, Nigeria.

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EARLY DESIGN OF THE CALCASIEU SALINITY CONTROL MEASURES PROJECT: CHALLENGES AND OPPORTUNITIES

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The Lake Calcasieu basin has undergone substantial land loss since 1932. The present-day Calcasieu Ship Channel (CSC) cross section is substantially larger than when the channel was first dredged for navigation over 100 years ago. This change has affected hydrology by: channeling saltwater inland into a historically low-salinity estuary; reducing freshwater residence time when the tide ebbs; and, increasing tidal amplitude through the broader waterway. The purpose of the CS-65 Calcasieu Ship Channel Salinity Control Measures project is to manage saltwater being introduced into adjacent waterbodies and wetlands through the CSC, thereby reducing the rate of loss of the interior wetlands.

In 2015, CPRA completed a Feasibility study evaluating four conceptual designs for managing saltwater introduction: a gate/lock system across the Lower CSC, paired pass through deep draft gates across the lower CSC, channelization of the CSC, and perimeter control. The Final Planning and Feasibility Decision Document recommended channelization as the preferred alternative for managing saltwater introduction.

In July 2016, CPRA began the preliminary design phase for the recommended channelization features. This phase consisted of two parallel efforts: preliminary design of the features as identified in the Feasibility report, and additional refinement of the individual features based on computational modeling. These efforts were conducted in parallel to expedite project implementation, and involved a pair of independent teams with coordination between each.

The refinement effort focused on evaluation of sets of features to identify whether all 14 salinity control features were necessary to achieve the project objectives and the effect of modifying feature components (e.g., sill widths). This effort identified the essential components of the project (the southern 5 salinity control barriers), as well as maximum sill widths for certain features. In addition, this effort examined the potential effects of the project on storm surge, post-storm drainage, and sedimentation in the ship channel. The design effort focused on hydraulic, geotechnical, and structural design of the individual features. The result of these efforts is a 15% Basis of Design document, which will serve as the foundation for future design and permitting efforts.

PRESENTER BIO: Mr. Allen is a Project Manager at CPRA. He has been with the agency for 9 years and has led the planning, design, and construction of a number of restoration and protection projects.

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NFWF PROJECTS AND PATH FORWARD: LOUISIANA

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In 2013, the US Department of Justice reached separate plea agreements with BP and Transocean to resolve the criminal cases resulting from the Deepwater Horizon explosion and spill. As part of the plea agreements, $2.544 billion was directed to the National Fish and Wildlife Foundation as a fiduciary for use on projects that would benefit Gulf of Mexico natural resources of a type impacted by the spill. Of the total amount, $1.272 billion was directed to be used in Louisiana for the restoration of barrier islands and the implementation of river diversions. Using monies from the plea agreements, NFWF established the Gulf Environmental Benefit Fund (GEBF) and is partnering with the Louisiana Coastal Protection and Restoration Authority to implement critical coastal restoration projects that advance the master Plan.

Utilizing GEBF funds, CPRA has designed 2 barrier island/headland projects, one of which has been constructed. Engineering and design is currently underway for 3 large-scale river diversions. In addition to these efforts, some GEBF funding has been utilized for adaptive management efforts aimed at implementing, operating and improving the performance of these and future barrier island and diversion projects. These along with potential future projects to be funded through the GEBF will be presented.

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THE LOWERMOST MISSISSIPPI RIVER MANAGEMENT PROGRAM (LMRMP): AN IMPROVED SUBSIDENCE UNDERSTANDING FOR THE LOWERMOST MISSISSIPPI RIVER CORRIDOR

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Improving our understanding of subsidence rates and mechanisms along the Mississippi River corridor south of New Orleans is critical for predicting the efficacy of restoration initiatives such as river diversions and marsh creations, and for anticipating the effect of relative sea level rise on the dredged channel. As part of the State of Louisiana's Lowermost Mississippi River Management Program funded by the RESTORE Act, several subsidence-related efforts are planned to begin in 2018. These will involve installation of a network of ground-based stations instrumented with RSETs and CORS GPS antennas that will be utilized to measure site-specific subsidence at several depth intervals, and will build onto a USACE-CPRA subsidence superstation already installed and operating since 2016 near Myrtle Grove in the proposed Mid-Barataria Sediment Diversion receiving area. These ground-based stations will also serve as reference points for an InSAR satellite effort to measure elevation changes through time along the river corridor using data from the ESA's Sentinel-1 satellite.

PRESENTER BIO: Mead Allison is a Professor in the Department of River-Coastal Science and Engineering at Tulane University and is the Director of Physical Processes and Sediment Systems at the Water Institute of the Gulf. He has 30 years of experience studying sediment dynamics in riverine, coastal and deltaic systems.

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RESUSPENSION CHARACTERISTICS AND CRITICAL SHEAR STRESS OF FINE GRAINED SEDIMENTS USED IN LOUISIANA COSTAL RESTORATION PROJECTS

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Louisiana Coastline is a disappearing at an alarming rate from 1932 to 2010 Louisiana has lost more than 18,000 square miles of land (CPRA 2017). Louisiana coastline is an indispensable asset not only to the approximately 2 million citizens of the coast but also to entire United Sates. The coastline harbors major ports that supply two thirds of the nations energy needs. Moreover, the state has three onshore-liquefied natural gas terminals; this is the most of any state in the nation (BWAB 2016). The wetlands loss creates major negative implications for human safety and economic health of coastline and the nation. The Costal Restoration and Protection Authority (CPRA) have a comprehensive master plan to restore and protect Louisiana's disappearing wetlands. The Master plan spending budget is heavily weighted on marsh creation projects, which are created using fine-grained sediment dredged from nearby rivers and channels to replenish the wetlands. This research aims to provide reliable experimental relations of resuspension rates, critical shear stresses τc, actual entertainment and net erosion for cohesive sediments used in Louisiana restoration projects and Louisiana's coastline in general. The principal method in this research was developed by (Tasi and Lick, 1986).

PRESENTER BIO: Laith is a Ph.D. Candidate and graduate researcher at the University of New Orleans in the Civil and Environmental Engineering Department. He has more than 5 years of experience researching cohesive sediment of Louisiana wetlands. His experience includes settling, resuspension, shear stresses, and hydrodynamics of Costal riverine deposits and their respective systems. He has also worked on the design of offshore Hydraulic Structures for costal purposes.

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BATHYMETRIC AND GEOPHYSICAL DATA COLLECTION WITHIN THE BARATARIA BASIN, LAKE PONTCHARTRAIN, LAKE BORGNE AND CHANDELEUR SOUND.

*Michael Lowiec[1], Syed Khalil[2], Ed Haywood[2], Rick Raynie[2], **Jeff Andrews**[1], and Beau Suthard[3]*

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In 2015 the Coastal Protection and Restoration Authority (CPRA) contracted APTIM to collect bathymetric and geophysical data within the Barataria Basin and a few select coastal lakes in southern Louisiana as part of the Barataria Pilot Study of SWAMP. Sub-bottom profiler, magnetometer and bathymetric data were collected within Barataria Bay, Little Lake, Lake Salvador, Lac des Allemands, Lake Cataouatche, The Pen, Bayou Perot, Bayou Rigolettes and other major hydrologic pathways. In addition to this data, sidescan sonar data were also collected in Little Lake and Barataria Bay.

During this second phase of SWAMP, bathymetric and geophysical data (bathymetry, sidescan sonar, seismic and magnetometer) were collected within Lake Borgne by APTIM. Within Lake Pontchartrain, Chef Menteur Pass, the Rigolettes, bathymetric data were collected by Oceaneering, Inc. T. Baker Smith completed collection of bathymetric data within the Mississippi River Gulf Outlet (MRGO) and is continuing to collect bathymetric data within the eastern portion of Chandeleur Sound. T. Baker Smith is also collecting sidescan sonar and bathymetric data within the western section of Chandeleur Sound. T. Baker Smith is expected to complete data collection in January 2018.

Linear poling was completed by APTIM during the geophysical data collection within the Tier 2 Oyster Seed Grounds in Lake Borgne. Poling is ongoing by T. Baker Smith within the Tier 2 Oyster Seed Grounds of the western section of Chandeleur Sound. Poling is being conducted concurrently with the geophysical data collection by T. Baker Smith. Oyster dredge sampling will be conducted by APTIM to provide a basic habitat characterization and identify the presence/absence of oyster reefs. Oyster sampling was conducted following sidescan sonar data collection in February and March of 2018. The goal of this investigation is to locate oysters and potential oyster habitat and compile a bathymetric map of these areas

PRESENTER BIO: Mr. Andrews is the Director of Marine Geoscience and MetOcean for APTIM, with more than 35 years of experience conducting hydrographic, geophysical and geotechnical investigations. He is a licensed Professional Surveyor and Mapper (PSM) and American Congress on Surveying and Mapping (ACSM) Certified Hydrographer (CH).

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RECENT GEOPHYSICAL SURVEYS IN HYDROLOGIC BASINS EAST AND WEST OF THE MISSISSIPPI RIVER

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In 2005, the Louisiana Coastal Area (LCA) Ecosystem Restoration Study Science and Technology Program proposed expanding CRMS to the System-Wide Assessment and Monitoring (SWAMP) program. The purpose of SWAMP is to ensure that a comprehensive network of coastal data collection activities is in place to support the development and implementation of the coastal protection and restoration program. Its goals include: an improved understanding of the effects of drivers on the system, early warning indication of changes in the system state, support for monitoring the effects of natural or anthropogenic disasters, reduced uncertainties regarding changing conditions, evaluating coastal protection and restoration program performance, data for numerical model validation and calibration, and support for planning, engineering and design and operations.

To fulfill some of these goals, in 2015 APTIM was contracted to collect hydrographic and geophysical data within Barataria Basin and within a few selected coastal lakes in southern Louisiana as part of the Barataria Pilot Study of SWAMP. A full suite of hydrographic and geophysical instrumentation were deployed including subbottom sonar, magnetometer, and single beam sounder. Data were collected within Barataria Bay, Little Lake, Lake Salvador, Lac des Allemands, Lake Cataouache, The Pen, Bayou Perot and Rigolettes, and other major hydrologic pathways. In addition to subbottom sonar, magnetometer, and single beam sounder, sidescan sonar data was collected in Little Lake and Barataria Bay. Over 1,600 line miles of data and 23 grab samples were collected during this Pilot Study.

In 2017, APTIM, Oceaneering and T.Baker Smith collected additional geophysical data (bathymetry, sidescan sonar, seismic and magnetometer) within Lake Pontchartrain, Chandeleur Sound and Lake Borgne. APTIM collected 699 nautical miles (nm) of geophysical data (bathymetry, sidescan sonar, seismic and magnetometer) within Lake Borgne. Poling of the water bottom was conducted in conjunction with the sidescan sonar survey. Oyster dredge tows will be conducted to groundtruth the poling and sidescan sonar data. During this second phase of SWAMP, T. Baker Smith collected 1280 nm of bathymetric and sidescan sonar data within the Mississippi River Gulf Outlet and Chandeleur Sound. T. Baker Smith also conducted poling of the water bottom within Tier 2 Oyster seed grounds in the western section of Chandeleur Sound. Oceaneering collected 740 nm of bathymetric data within Lake Pontchartrain, Chef Menteur Pass and the Rigolettes. APTIM oversaw the data collection efforts and used the data that was collected to evaluate the subsurface geological setting and to locate oysters and potential oyster habitat.

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THE LONG-TERM OUTLOOK OF THE MISSISSIPPI-ATCHAFALAYA BIFURCATION

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In a benchmark study conducted by the U.S. Army Corps of Engineers (USACE) Waterways Experiment Station in 1952, Harold N. Fisk, Ph.D. chronicled the geologic history of the Mississippi River and evolution of former diversions from initial formation to final capture. Throughout this progressive development, equilibrium between flow, gradient, and sediment load is maintained through river bed and cross-sectional adjustments to account for changing hydrodynamics. Using this knowledge of developmental patterns of past Mississippi River (MR) diversions and bank line surveys from 1914 to 1951, the future of the diversion at the Mississippi-Atchafalaya junction was predicted to reach full capture by 1980. These scientific realizations led to the authorization and construction of the Old River Control Structure (ORCS) Complex at the point of diversion in 1963 to artificially terminate the total capture of MR. Although this structure has limited flow from the Mississippi to the Atchafalaya to 30% of the total, the deltaic process has continued to advance in the Atchafalaya Basin and out to the Wax Lake and Atchafalaya Deltas.

More recently, Edmonds (2012) conducted a hydraulic and sediment transport modelling study on the Mississippi-Atchafalaya bifurcation using the Delft3D software suite developed by Deltares. The results account for complex hydrodynamic interactions from the MR/AR bifurcation to the Gulf of Mexico and estimate a total capture timescale of ~300 years without the ORCS present. To further compare this predictive effort with that of Fisk, in this current research we build on the Delft3D model to conceptually resurrect the hydrographic and geomorphic evolution of the MR/AR bifurcation suspended by the ORCS. We then used the results to revisit the cogency of Fisk's capture hypothesis and timescale, both temporally and spatially.

The comparison puts the predictions made in this study and those by Fisk and Edmonds within 17 years of each other to reach the final stage of flow capture (>50%) where the AR would become the predominant lower arm of the MR. This is good agreement between the Fisk and Edmonds predictive efforts performed over 60 years apart, one using rudimentary hydraulic trends and a geologic timeline assembled using thousands of boring logs, and the other through state-of-the-art computer modeling using the most recent data and observations. Taken one step further in this study by using an unsteady-state hydrograph, we used the Delft3D model to produce a non-linear flow evolution of the AR that virtually completes the capture lifecycle first described by Fisk. The results depict how the AR would grow into the newest lower river course without the ORCS in place by consuming up to 85% of the flow over a 150-year period. In addition to reiterating the ORCS's importance to flood control and navigation, this work intends to explore how the structure could be used for ecosystem restoration purposes by enhancing the delta-building processes already at work.

<u>PRESENTER BIO</u>: Mr. Andrus is a principal engineer with more than 20 years of civil and coastal engineering experience. He is well-versed in scientific research, field investigations, project design and management, and feasibility studies for complex coastal projects. He is also currently pursing a doctorate at LSU in Geology and Geophysics.

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PREPARE TO PREVENT – REDUCING FLOOD LOSSES WITH THE NATIONAL FLOOD INSURANCE PROGRAM AND THE COMMUNITY RATING SYSTEM

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Coastal Louisiana is incredibly vulnerable to flooding. In the aftermath of flood events, parishes have been left with millions of dollars in property damage, as well as lost economic opportunities. One way to reduce these physical and financial damages is to better prepare communities for flood risks before flooding occurs – a principle of hazard mitigation. Many coastal communities have extensive hazard preparedness programs and physical infrastructure to reduce their risks from flooding and storm damages. One such preparedness program is the National Flood Insurance Program's (NFIP) Community Rating System (CRS), which encourages communities to reduce flood risk through 19 hazard-mitigating and risk-reducing activities. Eligible activities include actions to increase public education, improve mapping and regulations, reduce flood damages, and improve warning and response systems. Participating communities receive points for each completed activity, and a score from 1-10 is assigned to each community. Scores of 9 or lower receive discounts on their NFIP premiums, ranging from 5% to 45% discounts. Only 5% of NFIP communities participate in the CRS, and many still have high scores and low discounts.

In 2015, I co-authored a paper that focused on CRS-participating communities in Louisiana. My dissertation research, which my talk will draw from heavily, focuses on coastal communities from Texas to Florida to determine which factors influence how likely a community is to have a lower CRS score and be better protected from flooding and generally more hazard-resistant. Contributing factors that affect CRS scores, and subsequently their level or risk) include a community's socioeconomic makeup, level of education, exposure to storms, population, and number of years in the CRS program.

Of the US 52 counties bordering the Gulf of Mexico, nearly half of them are not participating in the NFIP. While participation is not a requirement, the CRS provides financial benefits to homeowners and it has the potential to provide many financial and environmental benefits to larger scale communities. My dissertation research is looking into why more of these counties are not participating in the CRS, and what factors influence the scores of participating communities. A better understanding these scores will yield a better understanding of what drives adaptive planning and mitigation activities for flooding and other hazards, subsequently helping policymakers target and improve poorly performing communities.

PRESENTER BIO: Jennifer Argote is a fourth year PhD student (ABD) at LSU's College of the Coast and Environment. Her undergraduate research at Dartmouth College and her graduate work at LSU has focused on environmental policy, with a focus on issues facing Louisiana's coastal zones and the people who live in them.

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THE DEVELOPMENT OF A HYDRODYNAMIC/WATER QUALITY MODEL FOR OYSTER RESTORATION IN THE WESTERN MISSISSIPPI SOUND

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This study presents the development of a hydrodynamic and water quality model for the western Mississippi sound. The model was developed using the Visual EFDC program, which is an "advanced, 3D, time variable model" that links hydrodynamics with sediment transport and water quality modules. A computational grid has been generated consisting of 4 layers, each having 3000 cells. The cell size range is 1000m ≤ DiameterCell ≤ 3000m. The input data for the hydrodynamic model are water level, water temperature, salinity, and other meteorological data such as precipitation, and were mostly collected from the measurement stations of NOAA (National Oceanic and Atmospheric Administration) and USGS (United States Geological Survey). The hydrodynamic model was calibrated for the time period of Jan 1 to Dec 31, 2016. A sensitivity analysis is being performed in the light of which the parameters that most impact oysters in the western Mississippi sound will be identified. The model will be useful in identifying appropriate locations for oyster restoration in the western Mississippi Sound.

PRESENTER BIO: Dr. Armandei has expertise in offshore and coastal hydrodynamics. Currently, he is a postdoctoral associate in Mississippi State University, working on the hydrodynamic and water quality modeling of western Mississippi sound.

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IMPACT OF INVASIVE APPLE SNAILS *POMACEA MACULATA* ON BIOGEOCHEMICAL CYCLING OF METALS IN LOUISIANA WETLANDS

Sanjana Banerjee *and Paul L. Klerks*
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The apple snail *Pomacea maculata* is an invasive species that has recently been introduced and is now present in several Louisiana marsh areas. The introduction and range expansion of this species are bound to have a variety of ecological consequences. One of these consequences is a change in the biogeochemical cycling of metals. Such a change could result from the increased importance of marsh vegetation herbivory and resulting increase in fecal matter deposition on the sediment surface. In addition, the snails' filter feeding could result in uptake of dissolved metals from the water column with this becoming incorporated into the biota. Consequently, we expect that the introduction of apple snails could result in a change in the partitioning of a metal (like copper) between the various environmental compartments- animals, plants, sediment and water.

Two approaches are being used to determine whether the presence of apple snails affects the environmental distribution of copper. In the field, we are comparing metal levels in snail tissues, plants, sediment and water at multiple sites in Terrebonne and Lafourche parishes in Louisiana. These sites differ in physicochemical parameters (including water and sediment chemistry) and biological characteristics (including vegetation and snail density). The other approach uses laboratory mesocosms set up with sediment, water and aquatic vegetation collected from one of our field sites and spiked with copper. Metal levels will then be determined at the end of a 1-month exposure period, and the environmental distribution compared between mesocosms with and without apple snails. The research is ongoing; results will be presented at the meeting.

PRESENTER BIO: Sanjana Banerjee is a PhD student working in Environmental Toxicology under the guidance of Dr. Paul Klerks. Originally from India, she graduated with B.S. and M.S. degrees in Zoology. She is interested in the ecotoxicological consequences of the introduction of the invasive snail *Pomacea maculata* and their use as biomonitors.

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SOIL BINDING ABILITY OF *SPARTINA ALTERNIFLORA,* SMOOTH CORD GRASS, ESTABLISHED ON DREDGED SOILS IN LOUISIANA COASTAL AREA

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Several researches indicate that vegetation protect the coast from erosion by providing soil reinforcement, wave buffering, sediment trapping and overall hydrologic regime control. However the complex nature of coastal erosion process makes it hard to quantify the erosion resistance provided by vegetation. This research is focused on the study of soil binding ability provided by smooth cord grass, *Spartina alterniflora*, flourishing in dredged soil of Sabine Refuge Marsh Creation Project. Field vane shear test was conducted to obtain the in-situ un-drained shear strength of soil vegetated by *Spartina alterniflora*. Direct shear tests on the rooted soil samples collected from the site were performed to investigate the overall effects of roots on the shear strength of the soil. Tensile strength of roots was calculated using laboratory tensile test machine.

Two different root reinforcement models were used to study the correlation between the root-induced cohesion, Cr, and the root tensile strength. The first model, Wu et al. model, assumes that the tensile strength of all the roots crossing the shear plane is fully mobilized and all the roots break at the same time. The second model, Fiber Bundle Model, assumes that since roots have different strength values, they break at different points as a load is applied to the soil. Results from the vane shear test and the direct shear test reflected that the roots of *Spartina alterniflora* significantly increases the shear strength of soil. The increased shear strength for a location varied depending upon the root area ratio (RAR), depth of the soil sample and tensile strength of roots. Analysis using both the root reinforcement models shows overestimation of root induced cohesion. Finite element method analysis using commercial software ANSYS was used to study the soil binding ability of *Spartina Alterniflora* under wave forcing.

<u>PRESENTER BIO</u>: Mr. Baral is a graduate research assistant at programs of Civil Engineering and Construction Engineering Technology, Louisiana Tech University. His research is focused on soil stabilization of newly dredged lands in Louisiana coast using the native vegetation.

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FINANCING LOUISIANA'S COASTAL MASTER PLAN: FORECASTING GOMESA REVENUES

Stephen Barnes*, Dek Terrell, and Joseph Mason*

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For the last decade, supporters of Louisiana's coastal master plan have anticipated a wave of new revenue from the Gulf of Mexico Energy Security Act (GOMESA) to fund a major portion of the state's coastal protection and restoration work. However, those revenues have come in considerably below expectations in the first year of full funding raising serious questions about the future of this revenue stream as a driver of the state's coastal program. In our study, we review the changing economics of oil and gas exploration and production, which underpin the determination of GOMESA revenues. We also provide a detailed review of the allocation formulae for revenue sharing. We develop a forecast for oil and gas lease sales and production and develop a forecast for GOMESA revenues. Finally, we explore how changes in future oil and gas prices would impact future GOMESA revenues.

PRESENTER BIO: Stephen Barnes is Director of the LSU Economics & Policy Research Group and an associate professor in the Department of Economics at LSU. Dr. Barnes has been PI or Co-PI on over $8 million in grants including projects on economic forecasting, economic development, and the economic consequences of environmental changes.

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RISK-INFORMED FLOOD RESILIENCE PLANNING IN VIRGINIA BEACH, VIRGINIA

Brian K. Batten[1], *Ph.D., CFM, Rahul Parab*[2], *P.E., D.WRE, CFM, and John Squerciati*[3], *P.E., CFM*

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Coastal states and cities are facing tough challenges from increased flood frequency and impacts due to a combination of increasing sea levels, changing rainfall, and aging infrastructure. The response to these issues can be approached in many ways, but to be effective a holistic long-term plan must be developed. Successful resilience planning is a product of a nexus of multiple disciplines that encompass the problem and a solid understanding of how risk may evolve in the future and where to allocate resources to achieve the maximum benefit. Our presentation focuses on a case-study example overview of a comprehensive, bottom-up risk-informed flood resilience effort by the City of Virginia Beach, VA.

As a thriving coastal city, Virginia Beach is fully committed to taking the needed actions to identify and implement measures that enable flood resilience and reduce long-term exposure. The city is situated in the Hampton Roads region on the eastern Atlantic U.S. seaboard, which is subject to the highest rate of historical sea level rise on the east coast – in large part due to land subsidence.

In response to increasing flood impacts, Virginia Beach has undertaken a phased planning study effort to assess flood risk, assemble risk-informed strategies, and then layout a sequenced roadmap of activities to address existing and future flood risk. The study measured the vulnerability and building-level economic flood risk of assets for existing conditions and two future condition scenarios.

The impact assessment evaluated a range of conditions including tidal, nuisance and storm surge driven coastal floods including combined probable stormwater runoff were evaluated. Results were consolidated to a range of geographic units to align outputs to best inform various planning and engineering, and capital improvement activities. Additional water resources engineering analyses were conducted to inform infrastructure design, such as the joint probability of tidal elevations and rainfall, rainfall non-stationarity and future projections. Marsh loss and natural features were also evaluated in the context of changes in flood hazard and flood resilience strategies.

Resilience strategies, including policy and engineering options are being formulated from the wealth of information generated from the impact assessment. Strategies were framed for citywide or watershed-specific application. A "decision-framework", using feasibility and benefit-cost metrics was employed to objectively evaluate and prioritize strategies. Our presentation will provide an overview of the study effort, with highlights on lessons-learned for integrated resilience planning. Additionally, we will provide context on associated outreach activities and, how study outputs were received by the community and the region.

PRESENTER BIO: Dr. Batten is a senior coastal scientist and project manager with over 20-years of experience on coastal hazards and resilience. He has helped diverse clients at the federal, state and municipal level tackle the issue of risk-recognition and planning for flooding and sea level rise.

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THE ESSENTIAL ROLE OF BENTHOS IN COASTAL LOUISIANA HABITATS AND THEIR IMPLICATIONS FOR COASTAL RESTORATION

Melissa M. Baustian, *Tim J.B. Carruthers, Leland C. Moss, and Andrea S. Jerabek*
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Benthic organisms, such as microphytobenthos and macrofauna, are ecologically important as producers and consumers that support productive food webs and influence biogeochemical cycles in coastal habitats. Coastal Louisiana has extensive shallow water habitat made up of subtidal sediments, mud flats, wetland soils, and barrier island beaches. The ecological role of these benthos in supporting these ecological functions has not been well quantified in coastal Louisiana habitats. For example, commercially important juvenile penaeid shrimp are thought to feed on a variety of shallow-burrowing benthic macroinfauna with evidence suggesting that their growth rate is related to the biomass of these prey organisms. Microphytobenthos, in addition, are being recognized as essential basal carbon sources across these habitats that support the infauna.

Opportunities to restore coastal habitats in the Gulf of Mexico (GOM) are increasing, particularly through the construction of wetlands using dredged material, but recovering the ecological structure and function in these restored habitats is not a certainty. Therefore, quantifying the benthos and their habitats to better understand food web dynamics and carbon flow is essential for the better management of coastal habitats in GOM. Ecosystem and food web models are often utilized to run restoration scenarios to make project decisions but often depend on limited information about the benthic production and the characteristics of the substrate. Advancing the scientific understanding of the benthic ecology of these habitats will help to assess their role in supporting food webs and influencing biogeochemical cycles in coastal Louisiana habitats as well as serving as important references to evaluate the functional equivalency of restored habitats.

PRESENTER BIO: Dr. Baustian is a coastal ecologist with over 10 years of experience in researching the ecological responses of aquatic ecosystems to nutrient enrichment, eutrophication, and hypoxia. She is also the Deputy Director for the RESTORE Act Center of Excellence for Louisiana where she administers a competitive coastal research grants program.

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SHOREFACE SEDIMENT BUDGET INFLUENCE ON BARRIER ISLAND EVOLUTION, LOUISIANA, USA

***Benjamin Beasley**[1], Ioannis Y. Georgiou[1], and Michael Miner[2]*

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In Louisiana, barrier islands are undergoing rapid morphological change due to shoreface retreat, increasing bay tidal prism driven by high rates of relative sea-level rise (RSLR; 1 cm/yr) and interior wetland loss. Previous works utilized historical region-scale bathymetry change and shoreline change analyses to assess large-scale coastal evolution. However, more localized assessments considering the role of sediment transport processes in regional evolution are lacking. This is essential to predicting coastal change trajectories and allocating limited sand resources for nourishment. Using historic bathymetric and shoreline data dating to the 1890s for the Louisiana coast, 100-m spaced shore-normal transects were created to track meter-scale elevation change for 1890, 1930, 1980, 2006, and 2015. An automated framework was used to quantify and track barrier island evolution parameters such as shoreline change, area, width, bathymetric contour migration, and shoreface slope.

During the 125 yr analysis period, shoreline erosion mean rates slowed from 12 to 6 m/yr while lower shoreface migration mean rates increased from 7 m/yr in 1890 to 20 m/yr in 2006 and decreased to 4 m/yr in 2015. Locally, retreat rates for the Caminada Headland upper shoreface slowed from 14 to 6 m/yr while lower shoreface retreat rates increased from 14 to 20m/yr in 2006 and slowed to 7 m/yr in 2015. The lower shoreface of the Isles Dernieres transitioned from progradational to erosional and back to progradational (-5 m/yr in 1890 to 20 m/yr in 2006 to -15 m/yr in 2015).

Our analysis suggests that although shoreline erosion rates decreased, overall landward migration of the barrier system increased as the shoreface steepened during the stormy 2006 period followed by a period of relative quiescence in most recent period. This illustrates that the shoreface is more sensitive to storm impacts than is evident by the shoreline response and that these fluctuations play a key role in determining sediment budget trajectories. The return of the lower shoreface to progradational in some locations shows zones of post storm recovery possibly indicating areas where restoration would be more resilient.

Our results illustrate that monitoring subaerial island erosion rates are insufficient for evaluating regional dynamics of transgressive coastal systems. The longevity of barriers appears diminished due to a reduction in the shoreface sediment available and further corroborates the role of the shoreface on barrier island evolution. Advances in understanding these processes will facilitate more informed planning, management, and mitigation of transgressive barrier islands.

<u>PRESENTER BIO</u>: Ben Beasley is a graduate student at the University of New Orleans and a participant in the Coastal Science Assistantship Program (CSAP) administered by the Louisiana Sea Grant and supported by the Louisiana Coastal Protection and Restoration Authority (CPRA). He hopes to contribute to the understanding of the geomorphic processes along the Louisiana coast to help inform restoration efforts.

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WHAT SEDIMENT AND FLOW PROPERTIES CONTROL MUD DISPERSAL AND RETENTION IN COASTAL BAYS AND DIVERSION-RECEIVING BASINS?

Samuel J. Bentley, Sr, *Kehui Xu, Giancarlo Restreppo and Jiaze Wang*
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The sediment load of most large rivers is comprised predominantly of mud-sized sediment particles, with a smaller portion of the sediment load consisting of sand. For the Mississippi River, this split is approximately 90% mud, and 10% sand. Two primary controls on equilibrium area of a delta that can be sustained by a river include the total sediment load, and the fraction of the load that is retained to build land. For this reason, understanding the dispersal and deposition of muddy sediments in a river delta is critical to any large-scale conservation efforts for deltaic lands, including the Mississippi River Delta. It has been long understood that sand carried by a river tends to be deposited near the coastal river mouth, forming proximal bars that can be reworked into other deposits such as beaches. The dispersal and deposition of mud (the majority of total sediment load), and hence the retention of mud to build land, are much less well understood in such deltaic systems.

For the last seven years, our research group has studied the sediment and flow properties in coastal bays of the Mississippi River Delta, to better understand fundamental sediment dispersal and deposition processes, and how these processes can be steered to enhance land building. Through this work we have identified several important controls on how muddy sediment moves through the bays, and may be captured to build wetlands.

First, the ability of deposited muddy sediments to resist subsequent erosion by wave-current energy is regulated by the amount of time that the deposits have had to consolidate, compared to the hydrodynamic energy available for resuspension. In general, sediments that are allowed to deposit, consolidate, and strengthen over timescales of a month or longer can better resist resuspension by local waves in shallow water. In such cases, small changes in local wave energy can either promote erosion (higher energy) or allow deposition (lower energy). This sensitive balance determines whether mud can infill a bay, or bypass the bay. As a result, sediment retention can likely be enhanced by reducing wave fetch, and hence wave energy and resuspension potential of muddy sediments on bay floors.

Second, the direction and timing of waves and currents driven by winds is also important. For example, energetic onshore flows can both resuspend sediment, and elevate water levels so that adjacent marshes are flooded with mud-laden waters. Deposition of these muddy suspensions then promotes vertical accretion of these wetlands, contributing to wetland growth. Sediment supply to wetlands is highest when these onshore flows occur during periods of high sediment discharge, trapping even more muddy sediment in wetlands. This mechanism of enhanced wetland sediment supply extends out at least 20 km from river mouths into adjacent wetlands, suggesting that the radius of enhanced sediment supply to wetlands from diversions may be a comparably great distance.

PRESENTER BIO: Dr. Bentley is a professor in the LSU Department of Geology and Geophysics, he holds the Harrison Chair in Sedimentary Geology, and is Associate Dean for the LSU College of Science. He studies muddy coastal/deltaic sediment dynamics, with a focus on the Mississippi River Delta since 1998.

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COMMUNITY RESILIENCE AND ECOSYSTEM SERVICES: FROM EVIDENCE TO APPLICATION

***Brittany M. Bernik*[1]*, Jessica Henkel*[1]*, Jean Cowen*[3] *and Josh Mullenite*[1]*

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The concepts *ecosystem services* and *community resilience* attempt to evaluate aspects of how humans are affected by their environment. They therefore represent intersections between natural and social sciences, yet often experience barriers to cross- or inter-disciplinary collaboration. Traditional differences in respective research focus and limited information exchange between the natural and social sciences has slowed the process of addressing many key issues relevant to both fields, which in turn may hinder how information is incorporated in decision-making and management settings. For example, *ecosystem services* and *community resilience* assessments are in high demand for decision-support frameworks, but making quantitative measures that can be incorporated into these frameworks remains a challenge. In the natural sciences, numerous indices and metrics have been proposed and applied without movement toward a particular consensus. By contrast, research in the social sciences has emphasized the inherently subjective nature of quantitative measurements (i.e., valuations), and has favored the development of qualitative alternatives. These approaches have been useful for identifying power dynamics implicit in various decision-support frameworks, helping to protect diverse or vulnerable populations. By revealing the assumptions that underlie quantitative 'science-based' valuations, findings in the social sciences may help provide a lens for better documenting *ecosystem services* and *community resilience*.

Based on a review of ongoing coastal restoration and protection programs across the Gulf of Mexico, this talk presents a comprehensive summary of how *ecosystem services* and *community resilience* concepts are handled in practice. Conducting and comparing similar reviews on the state of research across natural and social science literature revealed gaps between theory and application. These finding highlight remaining management challenges and opportunities for future improvement.

PRESENTER BIO: Dr. Bernik is an evolutionary ecologist specializing in coastal restoration. As a RESTORE Science Policy Fellow she collaborates on science program management in support of Gulf coast ecosystem restoration. She previously worked to develop interdisciplinary science policy funding strategies as a Fellow of the National Academies of Sciences.

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ENHANCING LOCAL HAZARD MITIGATION PLANNING WITH TRADITIONAL ECOLOGICAL KNOWLEDGE IN A PARTICIPATORY MAPPING APPROACH

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Coastal community leaders, government officials, and natural resource managers must be able to accurately assess and predict a given coastal landscape's sustainability and/or vulnerability as coastal habitat continues to undergo rapid and dramatic changes associated with natural and anthropogenic activities, such as accelerated relative sea level rise (SLR). To help address this information need, a multidisciplinary project team partnered with the Pointe-au-Chien Indian Tribe on Sea Grant sponsored research in Louisiana to determine a method for producing localized vulnerability and sustainability maps for projected SLR and storm surge impacts, and determine how and whether the results of such an approach can provide more useful information to enhance hazard mitigation planning.

The goals of the project are to develop and refine SLR visualization tools for local implementation in areas experiencing subsidence and erosion, and discover the different ways stakeholder groups evaluate risk and plan mitigation strategies associated with projected SLR and storm surge. Results from physical information derived from data and modeling of subsidence, erosion, engineered restoration and coastal protection features, historical land loss, and future land projections under SLR are integrated with complimentary traditional ecological knowledge (TEK) offered by the collaborating local ecosystem users for these assessments. The data analysis involves interviewing stakeholders, coding the interviews for themes, and then converting the themes into vulnerability and sustainability factors. Each factor is weighted according to emphasis by the TEK experts and number of experts who mention it to determine which factors are the highest priority. The priority factors are then mapped with emphasis on the perception of contributing to local community vulnerability or sustainability to SLR and storm surge. The maps are used by the collaborators to benefit local hazard mitigation and adaptation planning.

The results to date in achieving the project objectives will be presented, including analyses of TEK data collected, and mapping products developed. This project will be provided as one example that reflects the overall concept of integrating TEK into scientific-based environmental management decision-making processes. Within this context, the presenter will share how collaborative research that employs participatory mapping techniques can help in identifying local priorities and gaining support for restoration and protection projects from local experts and their communities.

PRESENTER BIO: Dr. Bethel is the Associate Executive Director of Research for Louisiana Sea Grant. He has 20 years of experience in the application of geospatial technology, which includes remote sensing and geographic information systems, in multi-disciplinary research that addresses data and information needs for combined social and ecological decision support systems.

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MECHANISTICALLY DEFINING FLOOD ZONES ACROSS SOUTHEASTERN LOUISIANA

Matthew V. Bilskie, *Scott C. Hagen, Shu Gao*
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Flooding across coastal communities can be caused by high astronomic tides, coastal storm surge, and intense rainfall. These events can act individually or in tandem, as most recently observed by the 2016 Louisiana flood, Hurricanes Harvey, Nate, and Maria. Coastal surges can interact with inland water levels and rainfall runoff (and vice versa), which can create a complex hydrodynamic interaction across the coastal landscape. In order to effectively quantify and assess flood vulnerability across low-lying coastal regions, it is beneficial to delineate flood zones, or regions that are susceptible to coastal or hydrologic flooding and areas where they can collectively interact. Regions where they interact can be defined as a flood zone transition, but defining such a transition is a challenge. We utilize a numerical model to simulate various scenarios of coastal inundation and rainfall excess flooding to delineate a flood transition zone for southeastern Louisiana. First, we show that the collective interaction of combined coastal flood and rainfall excess events are non-linear with peak inundation depths less than the linear superposition of their individual components. Second, we show an initial definition of three distinct flooding zones for the Amite River basin: *Coastal*, *Hydrologic*, and a *Transition Zone*. This analysis provides a means to define flooding zones across low-lying coastal landscapes to better understanding driving mechanisms of flooding in order to support enhanced flood vulnerability and risk assessments.

PRESENTER BIO: Dr. Bilskie is a research scientist at the Center for Coastal Resiliency at Louisiana State University. He has experience in physics-based, high-resolution, modeling of astronomic tides and hurricane storm surge across the Gulf of Mexico and US east coast.

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IMPLEMENTING RESILIENCE AT FOUR SCALES: OPPORTUNITIES AND CHALLENGES IN COASTAL LOUISIANA

*Jeffrey Carney[1], **Traci Birch**[2], Andrea Galinski[3], Jennifer Gerbasi[4], and Colleen McHugh[5]*

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[5]Mayor's Office of Resilience and Sustainability, City of New Orleans, New Orleans, LA, USA

The purpose of this session is to encourage dialogue around the planning and implementation of resilience strategies in the Louisiana coastal zone. Community resilience has become a ubiquitous term in coastal planning and management related to enhancing capacity to cope with environmental change and disturbance. The concept was adapted by Holling (1973) as a descriptive ecological concept characterizing the capacity of natural systems to absorb disturbance and persist without qualitative structural change. Since then, resilience has come to encompass ecological, socio-political, and economic systems. While reconceptualization broadens the potential for resilience science and policy, some argue clarity and practical relevance have suffered, making implementation challenging. Communities face a number of difficult economic, social, and environmental changes requiring attention. There is a growing need for effective ways to support adaptation-related decision-making due to slow-onset and rapid environmental change. Typically, local decision-making such as infrastructure construction and the types of zoning and development regulations implemented assume environmental stability. Yet there is increasing awareness of uncertainty and vulnerability associated with environmental change. This panel discussion engages people and organizations working to build flexibility, adaptability, and durability into local decision-making to improve resilience at four different scales - site, neighborhood, community, and region. The participants will discuss 1) how their organization or community defines "community resilience," 2) associated scalar implementation mechanisms, 3) key challenges and opportunities they have faced, and 4) how others may apply these lessons.

PRESENTER BIOS:

Mr. Carney (moderator) is an Associate Professor of Architecture and the Director of the LSU Coastal Sustainability Studio, who works on resilience adaptation planning and architectural design.

Dr. Birch is an Assistant Professor of Research at the LSU Coastal Sustainability Studio, whose work focuses on resilience and equity in coastal planning and management.

Ms. Galinski is a Coastal Resources Scientist in the Planning and Research Division of the CPRA, focused on resilience planning and to providing assistance to communities in delivery of the Louisiana Coastal Master Plan.

Ms. Gerbasi is the Division Manager and Recovery Planner for the Terrebonne Parish Consolidated Government.

Ms. McHugh is the Resilience Design Manager with the New Orleans Mayor's Office of Resilience and Sustainability working to implement the *Resilient New Orleans* plan and associated strategies.

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THE CYBORG GARDEN

Michael Biros
Waggonner & Ball Architects, New Orleans, LA, USA

To date, the discourse around coastal land loss has been led by the scientific, engineering, law and policy disciplines. As the effects of coastal land loss increasingly impact communities, design disciplines will play an important role in helping communities cope with challenges. As recent theoretical advances have opened up the field of urban ecology, adaptation and resilience have emerged as key components of socio-ecological design. By engaging open-ended processes instead of deterministic master-planning and placing an emphasis on the landscape conditions, recent planning efforts such as LA SAFE and the Isle de Jean Charles resettlement project have shown how design can enrich the conversation by expanding our perspectives, reframing problems as opportunities, and reestablishing our communities' connections to the landscape.

Not too long ago, the coastal landscape was a continuous surface. There was a rich gradient of ecological conditions that responded to dynamic hydrogeomorphological processes. This surface has become interrupted by lines of infrastructure intended to impose binary conditions of water/land where once were degrees of wetness. Settlement divorced from ecological conditions resulted in ongoing unintended consequences such as subsidence and saltwater intrusion as well as maladaptive settlement patterns and practices like slab-on-grade foundations and new development in the floodplain.

While restoration of the surface to pre-disturbance conditions is often impossible, there are many opportunities to design new ecosystems and communities that reestablish socio-ecological connections to the landscape and help communities relearn how to live with water. New levees that may catalyze maladaptive development in subsidence prone soils present the opportunity to implement policies that proactively encourage forms of land-use and water management that limit future subsidence and flood risk. Canal right-of-ways can act as networks of linear parks linking neighborhoods to civic features such as parks, libraries and schools. Undeveloped subsided land can be designed to mimic the hydrological conditions of a bottomland swamp forest. A pump could be decommissioned and the polder flooded to become a new harbor/community for commercial fishermen.

The coastal landscape is a socio-ecological system. It's a walled-off urban hydrological machine nested in ecological tissue: a cyborg garden. And like any garden, it needs to be tended.

PRESENTER BIO: Mr. Biros is a landscape designer with more than 5 years experience working on projects in coastal Louisiana. He holds a Masters of Landscape Architecture from the University of Pennsylvania.

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ECOSYSTEM MODELING WITH A FOCUS ON HUMAN WELLBEING OUTCOMES: A CASE STUDY OF THE MID-BARATARIA DIVERSION PROJECT

*Matthew McPherson[1], and **Suzana D. Blake**[2]*

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Based on the vision and analytical framework of NOAA's Integrated Ecosystem Assessment Program, our work brings together a diverse team of researchers to create a toolbox for understanding the Barataria region in south Louisiana as a complex socio-ecological system responding to changes expected from proposed sediment diversion works.

Much of the modeling work done so far does not detail the implications that geo-hydrological projects have on ecosystem services and the communities directly benefiting from them. In an effort to surpass the difficulty of connecting bio-physical and social data we use a fuzzy logic expert-based modeling approach to describe the components of the system as well as the links, relations and feedback loops that shape it. Our approach further elucidates on the step-by-step processes that are required in order to accomplish the human wellbeing goals that the Coastal Protection and Restoration Agency aims to achieve through the implementation of this project.

PRESENTER BIO: Dr. Blake is a Research Associate with the University of Miami's Cooperative Institute for Maritime and Atmospheric Studies (CIMAS). In January 2017 she began her collaborative work with NOAA's Integrated Ecosystem Assessment Program (IEA). Her expertise is in Environmental Anthropology, particularly the role of experts in shaping decision-making.

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A SUSTAINABLE APPROACH TO COASTAL RESILIENCE

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We live in an ever-changing world, and climate change is always occurring and affects the environment where we live. Your environment may be wetter, drier, colder, warmer and/or stormier. The environment that we will discuss in this presentation is the coastal environment. Studies of world population all show that about 40% of the world population lives within 60 miles of the coast. In the US, NOAA reports that about 52% of the population live in coastal counties. Therefore, what happens in the coastal environment affects a significant portion of the world's population.

Due to sea level rise and subsidence in some areas, sunny day coastal flooding is occurring more frequently. In addition, the 2014 National Climate Assessment indicates that tropical storms, hurricanes, and Nor'easters appear to have increased magnitude and intensity (e.g., Hurricanes Katrina and Harvey, Super-storm Sandy, and the "Bomb Cyclone" January 2018) with significant effects and storm damages to the affected areas through increased storm surges.

These additional storm surge elevations are also being influenced by rising sea levels. Geology has shown that the sea level has been changing since the beginning of the earth. Geologic researchers, such as Michelle Kominz at Western Michigan University, work on rock records have shown that sea level has been greater than 100 meters higher and 100 meters lower that it is today. Current sea level predictions based on the year 2075 range from 0.5 feet to 4 feet, with most of the coastal community expected to experience a low range of sea level rise of 1.2 feet and a medium range of 2.4 feet. Whatever case, these water levels will magnify the effects of storm surge and waves by allowing bigger waves to get closer to the public and critical infrastructure.

Coastal storm surge flooding and resiliency studies are ongoing around the country and the world. We will present some resilient and sustainable coastal protection measures that are being utilized today and case study examples.

PRESENTER BIO: Stanley J. Boc Jr., PG, Dist. D. CE**:** Stan Boc, a professional geoscientist/geologist licensed in the States of Louisiana and Illinois, with nearly four decades of experience in fields of coastal engineering, oceanography, meteorology and geology. Stan is a technical expert in coastal restoration, shore protection and navigation.

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COASTAL WETLAND MIGRATION WITH SEA-LEVEL RISE: QUANTIFYING THE POTENTIAL FOR LANDWARD MOVEMENT AND COASTAL SQUEEZE IN NORTHERN GULF OF MEXICO ESTUARIES

***Sinéad M. Borchert*[1]*, Michael J. Osland*[2]*, Nicholas M. Enwright*[2] *and Kereen T. Griffith*[3]

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Coastal wetlands benefit human health and well-being through services such as shoreline protection, carbon sequestration, flood mitigation, seafood, recreational opportunities, and fish and wildlife habitat. In the coming century, accelerated sea-level rise will serve as a major stressor on the distribution and extent of coastal wetlands. Upslope, landward migration is one mechanism that allows coastal wetlands to adapt to rising sea levels. However, due to differences in topography and coastal urbanization, estuaries vary in their ability to accommodate migration. Low-lying urban areas can prevent migration, resulting in wetland loss where existing wetlands cannot keep pace with rising seas via vertical adjustments (i.e., coastal squeeze). Migration corridors are particularly important in highly urbanized estuaries where, due to low-lying coastal development, wetlands lack the space to move inland to adapt to sea-level rise. For future management of coastal resources, it is imperative to identify landward migration corridors and better quantify the potential for landward migration and coastal squeeze. For 39 estuaries along the wetland-rich northern Gulf of Mexico coast (i.e., the U.S. portion of the Gulf of Mexico coast), we quantified and compared the area available for landward migration of tidal saline wetlands and the area where urban development may prevent predicted migration, under three sea-level rise scenarios (0.5-, 1.0-, and 1.5-m by 2100).

In this region, the potential for wetland migration is highest within certain low-slope estuaries in Louisiana (e.g., Atchafalaya/Vermilion Bays, Mermentau River, and Barataria Bay) and southern Florida (e.g., the North and South Ten Thousand Islands estuaries). The potential for coastal squeeze is highest in estuaries containing major metropolitan areas that extend into low-lying lands. The Charlotte Harbor, Tampa Bay, and Crystal-Pithlachascotee estuaries (Florida) have the highest amount of urban land that is expected to constrain wetland migration. Urban barriers to migration are also high in the Galveston Bay (Texas) and Atchafalaya/Vermilion Bays (Louisiana) estuaries. As the rate of sea-level rise accelerates in response to climate change, coastal wetland ecosystem goods and services could be lost in areas that lack space for landward migration. The results from this study can assist conservation planners with developing future-focused landscape conservation plans that incorporate the protection of wetland migration corridors. This type of planning is critical to increase the adaptive capacity of these valuable ecosystems and simultaneously decrease the vulnerability of coastal human communities to the harmful effects of rising seas.

PRESENTER BIO: Sinéad Borchert is a Community Outreach Specialist with the Coastal Wetlands Planning, Protection, and Restoration Act and has over 11 years of experience in ecological research. Her recent projects have included workshops in Gulf communities to identify wetland migration corridors and vegetation surveys of Dauphin Island, AL.

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SEDIMENT PHOSPHORUS SPECIATION AND DISTRIBUTION IN COASTAL LA SEDIMENTS: IMPLICATIONS FOR HYPOXIA AND FOOD WEB DYNAMICS

Katie Bowes, *Kanchan Maiti, and John R. White*
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Excess loading of phosphorus (P) and nitrogen (N) into aquatic systems leads to degradation of water quality and diminished important ecosystem services. In the Northern Gulf of Mexico (NGOM), excess P and N loading has led to a seasonally present hypoxic area with less than 2 mg/L O_2 in bottom waters, approximating 26,000 km^2 in size in 2017. A sequential extraction (SEDEX) method was performed on surficial sediments from five different coastal and shelf sites as a function of distance from the Mississippi River mouth in the NGOM. To better quantify temporal variability in P distribution and speciation, samples were collected during both low (August) and high (May) river flow regimes. Sequential extraction techniques have been successful in separating pools of P into exchangeable or loosely sorbed P, Fe-P, Authigenic-P, Detrital-P, and Organic-P. Preliminary analyses suggest that May P concentrations are significantly higher than August P concentrations. There was no consistent trend in P concentration with sediment depth. The 0-10 cm sediment interval was characterized by a mean moisture content of 58.7% ± 12.1% and a mean bulk density of 0.582 ± 0.275 g/cm^3. Continued monitoring of sediment P speciation and cycling is critical for understanding coastal eutrophication and informing effective nutrient management strategies to combat hypoxia.

PRESENTER BIO: Katie Bowes is a Graduate Research Assistant in the Wetland and Aquatic Biogeochemistry Lab at Louisiana State University. Katie's research focuses on phosphorus speciation and distribution in coastal Louisiana as a function of seasonal hypoxia.

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A COASTAL SEDIMENT CRISIS OF DUST BOWL PROPORTIONS: WHY WE NEED A NEW DEAL FOR BENEFICIALLY USING SEDIMENT

Derek Brockbank
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In the 1920s, new farming techniques and technology was expanding farm production, but undermining the agricultural sustainability of America's breadbasket. When a 100+ year draught hit the Midwest, black blizzards blew topsoil for thousands of miles creating the "dust bowl" and America's first modern climate migrants. Many leaders, including President Roosevelt thought Midwest farms may be irredeemable and would need to be bought out, but under the direction of Hugh Hammond Bennet, the Soil Conservation Service (later the Natural Resource Conservation Service), put scientific and economic reforms in place to conserve soil and reclaim Midwest farmland for America. The Dust Bowl was technological and economic disaster, exacerbated by climatic changes, that was solved through a political commitment to save farmland and a federal investment to make it happen.

Our nation's coasts – and Louisiana more than anywhere else – is facing a parallel plight with the loss of coastal sediment, leaving coastal (rather than farming) communities in existential uncertainty. Do we have the national political commitment to counter our coastal sediment crisis and will there be the necessary federal investment to prevent catastrophic coastal erosion in the face of sea level rise?

As with the Dust Bowl, we are losing sediment at an alarming rate – over 100 million tons of sediment is lost every year out of the mouth of the Mississippi River. As with the Dust Bowl, engineering advancement and perverse economic incentives are driving this soil loss – studies (Dean & Houston) have demonstrated that in some coastal areas shoreline recession is 70% due to human engineering of the coast. Steps are being taken to address coastal erosion: The U.S. Army Corps of Engineers has a growing focus on Regional Sediment Management; Congress authorized a pilot program for beneficially using dredged material (Sec. 1122 of the 2016 WIIN Act); Louisiana's Master Plan calls for sediment diversions and marsh creation using river sediment. But is it enough? Will individual policies and cobbled together funding sources be the New Deal to put sediment on our beaches, dunes and wetlands where it's needed and save Louisiana and US coastlines? Louisiana and the nation have taken the first few steps, but our coastal sediment needs to be used at a much greater level and prevented from blowing in the wind (waves?).

<u>PRESENTER BIO</u>: Derek Brockbank is the Executive Director of American Shore and Beach Preservation Association (ASBPA), responsible for the growth, strategic planning, and government affairs goals of the nation's leading organization advocating for beach and coastal restoration. Prior to starting with ASBPA, Derek worked as campaign director for a RESTORE the Mississippi River Delta.

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PLANNING FOR FUTURE HURRICANE PROTECTION IN SOUTH CENTRAL LOUISIANA

Rickey P. Brouillette, *P.E.*
Coastal Protection and Restoration Authority of Louisiana

The Coastal Protection and Restoration Authority of Louisiana (CPRA) and St. Mary and Iberia Levee Districts explored the potential costs and benefits of a set of proposed coastal flood protection systems consistent with the Master Plan to reduce risks from storm surge in South Central Coastal Louisiana (SCCL). This study examined levee alignment alternatives running through Iberia and St. Mary Parishes, as well as upgrades to the existing riverine levee system segments in St. Mary Parish that are a part of the Mississippi River and Tributaries (MR&T) to achieve a 1 percent Annual Exceedance Probability (AEP) level of risk reduction for storm-induced flood events.

H&H modeling efforts estimated storm surge/wave and rainfall/tidal conditions to size levees, walls, gates and pump stations based on individual watersheds for both Parishes. The study included refined estimates of runoff rates and canal discharges based on modeling of multiple surge and runoff conditions using the ADCIRC/Swan models for levees and floodwall designs and U.S. Army Corps of Engineers' (USACE's) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) and River Analysis System (HEC-RAS). The study refined the planning-level cost estimates considering the local preferences of the levee alignment alternative through both parishes.

The project considerations were unique in that there are few stream gages, few existing Federal Emergency Management Agency (FEMA) models, and little runoff analysis in this area. The work included field surveys of channel and hydraulic structures. Modeled floodplain extents were validated by comparing model results against a limited number of observed conditions during the August 2016 flood based on local input.

Two scenarios were analyzed to determine the optimal size of proposed large navigation gates (1 percent AEP rainfall) and the required pump station capacities (for the 4 percent AEP rainfall) for major streams and bayous to ensure the construction of the proposed levee system would not induce additional flooding relative to present conditions. Based on the work, a 4 percent AEP (25-year) rainfall event coincident with a 1 percent AEP (the 100-year) storm surge event was selected to estimate the pumping capacity needed to minimize the risk of flooding. The 1 percent AEP rainfall coincident with mean high water (MHW) scenario was selected to estimated gate widths that would reduce the risk of rainfall flooding for rainfall-only events (with gates in the open position). Based on the work, gate opening sizes were optimized to ensure that with open gates, there will be little induced flooding for a 1 percent AEP rainfall event to preserve present-day conditions without excessive pumping costs and with local input to ensure proper consideration of navigation interests for sill depth and channel width.

Local stakeholders and Parish levee districts can weigh options for other cost savings based on cost-benefit analyses to determine if it is acceptable for certain areas or undeveloped land to flood in certain situations, thus reducing pumping or drainage requirements in favor of mitigation, or targeted relocations or buyouts. The state and parishes now have a set of robust models that can inform them in planning their efforts to minimize the flood risks to the region based on a shared vision for the region.

PRESENTER BIO: Mr. Brouillette is Operations Manager for CPRA. He has 30+ years of civil engineering experience, specializing in geotechnical engineering and flood risk reduction. He has managed a variety of issues such as corrosion, OMRR&R, and hydrologic and hydraulic modeling/planning. He holds a Masters from UL and ABD work in geotechnical engineering from UT Austin.

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GULF SHORELINE STABILIZATION IN A HIGHLY EROSIVE ENVIRONMENT

***Dion Broussard**, PE*

Coastal Protection and Restoration Authority, Lafayette, LA, USA

Rockefeller Wildlife Refuge is located in Cameron and Vermilion Parishes and has 26.5 miles of shoreline along the Gulf of Mexico. The Refuge originally contained 86,000 acres when it was donated to the State of Louisiana in 1919, but estimates indicate that the Refuge currently contains 71,000 acres. This loss is primarily due to the shoreline erosion along the Gulf coast, with long-term erosion rates of 40+ feet per year.

Understanding that shoreline erosion is a major problem, the Refuge has been proactive in finding methods to address the issue. To combat the direct loss of shoreline, the Refuge teamed with the Coastal Protection and Restoration Authority (CPRA) and the National Marine Fisheries Service (NMFS) to implement the Rockefeller Refuge Gulf Shoreline Stabilization Project. Due to several design challenges, including extremely soft soils, a demonstration project was constructed in 2009 to compare several shoreline protection options. Post-construction monitoring was used to recommend designing and constructing a reef breakwater with a lightweight aggregate core.

Based on results of the demonstration project, a breakwater has been designed to reduce erosion along 3 miles of the Refuge shoreline. The project is currently in construction. Several lessons learned from the demonstration and design process can be applied to projects throughout the Louisiana Gulf coast. This presentation will provide an overview of the history of the project, a review of the demonstration project along with post-construction monitoring assessment, review of the current project, as well as implications to other projects along the Louisiana coast.

PRESENTER BIO: Dion Broussard is a Professional Engineer managing maintenance events and construction projects for Coastal Protection Restoration Authority. As an engineer in the CPRA Lafayette Regional Office, Dion manages projects of varying levels of complexity and scale in the region, which covers the coastal zone from the Louisiana/Texas state line to the Atchafalaya River.

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AN OBJECT-BASED APPROACH TO CLASSIFYING URBAN AND WETLAND VEGETATION COVER USING HYPERSPATIAL, MULTISPECTRAL UAS IMAGERY

Whitney P. Broussard III[1], *Jenneke M. Visser*[2], *Robert P. Brooks*[3], *Tom Cousté*[1] *and John D. Foret*[4]
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Recent developments in Unmanned Aircraft Systems (UAS) have sparked interest in their ability to capture remotely sensed data and monitor changing land cover in both urban and natural landscapes. Workflow development, however, from data capture to actionable information is proving difficult in coastal environments. Here, we demonstrate the ability of UAS technology to collect hyperspatial (2-3 cm), multispectral (4 band) aerial images and to produce 2-dimensional orthomosaics and 2.5-dimensional digital surface models in two intermediate coastal marsh environments and one rural coastal community in southern Louisiana. We then use Object-Based Image Analysis (OBIA) techniques to classify the UAS-derived data stacks and create highly accurate, hyperspatial information products. In the urban community, we developed high resolution elevation models to support water resource planning efforts and classified building footprints, tree and forest canopy, impervious cover, and open water. In the intermediate marsh sites, we classified and mapped the dominant species, quantified the average plant height, mapped the land-water interface with 5 cm horizontal accuracy, and calculated a Normalized Difference Vegetation Index (NDVI) surface of the project area. Model results were validated with on-the-ground surveys. We suggest that these OBIA methods could be readily applied in multiple urban and coastal settings and could support other project operations and monitoring needs, such as land use land cover mapping, flood mapping, disaster response, and long-term monitoring efforts for both wetland mitigation banks and coastal restoration projects. Such a method could supplement and improve current field-based monitoring and assessment efforts at the project scale with remotely sensed, hyperspatial datasets of elevation and vegetation community composition.

PRESENTER BIO: Dr. Broussard is a Senior Scientist at JESCO Environmental and Geotechnical Services, Inc., with expertise in coastal ecology and geospatial technology. He leads the geospatial program at JESCO in support of coastal restoration, water management, natural resource management, environmental remediation, and survey/mapping efforts for local, state, and federal agencies.

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THE SIGNIFICANCE OF THE MAUREPAS SWAMP TO PAST, PRESENT, AND FUTURE GENERATIONS

Honora S. Buras
Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

The Maurepas Swamp provides innumerable benefits to people in addition to its habitat value. The Louisiana Coastal Protection and Restoration Authority (CPRA), along with many other agencies and NGOs have made a priority of saving the Maurepas Swamp while it is still possible. It is the second largest contiguous coastal forest in Louisiana, comprised of 77,500 ha of baldcypress/ water tupelo swamp between New Orleans and Baton Rouge. Severed from its natural connection to the Mississippi River through levee construction and closure of Bayou Manchac over 200 years ago, the forest no longer receives throughput of freshwater, nutrients, and sediments except through small streams and other nonpoint sources of stormwater runoff. Due to this and other factors, the majority of the swamp is rapidly declining and converting to marsh and open water.

There are many components of a comprehensive, basin-wide strategy for conservation and restoration of the Maurepas Swamp ecosystem, primarily through reintroduction of the river through controlled freshwater diversions and land acquisition. CPRA, with RESTORE funding, is in the final stages of engineering and design of a diversion through Hope Canal that will influence over 16,000 ha of the swamp. The 2017 Coastal Master Plan added several new river re-introduction projects targeting the swamp, further demonstrating increased recognition of the significance of Maurepas Swamp.

Much of the area is open to the public for recreational use as a Wildlife Management Area, which has recently been expanded through major land acquisitions through CPRA's Coastal Forest Conservation Initiative and other programs that have targeted the swamp for conservation acquisitions. Restoration should also improve water quality in the swamp and even beyond its boundaries.

Preserving the Maurepas Swamp is critical to local community resilience. Baldcypress swamps are important storm buffers. Considering the location of the Maurepas Swamp in relation to several major population centers and important industries with no hurricane levees to protect them from storm surge, it is vital that the Maurepas Swamp is able to continue protecting these communities and assets.

Through a combination of restoration projects and conservation acquisitions, much of the swamp can hopefully be saved for future generations if the sense of urgency is accompanied by concerted action on all fronts and support of many partners. This presentation will highlight the relationship between people and the Maurepas Swamp – its historical significance, causes of decline, numerous ecosystem services it provides, and an overview of various restoration and conservation activities that have been implemented by numerous entities to date.

PRESENTER BIO: Ms. Buras is a senior coastal resources scientist, botanist, and Master Naturalist with more than 19 years of experience planning, and implementing coastal restoration and protection, community resilience, and forest conservation projects and programs. She also has extensive additional experience promoting green infrastructure and educating the public on native plants and the natural resources of south Louisiana.

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ADAPTIVE DESIGN AND OPERATIONAL MANAGEMENT FOR NATURAL SYSTEM DESIGNS

Randy Bushey
Jacobs, Baton Rouge, LA, USA

Sediment diversion infrastructure design and construction along the lower Mississippi River (MR) in Lower, LA is being initiated to address the historic loss of coastal marshes. The coastal marsh losses reduce the storm surge protection for coastal Louisiana and result in diminished fisheries and coastal ecosystem habitat. The design of major sediment diversion projects at Mid-Breton (35,000 cfs) and Mid-Barataria (75,000 cfs) to divert sediment laden MR water during flood events (February – June) into these respective basins represent significant projects addressing restoration of coastal marshes. These are the first major controlled sediment diversion projects for marsh creation developed on the MR. The design, construction, and operation of the sediment diversion systems is based on capturing natural flood events – which occurrences are beyond the physical control of the diversion infrastructure operators. The operation of a massive infrastructure system that is based on the variability of nature, whether it is in Louisiana or Florida, and whether we are discussing the sediment diversion from the MR or the control of agricultural and Lake Okeechobee stormwater into the World's largest natural wetlands system, the Everglades, requires the understanding that we cannot fully predict nature. This understanding should be the basis for the design and operation of these restoration infrastructure systems. The Florida Everglades Construction project ($850 million) and the Comprehensive Everglades Restoration Plan ($8.9 billion) will be used to discuss lessons learned on adaptability that should be incorporated into the design, permitting, construction, and operations of major natural system infrastructure projects. All aspects of the design, preliminary site investigations, surveys, and land management prior to and during construction are key to the ability of the owner to incorporate adaptive management and operations into the design, construction, permitting, and operational parameters impacting the natural infrastructures ability to meet its design intent – the owner' goals and objectives. The natural environment cannot be fully anticipated – except through historical perspective – which does not include all natural scenarios which the infrastructure will encounter in its 50-100-year life expectancy. The operational adaptability requires an active monitoring system to timely identify natural event characteristics to make operational adjustments necessary to optimize the intended performance of the facility. Long term monitoring as well as real-time input monitoring is required to address the predictability of the infrastructure components performance. Each of the system components are required to have flexibility in their operational capacities. The presentation will explore the adaptive management design, construction and operational processes as they relate to design of natural infrastructure systems using the Everglades restoration project as an example of adaptive management leading to successful outcomes.

PRESENTER BIO: Randall Bushey, PE, is a senior water resource engineer with Jacobs specializing in design and construction services for reservoirs, dams, levees and stormwater treatment wetlands. He has 42 years of experience in Southeastern US.

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ENVIRONMENTAL FLOWS IN TEXAS: SUCCESSES AND LESSONS LEARNED

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Texas accelerated work on environmental flows in earnest after passage of state legislation in 2007. The Texas Commission on Environmental Quality was delegated responsibility for creating environmental flow standards to guide development of future water use permits. The TCEQ defines environmental flows as, "…an amount of water that should remain in a stream or river for the benefit of the environment of the river, bay, and estuary, while balancing human needs."

By 2009, a comprehensive, phased process was in place to guide creation of environmental flow standards. With similarities to the regional water planning process, stakeholder committees were created for major river basins. Each stakeholder committee elected a team of scientists charged with using consensus and the best available information, without consideration of impacts to human needs, to:

- Recommend water bodies for which environmental flow standards should be created,
- Determine whether those water bodies are "sound ecological environments," and
- Recommend flow regimes to maintain or restore sound environments.

Science teams were given a year to produce recommendations.

Environmental flow regimes are seasonal and yearly flows for specific areas that will support the productivity, physical extent and key habitats of those areas. By 2014, environmental flow standards had been created for streams and estuaries in 11 major river basins.

A variety of lessons were learned in this process:

- Uncertainty was highest when the process started. The first basins started work when guidance was still in development. The comfort level of scientists, stakeholders and regulators grew as the process continued.
- Consensus was critical to moving forward. Legislatively mandated deadlines forced groups to work rapidly towards decisions.
- Ecological data relating flow regimes to environmental health at specific locations was practically nonexistent and understanding of relationships between flow variability and ecosystem health is still limited. These limitations led to a subset of historical flows forming the basis for flow standards at many locations.

In anticipation of these challenges, adaptive management was incorporated in the legislation, allowing a ten-year period following creation of flow standards to conduct studies and evaluate whether the flow standards should be modified. The state has funded $4 million for those adaptive management studies to date.

PRESENTER BIO: Dave Buzan is an aquatic ecologist with Freese and Nichols in Austin, Texas and has worked on water quality and quantity issues in Texas since 1978 including nearly 30 years with the Texas Commission on Environmental Quality and Texas Parks and Wildlife Department.

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MODERN SUBSIDENCE RATES IN BARATARIA BASIN, LOUISIANA

***Mark R. Byrnes*[1,2]**, *Louis D. Britsch*[2], *Syed Khalil*[3]; *Jennifer L. Berlinghoff*[1], *Ricardo Johnson*[4], *Andy Fallon*[1]

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Subsidence in south Louisiana is a primary factor influencing restoration design and wetland habitat resilience. Understanding the causes and rates of subsidence across the Louisiana coastal zone is critical to successful planning and implementation for State Master Plan projects. To this end, we conducted an assessment of recent subsidence rates within the Barataria Basin. In particular, we evaluated campaign-style geodetic GPS (Global Positioning System) elevation measurements (8- to 24-hour continuous measurements for two separate days) for CPRA/National Geodetic Survey (NGS) secondary benchmarks and CORS (Continuously Operating Reference Station) elevations (primary survey markers) at 20 locations within Barataria Basin. All elevation measurements were made to an accuracy of approximately ±2.0 cm or less. Net elevation changes ranged from -2.0 to -10.9 cm, producing subsidence velocities of 2 to 8 mm/yr. These data record short-term subsidence trends (4- to 14-year time series) from direct survey measurements that are expected to be indicative of conditions at proposed restoration sites over the next 20 to 50 years. Two water-level time series were used to supplement direct elevation change measurements for northern Barataria Bay and at Grand Isle. Eustatic sea level for the northern Gulf of Mexico coast was determined using long-term water elevation measurements for the Cedar Key gauge (2 mm/yr). This change rate was subtracted from the two water-level gauge trends in Barataria Basin to obtain an estimate of subsidence velocity at each location.

Elevation change measurements indicate a compelling relationship between subsidence and age, composition, and thickness of Holocene deltaic deposits. In the northern portion of the basin, rates are relatively low, ranging from 2 to 4 mm/yr. This area is characterized by the oldest deltaic deposits related to the St. Bernard and Lafourche Delta Complexes, and sediment texture is coarser and more consolidated than finer-grained, more recent deposits in the southern part of the basin. Further, the northeastern portion of Barataria Basin has relatively thin Holocene deposits (i.e., shallow Pleistocene) compared with the southern basin. The northern half of the Basin also contains multiple overlapping delta lobes which may contribute to the stability of these Holocene deltaic deposits. Where subsidence rates increase to 5 to 8 mm/yr (southern basin), deltaic deposits generally are younger and thicker, resulting in greater consolidation potential. The relationship between age and thickness of deltaic deposits and resulting subsidence rates has been described previously in the literature for the Mississippi River delta. Although time series of high-resolution geodetic GPS elevation surveys were not available prior to the early 2000s, the relationship between magnitude of subsidence velocities and Holocene sediment composition and thickness developed prior to this time appears to be substantiated by our results.

PRESENTER BIO: Dr. Byrnes is a Principal Coastal Oceanographer with more than 30 years of experience evaluating wetland change processes, shoreline and wetland restoration strategies, regional sediment management and storm damage impacts for coastal and estuarine environments, and coastal change and geomorphic evolution of coastal and nearshore depositional environments.

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PERFORMANCE OF LEVEES DURING RIVER FLOODS AND RAINFALL EVENTS

***Jack Cadigan**, and Navid Jafari*
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The Spring of 2011 brought heavy rainfall and snowmelt throughout the Midwest, resulting in record flow rates and flood stages on the Lower Mississippi River from Cairo, Illinois to the Gulf of Mexico. In many locations, the flood crested at levels above those from the great floods of 1927 and 1937. The Morganza Spillway in Louisiana was opened for the first time since 1973, flooding nearly 5,000 square miles of rural land. As a result, the flood protection system of levees, walls, gates and spillways was loaded to its capacity, as evidenced by the large number of seepage boils and saturated levee embankments. This presentation presents calibrated 2-D and 3-D analyses of flow through levee embankments and underseepage in the shallow alluvial sand substratum. During the calibration process, approximately over 120 computational analyses were conducted in a thorough investigation of the effects of unsaturated soil parameters and evapotranspiration on levee seepage. A sensitivity analysis was performed to determine the controlling parameters on the progression of a phreatic surface through a levee during the drawdown phase of a high-water event. Following the 2011 flood, the USACE constructed a seepage berm at the study site. The calibrated levee model was used to explore the efficacy of the seepage berm and evaluate future underseepage remediation techniques like relief wells, which are a prevalent remediation technique in Louisiana for levees and dams. In particular, 2-D seepage models coupled with an add-in function to calculate specific flow through a relief well for a given river stage, were used to investigate pressure relief beneath the blanket at various relief well penetration depths and diameters. The factors of safety calculated without any seepage control, implementation of a seepage berm, and implementation of relief wells are calculated and presented. As a result, this research will assist in future implementation and performance of coastal protection projects.

PRESENTER BIO: Jack Cadigan is a graduate research assistant in the Department of Civil and Environmental Engineering at LSU. He research is focused on the stability of earth embankments and subsurface flow.

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ECONOMIC AND GEOMORPHIC COMPARISON OF OCS SAND VS. NEARSHORE SAND FOR COASTAL RESTORATION PROJECTS

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Demand for dedicated dredging in U.S. waters has more than doubled in the past decade, with particular growth in coastal Louisiana, where an estimated 90 million yd3 of sediment will be needed for barrier shoreline and wetland restoration over the next 50 years. Sediment acquisition for these projects is typically restricted to two primary sources: near shore (NS) materials of limited quantity and quality, and outer continental shelf (OCS) inputs of potentially higher quality and costs. Economic trade-offs between these source types have yet to be systematically analyzed, but are expected to be project- and location-specific; and influenced by a wide range of constraints. In October 2015, BOEM initiated a three year, cooperative marine institute (CMI) study to characterize these constraints and integrate them into a comparative, geo-economic framework useful for estimating the costs incurred, and the ecosystem services derived, from projects relying on these two source materials. This presentation provides an update on the economic portion of the CMI project, with a particular emphasis on data sources, descriptive statistics, and statistical development of generic costs models for projects using NS and OCS sediments. The update will include a mechanical description of how geophysical trajectories and costs data are being coupled into decision support tool for examining a wide range of economic trade-offs related to sediment characteristics, technological limitations, sediment transport distance, project scale (spatial and temporal) seasonal risks, and environmental policy.

PRESENTER BIO: Dr. Rex H. Caffey is a Professor of Natural Resource Economics in the LSU Agricultural Center and Louisiana Sea Grant. He conducts applied research and extension programming related to the economic and policy challenges of fisheries and coastal wetlands in the northern Gulf of Mexico region.

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CREATING A BENEFICIAL USE SITE IN THE BILOXI MARSH COMPLEX, ST. BERNARD PARISH, LOUISIANA

Elizabeth Calvit
Jacobs, Baton Rouge, LA, USA

The Biloxi Marsh Complex (BMC), is a collection of marsh islands, inlets, bayous, and bays in the most eastern reaches of St. Bernard Parish, lying east of Lake Borgne, west of the Mississippi Sound and south of Hancock County, Mississippi. The area is significant both to Louisiana and Mississippi due to is location and its ability to moderate salinity for the Mississippi Sound and Lake Borgne from the influences of the Gulf of Mexico and it value as a first line of defense for hurricane storm surge. The BMC is also one of the richest sources of oysters in the region, providing a livelihood to both Louisiana and Mississippi oystermen. Considering these factors and the marsh's historic land loss, an opportunity arose to create a new beneficial use site (BU) within the marsh complex. This new BU site could serve two purposes: provide a location for disposal of suitable dredged material and create new marsh to sustain the BMC. The permittee for the project was the Mississippi Department of Marine Resources since the new source of dredged material would come from a Mississippi project and there is not a site within the state with the capacity needed.

The challenge of permitting a BU site in the BMC included identifying existing private oyster leases, state water bottoms and oyster seed beds, and private landowners. Reviews of historic maps and aerial imaging helped identify potential sites that would avoid all conflicts. Ground truthing with site visits and interviews with parish officials, oyster task force members, existing landowners, Louisiana state agencies, federal agencies, and oyster lease owners assisted in narrowing down the list of potential sites. One of the most exciting aspects of the project and the most challenging was the concept of permitting a new BU site that would have the capacity to receive potential dredged material from both Louisiana and Mississippi. If permitted, it would be the first BU site that could be used by more than one state, allowing a more holistic approach to managing sediment and coastal land loss.

This presentation will describe this three-plus year process to permit the site. The strategies, challenges, and the ultimate success in gaining stakeholder support will be presented, with insights into the how to permit a BU site that can be used by multiple states.

PRESENTER BIO**:** Elizabeth Calvit has been working in the area of beneficial use for over 15 years. She was the lead author for the *Master Plan for the Beneficial Use of Dredged Material for Coastal Mississippi* and the *Project Managmeent Plan for Selected Beneficial Use Projects* (2002) updated in 2011.

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MONITORING AND ADAPTIVE MANAGEMENT MANUAL TO SUPPORT INTEGRATED ECOSYSTEM RESTORATION FOR THE *DEEPWATER HORIZON* OIL SPILL

Melissa Carle[1], *Ann C. Hijuelos*[2], *Nadia Martin*[3], *Michelle Meyers*[4], *Jamey Redding*[1], *Greg Steyer*[5], *Pete Tuttle*[6], *and Eric Weissberger*[1]

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The Oil Pollution Act (OPA) Natural Resource Damage Assessment (NRDA) regulations require monitoring of restoration projects to document effectiveness in meeting restoration objectives, and/or the need for corrective action. Given the unprecedented scale of the Deepwater Horizon oil spill and its associated restoration plan, the NRDA Trustees recognized a need for a robust, scientifically-based monitoring and adaptive management (MAM) framework to support restoration decision-making, corrective actions and measurement of restoration benefits across multiple scales. In July 2016, the NRDA Trustee Council formed the Cross-Trustee Implementation Group (Cross-TIG) MAM work group to promote consistency in monitoring across the seven TIGs and develop guidance on effective evaluation of restoration outcomes at project, resource, and programmatic scales.

Building upon the monitoring frameworks and conceptual monitoring plans developed by the Trustees for Early Restoration, the Cross-TIG MAM Work Group recently developed a MAM Procedures and Guidelines Manual Version 1.0 (MAM Manual), on behalf of the Trustee Council. The MAM Manual is intended to guide MAM efforts conducted by the Trustees and provides guidance on: (1) development of project-level monitoring and adaptive management plans, (2) implementation of project MAM, (3) evaluation of restoration effectiveness, (4) feedback of information to future restoration planning and implementation, (5) data management, and (6) reporting on the outcomes of restoration projects.

Specific monitoring recommendations are provided for the restoration of coastal wetlands, beaches, dunes, barrier islands, water quality, and recreational use opportunities. Monitoring guidelines for other types of restoration projects will be developed and presented in subsequent versions of the manual. The monitoring guidelines include a suite of core monitoring parameters for each type of project, as well as objective-specific monitoring parameters, definitions and associated guidelines for monitoring methods applicable to each core and objective-specific parameter, and recommendations of additional monitoring parameters to consider for adaptive management or validation of function and services. The establishment of monitoring guidelines will facilitate the aggregation and analysis of monitoring results across projects and the evaluation of restoration progress more broadly across the habitats and resources in the Gulf of Mexico region that were injured by the Deepwater Horizon spill.

PRESENTER BIO: Dr. Carle is a Monitoring and Planning Coordinator for the Deepwater Horizon Restoration Program at the NOAA Restoration Center. She has over 10 years of experience in coastal ecology and the evaluation of coastal restoration and serves as one of the leads for the Deepwater Horizon NRDA Cross-TIG MAM work group.

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RECENT RESTORATION AND ENHANCEMENT PROJECTS AT ROCKEFELLER REFUGE WITH DU/LDWF PARTNERSHIP

Mike Carloss
Ducks Unlimited, Inc., Lafayette, LA, USA

Ducks Unlimited (DU) and the Louisiana Department of Wildlife and Fisheries (LDWF) have been collaborating for over 25 years to enhance coastal wetland habitat at the Rockefeller Wildlife Refuge. The partnership between DU and LDWF has resulted in the completion of five projects at the refuge that have enhanced more than 11,300 acres of coastal marsh and 14,400 acres of adjacent marsh. Recent restoration projects through this partnership include the LSU Water Control Structure completed in 2015 and the Unit 4 Wetlands Enhancement that is currently in construction.

The LSU Water Control Structure project costed $1.4 million and was funded through a Cooperative Endeavor Agreement between LDWF and DU. The project included the removal of the Miller Lake and old LSU water control structures which were damaged by Hurricane Ike and were no longer capable of managing water levels within the Price Lake unit of the refuge. The deteriorated water control structures were replaced with six 48" pipe culverts with flap gates and weir boxes with a total weir length of 126 ft. The project also included a bulkhead structure, articulating concrete block revetment, 1,100 linear feet of levee reconstruction, and 379 linear feet of fishing pier. The new LSU Water Control Structure enables management of water levels and salinity in the Price Lake Unit of the refuge which is approximately 8,600 acres of coastal marsh habitat.

The Unit 4 Wetlands Enhancement project will cost over $1 million and is being funded through a North American Wetlands Conservation Act grant with matching funds from DU, LDWF, and Coastal Protection & Restoration Authority. The project will replace an old and outdated variable crested water control structure installed in 1967 at Unit 4 of Rockefeller Wildlife Refuge. The new structure will include six 48" culverts with flap gates and flashboard risers with a concrete T-wall bulkhead and approximately 700 linear feet of fishing pier. This structure will enable active management of water levels and salinity of the interior marsh consisting of over 5,000 acres of intermediate and brackish marsh.

The LSU Water Control Structure and Unit 4 Wetlands Enhancement projects are examples of critical conservation efforts through effective partnerships that resulted in the restoration and enhancement of over 13,600 acres of coastal marsh. These projects enable active management of wetland conditions to promote and enhance habitat quality for waterfowl and other wetland-dependent wildlife in addition to providing public access and recreational opportunities.

Presenter Bio: Mike is currently the Director of Conservation Programs for Ducks Unlimited. He retired from the Louisiana Department of Wildlife and Fisheries as Biologist Director in 2014, with much of his experience working on and managing coastal refuges and WMAs. He also worked for LA Office of State Parks and NRCS.

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INLAND FROM THE COAST: A MULTI-SCALAR APPROACH TO REGIONAL CLIMATE CHANGE RESPONSES

Jeffrey Carney[1], *Traci Birch*[1], *Clint Willson*[1], *Katie Cherry*[1], *Craig Colten*[1], *Scott Hagen*[1], *Cecile Guin*[1], *Aimee Moles*[1], *James Wilkins*[2], *Marla Nelson*[3], *Melissa Daigle*[2], *and Niki Pace*[2]

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While climate change is a global phenomenon, the impacts are experienced most acutely in place – to people's homes, communities, financial resources, culture, physical and emotional well-being. In August 2016, a low-pressure system dropped 22-31" of rain in two days across Louisiana's capitol region. Resultant flooding took 13 lives and caused damage to an estimated 156,000 structures. Touted as a "one-in-1,000-year flood" this was the third such event in 2016 to hit the southeastern US, and one of nine since 2010 (NOAA NWS, 2016).

The increasing convergence of inland and coastal systems (through coastal erosion, sea level rise, rural to urban migration and other factors) is a phenomenon Louisiana is experiencing on an unparalleled scale. Tragically, following the storms of the last decade, many residents moved away from the sea to reduce their risk—only to be flooded repeatedly from rain events over inland watersheds.

This presentation will reflect upon initial results of an applied research project titled "Inland from the Coast: A multi-scalar approach to regional climate change responses", funded through the Gulf Research Program of the National Academies of Sciences, Engineering, and Medicine and the Robert Wood Johnson Foundation. The project takes a multi-scalar, multi-disciplinary approach to river flood modeling, health and well-being research, and applied community design to improve flood recovery and long-term resilience across the greater Baton Rouge inland-coastal region. These efforts are linked to implement adaptive design opportunities in flood-damaged communities connecting university researchers with professional landscape architects, architects, planners, policy-makers, and community members to develop design and planning best practices for reducing risk and increasing regional adaptive capacity.

Initial results include: 1) multi-platform (SPRNT, HEC-RAS) preliminary watershed-scale models for a coupled inland-coastal system; 2) spatial and temporal indices measuring community resilience and wellbeing across the region; 3) best practices for adaptive design and policy case studies; and 4) urban fabric scaled architectural proposals that synthesize findings.

The presentation will capture a long term effort in the greater Baton Rouge region to build a framework to restore and enhance community wellbeing in the face of extreme weather and climate change. The presentation will not only synthesize research conducted over the first year of the grant but project pathways for this work to continue over the next two years as the project looks towards local implementation of its findings.

PRESENTER BIO: Jeffrey Carney is Director of the LSU Coastal Sustainability Studio and Associate Professor in the School of Architecture. Jeff's work in Louisiana has centered on the trans-disciplinary work of the LSU Coastal Sustainability Studio.

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QUANTIFYING ECOSYSTEM FUNCTIONS OF COASTAL HABITATS IN LOUISIANA TO IMPROVE UNDERSTANDING OF ECOSYSTEM SERVICES

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Maintenance and restoration of intact coastal ecosystems globally is considered to have high potential for supporting resilience of human communities, which can also be applied to coastal Louisiana. Ecosystem services provided by intact ecosystems can increase community resilience through: reducing direct impacts of waves, storm surge, and marginal erosion; providing essential habitat for juvenile and adult fisheries species, ducks, and other hunted species; and potential revenue raising functions such as nutrient and carbon sequestration. The 2017 Coastal Master Plan for Louisiana focuses on structural protection and restoration. Ecosystem based approaches that can restore or enhance intact natural ecosystems such as barrier islands, marshes, mangrove stands, aquatic vegetation, oyster reefs, and forested wetlands are an important component of current restoration efforts. These approaches can be cost effective and have potential to provide increased ecosystem services over time, with relatively low maintenance costs.

Even when secondary benefits of large, and small, scale restoration are recognized by communities and managers, quantifying these benefits so that they can be fully included in a decision making and prioritization process continues to be challenging. To develop common understanding and expectations amongst multiple stakeholders, a synthesis of ecosystem functions of the coastal ecosystems and the protective, social/cultural, and economic ecosystem services that these ecosystem functions may support, was developed. This framework for coastal Louisiana will be presented, with examples of ecosystem functions and supported ecosystem services that can potentially result from ecosystem based restoration actions. Once a framework is established, the next challenge is quantifying specific benefits.

Examples of increasing understanding of three ecosystem functions will be presented, wave attenuation, carbon storage (Blue Carbon), and fish and shellfish habitat suitability. Relevant spatial scales will be discussed as well as approaches for linking these different quantifications to communities, and stakeholders, as ecosystem services. Development of frameworks for common understanding amongst stakeholders of potential ecosystem benefits of restoration, as well as quantification of these benefits at appropriate scales, has potential to increase inclusion of multiple benefits of restoration more directly into planning and prioritization of restoration actions.

PRESENTER BIO: Dr Carruthers is a coastal ecologist with more than 20 years of experience in tropical and temperate coastal ecosystems globally. His work has focused on assessing ecosystem condition and understanding ecosystem approaches to adaptation and restoration, from field based science to support of management and policy development.

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RESTORE PROJECTS AND PATH FORWARD

***Vida S. Carver**, P.E.*
Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 ("RESTORE Act") dedicates eighty percent of the Clean Water Act civil and administrative penalties associated with the Deepwater Horizon oil spill to the Gulf Coast Restoration Trust Fund ("RESTORE Trust Fund").

Over 15 years, ending by April 4, 2031, the State of Louisiana, through the Coastal Protection and Restoration Authority ("CPRA") anticipates receiving approximately $811.9 million through the RESTORE Trust Fund - approximately $260.4 million under the Direct Component and approximately $551.5 million under the Spill Impact Component. Additionally, the CPRA will compete with other eligible entities to secure a portion of approximately $150-180 million through the Council-Selected Restoration Component.

The RESTORE Act requires the State of Louisiana, through the CPRA, to publish a Mulityear Implementation Plan detailing its plan to expend funds under the Direct Component of the RESTORE Act, subject to review by the U.S. Department of Treasury (Treasury), and a State Expenditure Plan detailing its plan to expend funds under the Spill Impact Component of the RESTORE Act, subject to approval by the Gulf Coast Ecosystem Restoration Council (RESTORE Council). Since the eligible activities for funding under the Direct Component and Spill Impact Component are nearly identical, and the requirements for both the Multiyear Implementation Plan and the State Expenditure Plan are similar, the State of Louisiana has combined these two plans into a single document entitled the State of Louisiana's RESTORE Plan. The State's initial RESTORE Plan was approved by the CPRA Board for submission to Treasury on July 15, 2015 for expenditure of then-available Direct Component funds. On September 21, 2015, Treasury formally notified the State that Louisiana was the first state to have a Plan accepted by Treasury for expenditure of Direct Component funds. The State's First Amended RESTORE Plan has since been submitted and approved by Treasury and RESTORE Council. This Amended Plan details the one Direct Component and three Spill Impact Component projects totaling $811.9 million.

Under the Council-Selected Restoration Component, the RESTORE Council created a Comprehensive Plan to restore the ecosystem and economy of the Gulf Coast region. As a way to evaluate and select projects, RESTORE Council developed a process known as the Funded Priorities List (FPL). CPRA, through the Council-Selected Restoration Component, submitted five projects, totaling approximately $38.1 million for consideration in the first FPL. After project vetting, including evaluation of use of best available science, budget reasonableness, and environmental compliance readiness, all five projects were selected for the first Funded Priority List.

PRESENTER BIO: Mrs. Carver is a licensed Professional Engineer in the Project Management Division at CPRA.

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DESIGN CONSIDERATIONS FOR ROCK SILLS IN LIVING SHORELINES

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Design of rock sills as toe protection associated with marsh restoration as part of a living shorelines challenges an engineer to think outside of their normal boundaries. When doing design of normal rock structures, engineers consider the elevation of wave runup under extremal events and look to protect the slope or ensure that there is limited overtopping volume. When designing a rock sill as part of a living shoreline, the sill should be completely inundated during certain parts of the normal tidal cycle to ensure functionality of the restored marsh that the sill is protecting.

There is limited design guidance available to engineers as they work out the design input conditions as well as good data to use to develop the design conditions for these rock sills. Two recent rock sills that were designed in the Northeast incurred design challenges to achieve a structure that resisted wave energy with minimal design footprints. The extremal events that are used in standard structure design submerge these structures such that they are no longer functioning as directly dissipating wave energy but rather work indirectly as a submerged reef. Design guidance for stone size and structure shape and profile such as those found in the U.S. Army Corps of Engineers *Coastal Engineering Manual* (EM-1110-2-110) or the *Hydraulic Design of Flood Control Channels* (EM-1110-2-1601) can still be used, but additional judgement is necessary when selecting the design conditions.

As design of rock sills as a part of living shorelines progress, more and more agencies and groups are providing guidelines. Several states are starting to put out design guidance for living shorelines. New Jersey has published a *Living Shorelines Engineering Guidelines* (2016) and the State of New York is looking to publish their design guidelines. These various guidelines will ensure that future design efforts can achieve the project goal of fringe marsh creation and stabilization.

PRESENTER BIO: Mr. Caufield is a senior coastal engineer with more than 15 years of experience specializing in the areas of hydrodynamic modeling, wave transformation, coastal structure design and sediment transport. He has extensive experience developing and employing numerical models for sediment transport, nearshore spectral wave transformation, bathymetric evolution and hydrodynamic processes.

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RESILIENCE IN CONTEXT: HOW CULTURE SHAPES AT-RISK COMMUNITIES

Brandon N. Champagne
Louisiana State University, Baton Rouge, LA, USA

In response to the growing number of flood-related disasters around the world, flood risk research is now pivoting to more qualitative concepts such as vulnerability and resilience to explain how societies can effectively plan for future flooding scenarios. Recent attention has concentrated on the idea of context in flood risk assessment; specifically how risk is perceived and considered among different socioeconomic groups. Considering the cultural fabric of a region or society during disaster risk reduction is known to benefit communities because it contextualizes these disasters, as well as the people living through them. For example, some communities in coastal Louisiana perceive their surrounding cultural landscape as too important to relocate from, despite the present risk that they live with.

However, other than this anecdotal evidence by people who live on the coast, there is not yet any definitive evidence that their shared sense of culture provides stability in terms of community cohesion and resilience after a disaster occurs. To prove this phenomenon, a dasymetric mapping technique was used in which cultural assets (places of worship, cemeteries, museums, etc.) were mapped and spatially analyzed along with known levels of flood risk and indicators of community vulnerability and resilience. The results of this approach validated the extensive ethnographic research that revealed the importance of these residents' way of life in post-disaster situations. Knowing the extent to which these cultural assets enhance a community's sustainability and resilience could help restoration planners consider them in their traditional cost benefit analyses in the future.

PRESENTER BIO: Brandon Champagne is a recent graduate of Louisiana State University with his Bachelor of Science in Coastal Environmental Science. His interests include modelling flood risk of communities in south Louisiana in order to help protect communities and make them more sustainable.

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MEASURING COMMUNITY WELL-BEING IN THE FACE OF INCREASED FLOOD RISKS: A CASE STUDY OF THE BATON ROUGE, LOUISIANA AREA

***Yi Ling Chan**, and Traci Birch*

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In August 2016, a low-pressure system dropped 22-31" of rain in two days across Louisiana's capitol region. Resultant flooding led to transportation and economic disruption across the Gulf Coast, took 13 lives, and caused damage to an estimated 156,000 structures. Touted as a "one-in-1,000-year flood" this was the third such event in 2016 to hit the southeastern US, and one of nine since 2010. Climate change predictions indicate severe precipitation events are likely to increase in frequency and intensity in the future. Risks to inland communities in south Louisiana compound ongoing threats to coastal areas from extremely shallow topography, sea level rise, land loss, and increased tropical storm intensities. As sea levels rise and shorelines erode, there is a growing recognition that retreat from the coast is preferred or required given significant fiscal, infrastructural, and social constraints on coastal settlement. The increasing convergence of inland and coastal communities is a phenomenon Louisiana is experiencing on an unparalleled scale, though the issue is not unique to the state. Following the storms of the last decade, many residents moved away from the sea to reduce their risk - only to be flooded repeatedly from rain events over inland watersheds.

East Baton Rouge, Livingston, and Ascension parishes are continuing to grow as people migrate from the coast but have increasingly been impacted by weather-related events. After natural hazards affect communities, it is up to individuals, policymakers, and developers to make adaptive decisions for sustainable futures. In order to build adaptive capacity, there needs to be an understanding of what it means to build back “better” than before.

The objective of this research is to develop an index to measure the variability of and capacity gaps in community well-being. Adopting the methods of Burton (2015) and Cutter et al. (2010), we collected over 100 variables relating to local well-being at the census-tract level in East Baton Rouge, Ascension, and Livingston parishes. The variables were categorized into public health and safety, community identity, economic stability, natural environment, and built environment to capture dimensions of well-being. Preliminary results indicate there are large gaps in the data, with some of the most important variables undocumented, such as mental health indicators. Data gaps are particularly striking in the rural regions of Livingston Parish, where individuals were affected most severely by the August 2016 floods. This index is situated as the first step in synthesizing profiles across the inland-coastal system and provides a tool for comparison of well-being in East Baton Rouge, Ascension, and Livingston parishes. Ultimately, this research can serve as a decision-making tool to inform adaptation best practices for current residents, policymakers and developers, and will help to identify communalities between coastal and inland communities for consideration in the event coastal residents migrate inland.

This research was performed with the support of the National Academies of Sciences and the Robert Wood Johnson Foundation.

<u>PRESENTER BIO</u>: Yi Ling Chan is a graduate research assistant at the LSU Coastal Sustainability Studio. She expects to receive her M.S. in geography, a minor in environmental science, and a GIS graduate certificate in May 2018 from LSU. Her research combines GIS and historical analysis to understand community resilience to flooding.

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OIL SPILL SETTLEMENT FUNDING AND ITS AFFECT ON CPRA'S IMPLIMENTATION PROGRAM

Maury O. Chatellier
Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

On June 02, 2017, the Louisiana State Legislature approved Louisiana's Comprehensive Master Plan for a Sustainable Coast. As did the 2012 plan, the 2017 version also details a $50 billion program over the next 50 years.

The 2017 Coastal Master Plan includes $18 billion for marsh creation, $5 billion for sediment diversions, and more than $2 billion for other types of restoration projects, providing land building benefits of 800 to 1,200 square miles compared to no action.

- $19 billion for structural protection and $6 billion for nonstructural risk reduction; these projects will reduce expected annual damage by $8.3 billion by year 50 as compared to no action and are expected to pay for themselves three times over the course of implementing the plan.

In all, the master plan outlines projects that cost, in present value, approximately $50 billion.

As an outcome of the Deepwater Horizon spill, there are three main funding streams that send money back to the Gulf to help each state recover from the oil spill. The National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund comes from the criminal settlement between Transocean and BP and contains $2.54 billion to fund projects that benefit Gulf Coast natural resources impacted by the spill. The RESTORE Act directs $5.3 billion of Clean Water Act penalties back to the Gulf for ecosystem and economic recovery efforts. And an additional $8.8 billion is available through the Deepwater Horizon's Natural Resource Damages (NRD) settlement to help restore wildlife and habitat damaged by the spill.

Louisiana will receive approximately $8 billion in restoration funding over the next 16 years. This influx of dollars available for environmental restoration significantly alters the State's future restoration planning and project implementation. The scale of projects will increase significantly. The increased funding will allow for early implementation of the State's "cornerstone" projects as well as the largest barrier island and marsh creation projects to date. While increased funding brings larger design and construction efforts, these funding streams have a finite value. It's imperative that proper management and utilization of these funds take place as at this time, future funding streams to complete the master plan implementation are unrecognized.

PRESENTER BIO: Mr. Chatellier is the Chief of the Project Management Division for CPRA and a registered Civil Engineer with more than twenty years of design and management experience. He has extensive agency experience having served as Chief Engineer and Senior Engineer in the Executive Division. He has a strong background in planning and development of the agency program for oil spill funded projects.

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WAVE ATTENUATION BY CONSTRUCTED OYSTER REEF BREAKWATERS

***Jason Chauvin**[1, 2], Qin J. Chen[2], Navid Jafari[2], Thomas Everett[1], Josh Carter[3]*

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Biloxi Marsh located in St. Bernard Parish, Louisiana has experienced significant shoreline erosion in recent years. The Living Shoreline Demonstration Project, completed in February 2017, constructed three miles of living shoreline structures to attenuate waves and thus combat marsh edge erosion along the shoreline of Eloi Bay. Several types of constructed oyster reef breakwaters were installed for this demonstration project. Along with the primary goal of shoreline protection, secondary goals include oyster growth and colonization, sediment accretion, and performance demonstration of the living shoreline products. Due to the experimental nature of these products, available performance characteristics are limited.

Wave attenuation across the constructed oyster reef breakwaters was measured using bottom-mounted pressure gages. Seven pressure gages were deployed to obtain wave characteristics on the unprotected and protected sides of four types of breakwater structures. The raw pressure data was processed to determine water surface elevation, significant wave height, and peak wave period. In addition to the wave gages, two water level sondes were deployed to record water surface elevations at the site. Topographic and bathymetric surveys were also conducted along transects at the wave gage locations to provide a profile of the shoreline and structures. The wave attenuation and transmission characteristics of the oyster reef breakwaters from the in-situ measurements will be presented.

PRESENTER BIO: Jason Chauvin is licensed civil engineer from Houma, LA. He has experience with multiple flood protection and coastal restoration projects. He is set to graduate with a Master's degree in Coastal and Ecological Engineering from LSU in May 2018.

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RESTORING THE CAMINADA HEADLANDS: AN EFFECTIVE AND SYNERGISTIC APPROACH

Adrian Chavarria *and Sharon Osowski Morgan, Ph.D.*
U.S. Environmental Protection Agency, Region 6, Dallas Texas, USA

The Caminada Headlands is the last of its type in Louisiana. Located south and east of Port Fourchon in Lafourche Parish, the headland is a 14-mile-long undeveloped beach that stretches from West Belle Pass on the west to Caminada Pass on the east. The beach, dune and marsh provide habitat but also serve to protect valuable infrastructure including Port Fourchon, LA Highway 1, and the lower Lafourche levee system. The Caminada Headlands have experienced extensive shoreline erosion and land loss to marsh, wetland, beach and dune habitats. Fortunately, the significance of the headlands is recognized and restoration is occurring incrementally and through synergistic, collaborative efforts. Two projects were completed by the State of Louisiana and two additional projects are planned with funding from the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program. The Caminada Headlands Backbarrier Marsh Creation (BA-171) project was recently approved for construction funding by the CWPPRA program. The BA-171 project will restore approximately 430 acres of marsh immediately behind a beach and dune restoration project completed in 2015. Efforts are currently underway to solicit bids for construction. The Caminada Headlands Back Barrier Marsh Creation Increment II (BA-193) CWPPRA project is currently in engineering and design. This project is immediately adjacent to the BA-171 project and behind the dune and beach restoration project completed in 2016.

The presentation will provide a brief orientation of the two existing restoration projects, focus on the design details and features of the two planned CWPPRA Projects, discuss the synergistic impacts of the projects, and identify cost savings and lessons learned.

PRESENTER BIO: Adrian Chavarria is an Environmental Engineer with EPA Region 6. He represents EPA on the CWPPRA Planning and Evaluation Subcommittee and is also a member of the CWPPRA Engineering Workgroup. He has a Bachelor of Science in Civil Engineering from the University of Texas at Arlington.

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INTEGRATING HIGH-FIDELITY MODELS WITH NEW REMOTE SENSING TECHNIQUES TO PREDICT STORM IMPACTS ON LOUISIANA COASTAL AND DELTAIC SYSTEMS

Qin Jim Chen[1,2]*, Kehui Xu*[2]*, Brady Couvillion*[3]*, Claire Jeuken*[4]*, Ap van Dongeren*[4]*, Robert McCall*[4]*, Mindert De Vries*[4]*, Cody Johnson*[2] *and Kelin Hu*[2]

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The successful implementation of the Louisiana Coastal Master Plan depends on (1) a thorough understanding of the deltaic system dynamics of coastal wetlands, shallow estuaries and barrier islands as well as their connection in order to manage sediment budgets, and (2) the development of the capability to quantify the (seasonally-varying) effectiveness of these natural landscapes in mitigating storm-induced waves and surges, and thus reduce hydraulic loads on flood defenses. However, both aspects require further development. The effectiveness of the deltaic system in flood risk reduction has thus far been difficult to quantify. An outstanding issue is that state-of-the-art numerical models need spatially- and temporally-varying input parameters of vegetation biophysical properties that are not easily obtained in-situ for large areas and at regular time intervals. Moreover, the sediment fluxes during storms between the barrier islands, shallow lakes and open bays, and the marshes are not well understood. To address both issues, this project is developing an innovative model system, which integrates state-of-the-art physical processes, high-resolution satellite data and in-situ measurements. The key components are (1) a set of integrated open-source, process-based models (Delft3D and XBeach), which operate at different spatial scales and have been proven for complex barrier/marsh systems; and (2) algorithms and databases that derive model input of vegetation properties from remotely-sensed (satellite) data ground-truthed by in-situ observations. The cooperative research is resulting in the following products: (a) a database of remotely-sensed and ground-truthed biophysical information for the Mississippi River Delta with high resolution in time and space, which can be used as input into computer models and for monitoring and evaluating the status of the salt marshes; (b) a high-fidelity hydrodynamic and eco-morphodynamic modeling system for Breton Sound, Barataria Bay and Terrebonne Bay that can be used in assessing the effectiveness and interdependency of barrier islands, wetlands and levees, and evaluation and management of large-scale restoration and flood defense systems; and (c) conceptual strategies to maximize sediment retention. These products and knowledge will have direct applicability and utility in support of the implementation of the Coastal Master Plan, and provide input to the flood risk modeling.

PRESENTER BIO: Dr. Chen is Professor of Civil & Environmental Engineering/Marine & Environmental Sciences at Northeastern University. He specializes in the development and application of numerical models for coastal dynamics (waves, currents, fluid-vegetation interactions, sediment transport). He conducts field experiments and application of remote sensing and high-performance computing technologies to solve engineering problems.

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FUTURE-PROOFING AMERICA'S ENERGY INFRASTRUCTURE THROUGH HOLISTIC RESILIENCY

***Chett Chiasson**, MPA*

Greater Lafourche Port Commission, Cut Off, LA, USA

Port Fourchon is America's most significant energy services port, servicing over 90% of all Deepwater energy exploration and production in the US Gulf of Mexico, accounting for approximately 1 in every 5 barrels of oil produced in the nation. We do this in a location which is the southernmost in Louisiana, and the most centrally-located port on the US Gulf, immediately on the edge of the Louisiana coast.

In total, over $1 billion of built assets are located in Port Fourchon providing the services needed to locate, produce, and bring ashore approximately 20% of America's oil and gas supply. As such, Port Fourchon leadership recognized long ago that we needed to plan for subsidence and sea level rise, and have been working for over 20 years to take our approach to capital planning beyond the sustainable development of our Port to one of Holistic Resiliency.

As we have implemented our Northern Expansion development, we have built our grey infrastructure higher and harder, by building our development lands, bulkheads, roads, and other infrastructure to higher elevations intended to outstrip the rate of subsidence and sea level rise. Additionally, we have methodically surrounded these grey infrastructure works with green infrastructure, constructing and/or restoring over 1,000 acres of marsh and cheniere forested ridge habitat as critical natural protective buffers to these built assets through the mitigation works required to offset our development.

Port Fourchon works closely with a host of partners ranging from our tenants in the energy industry to state and federal agencies, environmental and conservation non-profits and non-governmental organizations to protect our nation's critical energy infrastructure in a manner that adds or replaces habitat value to Louisiana's critically-imperiled landscape so that we can be truly holistically resilient.

PRESENTER BIO: Chett Chiasson is the Executive Director of the Greater Lafourche Port Commission, the public entity which manages both Port Fourchon and the South Lafourche Leonard Miller Jr Airport. Chett received both his undergraduate degree in Political Science and his Masters of Public Administration from Louisiana State University. Born and raised along Bayou Lafourche, he resides in Cut Off, Louisiana.

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MULTIPLE TOOLS FOR DETERMINING THE FATE OF NITRATE IN A DELTAIC FLOODPLAIN

Alexandra Christensen[1]*, Edward Castañeda-Moya*[2] *and Robert Twilley*[1]
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Large nitrogen loads to the Mississippi River watershed lead to high nitrate concentrations within coastal Louisiana and can have harmful effects on coastal ecosystems in the Gulf of Mexico. Connectivity describes the exchange between channels and floodplains and ultimately controls delivery of nitrate-enriched water to floodplain wetlands, where nitrate can be removed. Within any given delta, connectivity is controlled by tides and wind events (hourly), river discharge and vegetation (seasonally), and geomorphology (yearly). This project focuses on the hourly scale, as tides move water into and out of a floodplain and temperature encourages or discourages biogeochemical activity. Field sites at Wax Lake Delta (WLD), a prograding delta in southeastern Louisiana, were used to study the fate of nitrate within subtidal and intertidal freshwater marshes. Two 10m by 1m open-air chambers were enriched with $^{15}NO_3$ to study the transformation of nitrate in these systems. These sites vary in elevation relative to the tidal datum and dominant vegetation. Experiments were run in April at the start of the growing season. Relative contributions to nitrate removal from denitrification, biological uptake, and dissimilatory nitrate reduction to ammonium were measured throughout these experiments, with a total nitrate disappearance of 812µmol/m2hr and 78µmol/m2hr in the intertidal and subtidal chambers, respectively. These results are also used to parameterize a Delft3D-Water Quality model, which was coupled with our Delft3D-Flow model for January-June of 2015. Preliminary model results show spatial trends matching previous field observations, with lower nitrate concentrations in the intertidal wetlands and higher concentrations in the subtidal wetlands, similar to values in the distributary channels. These results highlight the importance of residence time and biological potential for nitrate uptake. Better quantification of residence time and connectivity between the channels and floodplains is still being pursued and will be essential to understanding the role of deltaic floodplains, such as Wax Lake Delta, in nitrate removal from rivers. Together these field and model experiments can also be useful in understanding the impact of restoration projects, such as sediment diversions, on an ecosystem's nitrogen budget.

PRESENTER BIO: Alexandra Christensen is a Ph.D. student in Oceanography and Coastal Sciences at Louisiana State University. Her research focuses on deltaic floodplain hydrodynamics and nitrate biogeochemistry. She maintains a system of monitoring stations at Wax Lake Delta, LA and carries out field and model experiments related to connectivity and nitrate processing.

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ENVIRONMENTAL FLOWS IN LOUISIANA: A STATEWIDE WATER BUDGET FRAMEWORK AND A PILOT STUDY FOR ASSESSING FRESHWATER FLOW IMPACTS TO LOUISIANA ESTUARIES

***Ryan Clark**, Scott Hemmerling, Melissa Baustian, Eric White, Yushi Wang, Harris Bienn, and Andrea Jerabek*
The Water Institute of the Gulf, Baton Rouge, LA, USA

The Water Institute of the Gulf (the Institute) has developed a framework to analyze available resources and demand for both surface water and groundwater across Louisiana, allowing researchers to analyze available water supplies and the consumption levels of various end users, including public supplies, agriculture, and industry. Case studies in the Carrizo-Wilcox, Chicot, and Southern Hills aquifers were used to test the assessment framework and its applicability under various use scenarios. By projecting the population and urbanization of communities into the future, evaluating energy costs and salinity levels, and studying coastal requirements for freshwater, the Institute is finding new ways to manage Louisiana's water and coastal resources. The research and data collected will help policymakers make informed decisions about water use and ensure that Louisiana will have an adequate supply of freshwater for public drinking as well as agricultural and industrial use.

One of the key uncertainties of the water resources framework was determined to be the quantity of freshwater necessary to be delivered to coastal estuaries by rivers. Freshwater input serves several essential ecological functions, including the regulation of salinity, and delivery of nutrients and sediments from the watershed. To begin quantifying these environmental flows, the Institute performed a pilot study to determine the effects of changing freshwater inflow of the Amite River to the marshes and swamps around Lake Maurepas. The Institute developed a state of the art computer model that has previously been used to determine the hydrologic, ecological, and land change effects of Louisiana coastal restoration projects from the Coastal Protection and Restoration Authority (CPRA) 2017 Coastal Master Plan. This project adapted that model to determine the ecological responses of the wetlands, swamps, and estuaries to variations in riverine freshwater input. It illustrated how variations in the flow of rivers such as the Amite can have effects on the suitability of habitats for key fish and wildlife species, as well as how it affects the distribution of wetland vegetation types over time. The methods developed in this pilot study can be adapted and used in coastal riverine systems across Louisiana, nationally, and around the world.

PRESENTER BIO: Ryan Clark is a Geologist at The Water Institute of the Gulf, with over 15 years of experience in large, multidisciplinary projects. His work includes research on water resources, flooding, and environmental flows. Clark earned a BS in geology from LSU, and an MS in earth science from Tulane University.

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IMPACTS TO SURGE AND WAVES DUE TO THE 2017 COASTAL MASTER PLAN

Zachary Cobell *and Hugh Roberts, PE*
Arcadis US, Highlands Ranch, CO USA

As part of Louisiana's 2017 Coastal Master Plan, simulations of hurricane-induced storm surge and waves have been conducted to determine the benefits of both individual projects as well as how projects interact with each other. The types of projects considered fell into two categories: structural risk reduction, such as levees, and restoration projects, such as march creations and diversions. The simulations identify two important aspects of how these projects interact with Louisiana's landscape. First, using simulations to predict how the implementation of risk reduction projects will displace water is critical to limiting induced damages and maximizing project benefits. Second, understanding how restoration projects can alter the design characteristics of adjacent structural risk reduction projects is important for the design and adaptive management of projects. During this presentation, examples for projects along the Mississippi River will be highlighted.

PRESENTER BIO: Zach is a water resources engineer specializing in large scale coastal, riverine, and hydrologic applications. He has successfully developed and applied models designed to analyze hurricane storm surge and waves, hydraulic scour analysis, sea level rise, coastal restoration impacts, levee design and feasibility studies, and water quality.

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MODELING STORM SURGE SUPRESSION IMPACTS IN GALVESTON BAY

Zachary Cobell[1], *Paul Tschirky*[1], *PhD, PE, Falcolm Hull*[1], *Chris Salise*[2], *Hugh Roberts*[1], *PE*
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The protection of the population and the critical infrastructure along the coastal and Galveston Bay has received significant attention since Hurricane Ike. Various dike and storm surge suppression and flood reduction barrier systems have been and are currently being proposed and studied to reduce the vulnerability of the upper Texas coast to storm surge and associated flooding. This study examines the modeling of the impacts of some of these proposed storm defenses from the perspective of both reducing risk due to storm surge and waves, as well as daily hydrodynamics and environmental conditions within Galveston Bay.

Galveston Bay is linked to the Gulf of Mexico through 3 main passes with the Houston Ship Channel at Bolivar Roads being the main conveyance pathway. Seven main freshwater inputs enter the system throughout the upper reaches of the bay. Given the geometry of the bay and the fact that storm surge suppression alternatives would include gated structures significantly reducing the cross-sectional area for flow in the 3 main passes, a flexible mesh model was desired. A combination of Deltares' D-Flow Flexible Mesh and ADCIRC were selected for this task.

Storm surge simulations were conducted using the coupled ADCIRC+SWAN storm surge and wave model. These simulations consisted of running hundreds of synthetic hurricanes developed during the FEMA Flood Insurance Rate Map study in Louisiana and Texas incorporating projected sea level rise values in 2085. Results were analyzed to understand the economic benefits associated with project alternatives along the Texas coast.

During non-storm periods, the storm surge suppression features, particularly gates, must be designed to ensure limited adverse impacts to the environmental conditions within the bay. Model validation was conducted for a historical three-year period, followed by simulations of the same three-year period with the storm surge suppression measured installed and gates open to understand impacts to salinity, water levels, and discharge through the gate openings. A series of gate configurations were analyzed to understand how to maximize discharge and minimize cost.

Results are presented from both phases of this work showing performance of the structures during both hurricane and daily conditions followed by recommendations for future work that will be important for understanding in greater detail how different vegetative and wildlife species might be impacted, as well as navigational considerations.

PRESENTER BIO: Zach is a water resources engineer specializing in large scale coastal, riverine, and hydrologic applications. He has successfully developed and applied models designed to analyze hurricane storm surge and waves, hydraulic scour analysis, sea level rise, coastal restoration impacts, levee design and feasibility studies, and water quality.

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NATURAL AND NATURE BASED FEATURES FOR COASTAL PROTECTION

Georganna B. Collins
Ecology and Environment, Inc., Houston, TX, USA

Working with Nature is an integrated process which involves means and methods to develop win-win solutions with respect to nature and projects that provide economic development and coastal protection. Working with nature has become a program launched in 2013 called Engineering With Nature (EWN) at the U.S. Army Corps of Engineers' Engineering Research Development Center that enables more sustainable delivery of economic, social, and environmental benefits associated with water resources infrastructure projects, such as navigation channel maintenance and inland stormwater management. As part of this EWN Program, in response to Hurricane Sandy recovery efforts, in 2015 a report on the Use of Natural and Nature-based Features (NNBF) for Coastal Resilience was prepared classifying NNBF, characterizing vulnerabilities, developing performance metrics, and addressing key policy challenges. To date, international guidelines are being developed to inform the conceptualization, planning, design, engineering, construction, and maintenance of NNBF used to support resilience and flood risk reduction for coasts, bays, and estuaries. This presentation highlights NNBF Guidance Document content addressing beaches, dunes, barrier islands, marshes, seagrass beds, and reefs.

PRESENTER BIO: Ms. Collins is a chief Landscape Architect and project manager with more than 20 years of experience planning, designing, and implementing habitat restoration construction projects. She has extensive experience with stream and river restoration, wetland restoration and habitat creation along the Mississippi River and coastal streams in Mississippi, Alabama, Texas, and Louisiana and has led more than 50 projects dedicated to preserving and restoring coastal shorelines nationally and internationally and is currently working with USACE and ERDC and others on preparing the International Guidelines for NNBF.

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ADVANCING EQUITY IN URBAN RESILENCE

Robert Collins
Dillard University, New Orleans, LA, USA

Within the last decade, Southeast Louisiana has become a global hub of resilience, disaster management, and innovation. As we continue to advance resiliency in the region, it is crucial that marginalized communities such as low-income communities and communities of color don't disproportionately bear the costs and are included in processes that promote progress in the region. In addressing the issues common to urban resilience, such as climate change, coastal land loss, water quality, and storm water management, there must also be a pointed effort to promote economic and environmental equity. One way to do this will be by ensuring marginalized individuals are able to enter the field and are also given fair access to the wide array of middle-skill jobs within the field.

As one of the few historically black universities in the state, Dillard University has long focused on targeted approaches to closing the equity gap in Southeast Louisiana. Whether through their Deep South Center for Environmental Justice or their forthcoming program in Urban Water Management, Dillard is constantly thinking of ways to create a pipeline of students entering middle-skill positions that are dedicated to building resilience and improving the urban environment. In essence, they are training and preparing a number of skilled workers that will help to diversify the region's workforce.

This presentation will discuss the importance of investing in local higher education institutions to help communities in Southeast Louisiana build resilience against natural and man-made disasters. It will also explain the importance of promoting equity, diversity and inclusion in the field of urban resilience. Doing so will ensure that any and all steps taken to develop strategies in resiliency will reflect the diversity and vibrancy of the region.

PRESENTER BIO: Dr. Robert Collins is Professor of Urban Studies and Public Policy at Dillard University, as well as a writer, speaker, and consultant specializing in urban politics, urban planning, and in understanding, preventing, and recovering from disasters. As an experienced university administrator, he served as the Founding Dean of the College of Arts and Sciences at Dillard University.

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ADAPTIVE TRANSITIONS: THE LONG -TERM PERSPECTIVE ON HUMANS IN CHANGING COASTAL SETTINGS

Craig E. Colten
Louisiana State University, Baton Rouge, LA, USA

There is ample discussion about community resilience and adaptation to changing environmental conditions. These vital discussions suggest that multiple, disjointed adaptations can propel coastal societies toward a viable future. What they lack is a sufficiently long-term perspective that considers the wide range of place-based cultural, social, economic, technological, and political factors that must blend together for a successful and sustainable transition. This paper will compare the concepts of adaptation and transition as they relate to the human coast of Louisiana and critique the absence of transition planning for Louisiana's coastal future. Using a diverse set of historical records on past environmental management projects, I will contrast the adaptations imposed on local societies with successful transitions in other situations. Science-based planning for coastal protection and restoration has largely neglected the social values, cultural norms, and belief systems embraced by the population of coastal Louisiana. An underlying assumption is that society will adapt. This perspective lacks both a sufficient temporal horizon and recognition of social complexity to incorporate adaptive transitions into the planning process. I intend this critique to highlight how past imposed adaptations do not lead to successful transitions. I will argue for a historically informed process that considers the past challenges and the potentials for merging science-based planning of the biophysical coast to mobilize adaptive transitions of the human coast.

Presenter Bio: Craig E. Colten is the Carl O. Sauer Professor of Geography at Louisiana State University. He has written several books on the environmental historical geography of Louisiana.

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SUPPORTING COASTAL OUTREACH WITH THE COASTAL INFORMATION MANAGEMENT SYSTEM (CIMS)

Craig Conzelmann[1]*, Charles R. Villarrubia*[2]*, Christina Hunnicutt*[1]*, and Edward L. Haywood III*[2]
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The Louisiana Coastal Protection and Restoration Authority (CPRA) has for nearly a decade made its coastal protection and restoration data and information widely available on the internet using a web-enabled, GIS-integrated system called SONRIS. Recently, ever growing responsibilities, an increase in data generation, and the need to deliver this information in a timely and efficient manner have inspired an effort by the CPRA to significantly improve its data management and delivery capabilities. The first step was the development of a Data Management Plan in January 2013 through a partnership with The Water Institute of the Gulf. The CPRA then partnered with the U.S. Geological Survey's National Wetlands Research Center (USGS) to produce the CPRA Coastal Information Management System (CIMS) in an effort to redesign its data management and delivery capabilities. As of the summer of 2014, CIMS is a combined network of websites hosted by CPRA (www.coastal.louisiana.gov), a GIS database, and a project relational database into one GIS-integrated system capable of robust visualizations. In addition to background information on the State's coastal protection and restoration programs, CIMS will also include a wide variety of up-to-date information such as program documents, satellite imagery, aerial photography, USGS quad maps, project information and boundaries, project infrastructure (including levees, floodwalls, and pump stations), monitoring station locations (CRMS-Wetlands), elevation benchmarks, ecological data, geophysical data, and information on the State's coastal community resiliency program. Users are able to perform a wide range of custom data retrievals for refining and summarizing information including enhanced graphing capabilities. Other specific types of data and information that will be available include hydrographic, meteorological, vegetation, soil properties, sediment elevation, bathymetric and topographic survey, wildlife, and fisheries data.

Large scale natural resource management requires sound data management that makes past data and information on project and program effectiveness available to project planners, engineers, and scientists. Also of critical importance is making coastal protection and restoration program information readily available to interested parties outside of the CPRA. Academic researchers can use the data generated by the program to improve the science informing the decision-making process. The public can use the information to understand how current and future program actions will affect their daily activities, which helps promote program transparency.

PRESENTER BIO: Craig Conzelmann is the team lead of the Advanced Applications Group operating out of the USGS Wetland and Aquatic Research Center. His team is one of only five software development groups operating in the USGS. He has over 20 years' experience designing and managing data driven desktop and web applications that blend ecological, tabular data with geospatial information to help resource managers make informed decisions.

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PHASED IMPLEMENTATION OF LONG DISTANCE SEDIMENT PIPELINE MARSH CREATION PROJECTS

***Nicholas Cox**, and Chris Williams*
Moffatt & Nichol, Baton Rouge, LA, USA

The presentation will center on marsh creation projects completed within the Barataria Basin along the Long Distance Sediment Pipeline corridor. Included is a discussion on sediment resources within the river near the Alliance Anchorage borrow area, and analysis of observed vs modeled infill rates for dredge borrow areas. Lessons learned from past dredge and fill activities can be used to inform future planned marsh creation work along the Long Distance Sediment Pipeline Corridor, as provided within the Louisiana Technical Implementation Group's Draft Restoration plan. Scenarios for adaptive management of the borrow site and phased implementation of the Draft Restoration marsh creation projects will be discussed.

After nearly 15 years of planning, permitting, design and construction of four separate marsh creation projects, nearly 1500 acres of marsh creation have now been constructed within the sediment starved Barataria Basin to aid in the reconstruction of the Barataria Landbridge. Each of the four projects utilized the Alliance Anchorage borrow area, providing a unique opportunity to analyze the use of the borrow area. Included will be a detailed analysis of the volume pumped during the construction of each project, followed by analysis of the rate of infill within the borrow area. This infill analysis can be compared to morphological modeling of sediment infill which was completed during the design of the Long Distance Sediment Pipeline project with the Delft3D software suite. The efficacy of morphological modeling for infill rates can be determined and discussed.

Finally, as part of the BP Oil Spill restoration process, the Louisiana Technical Implementation Group has published a draft restoration plan that included four separate marsh creation areas within the vicinity of the Long Distance Sediment Pipeline corridor. The presentation will discuss the merit of continuing to use the Alliance Anchorage borrow area and the corridor to complete construction of these potential marsh creation areas. Based on the results of the infill analysis, a probabilistic look at how available sediment volumes can be used to inform adaptive management of the borrow area and phased construction of the marsh creation areas.

PRESENTER BIO: Mr. Cox is a Coastal Engineer with over 6 years of experience planning, designing, and implementing coastal engineering projects in southern Louisiana including the design of over 300 acres of marsh creation, and the construction administration of over 1100 acres of marsh creation.

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SHELL BERMS, SHELL BERMS WHAT DO I SEE: I SEE MARSH-EDGE COLLAPSE LOOKING AT ME

***Frances Crawford**, and Mark Kulp*
University of New Orleans, New Orleans, LA, USA

Analysis of land loss of the southeastern Louisiana Biloxi Marsh indicates that 6.92 km^2 were lost between 1932-1995 and 11.19 km^2 for the interval of 1998-2010 (Couvillion et al., 2010). It has been suggested that interior ponding and wave erosion are dominant geomorphologic processes that lead to marsh degradation across the Biloxi Marsh. A unique characteristic of the Biloxi Marshes are the localized accumulations of large, marsh-edge parallel berms constructed of Holocene calcareous shells. Locally, berm heights are as much as 1 meter above MSL, hundreds of meters long, and several meters wide. Our work suggests that one mechanism contributing to marsh edge erosion is the presence of calcareous shell accumulations, which locally smother the marsh edge vegetation and cause dieback. In order to better understand the origin of these shell berms and their transportation onto marsh islands, we analyzed satellite imagery, time-series GPS data on berm polygons, grab samples, and above and below ground biomass along transects spanning the marsh edge-berm-interior marsh. Preliminary results indicate berms are primarily composed of *Crassostrea virginica* (with 9 less prevalent species), whereas offshore grab samples lack appreciable quantities of shell material indicating a remote or inconsistent source or excavation from deeper subsurface offshore strata. Transposition of shell berms onto and across the marsh platform coincide with high energy events that lead to elevated water levels and wave heights. Accumulated shells smother the marsh-edge vegetation, are later transported farther inward, and consequently expose a degraded marsh-edge platform that is more susceptible to erosion.

PRESENTER BIO: Crawford received her undergraduate degree in Geology and Geophysics at LSU, working at their Coastal Studies Institute on Holocene stratigraphy research. Her interests in coastal geology have continued as Masters Student at UNO, taking classes focused on coastal studies and studying the geomorphology of shell berms in the Biloxi Marsh.

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PATH FORWARD

Josh Crowe[1]*, Brad Barth*[2]*, and Rudy Simoneaux*[2]

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For the final part of the session, we will provide a schedule of milestones for Mid-Barataria and Mid-Breton Sediment Diversions, including the following work packages: design, construction, permitting/regulatory, and land acquisitions. We will provide a high-level assessment of the critical path activities that could affect project completion dates. Given the complexity of these large projects, risk and change management are part of the routine workflow for the Program Team. We will present the key risks to schedule and examples of how the Team has anticipated and managed such risks. Our discussion will conclude with potential future opportunities that can improve the pace or efficiency for the individual projects.

PRESENTER BIO: With over 20 years of experience in complex project management and large-scale program delivery, Mr. Crowe serves as Program Controls Manager of the Sediment Diversion Program and Project Manager of the Mid-Barataria Sediment Diversion Project.

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IMPLEMENTING PROCESSES TO INSTITUTIONALIZE PROJECT LEVEL STAKEHOLDER ENGAGEMENT AND OUTREACH

Morgan Crutcher
Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

Stakeholder engagement is an essential component of adaptive management at the project and program scales. Involving stakeholders in planning ensures transparency and consideration of stakeholder interests, values, ideas, experiences and expectations in decision-making. Engaging and collaborating with stakeholders builds trust, thereby increasing the likelihood of support for the restoration process by providing a common vision of success and creating the opportunity to resolve conflicts. It can limit costly delays from legal actions and support policy clarifications by building trust and shared understanding about the need for an individual project. Examples of stakeholder engagement include collaboration with federal, state, and local agency partners, non-governmental organizations, landowners and local community groups. The most prominent stakeholder engagement and outreach agency effort is the Coastal Master Plan process which includes a number of avenues by which stakeholders are engaged, from advisory boards and technical committees, to citizen groups and meetings with elected officials. A variety of funding sources through which CPRA projects and program are implemented (such as CWPPRA, NRDA, and RESTORE) also have specific outreach and engagement strategies that overlap or coincide with those of CPRA.

Opening and maintaining two-way communication pathways among stakeholder groups is critical to adaptive management. This presentation will document a new initiative CPRA is undertaking at the project level to standardize and streamline stakeholder engagement across projects and agency divisions and sections; develop an institutional knowledge base that exists across administrations; integrate internally across staff units; integrate externally with funding sources and programs existing processes, and facilitate social learning towards an end of elevating public understanding of agency work.

PRESENTER BIO: In her capacity as the Outreach and Engagement Manager for the Coastal Protection and Restoration, Morgan Crutcher …. She received her M.S. in Natural Resource Policy from the University of Michigan and a bachelors in Environmental Studies from Loyola University, New Orleans.

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ASSESSING THE WESTERN CAMINADA-MOREAU HEADLAND'S SHORELINE, ELEVATIONAL, VEGETATIVE, AND AVIAN RESPONSE TO BEACH, DUNE, AND MARSH CREATION

Glen Curole
Coastal Protection and Restoration Authority of Louisiana, Thibodaux, LA, USA

The TE-52 project is a beach, dune, and marsh creation restoration project. This project is located at the western terminus of the 27 km long Caminada-Moreau Headland. Elevation grid models were created using topographic and bathymetric survey data to determine volume changes in the project areas. Shoreline position data were analyzed to estimate shoreline changes along the Gulf of Mexico shoreline. Thirty randomized vegetation plots were placed in both the beach and dune creation area and the marsh creation area and these plots were sampled using the semi-quantitative Braun-Blanquet method. Post-construction winter shorebird surveys were conducted bi-monthly from late July thru April of each winter season. The headland length is currently expanding laterally due to longshore transport of beach and dune sediments to the downdrift spit, which is aggrading and elongating. However, a sizeable volume of sediment was removed from the beach and dune area during the early post-construction intervals due to severe dune scarping, overwash, and leveling. All the segments of the dune that were installed parallel to the Gulf of Mexico shoreline were leveled or severely scarped forming washover and dune terrace landforms that consists of narrow beaches and small berms.. While a substantial volume of sand was eroded from the beach and dune area, the 2015-2017 elevation data shows that 78% of these released sediments were retained within the system and conserved in the spit. These shoreline transgressions were probably induced by the passage of Hurricane Isaac, winter storms, and the influence of the Belle Pass Rock Jetties. While shoreline transgressions occurred along the Gulf of Mexico shoreface, the marsh creation area experienced only minor shoreline transgressions. Moreover, the longevity of the headland seems to have been prolonged by creating a wide back barrier marsh platform, which reduces the possibility of breaching and inlet formation. Currently the marsh platform consists primarily of salt flat habitat which does not support marine fisheries utilization. Although the embryonic tidal creeks have formed and vegetative cover has slightly increased in this project feature, gapping or natural breaching of the containment dike is needed to improve tidal exchange between Timbalier Bay and the marsh platform. The beach and spit habitats created by the project are being utilized by shorebirds and their foraging habitats are expanding. As a result, the shorebird data provides evidence showing that spit formation can increase the acreage available to shorebirds.

<u>PRESENTER BIO</u>: Glen Curole is a coastal resources scientist in the operations division of CPRA. During the past seventeen years, he has assessed the outcome of numerous restoration efforts. He has considerable experience with barrier island restoration, marsh creation, living shoreline, breakwater, sediment diversion, swamp restoration, shoreline protection, and hydrologic restoration projects.

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HOT SPOT EROSION ON GRAND ISLE, LA – IDENTIFICATION AND CAUSES

Victoria Curto[1]*, Arpit Agarwal*[2]*, and Josh Carter*[2]
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Grand Isle, located in Jefferson Parish, Louisiana, is the only inhabited barrier island in Louisiana. For more than 60 years, multiple coastal engineering projects have been constructed across the Grand Isle shoreline, which have resulted in a relatively stable Gulf Shoreline over the past decade. Over the past several years, chronic erosion has accelerated at the southwest end of the island, requiring continual maintenance to mitigate damages to the existing dune and island. This presentation discusses the identification and causes of the chronic erosion at this hot spot.

A coastal engineering analysis was conducted to develop an understanding of the processes controlling the shoreline morphology along Grand Isle with an emphasis on its southwest end. A statistical analysis of offshore wind data and subsequent nearshore wave hindcasting was performed to determine sediment transport pathways. The predominant direction of wave generated sediment transport is towards the northeast along the island except at the western end of the island where transport is bi-directional with localized accretion along the west jetty. Numerical modeling of the nearshore waves indicates that the Caminada Pass ebb shoal modifies the wave transformation near the west end of the Island so that the nearshore wave climate results in a divergent node in sediment transport despite the fact the overall net sediment transport is directed to the northeast. This divergent node results in an erosional hot spot which has led to severe erosion at that nodal point and accretion on the west jetty.

Previous studies have identified that the Barataria Bay tidal prism is increasing which results in an increase in the cross-section of the passes between the Bay and the Gulf of Mexico, along with subsequent growth of the shoals at the passes. Therefore, a morphologic analysis of the Caminada Pass ebb shoal bathymetry was conducted by comparing historical bathymetry. The morphologic analysis indicates a seaward migration of the Caminada Pass ebb shoal, modification of bottom contours immediately offshore of the western end of the island, deepening of Caminada Pass channel, and a shift of the ebb shoal attachment point. These observations correspond with expected morphological response of the ebb shoal to the increasing tidal prism of the Bay. Wave modeling was conducted to evaluate the change in nearshore wave-generated sediment transport resulting from the ebb shoal morphology. Results showed that as the ebb shoal grows, the attachment point on Grand Isle has shifted toward the West Jetty, and the refraction associated with evolving bathymetric contours results in a concentration of wave energy near the LA 1 bridge connection point leading to divergent node in the longshore transport and therefore, an erosional hot spot.

The future trends in ebb shoal morphology are expected to further strengthen this hot spot. This evaluation indicates that the understanding of the Grand Isle coastal processes is key for developing successful solutions to stabilize the island shoreline and protect the integrity of the dune and the island at this critical point. This morphologic response is not limited to Grand Isle: as the bays along the Louisiana coast continue to subside and deepen, leading to increased tidal prism, we expect similar changes to shoreline morphology along Louisiana's Barrier Islands.

PRESENTER BIO: Mrs. Curto, a UCLA and TU Delft alumna, is a coastal engineer with experience in planning, designing, and implementing coastal engineering projects. She has experience with coastal processes analysis and modeling as well as design of coastal structures.

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EVALUATION OF SMALL UNMANNED AERIAL SYSTEMS (SUAS) AS A LEVEE MONITORING TOOL

***Brennon Dardar[1]**, Balaji Ramachandran[1], Frank Yrle[2], and Gary LaFleur, Jr.[2]*

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Since 2005, Nicholls Geomatics Program is pioneering in the adoption of small Unmanned Aerial Systems (sUAS) for Coastal restoration and monitoring, Deepwater oil and gas production platform inspection, Critical infrastructure monitoring, Levee monitoring, Surveying, and park management applications. Nicholls obtained the Federal Aviation Administration (FAA) Certificate of Authorization (COA) in 2016 to study the Morganza to the Gulf levee system constructed and maintained by the Terrebonne Levee and Conservation District (TLCD) using sUAS. The study area is "Reach F" which is a five-mile portion of the Morganza to the Gulf levee system. The primary objective of the study is to evaluate the effectiveness of sUAS for monitoring levee structural stability and compare the accuracy of sUAS deliverables against conventional topographic surveying methods. The deliverables include a 2 cm to a pixel high resolution Orthomosaic image, a 10 cm Digital Surface Model (DSM) and 3D dense point clouds (photo derived). The methodology involves gaining survey control monuments used in the original levee surveys from TLCD. A monument near the levee system was used to perform Real Time Kinematic (RTK) Global Positioning System (GPS) surveys to establish a 100ft grid reference grid and critical points along Reach F. The reference data were used to verify the accuracy of the orthomosaic and DSM. Similarly, a Terrestrial Laser Scanning System (TLS) was used to generate a digital terrain model (DTM) of the levee using the same control network. An analysis of sUAS photo adjustments showed that ±1.6mm horizontal and ±2.1mm vertical error on the checkpoints used in the photo missions. We found about 80% of the reference points compared against DSM points were less than 2.4 cm which is within the error tolerances of RTK survey methods. We are currently comparing the volume and cross section area estimates obtained from conventional surveying methods and TLS DTM against sUAS derived DSM. Preliminary results indicate that sUAS is a far superior method in monitoring the levees in South Louisiana.

PRESENTER BIO: Mr. Brennon Dardar is an undergraduate student pursuing a Geomatics degree at Nicholls State University. Born and raised in southeastern Louisiana, Mr. Dardar grew as a young man hunting, fishing, and trapping in coastal areas which are vanishing. He plans to use geospatial technologies to preserve and restore the beautiful coast of Louisiana.

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ADAPTING TO A CHANGING COAST – POINTE-AU-CHIEN'S EFFORTS TO PROTECT CULTURE, LIFEWAYS, AND SACRED SITES

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Pointe-au-Chien inhabits and protects its traditional territory located in the Terrebonne Basin. The once fertile area supported numerous villages—such as En Bas La Pointe, Fa La, L'esquine, or Felicity Island—many of which are now inhabitable due to land loss and salt water intrusion. The culture, lifeways, and sacred sites of the Pointe-au-Chien people are connected to this traditional territory even though some of it may be seen as unusable to the outside world. The cultural practices associated with Pointe-au-Chien is integral to the identity of not only the Tribe, but to each individual Tribal member.

Since the early 1900s, Pointe-au-Chien people have continuously adapted to the changes to the coast, whether it was developing a fresh water catch basin, reducing agricultural production, relocating further up the bayou, or elevating our homes. In more recent times, the struggles to adapt are becoming more challenging due to outside influences and the increased rate of land loss. Notwithstanding, Pointe-au-Chien is committed to maintaining and preserving its cultural heritage for future generations through the development of adaptation measures and strategies.

While the primary strategy to maintain cultural heritage is to obtain federal recognition in order to clarify the legal status of the lands and government, the Tribe has also developed other adaptation strategies. The Tribe's adaptation goals are to maintain the community's language, cultural, and history, while encouraging others to recognize the importance of preserving one of oldest continuously inhabited communities on the Louisiana Gulf Coast. One strategy has been to work with its partners to secure funding in order to protect sacred sites that are eroding due to unnecessary cuts in the land by extractive industries. Another strategy includes preparing a National Register application to recognize the traditional lands of the Pointe-au-Chien as a traditional cultural landscape. In addition to protecting sacred sites, the Tribe has successfully advocated for grants to create both a community garden to grow and share foods that can no longer grow in the traditional territory and is in the process of creating a raised medicinal garden to continue growing medicinal plants that are threatened by salt water intrusion. The Tribe has also been very active in documenting traditional ecological knowledge, the history of the Tribe, and mapping traditional cultural properties in an effort to preserve them. All of these strategies require a balance of sharing knowledge while maintaining confidentiality of certain information.

PRESENTER BIO: Theresa Dardar is an elder and a community leader who advocates to protect the land and lifeways of the Pointe-au-Chien Indian Tribe. Her work has recently been focused on food sovereignty. She has served on the Tribal Council, and serves on numerous boards on behalf of the Pointe-au-Chien Indian Tribe. She is currently the President of the First People's Conservation Council.

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IMPROVING OUR UNDERSTANDING OF FAULTS AND SALT DOME INTERACTIONS IN SOUTHEASTERN LOUISIANA'S SUBSURFACE

Nancye H. Dawers
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The integration of subsurface geological and geophysical datasets into Louisiana's coastal master plan provides a means for understanding feedbacks between surface processes and processes that drive subsidence in many deltaic settings. In particular, the role that faults and salt structures play in affecting the Mississippi River delta plain have long been appreciated, but have remained poorly studied because of the lack of accessibility of high-quality subsurface datasets. Recently, an effort led by the New Orleans Geological Society and a number of energy-sector companies has resulted in several Louisiana universities gaining access to 3d seismic reflection data, fault trace maps, well and biostratigraphic data.

Results of this ongoing work are providing more accurate assessments of fault-related subsidence, the overall framework of shallow faults, and the interaction between faulting, sediment loading, compaction and salt flow/withdrawal. A broader scientific impact of this work is that gravity-driven faults in deltaic settings may be good candidates for shallow aseismic fault creep and slow-slip phenomena. At least several segments within the GMFZ are characterized by marsh breaks that formed aseismically over timescales of days to months, such as near Adams Bay and Lake Enfermer. The 1943 Vacherie faulting event had similar characteristics. I propose that a series of positive feedbacks keep the faults active in the near surface. These include differential sediment loading, compaction, mechanically weak fault surfaces, high fluid pressure, low elastic stiffness in surrounding materials, and low confining pressure.

In general, the late Quaternary fault population consists of the Baton Rouge-Tepetate fault zone, the Lake Pontchartrain-Lake Borgne fault zone, the Golden Meadow fault zone (GMFZ), and a major salt withdrawal structure - the Bay Marchand-Timbalier Bay-Caillou Island salt complex and West Delta fault zone, which lies just offshore. Relative to the more northerly fault zones, the GMFZ is significantly salt-involved. Salt's material properties are such that it flows at depth's greater than a few kilometers, is virtually incompressible, and hence buoyant relative to more compressed surrounding sediments. Salt structures occur along the GMFZ with brittle fault segments ending near or within the more ductile salt. Deltaic surface processes, which are highly dependent on local subsidence, are expected to vary depending on the distribution of salt structures and faults.

A better understanding of the geological and geophysical properties within the upper few kilometers should be a required component of current and future coastal master planning efforts.

PRESENTER BIO: Dr. Dawers is an Associate Professor at Tulane's Department of Earth & Environmental Sciences. She is a structural geologist with >30 years of experience. She has extensive experience with brittle fault growth, fault interaction and linkage. Her work on rifting, Basin & Range topography, and deltaic faulting is widely recognized.

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MISSISSIPPI DELTA RESTORATION: SHIFTING BASELINES, DIMINISHING RESILEINCE AND GROWING NON-SUSTAINABILITY

John W. Day
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Ecosystems and human communities of the Mississippi delta developed with predictable basin inputs, stable sea level, and as an open system with a high degree of interaction among drainage basin inputs, deltaic plain, and the coastal sea. Human activity altered the coast and lowered predictability. Management has become very energy intensive and dependent on cheap resources with more hard engineering and less ecological engineering. Pervasive alteration of the basin and delta and global change have altered the baseline and change is accelerating. Climate change projections include not only sea-level rise, but also more stronger hurricanes, increased large river floods, and more intense rainfall events and droughts. A $50 billion, 50-year comprehensive master plan is currently underway for a sustainable coast. But CMP models predict loss of most coastal marshes and implementation of energy-intensive management activities. There will be an increasing likelihood that such energy-intensive management will become increasingly unworkable and unaffordable with sea-level rise and increased energy costs. Living below sea level will become increasingly untenable. There will be recurring disasters without sustainable recovery. A sustainable Mississippi is outside of the boundaries of the current CMP.

PRESENTER BIO: Dr. John Day is an emeritus professor in the Dept. of Oceanography and Coastal Sciences at LSU. He has nearly 50 years of experience studying the Mississippi delta and other coastal systems world-wide. He has published nearly 400 scientific articles and 14 books.

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USING ECOSYSTEM MODELING TO EVALUATE TRADE-OFFS IN COASTAL MANAGEMENT: EFFECTS OF LARGE-SCALE RIVER DIVERSIONS ON FISH AND FISHERIES

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A coupled ecosystem modeling approach was used to evaluate how select combinations of large-scale river diversions in the lower Mississippi River Deltaic Plain may affect the distribution, biomass, and landings of fish and shellfish over decades relative to a future without action. These river diversions are controlled openings in the riverbank of the Mississippi River designed to reintroduce sediment, water, and nutrients into hydrologically isolated coastal wetlands in order to mitigate wetland loss. We devel-oped a spatial ecosystem model using Ecopath with Ecosim (EwE) software, and prepared it to receive output from a Delft3D hydrodynamic model coupled to primary production models. The Delft3D model provided environmental drivers including salinity, temperature, Chl *a*, total suspended solids, and change in wetland cover as a result of simulated river diversions over decadal model runs. Driver output was averaged either daily, monthly, or annually depending on the parameter. A novel oyster-specific subroutine was developed to incorporate information at daily intervals in Ecospace, while Ecospace runs on a monthly time step. The ecosystem model simulates biomass and distribution of fish and shellfish species, and landings of targeted fisheries species, as a result of environmental changes projected for a preliminary set of management scenarios designed to evaluate and screen select combinations of river diversions. Abundant local field samples and landings data allowed for model calibration and validation.The results of simulations indicate that inflow of Mississippi River water in estuaries may cause local shifts in species assemblages. These changes were in some cases direct effects of decreased salinity, such as locally reduced Spotted Seatrout biomass. Changes in some other species in the affected areas resulted from indirect effects; for example, reduced Chl *a* (as a result of increased TSS) resulted in near-field reductions of Gulf Menhaden. The simulations also showed that local biomass reductions were mostly the result of redistribution, since the scenario with the proposed diversions open had minimal impact on the total biomass or landings of species simulated in the Mississippi River Delta as compared to a future without action. The model and its output were used as a decision support tool to help evaluate and compare alternative management actions. The results of this study played a role in the decision by the Coastal Protection and Restoration Authority to prioritize moving forward to conduct more detailed analyses through engineering and design of the two middle diversions but not the two lower diversions that were tested in this study.

PRESENTER BIO: Dr. de Mutsert is Assistant Professor in the Department of Environmental Science and Policy at George Mason University, and the Associate Director of Research at the Potomac Environmental Research and Education Center. Her area of expertise is coastal and estuarine fish ecology with a focus on ecosystem-based fisheries modeling.

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OVERVIEW OF COASTAL PROTECTION AND RESTORATION IN THE TERREBONNE AND BARATARIA BASINS, LOUISIANA

***Daniel Dearmond**, P.E.*
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Louisiana's coast is an area rich in natural, economic, and cultural resources. The area supports world-class commercial and recreational fisheries and is home to an array of waterfowl, migratory birds, reptiles, and amphibians. The area maintains five of the top 12 ports (by cargo volume) in the United States and is a major energy supplier of our nation's oil and natural gas. The Louisiana coast is also home to more than 2 million people – nearly half of the state's population. This complex and fragile ecosystem is disappearing at an alarming rate (CPRA, 2017 Master Plan). The mission of restoring the diversity of coastal wetland habitats and protecting Louisiana's residents from storm surge is challenging. Louisiana's 2017 Coastal Master Plan provides a means to respond by outlining major strategies for restoration and flood protection and by directing available resources into prioritized projects. While there are many common reasons for land loss across coastal basins, implementation of projects within coastal basins can vary depending on basin-specific attributes such as habitat type, hydrology, availability of natural resources (e.g., sediment resources) or major landscape features (e.g., the Mississippi River). Project implementation and sequencing within a basin may be also influenced by the timing and availability of funding as well as regulations tied to each funding source.

Louisiana's Terrebonne and Barataria coastal basins, located between the Atchafalaya and Mississippi Rivers in south Louisiana, encompass approximately 5,700 square miles and include a wide range of habitats and landscape features, as well as several communities and numerous economic assets and infrastructure (e.g., Port Fourchon). Bayou Lafourche separates the two basins, with Terrebonne Basin to the west and Barataria Basin to the east. The southern-most reaches of the Terrebonne and Barataria Basins are bordered by barrier island complexes that are influenced by marine processes. Large shallow bay systems behind the barrier islands connect the tidally-influenced marshes in the southern portion of the basins. The marshes surrounding the bays are typically fragmented saline marshes, and travelling inland, marshes transition to brackish and intermediate and finally to freshwater marshes along with areas of swamp habitat located in the northern reaches of the basins. These basins have historically experienced high rates of land loss with some subbasins rapidly converting to open estuary. Each subbasin represents unique challenges to implementation of restoration and storm surge risk reduction efforts depending on several factors.

This presentation will provide an overview of the Master Plan restoration and protection strategies for the Terrebonne and Barataria coastal basins. Additionally, on-the-ground progress will be highlighted with an overview of constructed projects and examples of newly funded projects within each basin.

<u>PRESENTER BIO</u>: Daniel Dearmond is a registered professional engineer in Louisiana and holds a B.S. in Civil Engineering from Louisiana State University. He has several years experience as a consulting engineer working on a wide array of projects for both public and private sector clients involving engineering and design, project management, and construction oversight. For the past 15 years, he has worked in coastal restoration and is currently Regional Operations Manager of the CPRA Thibodaux Regional Office, responsible for oversight of project construction, O&M, and monitoring programs in the south-central region of Louisiana.

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ANALYSIS OF MARSH LOSS AND EROSION WITHIN NORTHERN BARATARIA BAY LOUISIANA: THE EFFECTS OF THE DEEPWATER HORIZON OIL SPILL

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The *Deepwater Horizon* oil spill caused varying degrees of oiling in the marshes of Louisiana, USA. In general, oil spills can cause widespread impacts to the structure, function, resilience and sustainability of coastal wetlands depending upon oil type, volume, degree of weathering, mode of contact and other environmental and biotic factors. Impacts of the oil release on the shoreline salt marshes along northern Barataria Bay, Louisiana were investigated. Our sampling sites span Barataria Bay from Wilkinson Bay to Bay Jimmy and represent areas of marsh shoreline classified as reference (no observed oil impact), moderately-oiled (some oiling identified), and heavily-oiled (significant oiling identified) as determined by soil total petroleum hydrocarbon concentrations and field observations. Available aerial images of the region were obtained over a time series to examine time periods representing a period prior to Hurricane Katrina (1998-2004), during Katrina (2004-2005), after Katrina but before the oil spill (2005-2010), and after the oil spill (2010-2013). Stakes were installed at the station in 2015 and distance to the shoreline was measured to present. Lack of sediment delivery into the marshes and sea level rise/climate change effects, among a suite of other human-induced and natural factors, cause a background erosion rate of approximately 1 m yr^{1} as found in other studies and at reference stations and during the pre-Katrina period in this study. During Hurricane Katrina, wind-induced (fetch) wave activity caused an increase in the background erosion rate at the stations that were subsequently (post-spill) classified as heavily-oiled. A higher erosion rate continued through the period after Katrina and prior to the spill. However, post-spill erosion rates were statistically similar to pre-spill/post-Katrina rates, indicating that oiling, overall, did not accelerate the erosion rates of the investigated shorelines. However, we cannot disregard the possibility that specific shorelines, depending on oiling intensity and location, may have seen accelerated erosion due to lethal impacts of the oil on vegetation and resulting substrate destabilization.

Presenter Bio: Don Deis is a principal scientist for Atkins and has 40 years of experience in the environmental science with interest in environmental evaluation, assessment, restoration, and monitoring of marine, estuarine, and coastal projects; impacts of oil and gas exploration, development, and transport; natural resource damage assessment (NRDA) related to disasters; and environmental rules and regulation.

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'WHAT COULD POSSIBLY HAPPEN?': COASTAL DECISION MAKERS' PERSPECTIVES ON STORM SURGE FORECASTING TOOLS

Denise E. DeLorme, *Scott C. Hagen and Matthew V. Bilskie*

Louisiana State University, Baton Rouge, LA, USA

This presentation reports on findings from stakeholder focus groups conducted for an interdisciplinary Louisiana Sea Grant College Program-sponsored project. The project purpose was to collect topographic elevation data (e.g., features such as levees, railroads, and roadways) from local knowledge in order to enhance a real-time hurricane storm surge forecasting system for coastal Louisiana, which includes the computational model and a readily-understandable and usable real-time hurricane storm surge forecasting visualization tool. A total of three focus groups were conducted during the project's second annual one-day workshops for targeted stakeholders (e.g., emergency managers, levy managers, other local officials) that were held at three different hazard-prone communities in coastal Louisiana. The same trained social scientist on the team moderated all focus groups using a flexible interview guide instrument that was constructed collaboratively. Each group was comprised of six to twelve participants who were workshop attendees, was audio-recorded with permission, and lasted approximately ninety-minutes. Analysis involved closely reading and coding the compiled transcripts to detect categories and themes. Topics discussed included characteristics of different types of local topographic features, firsthand experiences with past storm events, risk perceptions, familiarity with hurricane storm surge forecasting tools, perceived strengths and weaknesses of the forecasting tools, and recommendations for developing future related science-based decision-support products. The presentation will conclude by placing the findings in the broader context of emergency planning and response, coastal management, community resiliency, and transdisciplinary research outcomes.

PRESENTER BIO: Dr. DeLorme is a social scientist with a communications background and specialization in qualitative research methods. She collaborates with interdisciplinary teams on projects such as planning for sea level rise impacts and focuses on science communication, stakeholder engagement, and community outreach.

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SUBMERGED AQUATIC VEGETATION IN BARATARIA BAY, LOUISIANA: SEASONAL AND SPATIAL PATTERNS

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Submerged aquatic vegetation (SAV) provides significant habitat and ecosystem services across the Louisiana coastal zone, but the temporal and spatial variation in occurrence, biomass, and species communities of SAV have not been fully investigated in this region. To address this, we sampled SAV communities across 4 marsh types (fresh, intermediate, brackish, saline) in Barataria Bay, Louisiana, every 6-8 weeks in 2015. There was no significant temporal difference in SAV presence or percent cover (collectively: occurrence) throughout the year, despite significant changes in SAV biomass with greatest biomass in May and July, and lowest in December. SAV occurrence varied according to marsh type ($p < 0.001$), with fresh and intermediate marsh types supporting both higher SAV occurrence and diversity of SAV. Moreover, in fresh marsh, the occurrence of SAV was influenced significantly and negatively by the presence of invasive floating aquatic vegetation species ($p < 0.001$). The significant seasonal differences in biomass and species diversity which are not easily measured in contrast to the lack of differences in percent cover and presence indicators, have implications for research and management. These findings will refine sampling and restoration protocols to ensure appropriate parameters are collected to achieve specific goals. These data can guide future SAV research in Louisiana and the northern Gulf of Mexico, as well as inform restoration monitoring and project planning.

PRESENTER BIO: Kristin DeMarco is a coastal wetland ecologist who specializes in the effects of climate change on submerged aquatic vegetation (SAV) and wetlands. Her research describes the environmental drivers influencing SAV distribution and occurrence in estuaries and how these drivers are spatially distinguished.

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CITY OF NEW ORLEANS STRATEGIC PATHWAYS – RESILIENCE

Priya Dey-Sarkar[1] *and Dan Grandal*[2]*, PE CFM*
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The City of New Orleans turns 300 years old this year. With its unique city with character and culture, the City is planning for the next 100 years. Throughout history, New Orleans has dealt with its share of flooding and disasters. The City is extremely vulnerable and has a high level of risk – surrounded by the Mississippi River on one side and Lake Pontchartrain on the other. Elevations throughout much of the City are below sea level and the City is surrounded by levees that protect the City from flooding. The City is basically a bowl where all stormwater needs to be pumped out and over the levees. Over the years and in reaction to flooding events, the system has been improved and strengthened providing additional height on levee protection and additional pumping capacity. The City's pumping facilities are some of the largest in the world but are still overwhelmed by large storm events. Building a resilient adaptive system that accounts for climate change, subsidence and sea level rise is a difficult challenge whose success is critical to the future and existence of New Orleans.

The City of New Orleans and its Sewerage and Water Board are developing a long-term plan to create a sustainable resilient utility that elevates the level of service and protects the City's residents. Subsidence, sea level rise and increased intensity of storm events in the next 100 years are being considered. Operation and maintenance and the City's aging infrastructure is being evaluated to repair, upgrade or replace the existing systems in order to create a state of the art system with reliability and redundancy that help reduce risk to the residents of New Orleans.

The ongoing study and planning effort is the first step of a long-term plan for Sustainable Utility Performance. It is a comprehensive approach that addresses the service needs of the residents, climatic conditions expected and financial realities. Creation of a dedicated funding stream is being evaluated in support of financing ongoing repairs, operation and maintenance, and capital improvements necessary to raise the level of service. The approach utilized detailed hydraulic and hydrologic modes and considering a combination of green infrastructure and increased capacity upgrades. Green infrastructure is an innovative approach to water management that restores the natural water flows where the stormwater is reintroduced into the groundwater. Green infrastructure is effective, economical, and enhances community safety, natural environment, resilience and quality of life. This is a shift from pumping all the water out of the basin as quick as possible. We want to be able to live with water and store more water where it lands to help mitigate flooding by reducing the intensity of storms on the pumping system.

Infrastructure condition/capacity and green infrastructure can be the foundation of performance, but organizational capabilities are just as vital. Besides an infrastructure improvement and maintenance plan, this comprehensive approach needs to address workforce development, community and environmental sustainability, strategic resource management, customer satisfaction, infrastructure stability, operational and maintenance optimization, product quality, capital program delivery and financial viability. These ongoing efforts must continue as part of a larger Stormwater Master Plan and Strategic Plan.

PRESENTER BIO: Priya Dey-Sarkar works as facilities engineer at SWBNO as a FUSE fellow. She has managed millions in major capital improvements and worked to improve safety, reliability, and business performance in assets ranging from deepwater oil and gas to solar utility farms. She has a Civil Engineering degree and MBA.

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DISTRIBUTION AND HABITAT USE OF PIPING AND WILSON'S PLOVERS IN THE CAILLOU LAKE HEADLANDS RESTORATION PROJECT (TE-0100) AREA, 2012-2017

***Robert Dobbs**, Jessica Schulz, and Hardin Waddle*
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Louisiana barrier islands provide nesting, foraging, and resting habitat for many species of migratory shorebirds, including critical habitat for nonbreeding populations of the federally listed Piping Plover (*Charadrius melodus*), and important breeding habitat for the of-concern Wilson's Plover (*C. wilsonia*). Many Louisiana barrier islands are deteriorating rapidly due to combined effects of sea level rise, subsidence, and changes in sediment transport—effects that have changed the area and distribution of habitats available to birds. Coastal restoration efforts may offset the loss of island area, but there is a need to advance understanding of the degree to which restoration efforts maintain the dynamic array of habitats important to nonbreeding and breeding shorebirds.

The Isles Dernieres (Terrebonne Parish, Louisiana) have experienced an average shoreline erosion rate of 41.5 feet per year and have become fragmented into a string of ever-shrinking islands. To offset this land loss and ensure protection of the marshes and human communities of Terrebonne Parish, the NRDA Caillou Lake Headlands Restoration Project TE-0100 is currently underway at on a portion of the Isles Dernieres at Whiskey Island. This project involves dredging approximately 10.1 billion cubic yards of sediment from an offshore borrow area to create 933 acres of beach, dune, and marsh habitat on the island. We monitored Piping and Wilson's plovers at Whiskey Island during the five years (2012-2017) preceding the beach construction work that began in May 2017.

Piping and Wilson's plovers occur on the gulf coast at different stages of their annual cycles, and have different life history requirements at Whiskey Island. Piping Plovers do not breed on Whiskey, but use the island during migratory and winter periods. Primarily engaged in foraging, they use sheltered tidal flats most often, followed by foreshore and backshore beach habitats. Wilson's Plovers, on the other hand, breed in relatively high densities on Whiskey Island, and utilize a wider range of habitats more equitably, including more upland sand flats and washover areas. We use hierarchical models to estimate occupancy and abundance of Piping and Wilson's plovers, as a function of habitat type, while accounting for imperfect detection of individuals and ecological covariates. This represents a novel approach in examining how species of conservation concern, with different life history and habitat requirements, respond to changes in habitat availability in the face of persistent island erosion. Our work also establishes a baseline by which to evaluate effects of current restoration outcomes at Whiskey Island, and thus inform regulatory agencies on effects of coastal restoration efforts on the occupancy, abundance, and habitat use of sensitive shorebird species.

PRESENTER BIO: Robert Dobbs is an ecologist with expertise in ornithology, avian ecology and behavior, and coastal systems.

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INTRODUCING THE NATURAL INFRASTRUCTURE INITIATIVE: SOLUTIONS FOR COASTAL PROTECTION AND RESTORATION

***Michael J. Donahue**, Ph.D.*
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A growing "disconnect" exists between the tremendous amounts of dredged material generated from harbor/navigation channel maintenance, and the extent to which such material is beneficially used for coastal protection and restoration activities (e.g., beach nourishment, barrier island rebuilding, marsh creation). The increasing frequency of tropical storms and hurricanes has exacerbated the need for such material in repairing resultant economic and ecological damage. Yet, despite their prospective benefits, nature-based infrastructure solutions (e.g., beneficial use of dredged material), have yet to enjoy equal consideration with traditional "hard" infrastructure solutions.

While this "case study in missed opportunities" is a nationwide phenomenon, it is particularly relevant in the Lower Mississippi Delta where the beneficial use of dredged material can result in a "win-win" outcome for both "producers" and "consumers" of the material. Obstacles to the mainstream application of such nature-based solutions are many, yet not insurmountable. Among others, these challenges are economic (e.g., cost-competitiveness of the beneficial use of dredged material); logistical (e.g., local and timely availability of dredged material); and policy-related (e.g., the "federal standard" requiring selection of the least cost environmentally acceptable disposal method).

Recognizing the importance of the issue- and the opportunity to overcome these and other challenges- a unique partnership has emerged in the form of the Natural Infrastructure Initiative (NII) composed of a coalition of private sector companies (Caterpillar, AECOM, Great Lakes Dredge and Dock, Brown and Root, Intrexon) and a leading non-governmental organization (The Nature Conservancy). The members of the NII Steering Committee share an interest in promoting nature-based infrastructure solutions. They recognize, for example, that the beneficial use of dredged material for ecosystem restoration and protection can result in enhanced project performance, construction efficiencies, cost-effectiveness, ecological improvements, and enhanced coastal community resilience. Over the past year, the NII has produced and adopted a Strategic Plan to guide its actions, and is presently focusing on three work streams: 1) developing an "Identification Tool"- a data base to match dredging projects with opportunities for the beneficial use of the dredged material; 2) developing a formal framework for evaluating natural infrastructure opportunities; and 3) advocating for the design and conduct of a pilot project, in each Corps Division, to demonstrate the benefits of natural infrastructure solutions.

This presentation will provide additional background on nature-based infrastructure solutions; review the genesis of the NII; and discuss the challenges and opportunities in advancing the application of nature-based solutions to augment traditional approaches to coastal protection and restoration.

PRESENTER BIO: Dr. Donahue is a Vice President with AECOM and directs the company's National Coastal and Ecosystem Restoration Practice. He has more than 35 years of public agency, private sector and academic experience with a special focus on watershed-based planning and large scale ecosystem restoration and protection programs.

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ISEECHANGE URBAN FLOODING AND HEAT INVESTIGATIONS IN THE GULF COAST

***Julia Kumari Drapkin*[1], *Maris Jones*[1], *Lindsey Wagner*[2], *Sarah Olivier*[3], *Lida Aljabar*[4], *Brendan Yuill*[5]**

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Gulf Coast communities are becoming more vulnerable to extreme weather events every year, and being forced to make challenging choices to preserve their lives and protect their livelihoods. But when it comes to the impacts of weather and climate, the granular local data and context needed to inform infrastructure and long-term planning cannot be scraped from satellites, remote sensing, or radar data. This is particularly the case with respect to local urban and coastal flooding, indoor urban heat, and marine ecosystem changes.

ISeeChange is developing tools that empower citizens, scientists, city planners, and local community groups to collaborate and iteratively fill the data gaps as conditions change in real time. Our newest neighborhood flooding investigation in New Orleans includes residents documenting rainstorms with stories, photographs, and rain gauge data that add meaningful context and groundtruthing to remote sensing data. In partnership with citizens, ISeeChange was able to document and model 2017 summer flooding events at scales needed by both the National Weather Service as well as green infrastructure designers to mitigate flooding. A parallel urban heat investigation will focus on community health impacts in sync with temperature and humidity data. The ISeeChange team intends to scale these investigations to additional Gulf Coast communities in 2018.

Founded in 2012, ISeeChange is the nation's first community crowdsourced climate and weather journal that empowers users to document environmental changes with others and discuss the impacts over time. Our groundbreaking environmental reporting platform—available online and through a mobile app—personalizes and tracks climate change from the perspective of everyday experiences synced with data, bringing earth science home and into the spaces people know best and trust most- their own communities.

PRESENTER BIO; Julia Kumari Drapkin is the CEO and founder of ISeeChange, an award-winning community tool for adaptation. Drapkin currently serves on the board of the National Federation of Community Broadcasters and is a consultant for the think tank Resources for the Future and NASA.

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PUTTING PUBLIC-PRIVATE PARTNERSHIPS TO PRACTICE TO SUPPORT THE WORKING COAST

Justin Ehrenwerth[1]*, Joni Tuck*[2]*, Edwin Pinero*[3]*, Scott Hemmerling*[4,]* and Leah Brown*[5]

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Major industries (oil, gas, and shipping) are supported by a web of coastal infrastructure, including roads, ship channels, and ports, that are vulnerable to sea-level rise, subsidence and the next storm. For the "Working Coast" to continue to flourish, a holistic resiliency approach is needed. We present public-private partnership examples of where protection of critical infrastructure has ecosystem service benefits to help make communities more resilient in the face of climate change. This Public-Private Partnership Plus (P3+) combines the resources and expertise of public, private, and non-governmental organizations with the aim of enhancing coastal habitat and providing protection to critical infrastructure and communities. This approach can serve as a model across the Gulf and around the country with respect to collaborative planning and shared funding to construct nature-based coastal infrastructure and community protection projects. The nature-based project strategy will benefit multiple stakeholders, and will increase quality habitat and help sustain existing habitat. Nature-based protection features such as ridged and non-ridged wetlands and islands constructed of dredged material may be less expensive to emplace and require less maintenance than grey infrastructure, and often provide additional ecosystems service benefits such as expanded ecological habitat and recreational opportunities. Understanding how these nature-based protection systems can contribute to risk reduction, either alone or in combination with gray approaches, will yield lessons on how to develop site-specific, cost-effective solutions to coastal societal needs. These efforts are serving to conserve or restore natural systems to increase coastal resilience through providing ecosystem services, such as the attenuation of waves to reduce coastal flooding and erosion.

<u>PRESENTER BIOS</u>:
Mr. Ehrenwerth is the President and CEO of The Water Institute of the Gulf. Previously, Ehrenwerth served as the inaugural Executive Director of the Gulf Coast Ecosystem Restoration Council. Prior to joining the Council, Ehrenwerth served as Chief of Staff to the U.S. Deputy Secretary of Commerce, as well as Assistant Counsel to the President where he took the lead on Deepwater Horizon litigation for the White House.

Ms. Tuck is External Relations Manager for the Greater Lafourche Port Commission, which oversees Port Fourchon, Louisiana. The port services over 90% of the Gulf of Mexico's deepwater oil production, and plays a strategic role in furnishing about 18% of the United States oil supply.

Mr. Pinero is the Director of Water Programs for the United States Business Council for Sustainable Development. He has over 30 years of experience in many aspects of water management.

Dr. Hemmerling is the Director of Human Dimensions for The Water Institute of the Gulf. He has more than fifteen years of experience investigating anthropogenic alterations to the landscape and the impacts of development on coastal community resilience.

Ms. Brown is Policy, Government, and Public Affairs Manager at Chevron in New Orleans, LA.

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INNOVATIVE PARTNERSHIPS WITH THE US ARMY CORPS OF ENGINEERS (USACE) AND THE FUTURE OF THE 408 PROCESS

Durund F. Elzey, Sr.
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Innovative Partnerships: The USACE has several mechanisms for partnering and cost sharing with non-Federal entities to allow for continuing work and prioritization of permit reviews.

Examples include Section 214 of the Water Resources Reform and Development Act (WRRDA 214) of 2000 (Public Law No. 106-541), as amended, which allows USACE to accept funds from non-Federal public entities to give priority to the evaluation of their Department of the Army permit applications. Additionally, Section 1156 of WRDA 2016 amends both 33 U.S.C. 408 and Section 1007 of WRRDA 2014. It requires that, to the maximum extent practicable, review and approval of an activity being evaluated pursuant to Section 408 occur concurrently with any National Environmental Policy Act (NEPA) review of the activity. Section 1156 establishes timelines for determining if a request is complete and for making a final decision and also provides authority to accept and expend funds from non-federal public and private entities for Section 408 reviews.

Section 408: Through the Civil Works program, the USACE serves the public by providing the Nation with quality and responsive management of the Nation's water resources. As a result, USACE, in partnership with stakeholders, has constructed many Civil Works projects across the Nation's landscape. Given the widespread location of these projects, many embedded within communities, over time there may be a need for others outside of USACE to alter or occupy these projects and their associated lands. Reasons for alterations could include improvements or making repairs to the projects; relocation of part of the project; or installing utilities or other non-project features. Because these projects are in place for the benefit of the public, USACE will ensure that any alteration proposed will not be injurious to the public interest and will not affect the USACE project's ability to meet its authorized purpose. USACE accomplishes this through the authority of Section 408 and its associated procedures outlined in a guidance document, Engineer Circular (EC) 1165-2-216. The Section 408 authority is delivered through the Section 14 of the Rivers and Harbors Act of 1899, as amended, and codified in 33 USC 408 (Section 408) and provides that the Secretary of the Army may, upon the recommendation of the Chief of Engineers, grant permission to other entities for the permanent or temporary alteration or use of any USACE Civil Works project. The EC provides the requirements and procedures for an overall review process that can be tailored to the scope, scale, and complexity of individual proposed alternations, and provides infrastructure specific considerations for dams, levees, floodwalls, flood risk management channels, and navigation projects.

USACE has recently launched an effort to update and improve the Section 408 process. The effort will include various opportunities for the public to provide feedback.

PRESENTER BIO: Durund Franklin Elzey is Assistant Deputy District Engineer for Project Management for the U.S. Army Corps of Engineers, New Orleans District. Programs and projects under his purview include flood risk management, storm damage prevention, navigation, environmental and coastal restoration, river stabilization and harbor development, MR&T, and HSDRRS. Mr. Elzey earned his B.S. in Electrical Engineering from UNO and has worked for USACE in various project management roles.

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AMPHIBIOUS RETROFIT LOSS AVOIDANCE STUDY FOR INTERLAKE FIRST NATIONS IN CENTRAL MANITOBA

*Jason McMillan and **Elizabeth English***
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Current flood mitigation practices put in place to divert flood waters away from Lake Winnipeg and the City of Winnipeg into Lake St. Martin have exacerbated the flood rates and severity for the First Nations of the central Manitoba Interlake Tribal Council. The flood mitigation methods upstream have resulted in regular evacuations, and following a particularly harsh flood in the spring of 2011, severe damage to property. The Interlake Tribal Council, including Lake St. Martin First Nation, were all affected by the flood, with destruction of homes and land leaving many of the community members still displaced. The community, following the demolition of their damaged homes, was forced to relocate to new land.

Rather than relocating the community to a culturally inappropriate site, the Buoyant Foundation Project proposed taking one of the existing homes on the reserve, or a prefabricated house from a nearby relocation site, and retrofitting it with a buoyant foundation system. A buoyant foundation system is a subtle retrofit to existing structures that preserves community character while protecting a structure from a range of flooding events. The existing structure sits on framed buoyancy blocks and guidance posts which allow the building to travel up and down with flood waters. This poster presents a loss avoidance study for the Lake St. Martin Reserve to determine the financial viability of a buoyant foundation retrofit against various flooding scenarios. A loss avoidance study is a technical assessment of a property fitted with flood mitigation technology that compares the expected losses from a single flood event had the property not been retrofitted to the cost of installing the retrofit. It is a comparative study that is measured in dollars and evaluates the effectiveness of implementing flood mitigation technologies.

The loss avoidance study conducted on this prototype shows that even in a flooding event reaching no higher than the finish floor level, the loss avoidance ratio was greater than 1, meaning that in a single flooding event the retrofit saves the owner money, while giving the residents confidence that their home and belongings are safe. Given the certainty of seasonal flooding on the Lake St. Martin Reserve, the advantages of the amphibious retrofit are likely to multiply over time. This loss avoidance methodology can be used as a tool for selecting flood mitigation strategies across coastal Louisiana and the Mississippi Delta. By assessing the financial viability of buoyant foundation retrofits against displacement, post-disaster repairs or alternate strategies such as permanent static elevation, design decisions for the retrofit can be made with a level of specificity to the existing structure and resources available to the owners.

PRESENTER BIO: Dr. English is currently Associate Professor at the University of Waterloo School of Architecture in Cambridge, Ontario. Her areas of research include the study of wind loads on tall buildings, the aerodynamics of wind-borne debris, and strategies for the mitigation of hurricane damage to buildings in post-Katrina New Orleans.

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AN INNOVATIVE CLIMATE CHANGE ADAPTATION STRATEGY FOR FLOOD RESILIENCE AND THE PROTECTION OF CULTURAL HERITAGE

***Elizabeth C. English**, PhD, AM ASCE*
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Protecting existing communities from the increasing risk of flooding wrought by climate change is a challenging prospect. Forward-looking strategies capable of providing adaptability to future flood levels that are difficult to quantify in advance are especially needed.

Amphibious architecture offers an inexpensive, visually unobtrusive, adaptable and resilient approach to flood mitigation. As an alternative to permanent static elevation (PSE -- raising on stilts), amphibiation provides superior flood risk reduction without the reduction of accessibility, changes to lifestyle and visual impact that necessarily accompany PSE. While it is not a universally applicable solution, there are many circumstances in which this strategy can provide measureable benefit over all other available alternatives. While some regulatory issues remain, FEMA has acknowledged that amphibious retrofits to pre-FIRM structures that qualify as less than substantial improvement do not violate NFIP statutes.

The Buoyant Foundation Project (BFP) specializes in a specific type of amphibious construction -- retrofits to existing pier-and-beam structures that enable them to stay in place until the event of a flood, when they are capable of rising and floating on the surface of the water, returning to their original positions on their original foundations as the floodwaters recede. Amphibious construction is an adaptive flood risk reduction strategy that works in synchrony with a flood-prone region’s natural cycles of flooding. A buoyant foundation retrofit (BFR) is capable of providing an historic structure with protection from flood damage with little or no change to the appearance of the building or loss of visual coherence of the neighborhood. Although BFR is a solution that is not suitable for all types of flooding or building construction, it is nonetheless a flood mitigation and climate change adaptation strategy that has much to offer in appropriate situations such as may be found throught southern Louisiana.

The model for the BFP system of retrofit adaptations is derived from multiple examples of such installations developed over the last four decades in Old River Landing in Pointe Coupee Parish, Louisiana. The BFP currently has funded research and construction projects to provide amphibious retrofits in the Mekong Delta in Vietnam and for Native American communities in northern Canada. Construction of these projects is scheduled to occur in March, April and May of this year and thus we expect to be able to present these results for the first time at SOC18. The BFP team is also in the process of developing retrofit projects in North Carolina, Texas and Maryland. For more information please visit our website at www.bfpnola.org.

PRESENTER BIO: Dr. English is an engineer and Associate Professor of Architecture at the University of Waterloo. She founded the BFP in 2006 while Associate Professor-Research at the LSU Hurricane Center. She is internationally recognized as a leader in the development of amphibious construction, particularly retrofit applications for vulnerable low-income communities worldwide.

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WASTED WATER: THE ANTHROPOGENIC RELATIONSHIP BETWEEN HUMANS TO WASTE AND WATER SYSTEMS

Teresa Tran *Presented By:* ***Elizabeth English***
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The abstraction of our environments through our interactions and uses have removed us from our relationship with our water resources and waste management. Centralized infrastructure systems have increasingly become the necessary standard for urban and rural populations in developed countries.

In our present time of industrialization, technology and rapidly growing populations, modern systems have been designed to utilize water in more efficient ways and have forced us to abandon our former direct relationship with its supply as a natural resource and register of our actions. The symbolic relationship between humans and the projected ownership of water has become damaged as water is viewed as a disorganized chaos and an abundant resource for energy that must be controlled and distributed to our needs.

Water usage in the past has been through vernacular means of extraction and output. Usage was directly obtained from an exposed source that invoked awareness of changing environmental conditions and our anthropogenic actions upon it. Waste was managed in proximity to the user, allowing conscious choices to be made of its consequential effects on surrounding resources. Under the onset of overpopulation and the outbreak of disease, water and waste have become distanced and managed at larger scales to ensure health safety and decontamination of water resources. These modern systems take form in our spaces through plumbing, pumps, supply and wastewater pipes, filters, tanks, and sanitary fixtures that conceal their functions and connections. All systems and objects are geared towards efficiency and in turn have omitted the direct understanding of the environment and its increasingly damaged and changing state.

As these systems fail through wastewater bypasses, over capacitated storm water drains, flooding, and overly complicated networks dependent on maintenance and environmental stability, it exposes the shift in dependence of human populations from the surrounding environmental resources to the anthropogenic systems that stand between them and provide for their basic needs. In the Anthropocene, the environmental time scale is shifting and accelerating faster than the infrastructure humans have set in place and dependency on large systems fails to reestablish our interdependency with our artificial and natural landscapes.

PRESENTER BIO: Dr. English is an engineer and Associate Professor of Architecture at the University of Waterloo. She founded the BFP in 2006 while Associate Professor-Research at the LSU Hurricane Center. She is internationally recognized as a leader in the development of amphibious construction, particularly retrofit applications for vulnerable low-income communities worldwide.

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RIVER BAR DYNAMICS DRIVE SAND DISCHARGE THROUGH DIVERSIONS

***Christopher Esposito**, Man Liang, and Ehab Meselhe*
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The concentration of sand suspended in river channels is greatest near the bed. It is therefore common to assume that shallow river diversions will not be able to access the higher sand concentrations present in deeper waters, and their discharge will be depleted in sand. However in situations with a lateral bar near the diversion, the altered velocity field on top of the bar can cause unexpected sand transport dynamics. Understanding the details of the sand transport mechanisms through a diversion is a critical step towards designing diversions that minimize navigation impacts.

We use Delft3D to investigate the transport of sand through the Mid-Barataria Sediment Diversion. We vary the depth of the diversion entrance from 10 feet to 50 feet, while adjusting the width so that water discharge through the diversion is similar for all cases. For the diversion studied here, which is situated along a lateral bar in the river, we find that sand transport through the diversion is not significantly impacted by the depth of the diversion entrance. The high sediment concentrations near the bed on the bar top are transported into the diversion without respect to the depth of the diversion entrance.

This is a counterintuitive result that requires further study to confirm. Specifically, our work suggests that a productive research path would be to use a non-hydrostatic model to perform a detailed analysis of the complex, three-dimensional flow structures in the vicinity of diversions, and assess their influence on sand transport through the structure.

Presenter Bio: Christopher Esposito is a Research Scientist with The Water Institute of the Gulf. He has nearly 10 years of field and modeling experience studying sediment transport in river deltas and the connections between river channels and their floodplains.

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CONTOUR CULTI-PACKING POTENTIAL FOR ABANDONED MINES ON THE AMITE AND TANGIPAHOA RIVERS

Scott Eustis*[1], *Ezra Boyd[2], Becca Timmons[3], Maya Welch[1], and Natalie Montoya[1]
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Since the flash floods of 1983, state and federal agencies have published ecological and economic research on the impacts of sand and gravel mining on Florida Parish rivers. "Contour Culti-Packing" Wetland Forest restoration of floodplains from abandoned sand and gravel mines has been cited as a cost-effective means to mitigate flood height and stabilize meandering river channels. Implementation of this floodplain restoration technique has faced many hurdles; survey data remains a hurdle because of the limited funding and jurisdiction of the Louisiana Department of Natural Resources Abandoned Mine Land Program.

After reviewing data from four public agencies, we conducted a desktop survey of 266 mines in the 5-parish region, focusing on the Scenic River segments of the Amite and Tangipahoa Rivers. Grading and Re-planting of these sites likely provides a more impactful alternative to flood mitigation than dredging protected segments of Louisiana Scenic Rivers.

Our desktop survey involved the review of near-present day imagery via Google Earth Pro, and delineating mines based on four characteristic profiles, (Pits, Piles, Shrub, and Open Space) according to the National Wetland Inventory Protocol-limited the scale of the aerial photograph to a view from 4000-6000 ft. Three delineators, one trained, and three working from the four characteristic profiles, drew polygons on the Amite and Tangipahoa rivers.

Results are ongoing, but complete for the Scenic segment of the Amite River has been completed by all three delineators. The area inscribed by the 56 polygons includes a minimum of 8309 acres, and a maximum of 10319 acres. Most of the difference among delineations is a matter of the third and fourth characteristics, open space that is part of the mine property, rather than the pits and piles of the floodplain that was actually mined.

This presentation is dedicated to the late Dr. Ezra Boyd.

PRESENTER BIO: With an M.S. in Environmental Science from the University of New Orleans, Scott supports GRN's Science and Water Policy team by analyzing wetlands restoration projects, and by providing scientific arguments in comments against bad developments and wetlands destruction. Scott has a B.S. in Ecology from UGA's Odum School of Ecology.

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QUANTIFICATION OF SWELL ENERGY AND ITS IMPACT ON WETLANDS IN A DELTAIC ESTUARY

Thomas Everett[1,2], *Qin Chen*[2], *Arash Karimpour*[2] *and Robert Twilley*[2]
[1]T. Baker Smith, Baton Rouge, LA, USA
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The extensive coastal wetlands in Mississippi River Delta represent the seventh largest deltaic floodplain in the world, contributing to many services that sustain the economies of the region. Subsidence, sea level rise, saltwater intrusion, wave action from storms, and sediment depletion have contributed to chronic wetland losses, converting vegetated lands into open waters and increasing wind fetch. Among these factors listed, wave energy plays the largest role in marsh edge erosion in an open bay environment. Degrading barrier islands along the shoreline of this delta allow swell energy to enter protected bay areas, contributing to marsh edge erosion. Locally generated wind waves within enlarged bays also contribute to wetland loss. Quantifying the roles of swell and wind waves in marsh edge erosion is essential to any ecosystem restoration design. In this study, a numerical model is implemented to describe the wave climate of combined swell and wind waves in a deltaic estuary.

Terrebonne Bay was chosen as the study area because it has experienced one of the largest reductions in barrier islands and wetland loss rates among Louisiana estuaries. A continuous wave measurement in upper Terrebonne Bay was obtained over the course of a year. A spectral wave model is used to hindcast the wave climate in the estuary. The model results are compared against the in situ wave measurement. The wave power is partitioned into swell and wind sea at different locations in Terrebonne Bay using the model results. An extensive analysis on a valid effective wave power range that directly impacts the marsh edge is performed and presented. Insight into the temporal and spatial variability of wave power is gained. Through differentiating swell and wind sea energies around the bay, improvements of long-term wave power computation for shoreline retreat prediction are made. It is found that the swell energy becomes the primary driver of marsh edge retreat in the southwest part of Terrebonne Bay as the barrier islands are degrading.

PRESENTER BIO: Thomas Everett is a Civil Engineer E.I. with T. Baker Smith, specializing in coastal and hydraulic engineering. Mr. Everett obtained his B.S. in Civil Engineering (2014) and his M.S. in Coastal and Ecological Engineering (2016) from Louisiana State University in Baton Rouge, LA. He has worked on marsh creation projects, performed large-scale Hydrologic and Hydraulic analyses, and has multiple years of experience in coastal numerical modeling.

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SELF DETERMINATION IN A SINKING BASIN – HURDLES AND HINDRANCES TO PROTECTING TRIBAL CULTURAL HERITAGE IN SOUTHERN LOUISIANA

Patty Ferguson-Bohnee
Sandra Day O'Connor College of Law, Arizona State University, Phoenix, AZ, USA

The landscape of coastal Louisiana has changed tremendously since the 1930s. These changes result from man-made decisions and value judgments about what is important. The damage resulting from these decisions have now been compounded by sea level rise and subsidence. Often, the most vulnerable populations are excluded from the discussions, yet they are the ones that must adapt to the consequences of these decisions. This presenter will discuss the challenges of two Tribes in the Terrebonne Basin and their struggles to survive in the changing coastal environment.

The Gulf Coast, specifically the Terrebonne Basin, has continuously been inhabited by indigenous peoples whose lifeways, spirituality, and cultural heritage are connected to this place. Numerous village sites, fishing areas, and cultural sites have already been lost, yet the Pointe-au-Chien and Isle de Jean Charles Tribes located in this basin have been able to maintain their unique cultural identity.

Maintaining cultural heritage and self-determination in the Terrebonne Basin is an ongoing challenge. Although Tribes have the right to self-determination under the Declaration on the Rights of Indigenous Peoples, these rights are often not recognized, due to the lack of federal recognition by the United States government. The right to self-determination includes the right to freely determine political status and pursue their economic, social, and cultural development. Further, indigenous peoples have a right to their lands, territories and resources, and subsistence rights to support themselves. The lack of recognition threatens the survival and existence of indigenous peoples on the Gulf Coast, including not only the lack of inclusion in discussions about coastal restoration planning, but also the lack of options to respond to environmental threats.

International law recognizes not only the right of self-determination, but the right to maintain cultural heritage. The cultural heritage of these two tribes is threatened, and should be discussed in the coastal restoration and planning contexts, since indigenous peoples are inextricably tied to the land. More active measures need to be taken to address how Isle de Jean Charles and Pointe-au-Chien can maintain cultural heritage and self-determination in the face of land loss and climate change. This means that the framework needs to be adjusted to ensure that indigenous peoples are included in conversations, and that funding options are not limited to factors only important to economic development, but also to protecting cultural heritage.

PRESENTER BIO: Professor Patty Ferguson-Bohnee is the Director of the Indian Legal Clinic and Faculty Director of the Indian Legal Program at the Sandra Day O'Connor College of Law; she is also an attorney and member of the Pointe-au-Chien Indian Tribe. She is a strong advocate of indigenous rights, and has experience in status clarification of tribes and the impacts of land loss on tribal cultural heritage.

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RISK REDUCTION BENEFITS AND COSTS FROM LOUISIANA'S 2017 COASTAL MASTER PLAN

***Jordan R. Fischbach*[1]**, *David R. Johnson*[1,2], *David R. Groves*[3]
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Louisiana's Comprehensive Master Plan for a Sustainable Coast is a 50-year plan designed to reduce flood risk and minimize land loss while allowing for the continued provision of economic and ecosystem services from this critical coastal region. Under the plan's middle-of-the-road (Medium) environmental scenario, the master plan is projected to reduce expected annual damage from storm surge flooding by approximately 65% relative to a future without action: from \$5.3 billion to \$2.2 billion in 2040, and from \$12.1 billion to \$3.7 billion in 2065.

This talk builds on the previous presentation, which focuses on the methods applied for flood risk and damage analysis using the Coastal Louisiana Risk Assessment (CLARA) model. The master plan analysis used cost-effectiveness analysis to compare benefits and costs and rank project performance 10, 25, or 50 years into the future, but it did not consider how benefits and costs might accrue over time. Here, we extend the analysis conducted in support of the master plan and present estimates of the discounted net economic risk reduction benefit over a 50-year period from plan investments.

Here, we describe how the estimates of master plan risk reduction benefits were converted into a discounted time series and compared with project costs that would accrue if the projects are implemented according to the master plan schedule. We then present the results of this analysis, including estimates of net present value and benefit-cost ratios, under different future scenario assumptions. Benefit-cost results are shown for master plan risk reduction projects alone, or when including both risk reduction and restoration projects together. This provides an estimate of the additional risk reduction contribution from restoration when combined with significant investments in structural and nonstructural projects across the Louisiana coast.

Results suggest that the proposed risk reduction projects yield positive net present value across a range of assumptions, including discount rates as high as 7 percent. Net benefit over 50 years is higher under a more adverse sea level rise and coastal subsidence scenario. It is also positive across a range of discounting assumptions even when risk reduction benefits are compared against the full cost of the master plan (including restoration) under the more adverse environmental scenario.

PRESENTER BIO: Dr. Fischbach is a Senior Policy Researcher at RAND, Codirector of the RAND Water and Climate Resilience Center, and Co-Program Manager for NOAA's Mid-Atlantic RISA. His research focuses on coastal adaptation and urban resilience, and he has led the flood risk assessment supporting Louisiana's coastal master planning since 2010.

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VARIATION OF MR AND AR PLUME DISTRIBUTION FROM DATA SYNTHESIS OF HYCOM MODEL OUTPUTS AND MODIS IMAGERY

***Catherine Fitzpatrick*[1,2]**, *Alex Kolker[2,1], and Philip Chu[3]*
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Understanding the Mississippi River (MR) and Atchafalaya River (AR) plumes interaction with the open ocean is crucial for understanding many processes in the Gulf of Mexico (GOM). Though the MR and AR, their deltas, and plumes have been studied extensively, recent archives of model products and satellite imagery have allowed us to highlight patterns in plume behavior over the last two decades through large scale data synthesis. Using 20 years of HYCOM GOMu 0.04 (HYbrid Coordinate Ocean Model Gulf of Mexico uniform 1/25° grid) Reanalysis model outputs, 24 years of Army Corps of Engineers and 8 years of USGS discharge data, and MODIS imagery, we have estimated the spatial extent, geographic patterns, depth, and freshwater concentration of the MR and AR plumes across months, seasons, and years. Patterns were identified by mapping the minimum and maximum spatial area of the MR and AR plumes, their varied extent east and west, and south, and evaluating how often the plumes were incorporated into the Loop Current. From the synthesis and analysis of these data, the statistical probability of the combined plumes' spatial area and geographical extent as monthly and yearly averages were computed. Results show that the average monthly spatial extent of the MR and AR plumes into the GOM are strongly correlated to the average monthly river discharge from both rivers. No significant relationship was found between average yearly river discharge and average yearly plume surface area. River discharge and plume surface area at the monthly time scale were related except for a period from 2002 to 2007 in which the spatial extent of the plume was large while discharge remained average to below average. The MR and AR plumes consistently show greater eastern transport from June to August than in other months for the 20-year period analyzed. Relationships between plume spatial extent and the oscillation of the Loop Current to the north are still being investigated. Overall, studies on MR and AR plume distribution patterns and the parameters that affect them help us to understand the plumes' current behavior and enable us to predict changes that may occur as a result of human modification or coastal restoration efforts, i.e. river diversions, flood controls. Plume distribution patterns may also predict the influence of changes in fresh river water distribution on coastal wetlands and their ecosystems, particularly on fish and shellfish populations that are integral to the gulf coast economy.

PRESENTER BIO: Catherine is a graduate student at Tulane's Earth and Environmental Sciences Department and a research assistant for the Louisiana Universities Marine Consortium. She has an M.S. in Oceanography from Universidade Federal do Rio Grande (FURG) in Brazil. Her previous research has focused on beach morphodynamics on the southern Brazilian coast.

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DEVELOPMENT OF A STATEWIDE WATERSHED BASED FLOODPLAIN MANAGEMENT PROGRAM

Pat Forbes[1]*, Michael Ellis*[2]*, Casey Tingle*[3]*, and Christopher Knotts*[4]

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[2]Executive Director, Louisiana Coastal Protection and Restoration Authority
[3]Deputy Director, Chief of Staff, Governor's Office of Homeland Security and Emergency Preparedness
[4]Chief Engineer, Department of Transportation and Development

Following the 2016 floods, many efforts have been taken at the State, Federal, and Local levels to understand and improve Louisiana's flood risk situation. One thing that has stood out is the need for coordination between decision-making and regulating authorities, especially when they are working within the same watersheds. To support this, Louisiana requires an overarching floodplain management program to support floodplain management activities at all levels of government.

Louisiana's various floodplain management activities are currently performed by different jurisdictions in a largely uncoordinated fashion. At the state-level, various floodplain and risk management initiatives are managed across multiple agencies without a coordinating mechanism. Additionally, various jurisdictions such as city/parish planning & zoning departments or public works, regulate or undertake activities that affect floodplains independently, even when they affect the same watersheds. Floodplain issues are managed within a political jurisdiction, often without the mechanisms to consider the effects on other jurisdictions or the watershed on the whole. Effective flood plain management requires a paradigm shift from independent jurisdiction boundaries to management within watershed boundaries.

OCD, GOHSEP, DOTD, and CPRA have formed a steering committee to define and develop a coordinated, multi-agency comprehensive watershed based floodplain management program. This program will begin by leveraging existing State authorities and capabilities to support local jurisdictions in their floodplain management. The program will also identify state-level statutory and regulatory needs and support their development and implementation. The development of such a program will allow the State and its various jurisdictions and political subdivisions to coordinate at a watershed level and manage floodplains consistently using best practices across the State.

PRESENTER BIO: Pat Forbes has been the Executive Director of the state Office of Community Development since July 2011. In his executive capacity, he oversees the Community Development Block Grant and Local Government Assistance programs, as well as the housing, economic development and infrastructure programs that utilize federal disaster CDBG (CDBG-DR) funds for recovery from hurricanes Katrina, Rita, Gustav, Ike and Isaac. Prior to Hurricane Katrina, Forbes served as an engineer and technical assistant in the Governor's Office of Coastal Activities. Before his state service, he worked as a consulting environmental engineer, owned and operated his own company and served in numerous capacities at Georgia Pacific's Port Hudson paper mill. Forbes holds both a bachelor's degree in mechanical engineering and a master's degree in business administration from Louisiana State University in Baton Rouge.

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LOUISIANA SEDIMENT AVAILABILITY AND ALLOCATION PROGRAM (LASAAP) - A PLANNING TOOL FOR MANAGING SEDIMENT FOR RESTORATION

***Beth Forrest-Vandera*[1]**, *Syed Khalil*[2], *Ed Haywood*[2], *Rick Raynie*[2], *Quin Robertson*[1]
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Estimated to cost at least $50 billion over the next 50 years, the 2012 Master Plan restoration efforts are projected to build or sustain between 580 and 800 square miles of land. Success of the Coastal Master Plan restoration efforts depends greatly on locating, managing and utilizing sediments in a cost-effective manner. The Coastal Protection and Restoration Authority (CPRA) requires a planning tool that identifies compatible sediment sources for restoration and protection projects identified in the Coastal Master Plan. This tool needs to analyze dredge and construction locations along with hydrographic, geotechnical and geophysical data in a spatial format in order to efficiently and equitably manage valuable sediment resources.

The Louisiana Sediment Availability and Allocation Program (LASAAP) is a tool currently being developed to link the sediment needs of the State's restoration projects (marsh creation, barrier island and ridge restoration) to the appropriate potential sand/sediment sources (offshore, riverine, sediment from maintenance dredging, CDFs and other sediment sources).

In order to develop LASAAP, CPRA developed the Louisiana Sand/Sediment Resources Database (LASARD) to archive, populate, and maintain the geoscientific and related data acquired for ecosystem restoration on a GIS platform. LASARD has taken several years to properly develop and populate and forms a critical baseline to support LASAAP. We are currently using LASARD to complete an inventory of existing sediment data. Coupling the sediment/sand inventory and proposed Master Plan restoration projects will allow the state to evaluate their spatial relationships and in turn will result in efficient planning and cost effectiveness of the various restoration projects.

PRESENTER BIO: Dr. Forrest is a project geologist with over 11 years of experience supporting beach and marsh habitat restoration projects throughout the Gulf coast and eastern United States. For over 9 years, she has collaborated with the CPRA on LASARD, a database developed to help manage offshore sediment resources.

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WAVE ATTENUATION IN SAN FRANCISCO BAY

***Madeline Foster-Martinez*[1]*, Jessica Lacy*[2]*, Matthew Ferner*[3] *and Evan Variano*[4]**

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Salt marshes attenuate wave action. This reduction in wave energy can create conditions for sediment trapping and deposition, countering the effects of erosion and increasing the surface elevation of the marsh. Quantifying this wave attenuation under different conditions is critical to understanding how marshes function and to predicting how they will change with sea-level rise. Here, we measured this attenuation in the vegetated shallows of San Francisco Bay.

We conducted two field campaigns at the tidal salt marsh in China Camp State Park, one in winter and one in summer. At the site, the tide flows over mudflats and through three consecutive vegetation zones: Pacific cordgrass (*Spartina foliosa*), Pacific cordgrass with pickleweed (*Salicornia pacifica*), and pickleweed. High-frequency pressure sensors were deployed at seven stations along a cross-shore transect, and wave statistics were calculated from this pressure data. Vegetation surveys were conducted to measure vegetation parameters (e.g. height, stem density, number of leaf structures). The attenuation was modeled as an exponential decay, and decay constants were calculated for each vegetation type as a function of inundation. Drag coefficients as a function of Reynolds number were also determined.

The seasonal signal in wave attenuation was dominated by changes in Pacific cordgrass biomass. The aboveground biomass of Pacific cordgrass died back in the winter, while the pickleweed was largely unchanged between the seasons. The evolution of wave height through the marsh changed seasonally, which impacts the sediment transport and retention within the marsh. Yet, complete attenuation occurred about 75 m into the vegetated marsh regardless of season. The drag coefficients varied from 0.1 to 2. In comparison to smooth cordgrass (*Spartina alterniflora*), drag coefficients measured along the Gulf of Mexico coast were greater than those measured here; however, comparisons of exponential decay constants show pickleweed attenuates to a greater extent than both cordgrass species for similar inundation conditions. This dataset will inform designs for marsh restorations and management plans in the area and can inform future field studies along the Louisiana coast.

PRESENTER BIO: Dr. Foster-Martinez is a Postdoctoral Researcher at LSU's Center for Coastal Resiliency. Foster-Martinez completed a PhD at UC Berkeley, focusing on fluid mechanics of coastal marshes.

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APPLIED RESEARCH INITIATIVES

Angelina M. Freeman *and Richard Raynie*
Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

Focus applied research is a central component of the Louisiana Coastal Protection and Restoration Authority's (CPRA) adaptive management strategy. CPRA is formalizing an adaptive management process where scientific information is incorporated into decision making via a structured approach. Through focused applied research initiatives directed to answer specific research needs or questions, all steps in the adaptive management cycle can be refined. Central components of CPRA's adaptive management strategy include engaging science to: 1) Identify alternative management actions; 2) Select the management action based on the best available science; and 3) Assess performance of the implemented management decision.

Applied research initiatives are a key element of CPRA's knowledge base that is important to several steps in the adaptive management cycle. CPRA applied research programs such as the Coastal Science Assistantship Program and the RESTORE Act Centers of Excellence Research Grants Program resolve uncertainties at the project, regional, or coast-wide scales. Research initiatives are also supported on the project level to address applied questions related to project implementation and operations. Science advisory groups (committees or boards) are another important component of CPRA's restoration program that is based on the best available science. Between the years of 2014 to 2016, CPRA operated two different advisory groups, the Expert Panel on Diversion Planning and Implementation and the Science and Engineering Board. The 2017 Coastal Master Plan effort also included two technical advisory committees (TACs), the predictive models TAC and the resiliency TAC. The advisory boards were charged with specific and unique tasks to inform CPRA, and the disciplinary expertise provided help guide the restoration and protection program.

Developing scientific synthesis to assess performance of management decisions and project and program implementation is important to the success of the protection and restoration program. CPRA develops a number of data and project reports that summarize, document, and assess information. Synthesis reports on the basin-wide level are being advanced that summarize projects and cumulative effects of projects on restoration goals within the basin. As the coastal protection and restoration program progresses, it is important that CPRA documents background, objectives, outcomes, and lessons learned from its various applied research programs, and identifies new applied research needs. The collective institutional knowledge is critical for evaluating current and proposed research programs and for integration of results into program and project implementation.

PRESENTER BIO: Angelina Freeman is a coastal scientist working on large-scale ecosystem restoration at Louisiana's Coastal Protection and Restoration Authority. Previously, Angelina was Director of Science and Engineering Projects at Environmental Defense Fund in Washington, D.C. Angelina holds a Ph.D. in Oceanography and Coastal Sciences from Louisiana State University.

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CHALLENGES IN THE DESIGN OF SALINITY BARRIERS

Sergio D. Gaitan
Tetra Tech, New Orleans, LA, USA

As part of a 15-percent design effort for the CS-65 Calcasieu Ship Channel Salinity Control Measures Project, Tetra Tech and its subconsultants evaluated and compared cost-effective solutions for salinity barriers along the Calcasieu Ship Channel. The intention is to meet the project goals of reduced salinity and associated land loss, while retaining the viability of the Calcasieu Ship Channel inland waterway.

Salinity barriers effectively reduce the tidal volume exchange by reducing hydraulic conductivity between the Calcasieu Ship Channel and the lakes and bayous further upstream. However, these barriers must also allow local navigation of small craft vessels used by the local commerce, fisheries, and tourism industries. Barriers should also provide discrete openings to allow passage of fish, and aquatic life.

Two types of salinity barriers were designed: Shallow rockfill berms to reestablish the east and west shorelines of the ship channel along reaches which are now open onto the lakes. And, deep steel vertical wall barriers that reduce flow and saltwater exchange at the East and West Passes.

The integrated design effort involved defining the criteria for selecting design vessels to size the bypass dimensions for safe navigation, performing geotechnical field investigations to evaluate barrier stability and settlement analysis, developing hydraulic wind and vessel wave loading to evaluate stable stone size of the berms, and defining structural and deflection criteria for design the cantilivered combi-wall barriers in deep waters.

The challenge lies in how to design impermeable salinity barriers to withstand the forces of hurricane surge, winds, and ship waves, and have these barriers be stable over its service life given the soft nature of the soils native to this lake bed.

Constructability reviews were provided for this large scale marine construction project, along with estimates of probable construction and O&M costs. Adaptive Management was identified as an approach to optimize, monitor, and plan expenditures and retain project benefits over the service life of the project.

A 15 percent Basis of Design report and drawings were developed to facilitate future design and assist with the process of stakeholder engagement, review, and permitting approval.

PRESENTER BIO: Mr. Gaitán is experienced in design integration of hydraulic control structures, including the Panama Canal Third Set of Locks and the Lake Borgne hurricane surge barrier in New Orleans. Other projects involve floodwalls, stormwater pump stations, spillways, and outlets. Sergio obtained his bachelor and master degrees from the University of Minnesota.

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CPRA'S FLOOD RISK AND RESILIENCE PROGRAM

Andrea Galinski*, Mandy Green, Ashley Claro, and Bren Haase*
Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

Key Focus Area: This presentation focuses on building coastal resilience through the state's approach flood risk reduction, specifically CPRA's Flood Risk and Resilience Program and recommended nonstructural projects, resilience policies, and related activities.

Presentation Description: This oral presentation is one component of a session focused on CPRA's Flood Risk and Resilience Program and the related activities occurring in coastal Louisiana to build greater resilience in a future with increasing coastal flood risk. This session will highlight the multi-disciplinary approach needed to anticipate, plan, and prepare for increasing risk, and presentations will illustrate how a multitude of actors can advance coastal planning efforts including parish governments, non-governmental organizations, and academics. This presentation will include an overview of CPRA's Flood Risk and Resilience Program, as well as provide an update on ongoing projects and initiatives.

First, the presentation will summarize the state's approach to reduce coastal storm surge-based flood risk through the 2017 Coastal Master Plan, including various scenarios of future flood risk and how this risk may increase over time. Then the presentation will highlight CPRA's coastwide nonstructural project recommendations and resilience-related policy recommendations that are directed towards a range of other state and local entities to promote a more comprehensive approach. The presentation will then discuss CPRA's Flood Risk and Resilience Program, a state-led grant program to advance nonstructural planning and implementation, which is unique in geographic size, its focus on risk reduction over a 50-year time period, and its extensive engagement with a diverse group of stakeholders. The presentation will also provide an introduction to the Master Plan Data Viewer, a useful tool to better understand future flood risk and a resource to integrate flood risk planning across other state, local, and individual initiatives.

The presentation will include a briefing on the Flood Risk and Resilience Program's new initiatives including a forthcoming assessment of coastal parishes' nonstructural capacity to better understand the strengths and needs parishes may have to both implement nonstructural projects and develop the policy and programmatic measures to reduce the impacts of flooding. Lastly, a state-focused outreach project for other state agencies to encourage flood risk reduction in ongoing state planning initiatives will also be introduced.

PRESENTER BIO: Andrea's work has focused on development of the 2017 Coastal Master Plan, the state's guiding plan for the protection/restoration of the Louisiana coast. She has expertise in CPRA's Flood Risk and Resilience Program, which focuses on increasing flood risk awareness and supporting projects/policies that promote greater resilience across the coast.

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HYDROLOGIC SIMULATION AND ASSESSMENT OF REMOTE SENSING PRODUCTS OF THE 2016 LOUISIANA FLOOD IN THE AMITE RIVER BASIN

***Shu Gao*[1], *Matthew V. Bilskie* [2], *Scott C. Hagen* [1,2,3,4] *and DeWitt H. Braud* [4]**

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Riverine and coastal flooding are one of the most common environmental hazards that affect millions of people around the world. For example, in August 2016, a slow-moving upper level low-pressure system with a high amount of atmospheric moisture brought heavy rains from August 11 to August 13. The torrential downpours led to widespread flash flooding and river flooding across multiple parishes in Southeast Louisiana and Southwest Mississippi. Precipitation totals as high as 26 inches were recorded during the two-day event. A Louisiana Economic Development report documented that the state of Louisiana suffered more than eight billion dollars in damage from the catastrophic flooding. According to the National Weather Service (NWS) in New Orleans, the rainfall caused the Amite River, Comite River, Tangipahoa River and Tickfaw River to rise to record-setting levels. Some of the most serious flooding occurred along the Amite River, which runs between Baton Rouge and the nearby city of Denham Springs, and has its headwaters in southwestern Mississippi and drains into Lake Maurepas.

To develop an understanding of the driving mechanisms that caused the catastrophic flooding a campaign was initiated to collect and rigorously examine all possible remote sensing products in order to derive the flooding extent and depth within the Amite River basin. In addition, a Soil and Water Assessment Tool (SWAT) has been developed for the Amite River watershed to simulate runoff from the 2016 Louisiana flood event. The developed modeling products and remote sensing data will enhance the understanding of the hydrological processes within the Amite River basin. This will provide further insight into conceptualization of flood risk across river deltas and other low gradient coastal regions that are vulnerable to both riverine and coastal flooding.

PRESENTER BIO: Shu Gao is a PhD student in Civil and Environmental Engineering Department at Louisiana State University. She received Bachelor's degree in Geomatics Engineering from China University of Petroleum and Master's degree in Geography from Louisiana State University.

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"THE PINKER THE BELLY, THE BETTER THE SYSTEM": HOW AQUACULTURE AND RESTORATION LEGALLY FIT TOGETHER IN LOUISIANA'S WETLANDS

Lizzie Garcia
Tulane University Law School, New Orleans, LA, USA

Session Theme and Topic: Restoration and Protection in Practice: Lessons Learned from Other Coastal Areas
Fishing and seafood harvesting is a huge industry and an economic support of Louisiana. However, with declining fish populations due to habitat loss, pollution, and overfishing, aquaculture might be the next step in Louisiana's seafood industry. This causes a problem though, because aquaculture is highly damaging to coastal environments. Thankfully, integrated multi-trophic aquaculture systems are the new movement in creating sustainable aquaculture. The Veta La Palma project in Spain has already successfully implemented this wetlands restoring, fish producing aquaculture method. It could work in Louisiana's wetlands, but the big question is whether it could be legally implemented.

Veta La Palma in the Doñana marshlands at the tip of the Guadalqivir River in Southwestern Spain is a unique operation. This farm is a fish farm that incorporates a newly developing form of aquaculture called "integrated multi-trophic aquaculture systems" (IMTA). The practice of IMTA consists of careful ecosystem management that creates habitats not only for the targeted fish, but for a variety of flora and fauna. The concept is to restore the flow of water, creating a new self-dependent wetlands system that provides habitat for a wide array of species. Much like the coastal wetlands in Louisiana, the area that Veta La Palma lies on is a richly biodiverse coastal wetlands ecosystem. The Doñana marshlands are home to over 250 bird species, many of whom are endangered or threatened, as well as eels and a variety of fish.

The system results in healthy fish for commercial sales as well as wetlands restoration because of its systematic function. The multiple trophic levels support each other, which allows the commercial fish production and the wetlands restoration to support each other as well. The totality of the system results in a healthy environment and a profitable business.

Initially, implementing an IMTA project such as Veta La Palma in Louisiana appears to be a legal conundrum. The complexity derives from the confusing juxtaposition of a fish farm and a wetlands restoration project. Typically, projects are either restoration or development, not both. However, while U.S. federal law regarding aquaculture and restoration is a complicated and tangled web, Spain's aquaculture law is not much more streamlined. IMTA projects fit within the current federal and state legal systems surrounding both wetlands restoration and aquaculture. While it is confusing at first glance, the benefits of IMTA are legally possible in Louisiana.

PRESENTER BIO: Lizzie Garcia is a third year law student at Tulane University Law School. She received her BA from University of Miami in Marine Affairs and Anthropology, and her Masters of Professional Science in Marine Affairs and Policy from the University of Miami's Rosenstiel School of Marine and Atmospheric Science.

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SHELL PIPELINE USES NATURAL INFRASTRUCTURE SOLUTIONS TO PROTECT SHIP SHOAL PIPELINE AND IMPROVE THE NEARBY COASTAL ECOSYSTEM

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Natural Infrastructure solutions are often a viable and resilient candidate for pipeline maintenance and mitigation activities. Shell Pipeline Company LP (Shell) completed their first natural infrastructure project along the Ship Shoal corridor in Blue Hammock Bayou. This innovative project was designed to enhance pipeline integrity and safety, reduce infrastructure maintenance costs and protect and preserve the environment. Similar solutions to the approach taken in this project are currently being applied to support other Shell Pipeline Co LP assets.

Blue Hammock Bayou sits on the Louisiana coast, where the Ship Shoal Pipeline, a joint venture operated by Shell, runs 31-miles to deliver on average 200,000 barrels of crude oil a day from deep-water assets in the Gulf of Mexico to Louisiana.

The challenges were evident. The solution was not. Some of the challenges at this and similar sites include: Integrity of operating pipelines; Coastal erosion, further driven by subsidence, sea level rise and storms; Challenging maintenance requirements and rising costs; Changing hydrology and sediments that threaten an ecological asset and natural habitat; Increased marine traffic and potential for incident along the pipeline right-of-way.

To mitigate these challenges, Shell collaborated with Jacobs (formerly CH2M) and The Nature Conservancy (TNC) to create a non-traditional approach that would add positive impacts to the coastal ecosystem. The natural infrastructure solution, now a resilient and thriving ecological asset, was completed in October of 2015. The monitoring findings indicate that the natural infrastructure approach is already performing beyond expectations, with strong plant growth and accumulation— rather than erosion—of sediments. The sustainable solution is protective of the pipeline, has helped stabilize the marsh, and has enhanced the nearby natural habitat. Monitoring through point survey will be repeated to ensure performance of the site. This presentation will cover the non-traditional approach taken on this pilot project and will present an update on several other types of natural infrastructure solutions being applied on other sites as part of maintenance activities.

PRESENTER BIO: Leonard D Garrison III (Donnie). With over 20 years' experience with Shell Pipeline and over 35 years in the Oil and Gas Industry, Donnie has held positions from maintenance, operations, HSE supervisor to his current role as Sr. Operations Support Supervisor. Born and raised in the small Louisiana Coastal Community of Napoleonville, he later went on to receive his B.S. degree in Biology from Nichols State University.

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INDIVIDUAL VARIATION IN BROWN PELICAN (*PELECANUS OCCIDENTALIS*) FORAGING BEHAVIORS IN THE GULF OF MEXICO

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Animal movement decisions and associated rates of energy expenditure have important implications for survival and fitness, which in turn scale up to shape broader population dynamics. In coastal marine ecosystems, environmental conditions that promote resource availability are highly dynamic, necessitating the ability of foraging individuals to continually modify their behaviors over time. However, due to environmental disturbances, particularly those borne of anthropogenic processes, animals are often diverted from their normal activities, resulting in reduced efficiency of movement and potential fitness impacts. Modern tracking technologies have allowed remarkable insights into the foraging behaviors of animal populations, but often lack an important component of variation: that within the individual. A key line of inquiry is now: which individuals modify their behaviors in response to changing conditions, how do they do so, and what are the consequences? Answers to these questions are necessary to further understand both the ecological effects of environmental disturbance and the mechanisms by which individual specializations may arise within populations.

In the northern Gulf of Mexico, brown pelicans (*Pelecanus occidentalis*) navigate a foraging landscape that is patchy and dynamic at a variety of scales due to both natural and anthropogenic stressors. The species is therefore an ideal subject through which the trophic dynamics of the Gulf, as well as the broader significance of behavioral plasticity in uncertain environments, can be understood. From 2012-2017, we have attached GPS transmitters and accelerometers to breeding adult pelicans on Raccoon Island, the largest colony in coastal Louisiana. Particular focus is given to the fluctuation of behaviors within monitored individuals across time, especially in response to known environmental disturbances. We observed increases in foraging site fidelity in tracked pelicans as the breeding season progresses, but lower fidelity and less variation in energy expenditure in birds of higher body condition. Additionally, assessments of traditional foraging metrics such as trip distance, linearity, or duration have not yielded significant relationships among individuals, highlighting the importance of considering variation at multiple levels in attempts to characterize foraging strategies in wild populations.

Upcoming work will combine these findings with additional accelerometer analysis, ecotoxicological assays, and expansion to additional colonies to understand the relative contributions of foraging energetics, environmental cues, contaminant exposure, and restoration activities to population-level processes in heavily disturbed systems such as the northern Gulf. These and future results will provide unprecedented insights into the movement ecology and demography of an important seabird, which will provide valuable information to basic behavioral ecologists as well as barrier island restoration efforts currently underway throughout the Louisiana coast.

PRESENTER BIO: Mr. Geary is a senior graduate student transitioning into post-doctoral work, with 10 years of experience studying waterbirds on the Gulf coast. He has expertise in wildlife tracking and handling large quantities of fine-scale biologging data, and is currently beginning work linking brown pelican behavior with coastal restoration efforts.

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AVOIDING THE DREADED SUNKEN BREAKWATER: CONSIDERATIONS FOR STABILIZING SHORELINES IN SOFT SOILS

***Brett Geesey**, P.E.*
HDR Engineering, Inc., Lafayette, LA, USA

Coastal Louisiana faces many unique challenges including a constantly changing landscape due to subsidence, sea level rise, salt water intrusion, and shoreline erosion. Louisiana has one of the longest coastal shorelines in the United States with over 7,000 miles including bays, estuaries, channels, bayous, etc. These coastal shorelines are eroding at an alarming rate with some locations losing over 50 feet of shoreline position each year. Stabilizing these shorelines is one of many methods that are being used to help protect and restore Louisiana's coastal areas.

Federal, State, and local governments, as well as private interests, have implemented a variety of techniques to control land loss by reducing shoreline erosion. Traditionally, shorelines have been protected from erosion by wind-generated waves through construction of hard, armored structures such as rock breakwaters and bulkheads. Often, the most vulnerable areas in Louisiana that are susceptible to high erosion rates tend to have weak foundation soils. These weak foundation soils make traditional shoreline protection techniques difficult to design and construct.

This presentation will examine lessons learned while observing issues working with traditional breakwaters in areas with soft soils. Additionally, several less traditional methods and lessons learned from previous projects that incorporated these techniques will be presented.

PRESENTER BIO: Mr. Geesey is a coastal engineer with HDR Engineering, Inc. with over 10 year of experience in coastal restoration throughout the Gulf coast. His background includes design of shoreline protection, marsh restoration and creation, beach nourishment, numerical wave and circulation modeling, evaluation of coastal processes and their interaction with structures.

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OVERVIEW OF THE RECENTLY RECOGNIZED DIEBACK OF ROSEAU CANE (*PHRAGMITES AUSTRALIS*) IN COASTAL LOUISIANA

***Madeline Gill**, Rodrigo Diaz, and Andy Nyman*
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Roseau cane (*Phragmites australis*) dieback was first noticed during the fall of 2016 in the Mississippi River Delta. By summer of 2017 dieback had been observed in several locations across coastal Louisiana and appeared to coincide with the infestation of a scale insect (*Nipponaclerda biwakoensis*) commonly known as Roseau cane scale. Roseau cane scale is native to Asia and was not previously reported in North America. The scale can be found below the leaf sheath of Roseau cane and feeds by sucking sap directly from the stem. Three Asian parasitoids were found attacking the scale suggesting that the insect may have been in North America for a long time. The host range of the scale is unknown at this time; however, in China the scale has been reported in plants of the genera *Phragmites, Agropyron* and *Juncus*.

Roseau cane found in other regions of North America is detested for its invasiveness which outcompetes beneficial native vegetation. However, throughout the Mississippi River Delta Roseau cane provides important habitat for fish and wildlife and critical defense against salinity and wave action in water too deep for other plant species to tolerate. Roseau cane dieback in the Mississippi River Delta is resulting in patches of open water and poses a major threat to coastal integrity. Additionally, Roseau cane provides protection for oil and gas infrastructure, recreational camps used by biologists and sportspeople, and crucial navigation channels. Loss of Roseau cane at the lower Mississippi River Delta will likely cause significant ecological and economic impacts not experienced elsewhere.

PRESENTER BIO: Madeline Gill is a research associate with the Louisiana State University AgCenter in the department of entomology.

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ENSURING LIVING SHORELINES FOR THE LONG-TERM THROUGH MODELING AND MAINTENANCE: AN ALABAMA DESIGN EXAMPLE

*Kevin Hanegan[1], Nicholas Cox[2], Chris Williams[2], **Meg Goecker**[3], Mary Kate Brown[4], and Judy Haner[4]*
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The Nature Conservancy (TNC) is one of the leading organizations responsible for advancing living shoreline initiatives across the Gulf and particularly successfully in Alabama. With funding from the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund, TNC took the opportunity with the Lightning Point Living Shoreline Project (Bayou LaBatre, AL) to design a new, creative, and innovative green alternative for shoreline protection that can be resilient in the long-term. This project design combined beneficial use of dredged material techniques to create 50 acres of marsh, beach, tidal creek habitat; breakwater engineering along 1.5 miles of shore; and managed public access with low impact development techniques for a boat parking lot and boardwalks.

In Alabama, the living shoreline concept, as we know it today, has seen many iterations and innovations starting with the University of South Alabama oyster reef restoration program from 2003 (Point aux Pins) to the TNC-NOAA American Recovery and Reinvestment Act 2009 investment in 2010 (Coffee Island/Alabama Port) to Deepwater Horizon NRDA Swift Tract Project in 2016, and many others. TNC, in collaboration with the Dauphin Island Sea Lab, has been at the forefront, of the innovation and scientific testing of numerous living shoreline products (e.g. castles, ReefBalls, ReefBLK, Hesco, bagged oyster shell), raising awareness of shoreline protection alternatives to conventional hard armoring. Each iteration the data generated has produced many lessons learned including: 1) the need for wave, wind, and storm surge modeling to ensure cost effective protection of shoreline, and increased longevity and resiliency to storms, and 2) the importance of maintenance of restored sites to increase ability of restoration investment to respond to rising sea levels and subsidence.

The longevity and resilience of the restored marsh habitat is ensured by the protective capacity of the low-crested, rubble-mound shoreline protection feature designed with the aid of an innovative modeling technique. Waves directly offshore of the project site were hindcast for decadal timescales using a Mike21-SW wave transformation and wind-wave generation model of the Mississippi Sound, both for present conditions and for the future incorporating the latest regional relative sea level rise estimates. Relevant empirical equations for wave transmission over low-crested breakwaters were then used to transform the full modeled offshore wave climate to what would impact the marsh edge directly. The breakwater crest elevation was then optimized so that the transmitted wave climate would allow for a stable, non-eroding marsh edge and a resilient living shoreline habitat.

Once the site is constructed, the design team will develop a beneficial use of dredge plan that addresses a maintenance regime for disposal of dredge material using thin-layer techniques to raise the marsh elevation against projected sea level rise scenarios. This will not only increase longevity and resilience of the restored marsh and current marsh in the face of rising seas but also provide regular maintenance dredging of the ship channel, ensuring safe channel navigation for the Bayou La Batre commercial fishing fleet.

PRESENTER BIO: Ms. Goecker is a senior project manager and coastal scientist with Moffatt & Nichol. She has more than 15 years of experience in applied marine and coastal ecology with an emphasis in oyster, marsh, and seagrass restoration ecology.

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ADVANCES TO FLOOD RISK MITIGATION IN JEFFERSON PARISH

Michelle Gonzales
Jefferson Parish, Jefferson, LA, USA

Key Focus Area: This presentation focuses on building coastal resilience in Jefferson Parish through parish floodplain management and mitigation activities, including assisting with CPRA's Parish Pilot Project.

Presentation Description: This oral presentation is one component of a session focused on CPRA's Flood Risk and Resilience Program and the related activities occurring in coastal Louisiana to build greater resilience in a future with increasing coastal flood risk. This session will highlight the multi-disciplinary approach needed to anticipate, plan, and prepare for increasing risk, and presentations will illustrate how a multitude of actors can advance coastal planning efforts including parish governments, non-governmental organizations, and academics. This presentation will outline how Jefferson Parish is working to decrease flood risk through development and implementation of grants to mitigate flood prone structures.

Jefferson Parish prioritized the mitigation of flood prone properties after Hurricane Katrina and aggressively sought grant funding to elevate or reconstruction repetitive loss properties. In 2008, Jefferson Parish has the greatest number of Severe Repetitive Loss Properties at nearly 1,500. By leveraging Road Home, Insurance, and Grant funds, in the past 10 years that number has been reduced to just over 300 unmitigated structures. In the past year, Jefferson's office of Floodplain Management and Hazard Mitigation participated in a pilot project with CPRA to complete an application that allowed CPRA to see how a local government would use their suite of application products. What it allowed the office to realize is better information is needed about the housing stock in Coastal Jefferson.

Jefferson has now identified the area outside Levee protection in Jefferson parish to be listed as a Repetitive Loss area under the Community Rating System. As such, targeted outreach will be sent to all residents within this area annually. The messages that are sent will meet the Community Rating System Program for Public Information that was adopted by the Jefferson Parish Council in 2015. Sample topics are flood risk, ways to protect your property, and emergency preparedness guidelines. In addition to target messages, the office is preparing a specific analysis that has allowed staff to visit every structure in this area. Photos were taken as well as information gather regarding approximate height of the structure. This assessment will be geocoded and allow staff visually see where the homes with the greatest need to be elevated are located. From there, prioritization will occur so funding can be targeted to the neediest areas.

PRESENTER BIO: Michelle Gonzales is the Director of the Department of Floodplain Management and Hazard Mitigation with Jefferson Parish. Over the past five years, Michelle's office has received $100 Million to elevate or reconstruct flood prone structures. Previously, Michelle worked with FEMA and the Governor's Office of Homeland Security and Emergency Preparedness.

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BAYOU LAFOURCHE FRESH WATER DIVERSION – PRELIMINARY DESIGN

***Dan Grandal**[1], and Ben Malbrough[2]*
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The Bayou Lafourche Freshwater District (BLFWD), thru its existing partnership with the Louisiana Coastal Protection and Restoration Authority (CPRA), is committed to implementing the Mississippi River Reintroduction Into Bayou Lafourche (MRRBL) Project, a large-scale effort to nourish and protect the Barataria-Terrebonne Basins from coastal erosion and ensure long-term freshwater supply to communities and industries served by the BLFWD by limiting salt water intrusion and enhancing water quality. The project is part of CPRA's 2017 Master Plan and a priority project to provide freshwater resources and prevent further marsh losses in and adjacent to Bayou Lafourche.

The BLFWD has made significant improvements that have allowed increased pumping from the Walter S. Lemann Memorial Pump Station and increased capacity due to dredging and the removal of the Union Pacific Railroad (UPRR) bridge culverts in 2016, which was a major constriction in the bayou. These improvements led BLWFD to initiate efforts to design and construct a new pump station that will meet the goals of transferring a minimum of 1,000cfs into Bayou Lafourche. This presentation will highlight the complexity of the project and the multiple considerations shaping the project, while providing an overview over the completed efforts and the current design status.

Stantec Consulting Services is providing planning, preliminary and final design services, which consist of pump station design, CFD modeling and hydraulic analyses, station capacity determination, pump selection, mechanical design, electrical design, 3D sediment transport analyses, design survey, geotechnical investigation, preparation of civil layouts, SCADA system, utility service design and coordination, life-cycle cost analysis, preparation of contract documents, and preparation of construction cost estimates. The design includes provisions for emergency power and redundant system for reliability. The design uses 3D BIM to for real-time coordination and visualization of design progress. The design is currently in the 60% design phase and is scheduled to be designed and permitted by the end of 2018.

PRESENTER BIO: Dan graduated from Tulane University and is a resident of New Orleans. He works at Stantec and is a Professional Civil Engineer and Certified Floodplain Manager. He has over 20 years of experience in design of water resource projects including large pumping stations, drainage master plans and coastal protection projects.

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BRETON ISLAND RESTORATION EVOLUTION MODELING (BIREM)

Gregory M. Grandy[1]*, Brian Spears*[2]*, Joseph Long*[3]*, P. Soupy Dalyander*[3]*, Michael Poff*[4]*, Steve Dartez*[1]*, Brett Borne*[1]*, and Gary Emmanuel*[5]

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North Breton Island is the southern-most in a chain of barrier islands forming the Chandeleur Islands. North Breton Island is approximately 19 miles east of the port city of Venice, LA and approximately 62 miles southeast of New Orleans, LA. The Natural Resource Damage Assessment (NRDA) Trustees selected enhancement of North Breton Island as part of the 2014 Deepwater Horizon NRDA Phase III Early Restoration Plan to help restore injuries to natural resources. The USFWS is the lead implementing agency for this Project. The purpose of the North Breton Restoration Project is to increase island longevity by enhancing beach, dune, and back-barrier marsh habitats on the island to support nesting and foraging habitat for brown pelicans, terns, skimmers and gulls.

As part of the preliminary design process for the restoration of North Breton Island, a conceptual design was prepared and modeled for a period of 15 years following construction. Modeling of the conceptual design over the 15-year period of analysis was an innovative effort which integrated short-term storm response modeling with longer term morphodynamic modeling. USGS utilized XBEACH, which is capable of simulating beach and dune erosion, overwash, and breaching that can occur during extreme storm events, to model storm response (hurricanes) at Target Years 2, 7, and 12 post-construction. Modeled storm frequency, intensity, and duration were selected based on historical observations of recent storms near North Breton Island.

Coastal processes and forcing functions including gulfside erosion, bayside erosion, and relative sea level rise (combination of subsidence and sea level rise) were modeled by CEC. The modeling consisted of manually eroding the constructed template over the time segments surrounding the modeled storm events. Erosion and subsidence rates were selected based on historical shoreline positions, historical data, literature review, and project design surveys. Shoreline change, subsidence, and sea-level rise effects for the years between storm intervals were applied to the post-storm island landforms and the results were used as the pre-storm conditions for the subsequent XBEACH model simulation.

The integrated modeling effort consisting of USGS utilizing XBEACH software to predict storm response and CEC representing coastal processes by manually eroding the restoration template utilized multiple modeling techniques to assess future habitat benefits of the design template.

PRESENTER BIO: Greg Grandy is a Senior Environmental Manager with CEC. He has over 25 years of experience in the public and private sector leading multi-disciplinary teams in the restoration of wetland ecosystems. Mr. Grandy resides in Baton Rouge, Louisiana with his wife, Claire of 27 years, son Benjamin and daughter Isabel.

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OFFSHORE RENEWABLE ENERGY PLANNING INFORMED BY APPLIED SCIENCE RESEARCH IN THE GULF OF MEXICO

***Rebecca E. Green*[1]**, *Suzanne Tegen*[2], *and Walter Musial*[2]
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The United States (U.S.) Department of the Interior's Bureau of Ocean Energy Management (BOEM) is committed to developing, funding, and managing rigorous scientific research specifically to inform policy decisions on the development of energy and mineral resources on the Outer Continental Shelf (OCS). For over 40 years, BOEM and its predecessor agencies have funded applied science research in all U.S. OCS regions, including significant investments in the Gulf of Mexico (GOM) across a range of biological, physical, and social science disciplines. New research projects are informing BOEM's expanding role with planning and leasing for offshore renewable energy development in Federal offshore waters. This is pursuant to the Energy Policy Act of 2005 (EPAct), which authorized BOEM to issue leases, easements, and rights-of-way to allow for renewable energy development on the OCS.

The responsible Federal agencies are committed to supporting effective stewardship of offshore renewable energy activities, including through coordination and partnering on research priorities. In 2016, the Department of the Interior and Department of Energy jointly issued the National Offshore Wind Strategy, which identified an updated strategy for Federal engagement and investment in offshore wind research. Specifically, research is needed that can help focus regulatory efforts on the most important environmental and human-use impacts, as well as collecting data to inform wind farm feasibility, siting, and design. In alignment with this strategy, BOEM's Environmental Studies Program (ESP) is currently funding the National Renewable Energy Laboratory (NREL) to perform an offshore renewable energy feasibility study across technology types for the GOM. Initial results from the techno-economic feasibility study are supportive of future offshore wind development in the GOM. This ongoing study will further elucidate site-specific considerations, as well as benefits to regional job and economic growth.

Various other research programs are informing wind-wildlife impacts and offshore wind design standards. BOEM is currently partnering on the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS), which is providing data on broad-scale distributions of marine mammals, seabirds, and sea turtles in the region. BOEM is also funding a brown pelican study in the GOM, which has produced thousands of satellite-tracked locations for tagged birds. This type of regional environmental information will be made available in ocean portals and has proven important in siting and mitigating for offshore development. Additionally, there is a new multi-agency partnership called the Offshore Wind Technical Advisory Panel (OWTAP), which is working to develop U.S.-specific design standards and guidelines to account for the unique offshore conditions on the U.S. OCS, including relevance to storm events and hurricanes in the GOM. Moving forward, gathering input from stakeholders, including the Gulf Coast States, on research directions remains a priority for BOEM and its partners.

PRESENTER BIO: Dr. Green is a senior oceanographer with more than 20 years of experience in oceanographic research and ocean use planning. She is a member of BOEM's Environmental Studies Program where she has extensive experience in leading environmental studies to inform offshore energy management.

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OFFSHORE WIND ENERGY: THE FEDERAL PROCESS FROM START TO FINISH

Michelle Morin *Presented by:* ***Rebecca E. Green***
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In 2009, the Department of the Interior (DOI) announced the final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which w authorized by the Energy Policy Act of 2005. These regulations provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas. DOI's Bureau of Ocean Energy Management (BOEM) is responsible for offshore renewable energy development in Federal waters.

To date, BOEM has issued thirteen commercial wind energy leases offshore of Delaware, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, and Virginia. Additionally, BOEM is in the planning stages for additional wind leasing off the coast of the Carolinas and has received unsolicited lease requests from companies seeking to develop offshore wind energy for additional areas located offshore New York, New Jersey, and Massachusetts. In 2014, BOEM executed its first transmission right-of-way grant offshore Rhode Island for the Block Island Wind Farm, which became the first operational wind facility offshore the U.S. in late 2016. In 2015, BOEM executed the first wind energy research lease in Federal waters with the Commonwealth of Virginia's Department of Mines, Minerals and Energy. Along the Pacific coast, BOEM received unsolicited lease requests to develop wind facilities offshore Hawaii and California. BOEM is engaged in the planning process for potential lease sales offshore both California and Hawaii. BOEM is currently processing one unsolicited research lease request offshore Oregon for a marine hydrokinetic technology testing facility. To date BOEM has approved one construction and operations plan (COP) and three site assessment plans (SAPs). In late 2017, BOEM received its second COP for review, and anticipates up to three additional COPs being submitted in 2018. In addition to potential leasing in the Gulf of Mexico, the State of Louisiana can and may continue to be involved in supporting renewable energy activities that occur off the East Coast.

Either through a presentation or as part of a panel, BOEM representative(s) will provide a high-level overview of the BOEM Renewable Energy Program, including an explanation of the four distinct phases the program occurs in: (1) planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. We will also update the audience on the status of leasing and development on the Atlantic OCS as well as provide an outlook for future activities. In conclusion, we will discuss opportunities for State involvement in the process and how potential leasing and development in the Gulf of Mexico may be similar or different from what is occurring off the East Coast.

PRESENTER BIO: BOEM is the lead Federal agency responsible for overseeing offshore renewable energy development in Federal waters. Michelle Morin is the Chief of BOEM's Environment Branch for Renewable Energy responsible for environmental reviews, consultations, and studies related to renewable energy leasing and development on the Atlantic OCS.

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LOUISIANA COASTAL GEOHAZARDS ATLAS

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On January 5, 2018 the Louisiana Geological Survey (LGS) and New Orleans Geological Society (NOGS) began the formal process of constructing and publishing an atlas of the geohazards in the Louisiana coastal zone, with an emphasis on geohazards that affect land use and infrastructure. This atlas will build on the historical data, experience and expertise in producing geological maps at LGS. It will also, for the first time, integrate the interpretation of subsurface geology making use of the data and knowledge base of the oil and gas industry, which has been the expertise of NOGS. The atlas will use the existing new Landforms of the Louisiana Coastal Plain map which allows users to relate important geologic processes to the landscape. The objective of the Louisiana Coastal Geohazards Atlas is to produce a document in both digital and print form that is accessible to a wide range of applications for state and federal agencies, universities, private contractors working in the coastal zone, and non-governmental organizations. There will be an emphasis on geohazards, such as faulting and subsidence, that affect land use and infrastructure. This poster session will provide examples of the types of data and displays that will be included in the atlas.

The Louisiana Geological Survey (LGS) was established in 1934. Its mission is to provide relevant unbiased geological and environmental information to state agencies and other decision-making bodies leading to Louisiana's environmentally sound natural resource development and to economic prosperity for the state and its citizens. LGS has accomplished this mission through the publication of geological maps, geological bulletins and water resource bulletins. The New Orleans Geological Society (NOGS) was established in 1941. Its mission has historically been to facilitate the development of the profession and science of Geology in Louisiana through the publication of geological atlases and education support. Since Hurricane Katrina NOGS has expanded its objectives to include the promotion of the application of geology in engineering and environmental sciences.

PRESENTER BIO: Dr. Groat is a nationally renowned educator and government scientist. He is the Acting Director of the Louisiana Geological Survey. He is the former CEO of the Water Institute of the Gulf, former director of the Center for International Energy and Environmental Policy at UT Austin, and former director of the U.S.G.S.

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CLAY BALLS IN MY SOUP – CHALLENGES OF CONSTRUCTING COASTAL MARSH PROJECTS USING HIGH PLASTICITY CLAY BORROW

Joe Guillory[1], *P.E., Shannon Haynes*[2], *P.E., and Amanda Taylor*[2], *P.E.*
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[2]Coastal Protection and Restoration Authority of Louisiana, LA, USA

Located on the Northshore of Lake Pontchartrain in St. Tammany Parish, the Bayou Bonfouca Marsh Creation (PO-104) project was completed in January of 2018. The project, funded by Louisiana Coastal Wetland Planning, Protection and Restoration Project (CWPPRA), was designed by the Coastal Protection and Restoration Authority (CPRA) and constructed by Weeks Marine Inc. The project created 600 acres and nourished nearly 300 acres of low salinity brackish marsh through the placement of hydraulically dredged sediment from Lake Pontchartrain.

As with typical marsh creation projects, the target fill elevation on the project was set based on the expected settlement of the dredged slurry. During construction, extensive pockets of high plasticity clays were encountered in the borrow area that were not previously anticipated. High plasticity clays tend to stick together forming balls which makes the material more difficult to transport as well to spread once deposited in the marsh fill area. As a result, additional equipment was needed to spread the material throughout the project site. The additional equipment caused extensive shearing and bulking of shall Pleistocene soils in a volume nearly equal to that of the placed dredge material. This caused significant variability in the soil makeup throughout the marsh creation sites which in turn made it much more difficult to predict the final marsh elevation following primary consolidation, secondary compression and desiccation of the dredge fill material.

To address this issue, the high plasticity clays were strategically placed near the lake rim to produce a more robust section adjacent to the lake. This resulted in a mud wave that flowed more evenly through the cell allowing the project team to hone in on a more appropriate marsh fill elevation. On future projects with high plasticity clays, new approaches to successful construction of the marsh platform are needed. For example, additional geotechnical investigation is warranted to better understand how the material will flow in additional to settlement characteristics. In addition, the ability to modify the final fill elevation will provide the flexibility needed during construction and promote additional cooperation with the contractor.

PRESENTER BIO: Mr. Guillory is the Coastal Business Unit Leader for DDG. He brings a practical, yet technical approach to the design and management of marsh creation, hydrologic restoration, and regional drainage projects in south Louisiana.

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THE MID-BARATARIA SEDIMENT DIVERSION DESIGN AND CONSTRUCTION CONSIDERATIONS.

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The proposed Mid-Barataria Sediment Diversion (MBSD) spans a section of land between the Mississippi River and the Barataria Basin. The goal of the project is to reconnect and reestablish the natural or deltaic sediment deposition process between the Mississippi River and the Barataria Basin. The proposed project would require, at a minimum, 3 to 5 years of construction, perhaps longer, depending on the extent of needed ground modifications and soil stabilization measures. The proposed major project features are a diversion intake structure, gated diversion structure, diversion channel, back structure, outfall area, highway bridge, railroad bridge, utility relocations, pump station or drop structure, and dredge fill placement areas.

This presentation will discuss engineering and construction considerations for various components of the MBSD project. Because this is the first sediment diversion project at this scale being implemented in Coastal Louisiana with this intended marsh building purpose and goal, Engineering considers both physical and numerical hydraulic modelling tools for the design of the project components. Throughout history, the individual components of this project have been successfully constructed; however, this is the first time that these components have been put together to form a system for sediment diversion. The operation of a large infrastructure system that is based on the variability of natural river flood event frequency, hydrographs, or sediment load requires each component in the system to integrate operational flexibility into the design to meet the project goals.

The Diversion Program has elected to utilize the Construction Management at Risk (CMAR) project delivery method. The CMAR will be part of the design process and as such introduce constructability and cost efficiencies that will enhance the performance, efficiency, and adaptability of the project. Various construction methods are possible for each of the project features when considered independently, but the CMAR and Design Team will enhance the adaptive performance of the diversion by considering the components as a diversion system.

PRESENTER BIO: Mrs. Guillory is a registered Professional Engineer and a graduate of LSU with a M.S. in Civil Engineering and a B.S. in Biological Engineering. She is an Engineering Supervisor at CPRA with more than 10 years of design experience. Mrs. Guillory serves on the Engineering Team for the MBSD project.

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ANALYSIS OF IMPACT OF SALINITY ON WATER SUPPLY STRESS: IMPLICATIONS AND POTENTIAL SOLUTIONS FOR LOUISIANA FRESHWATER AND COASTAL SYSTEMS

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The protection, restoration, and conservation of freshwater resources are crucial for the health and resiliency of our coastal ecosystems and communities. One of the most under-appreciated challenges we face in this regard is the depletion of groundwater in coastal aquifer systems. Overuse of coastal aquifers can lead to subsidence and salt water intrusion. Motivated by this problem and the fact that many Gulf and Atlantic Coastal states are over-using groundwater resources despite having abundant surface water and annual rainfall totals, our research group has developed several tools to evaluate and address this problem.

Here we report on a new framework for incorporating the impact of water quality (with a primary focus on salinity) on water supply by using the Water Supply Stress Index (WaSSI). The study investigates the usefulness of the framework by investigating the impact of high-salinity waters on the availability of irrigation water for agriculture in the Chenier Plain and other areas in coastal Louisiana. The WaSSI metric was deconstructed into sectoral components such that the total available water supply could be reduced for a particular demand sector (agricultural irrigation in this example) based on available water quality information. The results highlight substantial impacts on water supply stress for farmers attributable to the landward encroachment of saline surface water and groundwater near the coast. Areas of high salinity near the coast also increased the competition for freshwater resources among the industrial, municipal, and agricultural demand sectors in the vicinities of the municipal areas of Lake Charles, Lafayette, and Baton Rouge. By understanding where, when, and how much "excess" surface water is available to offset groundwater use, this framework also serves as a foundation for investigating the adoption of cutting-edge water management design solutions such as Aquifer Storage and Recovery. The conjunctive management of surface water and groundwater can achieve greater resiliency of coastal water systems in Louisiana, especially in regions where the upper freshwater catchments and coastal ecosystems are highly inter-dependent.

PRESENTER BIO: Dr. Habib is a professor of Civil Engineering, with research expertise is in surface hydrology, climate variability; hydrologic modeling; water resource management; and uncertainty modeling of hydro-ecological models. He published more than 60 peer-reviewed journal articles. He served as a member on the Precipitation Committee of the American Geophysical Union and is currently serving on the Education Committee of the Consortium of Universities for Advancement of Hydrologic Sciences Inc. (CUAHSI).

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EVALUATION OF RADAR-BASED PRECIPITATION DATASETS FOR APPLICATIONS IN THE LOUISIANA COASTAL MASTER PLAN

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A suite of hydrological and ecological models is used in the Louisiana Coastal Master Plan (CMP) Integrated Compartment Model (ICM) to assess potential benefits of restoration and protection projects. A main driving input for these models is precipitation. Since precipitation is considered a major source of freshwater in coastal Louisiana (50-60 inches/year), accurate information about its magnitudes and spatial and temporal distributions is critical for successful implementation of the ICM and other CMP-related modeling studies. Accurate information on precipitation is also critical for establishing reliable and representative water budget analyses for coastal Louisiana.

Precipitation inputs into the ICM models have traditionally relied on a set of extremely sparse rain gauge stations. Given the relatively high variability of rainfall in this region, the limited spatial coverage of the available rain gauges is inadequate to provide reliable precipitation information to the ICM models. The impact of low-quality precipitation data can have significant impacts on the prediction of key ecosystem variables such as water level and salinity concentrations. In contrast to the sparse availability of rain gauges, weather radars can provide high-resolution rainfall estimates with excellent spatial resolutions and coverage over coastal Louisiana. However, radar-rainfall estimates are subject to various sources of uncertainties (e.g., range effects; anomalous propagation of radar beam; hail contamination; and uncertainty in reflectivity-rainfall relationships). Given these uncertainties, and the fact that the primary focus of existing radar-rainfall products is on operational real-time flood forecasting applications, it is necessary to evaluate the accuracy and representativeness of existing radar estimates before they can be used for long-term, regional-scale studies, such as those of the CMP. The main objective of this research project is to perform a regional-scale assessment of the radar-rainfall datasets and evaluate whether they can be directly used by the CMP studies. Unlike past assessment studies, which were geared towards short-term applications (e.g., flood prediction and forecasting), the focus of this study will be on assessing accuracy aspects that are of direct relevance to the CMP applications. The study will examine (a) the reproducibility of inter-annual and intra-annual variability by the radar dataset, (b) the representation of extreme rainfall events, and (c) the representation of spatial distributions of annual and seasonal rainfall across various regions of the coast with distinctly different climatic regimes. The study will provide the CMP with quantitative assessment on the advantages and limitations of the radar-based precipitation datasets and whether they can be readily used by the ICM models. This research will also provide insight on the levels of uncertainties in the radar-rainfall datasets and the implications for these uncertainties for the ICM models.

PRESENTER BIO: Dr. Habib is a professor of Civil Engineering, with research expertise is in precipitation estimation and validation; hydrologic modeling; water resource management; and uncertainty modeling of hydro-ecological models. He published more than 60 peer-reviewed journal articles. He served as a member on the Precipitation Committee of the American Geophysical Union and is currently serving on the Education Committee of the Consortium of Universities for Advancement of Hydrologic Sciences Inc. (CUAHSI).

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THE IMPACT OF UPLAND EXTREME RAIN EVENTS ON COASTAL MARSH SYSTEMS: A CASE STUDY FROM THE LOUISIANA CHENIER PLAIN

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Catastrophic rainfall-driven flood events have motivated the pursuit of regional-based flood mitigation initiatives over the past few years. In coastal regions, flood control efforts require a delicate balance in order to provide flood relief for upland residents while avoiding unintended consequences of downstream risk transference and aquatic habitat deterioration. Adding to this challenge are the widespread coastal protection and restoration structures that provide a variety of benefits for coastal communities but may also influence upland drainage patterns. Wind effects and high tides are also commonly cited as variables that impact the overall drainage of the coupled upland /marsh drainage system.

The aim of this study is to investigate the regional flood-response patterns within a regulated a coastal marsh system as a result of an extreme rain event within the upland system. The Grand and White Lake sub-basin of the Louisiana Chenier Plain is the testbed for the investigation. A calibrated hydrodynamic model will be used to simulate the system response (peak flood level and recession times) to the August (12-14) 2016 rain event. The model includes the effect of wind as well as dynamic structure operations at the four major locations including the effects of navigation traffic and water exchange through the various lock chambers. The model will be used to examine the impact of extreme rain events at key locations within the coastal marsh system, impact on the overall water budget, and to examine the significance of coastal protection structures and wind on upland drainage rates. This study will supplement the development of regional flood mitigation efforts within this area and can provide insight on the broader challenges associated with implementing regional flood mitigation efforts in hydraulically similar systems.

PRESENTER BIO: Professor Habib is an Endowed Chair in the Department of Civil Engineering and an Associate Director of the Institute for Coastal and Water Research. His specialties include applications of radar-rainfall data for improved hydrologic prediction, uncertainty analysis of hydro-ecological estuarine systems, and budget analysis of estuarine and coastal basins.

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NUMERICAL MODELING OF SEDIMENT TRANSPORT DUE TO ALONGSHORE CURRENT-SUPPORTED TURBIDITY CURRENTS OVER AN ERODIBLE BED

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Gravity driven particulate flows are considered as one of the chief contributors to sediment transport and geomorphic changes in marine environments. A special class of gravity driven particulate flows named wave and current supported gravity flows (WCSGFs), in which strong waves and currents are found as the major participants in fluid-mud dynamics has been recently introduced as one of the chief participants in shaping submarine geomorphology and coastal lines, owing to boundary layer (BL) turbulence induced by surface waves and currents, parallel or normal to the shore, in addition to the slope induced gravitational acceleration. Depending on the dominancy of waves or currents in producing BL turbulence, two major subclasses of WCSGFs can be defined: (I) Wave-supported gravity flows (WSGFs), in which gravity flows are driven by wave-induced BL turbulence (Traykovski et al., 2000; Wright et al., 2001) (II) Current-supported gravity flows (CSGFs), in which gravity flows are driven by current-induced BL turbulence (Wright et al., 2001). Although significant advances have been made on the details of WSTCs (Ozdemir et al., 2011; Yu et al., 2014; Cheng et al., 2015), less is known about gravity flows supported by tides, wind driven currents, and CSGFs.

The focus of present study is to investigate the role of alongshore currents on dynamics of WCSGFs, considering the change in sediment availability due to the bottom boundary that allows sediment mass exchange, i.e., erodible bed. To fully understand the fundamental characteristics of CSGFs over an erodible bed, a DNS study is conducted on a steady, turbulent, particle laden channel flow with a gentle transverse slope. The paper's objective is to get a clear interpretation of the flow structure of CSGF and to evaluate the coupling between current induced BL turbulence and suspended sediments for a various bed erodibility parameters, i.e. critical shear stress, erosion coefficient, and settling velocity.

Our preliminary results indicate that suspended sediment concentration in streamwise direction creates a spanwise flow due to density difference and transverse slope. It is also observed that the suspended sediment concentration has an inverse relationship with settling velocity, where by decrease in settling velocity, suspended sediment concentration increases and dissipates the turbulence. The increase in suspended sediment concentration leads to higher stratification in water column and consequently result in an increase in spanwise velocity. We also observed that the turbulence production term due to CSTC, non-linearly varies with the inverse of the settling velocity and the turbulence created by CSTC augments sediment suspension from the seafloor and tends to become a self- sustaining turbidity current.

<u>PRESENTER BIO</u>: Sahar Haddadian is a PhD student of Coastal Engineering in Civil and Environmental department at Louisiana State University. She is working on her PhD thesis with the subject of Numerical Modeling of Wave and Current supported Gravity flows over an erodible bed.

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ON COUPLING HYDROLOGIC, TIDE AND SURGE PROCESSES

***Scott C. Hagen*[1]**, *Matthew V. Bilskie[1], Shu Ghao[1], Hugh J. Roberts[2] and Donald T. Resio[3]*
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Flood risk at the coastal land margin is influenced by both hydrologic and tidal processes, especially in deltaic flood plains, which leads to the realization that there exist transitional zones of flood hazard and risk. This coastal flood plain phenomena can be better understood by delineating dominant contributors to flood hazard and risk as they move from surge-only (in the immediate coastal flood zone) to hydrologic and tidal (including both low impact, high frequency events such as winter storms and higher impact lower frequency events such as storm surge) to rainfall-induced-only further from the coast. While this transitional flood risk zone retreats towards populated areas with coastal land loss, it can also be advanced away from urban centers with the aid of Louisiana Coastal Master Plan projects. The aim of the overall research is to address these fundamental issues by defining regions where both rainfall runoff and storm surge (both winter and tropical storms) overlap through development of a coupled hydrologic and hydrodynamic model to enable more comprehensive enhanced flood risk assessments and more. The intent of this talk is to begin a discussion of how.

The examination of proposed Coastal Master Plan projects in terms of their potential long-term benefits in southern Louisiana are enabled by identifying transition zones. Currently, such considerations are often inadvertently omitted or included in very qualitative, deterministic terms. The approach discussed during this talk will provide the framework for the development of rigorous tools that can be used to improve long-term planning capabilities within all of the natural variability faced by these vulnerable communities. A result is clear objective guidance for decision-makers faced with difficult choices.

The talk will conclude with discussion of an improved capability to evaluate flood hazard and risk, and associated infrastructure impacts under present and future conditions. The developed hydrologic and coastal hydraulic flooding process-based and statistical models can serve as predictive instruments for physical climatic processes that will lead to a better understanding of coastal storms and their effects on the coastal landscape. This enhanced capability will result in refined storm surge analyses that will inform future project planning and design. These forecasting tools will establish the relative contribution of mechanisms that drive coastal change including storms, both hydrologic and coastal.

PRESENTER BIO: Dr. Hagen has authored more than 80 peer-reviewed journal articles with focus on massively parallel, high performance computational modeling of ocean, coastal, and inland astronomical and meteorological tides and flows. His more recent efforts expand into transport and biological modeling with respect to the coastal dynamics of sea level rise.

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MAXIMIZING THE RETURN ON INVESTMENT FOR COASTAL RESILIENCE PROJECTS

Peter J. Hall

Wood Environment and Infrastructure Solutions, Portland, Maine, USA

Coastal resilience will require that adaptation projects generate a return on investment to secure and maximize funding and drive the completion of projects that can impact a wide-range of stakeholders. As a long-standing partner with the 100 Resilient Cities (RC) organization our work supporting resilience is focused on projects that can allow the capacity of individuals, communities, institutions, businesses and systems within a city or region to survive, adapt and grow no matter what kinds of chronic stresses and acute shocks they experience. To support our global projects we are developing a state-of-the-art initiative in conjunction with the Arup/Lloyds Register Foundation "Resilience Shift" programme for a Resilience Return on Investment (RROI) framework. This new technology will drive the integration of climate data and impacts to critical infrastructure and quantify the associated resilience benefits to promote projects that can provide maximum value to society and across the life-cycle of projects with objectives that include:

- Development of a Resilience Return on Investment framework that can link climate impacts to infrastructure and the societies and stakeholder they support
- Provide a link of climate impacts to infrastructure design within an investment sector to drive stakeholder engagement and unlock capital for projects to imbed resilience and sustainability

This RROI project aims to catalyze a change in how critical infrastructure is designed, delivered, operated and financed. Our work in support of the global "Resilience Shift" Program is focused on quantifying the impact resilient infrastructure has on interconnected capacities of systems, businesses, infrastructures, communities, individuals, and institutions to withstand, respond, adapt and to the impacts of short-term acute shocks and longer-term chronic stresses and can be leveraged to benefit Louisiana's coastal communities, environment, and economy. This session will review our RROI framework and discuss the tools, approaches, knowledge, technology and education needed to make resilience tangible, practical and relevant to those developing, designing, financing, and operating critical infrastructure. The RROI framework provides an important framework that can drive climate resilience into critical infrastructure projects and align resilience within the financial sector to promote resilience engineering as an essential approach with quantifiable value metrics. Infrastructure clients are increasingly asking "what is the value for integrating resilience into our infrastructure projects?" and this session will provide an overview of an important framework which defines that value within project delivery and provide outcomes for the engineering community, financial sector and the societies these projects support.

One of the biggest challenges of the coastal resilience is to develop, finance and implement projects that can allow cities and regions to get the most out of every dollar they spend, whether on climate change or another challenge — and focus on solving multiple problems at once – building strength in multiple areas will help cities survive and thrive in the face of 21st century shocks and stresses. This session will provide a practical and scalable model to maximize ROI and finance, prioritize and complete impactful projects to make the Lousiness coast and communities more resilient to future climate impacts.

PRESENTER BIO: Peter J. Hall is the Climate Resilience and Sustainability Global Segment Lead for Wood E&IS and over 30 years of experience and manages the firm's strategic delivery framework that embeds climate resilience and sustainability into projects to reduce risk, improve value, and drive collaboration. He manages the firm's 100RC partnership and has supported sustainability and resilience projects for clients and cities throughout the Americas and Europe.
http://resilienceshift.org/wp-content/uploads/2017/10/046_Resilience-Return-on-Investment.pdf

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HYDROLOGIC RESPONSE TO WEATHER EVENTS IN THE FRESHWATER COASTAL WETLANDS OF THE BARATARIA PRESERVE

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The Barataria Preserve, a unit of Jean Lafitte National Historical Park and Preserve, is located in southeast Louisiana, about 15 miles south of downtown New Orleans. The preserve is representative of many south Louisiana freshwater coastal wetland landscapes threatened by relative sea level rise. A former distributary of the Mississippi River, which once carried a third of the river's flow, dominates the preserve's topography. During its active phase 3000 to 1500 years ago, this distributary deposited massive quantities of sediment and created natural levee ridges on either side of its channel. From the natural levee ridge high ground, the landscape slopes gently downhill along the backslopes and more sharply to the former channel, which is disconnected from the contemporary River yet connected to the active delta where it joins the Gulf Intracoastal Waterway (modified Bayou Barataria).

To better understand the preserve's flood regime and monitor variation in flooding along this natural elevation gradient over time, the preserve established a hydrology dynamics array. Between 2013 and 2015, twenty-seven water-level loggers were installed along three transects perpendicular to the distributary channel. Each transect begins near the channel and extends up and over the crest of its eastern natural levee ridge and part way down its backslope. The loggers record hourly measurements of water level and temperature at each location. High frequency sampling allows us to analyze the hydrologic impact of short-lived weather events, while also comparing the response across the elevation gradient.

The hydrologic response to large weather events is a big question for the park in terms of how water moves through the Preserve and how long water remains in different areas. We isolated several wind and rain events of similar magnitude using records from the park's weather station, and modeled the height of the water table along the transects before, during, and after each event. Using the amount of precipitation and wind speed/direction as proxies, we compared the rate and direction of change in the water level across the transects to determine if vertical position on the natural levee ridge produced any meaningful differences. Similarly, to gauge the effects of manmade infrastructure on local hydrology, we compared flooding in the impounded and un-impounded areas of the transects. This analysis of localized hydrological response to large-scale weather events will help inform future flood modeling, as well as park climate change response planning.

<u>PRESENTER BIO</u>: Parker Hamilton is a recent graduate of Tulane University, majoring in Environmental Studies. In 2017, he joined the Barataria team to assist with data management and processing.

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MAXIMIZING DIVERSION LAND-BUILDING WITH ENHANCED SEDIMENT SUPPLY

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With the large mid-basin sediment diversions moving forward into the engineering and design phase, the restoration community has increasingly focused on optimizing diversion operations to maximize land building while minimizing both ecologic and socio-economic disruptions, a critical task for securing regulatory approval and continued project funding. Preliminary design work has focused on (1) maximizing the Sediment-Water ratio of the diverted flow to minimize shoaling proximal to the diversion, a process that occurs when water is diverted dis-proportionally to sediment, and (2) operations timed around the river hydrograph to enhance sand extraction and land building capacity. While robust, these approaches have resulted in proposals for deep inlet structures that have significantly contributed to the projects' escalating cost estimates. With operational constraints that may limit the diverted sediment load and potential cost constraints on diversion capacity, continued work is needed on additional ways to maximize land-building when diversion flow is at less than maximum capacity. This research explores the efficacy of enhancing sediment diversions by increasing sediment supply using dredged sediment from the river, and assesses the effect of increased sediment supply on land-building. Finally, our research also addresses sediment retention in the receiving basin as a function of increasing sediment supply by evaluating sediment fluxes under various scenarios of flow, sediment load, and receiving basin (downstream) controls such as basin depth and geometry, tides, waves and the effect of inter-annual storms.

We use a Delft3D hydrodynamic and morphologic model to develop the delta where the diversion discharges into a conceptual receiving basin. We perform various simulations covering a broad parameter space for potential controls. These include the diversion flow and sediment input (or sediment flux), varied to reflect the range of potential operational schemes and expected capacity of the Mid-Barataria diversion, and explore the effect of enhanced sediment supply with simulations accounting for sediment load concentrations and sediment composition reflecting proposed as well as new sediment rating curves. The effects of sediment supply are quantified using a range of delta metrics including subaerial extent, depositional volume, and sediment retention by sediment class. Research outcomes from this study can inform diversion operations planning and enable maximum land-building, and help offset potential constraints on diverted flow.

PRESENTER BIO: Kevin Hanegan is a practicing coastal engineer with Moffatt & Nichol. He holds a BS in Civil Engineering from LSU and an MSc in Coastal Engineering from TU Delft. He is currently pursuing a PhD in coastal morphology from the University of New Orleans.

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PRELIMINARY DESIGN OF A MAJOR FRESHWATER DIVERSION: THE INCREASE ATCHAFALAYA FLOW TO TERREBONNE PROJECT

***Kevin Hanegan*[1]**, *Maarten Kluijver*[1], *Micaela Coner*[2], *and Austin Feldbaum*[2]

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Freshwater and sediment in the Atchafalaya River, in southern Louisiana, are currently confined to the leveed river until released well south of Morgan City into the Atchafalaya Bay. Confinement of the river, in combination with high rates of subsidence and rising seas, has resulted in salt water intrusion and marsh degradation. The Increase Atchafalaya Flow to Terrebonne Project was proposed to utilize freshwater and sediment from the Atchafalaya River to build, sustain and maintain wetlands in the sediment-starved deltaic basin to the east of the river's levee. A key component of the project is a 15,000 cfs freshwater diversion intended to hydrologically influence 500,000 acres of wetlands, and slow the current wetland loss being experienced in the basin.

To determine project feasibility and screen initial project features, Moffatt & Nichol developed a Wetland Morphology Module (WMM) for the comparison of project alternatives. This WMM is used to model the long-term effects of each alternative on salinity propagation throughout the Terrebonne wetlands, as indicated by changes in vegetation, land cover and open water. The WMM is dynamically coupled with a 2D hydrodynamic model and is used to evaluate the evolution of marsh types over time (50 year) under the stressors of hydro-period and salinity on a high-resolution scale. A series of model runs using the WMM was used to establish the required diversion capacity and necessary project components to achieve projected land loss prevention (LLP) benefits.

Subsequent phases of the project have focused on establishing and refining a preliminary project design. Completed tasks include determining the effects of the project on navigation through the adjacent Bayou Boeuf Lock, selecting a preferred gate and machinery type for the diversion structure, advancing the design of the structure to an approximately 15% level, optimizing the geometry and layout of the diversion channel, and siting a marsh creation area for the beneficial use of dredged and excavated sediments. Moffatt & Nichol is currently engaged in a series of tasks and next steps to further the project design and provide answers to key questions prior to moving forward with the 30% design effort. Topics being addressed include further defining downstream interactions with existing land and future projects, further investigating existing infrastructure that could be impacted, and determining the effects on sediment transport.

PRESENTER BIO: Kevin Hanegan is a practicing coastal engineer with Moffatt & Nichol. He holds a BS in Civil Engineering from LSU and an MSc in Coastal Engineering from TU Delft. He is currently pursuing a PhD in coastal morphology from the University of New Orleans.

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LONG-TERM SETTLEMENT OF THE CAMINADA HEADLAND BEACH NOURISHMENT AND DUNE RESTORATION IN COASTAL LOUISIANA

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The Caminada Headlands is a beach and dune system near Port Fourchon, Louisiana that provides natural protection for back barrier marshes against storm surges and wave overtopping. Due to significant shoreline erosion and regional subsidence, a beach and dune restoration project was initiated by Louisiana CPRA in 2012 to replenish the shoreline front. Because of the underlying soft deltaic sediments, this restoration effort was expected to significantly increase the applied stresses and hence result in subsurface sediment settlement. To monitor and quantify the degree of settlement occurring within the compressive sediment layers, extensive geotechnical investigations were conducted for design and installation of settlement plates and subsurface settlement anchors. This case study presents the geological and geotechnical investigations, measured material properties, and corresponding empirical correlations developed from laboratory consolidation tests. The pre- and post-survey elevations of the site are also used to determine the change in vertical stress with depth at the instrumented sites. With the measured material properties and vertical stress profiles, this study presents an inverse settlement analysis using SETTLE^{3D} and PSDDF programs, which are based on Terzaghi small strain and finite strain theories, respectively. The model predictions show both software can replicate field settlement measurements, which are subsequently used to predict the end of primary consolidation for the Caminada Headlands and validate empirical correlations. Guidelines are provided on conducting settlement and consolidation analyses to facilitate design of future coastal restoration and protection projects. The long-term settlement of the headlands are also utilized to study the impacts that decreased dune elevation has on the susceptibility of storm overwash.

PRESENTER BIO: Mr. Brian Harris is a graduate research assistant in the Department of Civil and Environmental Engineering at Louisiana State University. His research is focused on integrating laboratory tests, field measurements, and numerical models for predicting the settlement of marsh creation projects and flood protection infrastructure in Coastal Louisiana. He is a Louisiana CSAP Fellow and currently interns at CPRA.

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LOUISIANA LEVEE DISTRICTS AND HURRICANE PROTECTION PROGRAMS: FUNDING, IMPLEMENTATION, OPERATION, AND MAINTENANCE

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Coastal Protection and Restoration Authority (CPRA) of Louisiana, Baton Rouge, LA, USA

Louisiana's coast is a complex but fragile ecosystem that is disappearing at an alarming rate. Between 1932 and 2010, Louisiana's coast lost more than 1,800 square miles of land (CPRA, 2017 Master Plan). Between 2004 through 2008, Louisiana lost more than 300 square miles of marshland to Hurricanes Katrina, Rita, Gustav and Ike (Couvillion et. al., Land Area Change, 2011).

In response to the continued and increasing flood risk and to improve the sustainability of our coastal landscape, communities, and economic future, Louisiana relies on the master plan process to identify robust solutions to counter potential flood threats (CPRA, Master Plan 2017). Louisiana's 2017 Coastal Master Plan (Master Plan) outlines major strategies by directing available resources into prioritized projects. The Master Plan prioritizes up to $25B for Risk Reduction projects. The majority of these are structural protection projects, including earthen levees, floodwalls, floodgates, and pumping stations.

Project implementation and sequencing across the coast is influenced by the availability of funding and regulations tied to each funding program. Funding sources such as Louisiana's Capital Outlay, GOMESA, and the Federal Cost-Shared Projects have a vested interest in Louisiana's coast. CPRA partners with local, other state, and federal entities to utilize these funds for integrated ecosystem restoration and hurricane protection in coastal Louisiana.

This presentation will provide an overview of funding, implementation, operation and maintenance of Louisiana's Hurricane Protection Programs. This overview will include both Master Plan projects, other regionally planned projects and significant projects from the local, State and Federal entities that are consistent with the Master Plan. This presentation will demonstrate how CPRA and its partners maximize the effectiveness of funding to provide flood protection and risk reduction which will further improve the resilience of Louisiana's coastal communities.

PRESENTER BIO: Mr. Ignacio Harrouch, P.E., has over 23 years of geotechnical engineering and construction management experience. Prior to his service with CPRA, Mr. Harrouch earned a B.S. in Civil Engineering from LSU in 1992. He then worked for DOTD briefly, after which he spent approximately 10 years with several firms and as independent owner of his own geotechnical investigation and construction firm in El Salvador, conducting turn-key construction of telecommunications towers and designing large-scale manufacturing and wastewater treatment facilities throughout Central America and the Caribbean. Mr. Harrouch was then a Senior Geotechnical Engineer and Certified Project Manager with URS Corporation for approximately 7.5 years. He now heads CPRA's Operations Division, which includes the main Baton Rouge office as well as offices in Lafayette, New Orleans, and Thibodaux.

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PREPARING THE NEXT GENERATION OF LOUISIANANS FOR COASTAL CHALLENGES AHEAD: STRATEGIES TO EDUCATE AND INFORM

Robert Thomas[1], ***Joann Haydel***[2], *Ivan Gill*[3], *Dinah Maygarden*[4], *and Heather Neimic*[5]

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The purpose of this session is to engage in a discussion about the need for effective strategies in preparing the next generation of Louisianans to face the challenges posed by coastal land loss. As residents of coastal Louisiana face the unprecedented challenge of finding ways to work together for a resilient future, we find that a large portion of the population is poorly informed and unprepared to participate in making decisions about restoring and preserving the coast. How do we change this situation through education? The central questions are: How do we give a general message of hope when the prognosis is bleak for many parts of the Mississippi River Delta? And - How do we effectively reach young people to develop well-informed citizens prepared for the challenges ahead, and provide tools for them to pursue careers in coastal restoration fields? The panelists, who represent a diverse set of programs, from academia, non-profit and state agency organizations, will discuss the various strategies they currently implement to educate students and teachers about coastal issues; while asking: "Are we creating an informed citizenry of the future that will be able to handle these challenges more effectively than previous generations?" This session is also an opportunity for attendees to contribute to the discussion and actively connect with environmental educators to provide recommendations for educating the next generation about the challenges that lay ahead in coastal Louisiana.

PRESENTER BIOS:
Dr. Thomas (moderator) is currently professor of Mass Communication at Loyola University in New Orleans, where he holds the Loyola Chair in Environmental Communication and is the Founding Director of the Center for Environmental Communication at Loyola University.

Mrs. Haydel (session organizer), Education & Outreach Director for the Lake Pontchartrain Basin Foundation, provides educational programs for all ages, locals and visitors at LPBF's New Canal Lighthouse and off-site. She has over 20 years of experience teaching environmental science in both formal and informal settings.

Dr. Gill is science education coordinator in the Department of Curriculum, Instruction and Special Education at the University of New Orleans. In addition to teaching at the collegiate level in Geology Departments, he has taught in two New Orleans public schools and is certified to teach all science subjects.

Ms. Maygarden, Director of UNO- PIES Coastal Education Program, develops K-adult educational programs at Shea Penland Coastal Education and Research Facility and partners on a range of regional, coastal place-based, educational projects.

Ms. Niemic is a 4-H Youth Development Specialist currently serving as Director of the LSU AgCenter's Youth Wetlands Program. Drawing from her past 15+ years as an informal educator, camp director, and classroom teacher, Heather now develops programs to inspire the next generation of conservationists.

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BUSINESS PEOPLE UNITE IN THE FIGHT TO SAVE THE COAST

Michael Hecht
GNO, Inc., New Orleans, LA, USA

Coastal restoration is economic development. Flood protection, coastal restoration, and urban water management have the potential to not only safeguard and shape our region, but also to catalyze the development of a burgeoning economic sector, the water management sector. GNO, Inc. serves as a force of advocacy, information sharing, and coordination to facilitate growth of this sector in the ten parish super region it represents.

We are in fact seeing continued investment in the coast, not divestment. Multiple industries, including digital media and health sciences, continue to expand into the region. The environmental management industry, which is comprised of companies that deploy services and technologies that help other companies, and governments, address the challenges associated with flooding, erosion and subsidence, is also expanding. In greater New Orleans alone, the number of water management jobs is expected to grow by 23% over the next ten years. The majority of these jobs will require some education and training beyond a high school degree and can provide promising opportunities and viable pathways to the middle class.

The expertise and innovation in resilience, restoration, water management, and disaster recovery that has been in development over the past few decades will be an important economic export in the coming years as we see places across the world increasingly face similar challenges. As one example, Louisiana firms captured an average of $12 million per year in Army Corps contracts outside Louisiana from 2010 to 2015. In 2016, the amount of funding Louisiana firms secured in out-of-state Army Corps contracts surged to over $124 million.

GNO, Inc. has several initiatives meant to encourage and track this sector of the economy. Its State of the Sector report on water management aims to inform individual choices about what education and training programs to pursue and institutional investment in which programs are projects to be in high-demand in the future. Recognizing the absence of a unified voice from the greater business community advocating for coastal restoration, GNO, Inc. has created the Coalition for Coastal Resilience and Economy (CCRE). This neutral, non-partisan group of leaders from the Southeast Louisiana business community is positioned as an informed, educated voice of advocacy for sustainable restoration efforts in Louisiana's wetlands, river, delta and coastline.

PRESENTER BIO: Michael Hecht is President and CEO of Greater New Orleans, Inc., the economic development organization for southeast Louisiana. Michael holds an MBA from Stanford Graduate School of Business, where he was a member of the Public Management Program, and an undergraduate degree from Yale University, magna cum laude.

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SHIFTING SPECIES INTERACTIONS AND THE TROPICALIZATION OF THE NORTHERN GULF OF MEXICO SAV HABITATS

Kenneth L. Heck, Jr
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In the northern Gulf of Mexico (GOM), an increasing number of tropical species have recently become established among the extant warm-temperate fauna. These include a diversity of tropical fishes, manatees, green turtles, warm-water corals, and black mangroves. The impact of these species may be profound, primarily because temperate species are restricted from shifting northward by the North American land mass. Thus, as tropical species expand northward in the GOM, they must interact with native species and potentially compete for essential resources or become prey for each other. Here I focus on tropical immigrants capable of transforming the vast and highly productive seagrass-dominated systems of the northern GOM, emphasizing herbivorous parrotfishes and comparing their impact with native seagrass-resident fishes. Increased numbers of these parrotfishes, as well as expanding numbers of green turtles and manatees, will likely shift detritus-based food webs in seagrass meadows to those dominated by direct consumption of seagrasses. I provide estimates of some expected consumption rates and overall effects of newly arrived tropically associated seagrass herbivores and predict that the consequences of the tropicalization of northern GOM seagrass meadows will be: substantially reduced standing crops and structural complexity of seagrass meadows; increased energy flux through grazing food webs; and a greatly reduced nursery role that will result in much smaller adult populations of those finfish and shellfish species that rely on seagrasses as nurseries.

PRESENTER BIO: Kenneth L. Heck, Jr. is Chair of University Programs at the Dauphin Island Sea Laboratory and Professor at the University of South Alabama. He is a marine ecologist whose research has focused on plant-animal interactions in coastal waters, with an emphasis on seagrass-dominated systems. He has published nearly 200 scientific articles.

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LATE HOLOCENE SUBSIDENCE OF THE PIERRE PART DISTRIBUTARY COMPLEX, ASCENSION AND ASSUMPTION PARISHES, LOUISIANA

Paul V. Heinrich

Louisiana Geological Survey, Louisiana State University, Baton Rouge, LA, USA

Within Assumption and Ascension parishes, Louisiana, the Late Holocene Pierre Part distributary system exhibits anomalous anastomosing distributaries that originate from a formally active area of crevassing along Bayou Lafourche. Downstream, the anastomosing distributaries converge back into a single distributary channel.

First noticed in 1995, this anastomosing pattern has been interpreted alternatively to represent either the progradation of the Pierre Part distributary system into a shallow water lake within the backswamp of the Mississippi Alluvial Valley or the effects of neotectonics associated with the underlying Napoleonville Salt Dome. Interpretation of aerial imagery proved to be ambiguous in the determination of which hypothesis best explains this anomalous distributary pattern. An analysis of lidar digital elevation models strongly indicates that significant, noncatastrophic subsidence of the channels and natural levees occurred contemporaneously with and after the active discharge within the Pierre Part Distributary System. Such subsidence might explain the anastomosing pattern of this distributary system and topographic sags within the crest of its natural levees. However, the surface subsidence observed is insignificant relative to the total amount of salt dissolution of the Napoleonville Salt Dome that likely has occurred.

Bayou Bleu in Iberville Parish is another distributary system that exhibits an anomalous drainage pattern associated with a salt dome.

<u>PRESENTER BIO</u>: Mr. Heinrich is a Research Associate 4 at the Louisiana Geological Survey. He has over 35 years of work experience as either a geologist or geomorphologist in the private, state, and federal sectors. He has extensive experience in Quaternary geology and sedimentology.

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UNDERAPPRECIATED COLLATERAL EFFECTS OF GULF OF MEXICO SEA LEVEL RISE

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The anticipated collateral effects of sea level rise such as rising base for storm surge, increasing frequency of nuisance flooding, and increasing height of flood stages of “king tides” are now well recognized. However, other collateral effects sea level rise remain largely ignored according to data-based models of prehistoric sea level rise and fluvial-deltaic sedimentation. These collateral effects include the effects of headland erosion as a delta plain subsides, changes to river and groundwater profiles within alluvial valleys as sea level rises, and the nonlinear nature of the rate of sea level rise.

Delta simulations. Typical simulations of sea level rise for Louisiana delta plain mislead the public as they show sea level rise passively submerging the Mississippi River Delta. They show that the distributary and fluvial ridges surviving as elongate peninsulas extending into the Gulf of Mexico after the adjacent delta is submerged. This view of a submerging delta plain is falsified by the transgressive barrier island model of Penland et al. (1988). Unless protected from wave action, their model predicts that once the surrounding delta plain is sufficiently submerged, these ridges will be rapidly eroded and truncated to deltaic headlands flanked by barrier islands. Ultimately, the Mississippi River delta will bury the what remains of the delta plain and extend gulfward to the extent that sediment supply allows.

Fluvial Systems. The effects of future sea level rise on rivers can be anticipated based on the sequence stratigraphy of fluvial systems and the effects of post-glacial sea level rise of the Rhine-Meuse system of Europe and the Mississippi, Brazos, and other rivers of the Gulf Coast of the United States. Initially, it will be a rise river and groundwater profiles tens (in time extending to hundreds) of km inland. This will increase accommodation space and, at first, result in riverbed aggradation. In time, the aggradation of non-leveed floodplains will occur. In case of leveed rivers, the formation of perched floodplain within levees and groundwater flooding outside of levees can occur also in time. These effects ultimately can result in the destabilization of fluvial channels and an increase in the frequency of avulsions. The timing and magnitude of such effects need to be explored using numerical simulations.

Meltwater Pulses. The geologic record of past sea level rises related to the melting of continental ice sheets shows that sea level does not rise at an uniform rate. Rather, because of the periodic instability of continental ice sheets, the rate of sea level rise has occurred at accelerated rates. This is shown by the studies of the Holocene meltwater pulses 1A and 1B and of hypothesized submerged wave-cut benches preserved on the Central Texas continental shelf. Because of the limits to the resolution of radiometric dating techniques and original depth of the dated samples only the average rates of sea level rise are known. However, the preservation of upright fossil forests submerged by Carboniferous meltwater pulses and buried by tidal deposits indicates that sea level can rise at extreme rates, 5.5 m over a period of a few decades, as the result of a meltwater pulse. Such events, need to be kept in mind in projecting future sea level rise.

PRESENTER BIO: Mr. Heinrich is a Research Associate 4 at the Louisiana Geological Survey. He has over 35 years of work experience as either a geologist or geomorphologist in the private, state, and federal sectors. He has extensive experience in Quaternary geology and sedimentology.

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BASIN-WIDE CHANGES POST-CLOSURE OF THE MISSISSIPPI RIVER GULF OUTLET (MRGO) LEADING TO POTENTIAL NATURAL SWAMP REGENERATION ON THE MAUREPAS LAND BRIDGE, SOUTHEAST LOUISIANA

***Theryn Henkel**, Eva Hillmann, Kristen Butcher, and David Baker*
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The Maurepas Land Bridge is a critical line of defense in reducing risk from storm surge for communities around Lake Maurepas as well as East Baton Rouge. Historically, the land bridge was covered with swamp forest but was clear cut in the early 1900's when logging of cypress peaked in the region. While some natural regeneration occurred, it was limited by the introduction of nutria, lack of sediment, freshwater, and nutrient input due to leveeing of the Mississippi River, and subsidence. The construction of the Mississippi River Gulf Outlet (MRGO), which increased salinity in Lake Pontchartrain and Lake Maurepas, also had a negative effect on the remaining cypress stands. This navigation channel was closed in 2009. The Lake Pontchartrain Basin Foundation (LPBF) has been investigating and documenting the changes across the basin, resulting from this large scale, hydrologic restoration project. Because the Maurepas Land Bridge is a critical risk reduction feature on the landscape, the Lake Pontchartrain Basin Foundation (LPBF) is interested in restoring the swamp to maintain the land bridge, as well as to expand this important habitat type in the region. Swamp forest is an effective storm buffer by reducing and slowing storm surge. Conditions in the basin may have changed since the closure of the MRGO and the area may now be fresh enough to support growth of swamp seedlings and saplings. This presentation will discuss the area of influence of the MRGO when it was open and a two-year study of natural swamp regeneration study on the Maurepas Land Bridge.

Porewater salinity data was downloaded for the entire period of record from the Coastwide Reference Monitoring System (CRMS) for 21 CRMS stations. Porewater data (soil salinity) was analyzed to see if it was significantly different over time each station. Soil salinity was graphed over time by CRMS station and the soil salinity data was spatially mapped to predict the area of influence that the MRGO had, when it was open. Natural swamp regeneration study was conducted on the Maurepas Land Bridge. Plots were set up along a gradient from minimal observed regeneration (north) to healthier forest (south). Eight (50 x 50 meter) plots were randomly chosen in eight sub-areas on the land bridge. In both years, data was collected on all woody vegetation by tagging and measuring DBH of trees in each plot, identifying to species and recording location coordinates using a handheld gps, and then analyzed.

Using the CRMS stations where there was a significant difference in soil salinity before and after the closure of the MRGO and stations where the soil salinity decrease began coincident with the closure, a predicted area of influence for the MRGO was 525,207 hectares, much larger than originally predicted. This estimate could be conservative because the influence area may extend further west into the Maurepas swamp. The natural regeneration study revealed that there was a general trend of decreasing soil salinity, increased species richness, and increased number of individuals when moving south on the Maurepas Land Bridge. The tree species that dominated the small size classes tended to be considered understory to mid-story species in swamps, including red maple, green ash, and black willow and show pioneer species characteristics (wind dispersed seeds, not part of the climax canopy). These species were more abundant in fresher plots and absent from plots with elevated soil salinity. In contrast to the pioneer species, baldcypress was represented by a wide range of sizes, from small saplings to large trees over 60 cm in DBH and was found across soil salinities. In the plots with elevated soil salinity, there were a few larger baldcypress and no other species, indicating that these individuals survived the period of elevated salinity while the other swamp species experienced mortality.

<u>PRESENTER BIO</u>: Dr. Henkel is the Assistant Director for the Coastal Sustainability Program at the Lake Pontchartrain Basin Foundation, a local not-for-profit located in New Orleans, Louisiana. She is involved in projects that investigate the effects of "legacy river diversions", wetland loss, and swamp restoration.

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META-ANALYSIS OF NEKTON RECOVERY FOLLOWING MARSH RESTORATION IN THE NORTHERN GULF OF MEXICO

Terill A. Hollweg[1], *Mary C. Christman*[2], *Joshua Lipton*[1], *and Kristopher G. Benson*[3]
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Presentation Summary: We present a meta-analysis of nekton densities from existing measurements at restored marsh sites in the Gulf of Mexico compared to reference (i.e., natural) sites to describe general patterns of nekton recovery following restoration.

Presentation Abstract: Coastal wetlands in the northern Gulf of Mexico are critically important for maintaining diverse and valuable ecological and economic resources. To date, ecological research on marsh recovery following coastal wetland restoration typically has focused on individual sites, studies, and restoration types. To investigate broader regional responses that could inform future restoration planning, we conducted a meta-analysis of nekton densities measured at restored marsh sites in the Gulf of Mexico compared to reference (i.e., natural) sites to describe general patterns of nekton recovery following restoration. Mean total nekton density in restored marshes during the first five years following restoration was approximately 50% of reference marsh densities. In subsequent years (age of restored sites: 6–30 years), mean total nekton density in restored marshes was approximately 73% of reference marsh densities. While total fish densities at restored sites were similar to densities at reference sites, total crustacean densities were generally lower at restored sites. We observed a generally increasing trend in total nekton and total crustacean densities over the first 15 years following restoration; mean densities at restored sites were comparable to paired reference locations by approximately year 13. Our findings indicate that marsh restoration may not consistently result in nekton production similar to that of natural sites, particularly in the earlier years following restoration when baseline ecosystem processes are developing. We emphasize the importance of looking at other functional metrics of ecological recovery beyond nekton density, such as community composition, fish health or condition factor, population size structure, and food web structure. Based on our results, we also recommend that important abiotic and biotic factors be considered in restoration planning, implementation, and monitoring to ensure achievement of restoration goals in the northern Gulf of Mexico.

PRESENTER BIO: Terill Hollweg is an environmental scientist with expertise in restoration planning, monitoring, and evaluation. She received her PhD in oceanography from the University of Connecticut.

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ROSEAU CANE MORTALITY IN SOUTH LOUISIANA: WHAT WE KNOW AND A PLAN FOR THE FUTURE

Linda M. Hooper-Bùi[1]*, and Brian F. Snyder*[2]

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In the fall of 2016, local landowner Earl Armstrong reported that large swaths of Roseau Cane, *Phragmites australis*, were dying. Initially, the die-off was ascribed to an invasive scale insect, however, the plant damage wasn't primarily located on the portion of the stems infested by the scale. As the Roseau died, the plants turned brown at the tips of the leaves, and then brown moved toward the stems, eventually affecting the stems in the latter part of the plant death. Anecdotal evidence from local fishers and ranchers also pointed to *Phragmites* plants that lacked scale, yet the plants were dying.

Looking globally at historic *Phragmites* die-offs, insects have been implicated in several cases, but other factors such as sulfide levels (and other soil biogeochemical conditions), callus formation, phytotoxins, water levels and other factors are also potentially implicated. One of the theories is that plants suffocated; another theory was increased sulphides in the rhizosphere led to decreased nutrient uptake. Additionally, in China, a die-off was blamed on degradation products of oil pollution. In sum, the numerous factors found in die-offs of *Phragmites* outside the US are also potentially present in the Louisiana marshes and should be examined.

Brown marsh or the die-off of *Spartina alterniflora* or smooth cordgrass, which plagued Louisiana in the early 2000s, and stymied scientists as they searched for a cause. In the brown marsh project, environmental stressors were examined in laboratories, greenhouses, and the field. Salinity changes, hydrology, biogeochemistry of the soil and other abiotic factors such as air temperature and amount of rainfall were examined in a multi-disciplinary manner. Additionally, areas of stressed plants were remediated via sediment deposition, aerial seeding, and vegetative replantings. According to Len Bahr, the Governor's Executive Assistant for Coastal Activities, "…the entire 'brain trust' of Louisiana's coastal science community has been brought to bear on a single project, and they realized at the outset that for this thing to work, cooperation and open lines of communication would be critical." In the case of Roseau, lessons learned from the brown marsh die-off have not been heeded.

Abiotic and biotic factors may be implicated in the large-scale *Phragmites* marsh die-off in south Louisiana. It is the experience scientists gathered via the global *Phragmites* die-off and the *Spartina* die-off during the "Brown Marsh" episode, plus the incongruent data supporting the insect scale as the main culprit of the South Louisiana *Phramites* die-off, that leads us to our present study.

We examined *Phragmites* die-off from both biotic and abiotic perspectives. Whereas the scale insect remains an important locus of study, we argue that salinity, sulfide, water level, organic pollutants and other abiotic factors could also be causal, and we use CRMS data, USGS data, and other large databases to examine the problem in a holistic way. One aspect that remains open is looking at the issue from a plant health and pathology perspective. This presentation is both a report of data gathered to date, and an outline of how the project should proceed. That outline is based on lessons learned from global *Phragmites* die-offs, brown marsh die-off and also the Deepwater Horizon drilling disaster.

<u>PRESENTER BIO</u>: Dr. Hooper-Bùi is an ecosystem ecologist who has been studying food webs in the Gulf of Mexico since 2009. She has studied the effects of oil pollution and salinity gradients on food webs consisting of insects, plants, fish and birds. She has published more than 10 papers on coastal ecosystems in the past two years.

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SUBSIDENCE RATES FROM FAULTING DETERMINED BY REAL-TIME KINEMATIC (RTK) ELEVATION SURVEYS OF BRIDGES IN LAKE PONTCHARTRAIN

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One contributor to land loss in Louisiana is subsidence driven by active faulting; however, rates of vertical land motion due to faulting are poorly constrained. Previous work has shown least three faults associated with the Baton Rouge-Denham Springs Fault System are present in Lake Pontchartrain. Six bridge structures span the lake, linking the southern and northern shores, and intersect the surface fault traces. The bridges are supported on pilings, which were driven into well-consolidated Pleistocene clays, so measured offsets are from faulting and not Holocene compaction. High-resolution elevation data were acquired on all bridge structures by walking or driving the road surface or measuring elevations on pilings by boat. Patterns of offset are consistent on all structures. As the faults are approached from the footwall blocks, bridge elevation increases slightly by several centimeters (1-2 in.). At the traces, bridge elevation decreases by up to 26 cm (10.5 in.) on the oldest (~90 years) bridges. Largest offsets are within about 300 m (2000 ft.) of the traces. Beyond this distance, bridge elevation increases and then remains horizontal at a lower elevation than the footwall. This illustrates that a zone exists near the trace along which subsidence rates from faulting are higher than what is found farther way from the fault. Based on offsets and age of the bridges, subsidence rates were calculated. No offset was observed in the youngest (~10 years) bridge, possibly due to data collection sensitivity or the fault is not present. However, subsidence rates can be calculated from offsets in the older bridges. Subsidence rates attributed to faulting span a range from 1.5 mm/yr. to 2.8 mm/yr. (0.06 in/yr. to 0.1 in/yr.). The specific rates depend on the offset measurement.

<u>PRESENTER BIO</u>: Dr. Hopkins is a geologist and GIS specialist and has been at the Lake Pontchartrain Basin Foundation since 2016. His graduate research focused on understanding landscape response to active tectonics. At LPBF, he works on a wide range of coastal projects and provides technical support with GIS/GPS.

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APPLYING ADAPTATION PATHWAYS AND ROBUST DECISION MAKING IN STRATEGIC COASTAL PLANNING IN THE FACE OF CHANGE AND UNCERTAINTY

*Peter von Lany[1], **Adam Hosking**[2], & Brett Korteling[2]*
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The sustainability of our coastal communities and economy is depend upon extensive systems of human and natural infrastructure. These systems need to be reliable, resilient to extreme events and adaptive to future changes in economic and environment conditions as well as adaptable to potential future climate change.

In making long term decisions, it is important to make and implement choices that are robust and adaptive. This paper considers the application of ***Adaptation Pathways*** and ***Robust Decision-Making*** (using the Info-Gap technique) to help in the strategic long-term adaptive planning of flood risk management and water infrastructure systems. These tools provide a means to make investment decisions in infrastructure systems taking full account of the long-term uncertainties to make the best near-term decisions, as a start on the path towards achieving desired long-term outcomes.

We consider the application of Adaptation Pathways in two case-examples: the development of the strategic flood risk management plan for the Thames Estuary in London (UK); and a strategic project in Singapore to protect coastal infrastructure from the potential effects of climate change including sea level rise and an increase in future rainfall. In our third case-example we consider how Robust Decision- Making can be combined with Adaptation Pathways to help develop a regional strategic water resources plan across the south-east region of England.

The paper will give insights into these previous applications of these tools and set out recommendations for how their application to the challenges facing coastal Louisiana could provide a basis for more robust investment decision making while also affording an additional mechanism for engagement of affected communities and stakeholders in the decision-making process.

PRESENTER BIO: Adam Hosking is Jacobs's Global Director for Water Resources, including flood/coastal risk management and climate change adaptation. A Fellow of CIWEM and Chartered Scientist with more than 23 years' global experience, including leading the plan formulation approach for the 2007 State of Louisiana Coastal Master Plan.

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EAST ASCENSION PARISH FLOODPLAIN MANAGEMENT - A SYSTEM WIDE APPROACH

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East Ascension Parish (EAP) has had a long history of living with flood risk. Located between the Mississippi River and the Amite River, EAP extends from Bayou Manchac to the North, out into McElroy Swamp to the South. EAP is influenced by Lake Maurepas and coastal events in addition to river flood waters from the Amite River. EAP is shaped both by riverine and coastal hydraulic factors having to manage flood risk from both. Record flooding from the Amite River and Lake Maurepas in August 2016 highlighted the current challenges parish administrators are facing to balance development and flood risk. To address these challenges, The East Ascension Consolidated Gravity Drainage District #1 (EACGDD) has taken a system wide approach to evaluate flood prone areas, current flood protection systems, existing flood and drainage ordinances, and necessary flood protection improvements to better position EAP for future events.

EACGDD, supported by HNTB, has undertaken numerous initiatives to make East Ascension Parish more resilient to tomorrow's flood threats. This presentation gives an overview of the existing system and the challenges faced, the approaches taken, and a summary of current efforts. Specific efforts to be discussed include: Reanalysis of the Marvin Braud Levee System for FEMA certification; FEMA LOMR submittal for the Bayou Conway/Panama Canal drainage area; Ascension Parish channel and levee system improvements; and EAP Floodplain Management implementation plan. EACGDD has focused on updating their understanding of flood prone areas, addressing deficiencies and in the flood protection system, identifying where flood protection improvements are needed and evaluating parish drainage and floodplain management guidance that will support the parish goal of updating their Drainage and Flood Damage Prevention Ordinances. This presentation will also highlight technical details such as utilizing 1D/2D Ras analysis capabilities in the analysis of flood prevention measures and mapping, and the application of geospatial floodplain storage analysis to assess the effect of fill on regional flood storage.

PRESENTER BIO: Michael A. Hrzic, P.E. – Michael is a senior water resource engineer with more than 15 years of experience in the planning and design of flood protection measures having worked throughout the United States both for the public sector, USACE, and the private sector with HNTB.

PRESENTER BIO: Atri Sen, P.E – Atri is a senior project manager in the HNTB Baton Rouge office with more than 15 years of experience in managing flood resilience project throughout Louisiana and the Gulf Coast.

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QUANTIFYING ENVIRONMENTAL CONTROLS ON PHYTOPLANKTON COMMUNITY DYNAMICS IN LOUISIANA COASTAL ESTUARIES

Andrea C. Jaegge, *Beth A. Stauffer*
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The Atchafalaya-Vermilion Bay System (AVBS) is a large, shallow estuary that consists of five connected bays along the southern coast of Louisiana. This system is influenced by both the Atchafalaya and Vermilion rivers which carry nutrients, sediment, and fresh water into the AVBS. This study focuses on the western portion of the AVBS and includes the West Cote Blanche and Vermilion Bays which are sheltered from the Gulf of Mexico by barrier islands.

Working with the Louisiana Department of Wildlife and Fisheries, samples in both the West Cote Blanche and Vermilion Bays were collected from February 2016 – February 2018. Transects through both bays were used to quantify the environmental and physical controls on phytoplankton communities and examine temporal shifts in community composition. Preliminary results show that overall biomass is dominated by phytoplankton < 20 µm in size and that overall biomass is variable in both time and location. The physical environment of the Vermilion and West Cote Blanche Bays is also highly variable, showing trends in nutrient concentration, dissolved oxygen, salinity, and turbidity seasonally and moving from the on- to offshore sampling sites. These results suggest that picocyanobacteria and pico- and nanoeukaryotes are major contributors to overall community composition and that seasonal processes within this estuary may be controlling community abundances.

Flow cytometry is being used to determine the community composition of the < 20 µm size fraction and to assess the contribution of cyanobacteria to overall biomass. The presence of toxin-producing cyanobacteria in the AVBS is of interest as these communities have the potential to negatively impact this ecosystem. These results will be compared to a similar study in the Terrebonne Bay estuary which receives less freshwater input compared to the West Cote Blanche and Vermilion Bays and will be expanded upon using remote sensing techniques. This study provides new insights into the relationship between phytoplankton community dynamics and the physical environment of the understudied AVBS.

PRESENTER BIO: Andrea Jaegge is a second-year PhD student in Dr. Stauffer's phytoplankton ecology lab at The University of Louisiana at Lafayette. Her research focuses on quantifying environmental controls on phytoplankton communities in Louisiana's coastal estuaries. She's also interested in examining the presence of toxin-producing species and assessing their possible ecosystem impacts.

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3-D GEOLOGICAL STRATIGRAPHY OF COASTAL LOUISIANA USING SUBSURFACE BORINGS AND CONE PENETROMETER TESTS

*An Li, **Navid H. Jafari**, and Frank T.-C. Tsai*
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The subsurface geology of coastal Louisiana was formed under fluvial, deltaic, and coastal influences, which increases the uncertainty in design and eventual efficacy of coastal restoration and protection projects. To elucidate this complex geology, soil borings and cone penetrometer tests (CPTs) are the two most widely used investigation methods. However, they are not typically used together to develop three-dimensional soil stratigraphy models to reveal regionalized scale subsurface stratigraphy. In this presentation, geostatistical methods were used to construct multiple three-dimensional soil stratigraphy models at the Inner Harbor Navigation Canal (IHNC) along the Lower Ninth Ward in New Orleans, LA because soil borings and CPTs were conducted at twenty-four (24) sites. Ordinary kriging was used to regionalize the boring and CPT data and to build three-dimensional soil stratigraphy models. To explore spatial distribution of different soil types in the region, four soil stratigraphy models were established, including a soil classification model constructed using soil boring data and three soil behavior type (SBT) models constructed using CPT data. The 3-D geological stratigraphy of the IHNC will be discussed and compared with the CPT soil behavior type charts to show which one is more appropriate for coastal Louisiana. The implications of this comparison are immense because more accurate representation of soil types using in-situ testing methods (e.g., CPT) will facilitate better design and implementation of coastal protection and restoration projects.

PRESENTER BIO: Professor Navid Jafari is an assistant professor in the Department of Civil and Environmental Engineering at LSU. His research is focused on geotechnical engineering, with applications to the performance and design of marsh restoration and flood infrastructure projects.

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GEOTECHNICAL CHARACTERIZATION OF WETLANDS USING PIEZOCONE PENETROMETER TESTS

Navid Jafari[1], *Jack Cadigan*[1], *Jodie Crocker*[2], *Brian Harris*[1], *and Haq-Murad Nazari*[1]
[1]Louisiana State University, Baton Rouge, LA, USA
[2]Christian Brothers University, Memphis, TN, USA

The rate of erosion at the marsh edge is a key parameter for predicting the longevity of a given vegetated marsh, including future marsh creation projects and sediment diversions. Recent attempts to relate marsh edge retreat rate to wave power have met varying levels of success. The existing capability of predicting marsh edge erosion rate as a function of wave power and soil and vegetation properties is rather limited for engineering applications. For instance, Allison et al. (2017) show that without taking the marsh platform, soil, and vegetation into account, the relationships between marsh edge erosion rates and wave power on a basin or coastal-wide scale are not strong enough statistically to serve as a useful predictive model. Consequently, this study is focused on a methodology to estimate the geotechnical properties of wetlands. In particular, the piezocone penetrometer offers a quick and relatively simple method to characterize the geotechnical properties of the marsh to further the knowledge of spatial differences in key strength parameters. Using a piezocone penetrometer, the marshes of Terrebonne Bay were characterized based on tip resistance, soil moisture, and resistivity. The tip resistances were measured using a full-flow ball penetrometer, which are typically used in off-shore environments. This presentation presents the results of over a 100 CPT soundings collected in Terrebonne Bay at the marsh edge and inland. A simplified geological profile showing the thickness of the vegetative mat, thickness of the organic layer, and the depth to a confining interdistributary clay is constructed and presented. These results are the first step in quantifying the geotechnical properties of wetlands, which are important to better understand the vulnerability to waves and changes in environmental stressor like nutrients, sediment accretion, and salinity.

PRESENTER BIO: Dr. Navid Jafari is an assistant professor in the Department of Civil and Environmental Engineering at LSU. His research is focused on geotechnical design and performance of restoration and protection projects.

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MEASURING FOOD WEB RESPONSE TO HABITAT RESTORATION IN VARIOUS COASTAL ECOSYSTEMS

W. Ryan James[1]*, Steven Y. Litvin*[2]*, and James A. Nelson*[1]

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Coastal wetland habitats provide important ecosystem services, including supporting coastal food webs. These habitats are being lost rapidly. To combat the effects of these losses, millions of dollars have been invested to restore these habitats. However, the relationship between restoring habitat and restoring ecosystem functioning is poorly understood. Analyzing energy flow through food web comparisons between restored and natural habitats can give insights into ecosystem functioning. Using published stable isotope values from organisms in restored and natural habitats, we assessed the food web response of habitat restoration in salt marsh, seagrass, reef, and algal bed ecosystems. We ran Bayesian mixing models to quantify resource use by consumers and generated habitat specific food web hypervolumes for each ecosystem to assess food web differences between restored and natural habitats. Each ecosystem's food web responded differently to restoration, but our analysis revealed two major themes that mediate food web recovery. The type of restoration (habitat construction vs species removal) determined the increase or decrease in variation of resource use of the food web in the restored habitats, and the turnover time of the primary production sources determined the similarity between the restored and natural food webs. Using stable isotope mixing models to generate food web hypervolumes is a promising tool to quantify food web response and the recovery of ecosystem function to determine the success of habitat restoration.

PRESENTER BIO: W. Ryan James is a Doctoral Fellow in the Ecosystems Ecology Lab at the University of Louisiana Lafayette. His research focusses on energy flow in coastal ecosystems and how restoration affects ecosystem functioning with a focus on food webs.

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CHARACTERIZING THE HUMAN DIMENSION OF COASTAL CHANGE WITHIN THE SYSTEM-WIDE ASSESSMENT AND MONITORING PROGRAM (SWAMP)

Krista L. Jankowski[1,2]*, Angelina Freeman*[1]*, and Rick Raynie*[1]

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Implementation of Louisiana's System-Wide Assessment and Monitoring Program (SWAMP) is aimed at ensuring a comprehensive network of data collection activities to support and manage coastal protection and restoration efforts. These efforts can reveal how human factors like restoration projects and climate change affect both natural and built environments though another approach is necessary to understand social responses by coastal Louisiana communities and residents. Understanding how environmental changes (e.g. relative sea-level rise, ecosystem shifts) impact personal decisions and, ultimately, community evolution is crucial to evaluating the true impact of coastal protection and restoration activities. This study uses publicly-available demographic data to track changes to social variables (e.g. occupational category, home-ownership) at the community level as a measure of community resiliency.

PRESENTER BIO: Krista L. Jankowski is a broadly trained earth scientist whose recent work has focused on coastal and deltaic response to environmental change and the implications for coastal sustainability. She is currently working with the Louisiana Coastal Protection and Restoration Authority as a 2017-18 Gulf Research Program Science Policy Fellow.

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A PLANNING MODEL FOR THE FUTURE: LA-SAFE MOVES TOWARD IMPLEMENTATION

Steve Cochran[1], Camille Manning-Broome[2], Liz Williams Russell[3], Mathew Sanders[4], ***Pam Jenkins[5]***

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In 2017, LA SAFE (Louisiana's Strategic Adaptation for Future Environments), worked with residents of six Louisiana Parishes in an intensive and inclusive planning process around current and future land loss and flood risk. This interdisciplinary panel provides an overview of the process, its implementation, and how it can be modeled for use in other communities. LA SAFE created opportunities for participants at all levels (community, parish, and state) to discuss the state's future risks using the most relevant and current data modeling and best practices in community development. Per the U.S. Geological Survey, Louisiana currently loses more than 16 square miles of land per year due to coastal erosion. In response, the state and many of its constituent local communities implemented risk-reduction projects. In short, our coastal zone will remain vulnerable, and in some locations, this risk will be considerable, if not overwhelming. Louisiana SAFE fills a resilience gap that articulates a development strategy combining the science behind the Coastal Mater Plan with the community-building planning and policy techniques the state developed over its decade-long post-Katrina recovery effort. While the Coastal Master Plan focuses on technique to reverse negative environmental trends, Louisiana SAFE takes a people driven approach to maintain that unique way of life while remaining mindful of the future risk projects at the state's disposal. The panel provides an overview of the LA-SAFE unique dimensions including the planning process, the development of public-private partnerships, strategies for community engagement, and results of the comprehensive evaluation of the initiative.

<u>PRESENTER BIOS</u>:
Steve Cochran, Environmental Defense Fund, Associate Vice President for Coastal Protection has more than twenty years working on environmental issues.

Camille Manning-Broome, Center for Planning Excellence, Senior Vice President, has worked on issues of sustainability, resource management and planning for more than a decade.

Liz Williams, Foundation for Louisiana, Coastal Community Resilience Director, has worked in this field for more than five years, bridging the gap between the public and private sectors.

Mathew Sanders, Louisiana State Office of Community Development, Resilience Policy and Program Administrator, has designed the policy and plans for both LA-SAFE and the Isle de Jean Charles Project.

Pam Jenkins, University of New Orleans, Research Professor of Sociology, has more than 20 years in working on sustainability and community issues.

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IMPLICATIONS OF COASTAL CHANGE ON POPULATION AND HABITAT VALUE FOR BLUE CRABS

Andrea S. Jerabek[1], *Tim J.B. Carruthers*[1], *Kelly M. Darnell*[2], *Ann C. Hijuelos*[3], *Leland Moss*[1], *Lennah M. Shakeri*[2], *and Zack Darnell*[2]

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Emergent salt marsh serves as critical nursery habitat for many commercially harvested fish and invertebrate species, such as the blue crab (*Callinectes sapidus*). Along the U.S. Atlantic and Gulf coasts, blue crab landings totaled over 72,000 metric tons in 2016 for a wholesale value of over $218 million. In Louisiana alone, over 18,000 metric tons were harvested in 2016 for a wholesale value of over $49 million. Across the Gulf of Mexico, however, salt marshes are rapidly being lost due to subsidence, erosion, and sea level rise. Marsh loss is frequently not a simple retreat of the marsh edge, but a fragmenting of large marsh patches into many smaller marsh patches, gradually transitioning to open water. A better understanding of blue crab habitat use is essential for predicting future changes in fishery production and ensuring the sustainability of the fishery.

Habitat Suitability Indices (HSI) were developed as part of the Comprehensive Everglades Restoration Plan for southwest Florida estuaries, based on salinity, temperature, and flow, but limited local blue crab data were available, so crab responses to these three physical variables were summarized from the literature for megalopae and spawning females. More recently, as part of the 2017 Louisiana Coastal Master Plan process, a juvenile blue crab (8–40 mm carapace width [CW]) HSI was developed for coastal Louisiana marsh and shallow shoreline habitats. The model includes salinity and temperature as well as percent land. The major limitations identified in the development of the HSI were that the models do not directly account for marsh edge availability, nor do they include submerged aquatic vegetation (SAV) although these habitats can provide increased prey availability and protection from predators.

We studied the relationship between juvenile blue crab abundance and gradients of marsh fragmentation and SAV cover in Terrebonne Basin. This region of coastal Louisiana supports a large blue crab fishery, but is experiencing substantial marsh fragmentation and land loss. The aim of this project was to refine the current blue crab HSI for fragmenting coastal marshes in Louisiana. Abundance of juvenile blue crabs was strongly related to habitat type and fragmentation at local scales but not to fragmentation at larger scales. Juvenile abundance was analyzed against metrics of marsh edge and SAV availability to determine the relative contribution of these habitats to juvenile blue crab abundance. The results of these analyses, as well as potential recommendations to update the blue crab HSI for more accurate application to habitat suitability estimates for fragmenting marshes in coastal Louisiana will be presented.

PRESENTER BIO: Andrea Jerabek is a Coastal Ecologist at The Water Institute of the Gulf. Her research interests include understanding the underlying fisheries response associated with coastal erosion and land loss due to sea level rise, subsidence, and climate change.

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IMPLEMENTING MASTER PLAN MARSH CREATION PROJECTS

***Russ J. Joffrion**, P.E.*
CPRA, Baton Rouge, LA, USA

The panel session is discussion-only and will provide dialogue pertaining to the challenges and expertise gained from the in-house design and construction of marsh creation projects, the experience gained from the partnerships with construction contractors, and the research collaboration with local universities, to aid in the development of efficient design and construction methodologies for the implementation of master plan marsh creation projects.

List of Panelists:

- Rudy Simoneaux, P.E.: CPRA Engineer Manager
- Jas Singh, P.E.: CPRA Engineer Supervisor
- Chuck Broussard: Vice President, Weeks Marine, Inc. Dredging Division
- Dr. Navid H. Jafari, P.E., L.S.U. Dept. of Civil and Environmental Engineering Associate Professor

Session Organizer Bio: Russ J. Joffrion graduated from L.S.U. in 1993 with a B.S. in Civil Engineering. From 1993 through 2002, he worked for the LADOTD and was responsible for the geotechnical engineering design and construction of major bridge and roadway projects throughout the state. He moved to the LDNR in 2002 and is currently an Engineer Manager within the Engineering Division of the CPRA. He has managed the design of barrier island restoration, marsh creation, shoreline protection, diversion projects, and flood protection projects, and is responsible for the technical merit of flood protection and restoration projects within the Louisiana Coastal Zone.

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FLOOD RISK AND DAMAGE ASSESSMENT FOR LOUISIANA’S 2017 COASTAL MASTER PLAN

David R. Johnson[1,2] *and Jordan R. Fischbach*[2]
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Louisiana’s 2017 *Comprehensive Master Plan for a Sustainable Coast* consists of 124 projects intended to reduce flood risk and restore ecosystems across the coastal zone over the next 50 years. The plan allocates approximately $19 billion to structural flood protection projects and $6 billion to nonstructural measures such as home elevations, floodproofing, and voluntary acquisitions.

A series of systems models was used to evaluate flood risk in terms of the expected annual damage (EAD) with and without projects, under current conditions and in three future time periods (10, 25, and 50 years into the future). Specifically, the Coastal Louisiana Risk Assessment model (CLARA) was used to estimate flood risk in a future without action and risk reduction with proposed projects in place. Future time periods were evaluated in multiple scenarios with varying assumptions about factors such as sea level rise, future storm characteristics, population growth, and system fragility.

In this talk, we describe advancements in the flood risk modeling methodologies made between the 2012 and 2017 planning cycles. These included changes to the model’s spatial resolution and definition of policy-relevant spatial units, an improved treatment of parametric uncertainty and uncertainty propagation between model components, the addition of a module to consider critical infrastructure exposure, and a new population growth model. We will also present overall results regarding future flood risk in coastal Louisiana and the risk reduction benefits of the 2017 Master Plan.

PRESENTER BIO: Dr. Johnson is an assistant professor of industrial engineering and political science whose research focuses on environmental decision-making under uncertainty. He was worked since 2009 as a member of the Louisiana Master Plan’s Risk Assessment team and is the lead developer of the Coastal Louisiana Risk Assessment model.

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RESPONSES TO BEACH RENOURISHMENT BY NESTING SHOREBIRDS IN COASTAL LOUISIANA

Erik I. Johnson[1], *Sarah Bolinger*[1,2], *Samantha Collins*[3], *Kacy Ray*[4]
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[3]Rockefeller Wildlife Refuge, Department of Wildlife and Fisheries, Grand Chenier, LA, USA
[4]American Bird Conservancy, The Plains, VA, USA

Beach-nesting birds in Louisiana and across the country are facing alarming population declines. As beaches are developed, coastal habitat for birds is dwindling, increased human activity disrupts nesting and foraging, and Louisiana's shoreline is subsiding and eroding at an alarming rate. To reinforce coastal Louisiana's first line of defense against storms surges, the Coastal Protection and Restoration Authority has invested heavily in beach renourishment programs to elevate shorelines and barrier islands.

We evaluated the efficacy of three of beach renourishment projects – Cameron Parish Shoreline Renourishment (CS-33), Caminada Headlands Increment I (BA-45), and Caminada Headlands Increment II (BA-143) – on reducing storm- and predator-related risks to nests of the Least Tern (*Sternula antillarum*) and the Wilson's Plover (*Charadrius wilsonia*). We compared raw nest success probabilities at these three restoration sites against six control sites in 2016 and 2017.

We followed 855 Least Tern and 141 Wilson's Plovers nests to their fate. Least Tern and Wilson's Plover nests were 1.4 and 3.4 times more likely to be washed out from storms on unrestored beaches, respectively. However, nest depredation rates on renourished beaches were 1.3 and 2.0 times higher for Least Terns and Wilson's Plovers, respectively. Overall, hatching rates were 1.1 times higher for Least Terns and 1.6 times higher for Wilson's Plovers on restored beaches, suggesting that nest success increases resulting from opportunities to nest at higher elevations outweighed potential increased losses from predators. We hypothesize that increased nest predation risk on renourished beaches may be a function of increased nesting bird density, increased habitat suitability for predators such as coyotes, and/or reduced opportunities for hiding nests in relatively unvegetated habitats compared to unrestored sites. Interactions between extreme high tide events and depredation risk may be complex, and not independent, such that understanding these interactions and how restoration affects these risks is important for developing appropriate strategies for restoring and managing beaches and barrier islands.

<u>PRESENTER BIO</u>: Dr. Johnson is Director of Bird Conservation for Audubon Louisiana, a state office of the National Audubon Society. He has 17 years of experience in applied wildlife management, with a focus on birds and their habitats.

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SANCTUARY IN THE SWAMPS: SURVIVAL BY STRATEGIC MIGRATION, NATIVE AMERICAN COMMUNITIES IN SOUTHERN LOUISIANA

Laura D. Kelley
Tulane University, New Orleans, LA, USA

Unbeknownst to many in the New Orleans' metropolitan area, an hour and a half outside of the city, in lower Lafourche and Terrebonne parishes, there exist an interrelated network of small, still French-speaking Native American Tribes. How and why did these Tribes ended up in these remote bayous and what will happen to these communities in this era of climate change, coastal erosion, and rising sea levels are all questions that different members of this panel seek to address. My paper will seek to answer the first two questions and, in the process, re-evaluate the narrative of Native American presence and interaction in colonial Louisiana.

By the late 18th and early 19th century, the Native American landscape of the Lower Mississippi River Valley had altered considerably from the previous 100 years. For many Native Americans disruption of tribal communities caused by the onslaught of disease, abuse of alcohol, inter-tribal as well as general (European) warfare had already occurred. The once numerous Petites Nations of the Lower Mississippi River Valley had been reduced in numbers, absorbed by other tribes, migrated further West, or lived on the fringes of urban settlements by the time of the Louisiana Purchase.

However, some Native Americans chose a different path and with different outcomes.

The retreat to the bayous gave Native Americans freedom of movement as well as restrictions. With their self-imposed exile they had appropriated a space safe from white incursion, but at the cost of restricted trade as well as limited exposure to the wider world. By choosing these remote bayous in which to settle, these Native Americans escaped the horrors of forced removal, and quietly, but steadily, worked on constructing new communities. This sanctuary in the swamps provided a sense of place that continues to shape their collective identity to this day. However, as examined by others on this panel, these communities are now under direct threat, as saltwater intrusion decimates the Louisiana coast at an alarmingly fast rate.

PRESENTER BIO: Laura D. Kelley is an immigrant and ethnic historian at Tulane University and the Program Director of Tulane's *Summer in Dublin* Program. Since 2005, she has collaborated with the Pointe-au-Chien Indian Tribe on numerous research projects. She is the author of *The Irish in New Orleans* and is completing her second manuscript *We the People: Native Americans, Europeans, Anglo Americans, and the Complex History of Southern Louisiana from Colonial Times to the Present.*

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PERFORMANCE-BASED CONTRACTING FOR RESTORATION: BENEFITS AND CASE STUDIES

George Kelly
RES, Chief Markets Officer, Baltimore, MD, USA

Creative water resource solutions are being enabled by early restoration project delivery and performance-based contracting. Through performance-based contracts, projects are now being cost-effectively implemented and public funding is being leveraged. Such solutions and approaches provide a win-win for municipalities, counties, states, landowners and the local community.

Performance-based contracting is empowering successful delivery of both green infrastructure and natural resource restoration solutions across the Mid-Atlantic States, specifically related to TMDL and MS4 compliance and the expenditure of public funds in the Chesapeake Bay. Creative delivery and contracting approaches are being applied to address regulatory and funding challenges arising from water management, flood control and water quality issues.

With significant flooding events and restoration initiatives occurring along the Gulf Coast, policy-makers and community leaders are in search of innovative ways to finance and implement storm water management solutions. While Louisiana is in the process of implementing performance based restoration and a pilot program for nutrient trading, best practices from around the country can be applied to solve for regulatory and public-policy related challenges. This presentation will discuss the performance-based contracting approach in the Eastern Seaboard and consider application to the restoration initiatives in the Gulf Coast.

PRESENTER BIO: Mr. Kelly is a graduate of Tulane University and a cum laude JD and MSL graduate of the Vermont Law School. Since 1997, he has been a leader in promoting new policies at the federal and state levels supporting market-based solutions. He is a founding member of the National Water Quality Trading Alliance.

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INCREASING MUD CONVEYANCE TO THE MISSISSIPPI DELTA

G. Paul Kemp[1], *JohnW. Day*[1], *J. David Rogers*[2], *Liviu Giosan*[3], *and Natalie Peyronnin*[4]
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The 2017 Comprehensive Coastal Master Plan presents a grim view of what can be done to restore the Mississippi River Delta (MRD) using only the river sediment reaching Louisiana today. This realization has prompted a second look at bypassing dams on Lower Missouri River tributaries that could double mud supply to the Mississippi River Delta within 2 decades. Given that this technology can also reduce costs to sustain reservoir storage and improve riparian habitat for endangered species. Sand transport to the Mississippi River Delta (MRD) remains sufficient to build wetlands in shallow, sheltered coastal bays fed by engineered diversions on the Mississippi River (MR) and its Atchafalaya River (AR) distributary. But suspended mud (silt & clay) flux to the coast has dropped from a mean of 390 Mt y^{-1} in the early 1950s, to 100 Mt y^{-1} since 1970. This fine-grained sediment travels deeper into receiving estuarine basins and plays a critical role in sustaining existing marshes. Virtually all of the 300 Mt y^{-1} of missing mud once flowed from the Missouri River (MOR) Basin before nearly 100 dams were built as part of the Pick-Sloan water development project. About 100 Mt y^{-1} is intercepted by main-stem Upper MOR dams closed in 1953. But the remaining 200 Mt y^{-1} is trapped by impoundments built on tributaries to the Lower MOR, primarily the Platte and Kansas Rivers, in the 1950s and 1960s. Tributary dam bypassing in the Lower MOR basin could increase mud supply to the MRD by 100 to 200 Mt y^{-1} within 1 to 2 decades. Such emergency measures to save the MRD are compatible with objectives of the also urgent Missouri River Restoration and Platte River Recovery Programs to restore MOR riparian habitat for endangered species, as well as to reduce costs to improve and sustain reservoir operability for decades.

PRESENTER BIO: Dr. Kemp has studied and modeled marine and fluvial sediment transport, wetland restoration and habitat creation for over 30 years. He continues to advocate for restoration of the Mississippi River Delta as an Adjunct Professor at LSU.

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ENVIRONMENTAL CHANGE AND COASTAL RESOURCES: PERSPECTIVES FROM COLONIAL NEW ORLEANS

***J. Ryan Kennedy*[1]** *and D. Ryan Gray*[2]

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In the years since Hurricane Katrina, the City of New Orleans is typically presented as being in environmental peril, threatened by receding coastlines and sea level rise, the degradation of wetland buffers, and engineering miscues that have hastened environmental disaster. When it comes to the city's cultural heritage, these processes are often seen as related to issues of preservation: how does one preserve the coast, and thereby preserve the irreplaceable cultural resources, whether archaeological sites, indigenous communities, or traditional practices, that make southeastern Louisiana so distinct. In this paper, we suggest that historic archaeological sites in New Orleans are not just endangered remains of a vanishing past, but that they may provide data that can be used to understand human impacts on the coast throughout the period since European colonization.

In the Colonial era, New Orleans at times struggled with a tenuous connection to its food supply. French chroniclers were fascinated with native foods, particularly wild game, incorporating it into new 'Creole' cuisines. Eventually, coastal resources would become a central part of New Orleans foodways, and to this day New Orleans is synonymous to many with seafood. However, current seafood trends in the city diverge from historical practices, and archaeological analysis can reveal details of past fish consumption inaccessible via documentary evidence or modern fisheries data alone.

The Historic New Orleans Fisheries Project is a collaboration between University of New Orleans archaeologists and environmental scientists aimed at studying changes in the city's fisheries over the past 300 years. The project combines archaeology's ability to assess long-term change through time with the rich ecological data produced by present-day marine biology research to track changes in New Orleans-area fisheries driven by urban development, population expansion, and landscape modification since the city's 1718 founding. We draw on fish bones from three historic archaeological sites in the city to identify continuity and change over time by three metrics: taxonomic representation, fish size estimation, and stable isotope analysis. Taken together, these three measures allow us to determine the kinds of fish being eaten in historic New Orleans, changes in size of these fish over time, and underlying dietary or environmental changes (whether human-driven or not) experienced by these fish populations.

With modern projects like the Mississippi River-Gulf Outlet Canal driving change to local environments and fish populations, it is apparent that Louisiana's coastal fisheries are significantly altered since New Orleans's founding. Archaeological analysis provides the means to reconstruct the historic fisheries that supplied the city, and we hope our data can be useful in fisheries conservation and rehabilitation efforts. Likewise, these data speak directly to New Orleans' rich culinary heritage, providing insight into the kinds of fish eaten in the city prior to the advent of the modern, large-scale fishing operations of today.

PRESENTER BIO: Dr. Kennedy is a zooarchaeologist with more than 10 years of experience identifying animal remains from archaeological sites throughout North America. His research draws on changes in archaeological animal bone assemblages through time to examine past human impacts on and trade of wild animals, especially fish.

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"STUCK BETWEEN A LEVEE AND A SOFT PLACE - MEETING USACE & FEMA REQUIREMENTS IN JESUIT BEND POLDER, PLAQUEMINES PARISH"

***Melissa Kennedy**[1] and Katelyn Costanza[2]*

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Jesuit Bend is just south of Belle Chasse on the west bank of the Mississippi River in Plaquemines Parish. It is the most highly populated area outside of Belle Chasse within the parish. The area consists of a polder comprised of the existing 8.1 miles of the New Orleans to Venice (NOV) Non-Federal hurricane (back) levee and 8 miles of the Mississippi River Levee (MRL) on the west bank of the Mississippi River between Oakville and La Reussite, LA. Currently, the system does not provide protection from a hurricane event that would produce 1% (annual chance of exceedance) surge and wave elevations. The back levee was recently raised to approximately the 2% (50-year) level of protection according to USACE analysis. The current effective Flood Insurance Rate Maps in Plaquemines Parish, adopted on May 1, 1985, show homes and businesses outside of the designated Special Flood Hazard Area (SFHA). Through the LAMP Program, FEMA is currently evaluating and updating the Flood Insurance Rate Maps (FIRMS) for the portion of Plaquemines Parish that does not provide the 1% level of protection. The LAMP study results indicate that the Jesuit Bend polder will experience surge and wave overtopping during the 1% hurricane event. Consequently, homes and businesses will now be included within the Special Flood Hazard Area (SFHA). As such, Plaquemines Parish is concerned that insurance rates will drastically increase. The Jesuit Bend Polder also protects critical transportation infrastructure providing the only corridor to accommodate the transportation of products at Port facilities at Venice to the south.

HNTB has been supporting Plaquemines Parish through review of the FEMA LAMP analysis as well as evaluating cost effective options to increase the level of protection within the polder. HNTB has been performing coastal analysis for the levee and structure design elevations in conformity to current federal regulations specified by FEMA. Methods and modeling utilized to calculate design elevations are sufficient to provided hurricane risk reduction for the 1% hurricane event. Previous HSDRRS modeling efforts were used as a starting point to build WHAFIS transects for wave modeling and RUNUP2.0 for runup and overtopping modeling. Due to the proposed slope of the levee and foreshore, RUNUP2.0 was sufficient to provide runup calculations. The Technical Advisory Committee on Flood Defense of the Netherlands (TAW) method was also used as an additional check for proposed design elevations. Lastly, FEMA freeboard requirements for levee design, taken from Code of Federal Regulations (CFR) Section 65.10(b)(1)(iii) and (iv), were satisfied for each reach. HNTB is also evaluating the Mississippi River Levees ability to protect the polder from coastal flooding (adequate for 1% riverine flooding) utilizing the LAMP analysis principals and procedures. This was a necessary step in determining potential overtopping issues and the impact on the interior drainage for the area. This presentation will provide an overview of the project, the LAMP review and the investigations, analysis and design performed to date to increase the level of protection of the Jesuit Bend Polder.

PRESENTER BIO: Melissa Kennedy, P.E. Ms. Kennedy is a senior project manager in HNTB Baton Rouge's office with 30 years of experience in Water Resources Engineering. She began her career with the USACE prior to switching to private industry after 15 years. She has been with HNTB for 9 years, with 4 in Baton Rouge.
Katelyn Costanza, P.E., CFM BIO: Mrs. Costanza, owner of CE Hydro, a small woman owned firm, began her career with the USACE managing Civil Works projects. She also worked for the NOAA NWS providing nationally recognized expertise for improving critical lead time for the operation of the MR&T in the wake of the 2011 Flood.

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DOES MEASURING PRESENT-DAY RELATIVE SEA-LEVEL CHANGE IN LOW-ELEVATION COASTAL ZONES NEED RETHINKING?

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Although tide gauges are the primary source of data used to calculate multi-decadal to century-scale relative sea-level change, here we question the reliability of tide gauge data in low-elevation coastal zones (LECZs). Tide gauges measure relative sea-level rise with respect to the base of associated benchmarks. In the Mississippi River Delta, however, at least 60% of total subsidence occurs in the top 5-10 m of sediment. We find that benchmarks in the Mississippi River Delta (n=35) are anchored an average of 21.5 m below the surface and thus do not capture the majority of subsidence occurring in the delta. This leads to a systematic underestimation of the rate of relative sea-level rise. Tide gauges should be interpreted as recording only relatively deep subsidence, or the subsidence that occurs below the benchmark foundations. To calculate total subsidence, an array of surface elevations tables (SETs) should be used to measure the average rate of shallow subsidence across a wetland, and then shallow subsidence can be added to deep subsidence and eustatic sea-level rise as measured by a tide gauge. Ideally, SETs would be constructed to have the same foundation depth as local benchmarks.

PRESENTER BIO: Molly Keogh is a PhD candidate in Tulane University's Department of Earth and Environmental Sciences. She studies wetland hydrology, sedimentology, and restoration, focusing specifically on diversions in the Mississippi River Delta. Her current research investigates sediment accumulation and the resulting compaction of wetland soils.

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SEDIMENT RETENTION IN DIVERSION-FED COASTAL WETLANDS: A FIELD-BASED CONCEPTUAL MODEL

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The morphodynamics of river-dominated deltas are largely controlled by the supply and retention of sediment within deltaic wetlands and the rate of relative sea-level rise. Yet, sediment budgets for deltas are often poorly constrained. In the Mississippi River Delta, a system rapidly losing land to natural and anthropogenic causes, restoration efforts seek to build new land through the use of river diversions. At Davis Pond Freshwater Diversion, a new crevasse splay has emerged since construction was completed in 2002. Here, we use beryllium-7 (7Be) activity in sediment cores and USGS measurements of discharge and turbidity to calculate seasonal sediment input, deposition, and retention within the Davis Pond receiving basin. In winter/spring 2015, Davis Pond received 106,800 metric tons of sediment, 44% of which was retained within the basin. During this time, mean flow velocity was 0.21 m/s and turbidity was 56 formazin nephelometric units (FNU). In summer/fall 2015, Davis Pond received 35,900 metric tons of sediment, 81% of which was retained. Mean flow velocity in summer/fall was 0.10 m/s and turbidity was 55 FNU. The increase in sediment retention from winter/spring 2015 to summer/fall 2015 may be due in part to the corresponding drop in water flow velocity, which allowed more sediment to settle out of suspension. Although high water discharge increases sediment input and deposition, increased turbulence associated with higher current velocity may increase sediment throughput and decrease the percent of sediments retained in the system. Sediment retention in Davis Pond is on the high end of the range seen in deltaic wetlands, perhaps due to the enclosed geometry of the receiving basin. Future diversion design and operation should target moderate water discharge and flow velocities in order to jointly maximize sediment deposition and retention and provide optimal conditions for delta growth.

PRESENTER BIO: Molly Keogh is a PhD candidate in Tulane University's Department of Earth and Environmental Sciences. She studies wetland hydrology, sedimentology, and restoration, focusing specifically on diversions in the Mississippi River Delta. Her current research investigates sediment accumulation and the resulting compaction of wetland soils.

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UPDATES ON THE DEVELOPMENT AND IMPLEMENTATION TIMELINES OF SWAMP

Syed M. Khalil *and Richard C. Raynie*
Coastal Protection and Restoration Authority (CPRA) of Louisiana, Baton Rouge, LA USA

The Coastal Protection and Restoration Authority (CPRA) of Louisiana has developed the System-Wide Assessment and Monitoring Program (SWAMP) as an important strategy to support project monitoring, Master Plan models, and Adaptive Management. SWAMP has been developed as a long-term monitoring program to ensure that a comprehensive network of coastal data collection activities is in place to support the planning, development, implementation, and adaptive management of the protection and restoration programs and projects within coastal Louisiana. SWAMP incorporates the Coastwide Reference Monitoring System (CRMS), the Barrier Island Comprehensive Monitoring (BICM) program, and fisheries data collected by the Louisiana Department of Wildlife and Fisheries (LDWF) in addition to other aspects of system dynamics, including offshore and inland water-body boundary conditions, water quality, risk status, and protection performance which have historically not been the subject of CPRA-coordinated monitoring. This Program further facilitates the integration of project-specific data needs into a larger, system-level design framework. Monitoring and operation of restoration and protection projects will be nested within a larger basin-wide and coast-wide SWAMP framework and will allow informed decisions to be made with an understanding of system conditions and dynamics at multiple scales.

This presentation will provide an update on the implementation of various components of SWAMP in Barataria Basin, which began as a pilot implementation program in 2015. Beginning in 2017, the second phase of SWAMP is now being implemented in the areas east of the Mississippi River. Development of SWAMP design has been initiated for the remaining basins in coastal Louisiana west of Bayou Lafourche.

PRESENTER BIO: Syed Khalil focuses on geo-scientific issues and sediment management pertaining to Integrated Coastal Zone Management and is responsible for the design and implementation of the Louisiana Sediment Management Plan (LASMP) along with development of Louisiana Sand Resources Database (LASARD). He is co-Lead for implementation of Adaptive Management and SWAMP.

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REIMAGINING THE URBAN DRAINAGE CANAL – CASE STUDIES FROM THE SOUTH

John Kiefer
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Drainage canals enable substantial development in what were naturally and historically floodprone areas. These standard trapezoidal canals can lower the water table and provide substantial flood protection. They also often destroyed extensive wetlands, greatly simplified the natural drainage network including its streams and floodplains, and carry unabated pollutants to receiving rivers, bays and estuaries. Many of them require expensive perennial maintenance activities and are actively eroding. In an increasing number of cases, since they were designed for mid-1900's climate conditions, they no longer provide their designed level of service for flood protection. In some cases, canal right-of-ways may represent the single largest remaining publically-owned land outside of transportation alignments. These factors have led communities along the Gulf Coast and inland to re-imagine their urban canals.

This process characteristically invokes consideration of the triple bottom line, requiring infrastructure investment decisions involving quantifiable social and environmental benefits. For example, Sarasota County FL stormwater and natural resource managers envisioned a future where canals would be largely self-maintaining. Amec Foster Wheeler scientists developed a GIS-based capital investment approach for prioritizing canal projects to reduce maintenance and increase canal functions. The resultant decision support tool enables community leaders to understand and select from among competing alternatives that differ substantially in the levels of investment and benefits provided, ranging from simply stabilizing banks in place to repatterning the conveyances to function more like natural stream channels and floodplains.

In some cases, social benefits drive how communities address failing flood conveyances at least as much as the environmental reasons. For example, the City of Huntsville AL is creating a multimodal pedestrian corridor connecting a socio-economically disadvantaged community with downtown job centers. The corridor is centered on an enlarged floodway through the middle of downtown which is designed to become a cultural centerpiece of the city replete with trails, parks, water features and a charismatic pedestrian bridge. These elements are woven with architectural themes invoking the City's southern culture and its world-class rocket science industry. The corridor will include a meandering low-flow channel that conveys crystal clear water from springs in the City and will allow pedestrians to observe nature in what amounts to an open air aquarium.

Many communities are finding their own ways to reimagine their dilapidating stormwater drains, justifying large investments and capturing available co-funding that rewards planners for explicitly accommodating the triple bottom line in their designs.

PRESENTER BIO: Dr. Kiefer is a water resource engineer with more than 25 years of experience planning, designing, and implementing running waters restoration and improvement projects in substantially altered watersheds. His design team emphasizes harnessing natural forces to develop multi-functional projects requiring low maintenance with a high natural aesthetic.

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GEOMORPHIC EVALUATION OF BARRIER ISLAND SEDIMENT RESTORATIONS

***Brittany Kime**[1], Ioannis Georgiou[2], and Michael Miner[3]*
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Barrier islands are one of the first lines of defense against storm surge and hurricane damage for the southern Louisianan coastline. The degradation of the barriers due to increasing rates of subsidence, shoreline erosion, sea level rise, and frequent storm events, have created a sediment deficit to the barrier system, which hinders natural barrier migration, sediment deposition, and continuous composition. Our research and experiments used the numerical modeling program, Delft3D, and included simulating barrier island system environments and the various environmental factors barriers are subjected to, with several experiments including a re-nourished sediment deposition upon a main barrier. Additionally, for the simulated restoration, a quality comparison of nearshore sediments and outer continental shelf sediments was conducted to determine an adequate representation of the best restoration practice to increase the barrier longevity and lessen degradation from storm impact.

Nearshore sediments are typically smaller grained with less sand content, which comes from within the immediate barrier island system. This creates the sediment deficit to the overall system. The smaller grains are also less likely to withstand tidal, wind, and storm surge, and are more likely to be subjected to displacement, and sediment transport throughout the system. Outer continental shelf sediments used for restoration purposes have a larger grain size, and are primarily composed of sand. These sediments when used in restoration are more likely to help the barrier withstand wind, wave, tidal, and storm surge, maintain their deposition on the barrier, and are brought in from outside of the overall system, which lessons the strain for adequate sediments content throughout the system.

The Deltf3d computer modeling program emulates barrier island systems and the numerous parameters and fluctuating factors induced (wind, waves, tides, sediment deposition, etc.). In the experiments with sediment deposition as a restoration, the factors considered include: type of sediment used for replacement (nearshore versus offshore), within-system sediment replacement or outside system sediment replacement, and sediment transportation to determine if the barriers longevity is increased, or hindered.
Using Delft3d, the models indicate that using Outer Continental Shelf Sediments for barrier island restoration are more likely to increase the barriers longevity through the current transgressive phase against sea level rise, and dampen the impact of storm surge and hurricane damage than Nearshore sediment replacement which extracts in-system sediments, with grains less adequately suited for the environmental stressors.

PRESENTER BIO: Brittany graduated from Indiana University with her Bachelors in Geology and entered Graduate School at the University of New Orleans for a Masters in Coastal Science focusing on Coastal Geomorphology.

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SUSCEPTIBILITY OF ROSEAU CANE (*PHRAGMITES AUSTRALIS*) AND SELECT AGRONOMICALLY AND ENVIRONMENTALLY SIGNIFICANT POTENTIAL HOSTS

***Ian A. Knight**, Blake E. Wilson, Madeline Gill, Leslie Aviles, James T. Cronin, John A. Nyman, Rodrigo Diaz*

Louisiana State University, Baton Rouge, LA USA

Following an investigation into the die-back of roseau cane (*Phragmites australis*) in the Bird's Foot Delta and subsequent discovery of the invasive scale insect *Nipponaclerda biwakoensis* in the fall of 2016 surveys were coordinated to assess the extent of the scale infestation in the marsh. Information on the host range of the scale and its impact on *Phragmites* is very limited, and it is unknown the extent of the role the scale in the die-backs or its risk to other marsh or crop species. Initial observations indicated there may be differences in susceptibility to the scale and die-back among different genetic lineages of roseau cane.

Two studies were undertaken to investigate differences in susceptibility to the scale between the two varieties of *Phragmites* found in the Bird's Foot Delta. In the delta, five sites were selected within the Pass-a-loutre WMA were stands of the dominant "Delta" variety and the invasive "European" variety grew adjacent or in close proximity. Beginning in July 2016, these sites were sampled every three months to measure the extent of infestation by the scale, *Phragmites* heights and density, and ground cover. These two varieties and an additional "Gulf" variety, which is common throughout coastal Louisiana, were also propagated in a greenhouse and subjected to infestation by the scale to measure susceptibility and the effect of the scale on plant growth under controlled conditions. Lastly, other species of concern, including *Zea mays*, *Oryza sativa*, *Saccharum officinarum*, *Spartina alterniflora*, and *Schoenoplectus californicus* were assessed for their susceptibility to the scale.

Results from the paired plots indicate that while scale infestations were lower in the European variety patches early in the season samples, scale counts generally the same between varieties at each site. Because the European variety generally had higher stem densities than the Delta variety, end of season samples actually had higher scale counts per unit area. Despite this, the European variety still does not appear to succumb to the symptoms of the die-back syndrome suggesting that either the scale may play less of a role, higher infestation earlier in the season is result for observed differences in plant health, or the European variety exhibits some tolerance to the scale not found in the Delta variety. Despite the apparent success of the scale in colonizing coastal Louisiana, artificial inoculation of propagated plants proved challenging. Establishment of scale populations was only observed in *Phragmites* and the other potential host species appear to be unsuitable hosts to the scale under greenhouse conditions.

PRESENTER BIO: Dr. Knight is a postdoctoral research associate who joined Louisiana State University in August 2017 to investigate the invasive scale insect *Nipponaclerda biwakoensis* and its impact on *Phragmites* in coastal Louisiana. He comes to LSU from the University of Georgia where he studied the management of kudzu bugs in soybean.

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ARE WE ALL ON THE SAME TEAM? ANALYSIS OF LOUISIANA'S COASTAL MASTER PLAN AND LOCAL GOVERNMENT PLANS

***Claire Connolly Knox**, Ph.D.*
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With a football field amount of wetlands lost every 45 minutes, coastal Louisiana is experiencing the highest rate wetland loss in the nation. The primary causes of wetland loss are subsidence of the land and sea level rise; both contribute to saltwater intrusion that deteriorates freshwater vegetation. In the past 12 years, this coast has been challenged environmentally, economically, and socially with multiple hurricanes (Katrina, Rita, Gustav, Isaac, and Harvey) and the Deepwater Horizon Oil Spill. These disasters totaled more than $125 billion in damages and resulted in nearly 2,000 deaths. Harnessing the policy window opportunity, along with increased amounts of private and federal funding, Louisiana officials integrated coastal restoration planning with hazard mitigation – the first large-scale restoration plan to incorporate hazard mitigation in the U.S. While research indicates a state mandate for local government hazard plans results in a higher quality plan (i.e., Berke, 1996), there are no mandates to align state or federal large-scale restoration projects or plans to local land use plans in many states, including Louisiana. Researchers have acknowledged the importance of local land-use decisions and plans in implementing ecosystem management principles (Brody, 2003; Noss & Scott, 1997; McGinnis et al, 1999).

Building upon the planning quality and evaluation literature, this study analyzes comprehensive land use plans in Louisiana's coastal zone to systematically assess the quality of the plans within the context of a non-mandated, $50 billion large-scale state restoration plan. Specifically, this case study asks do the coastal parishes have the capacity to implement the non-mandated state restoration plan. This capacity is analyzed using a two-phased, coding methodology to systematically assess and test the quality of the 20 coastal zone parish comprehensive land-use plans. Sixty-nine coding indicators are organized into five categories (i.e., Factual Basis; Goals and Objectives; Inter-organizational Coordination and Capabilities; Policies, Tools, and Strategies; and Implementation) and analyzed for depth and breadth (Brody 2003; Tang, et al, 2008). Results indicate a great disparity between the plans with a majority of the local governments lacking the capacity to implement to the nonstructural programmatic elements of the state's Coastal Master Plan. The presentation will conclude with a discussion and recommendations for practice and future research.

PRESENTER BIO: Dr. Knox is an Associate Professor in UCF's School of Public Administration. Her research interests are environmental policy and planning, coastal hazards, and disaster response. She is an expert on analyzing policies and plans in coastal zones, as well as after disasters to identify gaps and recommend changes.

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AN ANALYSIS OF SUBSIDENCE RATES AND PATTERS WITHIN THE BARATARIA AND TERREBONNE BASINS USING SEAMLESS LIDAR SURVEYS

*Celeste Woock[1], **Alexander S. Kolker**[2,4], Mark A. Kulp[1], and Syed Khalil[3]*

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In recent decades, subsidence of coastal Louisiana has become a topic of substantial and growing concern to the scientific community, the local residents, and all those invested in the region's economy. This subsidence is the combined result of regional tectonics/faulting, fluid withdrawal, sediment compaction and post-glacial forebulge collapse. Many studies have undertaken the task of accurately quantifying subsidence rates throughout the region. As of yet, there is still a need for a comprehensive analysis of the region, which observes and delineates precise results on the dynamics of subsidence in southeastern Louisiana. This talk will compare the various contributors to both shallow and deep subsidence in regions within the Barataria and Terrebonne Basins. Comparing LIDAR datasets with approximately a twelve-year difference will highlight the local and regional changes in elevation precisely. Likewise, contrasting these data with a Holocene-Pleistocene boundary raster will be used to depict regions impacted more strongly by shallow or deep subsidence processes. Finally, creating an instantaneous slope map of the most recent LIDAR dataset will narrow the spatial and temporal spans of each factor contributing to subsidence. These data were acquired from a multitude of sources including, but not limited to: the Coastwide Reference Monitoring System (CRMS via CPRA), the Coastal Information Management System (CIMS via CPRA), United States Army Corps of Engineers (USACE), and the LSU Center for Geoinformatics. Short-term factors which contribute over tens of meters will be contrasted with those that cause kilometer-scale surface changes over millennia in order to gain a more comprehensive understanding of these dynamic processes and how their interplay may affect the geomorphology of the region. In this way, planning for the future of the Louisiana working coast can become a more manageable task through better understanding of the processes involved.

Presenter Bio: Alexander S. Kolker is an Associate Professor at the Louisiana Universities Marine Consortium and teaches in the Department of Earth and Environmental Science at Tulane University. His research examines the physical, climatic, geological and anthropogenic processes that govern coastal systems.

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A QUINTUPLING IN THE PREVELANCE OF COASTAL FLOODS IN THE SOUTHERN TERREBONNE BASIN: CLIMATE CHANGE, SUBSIDENCE OR COASTAL CONSTRUCTION?

Alexander S. Kolker
Louisiana Universities Marine Consortium and Department of Earth and Environmental Science, Tulane University, USA

The return period for nuisance-level coastal flooding in southern Terrebonne Bay has shifted from less than 10 times per year in the early 2000s to approximately 50-75 times per year in 2016 and 2017. Such flooding, which often occurs in days without precipitation, is now effectively a weekly/fortnightly event. However, there is a seasonal cycle to these floods, with the greatest flooding occuring during spring and summer/early autumn. Spring flooding is generally associated with the approaching phase of a cold front that forces water onshore, whereas summer/early autumn flooding, while less frequent, is often associated with tropical cyclones. The potential causes of this decrease in the return period of floods include an acceleration in rates of global sea-level rise, continued subsidence, changes in regional wind forcings, and the construction of the Morganza-to-the-Gulf (MTG) levee system.

This talk will quantitatively examine the relative contributions of climatic, meteorological, geological, and infrastructure-driven drivers and their impact on flood return periods by examining data from ~ 50 long running water level gauges in the Terrebonne Basin and the Barataria Basin. Additional data will come from meteorological records, records of global sea-level change, and subsidence benchmarks. This data-rich and comparative approach helps tease out the impacts of the MTG system on flood return period, as it was constructed in Terrebonne during this time period and no major comparable system was constructed in Barataria during this time period. This work has potential implications coastwide, as global sea level rise is a pressing concern, and the impacts of accelerating of global sea level rise are only beginning to be fully understood. Furthermore, levee systems play an important role in Louisiana's Coastal Master Plan; and while their impacts on reducing flood risks inside the poldered region has received considerable attention, their impacts on flood risks and ecosystem impacts outside levee walls are less well understood.

Presenter Bio: Alexander S. Kolker is an Associate Professor at the Louisiana Universities Marine Consortium and teaches in the Department of Earth and Environmental Science at Tulane University. His research examines the physical, climatic, geological and anthropogenic processes that govern coastal systems.

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EVALUATING FUTURE SUCCESS OF A FRESHWATER RIVER RE-INTRODUCTION TO THE FLOODPLAIN FORESTS OF MAUREPAS SWAMP, LOUISIANA

***Ken W. Krauss**[1], Richard F. Keim[2], Gary P. Shaffer[3], Jim L. Chambers[2], William B. Wood[4], Honora Buras[5], Brad Miller[5], and Carol Parsons Richards[5]*

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Many hectares of swamp forest already have been lost within Louisiana's coastal zone over the last century, and numerous efforts have been launched to determine the causes of swamp forest loss with an eye toward amelioration of stressors and future sustainability of remaining habitat. Despite the need, few rehabilitation projects of any kind targeting this ecosystem have been implemented. However, re-introductions of fresh water from the Mississippi River are an important coastwide strategy outlined by *Louisiana's Comprehensive Master Plan for a Sustainable Coast*, and may be rather useful as a rehabilitation strategy for those coastal swamp forests that have not yet undergone massive conversion to marshes or open water. Therefore, the State of Louisiana Coastal Protection and Restoration Authority (CPRA) has made it a priority to establish a river re-introduction project into Maurepas Swamp, a deteriorating swamp forest in Southeast Louisiana. This is a small river re-introduction project with flow rates through the diversion structure in Garyville, Louisiana, of < 57 m^3/s (2000 ft^3/s); however, its operation will target swamp forest and transitional marsh area of approximately 166 km^2. The Mississippi River re-introduction project and outflow management features are expected to facilitate connectivity of water between the river and this entire project area at least seasonally, and begin a decades-long process to rehabilitate that ecosystem. To determine the effectiveness of the river re-introduction project, we established five a priori performance measures based upon our scientific understanding of how healthy coastal swamp forests function and what may be needed in the Maurepas Swamp to remain persistent through greater resiliency to stressors into the future. The performance measures quantify (1) a hydrologic regime consistent with swamp forest sustainability, (2) decrease in salinity intrusion, (3) acceptable rates of surface elevation gain, (4) increased forest structural integrity, and (5) facilitated nutrient uptake and retention throughout the Maurepas Swamp. Evaluating the results of operating this river re-introduction project will provide information about the feasibility of, and reasonable expectations for, future river re-introduction projects targeting other coastal swamp forests in Louisiana, and potentially throughout the southeastern United States.

<u>PRESENTER BIO</u>: Ken Krauss is a Research Ecologist with the U.S. Geological Survey in Louisiana. He conducts research on scaling eco-physiological and eco-hydrological processes in coastal forested wetlands, investigates rates and controls over wetland greenhouse gas emissions, and studies and measures sea-level rise vulnerability of coastal wetlands around the world.

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OLD DATA USED IN NEW WAYS: INDUSTRY-BASED SEISMIC DATA USED TO EVALUATE THE EFFECT OF CENOZOIC FAULTS ON HOLOCENE STRATA OF LAKES BORGNE AND PONTCHARTRAIN, LOUISIANA

***Mark A. Kulp**, and Joseph Frank*

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Regionally extensive faults that cut across Cenozoic-age strata comprise a major Cenozoic structural fabric of the north-central Gulf of Mexico and have been extensively mapped in the hydrocarbon industry using deep seismic imaging and borehole data. Despite the fact that the location and history of motion along these coast-parallel faults is well known among members of the hydrocarbon industry, the exact location of these faults and whether they have affected Holocene strata of the Mississippi River delta plain has remained uncertain to the public because of the proprietary nature of the seismic data. Recently, hydrocarbon-industry seismic data donations have allowed Louisiana universities to perform more detailed mapping of deep-seated (>1 km depth), long lived (>1 My), fault trends across portions of the delta plain than has been previously possible by academia. These data provide an invaluable opportunity to examine whether Holocene stratigraphic relationships and modern morphological changes of the delta plain are a product of subsidence generated by slip along these faults, a significant question in the midst of major plans to locally restore degraded marsh and renourish barrier shorelines of the Mississippi River delta plain. In 2016 the oil industry provided two 3-D seismic surveys covering 860 km^2 of Lake Borgne and a 2-D seismic survey covering all of Lake Pontchartrain to the University of New Orleans. These data sets are located along an eastern portion of the Baton Rouge Fault system, a well-known active system of en echelon, down-to-the-south normal faults that frame the northern periphery of the Mississippi River delta plain. Several major faults (> 6 km-long fault trace) are imaged within the seismic surveys and extend from Lake Borgne across the New Orleans land bridge and into Lake Pontchartrain. Unfortunately, these seismic data were not originally processed for reliable imaging of strata or structures at depths less than approximately 500 m below the surface. To bridge the gap between the shallow subsurface and uppermost reliable limit of the industry seismic data, a shallow high-resolution seismic dataset was acquired in areas where faults at depth have been projected upward to intercept the modern delta plain surface and lake bottoms. Integration of high-resolution, shallow seismic data with the lower-resolution, deeper industry seismic data is fundamental to evaluating whether these faults are recently active (Holocene) and if they are strike aligned to nearby, linear wetland loss patterns evident within the marsh of the New Orleans land bridge.

PRESENTER BIO: Mark A. Kulp is interested in the stratigraphy, structure, and geomorphology of the northern Gulf of Mexico. His primary focus has been the sedimentary framework of the Louisiana coastal zone and the effects of sediment supply, relative sea-level rise, and storms on the coastal stratigraphy and geomorphology.

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VEGETATIVE PROPAGATION, S-RNASE SEQUENCING, AND MORPHOLOGICAL PROFILING OF *LYCIUM CAROLINIANUM* POPULATIONS IN COASTAL LOUISIANA

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The flowering shrub *Lycium carolinianum*, or creeping wolfberry, has the widest geographical distribution of any species in the genus *Lycium*. *Lycium* is one of the largest genera in the important family *Solanaceae*. From the Yucatan Peninsula to the Atlantic Coast of Florida, wild *L. carolinianum* populations provide essential food and habitat for local and migratory wildlife, including the endangered whooping crane, Grus *americana*. As a native, fruit-bearing shrub that is salt-, drought- and flood-tolerant, *L carolinianum* is suitable for inclusion in wetland bird management, coastal restoration plantings, landscape design, and more. For example, investigations on Asian *Lycium* species have indicated that *Lycium* berries possess high antioxidant and polysaccharide concentrations, which has encouraged further agricultural and medicinal research. Despite its diverse potential, limited research has been conducted on *L. carolinianum*, with no documented investigations to date into methods for establishing nursery stock. To address this, our research compares vegetative propagation methods and fruit and seed morphology of *L. carolinianum* plant material from six locations in coastal Louisiana (two sites in Cocodrie, one site in Dulac, two sites in Port Fourchon, and one site on Queen Bess Island). Additionally, we are isolating stylar mRNA from individual plants at each sampling location, genotyping the S-RNase locus to assess self-incompatibility (SI), and comparing SI profiles of Louisiana *L. carolinianum* populations to coastal populations from Texas and Florida. Preliminary results of greenhouse propagation trials indicate that Queen Bess *L. carolinianum* produced more growth, measured as number of leaves per individual, compared to other sites ($p = 0.0008$); hardwood cuttings produced more new growth than softwood cuttings ($p = 0.0001$), corroborating established fall/winter vegetative propagation methods for other shrub species; and the use of Hormodin 2 (IBA 00.3%, OHP, Inc., Bluffton, SC) did not affect *L. carolinianum* plant growth ($p = 0.5947$). This research can advance the inclusion of *L. carolinianum* in Louisiana wildlife management, horticulture, and food science by documenting mating types, propagation methods, and seed and berry characteristics.

PRESENTER BIO: Kellyn LaCour-Conant is a Masters student in Marine and Environmental Biology at Nicholls State University. She received bachelor's degrees in Biology and Russian from Amherst College, is an AmeriCorps alumna, and has worked with governmental and non-profit agencies for several years advancing ecological restoration. She is from Houston, TX.

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COMPARING PROTOCOLS FOR SPATIO-TEMPORAL CHARACTERIZATION OF VEGETATION USING UNMANNED AERIAL SYSTEMS ON TRINITY ISLAND, LA

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One of the primary elements of natural coastal protection are our Louisiana barrier islands, yet we are losing substantial components of these geologic features at an alarming rate. For example in 2017, large sections of West Raccoon Island, and the western spit of Trinity Island both became subtidal. This project concentrated on developing new methods to monitor the restoration, maintenance, and sustainability of Louisiana's barrier islands by using small unmanned aerial systems (sUAS) to collect image data. Here we report our results from using a lightweight fixed-wing rover in 30 minute flights that allowed us to obtain over 2,000 high resolution images in true color and near infrared frequencies of a section of Trinity Island in Fall 2015, Winter 2016, and Spring 2017. The imagery was stitched together to create an orthomosaic of the study area with uniform scale and a Digital Surface Models (DSM) depicting island elevations. These preliminary products were used to further classify target vegetation species based on pixels as well as groups of similar pixels (objects). We also compared images collected from satellite and sUAS for their ability to provide resolution of vegetative species. Image classification was then performed utilizing three different techniques to examine their merits in extracting cover classes from the sUAS imagery. Unsupervised classification was quick and efficient at extracting non-vegetation classes from the environment. With only vegetation classes remaining, maximum likelihood and object-based techniques were used to classify vegetation including Black mangrove *Avicennia germinans*, Smooth cordgrass *Spartina alterniflora,* and Marshhay cordgrass *S. patens*. We found that *A. germinans* was the dominant vegetation class, accounting for 27.09% of the study area at 11.47 hectares (ha). The next most abundant vegetation class was *S. alterniflora* at 16.60% of the study area at 7.03 ha. Both species were primarily located at the back barrier marsh landscape. The third most abundant species was *S. patens*, with a coverage of 7.98% at 3.38 ha, occurring primarily at the southern dune swale portion of the study area. Object-based classification resulted in the highest overall classification accuracy for the Winter (75.68%, Kappa 0.70) and Spring datasets (69.35%, Kappa 0.63), while maximum likelihood resulted in the highest overall classification accuracy for the Fall dataset (74.32%, Kappa 0.68).

Since traditional sources of remotely sensed imagery like satellites typically have a revisit time of 16 days, these methods may be inadequate to assess the damage done to a barrier island immediately following an event such as a hurricane or oil spill. We propose that small unmanned aerial systems will continue to increase in their effectiveness as on-demand, small-scale, high resolution monitoring tools for coastal studies. Based on our results, smaller, less apparent vegetation species are difficult to extract from small unmanned aerial system imagery, but major vegetation types such as Black mangrove and Smooth cordgrass can be extracted at a high resolution and an acceptable degree of accuracy.

PRESTENTER BIO: LaFleur has conducted biological research along Atlantic coasts ranging from Veracruz, Mexico to Cape Ann, MA. Since 1998 he has been based at Nicholls State University, where he serves as the executive director of the Center for Bayou Studies, with work that concentrates on processes within the Barataria-Terrebonne Estuary System.

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CONNECTING THE YOUTH TO COASTAL RESTORATION

Duyen Lam
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An important issue in coastal restoration is "how do we get people to care and be invested long term?" More importantly, how do we get the youth to be engaged beyond rehabilitation volunteering services?

Through long term reflection of myself as a college student and interactions with other students throughout my time with Coalition to Restore Coastal Louisiana (CRCL) and Volunteer LSU (VLSU), the answer became clear. We must build a stronger connection with students and current members of CRCL.

I believe the low youth retention to be because of the lack of knowledge on the seriousness of coastal land loss. For the youth to be invested long term, it must be made clear to them how the changes that are currently happening will affect them in their daily life and what our future goals for the fight are. How do we get students to listen? As a student, I find that it is crucial to expand our networks to find opportunities that will help us grow in our career path. If the Coastal Warrior community creates more environments for students to come and connect with current members about their work in coastal restoration, it will provide opportunities for the student to not only be educated on coastal issues, but also to expand their networks. In addition, the community should find it important to demonstrate in their work and livelihood that coastal restoration is a cause that they value. The combination of an increase in day to day activism from current members as well as opportunities for students to connect would provide a solid platform for youth involvement. The relationship between students and current members will grow with their growth in passion for coastal land loss efforts. This shared bond, as well as a broader understanding of coastal issues will in result increase youth involvement and retention beyond service projects.

PRESENTER BIO: Duyen Lam is a senior at Louisiana State University majoring in Environmental Engineering. She has three years of experience in planning and managing volunteering services for students in the surrounding communities. She has also been working with CRCL for two years in advocating for youth involvement in coastal restoration efforts.

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USING META-ANALYSIS TO UNDERSTAND RECOVERY OF VEGETATION AND SOILS IN RESTORED WETLANDS IN THE NORTHERN GULF OF MEXICO

*Allison Ebbets[1], **Diana Lane**[1], Philip Dixon[2], Terill Hollweg[1], Mary Husienga[3], and Jessica Gurevitch[4]*

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The extent to which ecological structure and function of restored coastal wetlands in the northern Gulf of Mexico recover to conditions in reference (i.e., natural) wetlands has not been synthesized across the literature, but such a characterization would inform future restoration design and monitoring. We conducted a systematic literature review and meta-analysis to evaluate whether vegetation and soil parameters at restored sites recover to levels found at paired reference sites. We then used this information to estimate a recovery time for restored wetlands. We identified 631 candidate publications; of these, 25 studies at restored coastal wetland sites in the Gulf of Mexico – including 18 studies from Louisiana - were suitable for quantitative meta-analysis of vegetation and soil recovery, using paired comparisons of reference and restored sites. The studies included in the meta-analysis focused on fresh, brackish, and saline coastal wetlands that were restored through techniques of either marsh creation using dredged material or the addition of a sediment layer to existing marsh ("thin layer restoration"). Restored sites ranged from < 1 to 30+ years old.

Belowground parameters (root biomass and soil organic matter) recovered more slowly than aboveground parameters (percent vegetation cover, aboveground biomass) and we observed a high degree of variability in the data. Mean recovery trajectories for belowground biomass and productivity, vegetation cover, and soil parameters indicated that mean values for restored sites reached reference site conditions within 30 years following restoration. On average, belowground parameters were 44% to 92% lower at restored sites < 15 years old compared to reference sites. Percent vegetation cover was 50% lower at restored sites compared to reference sites over the first five years of restoration; in contrast, aboveground biomass was 25% higher at restored sites compared to reference sites. We also evaluated recovery using the 20th percentile of site data, which we suggest is a more protective choice from a public policy perspective. This percentile analysis suggests slower and less complete recovery than the recovery curve based on mean values. Evaluation of the rate of recovery following restoration depended on which response group was measured; deciding which response group(s) to monitor will have a strong influence on the evaluation of project success.

PRESENTER BIO: Dr. Lane is a restoration ecologist with over 17 years of experience planning, monitoring, and evaluating ecological restoration projects. She has worked extensively for government clients on restoration planning in the Gulf of Mexico associated with the *Deepwater Horizon* oil spill.

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LOUISIANA’S RESPONSE TO EXTREME WEATHER

Shirley Laska
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Louisiana’s Response to Extreme Weather: A Test Case for Coastal Resilience (Springer, forthcoming mid 2018). The poster will reflect the adaptation challenges experienced by Louisiana residents, community and state leaders, the responses which have ensued and the integrated policy recommendations that have emerged from the state’s extreme weather experiences. Twenty scholars from Louisiana universities (LSU, Tulane, Loyola) and other U.S. universities (including M.I.T., Temple, Berkeley) and organizations such as the Nat. Academies of Science, the Water Inst. of La., the Stephenson Disaster Management Inst. as well as the Lowlander Center. Eight disciplines are represented (see above) and eight junior researchers. The concluding chapter describes how each chapter draft was reviewed by a scholar/practitioner from a different specialty/discipline that the authors hope to successfully communicate with, so that the chapters are better able to be accessible in a transdisciplinary way.

Chapter authors present at the SOC2018 to discuss the poster will describe their research, their findings, their policy recommendations, the outcome of the transdisciplinary review process and the integrated policy recommendations that stem from Louisiana’s experiences. The poster session will emphasize the adaptation policy recommendations from each chapter that are integrated into one document by all of the authors in the last chapter to again seek transdisciplinary benefits that emerged from the efforts.

The themes of the researchers’ work are:

-What states, especially coastal, can benefit from Louisiana’s extreme weather experiences because of common characteristics and likely similar experiences in the future that will expose them to the same challenges?

-How do small, coastal communities experience enhanced extreme weather and especially flooding – both inland rural and coastal rural?

-How can post-disaster development avoid deep social justice challenges?

-What is a path to restoring rental housing after a disaster – urban (embedded in gentrification dynamics) and suburban (with such strong recovery emphasis on owned homes)?

-When does professional assistance harm rather than help community recovery (“green dots”)?

-How to frame climate change strategies in critical and generalizable approaches?

-What is a useful approach to assessing coastal restoration in Louisiana?

-What are the challenges of resettling coastal residents and preparing receiving communities?

PRESENTER BIO: Dr. Laska is Professor Emerita of Sociology, University of New Orleans and Co-Founder of the Lowlander Center (lowlandercenter.org). She has undertaken several decades of environmental/community sociological research and application, often with collaborators from bio/physical and engineering disciplines.

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INVESTINGATING THE INFLUENCE OF RESTORATION PRACTICES ON PELICAN USE OF COASTAL ISLANDS

***Paul Leberg*[1]**, *Brock Geary*[2], *and Jordan Karubian*[2]

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There is a limited understanding of the efficacy of the most common coastal restoration approaches in providing seabird habitat. Restoration can fail to provide high quality habitat due to unforeseen effects on bird behavior, vegetation succession and predator communities. Models used in coastal planning assume that wildlife will use restored habitats in the same way they use natural habitats, however this assumption is generally untested. Furthermore, although management of potential nesting habitat is often focused on the site itself, seabirds depend on the linkages between terrestrial and marine habitats. Creating nesting habitat far from foraging areas or near sources of mammalian predators may result in restoration failing to provide suitable habitat or creating an ecological sink. In light of the threats coastal Louisiana faces, as well as the region's importance for seabirds, it is critical to resolve a suite of questions about the impacts of restoration. These include: how do seabirds respond to a shifting mosaic of available islands with changing vegetation and predator communities, how far do they travel to provision nestlings, and what is the extent to which birds move between breeding and foraging areas in our dynamic coastal landscape? Leveraging the opportunities provided by numerous restoration efforts in coastal Louisiana, we are investigating the degree to which outcomes were due to the restoration, the location of the restoration in relation to marine and wetland resources, or the level of predation threat.

Louisiana's coastal islands support significant proportions of the U.S. nesting populations of several seabirds, including the Eastern brown pelican (*Pelecanus occidentalis carolinensis*), a species of special concern in the state. Pelicans are among the top predators in coastal ecosystems and thus their wellbeing has implications for lower trophic levels. As pelicans are among the earliest nesters in nesting colonies, they indicate suitability of islands for the use by other seabirds. A better understanding of the specific impacts of restoration on pelicans would benefit coastal management overall.

We are using satellite and aerial imagery for nesting sites, as well as unused islands to quantify the changes in the spatial extent of habitats. Comparing restoration projects of different ages, and, to reference sites, we are assessing how time since restoration action affects avian habitat use. Cameras and spotting scope surveys are used to monitor nests to determine nest success, the causes of nest failure, and the abundance of nest predators. We will assess the importance of age of restoration activity, elevation, habitat size and location, vegetation succession and predation pressure on pelican nesting. The role of island location on nest success, movement and habitat use is being characterized using satellite-based tracking of breeding adult pelicans. This information will be related to physiological condition, foraging ecology, breeding success, and survival. Telemetry data will be used to quantify foraging ecology (frequency, distance, and duration of foraging trips) and parental care (trips to their nests coupled with direct observations of food delivery to nestlings per visit). This research will provide information on how pre-existing island characteristics in combination with restoration activities impact wellbeing of a representative colonial and the results will contribute to better outcomes of future restoration efforts across the coast.

<u>PRESENTER BIO:</u> Paul Leberg, is a professor of biology with more than 20 years of experience studying bird populations in coastal Louisiana, and has been studying the ecology of pelicans on coastal islands since 2007.

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EVALUATION OF SHOREBIRD NESTING HABITAT ENHANCEMENT USING HARD SUBSTRATE (CAMINADA HEADLAND RESTORATION PROJECT - BA-45)

***Delaina LeBlanc*[1]*, Richard DeMay*[1]*, Paul Leberg*[2]*, Darin Lee*[3] *and Emily Clark*[1]

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In 2013, the Coastal Protection and Restoration Authority (CPRA) initiated *The Caminada Headland Beach and Dune Restoration Project (BA-45)*, to provide protection to communities inland as well as habitat for beach nesting birds including Wilson's Plover and Least Tern. By dredging and pumping sand from an offshore borrow site, over 300 acres of beach and dune habitat was constructed. Even with available habitat, beach-nesting birds still face numerous challenges, including flooding, predation and disturbance; all of which are causes of nest failure for these species.

This project was designed to evaluate nest site selection among substrate types and hatching success for Least Tern and Wilson's Plover by supplementing the restored beach with a veneer of limestone or sandstone. It is thought that pure sand habitats are more prone to predation because of ease of nest location by predators. Hard substrate additions are used in this study to obscure or help camouflage shorebird nests therefore increasing the probability of hatching. Nine experimental plots, each approximately 45,000 sq. ft. were established in a 3x3 randomized block design along the dune crest. Plots were monitored during the 2016 nesting season pre-application and again in the 2017 season post-treatment. Nest searches were conducted and nests were monitored to determine nest fate along with environmental variables at the site.

Presentation of statistical analysis will determine any significant differences in the selection of nesting substrate and nest fate by substrate type. Results will guide best management practices to determine the applicability of these nest enhancement materials to future beach restoration projects for beach-nesting birds on the Louisiana coast.

PRESENTER BIO: Delaina LeBlanc serves the Barataria-Terrebonne National Estuary Program (BTNEP) as the Migratory Birds Coordinator. Delaina has worked with the program since 2007 conducting coastal bird research that serves in the protection of habitat for migratory and resident birds. She earned her MFA from Florida State University.

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THINKING OUTSIDE OF THE FUTURE BOX: SEDIMENT DIVERSION OPERATIONS, MONITORING, AND ADAPTIVE MANAGEMENT

Brian J. Lezina *and* ***Joseph W. LeBlanc***
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Sediment diversions are a keystone component of Louisiana’s plan to achieve a sustainable coast. As such, these projects are designed with the intent to accrue significant benefits over a large area, for the duration of these very long-lived projects. Given the potential for ecosystem-level responses, project-specific monitoring and adaptive management will play a vital role in informing the operation of the project to achieve project success. With projects of such scope and longevity, the design of the operations, monitoring, and adaptive strategy for these projects must not only account for immediate project needs (i.e. real-time monitoring over various spatial scales) but also consider the data needed to make future decisions, potentially decades in the future, based on trends over time and plans implemented at the initiation of the project.

Using the Mid-Barataria Sediment Diversion as example we will discuss these considerations when designing the operations, monitoring, and adaptive management plan for a large-scale sediment diversion. We will show how initial planned operations may play a key role in determining later-term ability to adaptively manage the project as well as monitoring considerations to ensure we are measuring for project success. A discussion concerning the role and specific challenges of adaptive management will then close the link between monitoring and operations.

PRESENTER BIO: Brian Lezina serves as the Assistant Administrator of the Planning and Research Division for CPRA. Brian’s experience spans 20 years in coastal wetland and estuarine ecology, restoration planning and regulation, and natural resources management within state government and academic sectors.

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IDENTIFICATION OF CARBON AND NITROGEN HOT SPOTS IN FOURLEAGUE BAY ALONG A SALINITY AND SEDIMENT GRADIENT

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Fourleague Bay is a coastal estuary southeast of the Atchafalaya Delta and receives sediment from the Atchafalaya River. As part of one of the few growing deltaic sites in Louisiana, it can be used to better understand the feasibility of mitigation projects for coastal land loss and resource deprivation through analysis of sediment dynamics. Sediment cores of 50 cm were taken from five marsh sites (FLM 1-5) and five bay sites (FLB 1-5) in Fourleague Bay using push corers to minimize sediment compaction. The sites occur along the direction of river discharge, thus forming a salinity and sediment availability gradient. Identifying carbon deposits quantifies organic contribution, which is an indicator of sediment productivity in the area, thus allowing for comparison throughout sites and with other coastal ecosystems. Cores were divided into 2 cm segments and analyzed for total carbon and total nitrogen through elemental combustion, and total phosphorus through atomic absorption to identify regions of greater carbon, nitrogen, and phosphorus accumulation or hot spots. There was a significant difference in total nitrogen in the top 10 cm of sediment between the bay (M=0.14, SD=0.04) and marsh (M=0.54, SD=0.16) sites; $t(16.07)=-10.11$, $p<0.001$. A significant difference was also observed in total carbon in the top 10 cm of sediment between bay (M=1.73, SD=0.43) and marsh (M=8.80, SD=2.44) sites; $t(15.61)=-11.49$, $p<0.001$. Further analysis using stoichiometric ratios is still in progress to identify clear trends along the gradients. Using accretion rates, carbon storage will also be estimated in marsh and bay sites. Trends will then be analyzed alongside environmental data to assist in the identification of qualities that facilitate hot spots of carbon and nutrient storage in the active coastal delta. Future research will ultimately include a comparison of these variables at Terrebonne Bay, a sediment starved region in coastal Louisiana. It's important to compare these two systems as the differences between them highlight changes that can occur when sediment supply is removed from coastal marshes.

PRESENTER BIO: Madeline LeBlanc is an LSU Coastal and Environmental Science undergraduate with a minor in Chemistry and is currently completing her honors thesis in the Coastal Systems Ecology Lab. She also has experience in Environmental Chemistry research at LSU and the Universite Joseph Fourier, and is a Udall and LASAL scholar.

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OVERVIEW OF COASTAL PROTECTION AND RESTORATION IN THE ATCHAFALAYA AND TECHE/VERMILION BASINS, LOUISIANA

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Louisiana's coast is a precious natural, economic, and cultural resource (CPRA, 2017 Master Plan). The mission of protecting and restoring the diversity of coastal habitats is challenging, and Louisiana's 2017 Coastal Master Plan provides a means to respond by outlining major strategies and by directing available resources into prioritized projects. While there are many common reasons for land loss across coastal basins, implementation of projects within coastal basins can vary depending on basin-specific attributes such as habitat type, hydrology, availability of natural resources (e.g. sediment resources) or major landscape features (e.g., the Atchafalaya River). Project implementation and sequencing within basin may be also influenced by the availability of funding, as well as regulations tied to each funding source. Funding sources such as RESTORE, NFWF, GOMESA and CWPPRA all have a vested interest in Louisiana's coast and have specific projects prioritized in the Atchafalaya and Teche/Vermilion Basins.

Louisiana's Atchafalaya and Tech/Vermilion coastal basins are located in central part of the Louisiana's coastal zone. The Atchafalaya Basin is located west of the Terrebonne Basin and encompasses wetlands in St. Mary Parish. The Atchafalaya Basin is the nation's largest river swamp, containing almost one million acres of America's most significant bottomland hardwoods, swamps, bayous, and backwater lakes (Atchafalaya National Heritage Area, 2017). The Teche/Vermilion Basin extends westward from the Atchafalaya through East and West Cote Blanche Bays, and includes Marsh Island and Vermilion Bay. The Tech/Vermilion Basin contains roughly 243,000 acres of wetlands in Vermilion, Iberia, and St. Mary Parishes (CWPPRA, 2017).

Louisiana's Atchafalaya and Tech/Vermilion coastal basins are unique among the Louisiana coastal basins as they are relatively geologically stable as they benefit from the Atchafalaya River delta. However, geomorphologic and hydrologic conditions have been altered by the dredging of navigation and petroleum access canals and the construction of spoil banks and levees. The effects of these alterations vary greatly from place to place, but generally they have created artificial barriers between wetlands and wetland maintenance processes, or removed natural barriers between wetlands and wetland decay processes (CWPPRA, 2017). Additionally, Sea Level Rise and shoreline erosion continue to impact these basins. These basins are in need of restoration and protection for environmental habitats and its coastal communities and both have some unique challenges to project implementation.

This presentation will provide an overview of the Master Plan restoration and protection strategies for the Atchafalaya and Tech/Vermilion coastal basins. Additionally, on-the ground progress will be highlighted with overviews of constructed projects and examples of newly funded projects in each basin.

PRESENTER BIO: Glenn Ledet, Jr. is the Assistant Administrator of CPRA's Operations Division and is currently responsible for the oversight and administration of CRPA's Regional Offices in Thibodaux, Lafayette and New Orleans. Mr. Ledet holds B.S. in Civil and Environmental Engineering from Louisiana State University and is also a licensed Professional Civil Engineer in Louisiana. Mr. Ledet has worked in coastal protection and restoration for over 10 years including planning, permitting, designing, and implementing environmental restoration and flood protection projects throughout coastal Louisiana.

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RESTORATION OF LOUISIANA'S BARRIER SHORELINES: APPLICATION OF SOFT AND HARD COASTAL PROTECTION APPROACHES

*Organizer - **Glenn Ledet, Jr.**, P.E., Asst. Administrator of Operations Division*
Co-organizer - Syed Kahlil, Geologist Asst. Administrator
Coastal Protection and Restoration Authority of Louisiana, Baton Rouge, LA, USA

Panel Session Description:
The barrier islands and headlands found along Louisiana's coastlines are extremely dynamic and provide substantial challenges during the design and implementation of restoration projects – specifically with regard to the use and engineering of hard structure protection methods. This dynamic environment requires coastal scientists and engineers to carefully consider many factors when evaluating the use and design of hard structures.

This panel will serve as a platform for coastal engineers, scientists and geologists to discuss the use and application of both soft and hard coastal protection methods on Louisiana's barrier shoreline. This discussion will include past use and associated lessons learned, potential future uses, and the required engineering and geological analyses to be performed prior to implementation of soft and hard structural protection measures.

LIST OF PROPOSED PANELISTS:
Josh Carter, P.E.
Principal Engineer
Mott MacDonald

Michael Poff, P.E.
President
Coastal Engineering Consultants, Inc.

Mark Byrnes, Ph.D.
Senior Coastal Scientist and Principal
Applied Coastal Research and Engineering

Tom Campbell, P.E.
Former President of Coastal Planning and Engineering (CP&E)
Retired

SESSION ORGANIZER BIO: Glenn Ledet, Jr. is the Assistant Administrator of CPRA's Operations Division and is currently responsible for the oversight and administration of CRPA's Regional Offices in Thibodaux, Lafayette and New Orleans. Mr. Ledet holds B.S. in Civil and Environmental Engineering from Louisiana State University and is also a licensed Professional Civil Engineer in Louisiana. Mr. Ledet has worked in coastal restoration for over 10 years including the planning, permitting, designing, and construction of environmental restoration and flood mitigation projects throughout coastal Louisiana.

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LESSONS LEARNED FROM TWO DECADES OF BARRIER ISLAND RESTORATION IN LOUISIANA

Darin M. Lee
Louisiana Coastal Protection and Restoration Authority, Thibodaux, LA, USA

Louisiana's Gulf shoreline is rapidly eroding and barrier shoreline projects aimed at maintaining ecosystem functions have been an early and integral part of the States restoration efforts. CPRA thru various funding sources, and with numerous cooperators, have been using various techniques to maintain and enhance the States barrier shorelines. Techniques such as the addition of sediments, the use of sand fencing, planting of vegetation, and installation of hard structures have all been utilized along the gulf shoreline. Implementing and monitoring various projects have provided unique challenges which have allowed the State to observe all aspects of shoreline management and to apply lessons learned in adaptively managing our barrier shoreline maintenance actions.

While initial efforts were small and focused on managing sediments already in place with fencing and plantings, efforts quickly moved to focus on sediment additions. Current projects have increased in the scale of sediment being added and have brought new challenges in finding sediment sources, construction durations, and costs.

This presentation will provide an overview of adaptive management in CPRA's barrier shoreline projects thru time. Some lessons learned during planning, designing, constructing, maintaining, and monitoring of various barrier shoreline efforts will be discussed and tied to future CPRA barrier shoreline efforts. How these lessons from all phases of a project have allowed CPRA to evolve from a project to a program perspective and begin to develop a comprehensive approach to future barrier shoreline maintenance will be provided.

PRESENTER BIO: Mr. Lee is a Coastal Resource Scientist with more than 25 years of experience planning, designing, and implementing wetlands restoration projects in LA. He is currently CO-LEAD of CPRA's Barrier Island Comprehensive Monitoring Program (BICM).

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MIDDLE MIOCENE THROUGH PRESENT FAULT HISTORY OF THE DELACROIX ISLAND FAULT SYSTEM

***Jarrett L. Levesh*[1]**, *Chris Mclindon*[2], *and Mark Kulp*[1]
[1]University of New Orleans, New Orleans, La, USA
[2]Upstream Exploration LLC, Metairie, La, USA

An in-depth study of the Delacroix Island producing field illustrates the evolution of the main east-west trending Delacroix Island fault during the last 13 million years and its effect on Holocene geomorphology. Well log correlation and 3-D seismic interpretation of 23 subsurface bio-stratigraphic horizons across the fault reveal a range of stratigraphic thicknesses, evident with a cross section, created with wells upthrown and downthrown to the fault. Wells across the fault, with well-log curve data to as shallow as 31m below the surface, were used to calculate interval thicknesses between the bio-stratigraphic markers. Isopach maps, created with these bio-stratigraphic interval thicknesses, indicate two styles of interval thickening and differential subsidence across the fault. Plots of interval thickness against depth and time as well as plots of sediment accumulation and depth versus displacement were created to assess the history of fault motion.

A lineation on the modern marsh surface coincident with the surface projected fault plane suggests fault movement during the Holocene. Historic satellite imagery (last ~ 60 years) of the field depicts continuous wetland loss on the downthrown side of the surface fault trace, suggesting that recent and continued fault movement may be contributing to marsh submergence.

Presenter Bio: Jarrett Levesh is a M.S. Candidate at the University of New Orleans and originally hails from Branford, Connecticut. Prior to enrollment at UNO he earned his B.S. in geology from Juniata College in Huntingdon, Pennsylvania. At UNO his M.S. thesis is focused on using well logs to assess the effects of fault movement on Holocene geomorphology.

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INTERACTIONS BETWEEN GROUNDWATER AND MISSISSIPPI RIVER IN THE MISSISSIPPI RIVER DELTA PLAIN

An Li *and Frank T.-C. Tsai*
Louisiana State University, Baton Rouge, LA, USA

The Mississippi River Delta Plain (MRDP) is one of the largest delta plains in the world and is social-economically imperative to Louisiana and the U.S. However, the MRDP has been suffering from a high rate of land loss due to the combination of sea level rise and land subsidence. While a large number of studies focus on surface water and river diversion for coastal protection and restoration, the role of groundwater is often neglected. Groundwater contributes an important part of water cycle to the Mississippi River as well as the wetland ecosystem in the MRDP. This study conducts numerical modeling of subsurface stratigraphy and groundwater flow, aiming to evaluate interactions between groundwater and the Mississippi River and to analyze the role of groundwater to land loss in the MRDP. Under fluvial, deltaic and coastal influences, the MRDP has a complex subsurface geology, which results in complex interconnectivities between the Mississippi River and the delta plain. This study utilizes existing geotechnical boring data in the plain from various agencies such as the USGS, the USACE, LDNR, CPRA, etc. and multiple indicator kriging to construct a three-dimensional subsurface stratigraphy model. The study area extends from Jesuits Bend to Head of Passes along the Mississippi River. The stratigraphy model is able to reveal spatial distribution of different soil types such as organic soils, clays, silts and sands. Meanwhile, the stratigraphy model is able to locate buried paleo-channels that connect the Mississippi River with the delta plain. A groundwater flow model is being built upon the stratigraphy model by adding parameters, such as hydraulic conductivity, specific storage, river conductance, surficial recharging rate, etc. The groundwater flow model will be used to evaluate interactions between groundwater and river water and to analyze how pore water pressure dissipates from the river to marshes.

Presenter Bio: An Li, a 4th year PhD student under supervision of Dr. Frank T.-C. Tsai, studies at the Department of Civil and Environmental Engineering at Louisiana State University. His research includes: modeling subsurface stratigraphy in the coastal area using boring, CPTs and geostatistics; and modeling groundwater flow and consolidation in the coastal plain.

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HYDRODYNAMICS AND SEDIMENT DYNAMICS IN BRETON SOUND OF LOUISIANA AND THEIR INTERACTION WITH SEDIMENT DIVERSION

***Guandong Li*[1]**, *Kehui Xu*[1,2], *Samuel Bentley* [2,3], *John Day*[1], *Yanxia Ma*[2,3], *and Zuo Xue*[1,2]
[1]Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, USA
[2]Coastal Studies Institute, Louisiana State University, Baton Rouge, LA, USA
[3]Department of Geology and Geophysics, Louisiana State University, Baton Rouge, LA, USA

Probably the most important parameter related to sediment diversion in Louisiana is the sediment retention rate, i.e., the fraction of sediment retained in the deltaic plain to actually build land. Mud and sand represent >80% and <20% of sediment load in the Mississippi/Atchafalaya Rivers, respectively, so the loss of mud represents a substantial issue in the land-building process. The mechanism of sand transport in aquatic systems is relatively widely understood. Muddy sediment dynamics, however, is much more complicated and has widely been recognized to be controlled by multiple nonlinear processes. Our study focuses on hydrodynamics and sediment dynamics of Breton Sound of Louisiana, which will be used as a receiving basin for a large sediment diversion in the near future.

Both historical and newly collected data are used in this study. Historical data of temperature, salinity, turbidity and others are used to study the spatial response of Breton Sound to multiple driving forces like river, winds, tides and waves. New data are collected using two instrumented tripods, on which multiple types of optical and acoustic sensors are deployed, including wave gauges, Optical Backscatter Sensor (OBS), Acoustic backscatter Sensor (ABS), Acoustic Doppler Velocimeter (ADV), and Pulse-Coherent Acoustic Doppler Profiler (PC-ADP). Our preliminary results show that wind-driven waves play a key role in sediment resuspension in shallow waters whereas tides and currents are important in driving sediment transport in Breton Sound. The long-term goals of this study are to validate a 3-D numerical sediment transport model using newly-collected data and to use this model to calculate sediment transport directions and fluxes. The findings of this project will eventually help calculate the estimated sediment retention rate in Breton Sound, provide direct suggestions on diversion operation size, timing and duration, and help the development of optimal diversion strategies of coastal Louisiana.

PRESENTER BIO: Mr. Guandong Li is a M.S. student at Louisiana State University. He is interested in coastal processes, sediment transport and geomorphology. More specifically, his work focuses on hydrodynamic and sediment dynamic in Breton Sound of Louisiana and their interaction with sediment diversion. He also has 4-year experience in marine surveying.

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INCORPORATING *GEUKENSIA GRANOSISSIMA* INTO LIVING SHORELINE RESTORATION IN *SPARTINA ALTERNIFLORA* DOMINATED LOUISIANA SALT MARSHES

***Jordan Logarbo*[1]**, *Ashley McDonald[2], Katie Ebinger[3], Ariella Chelsky[1], Anthony Rietl[1],and Brian J Roberts[1]*
[1]Louisiana Universities Marine Consortium (LUMCON), Chauvin, LA, USA
[2]Eckerd College, St. Petersburg, FL, USA
[3]University of Colorado, Boulder, CO, USA

Coastal wetlands provide many services including storm protection, nutrient cycling, fisheries production, and long-term carbon storage but are being lost as a result of multiple natural and anthropogenic stressors. Ecosystem engineers modify, maintain, and create habitats by modulating the availability of resources to other species, thereby exerting a large influence over local abiotic conditions. In Louisiana saltmarshes, the marsh cordgrass *Spartina alterniflora* and the gulf ribbed mussel *Geukensia granosissima* are coexisting ecosystem engineers that may form a mutualistic relationship that could enhance marsh stability and enhance living shoreline restoration efforts. We will describe two phases of a project evaluating the viability of incorporating *G. granosissima* into Louisiana living shoreline restoration projects.

We examined the impact of *G. granosissima* density and biomass on *S. alterniflora* above- and belowground biomass and stoichiometry, soil nutrient and carbon pools, and potential nitrification and denitrification (denitrification enzyme assay) rates for ten 0.25m x 0.25m x 10cm deep plots along a ~150m stretch of marsh edge at Sister Lake, LA to have a broad range in density and biomass (12-fold and 43-fold, respectively). *S. alterniflora* root biomass, % live roots, and root % N content all increased with mussel density and biomass. Both aboveground, belowground N pools and therefore total plant N pool also increased with *G. granosissima* density and biomass. Neither nitrification nor denitrification potentials were correlated with mussel density/biomass but nitrification increased with soil redox and DEA with soil N content. These results are consistent with *G. granosissima* potentially increasing the overall available nitrogen pool in marsh soils and ultimately leading to increases in total, and particularly, belowground, *S. alterniflora* biomass and N content.

We also describe an experiment that we started this year in which we have manipulated the density of ribbed mussels along Sister Lake's shoreline so that plots have had mussels removed, retained ambient densities or had densities increased. We are evaluating *S. alterniflora* biomass, primary production and nutrient stocks, soil and pore water nutrient concentrations and nitrogen cycling rates, soil accretion rates, and sediment strength in experimental plots over two growing seasons. These two combined efforts will provide critical insight on the viability of incorporating *G. granosissima* into living shoreline projects.

PRESENTER BIO: Jordan Logarbo earned her BS in Marine Biology from Nicholls State University. She is currently a Research Assistant in the Roberts Biogeochemistry and Ecosystem Ecology lab at LUMCON. She will be working on the second phase of this project as a MS student at LSU.

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THE ROLE OF PERCEPTION IN ANTHROPOGENIC AND NATURAL DISASTER PREPAREDNESS

Betsy Lopez[1], *Dr. Amy Lesen*[2], *Dr. Regardt Ferreira*[3], *Jessica Liddell*[4], *and Megha Patel*[4]
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Social capital, especially localized support, contributes to individual and community resilience. Perceived preparedness for future disasters may also be an important factor influencing an individual's—and more broadly a community's—resilience. Improving the perception and practice of preparedness should therefore be viewed as a mitigation strategy. Mitigation to future disasters typically centers on improving protective infrastructure and ensuring safety plans are updated. While this type of mitigation is necessary and should be of growing concern, human and social factors need to be considered to more holistically understand building disaster resilience.

An in-person, mixed methods survey was administered to approximately 300 individuals that reside in Port Sulphur, Galliano, and Bayou La Batre; all three areas were impacted by impacted by the 2010 Deepwater Horizon Oil Spill. Over 90% of the survey participants stated that they had never prepared for a large oil spill disaster, while over 95% of survey participants had previously prepared for a natural disaster. One of the quantifiable metrics of the survey was rating an individual's perception of preparedness to a future catastrophic event. Out of the interviewees, more than half believed their safety preparations would be very effective to protect members of their households. However, less than 25% believed their preparations would be very effective in limiting negative financial impact from a future disaster. Furthermore, results highlighted differing perceptions of preparedness to technological and natural disasters.

The research provides a useful case study that can be utilized to further understand the link between individual perceptions and disaster preparedness. The work contrasts perceptions to anthropogenic versus natural disasters, which is necessary as many communities, such as those on the Gulf Coast, increasingly experience multiple kinds of disasters over relatively short periods of time.

The research is supported by the Gulf of Mexico Research Initiative and the Consortium for the Resilient Gulf Communities.

<u>PRESENTER BIO</u>: Betsy Lopez is completing her Master of Science this May at the Tulane University Disaster Resilience Leadership Academy. She is a Louisiana native who has worked in the non-profit sector since graduating Summa Cum Laude from Newcomb-Tulane in 2010 with a B.A. in Environmental Studies and Communication and dual minors in Latin American Studies and Philosophy.

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A GENERAL FRAMEWORK FOR ANALYZING RELATIVE SEA LEVEL RISE AND SUBSIDENCE IN COASTAL LOUISIANA

***John A. Lopez**, and Michael Hopkins*
Lake Pontchartrain Basin Foundation, LA, USA

Understanding future land surface and water bottom elevations of Louisiana coastal area is critical to coastal planning but highly problematic. Relative sea level rise (RSLR) is the sum of two vectors of motion due to eustatic sea level rise and subsidence. This basic framework bellies significant complexity. The downward vector of subsidence may be caused by as at least eight natural processes, such as thermal contraction, depositional loading, halokenesis, faulting, distension, glacial rebound; and at least, six anthropogenic processes, such as fluid-extraction, salt mine collapse, structural settlement, oxidation of soils due to artificially lowering the ground water table. Any particular area of the Louisiana coast is not subject to all these process. However, all areas of the coast are subject to some combination of these processes that contribute to a resulting local subsidence vector with unique and variable rates over time.

Furthermore, to capture the resulting elevation of the actual coastal surface of land or water bottom, RSLR should be adjusted for the potential for accretion or erosion due to organic or mineral volume added or removed to the accommodation space. The aggradational or degradational processes affecting the coastal surface are not a vector of motion, but do offset the vectors of motion due to RSLR. The potential reduction in the subsidence vector by filling accommodation space may be a response to subsidence, because the accommodation space may trap available sediment. Conversely, subsidence may also expose the land surface to erosion by inundation, and, therefore waves, which further reduces surface elevation due to loss of sediment volume. The result of all these processes has been suggested as an "elevation adjustment," and the result might be called "net RSLR."

Further complicating this framework of Net RSLR is recognition that static sea level is a misnomer because the sea surface is in constant flux. The two basic actual water conditions are fair weather conditions with normal astronomical and meteorological forcing of tides, and storm conditions, i.e. hurricane surge. Both of these are significant. An increase in net RSLR will increase the tidal prism volume, but also the inertial energy of tides into the coast, which may dynamically raise water levels. Similarly for hurricane surge, a one-foot increase net RSLR will likely result in more than one-foot increase in hurricane surge because of increased speed of surge into the coast, and increased wave energy due to greater water depths. "Dynamic net RSLR" is intended to capture the true on-the-ground processes and be a more complete framework describing the basic component processes known to be active on Louisiana's coast. The logical framework is a basis for more advanced analysis.

PRESENTER BIO: Dr. John Lopez is a coastal scientist and Director of the Coastal Sustainability Program for LPBF. He previously worked for the U.S. Army Corps of Engineers in the Coastal Restoration Branch and for 20 years as a petroleum geologist in coastal Louisiana for Amoco Production Company.

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STATUS AND CHALLENGES OF WETLANDS IN CARBON MARKETS

Sarah K. Mack[1,2]*, PhD*
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Global, national, regional and state-level governmental participation in the stabilization of atmospheric greenhouse gases has facilitated several emissions trading market initiatives. Wetland restoration techniques have proven to be effective climate change mitigation strategies that promote enhanced carbon sequestration via increased vegetative productivity and carbon burial, as well as avoided carbon release when wetlands are lost. A carbon market that facilitates financial investment into wetland restoration can potentially create offsets that provide a wealth of co-benefits such as storm surge reduction, fish and wildlife habitat, recreation, job creation, and economic development that are vital to the sustainability of coastal Louisiana. However, to date no carbon offsets have been transacted.

This presentation will provide an update on regulatory and voluntary emissions trading markets with an emphasis on wetland carbon offset development. International market trends, emerging new markets, and evolving industry commitments will also be explored. Louisiana's wetlands will be discussed within the broader context of the opportunities and challenges that wetlands face within current carbon markets. Findings from the Luling Wetland Carbon Pilot that has recently been third-party verified and is awaiting transaction as the first wetland restoration carbon offsets globally will be detailed.

PRESENTER BIO: Sarah is a global leader in blue carbon. Sarah led the development of the first methodology for creating and monetizing carbon credits from wetland restoration. Sarah is leading the development of the first wetland carbon projects in the USA and works alongside government and private partners to generate carbon offsets.

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CHANGES IN BACTERIAL ABUNDANCE UNDER SEASONAL NUTRIENT VARIATIONS AND RELATIONSHIPS WITH PHYTOPLANKTON BIOMASS

Darian Madere, *Sibel Bargu, and Kanchan Maiti*
College of the Coast and Environment, Louisiana State University, Baton Rouge, LA USA

Bacteria and phytoplankton are important facilitators of nutrient and carbon cycling in coastal and estuarine ecosystems. However, inorganic nutrient uptake by bacteria and phytoplankton is dependent on seasonal changes and variability in river discharges that cause decrease or increase in nutrient availability into these systems. Such variability can influence their biomass, diversity, and metabolic oxygen demand there by controlling the distribution of carbon flow within the food web, and burial of organic matter. We conducted a 6-day microcosm experiment to measure changes in bacterial abundance compared to phytoplankton biomass and abundance. The experiments were carried out under 3 different nutrient regimes intended to represent seasonal nutrient conditions of early spring (high nutrient low abundance), late spring (low nutrient high abundance), and summer (low nutrient low abundance) in the Gulf of Mexico. Overall, phytoplankton growth was higher when bacteria were present in the same cultures regardless of nutrient abundance. With low initial concentrations of phytoplankton and high nutrient availability (early spring), the number of bacteria increased by 1.2x, while the amount of phytoplankton increased by 34x from Day 0 to Day 5. In cultures with high initial concentrations of phytoplankton and low nutrients (late spring), numbers of bacteria decreased 1.4x between Day 0 and Day 5, while the amount of phytoplankton still increased by 3.3x. In low initial concentrations of phytoplankton and low nutrient availability (summer), bacteria abundance increased 84x and phytoplankton remained low and only increased by 2.8x. This preliminary study indicates that phytoplankton rely heavily on both available inorganic nutrients and nutrients recycled by bacteria for their rapid growth, while bacteria seems to take advantage of low phytoplankton abundances to over compete for inorganic nutrients A more detailed study is needed to understand the seasonal competition of bacteria with phytoplankton for dissolved inorganic nutrients.

PRESENTER BIO: Darian Madere is a senior undergraduate student at Louisiana State University in the College of the Coast and Environment.

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NGO'S ROLE TO ADVANCE OUTREACH AND ENGAGEMENT ACROSS THE COAST

Simone Maloz
Restore or Retreat, Thibodaux, LA, USA

Key Focus Area: This presentation focuses on building coastal resilience through the work of NGOs to promote a greater understanding of future flood risk and empower individuals and communities to plan for increased risk.

Presentation Description: This oral presentation is one component of a session focused on CPRA's Flood Risk and Resilience Program and the related activities occurring in coastal Louisiana to build greater resilience in a future with increasing coastal flood risk. This session will highlight the multi-disciplinary approach needed to anticipate, plan, and prepare for increasing risk, and presentations will illustrate how a multitude of actors can advance coastal planning efforts including parish governments, non-governmental organizations, and academics. This oral presentation is dedicated to how nongovernmental (NGO) partners can advance resilience planning work by supporting and expanding outreach and engagement opportunities across the coast. Due to their grassroots connections, leadership positions, and often more flexible funding sources, NGOs play a key role in supporting coastal planning and have a particular strength in promoting community outreach and engagement activities.

The presentation will focus on the NGO perspective on the State's Flood Risk and Resilience Program and nonstructural recommendations. It will detail how nonprofits and the NGO community partnered with the state to build, and expand on, individual and community access to information. Specifically, the presentation will illustrate how the work of Restore or Retreat (ROR) provides a useful case study for NGOs advancing coastal planning initiatives and foster dialogue between state planners and local communities.

Examples of community outreach and engagement that ROR facilitated will be provided, including detailing the success of multiple Community Conversations held over the arc of the 2017 Coastal Master Plan development process, as well as promoting access to information through traditional language translation and non-traditional "translation" into an interactive digital format. ROR also encourages greater access to information through a weekly coastal podcast called Delta Dispatches. More recently, the group has been working to develop unique Coastal Library Kits for all public libraries in Louisiana to get the Coastal Master Plan into the hands of a wider range of readers, which has received endorsement of the Louisiana Governor John Bel Edwards. Lastly ROR is launching a coastal leadership program for native communities in coastal parishes. The presentation will conclude with insights and recommendations into how nonprofits may serve as effective partners and advocates to promote ongoing outreach about the critical coastal resilience issues the state faces.

PRESENTER BIO: Terrebonne Parish native Simone Maloz has served as Executive Director of Restore or Retreat since 2005. She works daily on the local, state and federal levels to advocate for the needs of the disappearing Louisiana coast, specifically to implement large scale projects in the Barataria and Terrebonne Basins.

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OIL AND GAS: FUTURE OUTLOOKS ON EFFECTIVE GOVERNANCE OF THE OUTER CONTINENTAL SHELF

Laura Mansfield

National Academy of Sciences, New Orleans, LA, USA / National Academies of Sciences, Engineering, and Medicine, Washington, D.C., USA

In the last year, there have been significant changes in the way the Federal government manages oil and gas resources for the benefit of the public. As the Louisiana economy depends on the oil and gas industry and support services, these changes may have noticeable impacts on communities and industry in the near future. There are three major changes worth highlighting: the Federal government's decision to withdrawal from the Extractive Industry Transparency Initiative, possible Gulf of Mexico Energy Security Act revenue reductions and its impact on coastal restoration projects, and the January 2017 Draft Proposed Program opening new planning areas for oil and gas leasing.

The Natural Resource Governance Institute's (NRGI) 2017 Resource Governance Index provides a comprehensive framework to examine the criteria for measuring effective governance of oil and gas in the Gulf of Mexico. This Index evaluates governance within three categories – value realization, revenue management, and enabling environment. Its analysis is heavily rooted in the ability for the public to access information in order to hold the government accountable and examines areas such as taxation, licensing, open data, control of corruption, rule of law, regulatory quality, government effectiveness, voice and accountability, revenue-sharing, and national budgeting. This index also provides insight into governance changes since the last Index in 2013, as well as comparative analysis with other countries.

Considering the results of the Resource Governance Index, a dialogue can begin discussing questions such as: How can public servants enhance effective governance practices? And how might major natural governance changes impact communities and industry? It is important to recognize the multitude of possible impacts of any action in order to weight the tradeoffs and plan accordingly. For example, there could be many different impacts of the Draft Proposed Program to lease more planning areas adjacent to Louisiana. Oil and gas development in the Eastern Gulf near the Florida coastline could have a wide range of impacts including becoming a competitive sector drawing industry and skilled workers away from Louisiana, or it could have the opposite impact of becoming complementary to Louisiana's oil and gas industry. By examining major governance changes through NRGI's Resource Governance Index criteria will develop a more robust understanding of possible implications for Louisiana communities and industry.

PRESENTER BIO: Ms. Mansfield has more than a decade of experience researching the socio-economic implications of oil and gas. She conducted an evaluation of the Gulf of Mexico for the Natural Resource Governance Institute's 2017 Index. Mansfield has also written on the political economy of petro-states exploring issues of social welfare and self-determination.

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HOW DOES MUD SUPPLY CONTROL THE LARGE SCALE HORIZONTAL RETREAT OF SALT MARSHES?

Giulio Mariotti[1] *and Alberto Canestrelli*[2]
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The long-term (3000 years) morphodynamics of an idealized muddy backbarrier tidal basin is studied using a shallow-water hydrodynamics and wind-wave model (Deltf3D-FLOW-WAVE), modified to include fully-coupled marsh organogenic accretion, biostabilization, drag increase, and wave-induced marsh edge erosion. The latter process is implemented with a novel probabilistic algorithm. Starting from an initially empty basin with a uniform bed slope, a network of channels incises the mudflat, sediment is released, and marshes establish at the basin landward margin. If enough mud is supplied to the basin from the shelf, marsh progradation counteracts marsh edge erosion and marshes expand. Starting from a basin (almost) filled with marshes, a drop in the external mud supply or an increase in the rate of relative sea level rise cause the basin to empty out by marsh edge erosion, while the marsh platform, aided by reworking of the sediment released by marsh retreat and mudflat deepening, keeps pace even with fast rates (10 mm/yr) of relative sea level rise. Even if the marsh does not drown, the marsh retreats faster if the rate of sea level rise increases, because more sediment is sequestered to fill the newly created accommodation space and is thus not available for marsh progradation. This study highlights how mud supply controls the large scale horizontal retreat of salt marshes, and suggests that predictions of marsh erosion require a basin-scale sediment budget.

PRESENTER BIO: Dr. Mariotti is an Assistant Professor in the Department of Oceanography & Coastal Sciences at Louisiana State University. His research over the last 10 years has focused on coastal morphodynamic modeling.

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LA QUINTA TERMINAL MITIGATION PROJECT: LARGE-SCALE ESTUARINE HABITAT CREATION IN CORPUS CHRISTI BAY, TX

***Luis M. Maristany*[1]**, *Aaron Horine*[1], *Josh Carter*[1], *and Paul D. Carangelo*[2]
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The Port of Corpus Christi Authority (PCCA) undertook creation of 6.6 acres of smooth cordgrass (*Spartina alterniflora*) habitat and 19.2 acres of shoal grass (*Halodule wrightii*) habitat as mitigation to support terminal development. The goal of the marsh creation was to maximize ecosystem production in the 200-acre site through a mix of seagrass and fringe estuarine marsh habitat. The site is also subject to substantial wave and ship wake energy and therefore required protection elements. Additionally, immediate ecosystem benefits were desired. Therefore, planned soil settlement was not considered a feasible approach; therefore, material used for marsh creation was selected to consist of higher sand content and construction methods were employed to pre-consolidate the placement site. Higher elevation "Crests" were constructed within the marsh habitat areas to account for future relative sea level rise (RSLR) by providing higher elevation areas that can be colonized as the sea level rises.

The marsh platform was created initially through the reuse of materials within the existing site area (a USACE beneficial use site that contained dredge spoils) to create Habitat Berms constructed and planted at elevations conducive to survival and propagation of smooth cordgrass. The dredge spoil material within the site proved to be subject to higher than expected levels of consolidation increasing the cut to fill ratio. A second phase was initiated where sandier material from an upland dredged material placement area was reused to construct additional Habitat Berms. The project included planting of 12.6 acres of marsh vegetation and 25.3 acres of shoal grass: the largest known actively planted seagrass mitigation project in Texas.

The upland dredged material was also used to construct an earthen berm approximately 1,500' long for wave protection from passing vessel wakes and reduce local wind-wave energy to levels conducive to the propagation of seagrass and fringe estuarine marsh habitat. The berm was shrouded with a geotextile cover wrapped around the sediment core to provide additional stability against wave impacts.

Hurricane Harvey (A Category 4 Storm) occurred immediately after construction. Harvey made landfall just north of the project site and exposed the site to winds and waves far exceeding design conditions for the berms. The protection berm withstood the storm, which incurred minor and easily reparable damage, and provided excellent protection to the newly created habitat that incurred no damages.

Currently, the project has exceeded the mitigation requirements and is serving as the model for future mitigation projects throughout the lower Texas Coast. By using dredged material for construction estuarine marsh habitat, the PCCA and Mott MacDonald have developed a sustainable solution which addressed the PCCA's needs for dredge material disposal while creating new estuarine marsh habitat which can be applied throughout the Gulf Coast of the United States.

PRESENTER BIO: Mr. Maristany is a project engineer with over 5 years of experience planning, designing, and implementing coastal and wetland construction projects. He has through experience with dredging, habitat creation, and coastal construction, and was the field engineer for the LA Quinta Phase I and II Projects.

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HOUMA NAVIGATION CANAL (HNC) LOCK COMPLEX (TE-113) – APPLICATIONS OF SALINITY CONTROL AND FLOOD PROTECTION

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Wetland loss in the Terrebonne Basin can be attributed to a combination of several factors. One primary contributor to wetland loss in Terrebonne is the intrusion of saltwater from the Gulf of Mexico into wetland areas initially formed and fed by the freshwater resources of the Mississippi River. Today, with limited freshwater distribution, saltwater infiltrates into fresh wetland areas and the fresh vegetative populations inhabiting these areas are quickly destroyed by the higher salinity levels. The root systems that had previously aided in holding the nutrient-rich but fragile wetland soils together no longer perform that function, causing shoreline erosion rates to increase substantially. The expansion of open water areas leads to more violent tidal action, further exacerbating the problem and affecting all aspects of estuarine life for wildlife, fisheries, and the human population that depends on them.

To combat these current currents threats to the Terrebonne Basin, the Terrebonne Levee and Conservation District (TLCD) has partnered with CPRA to begin the engineering, permitting, planning and design of the HNC Lock Complex. This project will provide primary benefits consisting of reduced salinity intrusion, distribution of freshwater in Terrebonne Parish, increase storm surge protection, and increase commerce and navigation capabilities.

The HNC Lock Complex Project is a large-scale, long-term protection and restoration feature recommended for implementation in Louisiana's Comprehensive Master Plan for a Sustainable Coast (2017 State Master Plan) as approved by the Louisiana State Legislature in June 2017. This complex was also included in the Morganza to Gulf of Mexico project by the U. S Army Corps of Engineers whose Post Authorization Change (PAC) Report identifies that the complex will provide both environmental and storm surge protection benefits.

The HNC Lock Complex Project will consist of a 110-ft x 800-ft lock, a 250-ft floodgate, adjacent floodwalls, and other project features that will be constructed to a 100-year annual exceedance probability elevation and with a 100-year design life; and will adhere to the Hurricane and Storm Damage Risk Reduction System (HSDRRS) design guidelines.

PRESENTER BIO: Mr. Marmande is the Principal/Owner of Delta Coast Consultants. Mr. Marmande is a Louisiana licensed professional engineer and land surveyor with over fifteen years of engineering and surveying experience working on coastal and flood protection projects in south Louisiana. He is the Program Manager for the Terrebonne Levee and Conservation District, managing all aspects of the Morganza to the Gulf Hurricane Risk Reduction project including the HNC Lock Complex.

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THE IMPORTANCE OF MEASURING, VALUING AND COMMUNICATING THE CO-BENEFITS OF COASTAL RESTORATION

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Landscape scale restoration and protection projects are essential at local, regional, national and global scales, but the cost to complete them far exceed the funding available. The ability to measure, value and demonstrate the co-benefits of coastal restoration is essential to making the business case to unlock funding, gain the necessary support and enhance the community and stakeholder buy-in needed to deploy and amplify critically important landscape-scale restoration and protection projects. Innovative funding mechanisms, collaborative partnerships and tools that demonstrate the integrated value of ecosystem restoration are necessary in delivering objectives to create more resilient coasts and communities.

Supported by strong public and private partnerships, Restore the Earth Foundation evaluates its restoration activities with a rigorous model which monitors, measures and reports on the environmental, social and economic value created by restoration and protection projects. The rigor of the model requires stakeholder engagement in advance of the restoration to collect baseline data. Data collection and monitoring are dependent on community-based relationships and dialogue to best incorporate local knowledge into the ecological restoration assessments and the social and economic values monitored and measured. This strong foundation of data ensures the validity of the model outputs.

This model values the ecosystems returned to the area including the water and air quality improvements and carbon capture (above and below ground), as well as the social and economic value created for local communities. Measured indices for social value include: direct and indirect job creation, cultural value of ecosystems, social and relationship value, social cost of carbon, hunting, fishing, birdwatching and recreation and the residual economies impacted by these activities. Measured indices for natural value include: air and water quality and quantity, phosphorus retention, nitrogen mitigation, soil stabilization and habitat creation.

Functioning as a "Rosetta Stone", this model translates the co-benefits of resiliency into meaningful and monetized parameters relevant to key stakeholders – e.g. industry, Parish government, community members, Tribes, local businesses and others. These translations provide the compelling business case to catalyze action. The application of the model to restoration is unique and critical in demonstrating the market value and integrated value provided by the array of co-benefits created. Many of these have regional, national and international benefits, such as carbon sequestration and hypoxia-zone reductions. The importance of a resilient Louisiana coast to the global economy is an excellent example of this connection.

PRESENTER BIO: Ms. Marshall has worked in coastal Louisiana for 5+ years, ranging in roles from research analyst, community engagement, project finance and project management for projects along the Gulf Coast. Marshall's primary expertise is in implementing restoration projects, working directly with public and private partners, community members, landowners and service providers.

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SELECTING ECOLOGICAL INDICATORS FOR AN ECOSYSTEM ASSESSMENT OF BARATARIA BASIN

Shannon B. Martin[1], *Kelly Samek*[2], *Niki L. Pace*[3], *Christopher Kelble*[4], *and Steve Giordano*[5]

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On 5 February 2018, NOAA's Gulf of Mexico Integrated Ecosystem Assessment (IEA) program and Louisiana Sea Grant held a workshop in New Orleans (in conjunction with the Gulf of Mexico Oil Spill and Ecosystem Science Conference) to identify relevant ecological indicators to assess the status and trends of ecosystem health of Barataria Basin, LA. This workshop brought together state and federal agencies, non-governmental organizations, academic researchers, and other stakeholders to discuss and provide input on the selection of relevant ecological indicators. These indicators are to be used in an ecosystem assessment of the Barataria Basin to evaluate the baseline of the system before a proposed long-term restoration project is operational. In order to seed the discussion, the organizers presented a vetted socio-ecological conceptual model of the Barataria Basin, provided examples of ecological indicators from two separate projects, and facilitated group brainstorming sessions. The workshop participants discussed, debated and assisted in the selection of the insightful ecological indicators and their ranking for prioritization via a consensus framework.

The workshop participants were separated into three work groups based on their area of expertise: water quality, species, and habitats. These groups were allowed to brainstorm and to develop a list of potential indicators. Ecological indicators were selected from a large list of potential variables based on three criteria: (1) data availability, (2) responsiveness to change, and (3) utility to managers and stakeholders. First for each indicator, consistent, credible data need to be available in at least a twenty year time series. Second, the indicator needs to be able to respond to or drive change in the ecosystem. Finally, the ecological indicator needs to be understood by managers and a wide range of stakeholders to be considered relevant.

After the initial brainstorming session, each group then rotated twice, and with each rotation were introduced to another group's list, and allowed to comment and amend that list. Afterwards, the full group reconvened. Each participant was given three votes and was asked to vote on which ecological indicators should be the highest priorities for use in the IEA based on their best, expert judgement. The facilitators tallied the votes to produce a final prioritized list of indicators at the end of the workshop. We will be presenting the results of this workshop and the consensus process.

PRESENTER BIO: Dr. Martin is an Associate Scientist with more than 20 years of research experience focusing on the ecology of coastal and estuarine systems. He is currently the lead scientist on a project to assess ecosystem status and trends of Barataria Basin for NOAA's Gulf of Mexico Integrated Ecosystem Assessment program.

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SOUTHEASTERN LOUISIANA UNIVERSITY'S TURTLE COVE ERS

Daniel McCarthy

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The Turtle Cove Environmental Research Station (Turtle Cove ERS) is a field research and educational outreach facility located in the wetlands on Pass Manchac in southeast Louisiana under Southeastern Louisiana University. It was created to facilitate and support a better understanding of Southeast Louisiana's coastal wetland environments through "research, education, and public outreach activities and programs for Southeastern's students, faculty and staff as well as the greater University community." This presentation will discuss the variety of ecological and environmental research and education programs that take place at Turtle Cove including the Marsh Restoration Program which centers on "building levees that prevent soil erosion and create a viable environment and land for new plants to thrive" as well as the education and outreach programs that take place to help spur public participation in scientific research such as the Field Training Program for Young Scientists.

PRESENTER BIO: Prior to his appointment as the Dean of the College of Science and Technology, Dr. Daniel McCarthy served as the Head of the Department of Chemistry and Physics. During his time as a faculty member at Southeastern, he has taught sixteen different courses ranging from Acoustics for Musicians to Electromagnetic Wave Theory.

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WHY ISN'T EVERYONE BACKFILLING? HISTORY OF RATOINALES FOR THE LACK OF BACKFILLING

***Giovanna McClenachan*[1,2]**
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Over 10,000 miles of canals for oil & gas activities and navigation have been dug in Louisiana's coast, causing significant amounts of marsh land loss. Directly and indirectly, these canals have accounted for 35%-60% of the land loss in coastal Louisiana by disrupting natural marsh hydrology with their spoil banks and acting as open portals for storm surges. When the canals were dug, the dirt being removed was placed adjacent to the canal along the edges as a raised ridge area. These spoil banks act as barriers to tidal flow that can bring mineral sediments further into the marsh. They cause water impoundment when overtopped by storm surges, increasing flooding on the land on either side of them, which leads to large amounts of indirect land loss from canals via prolonged periods of inundation. Not only was there marsh lost with the initial canal digging, but land loss can last for decades after as the marsh surface next to the canals is flooded for extended periods of time. By removing these barriers that restrict over-marsh flow in the system, natural hydrology can be restored to the wetlands and a stronger, more resilient marsh can return.

Spoil bank removal (canal backfilling) is relatively low cost and has been effective in the few instances it has occurred. However, despite the damage that canals have and continue to cause, spoil bank removal has not been used extensively as a restoration method in coastal Louisiana and is not included in the State's Coastal Master Plan. There are many reasons why spoil bank removal has not been widely adopted as a restoration strategy including issues with private land rights, modeling limitations, permitting restrictions, and concern for political backlash. This presentation delves into the multitude of reasons why spoil bank removal has not become a more prominent piece of the restoration strategy and how we could remove some of the barriers to making it a strategy more widely used.

Restoring the natural hydrology of coastal wetlands is essential to conserving the remaining land, as well as potentially gaining new land. A healthy marsh has been shown to vertically accrete at a rate that can keep up with sea level rise. By removing anthropogenic barriers that restrict over-marsh flow in the system, including unused oil and gas canals' spoil banks, the natural hydrology can be restored to the wetlands and greater amounts of sediment can reach the marsh surface. As sea level rise rates continue to accelerate, it is imperative that restoration projects increase the ability of the marsh to vertically accrete at rates to match the sea level rise.

PRESENTER BIO: Dr. McClenachan is currently a Postdoctoral Scholar at the University of Central Florida. She previously worked as the Science Director for CRCL and received her PhD in Oceanography and Coastal Sciences at Louisiana State University. She is intimately aware of land loss issues in Louisiana.

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MISSISSIPPI SEDIMENT RESEARCH AND LONG RIVER MODEL (DELFT 3D)

Alex McCorquodale
University of New Orleans, New Orleans, LA ,USA

A Regional 3-D model using Delft3d was developed for the Mississippi River between the Bonnet Carré Spillway (BCS) and the Head of Passes (HOP). The objective of the model was to evaluate the hydrodynamic and morphological responses of the River to sediment diversions. The model has lateral grid sizes of the order of 50 m with 10 parabolically distributed sigma layers with refinement at the bed. The lateral resolution was adjusted until the observed velocity distributions and recirculation eddies in Dr. Allison's ADCP data were sufficiently reproduced in the model. The Van Rijn 1984 sand transport model was used for the non-cohesive sediment transport. The model was calibrated and validated using the high flows in 2008 and 2011 using U.S. Army Corps of Engineers (COE) gage and flow data, sediment data from the USGS, sediment transport, current and bathymetric data from Dr. Mead Allison/The Water Institute of the Gulf (TWIG) and the Lake Pontchartrain Basin Foundation (LPBF).

The model was used to investigate the impacts on the River of four major diversions at: Mid Breton, Mid Barataria, Lower Barataria and Lower Breton. The diversions were assigned capacities of 35,000 m^3/s to 75,000 m^3/s. With all four diversions open the impact on the stage at New Orleans was approximately -1 ft. There was a shift in River currents towards each diversion intake that increased with the magnitude of the diversion. In general, there was increased local deposition on the opposite side of the River to the diversion and at point and alternating bars downstream of the diversion. The reduction on stream power due to the diversions also resulted in increased deposition especially between Fort St. Philip and Myrtle Grove. After a quasi-equilibrium of the model bathymetry was achieved, the sand capture rate by the diversions was close to the fraction of the Belle Chasse flow that was diverted times the sand load at Belle Chasse.

Reference:

McCorquodale, et al. 2017. *Development of a Regional 3-D Model for the Lower Mississippi River – Final Report,* submitted to CPRA Baton Rouge, Louisiana

PRESENTER BIO: Alex McCorquodale, Ph.D., P.E., P.Eng. is Professor Emeritus in the Department of Civil Engineering at the University of New Orleans. He recently retired after 21 years as the FMI Professor of Environmental Modeling at the University of New Orleans.

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UNDERSTANDING THE INFLUENCE OF SUBSURFACE GEOLOGICAL FAULTING ON INFRASTRUCTURE, SOUTHEAST LOUISIANA

***Elizabeth Chinn McDade**[1], Chris Young[2], Nancye Dawers[2], and David B. Culpepper[1]*

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Faults segments within the Baton Rouge fault zone are widely known to affect roadways, buildings, railroads and other infrastructure in southeastern Louisiana. However, the influence of active faulting on important infrastructure south of the Pontchartrain basin, including state highways that serve critical port facilities, has been insufficiently studied and documented. In part this is related to difficulties in mapping the effects of surface fault traces in poorly consolidated sediments and wetlands. A significant limitation is the lack of publically available scientific information and literature related to the proprietary nature of subsurface geological data owned by the oil and gas industry. In addition, considerable amounts of land in coastal Louisiana are privately owned, including large tracts of land held by commercial interests, creating hurdles to direct access to already known or suspected fault traces.

Fortunately, southeastern Louisiana does have a wealth of energy industry three-dimensional (3D) and two-dimensional (2D) seismic reflection data that can provide the foundation for constraining the subsurface geological structure that underlies the Mississippi River delta plain. This allows faults in the near-surface to be projected to the surface and fault trace maps to be created, refined and directly investigated by higher-resolution seismic imaging and sediment coring. An effort led by the New Orleans Geological Society in cooperation with several energy-sector companies, has given us access to 3D datasets in a number of areas within the coastal zone.

In our coupled projects (supported by the University Transportation Consortium/Transportation Consortium of South-Central States and the Department of Transportation & Development's Louisiana Transportation Research Center), we have compiled available fault locations from the 3D and older 2D industry data that we have access to with existing public domain resources to form a GIS-based tool for infrastructure planning and a foundation for more detailed work. This project is unique in the Louisiana coastal zone; with the exception of the Houston area, active fault systems of the Gulf Coast region have largely been ignored in infrastructure planning. Where confirmed by near-surface investigative procedures utilizing high-resolution 2D seismic and dating of sediment borings, this will result in greatly improved temporal and geospatial data on differential movement across faults. This work is expected to contribute to the planning and adaptive maintenance of transportation infrastructure in southeastern Louisiana.

<u>PRESENTER BIO</u>: Dr. McDade is a consulting subsurface geologist with 30 years of energy sector experience mapping deep geology, fault systems, and salt tectonics in Louisiana and the Gulf of Mexico. Since 2016, she has worked to advance knowledge of active faulting in south Louisiana using energy sector data for coastal planning.

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LESSONS LEARNED FROM SHORELINE PROTECTION DEMONSTRATION PROJECTS IN SOUTHWEST LOUISIANA

Thomas McGinnis, *and Margaret Luent*
Coastal Protection and Restoration Authority, Lafayette, LA, USA

As shoreline erosion pushes the marsh edge inland, shoreline protection becomes more complicated as the typical beach/berm setting suited for high exposure to wind and waves thins and disappears exposing the fragile marsh edge to hydrologic forces. The former marsh platform becomes the substrate upon which shoreline protection features are placed. This former marsh platform often has higher organic matter content and thick, soft clays which have a low weight-bearing capacity. The result is that the high-density rock rip-rap breakwaters traditionally used for shoreline protection sink into the weaker soils.

We monitored six shoreline protection structures in two highly erosive areas with low weight-bearing capacity in southwest Louisiana constructed as Coastal Planning, Protection, and Restoration Act (CWPPRA) demonstrations projects. The LA-0008 Oysterbreak demonstration and test sections for ME-0018 were deployed along the Gulf of Mexico off Rockefeller Refuge in eastern Cameron Parish where shoreline erosion averages 50 feet per year; both were federally sponsored by NOAA-NMFS. The Oysterbreak, a system of stacked, interlocking, concrete rings was two separate structures constructed at slightly different elevations and with different concrete mixtures. The ME-0018 test sections were a segment of traditional rock rip-rap and a section of light-weight aggregate core covered by rock rip-rap. Four different manufactured structures were assessed for the LA-0016 demonstration project federally sponsored by USDS-NRCS in northeast Vermilion Bay along Shark Island where shoreline erosion averages 40-45 feet per year. The four structures included Wave Attenuation Devices (adjacent, concrete pyramids), Wave Screen System (high-density plastic suspended between pilings), Bouyancy Compensated Erosion Control Modular System (styrofoam-filled, concrete-shelled barriers that articulate along the shoreline), and Ecosystem Units (stacked concrete plates supported by pilings). At each site, we monitored structure stability, wave breaking performance, shoreline movement, and soil volume change at and behind each structure and an unprotected reference area.

Lessons learned about the performance of each structure will be presented and considerations for scaling up from demonstration-sized to full-sized projects will be presented. We will also take an anecdotal look at another site along the Gulf of Mexico where a smaller width of Oysterbreak, Wave Attenuation Devices, and different sizes of rock rip-rap wave breaks were constructed. This site is a less erosive area (10-15 feet per year shoreline loss) at the eastern end of the Chenier Plain coast near Cheniere aux Tigre.

PRESENTER BIO: Mr. McGinnis is a wetland ecologist with 12 years of coastal wetland research and 10 years of restoration monitoring experience with experience in a variety of coastal wetland types from marshes to mangrove. He has been the monitoring manager for 12 restoration projects involving a variety of restoration techniques.

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RESTORATION FOR RESILIENCY ON THE EAST COAST: SUPERSTORM SANDY CASE STUDY

Tim Dillingham[1], ***Martin J. McHugh***[2], *J.D.*
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This presentation will highlight some of the East Coast experiences, lessons learned from projects and key gaps that may be able to be addressed based on practices from regions like the Gulf.

Superstorm Sandy had a devastating impact on coastal communities in New Jersey and other east coast states. While beach front communities took a tremendous hit and garnered much attention, significant damage also occurred in populated back bay areas up and down the Atlantic coast. All told, the storm and the subsequent response changed the landscape on how we look at our natural infrastructure and the valuable services it provides - from both a physical protection standpoint and an economic perspective. A number of federal and state agencies, foundations and other NGO's worked together to fund and implement projects to restore our natural resources with the objective of increasing protection for our built resources along the coast. Repairs to beaches, dunes and shorelines were a key component, but this new effort also included the restoration of wetlands, waterways, reefs and other resources that in the past had been a focus mainly for their habitat, species and water quality values. Following Superstorm Sandy, the additional benefits of restoring our natural assets in strategic areas was that they could add to the protection of our built assets. "Restoration for resilience" started to come into focus.

The restoration for resiliency projects implemented after Sandy incorporated both established methods and new techniques. Some forward-looking programs like Rebuild By Design and the Hurricane Sandy Coastal Resiliency Competitive Grants Program encouraged the use of new restoration approaches to drive the science and policy along the East Coast. New "green infrastructure" or "nature based" strategies were supported and some approaches utilized for years in other regions, such as the Gulf, were imported for use on in the mid-Atlantic. Traditional hard engineered practices were paired with softer engineered "green" approaches. Together all of the projects and techniques have informed the movement to reduce the vulnerability of coastal communities from increased storm activity, sea level rise and other impacts associated with climate change. A number of lessons learned have come to light and are still being realized to help educate practitioners and policy makers.

PRESENTER BIOS:
Tim Dillingham has led the American Littoral Society as its Executive Director since 2003. His work led to expanded advocacy regarding the restoration of Barnegat Bay, new partnerships promoting community based restoration projects, expansion of marine education programs, and the launch of a "Spill Spotters" program.

Martin McHugh has over 30 years experience in environmental protection and natural resource management. He joined RES's Mid-Atlantic Region to promote ecological restoration and mitigation for wetlands, streams, habitat and stormwater management. Marty focuses on "green infrastructure" and nature-based solutions to increase resilience and quality of life for Northeast communities.

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USING OIL AND GAS INDUSTRY DATA TO HELP ASSESS LEVEE INTEGRITY

Chris McLindon

New Orleans Geological Society, New Orleans, LA, USA

Oil and gas industry data and interpretation techniques can be used to delineate portions of flood protection levees that may be susceptible to the impacts of fault movement. The interpretation of 3-D seismic data, well logs, and biostratigraphic data have used to map faults and salt domes in south Louisiana for decades. Many of the faults appear to extend to the land surface, and several of these shallow-cutting faults appear to intersect primary flood protection levees.

Three cases of the coincidence of faults with historical crevasses of the Mississippi River at Vacherie, Luling and Fort St. Phillip will be examined to show the relationship between faults, salt domes, historical crevasses, and evidence of recent fault movement. Subsurface fault plane and salt dome maps will be used to document the relationship between the plane of the fault at depth and surface trace. The interaction between faults and salt domes, including the possibility of the dissolution of salt domes being a mechanism for fault movement will be discussed.

The fault at Vacherie ruptured the surface of the earth on April 12, 1943 forming an escarpment about one mile long with a maximum offset of 8 inches. The northern tip of the fault escarpment was about three-tenths of a mile from the Mississippi River levee. Subsequent borings taken across the fault by the Corps of Engineers indicated that the fault was active throughout the Holocene Epoch, and the offset of the fault at the Pleistocene surface was about three feet. The nearly perfect coincidence of this fault with the main channel of the crevasse which extends perpendicularly from the river into Lake Des Allemands indicates that historical episodes of fault movement had a causal relationship to the formation of the crevasse. Future episodes of fault movement on faults that intersect levees could potentially impact the integrity of the levee.

PRESENTER BIO: Mr. McLindon has been studying the subsurface and surface geology of coastal Louisiana for 37 years. Study has been both in his capacity as a geologist working in the oil and gas industry and as an interested citizen-scientist. He is currently the president of the New Orleans Geological Society, and he has overseen a research initiative based on providing access to oil and gas industry data to study surface geology at area universities.

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SPANISH PASS BENEFICIAL USE OF MISSISSIPPI RIVER NAVIGATION DREDGED MATERIAL

Brett McMann, P.E.*, Paul Tschirky, Ph.D., P.Eng. and Mike Schulze*
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Plaquemines Parish Government, Louisiana has entered into an agreement as local sponsor with the United States Army Corps of Engineers (USACE) to beneficially use material dredged from the Lower Mississippi River to restore wetlands and reduce land loss. The agreement is part of the Louisiana Coastal Area (LCA) Program and is for a 10-year period with an average of $10M per year for a total of $100M. The goal is to use dredged material from the federal navigation channel to create marsh and marsh features in the wetlands and bays adjacent to the Mississippi River to help restoration efforts.

Planning, engineering, design, hydrodynamic modelling, alternatives assessment, environmental assessment and construction for the first two projects has been completed. The second project of the program is now under construction using innovative transportation options to move dredged material for beneficial use further than before to the vicinity of Spanish Pass. The LCA BUDMAT – Spanish Pass Ridge Restoration project alternative, originally proposed as part of the State's 2012 Coastal Master Plan and Plaquemines Parish Ridge Restoration Program. The project calls for the restoration of a portion of the historic ridge that ran along the banks of Spanish Pass. Since Spanish Pass was cut off from the Mississippi River by levees, the historic ridge has subsided and eroded through time.

This first segment of the ridge restoration will include an approximately 7,375' long ridge (34 acres) constructed to an elevation of +8.0' NAVD88 with a 200' wide base. The earthen ridge will be backed by a 500' wide marsh platform (80 acres) along the entire length of the ridge on its north side. The marsh platform will be constructed to a height of +3.5' NAVD88. The construction of this project requires 2,750,000 cubic yards of material.

This project is being constructed through maintenance dredging of the Mississippi River Hopper Dredge Disposal Area (HDDA) located near Head of Passes. A cutterhead dredge loads hopper barges. Once loaded, the hopper barges are transported by tugboat to the designated pump-out location in the Mississippi River outside of the navigation channel. The material is then removed from the hopper barges by an unloader and transported via pipeline to the fill placement area.

These activities represent the second beneficial use project under the LCA program and aim to extend the beneficial use of navigation dredged material farther to the wetlands to placements areas that not only create marsh from the placement directly but help marsh restoration and retention in the surrounding area. A multitude of lessons have been learned which will help facilitate the optimization of the BUDMAT program for future projects.

PRESENTER BIO: Mr. Schulze is a professional biologist with Arcadis in the Coastal Protection, Restoration, and Resiliency Group with a variety of experience in water resources projects including ecosystem restoration and natural resource management projects.

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FINANCING COASTAL RESTORATION: EFFORTS UNDERWAY TO ALIGN PROJECTS AND DOLLARS

Charles Sutcliffe[1]*, Simone Maloz*[2]*, Shannon Cunniff*[3] *and* ***Lacy McManus***[4]
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[4]Greater New Orleans, Inc., New Orleans, LA, USA

As Louisiana grapples with one of the most challenging environmental crises in modern history, a wave of disaster-related funding from the BP oil spill presents a unique opportunity to catalyze large-scale coastal restoration and underwrite significant portions of the State's Coastal Master Plan. Yet, while BP and other 2010 oil-spill related dollars provide an extraordinary financial runway for the next 15 years of restoration and protection activities, it is critical that incoming funds today are maximized to provide the greatest returns possible in the future. To ensure this unique financial opportunity is fully capitalized
on, this panel will illustrate several key initiatives underway in the coastal financing space, including:

- Identifying mechanisms to best leverage current funding streams with project plans
- Outlining paths forward for key coastal funds and resources, such as bonding
- Exploring innovative revenue generation techniques which can service bonds and other funding sources
- Incentivizing public private partnerships and philanthropic support for restoration activities

The panelists herein will each describe their particular work underway to further these concepts and, collectively, how these efforts align to create a more sustainable future for restoration funding and project implementation.

PRESENTER BIOS:

Charles Sutcliffe: As Director of Policy and Programs for the Governor's Office, Charles is the lead staff for the Governor's Advisory Commission on Coastal Protection, Restoration and Conservation and CPRA Board subcommittee on Flood Risk and Resilience. Charles is involved in projects to identify and implement innovative financial instruments; initiatives to establish the viability and path forward on future revenue streams; and helped to communicate the economic case for Louisiana's Coastal Master Plan.

Simone Theriot Maloz: As Executive Director of Restore or Retreat, Simone works daily on the local, state and federal levels to advocate for restoration, protection, policy and funding needs of the disappearing Louisiana coast, specifically the Barataria and Terrebonne Basins. Simone serves on the Governor's Advisory Commission on Coastal Protection, Restoration and Conservation and is co-chair of the Commission's Diversion Subcommittee.

Shannon Cunniff: As Director of Coastal Resilience for the Environmental Defense Fund, Shannon develops strategies for expanding use of natural infrastructure and is exploring means to finance restoration of natural infrastructure.

Lacy McManus: As Director of Program Development for Greater New Orleans, Inc. (GNO, Inc.), the economic development alliance for the 10-parish Greater New Orleans region, Lacy oversees programs and initiatives related to the intersection of the environment and economy. This includes GNO, Inc.'s Coalition for Coastal Resilience and Economy (CCRE), water workforce development efforts, collaborations with schools of higher education, coastal financing explorations, and La SAFE business community engagement.

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LESSONS LEARNED FROM AN EXPERIMENTAL OYSTERBREAK ALONG A GULF OF MEXICO SHORELINE

***Earl J. Melancon**[1] and Thomas McGinnis[2]*
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The Louisiana Coastal Protection and Restoration Authority (CPRA) authorized an OysterBreak demonstration project (Project LA-08) as part of the CWPPRA Priority Project List #17 (PPL17). Project LA-08 is located along the Gulf of Mexico shoreline on the Rockefeller Wildlife Refuge of southwestern Cameron Parish, Louisiana. The primary purpose of this project was to test a bio-engineered product, OysterKrete™, to recruit oysters and to address rapid shoreline retreat. The project consisted of comparing two types of OysterBreaks side-by-side along the shoreline. Each OysterBreak was 65.5 m (215 ft.) long. One OysterBreak was composed of concrete rings made from OysterKrete and the other OysterBreak was composed of rings made from Standard-Weight concrete. OysterKrete is a patented concrete mixture “specifically formulated to attract naturally occurring oyster larvae” (from http://wayfarertech.com/).

The focus of this presentation is to discuss the lessons learned while documenting the challenges involved in adequately comparing oyster reef development on the two structures in a real-world natural setting. There were two biological assessment goals to specifically accomplish during this four-year project and study: (1) To quantify oyster colonization of the structures, and ability to build a sustained reef population with complex structure composed of multiple oyster size-class distributions (multiple cohorts), and, (2) To test OysterKrete against Standard-Weight concrete in its ability to enhance early oyster colonization.

Results of the four-year project can be summarized as follows: (1) Wave energy greatly influenced how oysters recruited, (2) Oyster recruitment to structures was not uniform across the breakwaters, (3) Oyster recruitment was correlated with Breakwater Rings’ elevation, (4) Evaluation of OysterKrete concrete versus Standard-Weight concrete to attract oyster larvae to recruit as spat is inconclusive, and (4) Evaluation of OysterKrete concrete versus Standard-Weight concrete to stimulate early and enhanced oysters recruitment is inconclusive.

Although both structure types, OysterKrete and Standard-Weight showed no significant oyster recruitment after 4-years, if either had any advantage it could not be evaluated because of highly variable elevations between rings and subsequent differences in tidal inundation frequencies, differences in wave energies and potential for predator exposures. We discuss suggested methods to improve experimental design, the overall influences of wind fetch and wave activity on oyster reef development, and the importance of locating structures with adequate oyster populations within the vicinity of breakwater placement.

<u>PRESENTER BIO</u>: Dr. Earl Melancon has over 40 years of research experience in oyster biology, ecology and fishery management. He is a Louisiana Sea Grant Scholar. He is also a Distinguished Service Professor-Emeritus with Nicholls State University where he served for 38 years.

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MINERAL AND ORGANIC ACCUMULATION RATES OF A MYRTLE GROVE WETLAND IN THE MID-BARATARIA BAY DIVERSION RECEIVING AREA

Nuri Melancon
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Louisiana is currently experiencing extreme land loss in coastal wetlands. Wetland areas are threatened by rapid subsidence compounded by accelerating sea level rise and a starvation of river-derived mineral sediment. One strategy for preservation and restoration of wetlands in the Mississippi corridor are river sediment diversions. The present project measures vertical accretion rates (mineral and organic) on a timescale of decades to a century of near surface sediments in the receiving area of the planned Mid-Barataria Sediment Diversion. Accretion rates are being determined at three sites using particle-reactive radiotracers (e.g., Pb-210 and Cs-137). The sites are near a superstation installed in 2016 examining subsidence rates and mechanisms in Mid-Barataria receiving area. The intent is to determine what role emplacement of the levees has had on accumulation at the site and to examine the interplay of sediment accumulation and relative sea level rise in controlling elevation and mineral and organic burial at a site where subsidence is well-constrained. Understanding the relationship between sediment accumulation and subsidence in this area is essential to future land-building initiatives.

PRESENTER BIO: Nuri Melancon is an undergraduate in the Department of Earth & Environmental Science at Tulane University. Nuri has assisted on a graduate project quantifying subsidence over the Holocene at the Myrtle Grove subsidence superstation. Upon completion of her Bachelors, Nuri plans to pursue a Masters of Science in Coastal Geology.

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COLLECTIVE RESILIENCE: PREPARING COMMUNITIES TO HELP THEMSELVES IN THE WAKE OF A LARGE SCALE DISASTER

Jamar Melton *(advised by Dr. Billy Pritchard), Melissa Estremera, and Vincent Hoang*
Episcopal School of Baton Rouge, Baton Rouge, LA, USA

A changing climate threatens to increase the frequency and intensity of coastal hurricanes at the same time that more Americans are moving into coastal zones and vulnerable areas increasing the risk of deadly and costly destruction. With the growing strength and destructive capability of these storms, it is becoming more and more important to equip communities with the tools, strategies, and resources to deal with the chaos left behind. There exists an increasing need for official government response to take advantage of new opportunities for collaboration, new communication technology, and a culmination of lessons learned in past storms that is unique to this state and its citizens.

The first part of my research addresses and argues for the need for official response to take advantage of opportunities for collaboration and new communication technologies in order to most effectively respond to future natural disasters. After studying the Great Flood of 2016 that took place in Baton Rouge, as well as Hurricane Harvey in Houston, Texas, it is clear that the next big step in disaster response is, in fact, large-scale community involvement. Organizations like the Cajun Navy, Crowdrelief.net, and the Texas Navy have grown to thousands of members and a level of sophistication on par with official government response. In interviews with Rob Gaudet, co-founder of the Cajun Navy and head of I.T. for the organization, he describes an intricate web of communications between victims, dispatchers, civilian boaters, and official responders spanning across many different communication platforms from Facebook through CV radio and even GPS locating applications. Through their actions and sophistication, and recently announced partnership with the state, the Cajun Navy has revolutionized Natural Disaster Recovery through the use of social media, and official response should soon follow suit.

In a disaster situation, where there is a significant amount of uncertainty there must be a higher line of understanding, trust, and communication between the public and institutional disaster response agencies. These things will allow for the fostering of **collective resilience**, leading to a more effective response and recovery experience. Doctors Chris Cocking and John Drury first published the term **collective resilience** in their study of group behavior in the immediate aftermath of terrorist attacks, and since then, their concept of collective resilience has very sparingly been applied to larger events such as hurricanes. The tendency of a large group (for example, the citizens of a city) to react positively to a negative stimulus can be measured, and even predicted by understanding that group's collective resilience. My research also included studying past hurricanes and the communities that they affected in order to outline ways to maximize collective resilience and positive recovery outcome in any community affected by future storms.

The overarching goal of my research was to develop a plan to be used by any city, not only those in Louisiana to first, establish a successful civilian response and recovery alternative, and secondly, to maximize collective resilience in order to create the highest possible chance of success.

PRESENTER BIO: Jamar Melton is a senior at the Episcopal School of Baton Rouge, where he is a member of the Honors Thesis Program. He will attend Vanderbilt University as part of the Class of 2022. He is advised on his thesis by Dr. Billy Pritchard, Vincent Hoang, and Melissa Estremera.

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THE LOWERMOST MISSISSIPPI RIVER MANAGEMENT PROGRAM (LMRMP): NUMERICAL INVESTIGATIONS OF EXISTING AND FUTURE WATER AND SEDIMENT DYNAMICS

***Ehab Meselhe*[1,2]*, PhD, PE, Mead Allison*[1,2] *PhD, and Brian Vosburg*[3]

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The Lowermost Mississippi River Management Program (LMRMP) is a RESTORE Act funded, large-scale program with the objective of moving the nation towards a more holistic management philosophy by creating a science based decision making framework. Numerical and physical models are powerful tools that can be integrated into this framework along with focused observational data collection and the synthesis and analysis of existing, under utilized data. This presentation will focus on the numerical modeling component of the study and provide a summary of the relevant research activities including the continuation of the advancement of existing numerical modeling tools through expanded production run scope and quantity; identifying, collecting and incorporating relevant observational data into the models, and taking advantage of model code upgrades, initiating the development of new models; and initiating cross calibration of the new Small Scale Physical Model at the LSU River Center with new and existing numerical models and developing a protocol for future parallel analysis.

Specifically, the modeling activities will include six components: 1) development of a Real-time forecasting system for water, sediment and select nutrients that will directly benefit the management of sediment diversion operations, as well as maintenance dredging operations in the navigation channel. The system could provide valuable information to prepare for and respond to riverine flood events; 2) application of existing models to provide initial insights on the morphologic evolution of sand bars in response to constructing and operating sediment diversions in the near term (3 to 10 years), and developing a new generation of models to fully explore and quantify the morphologic evolution of sand bars in response to operating multiple sediment diversions, dedicated dredging for restoration and potential changes to navigation dredging; 3) development of a Delft3D-Flexible Mesh (FM) to simulate the water, sediment and salinity distribution at the bird-foot delta. The model will be informed by new observations to fully capture and replicate the stratification observed in the region of interest; 4) application of existing local models to explore potential dredging optimization opportunities and to understand how maintenance dredging impacts potential restoration strategies (and vise versa); 5) identifying, through collaborative efforts with concerned stakeholders, ideas to address the long-term Lower Mississippi River channel sustainability and possible alternative channel configurations; and 6) development of an extensive dual applications and simulations using the suite of numerical models and the Small Scale Physical Model housed at the LSU River Center.

PRESENTER BIO: Ehab Meselhe is the Director of Natural Systems Modeling at the Water Institute of the Gulf, and a Professor at the River-Coast Science and Engineering Department at Tulane University. He has 20 years of experience developing and applying numerical models to riverine, coastal and deltaic systems.

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SUPPORTING LOUISIANA'S SHRIMP FISHERY IN A RESTORED COASTAL ENVIRONMENT

***Corey Miller**, and Nic Dixon*
Coalition to Restore Coastal Louisiana, New Orleans, LA, USA

Non-governmental organizations (NGOs), specifically, environmental organizations, can play a supportive role as fishing-dependent communities prepare for Louisiana's future environmental landscape. That role is explained through the results of a series of research efforts, analyses, and engagements led by the Coalition to Restore Coastal Louisiana (CRCL) to assist shrimpers in planning for their future.

Shrimping is Louisiana's most valuable commercial fishery and supports thousands of jobs. Louisiana shrimping also likely faces the most challenges into the future given climate change, wetland habitat loss, economic pressures, and other factors. In Southeast Louisiana, the leading plans for restoration use sediment diversions as a longer-term solution for saving the most wetlands. These projects will be critical to slowing land loss, but they may come with the expense of altering environmental conditions that certain commercial fisheries, including shrimp, depend on for productivity. As CRCL advocates for these restoration strategies that will likely impact segments of the shrimping community, the question, "what are we doing to help those fishing-dependent individuals, families, and communities prepare for the future?" deserves an answer.

Three separate, yet interconnected, efforts are highlighted: an economic analysis of the Louisiana shrimp value chain; a social analysis of shrimpers' perspectives on shrimping with diversions; and an effort to compile the current state of knowledge about Louisiana shrimp, shrimping, and shrimpers. These efforts are drawn upon to discuss challenges, successes, and lessons learned including the difficulty of planning for an uncertain future, identifying and correcting misinformation, dealing with mistrust, and more.

PRESENTER BIO: Corey leads CRCL's community engagement efforts with a focus on working with fishing-dependent communities through a social science perspective to improve resiliency in the face of a degrading landscape and increasing flood risks.

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HYPOXIA AND WATER TEMPERATURE DYNAMICS IN LOW-GRADIENT PARTLY REGULATED SYSTEMS – A CASE STUDY IN THE TECHE-VERMILION WATERSHED

Emad H. Habib, and ***Robert L. Miller***
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The role and impact of hypoxia (e.g., dead zones) along the Louisiana coastal shelf have been well researched in recent years. Dissolved oxygen potential and ecologically important factors (e.g., recruitment, egg development, metabolic rates, microbial activity, etc.) are also linked to water temperature. This study reports on a monitoring effort that aims to understand the linkage between flood events and the onset and duration of hypoxia in addition to the flood-based temperature response in a hydrologically altered low gradient watershed system. An in-situ sampling effort was performed to monitor dissolved oxygen and water temperatures at various points within the tidally-driven impaired waterways within the Teche-Vermilion watershed system in south Louisiana. Once a distributary of the Atchafalaya River, the Teche-Vermilion system is currently disconnected from the Mississippi-Atchafalaya River system by flood protection levees. Dissolved oxygen levels are maintained in part by the Teche-Vermilion Flow Augmentation Project.

A system-wide discrete sampling program was conducted with collection points distributed throughout the watershed. Sub-weekly measurements of dissolved oxygen, temperature, conductivity, and water clarity near the water surface were collected on the Vermilion River. Monthly measurements were collected at other locations distributed within the watershed for a one-year period. The data suggests a strong correlation between flood levels and low-dissolved oxygen within the Vermilion River sub-watershed. A similar pattern was observed at other points within the watershed but the relationship was not as pronounced.

The increased severity and duration of post-flood hypoxia on the Vermilion River compared to sampling locations outside of the Vermilion River sub-watershed stands out and suggests that the controlling mechanisms are spatially-varied across the low-gradient watershed system. Compared with USGS measurements on the Mississippi River, water temperatures were generally higher within the watershed during the winter periods with spring warm-up occurring earlier and more rapidly. In addition to increasing the hypoxia potential compared to pre-levee conditions, warmer water temperatures could alter the reproduction patterns for temperature-sensitive fish populations within the watershed. These observations provide a baseline for future habitat modeling efforts which will investigate the role of floodplain storage, land use, event-based hydrodynamics, flood control, and climate change scenarios on hypoxia and temperature dynamics within the Teche-Vermilion system.

PRESENTER BIO: Dr. Miller is a professional engineer and an associated professor in the Civil Engineering Department at the University of Louisiana at Lafayette. His specialties include hydraulic and hydrologic modeling applications for inland and coastal water systems, environmental monitoring, and the development and application of nonlinear structured population models in biology.

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THE GULFWIDE SAND INVENTORY: IDENTIFYING SIGNIFICANT OFFSHORE SEDIMENT RESOURCES TO INFORM OIL AND GAS PIPELINE DECOMMISSIONING DECISIONS AND LONG-TERM RESTORATION PLANNING

Michael D. Miner*, Bridgette Duplantis, and Jessica Mallindine*
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Large volumes (>100 million cubic yards) of high-quality sand are required to implement Louisiana's Coastal Master Plan and supplement the sediment deficit along its eroding barrier shorelines. Sand resources proximal to the barrier islands are of poor quality, and excavating sand closer to shore can potentially alter wave climate, negatively affecting the landward shoreline. Moreover, excavation of nearshore sand often occurs within the active coastal system, compromising the long-term effectiveness of projects and failing to address the need to supplement a deficit in the regional coastal sand budget. Utilizing offshore sand from outside of the active coastal system minimizes alterations to wave climate and introduces new sand to decrease the coastal sand deficit, improving project sustainability and geomorphic function. In general, detailed knowledge in the form of quantified offshore sand resource reserves estimates are lacking, and in areas such as Ship Shoal where large volumes of high-quality sand have been identified, up to 90% of those reserves are not recoverable due to a dense network of active and abandoned oil and gas pipelines obstructing sand resource development.

The Bureau of Ocean Energy Management (BOEM) is responsible for managing mineral resources (sand) on the Outer Continental Shelf (OCS) and, in 2009, implemented a policy to ensure that pipelines within areas designated as Significant OCS Sediment Resources are removed upon decommissioning and do not become permanent obstructions to development of that resource. Identification and designation of Significant OCS Sediment Resources is relevant to other potential use conflicts such as artificial reefs and offshore aquaculture facilities. Louisiana, through its Coastal Zone Management Program, has a similar policy and review process. Central to implementing these policies and informing decisions are detailed geological and geophysical data to quantify, characterize, and delineate sand resource reserves on the OCS.

To address this need, the Gulfwide Offshore Sand Inventory, a compressive, phased approach to collect and integrate sand resources data into an authoritative database to improve accuracy and resolution of reserves estimates and their locations, is being implemented by BOEM and Gulf Coast State partners. This inventory tool builds on decades of Gulf of Mexico sand resource evaluation work, such as the Louisiana Sand Resources Database (LASARD), to provide detailed information on reserves deposits that will greatly decrease uncertainty and costs related to restoration planning and design. Moreover, the database and attendant analytical tools are employed to designate areas as Significant OCS Sediment Resources, and a preliminary operational version is used regularly to inform decisions on pipeline decommissioning on the OCS. To date, ~15 million cubic yards of sand that was formerly obstructed from development as a resource has been made available as a result of these policies and decision support tools.

<u>PRESENTER BIO</u>: Dr. Miner works for the Bureau of Ocean Energy Management (BOEM), Marine Minerals Program, which manages offshore sediment resources for coastal restoration projects. His research focuses on coastal, deltaic, and continental shelf geology, geomorphic evolution, and sediment dynamics with applications to improving coastal management strategies.

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COASTAL GREEN INFRASTRUCTURE OPPORTUNITIES FOR URBAN COMMUNITIES

Ed Morgereth
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The future success of coastal restoration and resiliency in urban areas will be accomplished through nature-based features and adaptive management. Urban waterfronts provide a unique challenge for coastal ecological restoration and resiliency projects due to the amount of alteration and impacts to the associated natural systems. This presentation will focus on the use of adaptive and resilient green infrastructure such and living shorelines to address degradation impacts and regenerative measures to deliver enhanced ecological values. This presentation will highlight resilient and adaptive living shoreline measures and green infrastructure, such as tidal fringe marshes, floating wetlands, and green bulkheads from the Mid-Atlantic, that have applicability to the Gulf Coast and other estuarine systems along the coastal zones of the US.

PRESENTER BIO: Mr. Morgereth is a Senior Ecologist and Practice Lead with Biohabitats, Inc. As an environmental consultant he has provided conservation planning and ecological restoration services for over 25 years. He holds a Master Degree in Ecological and Environmental Sciences from Johns Hopkins University. His work includes a focus on coastal and estuarine ecological restoration and resource management including living shoreline restoration and natural and nature-based features. He also has applied experience in climate change adaptation and coastal resiliency including for projects along the Atlantic and Gulf Coasts. He served as a member of the Chesapeake Bay Program's Shoreline Management Expert Panel.

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BUILDING COMMUNITY RESILIENCE CAPABILITY IN NEW JERSEY

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The description of "community" may vary somewhat from state to state but most often it refers to a municipal jurisdiction. Municipalities are commonly not-for-profit municipal corporations with part time and unpaid elected leadership, the vast majority of which are good-willed and well-intentioned. Municipalities are often the primary service providers for its members and have responsibility for the functionality and protection of such valued natural resources as beaches and floodplains within the jurisdiction. Similarly, if the emergency management maxim is true that "all disasters are local" then it follows that municipalities also have primary responsibility for disaster preparedness and community resiliency, particularly in "home rule" states like New Jersey.

Municipal decision-making is a factor of good information and incentives but municipalities are often resource constrained and lack the planning capacity for comprehensive research to discern the best practices. Consequently, state and federal governments can best facilitate good community decision-making by supporting the development and access to best available information and incentivize prioritized risk reduction strategies. As one of the top three states for recurring flood claim losses over the past forty years and current claims 22% higher than the national average, NJ is fertile ground to test flood risk reduction strategies. FEMA Region II is assisting the state with the development of several tools to facilitate prioritized risk reduction strategies at the local level which include:

- A Community Flood Resilience Toolkit which distills best practices and ongoing resilience research into an easy read for busy municipal executives and helps them quickly appreciate the next steps for their community on a mapped journey toward greater resilience.
- Mitigation Benefit Estimator Model is a tool that provides statewide analysis of potential flood hazard damages and risk reduction benefits at the structure level. The analysis replicates FEMA's BCA Tool methodology to provide potential damages by reoccurrence interval (10-, 50-, 100-, 500-year), annualized losses, and potential mitigation benefits across the state. Results are available at the structure level or can be combined at any user-defined geography (neighborhood, city, county, etc.) up to a statewide level. The results will inform future planning and prioritization of mitigation resources and resilience-based activities.
- Community Profiles is a database created to ensure communities have the risk and disaster impact history information specific to the community to make financially sound investments in resilience by understanding what's at risk and what the return on investment would look like for each strategy undertaken.
- Multi-year (10 yr.) Funding Plan instills predictability and continuity of a long term vision for community-wide elevations in the seven highest risk counties, leverages economies of scale for dramatically more cost effective mitigation, fosters better local buy-in through increased time to plan and prepare, shifts the mindset to a grander scale with larger impact, and facilitates building a culture of resiliency at the local level. It served as a roadmap for changing the current mitigation funding scheme.

PRESENTER BIO: Michael F. Moriarty serves as FEMA Region II Federal Insurance & Mitigation Director leading a team focused on breaking the cycle of recurrent disaster damage through more resilient communities in NY, NJ, PR & the USVI by reducing future losses to homes, businesses, public buildings and critical facilities from floods and other natural disasters.

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THE PISTON CORER: A NEW TOOL FOR CULTURAL RESOURCES SURVEY IN NEARSHORE ENVIRONMENTS

Joost Morsink, *Charlotte D. Pevny, Barry D. Bleichner, Michael Faught, and Abigail C. Bleichner*
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Over 13,000 archaeological sites in the southeastern United States are threatened by subsidence, sea level rise, and erosion. Numerous terrestrial sites are already submerged or destroyed. The same natural processes, as well as anthropogenic practices, have jeopardized cultural resources along Louisiana's coast. Evaluation of the processes that affect archaeological sites in wetland and coastal landscapes lacks rigorous data concerning subaquatic conditions of cultural remains. Access to wetland sites can be difficult and current investigative methods are not always adept or practical for identifying archaeological sites and collecting subsurface samples in wetland or shallow subaquatic conditions.

The piston corer is an innovative and inexpensive method for extracting complete, intact soil columns in wet environments. The coring tube is made of a transparent polycarbonate material, allowing immediate visual assessment of sediments in the field and eliminating the need to transport cores to a laboratory for analysis. The extraction process is rapid, so the piston corer can be used to expeditiously survey large areas for the presence of cultural materials and submerged or buried landforms. Facilitating data collection allows archaeologists to effectively study drowned terrestrial sites, thereby preserving history in submerged and eroding landscapes that might otherwise be lost. Additionally, more efficient studies in nearshore environments contribute to best cultural resource management practices.

PRESENTER BIO: Dr. Morsink is an archaeologist with more than 15 years of experience in international cultural resource management. His research has been funded by Fulbright and NSF, and he has worked in Europe, the Caribbean, and the United States.

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MERMENTAU BASIN ANALYSIS REPORT

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The Mermentau (ME) Basin, located on the Chenier Plain in southwestern Louisiana, can be divided into two sub-basins (Lakes in the north and Chenier in the south), divided by the Grand Chenier-Pecan Island ridge complex along with Louisiana Hwy 82. Human-induced hydrologic alterations, including the construction of five Lock structures and numerous channels, have altered the hydrology of the basin and have hydrologically isolated the two sub-basins from one another. These anthropogenic changes in conjunction with hurricane tidal surges have cause habitat alterations and land loss prompting the construction of a number of restoration projects within the basin.

The Coastwide Reference Monitoring System (CRMS) network data, publicly available at www.lacoast.gov/crms2/home.aspx, were used to evaluate land loss, hydrologic function, vegetation and elevation change and the effects of coastal protection and restoration projects within the basin. An analysis was performed to determine if the distinct geographic groupings of CRMS sites by sub-basin was viable. A Principal Component Analysis yielded three principal components that were ultimately used in a hierarchical cluster analysis to group the Basin CRMS sites into classes for analysis purposes. The final site classification placed 34 sites in the Lakes Sub-basin and 19 sites in the Chenier Sub-basin.

The sites in the Lakes Sub-basin have experienced excessive flooding in recent years causing vegetation in the sub-basin to shift to species that are more tolerant of near permanent flooded conditions. In addition, marshes in the Lakes Sub-basin consist of highly organic soils and have adapted to the excessive flooding by expanding and in some cases, floating. These mechanisms have shown the Lakes Sub-basin to be resilient to land loss due to the locks system that buffers salt water and allows for vegetation expansion despite the persistent flooding. However, an analysis of water levels inside and outside of these lock structures showed sufficient drainage to be difficult to achieve in the current system. The lock structures are operated for drainage at every opportunity but due to the small number of outlets, sea level rise, and inefficiency of the Mermentau River to drain the Lakes sub-basin, target water elevation is rarely achieved. The marshes of the Chenier Sub-basin have not experienced the flooded conditions of the Lakes sub-basin, but are experiencing Gulf shoreline erosion, saltwater intrusion and, due to the drainage inefficiencies of the upper basin, a lack of sediment and freshwater input. Compared to CRMS sites in other basins, the Mermentau Basin scores poorly in percent time flooded and are vulnerable to submergence. However, since the Lakes sub-basin is kept relatively fresh with little tidal exchange and resulting erosion, the ME Basin has significantly higher land gain at CRMS sites than the other basins coastwide.

The constructed restoration projects in the basin appear to be having a positive effect on land loss trends. Future projects should focus on the protection of eroding shorelines in the basin but also adding additional drainage avenues to assist the Locks system in the removal of excessive water, especially under hurricane and upland flooding conditions. In addition, the maintenance and improvement of the existing locks should be prioritized to maximize efficiency of drainage and protect the Lakes Sub-basin from saltwater intrusion.

PRESENTER BIO: Mark Mouledous is a coastal resources scientist with over 16 years of experience working in coastal wetlands. He has extensive experience monitoring wetlands and wetland restoration projects all along the Louisiana coast.

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HOW SEA LEVEL RISE IS CHALLENGING AND CHANGING MIAMI BEACH

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The City of Miami Beach is a barrier island located between Biscayne Bay and the Atlantic Ocean that was developed by filling in natural mangrove wetlands with dredge spoil over a porous limestone base. In recent years, Miami Beach has observed an increased frequency of urban flooding caused by higher high tides, elevated groundwater levels, and oversaturated soils. With sea level rise and an increase in the tidal cycle (spring tides and king tides), tidal flooding has become a more common occurrence on the streets of Miami Beach. It is not uncommon to observe residents wading barefoot through knee-high flood waters to access their homes.

The City has responded aggressively with a pro-active program to reduce tidal flooding and mitigate its impacts by upgrading aging gravity-based storm water infrastructure with tidal control valves, pump stations, and other innovative structures. The plan includes installation of 70 pump stations, 140 new outfalls and raising 60 miles of seawall in the next five years; the ultimate goal to raise roads and buildings; and in fact, most of the island. Challenges in implementing this program on an island that is highly urbanized and a world-wide tourist destination are numerous.

The most vulnerable areas are contiguous with Biscayne Bay that is designated as an Aquatic Preserve and Outstanding Florida Waterway. Water quality is highly regulated and the program depends on treated storm water being discharged through the outfalls into the Biscayne Bay. Permitting the program with Federal, State and local regulatory agencies is challenging based on the volume of projects and fast paced schedule necessary to keep the streets from continued flooding. Stantec is playing a major role to assist the City in sustaining its infrastructure, rich culture, economic viability, and quality of life by facilitating the design, permits, and construction oversight of much of this challenging program. Stantec environmental and engineering professionals are actively working with the City Engineer and his staff to ensure that Federal, State and local laws and policies are followed; leaders in their fields whose goal is to promote and facilitate resiliency of our valued coastal populations as the challenge of sea level rise and climate change become an ever-apparent reality.

PRESENTER BIO: Dr. Mowry is the City Engineer for Miami Beach, Florida. Bruce has more than 35 years of experience working on municipal projects both in the United States and foreign countries. Bruce holds a Ph.D. in Civil Engineering from Mississippi State University, along with multiple other degrees and certifications.

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UNDERSTANDING GEOLOGIC PROCESSES TO FORECAST SEDIMENTATION RATES WITHIN THE TEXAS GULF INTRACOASTAL WATERWAY AND OTHER CHANNELS

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This presentation shows specifically the geological evolution of the Texas (TX) upper coast and how geology is connected to Regional Sediment Management Plans and the future goals of the Texas Gulf Intracoastal Waterway (GIWW) based on the history of the depositional environments and dredge placement areas (PAs) performance. In the last 6,000 years, the present estuarine environments were converted from fluvial dominated landscapes to coastal dominated environments. Geologic maps are now used to anticipate dredging needs, equipment, and sediment management practices for the expansion of navigation channels and the identification of habitat restoration projects. The idea is to anticipate areas of fast sedimentation due to natural processes and identify areas where dredging is connected to other processes. Specific examples of key dredging spots along navigation channels are presented under the perspective of geologic and geomorphologic processes, which have the intention of facilitating the work for the identification of beneficial use of dredge material (BUDM) projects combining it with concepts such as building with nature and using natural sediment transport processes.

The TX bays and Gulf coast inlets are some of the most frequently dredged areas for navigation purposes in the US. From the 1850s through 1993, at least 260 million cubic yards of sediments were excavated from Galveston Bay to maintain the federal navigation channels managed by the US Army Corps of Engineers (USACE) (Ward 1993). This significant amount of dredged material does not include dredging from private or state navigation and restoration projects. In many instances, the dredge material (some from geomorphological processes) was deposited into PAs adjacent to navigation channels or in Ocean Dredged Material Disposal Sites in the Gulf of Mexico. For Galveston Bay alone, about 27,000 acres of PAs have been created since World War II (Ward 1993). It is estimated that a very small volume of sediments that have been dredged in TX navigation channels were used for BUDM projects. We present examples of the Texas upper coast of how geological and geomorphological processes can enhance the planning of future BUDM projects specifically on the GIWW.

A key question to this process is: How much do we really know about what is called new dredged material? The expansion of maritime commerce and the position of TX ports in the international markets will drive the growth of dredging-related opportunities in to waterways and navigation channels. The Post-Panamax adaptation and the deepening and widening initiatives will require major dredging of our waterways and will spearhead the potential of beneficial use of dredge material (BUDM) practices on new “geological sediments”. In TX, the description of these recent sediments is already incorporated into the TX Coastal Sediment Geo Database (TxSed) and have connected engineers, geoscientists, academic groups and geotechnical experts, all after one simple goal: To understand the natural distribution of our future new dredged material along the Texas navigation channels and plan for better BUDM options for this new material.

<u>PRESENTER BIO</u>: Juan Moya., PhD PG (TX & LA) is a senior Geomorphologist with Freese and Nichols with more than 29 years of experience in coastal planning, habitat restoration, and living with nature projects. He has extensive experience with habitat restoration and BUDM applications taking advantage of natural processes in Texas. He has authored several sediment management master plans in Texas and internationally.

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NAVIGATING SHIFTING ENVIRONMENTAL SCENARIOS

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Canal Barge operates within 12,000 miles of inland waterways connecting 38 states and moving 624 million tons of cargo annually. In general, barge traffic enjoys better fuel efficiency, a better safety record, and a lighter environmental footprint compared to other modes of bulk product transport. One fifteen barge tow can carry the same load as 216 rail cars on 6 locomotives or 1,050 large semi-tractor trailers. Though a critical component of national economic infrastructure much of this waterway traffic occurs largely out of the public view.

The Gulf Intracoastal Water Way (GIWW) is one such inland waterway, spanning 3,000 miles from Texas to Florida connecting major gulf ports shipping energy products, chemicals, and other commodities. The barge industry along the GIWW faces some significant challenges including aging infrastructure and funding for channel maintenance, not just of the GIWW channel itself, but also the channels that feed it and it feeds to, not only, but primarily the Mississippi River. As the state of Louisiana seeks to manage the flow of water and sediment across the lower half of the state for purposes of restoration, it may seek to use the GIWW as a conduit requiring input from many industry partners on how this is done. Ultimately, the future of this major shipping lane depends heavily on the ability of the state of Louisiana to stem the loss of land separating the channel from the Gulf of Mexico.

PRESENTER BIO: Spencer Murphy received a B.A. in History from the University of Pennsylvania in 1993 and graduated from Tulane University Law School in 1996. His responsibilities at Canal Barge include regulatory issues, claims and litigation, contract administration, business planning, and governmental affairs. Mr. Murphy is active in a number of civic and industry efforts focused on water management.

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MORPHODYNAMICS OF BARRIER-INLET SYSTEM: THE BATTLE BETWEEN WAVES AND TIDE

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Barrier-inlet system undergoes rapid morphological evolution over time. It is important to understand the dynamics of the system to predict the evolution of modern coastline and to interpret the continental shelf sedimentary record. A spatially-explicit 2D model was developed to study the 100-10,000 years' evolution of barrier island and inlet morphology as function of tidal range, wave regime, storm surge regime, and sea level rise. The model solves the sediment transport by tidal dispersion, and includes wave-driven onshore, downslope, and longshore sediment transport. Differently from previous models, barrier and inlets are not parameterized a priori (e.g., by defining variables describing barrier width and height), but rather form by unconstrained self-organization. Preliminary results show that, for a given wave regime, the number of inlets and the landward extent of the flood tidal deltas increase with tidal range. Larger tidal range results in shorter, wider and drumstick shaped barrier islands. The morphological evolutions of barrier islands and back-barrier region are also influenced by wave height, bed slope, frequency of storm surges, and sea level rise rate. Barrier islands tend to become narrower with retrogradation and more frequent breaching due to sea level rise. Model results will be tested with the centennial evolution of barrier islands (i.e. barrier geometry and stratigraphy) in the Mississippi Delta. The model will help to predict the evolution of barrier-inlet systems at the centennial time scale.

PRESENTER BIO: Shamim M. Murshid is a PhD student in the Department of Oceanography and Coastal Sciences at Louisiana State University. His research focuses on numerical modeling of the evolution of different aspects of coastal morphology and sediment transport processes.

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3D MODELING ASSESMENT OF INTAKE ALTERNATIVES ON THE LOWER MISSISSIPPI RIVER AT BAYOU LAFOURCHE

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The Bayou Lafourche Fresh Water District (BLFWD) has proposed pumping capacity improvements project (PCIP) to their existing pumping facility in Donaldsonville on the Lower Mississippi River (LMR) at the head of Bayou Lafourche. The objective of PCIP is to minimize sediment ingested by pumps through different alternatives. A comprehensive modeling system was developed to assess the conceptual level intake alternatives, including sedimentation in forebay, sediment management in Bay Lafourche, and the environmental impact assessment in Lower Mississippi River. This paper presents a modeling assessment study in support of the review of conceptual level intake alternatives using a 3D model.

Baird's in-house developed model MISED was used to simulate the hydrodynamics, sediment transport, and morphological changes in the LMR. MISED model is a 3D hydrodynamic and sediment transport model that employs a highly efficient numerical method (Lu and Wai, 1988). The sediment transport module of MISED can simulate the transport of both cohesive sediment and non-cohesive sediment in forms of suspended load and bed load. Both sediment transport forms play an important role in the morphological evolution in the Mississippi River and will influence the amount of sediment withdrawn by the intakes to Bayou Lafourche. Therefore, it is important to simulate both sediment transport modes for this modelling assessment. The model can also account for key morphological processes, such as bed form, bed sediment grading, and consolidation.

For this application, the model domain is selected as a river segment centred on Donaldsonville, Louisiana and extends about 10 miles in both downstream and upstream directions. This river segment contains two river bends. A total of eight sediment classes were used to represent the available sediment in the river from clay to coarse sand.

Recommendations on the intake alternatives were made by evaluating the impacts of forebay and in-water intakes on flood levels on the river and sedimentation in forebay, i.e. sedimentation volume for maintenance dredging, frequency of maintenance dredging, and minimizing the sediment ingested by the pumps.

The results of this study demonstrated the importance of using a 3D model with a high-resolution grid since the transport direction of bed sediment is in the direction of near-bed currents although it is also impacted by bed slope. At a river bend, a secondary (helical) flow is generally present, resulting in a significant deviation between the direction of near-bed currents and surface currents. This fully three-dimensional (3D) flow structure should be simulated using a 3D model.

PRESENTER BIO: Dr. Nairn is a Principal of Baird & Associates and has over 30 years' experience as a river and coastal engineer. He has worked on challenging coastal and river engineering projects in over 50 countries including many of the world's largest deltas in North and South America, Africa and Asia.

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GEOSTATISTICAL IDENTIFICATION OF POTENTIAL HOT SPOTS IN TIDAL MARSH DETERIORATION

Lindsay D. Nakashima *and Karen A. Westphal*
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The secular imbalance between sediment supply and the effects from major storms, marsh deterioration, sea level rise and subsidence are contributing factors to Louisiana's coastal land loss. This study identifies some indices of land loss from spatial and geostatistical analyses of bankline erosion and adjacent marsh flanking Freshwater Bayou Canal, which bisects the chenier plain in southwest Louisiana. The canal originated in 1968 as a major, dredged navigation channel linking the interior waters of the Gulf Intracoastal Waterway to the Gulf of Mexico. Freshwater Bayou Canal existed initially without stabilization measures, but ultimately required the emplacement of freestanding rock dikes to curtail persistent bankline retreat and marsh erosion.

This project utilizes aerial photography flown between 1969 and 2015 and analyzes sequential changes in bankline position, measures the rates of change in channel width and identifies marsh loss by classifying imagery into either land or water constituents preceding and following the placement of the rock dikes. We thought that sections of banklines with the highest retreat rates were collocated with the most rapidly deteriorating areas of tidal marsh that could be identified as non-random, statistically significant hot spots of land loss. We utilized 9 sets of aerial photography to digitize the Freshwater Bayou Canal banklines and a series of rock dikes. Land-water areas were classified within raster files at a spatial resolution ranging from 0.3 m-square to 1 m-square. Vector grid files corresponding to the spatial resolution of the imagery were made and point files marking the center of each grid square were attributed as either land or water. The points were clipped and aggregated to the area of interest for statistical analysis and hot spot geoprocessing to identify existing and emerging spatially clustered areas of land loss locations for comparison with the actual land loss areas shown in the imagery.

Hot spot analysis is a useful approach for evaluating existing and potential areas of marsh loss. Although the spatial patterns are not intrinsically predictive, they can assist with recognizing potential future patterns of marsh loss. Statistically significant areas of potential marsh loss identified in the initial years of analysis corresponded with areas of actual marsh deterioration shown the most recent Freshwater Bayou Canal aerial photography. However, rapid bankline retreat and severe marsh deterioration along the canal always preceded the placement of rock dike erosion control measures. Comparing the most vulnerable and rapidly eroding marsh areas from the hot spot analysis with the bank stabilization measures along Freshwater Bayou could broaden the spatial scale of the State's coastal restoration strategies by signifying areas of emerging marsh loss, which can facilitate the placement of projects and accelerate the deployment of additional countermeasures such as marsh creation along with traditional rock dike placement to increase the longevity of bankline restoration projects and restore vital habitat.

PRESENTER BIO: Dr. Nakashima is a coastal geomorphologist and GIS analyst with over 30 years' experience in Louisiana developing geospatial solutions and applying GPS/UAV technologies to programs relating to Audubon's Mississippi Flyway, Paul J. Rainey Wildlife Sanctuary, the Rainey Conservation Alliance, and the Mississippi River Delta Restoration Campaign.

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THE ISLE DE JEAN CHARLES RESETTLEMENT PROJECT – AN ADAPTATION PLAN TO MAINTAIN CULTURAL HERITAGE AND STRENGTHEN COMMUNITY RESILIENCE

Chief Albert P. Naquin
Isle de Jean Charles Band of Biloxi-Chitimacha-Choctaw Indians, LA, USA

The decision to resettle is not an easy one, but for the Isle de Jean Charles Indian Community, there is little choice. From 1955 to the present, the Island has lost most of its land — dwindling from 22,400 acres to 320 acres. In 2001, the Army Corps of Engineers decided that it was not cost efficient to include Isle de Jean Charles in the Morganza to the Gulf Hurricane Protection Levee. At that moment, Chief Albert Naquin knew that he had to mobilize his community to rethink his Tribe's adaptation strategy; exclusion from the protection of the levee meant his people would be at the mercy of rising waters and passing storms. In an effort to preserve and maintain tribal culture and heritage for future generations, the Tribe decided that it should resettle together further away from the coast.

Since 2001, the Tribe has been affected by a myriad of disasters, including numerous back-to-back hurricanes and the BP Oil Spill. These environmental disruptions and lack of support have further fueled the desire to resettle in a way that promotes and protects the unique identity and cultural heritage of the Isle de Jean Charles people. Through the resettlement process, the Tribe has been able to model a sustaining community and develop meaningful partnerships that strengthen community resilience.

The Tribe has engaged in many efforts to raise funds to relocate its Community. In 2017, through a National Resiliency Competition, the U.S. Department of Housing and Urban Development selected the Isle de Jean Charles Resettlement Project. The project proposal included purchasing land for the Tribe and resettling the Tribal members together, and reuniting them with tribal members who have already relocated due to land loss, flooding, and hurricanes. The Tribe also included a community center in its proposal. Since the Tribe lacks federal recognition, the State submitted the project on behalf of the Tribe. The Tribe is now working hard to ensure that the intent of the project is achieved. This includes recognizing the rights of the Tribe, which the State has been reluctant to do thus far. The Tribe's view is that a successful resettlement project must consider the goals of the Tribal community and its desire to maintain cultural heritage as a Tribe, not just random individuals living near each other.

Chief Naquin will discuss resettlement as a resilience strategy, give an overview of the obstacles to resettle, discuss the efforts to maintain community and lifeways in the face of the changing landscape, and share the current status of the Island's resettlement project.

PRESENTER BIO: Chief Naquin is the Traditional Chief of Isle de Jean Charles Band, located in Terrebonne Parish, Louisiana. A strong advocate for his people and homeland, he has represented his Tribe on numerous occasions at the local, state, federal, and international levels. He has been advocating for resettlement of his Tribal community since 2001. He is a Vietnam veteran.

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RESOURCE USE AND CONDITION OF WHITE SHRIMP, *LITOPENAEUS SETIFERUS*, IN A RAPIDLY CHANGING HABITAT

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Increased temperatures have allowed the black mangrove (*Avicennia germinans*) to expand its range and overtake salt marsh habitats typically dominated by smooth cordgrass (*Spartina alterniflora*) throughout much of the Louisiana coast. As this dramatic shift in dominant ecosystem type occurs over timescales as short as a few years, a major question that must quickly be answered involves the effect of this habitat shift on commercially and culturally important species that rely on these areas as essential to the completion of their life cycle. We assessed the diet and condition of white shrimp, *Litopenaeus setiferus*, in the salt marshes surrounding Port Fourchon, Louisiana, an area currently experiencing this habitat shift. Shrimp incorporate a wider range of resources into their diet than previously assumed, and their caloric content and resource reliance is greatly influenced by their bay of residence, rather than the type and amount of dominant habitat type, salt marsh or mangroves, present within their home range. White shrimp diet is more plastic than previously documented, and underlying variability in the ability of different bays to produce, rather than rapid shift in dominant habitat type, effects the condition of the shrimp produced by Louisiana's estuaries.

PRESENTER BIO: Justin Lesser is a 2nd year PhD Student and LA Board of Regents Fellow in the Ecosystems Ecology Lab at the University of Louisiana at Lafayette. He earned a M.Sc. in Marine Biology at Northeastern University, and studies the assembly and function of food webs in coastal ecosystems.

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HYDRODYNAMIC CONTROLS ON THE MORPHODYNAMIC EVOLUTION OF SUBAQUEOUS LANDFORMS

Timothy L. Nelson*, and Ioannis Y. Georgiou*
University of New Orleans, LA, USA

The southern Chandeleur Islands are an ideal setting to study shoal evolution given their history of submergence and re-emergence. Here, numerical models shed light on the attendant processes contributing to shoal recovery and reemergence following a destructive storm event. Simulations of a synthetic winter storm along a cross-shore profile using Xbeach shows that convergence of wave-induced sediment transport associated with repeated passage of cold-fronts initiates aggradation, but does not lead to reemergence. A Delft3d model of the entire island chain shows that as these landforms aggrade, alongshore processes driven by incident wave refraction on the shoal platform, backbarrier circulation and resulting transport become increasingly important for continued aggradation and eventual emergence. Aggradation magnitudes are a function of depth and range from 2 – 10 mm per event (onset to recovery to near mean sea level). In the absence of large storms, this modest aggradation can be more than one meter in a few years.

PRESENTER BIO: Timothy Nelson recently received a M.S. in earth and environmental sciences from the University of New Orleans in December of 2017. He has previous experience with remote environmental site assessments, mobile laboratories, and origins-of-life research.

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SMALL UNMANNED AIRCRAFT SYSTEMS AND LIDAR INTEGRATION TO MAP REMOTE AREAS

***Chad Netto**, GISP*
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LiDAR (Light Detection and Ranging) sensors have been around for several years and have become widely adopted in the surveying, transportation, oil, utility, mining, agriculture, and archaeology industries. The ability to quickly and accurately survey an area has enabled industries to save time and money. While mobile and terrestrial LiDAR systems have become more common, aerial based LiDAR systems are not as common due to the resources needed to support its operation. Small Unmanned Aerial Systems (sUAS) and changes in FAA regulations have created an opportunity for aerial LiDAR to become more accessible.

sUAS offer a unique advantage over traditional survey methods in that it can quickly cover wide areas and access remote or inaccessible areas. sUAS equipped with an active sensor such as LiDAR has the potential to penetrate vegetation and produce accurate measurements. This presentation will focus on the collection of sUAS based LiDAR data on the Louisiana coast, the challenges, and results associated with the operation.

PRESENTER BIO: Chad Netto, Chief Operating Officer at Chustz Surveying, oversees unmanned/ manned aerial surveys from mission planning and safety protocols to processing and deliverables. Chad brings 13 years of experience in remote sensing, data analysis/ visualization, and GIS. He is a certified Geographic Information Systems Professional and an FAA Remote Pilot.

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MEETING EDUCATION NEEDS IN COASTAL ENGINEERING AND SCIENCE

John Nicklow
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Louisiana is currently facing a coastal land loss crisis that is putting ecosystems, communities and livelihoods at risk. To address and overcome the challenges that have arisen and will continue to arise as a consequence, it is critical for Louisiana to build a local workforce that will meet current and future demands. This will require significant investments in human capital, via education, to improve the quality and skills of the workforce entering the coastal restoration and water management industries. Doing so will not only serve local communities, but will also solidify Louisiana as a hub of leadership and expertise for coastal communities throughout the world.

The University of New Orleans is helping to build this labor pool through its Coastal Engineering and Coastal Sciences (CEAS) Program. One of the only of its kind in the country, the program offers two graduate level certificates in Coastal Engineering and Coastal Sciences. The curriculum for the program was uniquely designed to focus on coastal environments similar to those found in the Gulf Coast. The creation of this program has signified a great stride towards the promotion of cross-collaboration between higher education institutions and the environmental management sector. It has ensured that the fields of coastal delta engineering and sciences in the region are filled with homegrown workers to meet their growing demand.

This presentation will discuss the importance of higher education institutions aligning with the needs of coastal restoration and water management industries to ensure we are developing a workforce that has the ability to protect Louisiana's coast. The University of New Orleans' CEAS Program can be used as a model in preparing and integrating such a critical program.

PRESENTER BIO: Dr. John Nicklow serves as the President of the University of New Orleans. He has 20 years of higher education experience as a faculty member and administrator, and he is a registered professional engineer and a certified professional hydrologist.

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A NEW SUBSIDENCE MAP FOR COASTAL LOUISIANA

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Coastal Louisiana has experienced catastrophic rates of wetland loss over the past century, equivalent in area to the state of Delaware. Land subsidence in the absence of rapid accretion is one of the key drivers of wetland loss. Accurate subsidence data should therefore form the basis for estimates of and adaptations to Louisiana's future. Based on subsidence rates at 274 CRMS stations we present a new subsidence map and calculate that, on average, coastal Louisiana is subsiding at 9 ± 1 mm yr^{-1}.

Our subsidence map shows a spatially continuous pattern of subsidence rates as recorded at the land surface. While spatial variability between our discrete monitoring sites is high (variability saturates at approximately 30km), the map shows that the expected average subsidence rate is relatively uniform across coastal Louisiana. It should be noted, however, that uncertainties at individual monitoring sites are significantly higher, and we therefore stress that both model and data uncertainties should be taken into account when estimating subsidence rates at specific localities, including those that coincide with CRMS sites. The map predicts slightly higher than average subsidence rates in the eastern Chenier Plain, the Atchafalaya and Wax Lake Deltas, and along the Mississippi River downstream of New Orleans. The lowest rates are found in the western portion of the Chenier Plain.

The map can be found in: GSA Today, v. 27, http://dx.doi.org/10.1130/GSATG337GW.1

PRESENTER BIO: Dr. Nienhuis is an assistant professor in coastal geomorphology at Florida State University. His research involves developing and applying morphodynamic models of barrier islands, river deltas, and floodplains, with the overall goal of improving decadal and centennial timescale morphologic predictions.

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NEW ORLEANS' JOIE DE VIVRE THE JOY OF LIVING IN NEW ORLEANS

Sunantana Nuanla-or
MLA Louisiana State University, Berkeley, CA, USA

New Orleans is well-know for its precarious location as it sits between Mississippi River and Lake Pontchartrain. With elevation below sea level, levee and flood walls have been built for protection. On the other hand, these boundaries disconnect people from interacting with water. This is important since hurricane Katrina has changed people's perception towards water. Lesson learn from the past, stronger and higher levee and flood walls are inadequate to protect us against future devastation. To live in the age of climate change, sustainable development and ecological design are in need of consideration to create sustainable future of New Orleans.

How to connect people to water? This project first investigates New Orleans in urban scale seek for the area of lake Pontchartrain as the typology area of the new design for the levee. With only fifteen minutes from downtown New Orleans, this quiet lakefront has a great potential to be a new city attraction. The design articulates land use strategy with sustainable development method to create the new proposal of lakefront development. In the existing condition, the levee acted as disconnector. With the new design proposal, levee plays an important role as a linkage of people with water and integrate to people's recreations. Moreover, it adds ecological function to the city's water system as it performs in urban water purification and protected wetland. In this design solution, we can celebrate the joy of living in New Orleans with nature and take advantages of the rich precious natural resources of water.

PRESENTER BIO (50-word maximum): Sunantana is a Landscape Architect. Her broad experiences ranging from residential landscape design to large, complex urban areas, has informed her professional goals as a landscape architect to create ecological and sustainable site designs that support the wise management of environments and improves the quality of life for our society.

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CREATED MARSHES SUPPORT FEWER FISH AND CRUSTACEANS THAN NATURAL MARSHES

***John Andrew Nyman**, and Scott Harlamert*
Louisiana State University Agricultural Center, Baton Rouge, LA, USA

Diversions are a large part of Louisiana's Master Plan as indicated by three sediment diversions that are predicted to create 79,967 acres wetlands at a cost of $1,861,100,000; i.e., $23,273/acre. Constructing wetlands with dredged material is an even larger part of the Master Plan than diversions as indicated by 40 dredging projects that are predicted to construct 321,400 acres of wetlands at a cost of $17,110,000,000; i.e., $53,236/acre. Most research to improve the efficiency of diversions and created wetlands focuses on vegetation. For over 50 years however, almost every justification of coastal restoration in Louisiana highlights fish and wildlife that use wetlands. Furthermore, Louisiana's 2017 Master Plan mentions fish twice as often as it mentions vegetation. None-the-less, relatively little research is designed to optimize the effects of restoration on fish and crustaceans (i.e., nekton).

We compared the quality and quantity of habitat for nekton among three treatments: (a) pre-restoration (large, open water), (b) restoration target (natural marsh), and (c) actual restoration (created marsh). We replicated all three treatments at four sites in southeast Louisiana; all four of the created marshes were at least five years old. All created marshes were constructed with hydraulically dredged sediment from open water bodies or the Mississippi River that was deposited in shallow open water areas that had earlier supported emergent vegetation. All four sites were in areas where natural wetlands were dominated by *Spartina patens*, which is the most common plant in coastal Louisiana. Sites were visited seasonally: spring, summer, fall, and winter. We replicated sampling within each site-treatment combination in triplicate. We used nekton collected with throw-traps as an indicator of nekton habitat quality; we used the distance from a random point to the first available nekton habitat as an indicator of nekton habitat quantity.

Habitat quality was similar in natural marshes and created marshes in terms of abundant species but there were differences, which agreed with a previous comparison of edge habitat between natural and created marshes. Habitat quantity differed between natural marshes and marshes constructed using dredged material. Created marshes had less habitat than natural marshes and thus probably provide fewer nekton than natural marshes to estuarine ecosystems. Until better data are available, we recommend that wetlands constructed from dredged material are designed explicitly to create nekton habitat as well as emergent vegetation. Such design features could include a lower surface elevation and/or increased interspersion of ponds and channels throughout the created marshes.

PRESENTER BIO: Andy has worked with wildlife managers and wetland restoration agencies for over 25 years and has coauthored over 70 peer-reviewed publications. The most-cited address wetland loss, oil spills, or marsh vertical accretion, which allows coastal wetlands to offset some subsidence and/or sea level rise.

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HOW HIGH SHOULD CREATED WETLANDS BE BUILT?

John Andrew Nyman
Louisiana State University, Baton Rouge, LA, USA

Diversions are a large part of Louisiana's Master Plan as indicated by three sediment diversions that are predicted to create 79,967 acres at a cost of $1,861,100,000; i.e., $23,273/acre. Marshes created with dredged material are an even larger part than diversions as indicated by 40 dredging projects that are predicted to construct 321,400 acres at a cost of $17,110,000,000; i.e., $53,236/acre. Most research to improve the efficiency of diversions and created wetlands is designed to increase vegetation. For over 50 years however, almost every presentation and document addressing Louisiana's wetland loss problem mentions fish and wildlife. Furthermore Louisiana's 2017 Master Plan mentions fish or wildlife twice as often as it mentions vegetation.

Created wetlands are routinely constructed so that their initial elevation is higher than natural wetlands. There are several justifications for the higher elevation: (i) dredged sediments will consolidate under their own weight for several years, (ii) dredged sediments will induce consolidation of underlying sediments for several years, (iii) new plants lack large root systems that allow mature plants to tolerate flood durations associated with lower elevations in natural marshes, (iv) higher elevation reduces storm surge more, and (v) higher elevation is required for the created wetland to survive 20 years of local subsidence and global sea-level rise.

Currently available information suggests that these first three justifications are valid whereas the latter two are invalid. Furthermore, the justifications ignore fish and wildlife functions.

- Extra elevation to reduce storm surge is not a valid justification for wetland restoration projects that are too far from flood protection levees to affect storm surge there. Detailed hydrologic and economic modelling is needed to determine the hydrologic and economic conditions that justify increasing the elevation of constructed wetlands rather than constructed levees.
- Extra elevation is unnecessary to survive local subsidence and global sea-level rise for wetland restoration projects that will experience sea-level rise rates projected for the next 30 years and typical subsidence rates in coastal Louisiana because marsh vertical accretion will cause created wetlands to gain elevation at rates in natural wetlands, which can average 10 mm yr^{-1}.
- Extra elevation delays rather than extends fish and wildlife use of created wetlands because fish and wildlife use of wetlands depends upon flooding frequency and edge habitat.

I recommend that after initial compaction, created marshes be only a few centimeters higher than natural marshes to allow new plants a few years to establish large root systems. Additional elevation increases costs but delays rather than extends wetland benefits.

PRESENTER BIO: Andy has worked with wildlife managers and wetland restoration agencies for over 25 years and has coauthored over 70 peer-reviewed publications. The most-cited address wetland loss, oil spills, or marsh vertical accretion, which allows coastal wetlands to offset some subsidence and/or sea level rise.

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LET THE OYSTERS DO THE WORK: A PROPOSAL FOR CREATING TRULY BIOGENIC STRUCTURES FOR RESILIENCE AND RESTORATION

Tyler Ortego[1], *Matthew Campbell*[1], *Steven Hall*[2] *and Robert Beine*[1]
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[2]North Carolina State University Dept of Biological and Agricultural Engineering, Raleigh, NC, USA

Oyster reefs aren't just a valuable resource or desired outcome of a living shoreline. The heavy calcium carbonate shells of millions of oysters represent a significant source of biogenic building material. By growing reefs onto modular 3D scaffolds, we can substantially increase cost efficiency and efficacy of created reefs. A number of techniques have been developed to either protect shorelines, restore oyster reefs or even do both. However, these techniques have their own inherent shortcomings. For example, living shoreline structures are installed along the project shoreline, a location that may or may not support robust reef development. In any case, these reefs have a long way to go to replace the lost resource. We want to let the oysters do the work. Much like a sustainable forester plants seedlings on rotating plots of land and selectively harvests at the right time, we propose to plant modular three dimensional scaffolds in prime oyster growing waters and nurture until generations of oyster growth create living building blocks. After the grow-out period, the living building blocks would be transported and installed into a final design configuration. The biogenic component provides the necessary structural integrity and mass to satisfy engineering criteria for the ultimate project. Proposed uses for these building blocks include living shorelines, barrier reefs, brood stock sanctuaries and preparation for large scale hydrologic modifications. To validate the hypotheses behind this proposal, the authors examine data collected from test scaffolds installed in southwest Louisiana between 2007 and 2014. Data includes oyster biometrics and bulk geometry. One study even examined the relative strength of concrete and biogenic oyster reef composite compared to the initial concrete. In addition, a number of scaffold designs and oyster friendly substrates were evaluated for constructability and performance. The authors present calculations to demonstrate cost efficiencies and quantify ecosystem services provided by the "scaffold nursery" and discuss business model innovation.

PRESENTER BIO: Tyler Ortego is a coastal engineer and entrepreneur with a passion for commercializing promising environmental technologies.

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RESTORING THE SWAMP: HYDROLOGIC RESTORATION AND VEGETATIVE PLANTING IN THE DES ALLEMANDS SWAMP

***Sharon Osowski Morgan**, Ph.D.**,** Adrian Chavarria, and Patricia A. Taylor, Ph.D., P.E.*
U.S. Environmental Protection Agency, Region 6, Dallas, Texas, USA

Louisiana swamp forests provide important wildlife habitat and storm surge protection for nearby communities. The Des Allemands swamp located in St. James Parish, is experiencing a loss of marsh and a declining cypress forest. Many years of study by Louisiana State University researchers demonstrated because of impoundment, subsidence, and inadequate accretion of sediments and organic matter, some areas are highly stressed and converting to open water, floating aquatic plants, and fresh marsh. The Hydrologic Restoration & Vegetative Planting in Des Allemands Swamp (BA-34) project, funded under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) was recently completed to address the hydrologic impoundment condition. The BA-34 project is the first project funded under the CWPPRA program to restore a swamp. EPA Region 6 is the federal project sponsor and the Coastal Protection and Restoration Authority (CPRA) is the local sponsor.

The initial BA-34 CWPPRA project included a siphon feature however the project was re-scoped to focus on the remaining project features. The constructed project features include six spoil bank gaps excavated into the swamp to reverse the impoundment effects that are serious impediments to healthy swamp structure and function. Cypress and tupelo seedlings were also planted to help reestablish the swamp forest in highly stressed areas. Over time, project benefits should include reduced swamp submergence and increased swamp productivity. This strategy will, in turn, provide wildlife, fishery, and storm buffering benefits. The project will enhance an area of swamp (2,395 acres) that would continue to degrade without this project.

The presentation will include a brief project history, review the constructed design features and construction methodology, and provide lessons learned for future projects.

PRESENTER BIO: Dr. Sharon Osowski-Morgan is an Ecologist with EPA Region 6 and CWPPRA Environmental and Monitoring Workgroups representative. She earned a Ph.D. in Ecology (Utah State), a MS in Environmental Toxicology (Clemson), and a BS in Biology (Baylor). Dr. Morgan is a certified Senior Ecologist and certified Wildlife Biologist.

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COASTAL LAND LOSS AND THE FUTURE OF LOUISIANA'S ARCHAEOLOGICAL RECORD

Brian E. Ostahowski
President, Louisiana Archaeological Society, New Orleans, LA, USA

This presentation examines the effects of land loss to the coastal archaeological record of Louisiana. The impacts to archaeological record observed from different scales (coast-wide, regional, and the individual archaeological site) demonstrate that our ability to understand Louisiana's past may be permanently altered. New directions for future research are also proposed.

PRESENTER BIO: Mr. Ostahowski is archaeologist with more than 14 years of experience in cultural resource management projects. He currently serves as the President of the Louisiana Archaeological Society and is actively involved with coastal Louisiana archaeology, advocating for threatened cultural resources along southeastern Louisiana.

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QUANTIFYING AND PRIORITIZING OPPORTUNITIES FOR CANAL BACKFILLING IN LOUISIANA

Haigler Pate

National Park Service, Jean Lafitte National Historical Park and Preserve, New Orleans, LA, USA

Canal backfilling-degrading and replacing the spoil adjacent to canals-has a wide range of potential benefits for the restoration of Louisiana coastal wetlands, but is not explicitly incorporated into current coastwide-scale restoration plans. I worked to characterize backfilling opportunities using a GIS analysis of publicly available datasets to quantify and prioritize the area and distribution of spoil currently suitable for use as canal backfill. I used multiple filters to select backfillable spoil features based on the predicted stability of the surrounding landscape, feature size, and proximity to Congressionally-authorized navigation channels or active oil and gas wells. Even this much-reduced extent of spoil indicated significant opportunities for backfilling distributed throughout Louisiana coastal areas.

The Barataria, Mermentau, and Terrebonne hydrologic basins contained most of a total prioritized backfillable spoil area of approximately 10,775 hectares. The total is similar to the area of linear restoration projects included in Louisiana's 2012 Comprehensive Master Plan for a Sustainable Coast. Coastwide canal backfilling could be accomplished for less than a third of the cost of those projects, and greater savings and performance could be achieved by combining backfilling with master plan projects whose footprints they intersect. Rough estimates of the value of wetlands that could be created through canal backfilling are $1.33 billion, or $0.14 billion per year. Estimates of the net present value of a crash program of coastwide backfilling ranged as high as $2.7 billion after 50 years.

The description of results above was as of 2014, and will be updated to reflect more current data.

PRESENTER BIO: Mr. Pate is the Natural Resource Program Manager for Jean Lafitte National Historical Park and Preserve, and has 15 years of experience in various park resource management roles including planning and implementing canal backfilling projects at Jean Lafitte. This work was the result of a master's project at Duke University.

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TROPHIC INTERACTIONS BETWEEN MICROZOOPLANKTON AND PHYTOPLANKTON IN THE ATCHAFALAYA VERMILION BAY

***Mrunmayee Pathare**, Beth A. Stauffer and Hans Prevost*
University of Louisiana at Lafayette, LA, USA

Microzooplankton (MZP) grazers are major consumers of primary production in coastal systems, forming an important trophic link between small primary producers and larger consumers. MZP exert significant top-down control on phytoplankton and play a role in structuring phytoplankton community composition due to preferential feeding. Grazing of phytoplankton by MZP has important implications for nutrient cycling and food-web structure in coastal estuarine systems, where fast growth of picoplankton can cause blooms and eutrophication. The Atchafalaya Vermilion Bay System (AVBS) is a shallow, turbid estuary in south Louisiana which receives freshwater from the Atchafalaya River as well as smaller river systems. Barrier islands like Marsh island limit the exchange of water between the AVBS and the northern Gulf of Mexico, and may contribute to the consistently low salinity (0-4 ppm) recorded here. Several studies have suggested that the AVBS is dominated by wind-driven circulation, which may account for the year-round high turbidity and low salinity, with salinity fluctuations primarily related to storm activity. The AVBS supports a nursery ground for commercially important fish species, like brown shrimp and gulf menhaden, and changes in the base of the food web will have impacts at higher trophic levels which consume them in their larval and adult stages.

Samples have been collected since 2016 from a nearshore site in Vermilion Bay to examine the top down and bottom up controls on phytoplankton abundance and community composition on a seasonal scale. Samples were also collected in July 2017 and October 2017 from three sites in the northern Gulf of Mexico to the southeast of the AVBS to study the phytoplankton abundance and community composition, and microzooplankton grazing interactions on a spatial scale of differing river and marine influence. Size fractionated chlorophyll biomass, microscopy and flow cytometry was used as a proxy for phytoplankton abundance, and dilution experiments were used to study trophic interactions.

Size fractionated chlorophyll biomass was dominated by pico- and nanoplankton for most months from 2016 at AVBS, with microplankton dominating biomass only in spring 2017. Results of dilution experiments conducted at AVBS showed a variety of grazing responses dominated by positive slopes and non-linear dynamics. Grazing mortality ranged from 0.21 day-1 to 0.27 day-1 which is lower than figures reported in similar estuaries and coastal areas. These results suggest saturated grazers and complex interactions between the grazers and phytoplankton due to factors, such as selective grazing by MZP and a release of grazing pressure on certain size fractions or species of phytoplankton. Flow cytometry and Utermöhl cell counts were used to identify and enumerate community composition and grazing-induced changes in community composition of phytoplankton and MZP and were used to interpret non-linear and positive slopes observed in dilution experiments.

Presenter Bio: Mrunmayee Pathare is a Masters student in the Stauffer lab at the University of Louisiana at Lafayette. She is interested in studying the top down and bottom up processes affecting phytoplankton and trophic interactions between microzooplankton and phytoplankton in coastal and marine environments.

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ASSESSING THE EFFECTS OF COLD FRONTS ON HYDRODYNAMIC CHARACTERISTICS AND TEMPERATURE-SALINITY PATTERNS IN BARATARIA BAY

***Ali Reza Payandeh**, Dubravko Justic, and Giulio Mariotti*
Louisiana State University, Baton Rouge, LA, USA

In situ measurements from Barataria Bay, Louisiana, for the period December 2016 - February 2017, have been analyzed for low frequency fluctuations. A total of 17 cold fronts were identified during the observation period. Wavelet Coherence (WC) was used to examine the impact of cold fronts on water levels, currents, salinity, temperature and suspended sediment concentration. WC results showed the dominant 3 - 7 days period signals in crossshore wind stress, atmospheric pressure, and water levels over the entire observation period, consistent with the passage of cold fronts over the northcentral Gulf of Mexico. The crossshore current was highly correlated with wind stress over 3 - 7 day period but the alongshore current was not significantly affected by the wind stress. Cold fronts appeared to have little influence on the bay salinity and salinity intrusion was not observed during southerly winds prior to cold front passages which was likely due to the compensatory influence of fresh water discharge from Mississippi River. The mean phase difference between cross shore wind stress and water level was 17 degrees and the mean time lag was 7 h. The largest observed sea level variation of 71 cm occurred in response to the strongest cold front event during the observation period that was characterized by a 0.66 N/m^2 crossshore wind stress and flushing rate of 3,000 m^3/s.

Presenter Bio: Ali Reza Payandeh is a Ph.D. student in Department of Oceanography and Coastal Sciences at Louisiana State University. He has gained extensive experience as a coastal engineer and modeler participating in a number of coastal engineering projects prior to enrolling in a Ph.D. program at LSU.

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A MIGRATORY SONGBIRID CONNECTS FORESTED WETLANDS ACROSS CONTINENTS

Katie Percy *and Erik I. Johnson*
Audubon Louisiana, National Audubon Society, LA, USA

The Prothonotary Warbler (*Protonotaria citrea*) is a Nearctic-Neotropical migratory songbird that is considered a top conservation priority species because of rapidly declining populations. It specializes on wet forests both during the breeding and non-breeding seasons. An estimated 25% of the global breeding population of Prothonotary Warblers occur in Louisiana, with 10% occurring in the state's coastal zone alone. Thus, understanding the nesting and migratory ecology of Prothonotary Warblers that breed in Louisiana has particular importance for addressing conservation needs of the species. Because Prothonotary Warblers nest in cavities and will readily use man-made nest boxes, Audubon Louisiana staff and volunteers began installing and monitoring nest boxes in Louisiana in 2013. By 2017, we have installed 140 predator-guarded nest boxes at seven sites across south Louisiana and average annual nest success across study sites has remained relatively high (range: 84.1 – 100.0%).

To better understand Prothonotary Warbler migratory ecology we have deployed archival light-level geolocators that use photoperiod and sun position to estimate daily latitude and longitude (± 100-150 km) positions of an individual bird throughout their migration. Between 2013 and 2016 we deployed 46 geolocators on Prothonotary Warblers, 14 of which (30%) have been recovered. Data from recovered geolocators reveal broad patterns in the timing of migration, with fall migration being particularly prolonged (up to 3.5 months), including multiple prolonged stopovers along the northern Gulf Coast and several sites in Central America before arriving on wintering grounds in northern Colombian wetlands. These data emphasize the importance of wetland conservation throughout the Americas, with Louisiana serving as a critical central role for this conservation priority species.

PRESENTER BIO: Katie Percy has a B.Sc. from Louisiana State University in Natural Resource Ecology and Management and a M.Sc. from the University of Tennessee in Wildlife and Fisheries Science. She has been involved with field-based bird research and monitoring for 10 years. She has specifically been involved in Prothonotary Warbler nest box monitoring and geolocator research since 2015.

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CONTINUOUS AND DISCRETE WATER QUALITY IN BASINS EAST AND WEST OF THE MISSISSIPPI RIVER

Brian C. Perez[1]*, Mike Boudreaux*[1]*, John Lambou*[2]*, Richard Raynie*[3]*, and Syed Khalil*[3]
[1]Jacobs, Baton Rouge, LA, USA
[2]APTIM, Baton Rouge, LA, USA
[3]Louisiana Coastal Protection and Restoration Authority, Baton Rouge, LA, USA

The State of Louisiana and its partners have invested considerable resources and have made long-term commitments to the restoration and management of Louisiana's coastal system. This restoration and management program requires monitoring targeted parameters to compile a foundation of quality data to understand how the main drivers of system change influence specific system characteristics. The System Wide Assessment and Monitoring Program (SWAMP) was developed to identify the overarching goals of the monitoring program and to obtain repeated long-term (e.g., years to decades) measurements that can be analyzed to detect changes that may result from a variety of sources, including large-scale restoration and protection projects, environmental disturbances, changing climate, and other major drivers that impact the system.

Water quality is an important component of the SWAMP monitoring program in documenting changes of key water quality parameters in estuarine open water bodies that are sensitive to system drivers and are critical for understanding system dynamics. Barataria Basin was selected as the initial location to demonstrate the application of a system-wide approach to monitoring water quality at the basin scale and 23 stations have been monitored monthly for selected water quality parameters since November 2015. Beginning in November 2016, the water quality monitoring program was expanded to both Breton Sound (18 stations) and Pontchartrain Basins (18 stations).

At each SWAMP water quality station, monthly measurements of temperature, specific conductivity, salinity, turbidity, and dissolved oxygen are taken at one-foot intervals over the depth profile. In addition, a discrete water sample is collected at mid-depth to be analyzed for chlorophyll *a*, total suspended solids, volatile suspended solids, and a suite of nutrients (total Kjeldahl nitrogen, total phosphorus, nitrate+nitrite, ammonium, orthophosphate, and silica).

In addition to discrete monthly sampling, CPRA and USGS have instrumented 4 pre-existing continuous recording stations in Barataria Basin to include chlorophyll, dissolved oxygen, and turbidity measurements.

This presentation will provide an overview of the SWAMP Water Quality program and discuss initial findings from the monthly and continuous monitoring conducted.

PRESENTER BIO: Brian Perez is a wetland and estuarine ecologist with Jacobs with 24 years of experience working in coastal Louisiana. He specializes in surface elevation and accretion dynamics, nutrient dynamics, and wetland monitoring. He has served as the senior scientist for the CRMS-*Wetland* monitoring program for the past 10 years.

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LOUISIANA COASTAL PROGRAM LAW AND POLICY

David A. Peterson[1]*, Ryan Seidemann*[2]*, S. Beaux Jones*[3]*, Richelle Moore*[4,] *and Megan K. Terrell*[5]

[1] General Counsel, Coastal Protection and Restoration Authority, Baton Rouge, LA, USA
[2]Section Chief, Lands and Natural Resources Section, Louisiana Department of Justice, Baton Rouge, LA, USA
[3]Attorney, Baldwin, Haspel, Burke & Mayer, LLC, New Orleans, LA, USA
[4]Deputy General Counsel, Coastal Protection and Restoration Authority, Baton Rouge, LA, USA
[5]Legal Advisory – Coastal Activities, Environment and Natural Resources, Louisiana Governor's Office, Baton Rouge, LA, USA

The purpose of this session is to present a discussion of current legal and policy issues impacting Louisiana's Coastal Program. Panelists will include government, coastal and private attorneys who are actively engaged in advising and counseling various public and private clients relative to the State of Louisiana's integrated coastal protection efforts. The discussion will include general discussions of land rights issues, including public and private lands, environmental law policies and ecosystem restoration permitting issues, mitigation banking, and innovative project delivery methods, including outcome based performance contracting. The panel discussion will end with all panel members considering the legal and policy issues relating to integrated coastal protection relative to education of Louisiana's future coastal lawyers.

PRESENTER BIOS:
Mr. Peterson is General Counsel for the Louisiana Coastal Protection and Restoration Authority (CPRA) and has worked for more than 20 years in the areas of environmental and coastal issues and litigation within both the public and private sector, having spent the last 10 years as counsel for CPRA and the CPRA Board as an assistant attorney general with the Department of Justice and directly for CPRA.

Mr. Seidemann is the Section Chief of the Lands & Natural Resources Section at the Louisiana Department of Justice with over 10 years' experience in the areas of environmental, natural resources, land use, and disaster law as well as in archaeology and cemetery studies.

Mr. Jones is currently an attorney with Baldwin, Haspel, Burke & Meyer, LLC with a practice based in litigation and administrative matters, focusing on environmental, coastal, and oil and gas law. Mr. Jones was previously an assistant attorney general with the Louisiana Department of Justice Lands and Natural Resources and Environmental Sections.

Ms. Moore is Deputy General Counsel for the Louisiana CPRA with over 10 years' experience in contract, public procurement, environmental, and coastal issues in both the private and public sector. Ms. Moore has been the primary legal counsel for CPRA relative to CPRA's Outcome Based Performance Contracting initiative and enabling legislation.

Ms. Terrell is Legal Advisor for Coastal Activities, Environment and Natural Resources with the Louisiana Governor's Office and was formerly Deputy Director of the Civil Division and the Section Chief of the Environmental Section at the Louisiana Department of Justice with over 10 years' experience in the areas of environmental, natural resources, land use, permitting, mitigation and disaster law. Ms. Terrell was the lead in-house legal advisory for the Louisiana Department of Justice for the Deepwater Horizon Oil Spill.

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FROM TRASH TO TREASURE: CONVERTING A MUNICIPAL LANDFILL INTO AN ECOLOGICAL GEM AND RECREATIONAL DESTINATION

***Matthew E. Petty*[1]**, *Laura Burbage*[2], *and Warren Newman*[3]

[1]CDM Smith, Columbus, OH, USA
[2]CDM Smith, Newport News, VA, USA
[3]CDM Smith, Edison, NJ, USA

As one of the remaining priorities of an outgoing Governor's administration, the New Jersey Department of Environmental Projection (NJDEP) wanted to expedite the closure of the 65-acre Harrison Avenue Municipal Landfill in Camden, New Jersey. However, landfill closure was only one priority, as NJDEP sought to turn the site into a crown jewel of a metro park with a diverse array of ecological features and recreational amenities. Working with the environmental scientists and engineers of CDM Smith, existing natural resources were delineated and inventoried and innovative restoration designs developed to accomplish two seemingly disparate goals: adequate landfill closure and ecosystem restoration.

The restoration design included the creation and restoration of complex freshwater tidal marshes and scrub-shrub wetlands, intricate tidal channels, living shorelines, bioengineered shoreline stabilization, upland forests, pollinator meadows, and wildlife features like artificial bald eagle perch poles and beds for imperiled freshwater mussels. Conservation areas designated to preserve super-canopy trees where solid waste levels were low, providing local wildlife with refuges during construction. Other aspects of the project include incorporating bioswales and other stormwater features and designing recreational use features like paths, gardens, playgrounds, overlooks and vistas, a fishing pond, and a kayak launch.

The presentation will explore how restoring natural areas and improving coastal resiliency can occur in unlikely areas. It will touch on innovative elements of restoration design, including tidal marsh and channel restoration and creation, that can be applied to coastal ecosystems, including those in Louisiana. It will also focus on the importance of the human element in ecosystem restoration and the ability to increase both the ecological function and the recreational use of a natural area, particularly in an urban environment. This project also offers lessons learned, particularly in the realms of environmental permitting, stakeholder management, and working with unique site constraints.

<u>PRESENTER BIO</u>: Mr. Petty is an ecologist with more than 10 years of experience conducting stream and wetland assessments and designing and implementing wetland restoration projects. Matt has a long history of working with stakeholders nationwide to evaluate and implement projects that improve coastal resiliency, restore and preserve natural resources, and provide community benefits.

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ADVANCING SEDIMENT DIVERSION OPERATIONS DISCUSSIONS: TESTING RECOMMENDATIONS OF AN EXPERT WORKING GROUP

Natalie S. Peyronnin[1]*, Rex Caffey*[2]*, James Cowan Jr.*[2]*, Dubravko Justic*[2]*, Alex Kolker*[3]*, Shirley Laska*[4]*, Alex McCorquodale*[4]*, Earl Melancon Jr*[5]*, Ehab Meselhe*[6]*, Steven Midway*[2]*, James Nelson*[7]*, J. Andy Nyman*[2]*, Jenneke Visser*[7]*, Randall Wells*[8]*, John White*[2]*, and James Wilkins*[2]

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Louisiana's coastal future relies on reconnecting the Mississippi River to the delta and allowing the water, sediment and nutrients from the river to nourish and sustain existing marshes and rebuild lost wetlands. Through a series of gates, a sediment diversion can allow discharge of up to 75,000 cfs from the river to the adjacent marshes at various times and flows. The very nature of the size of the flow, similar at times to the average flow of the Missouri River, can fundamentally alter the ecological and social landscape. The inherent flexibility of the structure and its operations require a dynamic balancing of multiple objectives and constraints of the ecosystem and the communities that rely on those resources.

At State of the Coast 2016, the Sediment Diversion Operations Working Group, an interdisciplinary group of experts, presented the recommendations developed for operating a sediment diversion to maximize the amount of land built or sustained, while also balancing the needs of the ecosystem and coastal communities. The recommendations were developed over an eight month period where the working group, along with 42 other invited guest experts, evaluated how the operation of a sediment diversion could affect every major aspect of the coast. This was accomplished by maximizing operations for each single objective, void of other constraints, and then evaluating the commonalities and dissimilarities in each strategy.

The recently published results included a set of recommendations for operational strategies, both initially and over long-term operation of the diversion. The working group is currently testing the recommendations through hydrodynamic, morphology and vegetation models to determine how the expert predictions of outcomes compare to the predictions of 3D, process-based models. This presentation will summarize the interdisciplinary approach to an environmentally and socially complex problem, overview the recommendations of the working group and provide some preliminary modeling results from the on-going effort.

PRESENTER BIO: Natalie Peyronnin is the Director of Science Policy at the Environmental Defense Fund. Prior to EDF, Natalie worked on the Coastal Master Plan at CPRA and served as the Science Director for the Coalition to Restore Coastal Louisiana. She has a B.S. in Wildlife and Fisheries, a MS in Oceanography and Coastal Sciences and is a PhD candidate in Marine, Estuarine Environmental Sciences.

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LESSONS LEARNED FROM EXISTING MISSISSIPPI RIVER DIVERSIONS

Erin M Plitsch
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Reintroduction of freshwater from the Mississippi River into coastal estuaries is an important restoration tool for the Louisiana Coastal Area, which is experiencing rapid land-loss. Reconnecting the river to outlying estuarine basins via large-scale sediment diversions is an integral part of Louisiana's Master Plan for a Sustainable Coast, and the lessons learned from currently operational diversions can aid in the development of future projects.

Louisiana coastal restoration projects currently include structural diversions such as the Caernarvon and Davis Pond Freshwater Diversions, as well as smaller-scale siphons. In addition to these controlled structures, there are a number of uncontrolled crevasses, including the West Bay Sediment Diversion. While the project designs vary among these diversion types, their operation and management over time allows for a greater understanding of the natural processes involved, as well as management and operational approaches.

Despite a salinity-based management plan for the Caernarvon and Davis Pond Freshwater Diversions, an ancillary benefit of sediment accumulation has been observed in both outfall areas. In the case of the West Bay Sediment Diversion, however, sediment build-up has taken longer than anticipated to be observed. Sediment accumulation and retention has been facilitated in the West Bay receiving basin both from high river events, and the construction of dredged-material islands. Observations from these diversions lend guidance to the planning of future diversion structural designs and adaptive management regimes.

These diversions, as well as smaller-scale controlled and uncontrolled freshwater inputs, also shed light on a number of considerations that arise with long-term project lives. As structures age, maintenance must be taken into account, and as technology changes, the costs for these events may rise over the project life. Particularly with projects that share financial burden, multi-agency coordination throughout the project life remains important. Outfall landscape and hydrology can impact project performance, and both initial conditions as well as possible changes over time to the outfall landscape should be considered. Changing needs of the outfall environment and/or user groups may require adjustments to the management and operational plans, requiring some flexibility and further coordination between agencies at all levels of government, as well as with communities and stakeholders.

Freshwater Diversions are an important tool for coastal restoration in Louisiana. By examining the many lessons learned from existing projects, greater optimization and benefit can be achieved through the conscientious design and management of future structures.

PRESENTER BIO: Ms. Plitsch is a Coastal Resources Scientist with CPRA's Operations Division. Her focus is on the monitoring and operational management of currently constructed diversion projects, and she serves as chair of the Caernarvon and Davis Pond Freshwater Diversion technical working groups.

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DON'T HAVE TO OUTRUN THE BEAR – I JUST NEED TO OUTRUN INITIAL CONSOLIDATION AND COMPACTION

***Michael T. Poff*[1]*, Brad Miller[2], Greg Grandy[3], Steve Dartez[3] and Brett Borne[3]*

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One of the most critical design criteria for successfully designing and constructing barrier island restoration projects is determining the initial consolidation and compaction rates of the emplaced fill and underlying soils within the beach, dune and marsh restoration templates. Target elevations for the habitat zones within the restoration plan are established based upon historical data, surveying healthy resource habitats within the system, coastal processes analyses, and numerical modeling. Sustainability of these features over the desired project life is dependent on first, achieving the target elevations during construction and second, correctly predicting the evolution of the features over time as the habitats undergo morphologic changes in response to natural processes and anthropogenic influences.

Detailed geotechnical investigations are undertaken during the design process. The investigations include a desktop analysis to review historical data such as design reports from nearby projects or monitoring data of completed projects. Sampling plans are developed to site boring locations within the beach, dune, and marsh fill templates and along the alignments of containment features or structural complements. Borings are collected utilizing various equipment selected to meet site constraints and environmental conditions, and typically range from 40 feet to 100 feet below existing grade. The native sediments are tested and compared to the borrow source sediments to yield design criteria for initial consolidation and compaction and long-term settlement for each habitat feature as well as containment dike and structure slope stability.

The elevations of the beach berm, dune crest, and marsh platform are determined in an iterative process. Based on the coastal process analyses and modeling, the target "post-construction" elevations are selected. The design criteria for initial consolidation and compaction and then added to the target elevations. Background subsidence is also accounted for by multiplying the historic rate times the project life, and adding that to the target elevations. Lastly, construction tolerances are included to address equipment and other factors affecting placement of sediments in the marine environment. Collectively these parameters comprise the construction template elevations specified on the construction plans and within the technical specifications. Detailed surveys are performed during construction to ensure the dredge contractor is achieving the correct elevations.

Key lessons learned from past project experience include the addition of borings within the beach and dune templates noting early restoration projects only analyzed the settlement of the marsh platform, addition of cone penetrometer tests to complement and calibrate the borings thus providing a lot more sampling points in a cost effective manner, and inclusion of overwash plates with the settlement plate monitoring systems to enable the measurement of overwash from the beach and dune onto the marsh platform when computing the net settlement of the marsh and wetland habitats over time.

PRESENTER BIO: Michael Poff is President of CEC. He holds a Master Degree in coastal engineering from the University of Delaware. His expertise is ecosystem restoration, erosion control, beach nourishment, and marine structures. Mr. Poff resides in Naples with his wife, Danielle of 19 years, and daughters, Mallory and Victoria.

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BENTHIC INVERTEBRATE ECOZONES OF THE CAERNARVON/BRETON SOUND ESTUARINE SYSTEM OF THE PONTCHARTRAIN BASIN

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In estuaries, fresh water and sea water mix to produce zones of intermediate salinities with distinct benthic invertebrate associations termed ecozones. This study was conducted to provide a better understanding of ecozones and how environmental changes affect them. In a previous study, ecozones were determined in the Pontchartrain Basin north of the Mississippi River Gulf Outlet (MRGO). They included: (1) the *Rangia* ecozone; (2) the Oyster/*Mulinia* ecozone; (3) the hypoxia stressed bivalve ecozone; and (4) the seagrass/large bivalve ecozone. This study was on the Caernarvon/Breton Sound Estuary located south of the MRGO. Benthic invertebrates were sampled from 20 sites using a petite Ponar dredge. Clams, other large organisms and shells were also sampled with a rake dredge. Primer CLUSTER analysis was used to generate a dendrogram in which taxa found in three replicate Ponar samples were hierarchically ranked into groups based on a Bray-Curtis similarity matrix.

Highly dissimilar groups derived from the cluster analysis; the distribution of large bivalve shells, *Rangia*, oysters and *Mercenaria;* and salinity data from the Lake Pontchartrain Basin Foundation Hydrocoast maps and this study were used to delineate ecozones. Two groups were combined to form the *Rangia* ecozone because they had slight salinity differences and live *Rangia* and shells were present in both groups. The next down estuary ecozone was the Oyster/*Mulinia* ecozone, which was based on a single group. The most important species separating this group was the clam *Mulinia lateralis.* Oysters were not present in the Ponar samples, but oyster shells were abundant in the dredge samples.

The last down estuary ecozone, the hypoxia stressed bivalve ecozone, had the most diverse biota. *S*hells of the large clam, *Mercenaria,* were present at most sites, but only one small, live *Mercenaria* clam was present. Salinity stratification and low bottom dissolved occurred at these sites and stress tolerant polychaetes were abundant. Large invertebrates, including other bivalves, snails, whip corals, brittle stars and starfish, were also present at three offshore sites. The seagrass/large bivalve ecozone which was present on northwestern shoals of the Chandeleur Islands in the previous study was absent.

<u>PRESENTER BIO:</u> Dr. Poirrier, Professor Emeritus of Biology at the University of New Orleans, has conducted numerous studies on the restoration of Lake Pontchartrain, including SAV and marsh restoration, *Rangia* clams, other benthic invertebrates, fishing reefs, and water quality.

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SALINITY ZONATION OF PONTCHARTRAIN BASIN SAV AND CHANGES IN LAKE PONTCHARTRAIN SAV ABUNDANCE SINCE 1953 DUE TO ENSO SHIFTS AND HURRICANES

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Submerged aquatic vegetation refers to rooted, vascular plants adapted for living underwater. These plants, commonly referred to as grass beds and seagrasses, provide diverse ecosystem services that enhance coastal restoration. Services include food and habitat for shrimp, crabs, fishes, sea turtles, ducks and manatees; stabilizing sediments, reducing wave action, nutrient recycling, the release of oxygen into the water column and carbon sequestration. Despite their importance, little is known about the biology of many species and factors which affect their distribution, abundance and seasonal dynamics in coastal Louisiana. A study of the Pontchartrain Basin SAV was conducted to provide some of this basic information. The upper Basin was found to be dominated by freshwater species whose down Basin distribution is limited by their salinity tolerance. *Cabomba caroliniana* and *Potamogeton crispus* were limited to salinities below 0.5. *Ceratophyllum demersum*, *Heteranthera dubia*, *Hydrilla verticillata, Najas guadalupensis*, *Potamogeton pusillus* and *Potamogeton perfoliatus* extended to salinities around 3.5. *Vallisneria americana* and *Zannichellia palustris* occurred to about 5 and *Myriophyllum spicatum* to about 15. *Ruppia maritima,* a euryhaline species, occurred at salinities from 0.2 to 31. The true seagrasses, *Halodule wrightii*, *Halophila engelmanii*, *Syringodium filiforme*, and *Thalassia testudinum* occurred at mean salinities of 27 in 2014 and 31 in 2015. In these subtropical waters, some species were abundant during the winter and spring and declined during the summer. Upper Basin SAV is dynamic and species distribution changes with salinity, water clarity and eutrophication. Lower Basin SAV and seagrasses are changing due to high rates of relative sea level rise and erosion of marsh and barrier islands.

We have also studied long-term changes in Lake Pontchartrain SAV. Abundance was reduced by 70% from 1953 to 1990 due to increased turbidity from urbanization and shell dredging. A La Niña drought from 1998-2001 increased SAV to 80% of the 1953 coverage, but declines occurred after the drought and there was extensive damage from Katrina and other hurricanes between 2005 and 2012. SAV mainly consisted of narrow bands of *R. maritima,* with *V. americana* limited to areas near the mouths of streams. The 2014-2016 El Niño lowered hurricane activity and increased precipitation which decreased salinity. In 2014, *V. americana* began to increase and by 2016 dense beds extended out to 100 m near Cane Bayou and smaller beds extended west to Green Point and east to Goose Point. Coverage in 2016 was about 10% of the 1953 level.

PRESENTER BIO: Dr. Poirrier, Professor Emeritus of Biology at the University of New Orleans, has conducted numerous studies on the restoration of Lake Pontchartrain, including SAV, marsh restoration, *Rangia* clams and other benthic invertebrates, fishing reefs, and water quality. He also studied SAV in the Jean Lafitte National Park.

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OVERVIEW OF COASTAL PROTECTION AND RESTORATION IN THE CALCASIEU/SABINE AND MERMENTAU BASINS, LOUISIANA

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The mission of protecting Louisiana's residents from storm surge and restoring the diversity of coastal wetland habitats is challenging. Louisiana's 2017 Coastal Master Plan provides a means to respond by outlining major strategies for restoration and flood protection and by directing available resources into prioritized projects. While there are many common reasons for land loss across coastal basins, implementation of projects within coastal basins can vary depending on basin-specific attributes such as habitat type, hydrology, availability of natural resources (e.g. sediment resources) or major landscape features (e.g., the Mississippi River). Project implementation and sequencing within a basin may be also influenced by the timing and availability of funding, as well as, regulations tied to each funding source.

Louisiana's Calcasieu/Sabine and Mermentau coastal basins, located between the Sabine River and Freshwater Bayou Canal, encompasses approximately 768,000 acres and covers all or parts of Calcasieu, Cameron and Vermilion Parishes. The Mermentau Basin's primary source of freshwater is the Mermentau River and includes the freshwater reservoirs of Grand and White Lakes. The Calcasieu/Sabine Basin is a shallow coastal system with freshwater supplied from the northern reaches of the Sabine and Calcasieu Rivers. The Calcasieu Ship Channel, located along the western edge of Calcasieu Lake, serves as a major shipping corridor with direct access to the Gulf of Mexico.

Major objectives in this region include reducing salinities to create fresher marsh habitats, building and sustaining new land in existing open water areas and providing protection features along established beaches, rivers, lakes and canals. Restoration and protection of this region not only preserves the ecosystem but also supports the abundant wildlife habitat and an economy that is vitally important to the State of Louisiana and the nation. This presentation will provide an overview of the Master Plan restoration and protection strategies for the Calcasieu/Sabine and Mermentau coastal basins. Additionally, on-the ground progress will be highlighted with an overview of constructed projects and examples of newly funded projects within each basin.

PRESENTER BIO: Darrell J. Pontiff, P.E., earned a Bachelor's of Science degree in Civil Engineering from the University of Louisiana at Lafayette in 1979. He has worked in coastal restoration for 13 years. He is currently the CPRA Regional Operations Manager for Southwest Louisiana. In that role, he is responsible for construction and operations and maintenance of projects in that region.

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INFLUENCE OF BLACK MANGROVE (*AVICENNIA GERMINANS*) EXPANSION ON AQUATIC COMMUNITIES AND FOOD WEBS OF SALT MARSHES IN EASTERN COASTAL LOUISIANA

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Louisiana salt marshes support high biodiversity and complex food webs. They provide many essential ecosystem services, like nursery habitat for commercially and recreationally important species. However, the distribution of these salt marshes is changing. Due to less frequent and less severe winter freeze events, black mangroves (*Avicennia germinans*) are shifting north, expanding, and taking over salt marshes. Black mangrove area is expected to increase with rising future temperatures, but little is known about how this affects marsh-dependent organisms. To understand the influence of mangrove expansion on aquatic marsh organisms, two components were analyzed: community composition and food webs.

Port Fourchon and Grand Isle coastal wetlands in eastern Louisiana with three habitat types, marsh-dominated, mangrove-dominated, and a transition or mix of the two, were studied in 2016. Community composition or the proportion of different species was sampled and analyzed for abundance and diversity. Primary carbon sources (emergent vegetation, suspended particulate organic matter, macroalgae, and soil organic matter) and consumers (blue crabs, brown shrimp, grass shrimp, Gulf killifish, marsh periwinkle, and southern ribbed mussels) collected at each habitat type were measured using stable isotope analysis ($\delta^{34}S$, δ13C, $\delta^{15}N$) to identify trophic levels and basal carbon sources or primary producers at the base of the food web.

While data analysis is ongoing, recent results indicate that the community composition is different between habitat types at Port Fourchon, but Grand Isle composition is more similar among habitat types. Additionally, the basal carbon sources supporting the marsh periwinkle shifts between marsh and mangrove habitat types, while all other consumers remain static. This research will further develop our understanding of how shifts in vegetation influences marsh-dependent animals and may inform coastal restoration efforts and fisheries policy on the possible consequences of mangrove planting and expansion.

<u>PRESENTER BIO</u>: Christina Powell is a graduate student at Louisiana State University pursuing a master's degree in Oceanography and Coastal Sciences. She has worked in coastal wetlands for 6 years, with experience in various projects studying coastal habitats, including habitat monitoring and blue carbon quantification.

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A REVIEW OF WETLANDS MANAGEMENT STRATEGIES

Phil Precht
ConocoPhillips Company, Houma, LA, USA

The ConocoPhillips Coastal Wetlands are located in southeast Louisiana, encompassing approximately 636,000 acres of predominantly wetland habitat. Formerly known as the “LL&E Fee Lands”, the Coastal Wetlands are considered to be the largest privately-owned wetlands complex in the state of Louisiana and the United States. These wetlands are among the most ecologically and economically significant in Louisiana and the United States, yet they are also the most vulnerable to erosion and subsidence due to a variety of natural occurrences. In addition to vital habitat benefits, the Coastal Wetlands provide a buffer for critical business infrastructure as well as protection for nearby communities against major storms and tidal surge events.

The tremendous challenges presented by the habitat change and land loss on the Coastal Wetlands provide significant opportunities for ConocoPhillips to engage and collaborate with public and private entities, non-profits and academia in a combined effort to reverse land loss trends.

This presentation will discuss the success of current state and federal programs in reducing land loss rates and will illustrate how early engagement of private landowners in project development will facilitate implementation and increase success. The presentation will also highlight the unique habitat restoration initiative between ConocoPhillips and Ducks Unlimited and how this model for success can be adapted as further opportunities for industry, landowners, and non-profit collaborations are explored in the context of emerging private environmental markets such as wetland mitigation, carbon sequestration and public/private “pay for success” models of project implementation.

PRESENTER BIO: Currently serving as Director of the Coastal Wetlands Group, Phil joined the ConocoPhillips Company in 1981 after earning degrees in Biology and Business from McNeese State University in Lake Charles. During these early days, Phil also obtained a commercial fixed wing pilots license and instrument rating, which he holds to this day. He began his career in the exploration and production operations division and later worked in the mid-stream cryogenic gas processing and p/l operations division. In 2010, Phil began his current position with the Coastal Wetlands Group, where he is responsible for the management of the largest expanse of privately owned wetlands along the Gulf Coast, if not the United States. In 2012, Conoco Phillips and Ducks Unlimited initiated its first Habitat Restoration Agreement. This ongoing collaboration, now in its fifth year, is a direct result of Phil’s leadership and commitment to be more pro-active in efforts to restore and protect the ecologic and economic assets of the ConocoPhillips coastal wetlands.

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THE BARATARIA ELEVATION-HYDROLOGY ARRAY: A LANDSCAPE SCALE TOOL FOR SCIENTIFIC UNDERSTANDING AND RESOURCE MANAGEMENT

W. Parker Hamilton[1], ***Laura Rack***[1], *Christopher Ahlgren*[1,2] *and Julie L. Whitbeck*[1]
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Aware of the high rate of relative sea level rise observed at the seaward end of the Barataria Basin more than 50 kilometers south of the Barataria Preserve, and already observing increased flooding at the Preserve itself, in the mid 1990’s park resource managers and ecological scholars prioritized understanding the consequences of increasing flooding depth and duration for the ecological integrity of the Preserve’s predominantly freshwater coastal wetlands. They sought tools that would enable park managers and scientists to measure change over time and also to predict hydrological, biological and biogeochemical responses to change. In 1998, they established a 5 hectare research and monitoring plot in a mature bottomland hardwood ecosystem, spanning a 1 meter elevation gradient extending from the crest of a natural levee ridge down its backslope to the edge of baldcypress swamp. In the next decade, scientists added more long-term research plots and a transect spanning the breadth of the Preserve landscape and traversing its geological “backbone”. Over the past 5 years, the park has established an on-site weather station and an elevation and hydrology dynamics monitoring array.

Here we introduce our newest tool: the elevation and hydrology dynamics monitoring array. We describe its landscape scale design, its instrumentation, the observations it enables, the data we collect and our plans for data stewardship and data sharing. We address its role in the portfolio of change-observing tools at the Barataria Preserve, how it leverages existing datasets and studies, and how it complements similar tools at sites across the Gulf of Mexico coastline and along coasts worldwide.

The array consists of 13 stations established along a transect crossing the Mississippi River distributary channel that shaped this landscape, plus 6 stations at key park infrastructure sites. This “backbone”-traversing transect captures most of the geological, hydrological and ecological variation in the upper Barataria Basin. We have installed a benchmark rod, a surface marker horizon and a water level well at each station, and we have provided a surface elevation table collar for all but the floating marsh benchmarks. These stations leverage established vegetation monitoring plots, and they are augmented by a spatially-intensive array of water level loggers deployed from Bayou des Familles across its eastern natural levee ridge and down its impounded backslope bordering the hurricane protection levee.

What do these tools offer park managers? Can they help the park prepare for changing conditions? For example, can they contribute to assessments of the vulnerability of park infrastructure or of the natural and cultural resources the Preserve protects? Beyond park boundaries, can these ecosystem- to landscape-scale tools inform coastal management at regional scales? How can they contribute to building scientific understanding? Using the Barataria Preserve as a case study, we describe our aspirations for learning from the elevation and hydrology dynamics array and from the broader portfolio of change-observing tools it joins.

PRESENTER BIO: Laura Rack worked with Jean Lafitte National Historical Park and Preserve as an Environmental Stewards Intern, and she will be attending graduate school in the fall. She has experience working in protected areas in Louisiana and Belize as a research coordinator and project coordinator.

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LEVEE MONITORING AND ESTUARY ASSESSMENT USING SMALL UNMANNED AIRCRAFT SYSTEMS (SUAS)

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The main function of the Gulf Hurricane Protection System (GHPS) is to provide flood protection, drainage, and environmental benefits, while allowing navigational passage to Gulf of Mexico (GOM). The hurricane protection system consists of approximately 72 miles of earthen levee with 12 floodgate structures proposed for the navigable waterways. The GHPS project purpose is to protect development and the remaining fragile marsh from hurricane storm surge. The area is significantly affected by tides emanating from the GOM. Deterioration of coastal marshes, because of saltwater intrusion, land subsidence and the lack of interchanges from the Mississippi River have increased surge inundation. The primary objective of this research project is to evaluate the effectiveness of small Unmanned Aerial System (sUAS) for monitoring earthen levee structural stability and environmental impact on surrounding coastal ecosystem. The prototype study area is a five-mile stretch Reach F of the Morganza to the Gulf levee for Terrebonne and Lafourche Parish in South Louisiana. The current capabilities include a fixed wing and rotary sUAS with color, infrared, and multispectral sensors with varying resolution, with 35 to 45 minutes endurance operable in wind gusts of 30 to 40 mph. We will be presenting results from our Aug 21, 2016 (right after the south Louisiana floods) and Feb 18, 2017 sUAS missions. The adopted sensors were suitable for generating a high resolution Digital Surface Model (DSM) and characterization of the habitats surrounding the levee structure. The raw image data were processed to obtain the following deliverables namely a high resolution (2 cm to a pixel) Orthomosaic image, a dense point cloud (photo derived), 10 cm DSM and Normalized Difference Vegetation Index (NDVI). The high-resolution 3D DSM was valuable in studying the structural stability of the levee. The Quality Assurance /Quality Control (QA/QC) report after a bundle adjustment on the raw images shows an error of ±1.6 mm horizontal and ±2 mm vertical on the check points. Reference data was collected at a 100 ft. grid and critical points along the levee using a Real Time Kinematic (RTK) Global Navigation Satellite System (GNSS) surveys. Reference data was used to perform accuracy assessment of DSM derived elevations. We found that 78% of the reference points (56/72) were less than 2.4 cm which is within the error tolerances of RTK survey methods. The errors were primarily on the stretch of the levee that were about 200 ft. from the centerline where the bordering vegetation had a high density. We find this method very accurate and cost-effective compared to conventional ground methods in monitoring the levee system. We also present preliminary results of analyzing multispectral orthomosaic images using different image classification techniques to discriminate between water and land interface, as well as to classify organismal cover types surrounding the structure. Future research effort will involve integration with Lidar and Hyperspectral sensors for modelling the lock structure, enhancing the accuracy of the 3D surface model, and automated extraction of vegetative cover to decipher the estuary health.

PRESENTER BIO: Dr. Ramachandran has over 18 years of research experience in the areas of GIS, GNSS, RS, UAS, Laser Scanning, Spatial Data Mining, Mobile and Pervasive Computing, Wearable Computing, Data Fusion, Decision Support Systems, and Environmental Planning. His research is usually inter-disciplinary in nature and pioneers in adoption of Geospatial technologies.

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SUPPORTING RESTORATION DESIGN – DATA COLLECTION AND NUMERICAL MODELING OF THE CALCASIEU SHIP CHANNEL ESTUARINE SYSTEM

*Ehab Meselhe, PhD, PE, **Cyndhia Ramatchandirane**, Yushi Wang, PhD, and Eric White, PE*
The Water Institute of the Gulf, Baton Rouge, LA, USA

To support the design work of the Calcasieu Ship Channel Salinity Control Project (CS-65) in southwest Louisiana, the Water Institute of the Gulf was tasked with conducting extensive field data collection campaigns and with parameterizing numerical models to examine project impacts on water level, salinity, and sediment dynamics within the Ship Channel, Calcasieu Lake, and the surrounding wetland systems.

Project planning was aided by analyses of three different numerical model tools. First, the Integrated Compartment Model (ICM), a planning-level model of the entire Louisiana Coastal Zone, was used to help understand the general hydrologic and salinity response of the proposed project and its potential impact upon vegetation dynamics across a 50-year planning horizon under assumed relative sea level rise scenarios. Second, the MIKE modeling software was used to develop a Chenier Plain-regional model that allowed for a finer-resolution than the ICM analysis. This model was used to quantitatively examine flow and salinity dynamics of the various engineering design configurations that were adjusted by the design team. Finally, a high-resolution model of the Ship Channel was developed with the Delft suite of models. This high-resolution model was used to examine project impacts of the proposed design on sediment dynamics within the Ship Channel and Calcasieu Lake domains.

Field data collected to calibrate these models included bathymetry, and hydrologic and water quality measurements. During the design phase of the selected project, an additional field program and modeling effort were implemented to examine project impact specifically on sediment issues, such as navigation channel maintenance. To characterize the sediment transport dynamics in the Calcasieu ship channel system, a basin-scale sediment budget is being developed using a combination of fixed sensors, boat-based surveys, and sediment core geochronology. The modeling component of the project incorporates these datasets to improve understanding of the sediment dynamics in the system. This will help assess project impact on the lake, channel sediment deposition, and implications for channel dredging.

PRESENTER BIO: Cyndhia Ramatchandirane and Dr. Yushi Wang are Research Scientists at the Water Institute of the Gulf. Ms. Ramatchandirane has 6 years of experience collecting and processing field data along the Louisiana coast. Dr. Wang has more than 6 years of experience conducting hydraulic and water resources studies using numerical models.

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THE LOUISIANA, MISSISSIPPI, ALABAMA COASTAL SYSTEM (LMACS); EMBRACING FUNCTIONAL BOUNDARIES TO DRIVE COMPREHENSIVE ESTUARINE RESTORATION

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The LMACS is a restoration planning area that is based upon functional boundaries of the coastal estuary that spans from Lake Borgne to Mobile Bay and extends seaward to the Biloxi Marsh in LA and the barrier islands in MS and AL. The idea of using this area as a basis for multi-state restoration coordination recently grew out of long standing partnerships between the principal agencies (listed above) that developed in the Gulf of Mexico Alliance (GOMA). Many other agencies, nongovernmental organizations and institutions of higher learning are already engaged in work that may be synergistic with this concept. For example, efforts are ongoing to improve cross-border sharing of hypoxia and other water quality data. The networks and protocols that develop through these interactions will make it much easier to identify additional data needed to support a comprehensive assessment of the LMACS.

The primary goal of this partnership is to conduct comprehensive hydro- geophysical, biochemical and economic modeling of the LMACS which will be used to develop a restoration "master plan" for the estuary. This plan, the Restoration Framework for Sustainable Fisheries (RFSF), will assess geomorphic and other restoration approaches to support the long-term recovery and stability of traditional oyster, shrimp and fin fisheries. Aspects of the built environment and the human communities that depend directly on these resources will also be addressed. The intention is for the RFSF to guide restoration project development, prioritization, and implementation over a 50-year horizon to improve synergies with ongoing efforts such as the Louisiana Coastal Master Plan.

The geomorphic history and anticipated trajectory of the LMACS estuarine barrier is of significant interest for our team. Ongoing erosion and fragmentation of the Biloxi Marsh and barrier islands are causing the system to become increasingly marine. This geomorphic instability will likely drive a unique set of restoration priorities compared to similar class estuaries such as the Chesapeake Bay.

Currently, LMACS and related planning efforts are being developed with state and GOMA resources to make this multi-state approach to restoration of the estuary a reality.

PRESENTER BIO: Mr. Ramseur has directed the MDMR Office of Coastal Restoration and Resiliency since the Legislature established it in 2014. He has led landscape scale restoration efforts in coastal Mississippi for the last 20 years. He has a B.S. in Geology and Anthropology from Tulane University in New Orleans.

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NON-ROCK ALTERNATIVE TO SHORELINE PROTECTION

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In 2009, CWPPRA approved funding for a demonstration project: (LA 16) PPL 18. Non-Rock Alternative to Shoreline Protection.

The project was proposed because:
"Several shoreline areas in coastal Louisiana experience significant erosion, but site conditions including unstable soil conditions, subsurface obstructions, and accessibility problems severely limit alternatives for shoreline protection. The adopted standard across coastal Louisiana, where conditions allow, is the use of aggregate in either a revetment or foreshore installation. The major advantages of using rock are durability, longevity, and effectiveness. However, in areas where rock is not conducive for use and site limitations exist, current "proven" alternatives that provide equivalent advantages are limited."

The restoration strategy is described as:
"Several "new" concepts of providing shoreline protection have surfaced in the last couple of years. These concepts, however, have not been researched or installed due mainly to budget limitations or the apprehension of industry, landowners, or others to "try" an unproven product. The intent of this demonstration project is to provide a funding mechanism to research, install, and monitor various shoreline protection alternatives in an area(s) of the state where physical, logistical and environmental limitations preclude the use of current adopted methods."

Four proposed solutions were chosen for construction and installation in Iberia Parish, LA to protect the shoreline of Shark Island. NRCS began monitoring the project in 2013, and is scheduled to issue a final report in early 2018.

The 2018 State of the Coast conference could be an excellent forum for revealing what NRCS has learned from this important demonstration project.

PRESENTER BIO: Charlotte Randolph is the former parish president of Lafourche Parish, which sits at the epicenter of the coastal erosion crisis. She led the 20-parish Parishes Against Coastal Erosion for six years and served on the National Association of Counties Energy, Environment and Land Use committee for five years.

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OVERVIEW OF CPRA'S ADAPTIVE MANAGEMENT PROGRAM

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Managing complex environments in which the natural and socio-economic systems are highly integrated is inherently difficult. Adaptive management facilitates resilient management of ecosystems with the premise of using the best available knowledge to design and implement projects, while establishing an institutional structure that enables learning from outcomes to adjust and improve decision making. Adaptive management is a key feature of Louisiana's Coastal Master Plan, which allows for flexibility in implementation as conditions change, resolution of uncertainties to improve future decision-making, and enables the modification of constructed projects while informing the development of future projects. By allowing flexibility in implementation as conditions change, CPRA's Adaptive Management program is essential to the long-term adaptability of these projects and the achievement of the greatest amount of positive ecosystem improvement.

Adaptive Management has also been identified as a requirement for projects funded by some Deepwater Horizon funding sources such as Natural Resource Damage Assessment (NRDA), Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies Act (RESTORE Act), and Gulf Environmental Benefit Fund (GEBF). CPRA is currently developing an operational Adaptive Management strategy which will meet the needs of CPRA and these various funding programs. The strategy will build on the lessons learned from other large ecosystem restoration programs around the USA and provide a structured process for making decisions.

Communication, applied research, synthesis reporting, data collection, and information management are key components of CPRA's Adaptive Management strategy, providing necessary data and information to decision-makers on a timely basis. Many processes already exist at CPRA in relation to project planning, implementation, construction and monitoring. These processes will be re-examined and refined or streamlined where appropriate. In addition, critical communication pathways will be evaluated to ensure that the new information and lessons learned are strategically utilized to inform decisions.

PRESENTER BIO: Mr. Raynie is the Coastal Resources Administrator within CPRA's Executive Division and is leading the development of CPRA's Adaptive Management program. He has worked in Louisiana's restoration program for over 25 years and contributed to the development and management of coastal wetlands monitoring programs for Louisiana (CWPPRA, CRMS, SWAMP, etc.).

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THINKING BEYOND YEAR 50: STRATEGIES FOR THE LONGER TERM

Denise J. Reed
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Louisiana has under gone multiple long-term planning efforts in the last 30 years. When restoration efforts started in earnest with federal funding in the early 1990’s 20 years was seen as long term. Planning for risk reduction projects were longer but as so few were actually constructed and completed to standard before Hurricane Katrina, there was a limited need to think decades ahead. Gradually the ‘standard’ time frame for coastal planning was extended to 50 years and both the 2012 and 2017 Coastal Master Plans have been founded on analysis that embraces future change on that time scale.

Sustainability has been a metric considered in coastal planning in Louisiana but the increasing uncertainty regarding future conditions multiple decades into the future makes detailed analysis of project effects challenging. Some studies have used specific assumptions about the future to depict conditions at 2100 with images of coastal waters approaching Baton Rouge. But the multiple possibilities of when sea-level rise reaches critical thresholds, where storms will hit, and what riverine sediment and freshwater resources will be available, while they could be analyzed, likely result in a wide range of possible futures making investment decisions challenging.

Rather than analyses around all the possibilities, a more useful approach might be to focus on what we really need our coast to provide and where it might be possible to achieve those outcomes. Our existing knowledge and analysis shows areas of opportunity and areas of challenge for the coastal landscape. Thus, ecosystem based needs must be spatially flexible if they are to be sustainable – harvest areas will shift due to external forces not only due to restoration action. There will be more limited suitable areas for those harvest resources dependent on wetlands and if they are deemed essential for food security then manipulating conditions to enable more direct farming rather than natural system harvest could be necessary. For water dependent industries, as the water moves inland there may be few options but for the industry to follow. Maintaining artificial islands or peninsulas for specific high-value purposes may be feasible but a surrounding buffer of natural landscape will only possible in some areas.

Communities will change as they have always done in response to a balance of history, future risk, and economic need for proximity to resources. Planning for communities will need to focus more on future economies and livelihoods, some of which could still be ecosystem based, than storm surge risk and tradition, and opportunities will be limited in some areas. The 2017 Coastal Master Plan already shows the challenge of landscape sustainability in the Chenier Plain and in the lower areas of the Delta Plain. Investments are now being made that provide realistic benefits for decades to come. Planning for the decades after that will need to start soon. As Louisiana has been a leader in coastal planning for the next 50 years, it can continue to ‘think forward’ and begin the conversation about what comes next. Our science-based master planning process has been a success and we implement projects at a scale far beyond most other coastal systems. But our challenge is greater and unfortunately more immediate. While project implementation proceeds, we must continue to think about the next steps, and the next, and the next.

PRESENTER BIO: Dr. Reed is a coastal restoration scientist with more than 30 years of experience researching coastal dynamics and supporting coastal planning efforts.

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A RECENT UPDATE IN CARBON TRANSPORT: THE MISSISSIPPI-ATCHAFALAYA RIVER SYSTEM

***Jeremy H. Reiman**, Y. Jun Xu, and Emily M. DelDuco*
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The Mississippi-Atchafalaya River System (MARS) provides approximately 80% of the total freshwater delivered from the United States to the Gulf of Mexico, functioning as a significant medium for carbon transport from land to the sea. Around two-thirds of the carbon transported to the world's oceans is composed of a combination of dissolved inorganic carbon (DIC), primarily in the form of bicarbonate (HCO_3^-), and dissolved organic carbon (DOC), which are the carbon species most available for biogeochemical processing by coastal organisms. As recent research has shown that climate change is likely have a significant impact on global carbon transport, understanding the dynamics of carbon mass transport from the MARS to Louisiana's coast plays a vital role in managing our coastal ecosystems for future generations. Past studies have quantified the amount of carbon transported from the Mississippi River to the Northern Gulf of Mexico, however there has been no study in recent years on the total contribution of dissolved carbon from the Mississippi-Atchafalaya River System. As the Atchafalaya River receives 30% of the total flow from the Mississippi River diverted through the Old River Control structure, the Atchafalaya River is a large river system that consequently has the potential to transport large amounts of carbon to the Gulf.

The goal of this study is to update the scientific community and coastal managers on the total amount of dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) delivered to Louisiana's coast annually in recent years by the MARS and compare these findings with past research on the Mississippi River. Monthly water samples were gathered from 2015-2017 in the Mississippi River at Baton Rouge and the Atchafalaya River's Wax Lake and Morgan City outlets. In addition, multiple samples were collected during a flood event in 2016 to assess a potential carbon flux pulse. All samples were analyzed for concentrations of DIC, DOC, and their respective stable isotopic signature ($\delta^{13}C$). In-situ measurements on partial pressure of carbon dioxide (pCO_2), temperature, pH, dissolved oxygen, and specific conductance were conducted at the three locations during each sampling trip. Our initial results support past research showing drastic hydrologic and temporal trends in DOC and DIC concentrations and sources. Concentrations of DOC in the Atchafalaya River were much greater than in the Mississippi, while DIC concentrations were slightly lower in the Atchafalaya River. Consequently, the Atchafalaya River contributes a substantial amount of the annual DOC and DIC loads to the Northern Gulf of Mexico from the MARS. Our findings suggest the need for considering the Atchafalaya River when quantifying the transport of both inorganic and organic carbon to the Gulf of Mexico.

PRESENTER BIO: Jeremy is a Master's student at Louisiana State University with research focusing on dissolved carbon transformation and transport in large river systems.

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FLOODPLAIN INFLUENCE ON CARBON TRANSPORT IN ATCHAFALAYA RIVER BASIN

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Rivers not only function as a conduit for the delivery of terrestrial constituents to oceans, but they also serve as an important medium for biogeochemical processing of these constituents. While extensive research has been conducted on the transport of carbon in many rivers, less is known about the transport and transformation of carbon species in rivers with extensive floodplain connectivity. The Atchafalaya River is not only the largest distributary of the Mississippi River, but it's lower basin is home to the North America's largest intact river floodplain network, known as the Atchafalaya River Basin (ARB). Research and surveys have documented the ARB as a highly productive floodplain cypress swamp that plays an important role in the removal of nitrogen from the Atchafalaya River prior to flowing into the Northern Gulf of Mexico. However, no publication exists on dissolved carbon transport and transformation along this river-swamp system. Such information can be beneficial for updating the scientific community on the role of river floodplains on carbon cycling, and can also assist in understanding the effects of biogeochemical processing in the ARB on the quality of water delivered to Louisiana's coast.

To obtain the information, monthly water samples were gathered from 2015-2017 on four different locations on the Atchafalaya River. Our sample design allows for a comparison of dissolved carbon transport in the upstream leveed portion of the river (Simmesport to Butte La Rose) and the downstream river section flowing through the ARB (Butte La Rose to Morgan City and Wax Lake Outlets). All samples were analyzed for concentrations of dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), and their respective stable isotopic signature ($\delta^{13}C$). In-situ measurements on partial pressure of carbon dioxide (pCO_2), temperature, pH, dissolved oxygen, and specific conductance of river waters at each location were conducted during the monthly sampling trips. Our initial data analysis found a general increase in DIC concentrations and loads from upstream to downstream in the lower portion of the Atchafalaya River, while DOC concentrations and loads varied greatly spatially and temporally, primarily in the lower portion of the river. These results suggest a significant amount of carbon processing occurs in the Atchafalaya River Basin, influencing the chemistry and quality of surface water delivered to Louisiana's coast.

PRESENTER BIO: Jeremy is a Master's student at Louisiana State University with research focusing on dissolved carbon transformation and transport in large river systems.

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SHORT RIVER MODEL (DELFT 3D) AND DIVERSION ANALYSIS

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This research is a continuation of an ongoing effort to improve predictions for bathymetric and morphological changes in the Lower Mississippi River as well as the associated analysis and prediction on impacts (individual and cumulative) from planned diversions utilizing Delft3D.

Based on all the development made to date in establishing a functional, calibrated and validated Delft 3D Model as part of the MRHDM Study and academic research, it was possible to further modify the model and shorten it for computational improvements as well as to allow the establishment of a domain focused on morphologic changes below Belle Chasse. The model domain was reduced and extends from Belle Chasse (RM 75.5) to Head of Passes (HOP) instead of Bonnet Carré Spillway (RM 127) to HOP (RM 0). The upstream boundary conditions were based on Belle Chasse time series for discharge and sediment input. The MRHDM or 'long model' was calibrated by McCorquodale et al (2017). The roughness and bathymetry were maintained in the new reach (shortmodel). The shortmodel was then calibrated to ensure that stage, flow distribution and sand transport of the long model were retained.

The CPRA is currently in the design and/or permitting phase for the Mid-Barataria Diversion and the Mid-Breton Diversion. Any permitting of a diversion on the Lower Mississippi River will require an assessment of cumulative impacts as well as impacts from individual diversion flows. Therefore, this research helps to identify interdependencies between various flows and a variety of diversion cases with a focus on the morphologic changes within the Mississippi River itself. In addition, this research will aim to modify the Delft 3D model developed under the MRHDM Study, by performing analysis on parameters like the input hydrograph, Eddy Viscosity/Diffusivity, Relative Sea-Level (RSL) Rise and sediment flux in the Mississippi River.

Reference:
McCorquodale, et al. 2017. *Development of a Regional 3-D Model for the Lower Mississippi River – Final Report,* submitted to CPRA Baton Rouge, Louisiana

PRESENTER BIO: Ms. Reins, is a senior engineer with 16 years of experience in coastal engineering work, who has worked on numerous coastal restoration projects in Louisiana. Her river research included sediment analysis on the Red River near Old River and Delft3D sediment modeling on the Lower Mississippi River.

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USING 7-BERYLLIUM TO CALCULATE FLUVIAL SEDIMENT DEPOSITION RATE IN A DISTAL BAY AND ASSOCIATED WETLANDS IN FOURLEAGUE BAY, LOUISIANA

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To combat land loss along the Mississippi River Delta, Louisiana has launched a historic campaign to sustain and regrow coastal lands using, in part, sediment diversions. Fine sediments constitute the majority of sediment load in the Mississippi, but are under-studied with respect to dispersal processes, particularly in terms of sediment supply to distal deltaic bays and wetlands. The Atchafalaya River and associated wetlands serve as prime study areas for this purpose. Fourleague Bay has remained stable against the deteriorative effects of relative sea level rise, standing out along Louisiana's declining coastline. Push cores were collected once every two months, from May 2015 to May 2016, along ten sites within Fourleague Bay, Louisiana. Of the ten field sites, five are located across a longitudinal transect in the middle bay, while the other five are located in adjacent marshes. All sites fall within ~10 to 30 km of the Atchafalaya Delta, extending south towards the Gulf of Mexico. Cores were extruded in 2 cm intervals, dried, ground, and analyzed via gamma spectrometry for the presence of ^{7}Be. Inventories of ^{7}Be were then calculated and used to determine daily apparent mass deposition rates (AMDR) of fluvially derived sediment over twelve months. Average AMDR values for the bay and the marshes are compared with Atchafalaya River discharge, wind data, and atmospheric pressure through the year of sampling. Peak marsh AMDR, 0.88 ± 0.20 kg m^{-2} d^{-1}, occurred just after historically high river discharge. Peak bay AMDR, 1.2 ± 0.67 kg m^{-2} d^{-1}, occurred during seasonal low river discharge and calm winds. Average bay and marsh AMDRs have a moderate negative correlation when compared. Results indicate that, during periods of moderate to high river discharge, riverine sediment bypasses the bay floor and enters the marshes directly, a process enhanced by the passage of strong atmospheric fronts. Only during periods of low river discharge and relatively calm winds do riverine sediments aggregate directly onto the bay floor.

PRESENTER BIO: Mr. Restreppo is a PhD candidate in the Department of Geology & Geophysics at Louisiana State University, Baton Rouge. His research involves the integrated use of radioisotopes, stratigraphy, and sediment data to gauge fine-sediment dynamics and recent sedimentation patterns along the Louisiana coast.

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RESTORING LOCALITY: AN ANTHROPOLOGICAL PERSPECTIVE OF THE COMMUNITIES OF LOWER TERREBONNE PARISH AND ENVIRONMENTAL RESTORATION

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This ongoing project examines environmentally and economically at-risk communities in lower Terrebonne Parish, Louisiana, around which various organizations currently operate environmental coastal restoration projects aimed at combatting land subsidence. I seek to better understand how local communities perceive and interact with environmental restoration projects and organizations. I hypothesize that differences exist between how those involved in creating restoration projects and people who inhabit their areas of impact view the region; this disjuncture, in turn, may affect how local people conceptualize restoration projects and any ancillary environmental effects. The project seeks to answer: How has coastal land loss affected regional environments and human populations? How have coastal restoration efforts affected regional environments and human populations? How do non-local organizations in charge of restoration projects interact with local peoples? How much power do local peoples have throughout the process of conceptualizing and implementing restoration projects? Are local people invested in restoration projects? In what ways do local communities organize to protect and further their real or imagined interests?

I employ long-term participant observation (of at least a year), coupled with dialogue analysis of interviews with community members and coastal restoration representatives, to appreciate how locals and non-locals relate to a regional historical ecology in a landscape where human activity has simultaneously contributed to land subsidence and creation. Because the people of lower Terrebonne Parish rely heavily on their local environment for economic resource extraction, primarily of marine fauna, the study focuses upon occupational and subsistence activities as a means of approach into the historical ecology of this coastal region. Using participant observation I accompany locals on their economic pursuits, such as shrimping. Participant observation helps me to better realize how people go about their daily lives and pursue their livelihoods. Interviews, the bulk of the data collected, are conducted on topics related to the local environment and restoration projects. After fieldwork is complete, these interviews will be transcribed and analyzed using discourse analysis techniques (e.g., identifying common themes in discourse about the environment). Supplementary methods, such as GIS analysis of fishing trips to understand spatial ties between residents and how their actions play out across a landscape are also employed to elucidate human/environment relations. GIS data is collected during periods of participant observation and then compared to coastal restoration project footprints. It is my hope that this project contributes to dialogue between communities, who possess local knowledge, and outsiders implementing highly technical projects focused on rehabilitating former ecologies around said communities across the Louisiana coast.

PRESENTER BIO: Mr. Reuther is a doctoral student at Tulane University. He has investigated plant identifications at archaeological sites and indigenous revitalization movements in Brazil. He has also worked in Cultural Resource Management as an archaeologist across the United States. Currently he studies community responses to coastal restoration in lower Terrebonne Parish.

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EVALUATION OF LOUISIANA ECOTYPES OF SALTGRASS FOR SELECTION AND USE IN SALT MARSHES OF THE COASTAL ZONE OF LOUISIANA

Curt J. Riche, *Garret Thomassie and Daniel Pingel*
USDA-NRCS Golden Meadow Plant Materials Center, Galliano, LA, USA

Saltgrass (*Distichlis spicata*) is a highly desired plant for coastal and saline wetland restoration projects. It is a species frequently desired for re-vegetation contracts by conservation partners, including those representing federal, state and parish governments and private consultants. However, there is a lack of quality tested plants of the species, especially in sufficient numbers for growers to obtain for commercial production.

Saltgrass is a mat-forming, strongly rhizomatous perennial grass that prefers moist, saline soils, and is often found in sandy, alkaline locations. It is significant in the salt marshes, which provide nesting grounds for birds, fish and larvae of many species of marine invertebrate animals. Saltgrass persists in saline inundated ecosystems including marshes along the coasts of the Atlantic and Pacific Oceans, and the Gulf of Mexico. It is also one of the more drought-tolerant marsh grasses.

The Golden Meadow Plant Materials Center, Galliano, LA is currently evaluating 25 accessions of Saltgrass collected across coastal Louisiana. Evaluations include overall vigor, drought and flood tolerance, seed production and viability, plant density and cover and rhizomatous spread. The accessions are planted in a randomized complete block design consisting of 3 replications in a field where water levels can be managed and manipulated to simulate tidal flux, as in the marsh.

PRESENTER BIO: Curt J. Riche' is assistant manager at the USDA/NRCS Golden Meadow Plant Materials Center. He received his M.S. in Agronomy from Louisiana State University. With more than 7 years of coastal wetland experience, he has been involved with coastal restoration projects dealing with Louisiana's wetland and barrier island vegetative resource concerns.

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HYDROPERIOD AND STOICHIOMETRY RATIOS CONTROL FOLIAR DECOMPOSITION RATES IN MARSH-MANGROVE ECOTONES IN COASTAL LOUISIANA

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Understanding environmental driver interactions that control wetland organic matter decomposition rates (Kd) is critical in evaluating soil formation and organic carbon cycling, particularly in coastal areas undergoing restoration. Here we analyze the differences in decomposition (Kd) rates and C:N:P ratios of foliar tissue of the mangrove species *Avicennia germinans* (AG) and *Spartina alterniflora* (SA) in Port Fourchon, LA, USA, a coastal region undergoing subsidence and expansion of mangroves as result of lack of freeze events in past 20 years. We hypothesized that AG foliar Kd rates will be higher than for SA due to lower C:N ratios in mangrove tissue; we also expected spatial differences in Kd (d^{-1}) values across sites with different stages of AG expansion. We deployed replicate litter decomposition bags (400 cm^2) in February 2017 (winter) containing foliar material for both species at three sites (Point, Interior, Canal) with monospecific stands of AG and SA. Bags were deployed in blocks defined by dominant vegetation. We also evaluated the differences in Kd values between two adjacent mangrove ecotypes (scrub vs fringe) to determine if C: N: P ratios varied within the same species as result of soil fertility and elevation. Bags were sampled at regular intervals (7, 14, 28, 56 d) after deployment. Hydroperiod and pore water salinity, H_2S, NO_3, NH_4, and PO_4 were sampled every 3 months during the study period (February-July). Our results reveal that mangrove Kd rates were significantly higher in all treatments associated with long hydro-periods. Monthly duration of inundation was higher at the Point (145-224 d) than in the Interior (30-100 d) and Canal (10-60 d) study sites. Average AG Kd rates ranged from 0.015-0.025 d^{-1} while SA rates varied from 0-0.01 d^{-1}. Differences in AG Kd rate were also significantly different between the scrub (0.022 ± 0.001 d^{-1}) and fringe AG (0.015 ± 0.002 d^{-1}) ecotypes, indicating spatial differences in C:N:P ratios. Our results show that as mangrove dominance and spatial extension increase, there is potentially higher net organic carbon availability controlling soil carbon storage in this coastal region.

PRESENTER BIO: Dr. Victor H. Rivera-Monroy is an Associate Professor in the Department of Oceanography and Coastal Sciences, LSU; his research projects encompass assessments of estuarine and coastal ecosystems productivity, biogeochemistry of wetlands, landscape modeling/ecosystem models, and development of coastal management programs.

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HIGH SPATIAL VARIABILITY IN BIOGEOCHEMICAL RATES AND MICROBIAL COMMUNITIES ACROSS LOUISIANA SALT MARSH LANDSCAPES

***Brian J. Roberts*[1], *Ariella Chelsky*[1], *Anne E. Bernhard*[2], *Anne E. Giblin*[3]**

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Salt marshes are important sites for retention and transformation of carbon and nutrients. Much of our current marsh biogeochemistry knowledge is based on sampling at times and in locations that are convenient, most often vegetated marsh platforms during low tide. Wetland loss rates are high in many coastal regions including Louisiana which has the highest loss rates in the US. This loss not only reduces total marsh area but also changes the relative allocation of subhabitats in the remaining marsh. Climate and other anthropogenic changes lead to further changes including inundation patterns, redox conditions, salinity regimes, and shifts in vegetation patterns across marsh landscapes. We present results from a series of studies examining biogeochemical rates, microbial communities, and soil properties along multiple edge to interior transects within *Spartina alterniflora* across the Louisiana coast; between expanding patches of *Avicennia germinans* and adjacent *S. alterniflora* marshes; in soils associated with the four most common Louisiana salt marsh plants species; and across six different marsh subhabitats. *Spartina alterniflora* marsh biogeochemistry and microbial populations display high spatial variability related to variability in soil properties which appear to be, at least in part, regulated by differences in elevation, hydrology, and redox conditions. Differences in rates between soils associated with different vegetation types were also related to soil properties with *S. alterniflora* soils often yielding the lowest rates. Biogeochemical process rates vary significantly across marsh subhabitats with individual process rates differing in their hotspot habitat(s) across the marsh. Distinct spatial patterns may influence the roles that marshes play in retaining and transforming nutrients in coastal regions and highlight the importance of incorporating spatial sampling when scaling up plot level measurements to landscape or regional scales.

PRESENTER BIO: Dr. Roberts is the Associate Director of Science and an Associate Professor of Ecosystem Science and Biogeochemistry at the Louisiana Universities Marine Consortium. He has been serving on the Executive Committee of the GoMRI-funded Coastal Waters Consortium project examining the impacts of the Deepwater Horizon oil spill on coastal wetlands.

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EFFECTS OF ORGANIC MATTER ON SETTLING CHARACTERISTICS OF FINE GRAINED SEDIMENTS OF COASTAL LOUISIANA

***Brittany Roberts**, and Malay Ghose Hajra*
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Coastal wetland loss is a critical environmental problem across the United States. These ecosystems provide vital services to people and the environment as a whole. Some of these roles and services provided by wetlands include erosion control, flood protection, carbon sequestration, and maintenance of water quality. The natural flood protection has already been greatly weakened by coastal land loss in Louisiana and similar deltaic areas throughout the world. If this trend continues, many communities are at severe risk of physical and infrastructural damage. Significant infrastructure would be exposed to open water conditions making those areas less suitable for human life as well as other living organisms. Restoring the wetlands is paramount to the survival of the surrounding wildlife and communities.

One of the proposed methods to reverse the erosion of the coastal wetlands is marsh creation. In this process, sediments are hydraulically dredged from nearby canals and then transported to fill in sediment-starved marshland. The dredged material comes up as a slurry that is pumped to the marshland and is allowed to consolidate over several days. The goal here is to make sure that the projects minimally impact the native flora and fauna while restoring the marsh. Comprehensive characterization of the dredged sediments is crucial in successfully constructing a marsh creation project. The settling characteristics of the dredged material are affected by solids concentration, salinity, composition of the solids, and organic matter present in the soil.

This presentation will explain the different components of a marsh restoration project and discuss the effects of organic matter on settling characteristics of dredged sediments used in Louisiana coastal marsh creation projects.

<u>Presenter Bio</u>: Ms. Roberts holds a Bachelor's of Science degree in Civil Engineering. She's a graduate student in the Civil and Environmental Engineering department, and her research is in coastal geotechnics. For her research, Ms. Roberts is evaluating the effects of organic matter on settling characters of coastal dredged sediments.

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MARINE DEBRIS EDUCATION AND PREVENTION PROGRAM

Alma Robichaux

Nicholls State University, Barataria-Terrebonne National Estuary Program Education/Outreach/Scientist, Thibodaux, LA USA

Engaging high school students and the general public in the solution to marine debris is imperative. The Marine Debris Education and Prevention Program accomplishes this goal. Juniors and Seniors from 14 high schools in 4 parishes in Southeast Louisiana participate once a quarter (4X/year) in the Program. The students are brought by bus to Elmer's Island which is manage by the Louisiana Department of Wildlife and Fisheries and was recently restored by the Louisiana Coastal Protection and Restoration Authority. The Marine Debris Education and Prevention Program (MDEPP) participants record and input the data into NOAA's Marine Debris Program database. The data is collected monthly and has been going on for 2 years. BTNEP is also partnering on a grant with Mississippi State University to determine the amount of microplastics on the Gulf Coast. The MDEPP participants also collect water and sediment samples monthly and analyses them for microplastics.

The Debris Shoreline Survey Field Guide created by Sarah Opfer, Courtney Arthur and Sherry Lippiatt is the protocol used for the collection of data and monitoring of marine debris. The Accumulation study protocol is followed which provides information on the rate of deposition of debris onto the shoreline. Water and sediment samples are also collected to analyse for microplastics.

The other 8 months of the year, volunteers from throughout the Estuary Program area participate in the study. This is an effective way to involve a large number of citizens and train them to set up monitoring areas throughout the southeast.

This Program provides data, awareness, planning, stewardship, prevention and many other positive outcomes.

PRESENTER BIO: Alma Robichaux is BTNEP's Education and Outreach Coordinator. She is also part of the scientific staff. She has over 25 years of experience in the educational field and also has a Master's degree in Marine Science.

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INFERRING CAUSES OF MARSH LOSS FROM SPATIAL PATTERNS OF MARSH CHANNEL WIDENING

Giulio Mariotti *and* ***Jeremiah Robinson***
Louisiana State University, Baton Rouge, LA, USA

Marsh loss is caused by variety of factors whose contribution is often difficult to isolate. This lack of knowledge hampers the ability to implement effective restoration activities. Here we suggest that spatial patterns of marsh erosion might be used to discern between two drivers of marsh loss: increase in sea level rise rate and decrease in sediment supply. The erosion rates of marsh channels between the 1950s to present were measured by GIS analysis for locations in Louisiana, North Carolina, Virginia, New York, and Massachusetts. In all sites, channel widening is faster where the channel is wider, but the functional relationship between widening rate and channel width varies among sites. It is hypothesized that the different patterns of channel widening depend on the rate of sea level rise and sediment supply. These predictions will be tested with a simplified 2D model for marsh evolution.

PRESENTER BIO: Jeremiah Robinson is a second year master's student at Louisiana State University under the tutelage of Dr. Giulio Mariotti. Jeremiah has a background in geology and is interested in coastal restoration, coastal development, resource exploration, environmental policy, and disaster mitigation.

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BANKING ON MARSH CREATION AT THE REFUGE

***Erin Rooney**, PE, CFM*
HDR Engineering, Inc., Metairie, LA, USA

Rockefeller Wildlife Refuge, located in Cameron and Vermilion Parishes, was donated to the State of Louisiana by the Rockefeller Foundation in 1920. The deed of donation requires the State to maintain the property as a refuge and preserve for all wildlife and fisheries species among other requirements. Refuge staff maintains the property as one of the most biologically diverse areas in the country by practicing biological management and allowing for demonstrations and testing of new marsh management practices. The creation of additional marsh habitat is one method among many that the Refuge uses to maintain the property through biological management.

The Refuge works with oil and gas industry to allow exploration within the Refuge. To offset impacts to wetlands by these activities, and to help fund marsh creation work in the Refuge, the Refuge entered a mitigation banking agreement with State and Federal agencies for marsh creation projects on the property. The Refuge agreed to build the marsh at three sites within the Refuge totaling over 170 acres. After elevation and vegetation requirements are met at each of the sites, the Refuge would have the ability to use the mitigation credits for impacts to wetlands within the Refuge. The three marsh sites were constructed in 2008, 2011, and 2014 with marsh planting one year after each construction. Post-construction, elevation and biological surveys are conducted at specified intervals to assess the health of the marsh and release mitigation credits for sale.

Each of the three sites has had its own successes and difficulties. Lessons learned and best practices can be gathered from these project histories while also highlighting the biological management of the Refuge.

PRESENTER BIO: Erin Rooney is coastal engineer with project experience including shoreline protection, marsh creations, and feasibility studies. She has been involved with design, construction, and post-construction monitoring of Refuge projects since 2011. She serves on the Executive Board of the Coasts, Oceans, Ports, and Rivers Institute Louisiana Chapter.

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IT'S ALIVE – ASSESSING THE RESTORATION SUCCESS OF A RECYCLED OYSTER SHELL LIVING SHORELINE IN BILOXI MARSH

Christa Russell[1], *Deborah Visco Abibou*[1], *and Giovanna McClenachan*[1,2]
[1]Coalition to Restore Coastal Louisiana, New Orleans, LA, USA
[2]University of Central Florida, Orlando, FL, USA

Oyster reefs can reduce marsh edge erosion by attenuating wave energy, can provide a suite of ecosystem and habitat services, and have the potential to keep pace with sea level rise through vertical growth of newly recruited oysters. The Northern Gulf of Mexico is home to numerous and varied artificial oyster reef structures, but relatively few have information on monitoring. As Louisiana continues to experience land loss at a severe rate, it is critical to capture the effectiveness of living shorelines as restoration projects, and provide comparable impacts data for the variety of artificial reef techniques in use. We monitored a newly constructed artificial oyster reef in southeast Louisiana to evaluate the success of the living shoreline project and contribute to the available impacts data of artificial oyster reef structures. The half-mile long reef was placed in Biloxi marsh by the Coalition to Restore Coastal Louisiana (CRCL) in November of 2016 and is made of recycled oyster shell from New Orleans area restaurants, contained in galvanized steel gabion baskets.

We assessed the Biloxi reef's ability to both afford shoreline protection and provide habitat and ecosystem services. We established four reef sites, placed at approximately the midpoint of each of the four reef segments, and four control sites, located just to the south of the constructed reef. The sites in each set (control and reef) were located at approximately the same distance apart within the half-mile sampling areas. The reef and adjacent marsh and control site were monitored for marsh edge erosion, vegetative cover, soil strength, submerged aquatic vegetation, water quality parameters, and oyster and other encrusting organism recruitment. Baseline data was collected in December 2016 and subsequent sampling occurred monthly for marsh edge erosion, bi-annually for vegetative cover, soil strength, and water quality, and annually for reef development.

Preliminary results suggest that CRCL's reef is significantly reducing the erosion rate of the adjacent marsh, thus functioning as an effective shoreline protection measure. We also documented recruitment of at least two distinct size classes of juvenile oysters, representing two successful spat sets from November 2016 to December 2017. Based on field data and historic satellite imagery, we present additional results detailing the extent to which the reef is reducing shoreline erosion and enhancing ecosystem function, and the development of the reef as a living shoreline. As the only shoreline protection measure in the Biloxi Marsh constructed of recycled shell, we provide a novel data resource for the comparative evaluation of shoreline protection techniques in the area.

<u>PRESENTER BIO</u>: Christa joined the Coalition to Restore Coastal Louisiana in 2015 where she focuses on the monitoring of the Coalition's habitat and oyster reef restoration projects across Louisiana's coast. She also coordinates the Oyster Shell Recycling program, which engages volunteers and restaurant partners to repurpose oyster shell resources for coastal restoration.

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DIGITAL TOOLS TO PROMOTE NONSTRUCTURAL MITIGATION

David Johnson, and ***Tugce Sahan***
Purdue University, School of Industrial Engineering, West Lafayette, IN, USA

Key Focus Area: This presentation focuses on building resilience through development of a web-based tool to illustrate to homeowners the benefits of nonstructural mitigation and to collect structure-specific flood risk data for coastal planning efforts.

Presentation Description: This oral presentation is one component of a session focused on CPRA's Flood Risk and Resilience Program and the related activities occurring in coastal Louisiana to build greater resilience in a future with increasing coastal flood risk. This session will highlight the multi-disciplinary approach needed to anticipate, plan, and prepare for increasing risk, and presentations will illustrate how a multitude of actors can advance coastal planning efforts including parish governments, non-governmental organizations, and academics. This presentation will focus on an exciting initiative to develop a web-based tool that harnesses Google Street View to illustrate the benefits of nonstructural mitigation options, as well as machine learning to collect structure data for coastal planning efforts.

When developing plans for nonstructural mitigation, one of the first hurdles local and state regional decision-makers must clear is gathering data on what assets actually exist on the ground in their jurisdictions. Even in areas like Louisiana—where significant effort has been taken to study flood risk since Hurricane Katrina struck in 2005—property data sets are incomplete, fragmented across agencies and jurisdictions, and obsolete. This presentation will discuss an initiative to create access to better structure data as well as to highlight the benefits of mitigation to homeowners and urban planners. This is being accomplished through development of a new automated data collection and visualization tool. The application is being developed by Purdue University through a grant from the Carnegie Mellon Foundation, and in partnership with CPRA.

This new tool will use automated image processing of Google Street View, overhead satellite, and other imagery to extract data relevant to structural flood risk characteristics (e.g., foundation heights, square footage of building footprint). These features are combined with hazard information from the Coastal Louisiana Risk Assessment model to construct structure-level estimates of risk under current and future conditions, as well as projections of the risk reduction impact of mitigation measures such as elevation-in-place or floodproofing. The information will be presented in a decision support tool for homeowners and urban planners to better understand potential future flood risk to a specific structure selected through an interactive map portal. The data can also be compiled over all structures in an area to produce better estimates of aggregate exposure to risk and to improve cost estimates for nonstructural mitigation in different areas across the coast. As a partnership between state government and academia, funded by NGOs, for the benefit of individual homeowners and local planners, this project represents an example of the multi-sector collaborations required to produce innovate approaches to community resilience.

PRESENTER BIO: Tugce Sahan is a PhD student in industrial engineering at Purdue University. She is working to develop web-based tools and automated data collection systems for improving our knowledge about flood hazards and the effectiveness of nonstructural mitigation.

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EVOLUTION OF PLANNING ANALYSIS TO SUPPORT THE LOUISIANA COASTAL MASTER PLAN: 2012 TO 2017 AND BEYOND

David G. Groves[1], Christina Panis[2], ***Ricardo Sanchez[3]***

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The Louisiana Coastal Protection and Restoration Authority's (CPRA) long-term Coastal Master Plan presents a comprehensive response to the urgent challenges of massive coastal land loss and increasing hurricane risk, driven by uncertain future trends like sea level rise and coastal subsidence. Updated every five years at the direction of the state legislature, the state master plan provides a 50-year blueprint for coastal restoration and flood risk reduction projects coastwide.

The 2012 Coastal Master Plan used a new set of systems models and RAND-developed Planning Tool to identify a $50 billion combination of projects to support a more sustainable coast for Louisiana. Projects included restoration projects, such as river diversions and marsh creation, and both structural and nonstructural risk reduction projects. At the time, the 2012 Master Plan estimated that net coastal land loss could be halted by 2030 and gradually increase over the following two decades under a *moderate* scenario. Under a *less optimistic* scenario, land would decline through 2060, but at about half the rate as would otherwise occur. Future flood risks from hurricane storm surge could be reduced from the future without condition by 61% and 77% for the *moderate* and *less optimistic* scenarios, respectively.

The 2017 Coastal Master Plan updated the 2012 Plan by using refined models and evaluating projects across an updated set of future scenarios. The Planning Tool was again used to identify $50 billion of projects to sustain the landscape and reduce flood risk across the scenarios. The updated analysis, however, showed that for all scenarios coastal land loss would continue to decline with the implementation of the Master Plan. Furthermore, it showed that preparing for a more optimistic scenario would reduce the effectiveness of the Master Plan if a less optimistic scenario were realized, and vice versa. The analysis also explored adjustments to the plan to improve specific ecosystem outcomes, such as habitat for white and brown shrimp. These analyses showed significant tradeoffs in building land and improving outcomes for brown shrimp.

The 2012 and 2017 analyses, when viewed together, show the importance of continually evaluating the Master Plan over time as data and models improve and as conditions on the ground evolve. This talk will present key results from the two analyses and suggest how future plans can build upon the strong analytic foundation of the 2017 Coastal Master Plan. Applications of this methodology in other coastal contexts will also be described.

PRESENTER BIO: Dr. Groves is a senior policy researcher at RAND and a codirector of the RAND Water and Climate Resilience Center. Groves is a key developer of new methods for decisionmaking under deep uncertainty. He works directly with water resources managers and coastal planners to develop climate adaptation and resiliency plans.

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EPIFAUNAL ABUNDANCE AND DIVERSITY IN SPARTINA ALTERNIFLORA MARSHES

***Ronald P. Scheuermann III**[1], and Brian J. Roberts[2]*
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[2]Louisiana Universities Marine Consortium, Chauvin, LA, USA

There have been relatively few studies focusing on the distribution of epifaunal communities in cordgrass saltmarshes of coastal Gulf of Mexico. Previous studies have determined the importance of meiobenthos in the salt marsh food web, but there has been little said about the importance of epifauna or their possible sensitivity to oiling events. The focus of this research is to determine the spatial distribution and abundance of marsh macrobenthic epifauna and examine how these patterns vary seasonally. Three well studied marsh sites, dominated by *Spartina alterniflora,* at the Louisiana Universities Marine Consortium (LUMCON) in Cocodrie, LA at the northern end of Terrebonne were used. Spatial patterns in abundances and diversity were evaluated by sampling at 5 distances (1m, 10m, 20, 30m, and 50m) from the marsh edge at each site. Six litter bags were staked down parallel to the shoreline with 1m between each bag and deployed for 1 month at each distance following the approach of Fell et al. (2006, 2003). Seasonal patterns in epibenthic fauna abundances and diversity are being evaluated during four seasons (October-November, January-February, April-May, July-August) over a single year. The litterbags were recovered after a period of one month and washed in the lab with sieves to separate the fauna from the detritus prior to identification to the lowest taxonomic level possible. This presentation will discuss the relationships between epifaunal communities and their distance from the marsh edge along with the possible influences seasonality and hydroperiod may exert on the communities.

This study will provide information on the seasonal and spatial dynamics in the abundance and diversity of epibenthic faunal communities that play key roles in food webs of salt marsh communities. Additionally, this project will provide important baseline information for planned investigations on the impact of oiling on these important communities and the overall marsh ecosystem

<u>PRESENTER BIO:</u> Ronald is a graduate research assistant in the Roberts' lab of biogeochemistry and ecosystem ecology at Louisiana Universities Marine Consortium (LUMCON). He received his B.S. in biology from University of Holy Cross in New Orleans Louisiana, and he is currently studying at Louisiana State University's Department of Oceanography and Coastal Sciences.

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USING MONTORING NETWORK STRUCURE TO INFORM MULTIPLE LINES OF EVIDENCE TOWARD CAUSAL ASSESSMENT OF RESTORATION EFFICACY: A PROOF OF CONCEPT

***Donald R. Schoolmaster Jr*[1] *and Bernard Wood*[2]**

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The Louisiana Coast-wide Reference Monitoring System (CRMS) was developed to address two important needs: 1) To provide a network of reference sites against which to evaluate the effectiveness of specific restoration projects and 2) To determine the large-scale cumulative effects of groups of restoration projects. Quantitatively, these goals require the development of different sets of tools. For example, the second goal might make use tools for spatio-temporal trend detection, while the first requires tools to assess hypotheses related to causal attribution. In this work, we demonstrate the use of change-point detection methods at strategically chosen sites across the network to build a case for event-specific causal attribution.

As an example of this approach, we tested the ability of the CRMS network hydrological data to detect, assess the impact, timing and spatial extent of the effects of the breach of Mardi Gras Pass in early 2012. We found evidence of a significant shift in the salinity regime at the CRMS site nearest the breach between April and May 2012. In addition, we found evidence for salinity shifts in more distant sites at later dates. Finally, we found no evidence for a regime shift at a ‘control’ site located near the breach, but on the opposite side of the river, such that it was isolated from the hydrological effects of the breach. We found no evidence for shifts attributable to the breach in other hydrological variables that we tested, including water elevation or temperature. The combination of these spatial and temporal results provides a preponderance of evidence that the breach of Mardi Gras Pass altered the salinity regimes in the adjacent areas.

We argue that this approach of strategically using network sites to develop multiple lines of evidence to inform an hypothesis of causal attribution can be usefully applied to detect and assess the effect and spatial extent of individual restoration projects across the Louisiana coast.

PRESENTER BIO: Dr. Schoolmaster is a Quantitative and Theoretical Ecologist who specializes in informing complex, multivariate, ecological hypotheses with long-term monitoring data. He is an Ecologist at the US Geological Survey, Wetland and Aquatic Research Center

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LONG-TERM IMPACT OF OILING ON SALT MARSH NITROGEN CYCLING PROCESSES

***Charles A. Schutte*[1]**, *John M. Marton*[2], *Ariella Chelsky*[1], *Anne E. Bernhard*[3], *Anne E. Giblin*[4], *and Brian J. Roberts*[1]

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Human activities have increased the amount of nitrogen delivered to the coastal ocean by river and groundwater discharge, causing problems such as hypoxia and harmful algal blooms. Salt marshes intercept some of this land-derived nitrogen before it reaches the ocean. They are important sites of denitrification, a microbial process that converts bioavailable nitrate into inert nitrogen gas, thereby removing it from coastal ecosystems. In 2010, the Deepwater Horizon oil spill released ~5 million barrels of crude oil into the Gulf of Mexico, significantly oiling ~800 km of shoreline occupied by wetlands. We investigated the long-term impact of oiling on salt marsh nitrogen cycling processes, with a particular emphasis on the ecosystem service of nitrogen removal provided by denitrification.

We measured potential nitrification and denitrification rates, abundances of nitrogen cycling functional genes, and soil properties and extractable nutrient contents at four sites in Terrebonne Bay, Louisiana. These measurements were conducted approximately bimonthly over the course of one year (2013-2014), around 3 years post-oiling. Two pairs of sites were selected that were separated by ~6 kilometers. Within each pair, one site was oiled and one site was unoiled, and these sites were separated by less than 1.5 kilometers.

Potential nitrification and denitrification rates varied substantially over the course of the year and across transects extending 20 meters inward from the marsh edge. Nitrification rates had an apparent temperature optimum of 20-25°C and correlated significantly with extractable ammonium concentration, soil redox potential, and functional gene (amoA) abundance of ammonia oxidizing bacteria (but not ammonia oxidizing archaea). Potential denitrification rates correlated most strongly with extractable nitrate concentrations and also with functional gene (nirS) abundance. Extractable nitrate, in turn, correlated strongly with potential nitrification, consistent with a coupling between nitrification and denitrification rates in these salt marsh sediments that existed regardless of oiling history.

Potential denitrification rates were only different between unoiled than oiled sites in 2 of the 7 months sampled, whereas potential nitrification rates were higher in unoiled than oiled sites in 6 of the 7 months. This result contrasts strongly with published potential nitrification rates from 2012 when there was no difference between the same oiled and unoiled sites. Some oiling impacts may only be felt years after oiling or may be exacerbated by shifting hydrologic or climatic conditions. Our findings highlight the need for long-term monitoring of important salt marsh ecosystem functions both pre- and post-disturbance.

PRESENTER BIO: Dr. Schutte is a research scientist in the Ecosystem Ecology and Biogeochemistry lab at LUMCON. His broad research interests include nutrient and greenhouse gas cycling in marine and coastal ecosystems.

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STATEWIDE PASSIVE DETECTION FOR ORGANISMAL RESEARCH VHF NETWORK

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Utilization of very high frequency (VHF) radio telemetry for wildlife tracking first arose in the 1960s when the technology restricted use to animals large enough to handle the burden of heavy transmitters. With recent advances in the field, organisms as small as dragonflies may now be tracked via radio telemetry. Bird Studies Canada established the first passive detection VHF network in North America by combining VHF receiver stations with deployment of tiny, coded radio tags called nanotags, thereby, creating the Motus Wildlife Tracking System.

The establishment of Motus-compatible stations and implementation of Louisiana's Statewide Passive Detection for Organismal Research (SPDOR) network throughout coastal Louisiana will allow the Louisiana Department of Wildlife and Fisheries, Barataria-Terrebonne National Estuary Program, and their partners to track hundreds of organisms at once provided those tagged organisms move through the approximately 9-mile detection radius of one station. The potential for such a network of stations to contribute to our current knowledge level concerning Species of Greatest Conservation Need (SGCN) is substantial and is identified as a strategy for the conservation of landbirds in the Louisiana Wildlife Action Plan (Holcomb *et al.* 2015).

Due to the passive nature of data collection by the network of stations, SPDOR will also potentially contribute to the projects of countless other scientists across the continent with no added cost other than supplying downloaded data to the other researcher(s). SPDOR has almost limitless potential for partnering with other agencies, industry, nonprofits, academia, and others. Existing projects enabled by the SPDOR network have examined habitat use by federally threatened shorebirds, use of coastal forests by Neotropical migrant landbirds, and determination of time budgets of beach-nesting birds. Projects like these will facilitate consideration of avian resources during coastal restoration decision-making, generating added value for these critical efforts.

PRESENTER BIO: Mr. Seymour has been the Nongame Ornithologist for the Louisiana Department of Wildlife and Fisheries for almost 11 years, during which time he has coordinated projects on marsh birds, shorebirds, colonial waterbirds, raptors, and Neotropical migratory landbirds. Michael also provides guidance to minimize impacts to Species of Greatest Conservation Need.

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SURFACE ELEVATION CHANGE AND LAND CHANGE OBSERVED USING CRMS DATA

***Leigh Anne Sharp*[1]**, *and Camille L. Stagg*[2]
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Surface elevation, accretion, water elevation, surface and porewater salinity, vegetation and soil characteristics, and land change data have been collected by Louisiana's Coastwide Reference Monitoring System (CRMS) for about a decade at 390 sites across coastal Louisiana. Of those, 332 have surface elevation data that can be assessed along with land change data to infer which processes are influencing recent land change. In the Chenier Plain sites, the 2010-2011 drought was associated with negative elevation trajectories; however, the decline in surface elevation did not lead to land loss. In contrast, terminal flooding in the Chenier Plain was associated with negative elevation trajectories that did ultimately lead to landloss. In the Deltaic Plain landloss, in general, is not associated with elevation loss, suggesting that erosion, not subsidence, may be responsible for continuing landloss there. Over the last decade, wetland surface elevation trajectories have been positive at 75% of sites, including those in coastal areas near the Mississippi River delta that have seen the most historic landloss. Land change data reveal continuing landloss at just 14% of CRMS sites and land gain at 10% of CRMS sites including those in the birdsfoot delta and in the upper Mermentau basin. Furthermore, at least eight sites that were classified as floating marsh at project inception are now attached, including sites downstream from diversions and near the Atchafalaya delta. In general, CRMS data reveal that the coast of Louisiana is dynamic, that much of it has been stable in recent years, and that restoration efforts in concert with natural processes have increased stability in some areas.

<u>PRESENTER BIO</u>: Leigh Anne Sharp is a coastal scientist with over 15 years experience working in coastal wetlands and assessing restoration project effectiveness. She currently manages science development and application of the Coastwide Reference Monitoring System and contributes to CPRA's ongoing coastal monitoring effort.

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BUILDING A CITIZEN SCIENCE PROGRAM FOR WATER QUALITY MONITORING IN NEW ORLEANS EAST

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The New Orleans East community of Village De L'est is a suburb known for its large Vietnamese community where many residents live along banks adjacent to the Maxent Canal. Fecal contamination is a significant problem for coastal and freshwater communities. Identification of sources of contamination through microbial source tracking is an essential resource to prevent disease and ensure water quality. (Harwood, V. J. *et al.* 2015) This study aims to determine human and other sources of fecal contamination in Village De L'est. The current EPA method for quantification of fecal indicator bacteria is *E.coli*. U.S. EPA recreational water quality criterion with membrane filtration for *E.coli* is a geometric mean (GM) of 126 CFU/100ml for freshwater systems. The Standard Threshold Value (STV) for *E.coli* is 410 CFU/100 ml (USEPA 2012). 1000 ml and 100 ml freshwater samples were collected from 5 locations along the canal as it runs through the community. QPCR targeted *Bacteriodales* to identify and quantify potential sources of contamination. 1000 ml samples were collected and vacuum filtered through 0.45 mmembrane filters. DNA extraction was performed using Qiagen DNeasy Power Soil Kits and frozen for qPCR. 100 ml samples were used with IDEXX Quanti Tray 2000 kits to determine most probable number (MPN) of *E.coli*. qPCR of Human, Cattle, and *Enterococcus spp.* were targets was performed using the Amplified Biosystems StepOnePlus Real-Time PCR System. 47% of samples were positive for Human Markers, 11% for Cattle, and 100% of samples contained *Enterococcus* DNA. Sites 3, 4, and 5, exceeded the GM of 126 CFU /100ml for safe use of recreational freshwater systems (233 CFU/100 ml, 647 CFU/100ml, and 483 CFU/100 ml respectively). These results suggest minimal cattle fecal contamination. Analysis of correlations between *E.coli* and our PCR targets is the next step. Future research will focus on quantification and source identification of *Bacteriodales spp.* and *E. coli* with ddPCR. This project will continue to collect water samples and increase our sample size to improve the utility of our GM calculations for use with EPA recreational water guidelines. These findings will also be presented to the MQVNCDC and members of the community.

PRESENTER BIO: Dr. Sherchan is an assistant professor in the Dept .of Global Environmental Health Sciences at Tulane. He has extensive experience with water quality, microbial source tracking, fecal contamination and environmental microbiology.

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HYPOXIA IN THE MISSISSIPPI BIGHT: UNDERSTANDING INTERACTIONS OF CIRCULATION AND BIOGEOCHEMISTRY IN A COMPLEX RIVER-DOMINATED COASTAL ECOSYSTEM.

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The waters to the east of the Mississippi River Delta, including the Mississippi Sound and Bight, are relatively understudied compared with the Louisiana Shelf to the west. Nonetheless, the Mississippi Sound and Bight, like the Louisiana Shelf, contain productive fisheries, are subject to environmental issues such as oil spills, and experience seasonal hypoxia. The CONCORDE Consortium and other projects have recently been investigating this complex, river-dominated ecosystem. Because the Mississippi Sound and Bight receive fluvial inputs from three states and is comprised of both state and federal waters, potential management efforts are also complicated. In this presentation, we focus on hypoxia in this system and explore the interactions of different source waters. With oxygen isotopes, we find that outflow from the Mississippi River is typically not the dominant freshwater source to the Mississippi Sound/Bight region. Furthermore, with radium isotopes we observe a significant influence of submarine groundwater discharge (SGD) which is also correlated with hypoxic conditions. This relationship suggests that “bottom-up” influence of reduced substances on oxygen consumption can be an important contributor to hypoxia.

PRESENTER BIO: Dr. Shiller is Bennett Distinguished Professor in the Sciences at USM with over 30 years of experience in marine geochemistry. He has experience studying fluvial, coastal, and open ocean systems. His work has focused on trace element distributions as well as chemical impacts of hypoxia and the Deepwater Horizon blowout.

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MISSISSIPPI RIVER MID-BASIN SEDIMENT DIVERSION PROGRAM – THE STATE OF THE PROGRAM

***Rudolph A. Simoneaux, III*[1]**, *Brad Barth*[1], *and Seth Irby*[2]

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In 2016, the Louisiana Coastal Protection and Restoration Authority established the Mississippi River Mid-Basin Sediment Diversion Program. The goal of this program was to synergistically implement two cornerstone projects of the 2017 Coastal Master Plan - the Mid-Barataria and Mid-Breton Sediment Diversion projects. This presentation will discuss the purpose and background of the program, and provide details on the some of the key programmatic elements being used for the delivery of these two mega-projects.

Due to the size and complexity of these projects, the program approach involves multiple teams working on several concurrent activities. The presentation will discuss the structure of the program, the individual teams, and how each team functions. An overview of the current environmental and engineering project activities, as well as upcoming tasks, for both projects will also be discussed.

Session attendees will also gain an understanding of the history and differences of the two projects, why sediment diversions are so important to the sustainability of the surrounding basins, the importance of community outreach, an introduction of the innovative construction delivery model being used, and a summary of the primary risks associated with the projects. Additionally, this presentation will serve as a prelude to the three other topics included in this session, which will discuss the engineering and construction of the project, the development of an operation plan for sediment diversions, and an overview of the milestone schedule.

PRESENTER BIO: With over 14 years of experience in coastal and ecosystem restoration, Mr. Simoneaux currently holds the position of Manager for CPRA's Engineering Division where he has worked since 2004. Mr. Simoneaux received a B.S. in Civil Engineering from Louisiana State University in 2004 and is a Registered Professional Engineer in State of Louisiana.

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ANALYSIS OF THE HISTORICAL CHANGE IN STORM SURGE ACROSS COASTAL LOUISIANA VIA LAND TO WATER ISOPLETHS

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Relative sea level rise (RSLR) has the potential to negatively impact the Mississippi River Delta (MRD) and the industries it supports including a fishing industry that produces the largest seafood harvest in the contiguous United States, a petroleum industry that produces the most crude oil and the second most natural gas in the United States, and a shipping industry that has made Louisiana the top export state in the nation. More than 1,875 square miles (4,856 sq km) of coastal Louisiana wetlands along with numerous barrier islands were lost between 1932 – 2000 due to, among many factors, erosion and RSLR. Comparable hydrodynamic storm surge models that represent historical eras of the Louisiana coastal landscape could be developed to analyze the change in hurricane storm surge (e.g. peak water levels, inundation time and volume of inundation) due to land loss. Land:Water (L:W) isopleths, defined as lines on a map indicating a constant value of a given variable, are developed to describe areas with constant values of the ratio of land to water (L:W). These L:W isopleths have been calculated along the Louisiana coast from Sabine Lake to the Pearl River. A storm surge model featuring a simplified coastal landscape (bathymetry, topography, bottom roughness) of present day coastal Louisiana was developed via the L:W isopleths. A similar approach is utilized to create historical storm surge models for circa 1930 and 1970.

The goal is to analyze the historical change in hurricane storm surge along coastal Louisiana. The L:W isopleths found to most closely reproduce the detailed coastal Louisiana landscape for c.2010 are utilized to create historical storm surge models for c.1930 and c.1970. The ADvanced CIRCulation (ADCIRC) code is used to compute water surface elevations and depth-averaged currents forced by hurricane wind and pressures for a set of historical hurricanes. Hydrologic Unit Code 12 (HUC12) sub-watersheds provide geographical bounds to quantify mean maximum water surface elevations (WSEs), volume of inundation, and time of inundation. HUC12 sub-watersheds also provide the capability to analyze on a HUC12-by-HUC12 basis the change in storm surge over time (e.g. 1930 vs 1970 and 1930 vs 2010). Simulation results will reveal the changes in storm surge across coastal Louisiana from 1930 to 2010 and provide insight to policy makers of areas with rapidly changing surge parameters.

PRESENTER BIO: Christopher Siverd is a Graduate Research Assistant at Louisiana State University in the Department of Civil and Environmental Engineering.

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BUILDING COASTAL SUPPORT THROUGH INNOVATIVE COMMUNICATIONS AND MARKETING STRATEGIES

Ryan Chauvin[1], Emily Falgoust[1], Emily Guidry Schatzel[2], Jacques Hebert[3] and ***Elizabeth Skree**[4]*

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In summer 2017, the Louisiana Legislature unanimously passed the 2017 Coastal Master Plan. Containing more than 100 projects, the 50-year, $50-billion plan is the state's blueprint for coastal restoration and protection efforts.

Following passage of the plan, Restore the Mississippi River Delta, a coalition of local and national non-profit organizations advocating for Louisiana coastal restoration, identified 17 restoration projects from the master plan that, if prioritized and implemented quickly, will help restore and maintain as much of the coast as possible. In November, we released the report, "Recommendations for Coastal Restoration Projects and Programs in Louisiana."

Rollout included an updated interactive project map where visitors can learn about specific projects and project types, what basin they're in, and what construction phase they're in; a beautiful report available in both PDF and print versions; social media promotion via Facebook and Twitter as well as episodes on our Delta Dispatches podcast and radio show; and media tours of the Maurepas Swamp, an area containing three of our coalition's 17 priority projects.

Media engagement resulted in local TV and radio coverage, and print stories in local and national outlets, including The Times-Picayune, The Advocate, The Courier and Daily Comet, ClimateWire, WBRZ, WVUE Fox-8, Lake Charles American Press and more. To date, more than 7,000 people have engaged with priority project content on our website, and more than 50,000 people have engaged with our report content on Facebook.

A challenge we as the communications team had was taking a report about complex projects, many of which have not begun construction, and making it interesting to both the public and the media. We couldn't take people out to see these projects in action building land, or even under construction. We instead had to creatively tell the story of why these projects are important to coastal restoration efforts, how they will help rebuild Louisiana's coast, and why it's important that they advance as quickly as possible. In our messaging and media engagement, we selected messages that would resonate with journalists in order to engage as many markets and reach as many people as possible. This challenge of making restoration more accessible to people and media also inspired us to develop a 360 video for use at tabling events and in meetings, to virtually put people into restoration sites and other places along the coast, so they could see and experience coastal restoration.

PRESENTER BIO: Elizabeth is Communications Manager for Environmental Defense Fund's Coastal Resilience and Mississippi River Delta Restoration programs. She manages media and public relations, marketing and promotions, and content creation. She also serves on the Communications Committee for Restore the Mississippi River Delta.

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USING ADAPTIVE MANAGEMENT FOR SUCCESSFUL MARSH RESTORATION AND SHORELINE PROTECTION

Gerald Songy[1]*, Brett Geesey*[2]*, and Joelynn Barclay*[3]
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[2]HDR Engineering, Inc., Lafayette, LA, USA
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The West Bay shoreline of Galveston Island, Texas experiences many issues similar to the coastlines of Louisiana including sea level rise, land subsidence, lack of natural sediment supply, wave induced erosion, and other impacts. These impacts have resulted in a significant decline of marsh habitat over several decades at West Bay, which includes Galveston Island State Park (GISP). The West Bay area is vital habitat for birds, fish, and other wildlife, and also serves as a recreational area for residents and tourists at Galveston Island. The West Bay marsh also acts as a buffer for State Highway 3005, which is the main highway along Galveston Island.

Several projects have been completed in this area as part of an overall regional effort to restore marsh complex along the bay shoreline of west Galveston Island dating back to 1999. Application of adaptive management principles and development of multiphase restoration concepts have improved the success of these projects over time. Adaptive management principles have resulted in several advancements in project design and construction, including more cost-effective sediment placement configurations and application of more robust methods for protecting the restored marsh fringe from wave action.

As part of this continued adaptive management plan, two marsh restoration projects were completed in July 2017 along the West Bay shoreline to mitigate loss of marsh habitat. The projects are located at Gangs Bayou near Sportsman Road, and at Carancahua Cove. Eighty acres of marsh complex were restored in shallow open water adjacent to existing marsh using sand dredged from nearby borrow areas. The dredged material was placed with the intent to create wide, gently-sloped, emergent mounds constructed to elevations suitable for planting and natural colonization of intertidal marsh grass. Rock breakwaters were constructed to help protect the newly restored marsh from wave energy. The breakwaters were chosen based on adaptive management principles learned from previous projects using Reef Balls and geotextile tubes. These 2017 projects are being managed and funded through a partnership between the Texas General Land Office and Texas Parks and Wildlife Department.

This presentation will include background information on the project area, details on design and construction phases, plans for a 5-year monitoring effort, and lessons learned from adaptive management principles that can be used in Louisiana and throughout the Gulf Coast.

PRESENTER BIO: Mr. Songy earned a B.S. in Civil Engineering from Louisiana State University and a M.S. in Civil Engineering with a concentration in Coastal and Marine Engineering from Delft University of Technology. Since joining HDR in 2016, he has gained experience in shoreline protection, marsh creation/restoration, and beach nourishment projects.

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NUMERICAL MODELING OF WAVE DYNAMICS AND DIVERSION-INDUCED SEDIMENT DISPERSAL IN THE BARATARIA BAY

Soroush Sorourian *and Haosheng Huang*
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To combat the chronicle land loss problem over the coastal Louisiana, Louisiana's Comprehensive Master Plan for a Sustainable Coast (2017) highlighted large scale sediment diversions as one of the most efficient and sustainable land-building and land-stabilizing solutions. In order to quantify the dispersal pattern of diversion-laden sediment and its remobilization under coastal ocean processes, such as waves, tides, and wind-driven subtidal circulation, a numerical modeling suite is employed. In this study, a three-dimensional, unstructured grid, Finite Volume Coastal Ocean Model (FVCOM) is developed to assess the sediment dynamics due to ocean current, wind wave, and river diversion in the Barataria Basin. The three components of the modeling suite, hydrodunamics (FVCOM), wave (FVCOM-SWAVE), and sediment (FVCOM-SED), are fully coupled.

The numerical model domain covers most of the Alabama-Mississippi-Louisiana-Texas continental shelf with very high horizontal resolution (on the order of 15 meters) in the Barataria Bay. For hydrodynamic modeling, model simulation results are compared with 19 observational data for model calibration and validation. For the wave modeling, six offshore and coastal stations from National Data Buoy Center (NDBC) and Coastal Studies Institute (CSI) are incorporated for model validation. Regarding sediment transport, nine sediment classes are considered from various riverine and diversion sources in addition to non-uniform initial sediment distribution encapsulating more than 50000 historical data.

The present high-resolution numerical model successfully captures near field dynamics at hydraulically supercritical river and diversion plume, dispersal pattern and shelf-bay exchange of sediments. Wave-current coupled model attest locally generated wave field within the Barataria Bay and is able to provide combined bed shear stress to remobilize sediment in the estuary. This model can provide policy-makers and resource managers an important tool in coastal restoration planning.

<ins>PRESENTER BIO</ins>: Soroush Sorourian is a PhD Candidate from Department of Oceanography and Coastal Sciences, LSU. His research interest pertains numerical modeling of coupled hydrodynamic-wave-sediment models to assess sediment dynamics in coastal zone and estuarine systems. Additionally, he has > 6 years of experience as a coastal modeler and maritime structure designer.

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EFFECT OF HYDROLOGIC RESTORATION ON COASTAL LOUISIANA FRESHWATER WETLAND SOIL PROPERTIES AND RESILIENCY

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Marsh loss is a major concern in the Mississippi River Delta and is a result of many factors including sediment or nutrient deprivation and salt intrusion. Freshwater diversions are designed to reintroduce freshwater from the Mississippi River in order to maintain freshwater marsh vegetation and nutrient cycling functions in Coastal Louisiana wetlands. One aspect of preventing marsh loss is accretion, which can be driven by mineral sedimentation or the buildup of organic matter. This study characterized soil properties at a freshwater diversion site before full freshwater flow to the site began with the intention of resampling after a decade of diversion operation. We present a baseline of nutrient status and accretion processes of this marsh before freshwater, sediment and nutrient input occurred. There were 142 stations (0-10 and 10-20 cm depth) to determine a baseline of soil moisture, bulk density (BD), pH, organic matter content (OM), total phosphorus (TP), nitrogen (TN), and carbon (TC). Maps of soil properties in the recently accreted 0- to 10-cm depth interval were produced using kriging. From the spatial correlation analysis, we observed that TN, TC and OM, in the 0- to 10-cm depth interval, had similar properties and were closely inversely related to BD. These results allowed us to infer the mechanism of accretion across the wetland, which varied with distance from the river. Continuing study of Davis Pond freshwater diversion area is ongoing, and a sampling team will return in April and May 2018 to observe the changes in biogeochemical processes, accretion, plant nutrient uptake and community structure. Although there are several diversions currently in operation and several more are planned in coastal Louisiana, long term effects of freshwater restoration projects have yet to be quantified. This research can reveal the potential impacts of freshwater diversions on freshwater marsh soil properties related to resilience in coastal Louisiana.

PRESENTER BIO: Alina Spera is a master's candidate in the Wetland and Aquatic Biogeochemistry Laboratory at Louisiana State University. Alina's research focuses on the impacts of large scale restoration projects on freshwater wetland biogeochemical processes.

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VOLUNTEER AND COMMUNITY INVOLVEMENT IN RESTORATION EFFORTS

James Stram
Common Ground Relief, New Orleans, LA, USA

Education of local stakeholders, and people across the country is critical for generating the political will necessary to properly address coastal land loss. Involving people in restoration efforts is an effective way to create informed and motivated stewards of Louisiana's wetlands. Common Ground Relief has been working with local and non-local volunteers for a decade, much of that time doing wetlands restoration work exclusively. We are able to use our volunteer base to do planting projects, invasive species control, and grow wetlands plants in order to take on, and aid with projects that may otherwise be overlooked, or are not large enough to be considered by other organizations. We are able to supplement both plant material and manpower to help with state, federal, and NGO projects. We would like to share our experience, both what has worked and what hasn't, as well as share our plans for the coming years in our presentation.

PRESENTER BIO: Mr. Stram has a degree in environmental science from McGill University class of 2010. He started working with Common Ground Relief in 2011, and has been running the wetlands restoration program since 2012.

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MONITORING COASTAL WETLAND VEGETATION USING HIGH-RESOLUTION SATELLITE IMAGERY

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There has long been increasing needs for more efficient collection of data to quantify, monitor, and model ecosystem condition, performance, and resilience. Traditional ground based data collections, such as field surveys, can be useful for small geographic extents but are often not feasibly or fiscally practical for large project areas or areas with limited access. Environmental monitoring, especially to evaluate the success of restoration projects, requires the ability to detect and map land surface attributes and landscape level characteristics over time and space. The most practical methods for these assessments are through the acquisition, processing, and analysis of high spatial resolution space-borne imagery (< 5 meter spatial resolution). Remotely sensed data provide spatial and temporal perspectives on ecological phenomena that would otherwise be difficult to study. Advanced remote sensing techniques have transformed ecological research by providing enhanced spatial and temporal capabilities, enabling scientists to examine a range of ecological systems and parameters.

This presentation highlights recent efforts using remote sensing technologies, and subsequent analytical capabilities, to support coastal wetland monitoring and management. Traditional space-borne systems and data have been constrained by cost, resolution (i.e., temporal, spatial, and spectral), and an overall lack of flexibility since acquisition and processing typically requires third-party solutions. However, contracts like EnhancedView and advancements in some sensors reduce many of those limitations. The EnhancedView contract provides access to archived imagery and allows for tasking of satellites carrying sensors with higher spatial, spectral, and temporal resolutions, like the WorldView-3 sensor. Recent efforts have focused on image acquisition, processing, and evaluation of metrics for detecting, quantifying, and monitoring coastal ecosystem structure and function. Case studies include: (1) the use of the Normalized Difference Vegetation Index for tracking changes in vegetation health, resistance to, and recovery from, disturbance events, (2) species-based classification to quantify genotype impacts and resistance, (3) the use of stereo imagery for estimating vegetation height, (4) landscape pattern metrics to evaluate wetland structure and ecosystem integrity, and (5) the development of a raster-based floristic quality index for assessing and tracking the quantity and quality of dominant vegetation species.

Ultimately, these remote sensing technologies provide more efficient methods for measuring wetland ecological condition, monitoring critical landscapes, identifying areas of high conservation value, assessing impacts from disturbance events, evaluating and comparing restored wetland performance to reference wetlands, and assisting in restoration planning and adaptive management.

PRESENTER BIO: Mr. Suir is a research agronomist with more than 15 years of experience in monitoring and evaluating wetland ecosystems. He has extensive experience with remote sensing applications for quantifying the structure, function, and resilience of natural and restored wetlands. Mr. Suir has led numerous large-scale projects that were dedicated to preserving or restoring wetland resources as part of Environmental, Navigation, Regulatory, and Restoration initiatives.

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MARINE ENTERPISE ZONES FOR COASTAL COMMUNITY DEVELOPMENT

John Supan *and Robert Twilley*
Louisiana Sea Grant College Program, LSU, Baton Rouge, LA, USA

Industrial parks are areas permitted and/or zoned for the operation of prescribed businesses without the need for individual permitting. Such community programming is commonly used in the economic development of inner cities and rural areas across the United States. This same concept can be applied to coastal waters delineated, permitted and administered for certain sea farming and marine activities to circumvent user conflicts, navigation, security, liability and environmental issues.

The concept of state aquaculture parks was proposed in 1992 by the National Research Council's Committee on Assessment of Technology and Opportunities for Marine Aquaculture in the U.S. "Entrepreneurs could lease space and infrastructure and be covered by an umbrella permit. Such parks would foster commercial operations, but even more importantly, would foster commercialization (i.e., parks could play an important role in technology transfer). A planned linkage between technology centers and such aquaculture parks would facilitate the deployment of new technology."

Following these concepts, a 25-acre and 13-acre inshore aquaculture park was established by the 2012 and 2017 Louisiana Legislature administered by the Grand Isle Port Commission in Caminada Bay, Louisiana, in collaboration with the Louisiana Sea Grant College Program. Floating cage technology is used to deter oyster predation, allow timely aerial drying to control biofouling to reduce labor costs and assure rapid growth. The sites support successful commercial farming of triploid oysters (*Crassostrea virginica*), a product of Sea Grant's Oyster Research Laboratory's oyster breeding program.

Such successful programming should be applied to Louisiana's coastal restoration planning. Marine spatial planning combined with future operational planning, can identify "grow zones" for optimal oyster production, using off-bottom methods to help coastal residents transition their livelihoods to our ever changing coast.

PRESENTER BIO: Dr. Supan is a retired professor with more than 30 years of experience in oyster culture, management and sanitation. He leads the gulf region in innovative oyster programming using hatchery-based oyster production and breeding. His concepts for coastal planning are new and progressive to address adaptive change and transition.

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PLANKTON COMPOSITION AND DISTRIBUTION IN BRETON AND BARATARIA BASINS AND IMPLICATIONS FOR FOOD WEB MODELS

Malinda Sutor[1], *Shaye Sable*[2], *and Natalie Martin*[1]
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Lower trophic level dynamics are key components of ecosystem function, but are relatively little understood in the shallow estuary systems of the Gulf Coast. Plankton play important roles in nutrient dynamics and supporting upper trophic levels like commercially important fisheries (i.e. Gulf Menhaden). These shallow systems are difficult to sample for plankton and relatively little work has been done to examine the community composition and abundance of plankton in these estuaries. This is an important data gap in our current understanding of ecosystem function and food web modeling. Twenty monthly transects (September 2007-April 2009) were conducted in Barataria Bay and Breton Sound Estuaries to assess nutrients, water quality, and plankton biomass and community composition. Preliminary results show that the plankton community composition is different between estuaries, between low and high freshwater input events within each estuary and on a salinity gradient within each estuary. These results will be compared to current food web model inputs for lower trophic levels and the implications of potential changes in model results and interpretations will be discussed.

PRESENTER BIO: Dr. Sutor is a plankton ecologist with expertise in image analysis, bio-optics, bioacoustics, and extensive field experience in estuarine, coastal, and offshore environments. Her research encompasses phytoplankton, microzoplankton, mesozooplankton, and ichthyoplankton distributions and community dynamics.

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HEAVY METAL TOLERANCE IN THREE MARINE PHYTOPLANKTON SPECIES: EFFECTS OF CADMIUM ON ALGAL PHYSIOLOGICAL PROCESSES

***Sabrina Tabassum-Tackett**, Beth A. Stauffer, and Paul L. Klerks*
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Heavy metals are a major component of anthropogenic pollution in aquatic ecosystems. Phytoplankton species, including those that can form harmful algal blooms (HABs), can be affected by metal pollution, causing shifts in their abundance that can in turn have consequences for communities of primary producers. In order to determine the effects of cadmium (Cd) on primary producer growth and relative abundance of different algal species, we are studying the sub-lethal effects of Cd in two HAB forming species *Heterosigma akashiwo* and *Akashiwo sanguinea*, and the diatom *Coscinodiscus sp*.

Single-strain cultures are maintained under laboratory conditions, using a modified f/2 culture medium without EDTA. Cultures are maintained at 20 ppt salinity, 18-19º C, and a 12-12h light-dark cycle. The phytoplankton species are exposed for 14-days to a broad range of Cd concentrations. Sublethal endpoints measured include: specific growth rate via cell counts, chlorophyll-a pigment concentration, and photosynthetic yield (F_v/F_m). In addition to quantifying the effects on algal biological processes, C-content per cell will be quantified as well. This research will provide insight into the metal tolerance of several algal species and the potential for metal exposure to affect the relative abundance of these species. This research is ongoing; results will be presented at the meeting.

PRESENTER BIO: Sabrina Tabassum-Tackett is a Biology Masters student working in Environmental Toxicology under the guidance of Dr. Paul Klerks. Originally from Bangladesh, she graduated with B.S. in Microbiology from Marshall University, WV. She is interested in the effects on heavy metals on estuarine and marine phytoplankton.

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INTRODUCTION TO ROCKEFELLER REUGE AND CORRESPONDING LEVEE REPAIRS

***Beau Tate**, P.E.*
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Rockefeller Wildlife Refuge (RWR) lies within the southeastern portion of the Chenier Plain Region of southwestern Louisiana in Cameron/Vermilion Parishes. RWR borders the Gulf of Mexico for 26.5 miles and extends inland toward the Grand Chenier ridge, a stranded beach ridge six miles from the Gulf. When it was deeded to the state in 1920 RWR encompassed approximately 86,000 acres. However, since then the property has lost approximately 14,000 acres and currently stands near 72,650 acres.

The original purpose of RWR was to provide a sanctuary/preserve for wildlife and fisheries and there has been little deviation since then to this original vision. The refuge also serves as a research site for marsh management strategies (i.e., limiting saline encroachment, and reversing marsh deterioration).

Beginning early in the twentieth century, large scale human-induced hydrologic alterations began to alter hydrology of the entire region (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2002). Dredging of the Old Intracoastal Waterway and the Gulf Intracoastal Waterway (GIWW) allowed flow east/west through the new canals rather than sheet flowing across the marsh in a southerly direction toward RWR. North/south water flow patterns continued to change with the dredging of the upper Mermentau River and its four major tributaries between 1915 and 1935.

Other hydrology changes caused by navigation, drainage, and mineral development projects have further necessitated and influenced marsh management. The Humble Canal, the Union Producing Canal, and construction of the Superior Canal connecting Grand Lake with RWR caused additional changes in regional water flow patterns. Breaching of Highway 82 by the Superior canal, additional oilfield canals constructed along the Superior Canal, and construction of the Property Line Canal permanently altered normal sheet flow patterns and changed regional hydrology by creating a direct link between the Chenier Sub-basin, the Lakes Sub-basin, and the Gulf of Mexico. Because of this, RWR was forced by agricultural interests in the Upland Sub-basin to construct the East End Locks at the intersection of the Property Line Canal and Humble Canal.

Active Marsh management strategies were initiated on RWR at a time when royalties from oil/gas operations on the refuge increased and habitat degradation from eat-outs, fires, saltwater intrusion and vegetation die-offs was approaching major proportions. By 1954, over 40 gated culverts were placed in over 50 miles of levees constructed in strategic locations on the refuge for salinity control, with each resulting impoundment identified as a management unit. Hurricane Audrey and Hurricane Rita both significantly damaged levees and water control structures. RWR has currently completed 2 phases (38 miles) of levee repairs and is in the bid phase for phase three (22 miles) of Hurricane Rita levee repairs.

PRESENTER BIO: Mr. Tate is a senior engineer with more than 19 years of experience planning, designing, and implementing Coastal Restoration, Protection, and Civil construction projects. He has extensive experience with barrier island restoration, marsh creation, and levee construction projects, and successfully completed projects across the gulf coast.

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MARSH CREATION DESIGN CRITERIA AND PROJECT PERFORMANCE

*Russ Joffrion, P.E., **Amanda Taylor**, P.E., Julia Wall, E.I., Tye Fitzgerald, P.E. and Stuart Brown*
Coastal Protection and Restoration Authority, Baton Rouge, Louisiana, USA

For decades, the state of Louisiana has successfully designed and implemented marsh creation projects within the Louisiana Coastal Zone in an attempt to restore degrading coastal habitat, restore wetlands, limit salt water intrusion, and rebuild degraded coastal land-bridges. The CPRA has utilized the expertise gained from the in-house design and construction of marsh creation projects, and the experience from construction contractors, field office engineers, engineering consultants, federal sponsors, and non-federal/local sponsors to develop design and performance criteria for Louisiana Marsh Creation Projects.

In order to maximize the ecological benefits and ensure longevity of these Marsh Creation Projects, an appropriate construction marsh fill elevation should be estimated based on the local water levels found in the project area. The methodology for estimating the constructed marsh fill elevation presented in the *Marsh Creation Design Guidelines* is the Percent Inundation Methodology which refers to the percentage of a year in which a marsh elevation would be inundated based on local water levels. Marsh inundation plays a critical role in measuring a project's performance as different marsh types perform best under different optimal inundation ranges.

Project performance directly relates to the anticipated project life as well as the optimal inundation range needed to achieve healthy marsh. Successful projects translate to having a constructed marsh platform that settles into the optimal inundation range within a few years after construction and remains there the majority of the project life. The presentation will give an overview of the *Marsh Creation Design Guidelines*, discuss the methodology for estimating an appropriate constructed marsh fill elevation, and relate the constructed marsh fill elevation to anticipated project performance.

PRESENTER BIO: Amanda Taylor has been a Project Engineer for the Coastal Protection and Restoration Authority for the past 4 years and has been involved in the design of multiple marsh creation and hydrologic restoration projects in Coastal Louisiana.

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LAST ISLAND RESTORATION: REFLECTING ON 20 YEARS AND LOOKING INTO THE FUTURE

***Patricia A. Taylor**, Ph.D., P.E.*
U.S. Environmental Protection Agency, Region 6, Dallas, Texas, USA

Last Island, or Isle Dernière, was exactly as it sounds, the last barrier island along the Louisiana coast. The island was known for white sand beaches, clear water and continuous breezes. In the mid-1800s, wealthy families spent summers in large vacation homes along the 21-mile long stretch of white sand. The Gulf breeze made it a perfect spot to escape the heat and humidity of the mainland until a hurricane in August of 1856. The hurricane that made landfall just south of New Iberia, Louisiana was believed to have been a Category 4, with wind speeds of 150 mph at maximum intensity. The storm surge was estimated up to 12 feet and island was thought to be no more than five feet above sea level. All of the structures were destroyed and of the approximately 400 vacationers, only 203 survived. Last Island broke up into five smaller islands, as many areas were completely washed away.

EPA Region 6 in partnership with the Coastal Protection and Restoration Authority (CPRA) recognized the value of restoring the Louisiana barrier islands, completing the first three barrier island restoration projects funded by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program. The Isles Dernieres Restoration East Island (TE-20), Isles Dernieres Restoration Trinity Island, (TE-24) and Whiskey Island Restoration (TE-27) CWPPRA projects were completed almost 20 years ago and are nearing the end of the 20-year design life. The presentation will provide an overview of the project designs and features, discuss current status and project performance, identify lessons learned, and recommend future actions to preserve the valuable habitat and provide coastal resiliency.

PRESENTER BIO: Patricia A. Taylor, Ph.D., P. E., is an Environmental Engineer with EPA and a Southern Methodist University Adjunct Assistant Professor. Dr. Taylor has over 33 years of experience in Civil/Environmental engineering and project management.

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USING MISSISSIPPI RIVER SEDIMENT: THE SUCCESS OF THE BAYOU DUPONT PROJECTS

Brad Crawford, P.E., and ***Patricia A. Taylor**, Ph.D., P.E.*
U.S. Environmental Protection Agency, Region 6, Dallas, Texas, USA

The Bayou Dupont Sediment Delivery System (BA-39) was the first project funded by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) to use Mississippi River sediment to directly offset land loss. EPA Region 6 in partnership with the State of Louisiana Coastal Protection and Restoration Authority (CPRA) completed the design and construction of this innovative project in 2010. Sediment dredged from the Mississippi River was delivered via pipeline to create 568 acres of marsh. Recognizing the success of the BA-39 project, subsequent projects were implemented.

Using the same pipeline access route and riverine sediment delivery via pipeline concept, the Long Distance MS River Sediment Pipeline (BA-43 EB) and Bayou Dupont Marsh and Ridge Creation (BA-48) projects were constructed. These restoration projects were funded through the Louisiana Coastal Impact Assistance Program (CIAP), State of Louisiana funding (Surplus), and CWPPRA. The BA-43 EB project created and nourished approximately 480 acres of marsh. The BA-48 marsh and ridge creation project created 277 acres of marsh, nourished approximately 93 acres of marsh and created 20 acres (11,000 linear feet) of maritime ridge by long distance pumping of Mississippi River sediment.

An additional CWPPRA project sponsored by EPA Region 6 with CPRA as the local sponsor was recently completed in 2017. The Bayou Dupont Sediment Delivery - Marsh Creation and Terracing #3 (BA-164) also utilized the access route and infrastructure previously put into place for the BA-39 project. This project created and nourished approximately 144 acres of emergent intermediate marsh using sediment from the Mississippi River, and constructed 9,679 linear feet of terraces. The BA-164 project complements the other restoration projects in the area.

By dredging the Mississippi River and pumping the sediment via pipeline into areas of open water and broken marsh, these projects created and/or nourished almost 2.5 square miles of land, created over 2 miles of ridge and nearly 1.8 miles of terraces to directly address land loss. The proximity of these projects to the Mississippi River provided a prime opportunity to utilize this renewable river sediment resource. The presentation will review the construction, examine the post-construction results of the EPA sponsored projects, and provide lessons learned for future projects.

PRESENTER BIO: Patricia A. Taylor, Ph.D., P. E., is an Environmental Engineer with EPA and a Southern Methodist University Adjunct Assistant Professor. Dr. Taylor has over 33 years of experience in Civil/Environmental engineering and project management.

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LOUISIANA MASTER NATURALISTS: THE MANY WAYS TO MAKE SAVING THE COAST A PERSONAL IMPERATIVE

Robert A. Thomas
Loyola University New Orleans, Louisiana, USA

The Louisiana Master Naturalists Association (LMNA) exists to advance awareness, understanding, and stewardship of the natural environment in Louisiana by developing a corps of well-informed citizen volunteers dedicated to service in conservation and natural history education within their communities.

The first chapter formed in the Spring of 2012 in Greater New Orleans and launched its first training course that fall. Soon thereafter, chapters formed in Lafayette (Acadiana), Lake Charles (Southwest), Baton Rouge (Greater Baton Rouge), Shreveport-Bossier (Northwest), Alexandria (CenLa) and Monroe (Northeast).

There are several aspects of LMN that attract dedicated citizens:

- It has become a gathering place for like minded citizens who treasure Louisiana's natural resources
- The LMNA is a statewide program that educates Louisiana citizens about our flora, fauna, and other aspects of our environment and ecosystem.
- It is producing a cadre of engaged citizens who are increasing informed of Louisiana's natural history heritage
- Once certified, Master Naturalists use their talents to educate others or assist programs that promote and protect Louisiana's natural heritage.
- Individual Certified Louisiana Master Naturalists (CLMN) donate a minimum of 20 volunteer hours each year, enhancing public understanding of Louisiana's natural world.
- Chapters are expanding interest among the public in the state's flora and fauna.
- The bottom line is that an informed citizenry will make better decisions that result in a brighter future for Louisiana natural resources.

As of 2017, more than 500 people have been through natural history training with Louisiana Master Naturalist, and with all seven chapters now in place and the state organization being strengthened, the numbers should expand rapidly.

This panel talk will focus on the communication system used in LMNA and means by which coastal issues are being simplified and effectively communicated. Techniques will be mentioned that have been used by the speaker since 1978.

PRESENTER BIO: Dr. Thomas is professor of environmental communication and teaches in Loyola's environment and biology programs. He holds the Loyola Distinguished Scholar Chair in Environmental Communication.

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NATIVE PLANT SOLUTIONS FOR COASTAL RESTORATION ALONG THE GULF COAST

Garret Thomassie, *Curt J. Riche' and Daniel Pingel*
USDA-NRCS Golden Meadow Plant Materials Center, Galliano, LA, USA

The mission of the Plant Materials Program is to find plant solutions to solve conservation problems. NRCS plant material activities are to provide timely and effective vegetative solutions for identified resource needs. This information is incorporated into technical documents and training products for federal and state government agencies, universities and the general public. The Program also identifies, tests and selects plants for vegetative and seed Conservation Plant Releases to provide for commercial production of plant materials to protect and conserve our natural resources.

One of twenty-five centers across the United States, the Golden Meadow Plant Materials Center is responsible for Critical Area Stabilization concerns which address coastal areas, dunes and marshes. The Center supports re-vegetation efforts along the northern Gulf Coast through development and evaluation of plant propagation and plant establishment technology for the restoration and enhancement of associated coastal habitats (e.g. coastal marshes, coastal prairies, Chenier ridges).

Coastal remediation involves identifying and evaluating plant species for coastal erosion control, marsh restoration and dune stabilization. The Center identifies and collects emergent and submersed aquatic plant species from different marsh ecosystems for 1) the re-vegetation of coastal zones affected by intense wind and water erosion; 2) the selection of robust plant varieties resilient to changing salinity and water regimes; and 3) the enhanced diversity of coastal dunes and barrier islands.

PRESENTER BIO: Garret Thomassie is manager at the USDA/NRCS Golden Meadow Plant Materials Center. He received his BS Horticulture from the University of Louisiana, Lafayette. With more than 19 years' of coastal wetland experience, he has been involved with coastal restoration projects dealing with Louisiana's wetland and barrier island vegetative problems.

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WOODY PLANT SELECTION FOR COASTAL MARITIME RIDGE RESTORATION AND REVEGETATION

*Daniel Pingel, **Garret Thomassie** and Curt J. Riche'*
USDA-NRCS Golden Meadow Plant Materials Center, Galliano, LA, USA

USDA Natural Resource Conservation Service Plant Materials Program is committed to finding innovative and adaptive vegetative strategies to protect resource concerns. The Golden Meadow Plant Materials Center in Galliano, LA focuses on Critical Area Stabilization of coastal habitats including coastal marshes and estuaries. Coastal restoration is a key concern in Louisiana as the state experiences more coastal land loss than any other in the US.

Coastal restoration is challenging because human activities force the imitation of natural successional processes. This presents its own challenge as succession varies from region to region and is on a projected, possibly generational timescale. The ultimate goal of coastal restoration is to get degraded environments to a state as close to natural as possible. Each project presents a chance to learn what steps need to be taken for a system to balance itself and reach an artificial equilibrium.

Port Fourchon, LA has been rapidly developing over the last 20 years. As it has developed its port facility, it has provided the dredge material for the necessary mitigation to the surrounding marshes. One project involved the use of dredged material in the restoration of a maritime forest ridge. This presented an opportunity to identify native woody species useful in the revegetation of constructed ridges from dredged material. Dredged material can become colonized by native plants over an extended period of time. The goal of the study was to identify native woody species that could tolerate variable soil conditions and maintain the integrity of the constructed coastal ridge to accelerate revegetation and control erosion.

PRESENTER BIO: Garret Thomassie is manager at the USDA/NRCS Golden Meadow Plant Materials Center. He received his BS Horticulture from the University of Louisiana, Lafayette. With more than 19 years' of coastal wetland experience, he has been involved with coastal restoration projects dealing with Louisiana's wetland and barrier island vegetative problems.

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CONSTRUCTION CHALLENGES IN COASTAL RESTORATION – BUILDING BETTER BARRIER ISLANDS

Whitney C. Thompson[1]*, P.E., Chris Allen*[2]*, Jacques Boudreaux*[2]*, P.E., and Barry Richard*[2]*, P.E.*
[1]APTIM, Baton Rouge, LA, USA
[2]Louisiana Coastal Protection and Restoration Authority, Baton Rouge and New Orleans, LA, USA

As the State of Louisiana accelerates its implementation of restoration projects, the challenges associated with the uniqueness of each new project increase as well. This presentation will focus on the recently completed Shell Island West restoration project to offer some insight on project-specific challenges encountered, how they were assessed and solved during construction, and also draw from experiences with other similar projects as comparisons and guidance for future project implementation.

Although barrier island projects have been implemented now for several decades, the construction plans, specifications, equipment and methods have become increasingly complex with each design and construction. For example, as more potential project areas are conceived and implemented, the proximity to utilities and infrastructure becomes more of a reality and must be considered as a design parameter. Borrow material sources are increasingly complex to access. As the restored acreage increases, the manpower, equipment, and coordination required to transform these projects from concept to habitat do as well.

The Shell Island West NRDA restoration project (BA-111) is located in Plaquemines Parish in the heart of our working coast. Construction challenges and solutions, such as the inability to construct primary dikes for marsh creation near pipelines, will be highlighted in this presentation. Another component of the design is the use of a Mississippi River borrow area. For this project, the borrow area was located on the left descending bank and was accessed by winching a concrete-coated sediment pipeline across the Mississippi River navigation channel in coordination with the USACE, the State, and the pilots' associations without requiring an interruption in navigation operations.

As of result of coordination efforts and expertise of all involved during construction, the project successfully completed the restoration of approximately 13,000 linear feet of beach and dune and over 290 acres of marsh habitat. This project reestablished the Shell Island East and West barrier islands by rebuilding beach, dune, and back barrier marsh that once existed utilizing a total of nearly 6 million cubic yards of material dredged mostly from the Mississippi River. This presentation will detail the implementation of the Shell Island project, the challenges faced, and the solutions applied.

PRESENTER BIO: Ms. Thompson is responsible for the design, management, and construction administration of coastal restoration projects in Louisiana for APTIM, including marsh creation/dredging, barrier island restoration, and shoreline protection. She is a licensed professional engineer in Louisiana and Texas and graduated from Louisiana State University.

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ADVANCEMENTS IN THE DESIGN OF ARTICULATING CONCRETE BLOCK.

***Christopher I. Thornton**, PhD, P.E.*
Colorado State University, Fort Collins, CO, USA

Recent testing and analysis conducted by Colorado State University (CSU) on Articulating Concrete Block (ACB) systems has resulted in advancements to currently used design procedures. Assumptions utilized in the formation of the Factor of Safety methodology recommended by the National Concrete Masonry Association (NCMA) have been examined and modifications to existing design tools developed. Analysis of test data has shown that procedures developed at CSU provide design engineers a more robust method for applying test performance results to field applications. In addition, testing conducted on ACB systems exposed to a hydraulic jump has resulted in a better understanding of design components required under turbulent flow conditions. This presentation will briefly summarize hydraulic testing, analysis and application of ACB systems in hydraulic designs.

PRESENTER BIO: Dr. Thornton is the Director of the Engineering Center and Hydraulics Laboratory at Colorado State University. He has over 25 years of experience in conducting hydraulic model studies and has specialized in high energy, supercritical flow conditions and performing prototype performance tests on erosion control techniques.

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BARRIER ISLAND SHALLOW SUBSURFACE STRATIGRAPHY AND ITS ROLE IN THE RELATIVE STABILITY OF GRAND ISLE, LA

Julie A. Torres *and Mark A. Kulp*
University of New Orleans, New Orleans, LA, USA

Understanding the past morphodynamic evolution of barrier islands is necessary to determine their probable physical response to future relative sea level rise. An understanding of the fundamental processes driving long-term and short-term morphological changes within barrier island systems seems to be generally well developed. However, the detail needed to decipher barrier evolution at an intermediate scale (~10^1-10^3 yrs) is lacking for many coastal Louisiana barrier systems. One method for resolving barrier island stratigraphy formed during such time intervals, hence leading to an understanding of the responsible physical processes, involves the use of ground penetrating radar (GPR) that can provide a detailed glimpse into the shallow subsurface stratigraphic relationships.

Grand Isle, a Louisiana barrier island located 80 km south of New Orleans, has exhibited remarkable stability within historic times with regard to overall size and position relative to other barrier islands of the Louisiana coastal zone. Previous work from the 1960's identified the presence of numerous beach ridges on the basis of aerial photography; however, a detailed analysis of their stratigraphic framework has not been completed. This work focuses on the possibility that these ridges and the near-surface sedimentary framework have affected island stability, which is being investigated through the collection of approximately 11 km of GPR data, the first known acquisition of such data on the island. GPR data, historical aerial imagery, and optically-stimulated luminescence (OSL) analysis of beach ridge sediment samples are collectively being used in an attempt to document the timing of island stratigraphy, beach ridge formation, rates of island progradation and the fundamental geologic framework that contribute toward the island's stability in the midst of high rates of relative sea level rise.

PRESENTER BIO: Ms. Torres was born in Metairie, Louisiana. She obtained her two B.S. degrees in Earth & Environmental Sciences (2009) and Biology (2011) from University of New Orleans. She is currently pursuing her M.S. degree in Earth & Environmental Sciences with a concentration on coastal and geomorphologic studies under Dr. Mark Kulp.

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OVERVIEW OF COASTAL PROTECTION AND RESTORATION IN THE PONTCHARTRAIN AND BRETON SOUND BASINS, LOUISIANA

John Troutman
Coastal Protection and Restoration Authority of Louisiana, New Orleans, LA, USA

The mission of protecting Louisiana's residents from storm surge and restoring the diversity of coastal wetland habitats is challenging. Louisiana's 2017 Coastal Master Plan provides a means to respond by outlining major strategies for restoration and flood protection and by directing available resources into prioritized projects. While there are many common reasons for land loss across coastal basins, implementation of projects within coastal basins can vary depending on basin-specific attributes such as habitat type, hydrology, availability of natural resources (e.g. sediment resources) or major landscape features (e.g., the Mississippi River). Project implementation and sequencing within basin may be also influenced by the timing and availability of funding, as well as regulations tied to each funding source (e.g., NFWF funds for Louisiana are to be used for barrier islands and diversions).

Louisiana's Pontchartrain and Breton Sound coastal basins, located east of the Mississippi River, encompass 5,800 square miles and include a wide range of habitats and landscape features, as well as a large portion of the state's coastal population. The upper Pontchartrain basin is primarily degraded swamp habitat surrounding Lake Maurepas. The middle basin is dominated by Lake Pontchartrain and adjacent intermediate wetlands, whereas the outer basin contains expansive brackish and salt marshes in eastern St. Bernard Parish flanked by the distant Chandeleur Islands. Breton Sound basin is significantly influenced by the Mississippi River and contains extensive fresh and intermediate marshes grading into brackish and salt marsh at its fringe. These basins are in need of restoration and protection of its communities and both have some unique challenges to project implementation. This presentation will provide an overview of the Master Plan restoration and protection strategies for the Pontchartrain and Breton Sound coastal basins. Additionally, on-the ground progress will be highlighted with an overview of constructed projects and examples of newly funded projects within each basin.

PRESENTER BIO: John Troutman holds a M.S. in Fisheries with a minor is Applied Statistics from Louisiana State University. He has worked in coastal restoration for 20 years and is currently responsible for oversight of project construction, O&M, and monitoring programs in the southeastern region of Louisiana.

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TREE RINGS AS INDICATORS OF COASTAL CHANGE AND INLAND MARITIME RESTORATION

Clay Tucker
Louisiana State University, Baton Rouge, Louisiana, USA

In the wake of rising sea levels and shifting climate, human and natural systems near the coast will experience rapid change in the near future. As coastal ecosystems and shorelines regress, saltwater covers habitable land and penetrates freshwater ecosystems. The Coastal Master Plan rarely accounts for inland, freshwater ecosystems, in part because little is known of the effects of intruding saltwater into those areas.

Trees play an important role as indicator species of past and potential future changes of sea level, climatic, and other environmental stress rates. Stress from saltwater intrusion into maritime forests causes trees to be especially sensitive to their environment, and this stress is evidenced by annual growth rings. Tree ring chronologies provide a basis of past environmental conditions so that future scenarios may be more confident. Tropical cyclones cause large pulses of saltwater within these areas and are thus easily recorded in growth rings.

This study uses baldcypress trees in the LaBranche wetlands west of New Orleans, LA to produce chronologies longer than the historical record of hurricanes and other climate parameters (e.g., drought). Additionally, growth rings from deceased trees provide evidence for multiple years of the stress to and stubborn resilience of trees. This stress eventually leads to an ultimate death that usually coincides with distinct traumatic events and anthropogenic modifications (e.g., hurricanes, Mississippi River Gulf Outlet). Tracking tree-growth responses to sea-level rise and exogenous disturbances of the past may aide in predicting future responses of coastal swamps and forests, thus aiding restoration of these fragile ecosystems.

PRESENTER BIO: Clay is a PhD Candidate in Geography at Louisiana State University, a native of Baton Rouge, Louisiana, and an avid user of Louisiana coastal ecosystems. He has identified dendrochronology as a new method for assessing ecosystem health in coastal areas and wishes to use this knowledge for new restoration techniques if possible.

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APPLICATION OF ELECTRO-KINETIC BARRIERS AGAINST SALTWATER INTRUSION

***Chandra Mouli Tummala**, and Sanjay Tewari*
Louisiana Tech University, Ruston, LA, USA

Coastal regions usually face challenge of preventing saltwater intrusion into groundwater. The severity of the saltwater intrusion depends on various geological factors such as sub-surface soil types and groundwater levels. It also depends on how much groundwater is being pumped out on regular basis. Increased levels of chloride ions and electrical conductivity of the ground water are indicators of salt water intrusion, especially near the coastline. The application of electro-kinetic fence as a barrier against charged salt ions (Na^+ and Cl^-) present in seawater is a promising option, which recently got increased attention. In this research project an electro-kinetic fence is being used as an electrical barrier between saltwater and fresh water to prevent saltwater intrusion.

The basic electro-kinetic process is defined by forced/induced movement of target ions in water-rich soil/sand medium under applied low strength direct-current electrical field between electrodes of opposite polarities. There are several specific mechanisms that contribute to this movement of ions. However, the most important ones are electro-osmosis, electromigration, and electrophoresis. In case of electro-kinetic fence a series of electrodes with same polarity aligned usually in a linear configuration creates an electrical barrier for ions that have same polarity as the electrodes in the fence. Multiple such barriers in various configurations could be used against salt ions to protect groundwater.

The ability of electro-kinetic fence to prevent saltwater intrusion is being investigated and the focus has been on studying the factors that are affecting the efficiency of the electro-kinetic fence. The effect of applied voltage, spatial arrangement/configuration of electrodes on reduction of saltwater intrusion is being investigated.

PRESENTER BIO (50-word maximum): Chandra Mouli Tummala is a Graduate Research Assistant at Louisiana Tech University. He graduated with a master's degree in Environmental Engineering from Bradley University. He is interested in water/wastewater treatment processes, site remediation, air pollution and solid waste management.

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MARINE MINERALS INFORMATION SYSTEM UPDATE

Lora Turner[1]*, and Alexa Ramirez*[2]
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[2]Quantum Spatial, St Petersburg, FL USA

Sediment resources, such as sand or gravel, located on the Outer Continental Shelf (OCS) are leased to local communities or Federal agencies to assist with restoration of shorelines or coastal wetlands. The Bureau of Ocean Energy Management's (BOEM) Marine Minerals Program holds geospatial data obtained from our partners and aims to maximize the potential use of sediment resources; BOEM is developing a Marine Minerals Information System (MMIS) with an interactive viewer that contains information on past leases; environmental studies, cooperative agreements, as well as existing and potential sediment resources. The system is primarily compiled from derived information and has been combined into a uniform data model to support a National OCS Inventory.

On a national scale, little is known about the character, quantity, and location of sediment resources on the OCS and the habitat this provides marine biological communities. To inform, support and enable multi-use ocean planning, coastal protection and restoration projects, it is crucial to know the location and extent of compatible sediment resources on the OCS. This is being enabled by closely collaborating with local municipalities, States, Federal agencies and other stakeholders to understand, quantify and assess our offshore sand resource needs: MMIS allows analysis and greater understanding of the inventory holdings to be accomplished together.

Using ArcGIS software, BOEM is developing the MMIS to provide access to data derived from our leases, projects and research. These derived datasets have been organized into a sediment resource data model and used to help discover and analyze marine minerals information, allowing BOEM to spatially depict information and better manage the resources. MMIS includes a planned public access point for information on BOEM's projects and studies.

<u>PRESENTER BIO</u>: Lora Turner is a physical scientist within the Bureau of Ocean Energy Management's Marine Minerals Program with 20+ years of experience in physical oceanography, meteorology, and GIS. Lora earned a Bachelor's degree in Physical Geography (University of Arizona) and a master's degree in Meteorology and Oceanography (U.S. Naval Postgraduate School).

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CANALS: MOST LOUISIANA LANDLOSS IS CAUSED BY CANALS AND RESTORING CANALS IS SUCCESSFUL

R. Eugene Turner
Louisiana State University, Baton Rouge, LA, USA

Canals and the spoil banks created by disposal of the dredged materials cause wetland loss by the direct replacement of one habitat with another and indirectly alter local wetland hydrology. The total length of spoil banks in 1978 was long enough to cross the coast east-to-west 80 times with a spoil bank height up to 3-6 times the natural tidal range. The total direct impacts of canals and spoil banks is about 16 percent of the wetland loss in coastal Louisiana. The remaining 84 percent of wetland loss is from other causes, including the indirect impacts of canals. The specific mechanisms almost always involve changes in wetland hydrology as the key agent of change. The canal effects are multiple and include changes in wetland flooding and drying frequency. The spoil weight compacts the soil beneath, thereby reducing below-ground water flows, whereas the spoil bank inhibits above-ground water flows on a grand scale. This damming above- and below-ground creates waterlogged soils, which may lead to toxic sulfide accumulations and reduces the accumulation of soil organic matter which controls vertical accretion; the same damming effect causes longer drying cycles which leads to soil oxidation. A site-specific example is on the south side of Jug Lake, west of Houma, La; there the adjacent wetland went from around 15% open water to 85% open water within 2 years after dredging. Another example is the wetland-to-open water conversions for 27 salt marshes in the Barataria, Breton Sound and Terrebonne estuaries (exclusive of canal area) from1955 to 1990; open water area increased when dredging increased, and stabilized or slightly declined when dredging ceased. The sum of these effects created a direct relationship between canal density and land loss from the 1930s to 1990 for the deltaic plain (excluding the highly mineral soils found at the tip of river deltas).

Backfilling is the process of restoring the canal and spoil bank habitat to create marsh and restore tidal hydrology. Backfilling restoration success has been followed several times over the last 35 years at multiple locations and with favorable and predictable outcomes, but with virtually no negative consequences. Backfilling restores marsh, prevents future wetland loss, and is highly cost effective. Backfilling can be quickly implemented coastwide and directly addresses the main cause-and-effect driver of coastal wetland loss. The backfilling benefits increase over time, although complete restoration will take longer than twenty years. Improving the completeness of spoil removal, coupled with appropriate site selection, could speed up the restoration process and enhance the success of future backfilling projects. The increased success of backfilling over time illustrates how ecological processes often operate on longer timescales than those allowed for by restoration monitoring plans. The absence of a highly effective State/Federal backfilling program continues to be a huge missed opportunity to conduct cost-effective restoration that could be done at a relatively low cost.

PRESENTER BIO: Dr. Turner is an LSU System Boyd Professor with 43 years experience in wetland ecology, management and restoration in Louisiana and worldwide. He is author of 17 books and >150 peer-review journal articles, received national and international wetland awards, and served on several National Academy of Sciences panels.

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ECOSYSTEM DESIGN: PROCESS-BASED APPROACHES TO OPERATING CONTROLLED FLOODS FOR DELTA RESTORATION

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The approaches to ecosystem restoration in highly engineered landscapes, where focus on human welfare dominates needs of processes to sustain ecosystems, is under review using concepts known as 'ecosystem design'. The combination of design approaches to ecosystem ecology, where processed based approaches to ecosystems have to focus on novel ecosystems to provide ecosystem services that can support social well-being. Such approaches utilize reference ecosystems as source of design criteria, but finding opportunities for processes within existing project design criteria that may result in formation of novel ecosystems within human dominated landscapes. Ecosystem design methodologies incorporate systems engineering with design thinking and systems ecology to modify existing traditional engineering approaches to work with nature. Ecosystem design challenges along deltaic coastal settings is to provide opportunities from river floods to allow estuarine ecosystems to adapt to changing conditions of sediment supply, subsidence and sea level rise. This presentation will focus on an ecosystem design framework to connect the river's present engineered flood pulse to the coastal landscape, with focus also on estuarine recovery. The ecosystem design criteria are to operate controlled flood pulses that will build and maintain wetlands with augmented sediment delivery and provide seasonal salinities that promote fisheries in estuaries and retain nutrients to reduce offshore hypoxia. The Atchafalaya Coastal Basin from Old River Control Structure to downstream coastal deltaic floodplains represent an engineered landscape of a river-occupied coastal basin, from which over five decades of system response provide ecosystem design principles to guide flood-pulse operations for flood control structures proposed in other coastal basins, such as mid-Barataria Bay diversion. Synthesis of existing system response under river pulsing scenarios together with a first order box model was used to provide guidance on seasonal salinity fluctuations to determine hydraulic residence of freshwater inputs into coastal basins. The design criteria include a flood pulse that generates a residence time in the downstream estuary of about two weeks for an average duration not to exceed 60 days. This analysis was coupled to analytics to estimate optimum conditions of sediment transfer from the river to an active deltaic floodplain, and allow for estuarine productivity in downstream estuary. The restriction on duration of the flood-pulse will allow for an 'estuarine recovery' period during late spring to promote delta secondary productivity (fisheries). Secondary productivity changes because of the alteration of salinity and nutrient regimes can be further simulated using mechanistic modeling approaches such as AQUATOX. With outfall conveyance characterized by overland flow and extended hydraulic residence times in, and contact times with, the freshwater marsh systems, this strategy will also promote nutrient reductions (estimated at about 50% reduction of nitrate loading). Delta restoration requires calibrated predictive models for design that can be grounded in comprehensive analysis of highly engineered coastal basins.

PRESENTER BIO: Dr. Twilley is Executive Director of Louisiana Sea Grant College Program and professor in the Department of Oceanography and Coastal Science at LSU. He has been involved in developing ecosystem models coupled with engineering and landscape designs to formulate adaptation strategies for coastal communities, known as ecosystem design.

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NATURAL TEMPLATES FOR COASTAL RESILIENCY AND STORM PROTECTION: CAMERON COUNTY TEXAS, EROSION RESPONSE PLAN

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Specific strategies for coastal risk reduction were achieved through a combination of nature-based features (e.g., beaches and dunes) and nonstructural elements (e.g., land-use policies) to improve coastal resilience along South Padre Island in Cameron County Texas. Cameron County developed an Erosion Response Plan (ERP) to explore methods to address erosion and storm risks along its Gulf -facing beaches to reduce costs, resulting from damage to private property and public infrastructure.

Dune conservation and management are critical components of the ERP for coastal resiliency and storm protection because sand exchange between the beach-dune system impacts long-term shoreline response, storm damages, and land use practices. Location of infrastructure (e.g., roads, utilities, dwellings) within natural coastal systems can compromise a systems ability to respond to storm and normal erosion processes. For example, Park Road 100, a state roadway along northern Padre Island, bisects the present natural dune system, is vulnerable to long-term shoreline migration, and constrains potential future development due to its location relative to active beach and dune sedimentation processes. Relocating the road would promote long-term public safety and provide accommodation space for beach/dune restoration and compatible inland development while reducing vulnerability to storms.

Based on projected shoreline position in approximately 30 years, the ERP risk reduction strategy included a number of recommendations: 1) a building setback line (BSL) to conserve a protected dune line and limit residential and commercial construction in high hazard areas; 2) a protective dune system based on average beach width determined from the Mean Higher High Water (MHHW) shoreline landward to the first line of vegetation; 3) natural dune morphology and topography quantified from 2013 lidar data; and 4) FEMA guidelines for protection against a single 100-yr storm event (FEMA, 2011).

Given natural dune dimensions in the project area, a storm protection dune was designed to have maximum slopes of 1:5, a minimum base width of 200 feet, a height of +16 feet NAVD88, and a crest width of 90 feet. Given these dimensions, restored dune volume above +11 feet NAVD88 (Base Flood Elevation [BFE]) would be approximately 575 cubic feet per foot width of dune face. FEMA (2011) recommends 540 cubic feet per foot width of dune above BFE to provide protection from a single 100-yr storm event. Consequently, the BSL would begin from the existing line of vegetation (approximately 110 feet from the MHHW) and extend 200 feet landward. In addition, a 30-foot buffer zone is included at the inland margin of the dune, to account for the dune naturally shifting inland (Psuty and Rohr 2000).

<u>PRESENTER BIO</u>: Steve is the Coastal Program Manager for Neel-Schaffer. He has more than 30 years of scientific, managerial and planning experience administering coastal initiatives for state government, USACE, and private companies. He received his Bachelor’s degree in Marine Biology from UNC-Wilmington, and master’s degree in Oceanography and Coastal Sciences from LSU.

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THE IMPACTS OF COREXIT EC9500A ON WETLAND MICROBIAL ACTIVITY AND COMMUNITY STRUCTURE IN BARATARIA BAY, LA., USA

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On April 20, 2010, the BP Deepwater Horizon oil platform in the Gulf of Mexico experienced an explosion that resulted in the largest marine oil spill in U.S. history. As a remediation tactic, 7.9 million liters of dispersant, Corexit EC9500A, was sprayed into Gulf of Mexico waters. It has been shown in previous studies that exposure of coastal wetland soil to Corexit can lead to the reduction in several important microbial-mediated ecosystem services related to water quality (denitrification) and ecosystem primary productivity (nitrogen mineralization). To get a more complete picture of how Corexit impacts coastal marshes, it is vital to look at how the microbial communities in the soil react to different levels of Corexit exposure. It is possible to find a link between shifts in the microbial community and changes in ecosystem services by analyzing changes in microbial activity and community structure over time with Corexit exposure. Heterotrophic microbial respiration was measured for both wetland soil and estuarine sediment in Barataria Bay, LA., USA. Triplicate cores for wetland soil and estuarine sediment were collected and analyzed for microbial biomass carbon and nitrogen, %LOI, moisture content, TP, and TC/TN. There were four treatment levels (control, 1:10, 1:100, 1:1,000) of Corexit:wet soil ratios under anaerobic conditions. Gas samples were analyzed on a Gas Chromatograph (FID) to monitor microbial respiration over time. The samples were then analyzed for microbial community structure using a metagenomics approach. These results will indicate how microbial activity and community structure in coastal wetland soils shift in response to Corexit exposure. This research may provide more insight on how coastal wetlands will respond/recover over time after exposure to dispersant.

PRESENTER BIO: Jessica Vaccare is a graduate student in the Wetland and Aquatic Biogeochemistry Laboratory at Louisiana State University. Jessica's research focuses on ecosystem services and nutrient cycling in coastal wetlands.

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WIND WAVES DRIVE MULTIPLE MECHANISMS OF EROSION OF THE MARSH SCARP IN BARATARIA BAY, LA

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The coastal wetlands of Louisiana have been disappearing rapidly. Erosion of the marsh edge from wind waves has been shown to be a major mechanism of land loss. Long-term (>100 years) measurements show that, for the same fetch, marsh edges exposed to the north erode twice as quickly as marsh edges exposed to the south. A possible explanation might reside in the peculiar hydrodynamics of coastal Louisiana, where northerly winds are associated with low water levels and southerly winds are associated with high water levels. We hypothesize that the difference in the erosion rates is caused by a different modality of edge erosion at different water levels. To test this, wind waves and water level were measured in a semi-enclosed portion (fetch = 1200 m) of Barataria Bay (LA) for one year. Two transects of sensors, one at a north-facing shoreline and one at a south facing shoreline, extended from the marsh platform to several meters off shore. For the same wave height, depending on the water level, waves either overshot the marsh platform or the waves attacked the marsh boundary. When water levels were low (northerly winds), waves hit the marsh scarp directly, when water levels are high (southerly winds), waves go over the marsh and are attenuated. When these findings are incorporated into a simple numerical model of marsh-edge erosion, the altered model performs better in predicting shoreline erosion over ~100 years.

The presence of different “styles” of marsh edge erosion suggests different optimal strategies to prevent erosion: protection at the base of the edge in northerly facing sites and protection of the top of the edge at southerly facing sites.

PRESENTER BIO: Kendall Valentine is a PhD candidate at Louisiana State University working with Dr. Giulio Mariotti. Ms. Valentine’s research focuses on coastal ecogeomorphology, exploring the interactions between physical, geological, and biological processes that change the landscape of the coast via field campaigns, laboratory experiments, and process-based models.

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CASE STUDY OF HISTORICAL APPROACH TO FRESHWATER INFLOW NEEDS IN TEXAS

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In the late 1990's, as part of the Trans-Texas Water Program (TTWP) for the Southeast Area, a number of important environmental issues were identified which are associated with future water resources management in the region. The Management Committee for the Southeast Area TTWP subsequently created several focus groups to deal with some of these specific water issues. One of the groups was the Galveston Bay Freshwater Inflow Group (GBFIG), an ad hoc committee concerned with the health and productivity of Galveston Bay. As a result of the GBFIG's work, a water availability model was developed to assess current and future water resource management impacts on projected freshwater inflows into Galveston Bay.

In the late 1990's the Texas Water Development Board (TWDB) and the Texas Parks & Wildlife Department (TPWD), under the Texas Bay & Estuary (B&E) Program, completed a report on the effects of freshwater inflows to Galveston Bay. The report examined two main topics: a) Establishing the effects of freshwater inflows on living organisms, and, b) Presentation of the methodology used in determining the freshwater inflow needs of the bay which would maintain an ecologically sound environment and a productive estuary.

The Galveston B&E study computed freshwater inflows into Galveston Bay for the historical period of 1941-1990. Freshwater inflows were determined by; compiling historical gauged inflow from the Trinity and San Jacinto basins, and computing rainfall-runoff relationships for ungagged watersheds. However, no predictions were made on future water resource management.

The work performed by the Texas B&E Program lead to the "First" determination of recommended freshwater inflows for maximum productivity of Galveston Bay. In anticipation of those early recommendations, the GBFIG was concerned with multiple issues related to current and future freshwater inflows into Galveston Bay:

- Based on existing authorized water rights permits, what are the impacts from current and future diversions on freshwater inflows to the bay?
- Does the geographic distribution of freshwater inflows significantly change over time due to future water resource management?
- How do current and future projected freshwater inflows compare to the recommended freshwater inflows necessary to maximize fisheries productivity?

The objective of the GBFIG study was to develop preliminary estimates of freshwater inflows into the bay under three different inflow scenarios; Naturalized, Current development, and Full development conditions.

This study was one of the first efforts in Texas to link the watershed to the coastal environment by evaluating watershed resource management impacts on bay and estuary inflows. David and Dan will be presenting our more recent efforts in doing the same.

PRESENTER BIO: Augusto Villalon is Licensed Engineer in the State of Texas with Freese and Nichols in Austin, Texas and has worked on water resource management issues since 1990.

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CREATION OF A WETLAND RESEARCH FACILITY AT CADE, LOUISIANA

Jenneke M. Visser
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The Wetlands Research Facility enhances the educational and research resources at UL-Lafayette. It uses a series of eight 0.3-acre ponds that were previously used for crawfish research. Construction included installation of liners to separate the brackish wetlands from the surrounding freshwater system, soil grading to create flooding gradients, and pumps to create a daily tidal cycle.

The wetlands currently include two different salinity regimes (fresh 0 ppt and brackish ~6 ppt). Each wetland is furnished with monitoring equipment mimicking a Coastal Reference Monitoring System (CRMS) site. In addition, the facility is located within a mile of a NOAA national climatic data center station. The facility is used by multiple disciplines for educational and research initiatives in the field of coastal wetland ecosystems.

The wetlands allow for detailed observations on plant, soil, and water quality responses to the different environmental and hydrologic conditions. A team of faculty with various expertise areas collaborates on questions related to vegetation responses, soil and water chemistry, and hydrological forcing functions. The wetland size is sufficient to use small plots for manipulative experiments, such as sediment addition, simulated grazing, elevation change, etc. The wetlands can be used to test different manipulations before application to real coastal wetland restoration projects. The wetlands can also be used for projects that assist faculty in developing coastal research proposals and class projects.

PRESENTER BIO: Dr. Visser is a Professor at UL Lafayette. In the last 30 years, Dr. Visser has authored numerous journal articles and book chapters related to coastal wetland ecosystems and restoration. She has been an advisor to coastal wetland restoration planning, and has made significant contributions to restoration outcome forecasting.

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OIL AND GAS AS A STAKEHOLDER IN LOUISIANA'S FUTURE

Ian Voparil
Shell Exploration and Production Company, New Orleans, LA, USA

Shell has a long history in Louisiana – for more than a century, we've collaborated with, and invested in, the parishes and communities where we live and work creating economic opportunity and the energy industry as we know it today. In 1916, Shell started by buying land west of New Orleans with thoughts of developing a terminal and refinery at a place now called NORCO. In the 1940s, Shell explored the shallow waters off Grand Isle, and we have continued further and deeper into the Gulf of Mexico since then, e.g. the first platform in waters over 1000 feet deep with Cognac in 1978 all the way to the Stones FPSO, the world's deepest oil and gas project, operating in around 9,500 feet of water.

We are proud of the role we've played in the energy industry and Louisiana over this century, providing employment to thousands, generating royalty and revenue to both parish, state, and federal governments, and being a part of the communities of the working coast.

Shell recognizes the serious problem that land loss creates for coastal Louisiana and the nation – it also affects Shell directly and indirectly including our assets and operations upstream and downstream across the state and further, and our workforce and partners comprised of people from coastal communities.

We have supported and participated in coastal protection and restoration efforts for decades with local and national partners like BTNEP, NFWF, CCA, EDF, America's Wetlands Foundation, Restore the Earth, Lake Pontchartrain Basin Foundation, and others.

Now we are focused on actions that will meet this challenge by bringing together federal and state government, communities, and the private sector in constructive and collaborative ways.

PRESENTER BIO: Ian Voparil is the Coastal Management Lead for Shell in New Orleans. He focuses on non-technical issues management to improve business opportunity while growing environmental and social performance. Ian has a Ph.D. in Oceanography from the University of Maine and worked as a lecturer and researcher at the University of California-Santa Cruz before joining Shell.

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RESTORE ACT LOWERMOST MISSISSIPPI RIVER MANAGEMENT PROGRAM (LMRMP): BACKGROUND AND OVERVIEW

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The Lowermost Mississippi River Management Program (LMRMP) is a RESTORE Act funded, large-scale program with the objective of moving the nation towards a more holistic management philosophy by creating a science based decision making framework. Led by the state of Louisiana's Coastal Protection and Restoration Authority, it is a multi-disciplinary, 3.5 years, 9.6 million dollar effort. The LMRMP is designed to; enhance our fundamental knowledge of in-river physical processes and regional geologic controls on subsidence, improve existing and create new predictive modeling tools, and use those tools to evaluate and compare existing and potential management elements and strategies. This presentation will provide the background and overview of this very broad and ambitious program, and the following presentations will provide more detail on key elements of the program.

The LMRMP is comprised of 5 technical elements. The expanded use and development of Mississippi River Models, Subsidence Investigations, Surge Modeling with CSTORM-MS, Geomorphology of Lowermost Mississippi River Channel Bars, Dredging Alternatives. Each of these elements is made up of 5 or 6 core tasks. The subsidence, dredging and, geomorphology elements are data collection and synthesis intensive. They will produce the information which will drive the improvement of existing numerical tools and creation of new tools in the two modeling elements. The modeling elements will produce real time predictive tools, as well as evaluate a vast array of potential channel management scenarios. The goal is to find solutions to river management issues that are mutually beneficial to as many user groups as possible. As such, input from stakeholder groups is put at a premium in this program and a strong outreach effort will maintain contact and discussion throughout the life of the program.

Interim results from the LMRMP will be presented at SOC20 and the final results of the program will be presented at SOC22 and beyond.

<u>PRESENTER BIO</u>: Brian Vosburg is a Geologist with Louisiana's Coastal Protection and Restoration Authority. He has over 10 years of experience working with the physical science and policy issues that drive management decisions in the Lower Mississippi River.

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SYSTEMATIC LARGE-SCALE ENVIRONMENTAL RESTORATION OF ORGANIC MUCK IMPAIRED WATERWAYS - A CASE STUDY

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Suspended muck sediments within coastal waterways cause several undesirable consequences. These include the deterioration of water quality, covering of seagrass beds, creation of anoxic benthic conditions negatively impacting the infaunal communities which are the basis of the aquatic ecosystem food chain, creation of malodorous and aesthetically displeasing muck plumes, and damage to boat motor cooling systems from entrained muck. Due to both hydrology and physiography, some deeper portions of coastal waterways near tributaries or estuaries often collect significant quantities of muck, while these fine-grained nutrient-rich organic sediments with a high water content, also create shoreline water depths too shallow for boaters to navigate without disturbing the muck sediments.

The Coalition to Restore Coastal Louisiana (CRCL) has long recommend removal of these muck sediments as an efficient means to improve water quality and natural resources within an overall waterbody and as the means of supplying valuable sediments for ongoing marsh restoration efforts.

Recent systematic efforts undertaken within the Indian River Lagoon (IRL) in Brevard County, FL provides a valuable case study for large-scale restoration of muck impaired waterbodies. A thick layer of muck covers much of the bottom of the IRL. Meanwhile, IRL based comprehensive conservation and regulatory agencies recommend removal of these muck sediments as an efficient means to improve water quality and natural resources within the overall IRL, which works to remove the legacy loads of nutrients and pollutants associated with re-suspended muck sediments, negatively affecting seagrasses.

As a remedy to the Brevard County IRL muck sedimentation problems the Brevard County Commission authorized Ordinance 2016-15 establishing a 10-year ½ cent sales tax. Which in turn, funds local projects planned to meet water quality targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. Of special note, almost two-thirds of the total sales tax revenues (estimated at over $340,000,000) will be used for direct muck sediment removal through dredging.

These proposed environmental restoration based dredging projects, will specifically target *removing* muck sediments from broad expanses of shallow-water ecosystems. Brevard County with further enhance the muck removal by *reducing* the generation of new muck sediments by working to eliminate excess fertilizer applications, curbing stormwater runoff, ameliorating failing septic systems, and eliminating wastewater treatment facility discharges. Subsequent endeavors will include *restoring* acres of new submerge aquatic vegetation and oyster reefs. Finally the County proposes to document their citizen’s return on their investment through a series academic *reporting* efforts.

PRESENTER BIO: Mr. Wagner is a senior dredging engineer with roughly 20 years of experience planning, designing, and implementing various dredging engineering projects, including developing long-range dredged material management plans; designing upland dredged material containment facilities; creating dredging management plans, economic evaluations, and assessing alternate dredging technologies.

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INCORPORATING INTERNATIONAL EXPERIENCES INTO EDUCATION

William S. Wainwright
Northshore Technical Community College, Lacombe, LA, USA

Louisiana's community and technical colleges have been extremely critical in creating a workforce pipeline for jobs in Louisiana's coastal restoration industry. Not only do they provide access to a host of industry-recognized credentials that are necessary to building a labor pool of skilled craft workers, they also offer a pathway to four-year college degrees. As they continue to fill their job-training role and advance upward mobility for students, community and technical colleges should also continue to explore innovative approaches to enhancing student's learning experiences. Four regional institutions are doing just that through a cross-campus collaboration that will incorporate international experiential learning into their respective curriculums.

Northshore Technical Community College, Delgado Community College, Nunez Community College and Fletcher Technical Community College have come together to develop the Global Water Management Collaboration Program. Through the program, ten students will be granted an opportunity to go on a week-long study abroad trip to Amsterdam, Netherlands this spring to get a firsthand look at the city's green infrastructure that heavily relies on the reuse of rainwater. The Dutch have long been pioneers in innovative water management strategies and New Orleans has taken great strides to learn from their innovations. To complement the trip, students will also visit local water management sites in Baton Rouge, Houma, and New Orleans prior to the trip. The trip will encompass a variety of relevant activities including intercultural workshops, guest lectures, and visits to the Ministry of Infrastructure, Public Works and Water Management and the National Flood Museum, plus more. This opportunity will provide students with an in-depth exploration of water management abroad and will supplement their education as they enter into the water management sector. This presentation will discuss how this partnership and program came to be and how other colleges can replicate similar programming.

PRESENTER BIO: As the Chancellor of NTCC, Dr. William Wainwright oversees and orchestrates the successful implementation of technical education and transfer programs, on and off campus classes. Wainwright works with community and civic leaders and elected officials to help bring resources to the region, to ensure the college's programs meet the short and long-term needs of area business and industry, and to forge community collaborations.

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ANALYSIS & DESIGN OF A NATURE-BASED SHORELINE RESTORATION ALONG MOBILE BAY, ALABAMA

***Ryan Lee Waldron**[1], PE, Barry A. Vittor[2], Eddie Kerr[3], PE and Tina Sanchez[3]*

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Prior to 1918, the mouth of the Fowl River migrated and opened directly into Mobile Bay 4,500 feet south-southwest of its prior location. The former mouth location transitioned into a purely tidal marsh, that is now known as the Salt Aire Property. The exposed salt marsh is currently unprotected from wind driven waves approaching from the South to the East, the most predominant group of wind directions. Over many years of exposure to unencumbered wave action from Mobile Bay, the unprotected portion of the Salt Aire Property and adjacent peninsula have both eroded significantly, some locations retreating more than 200-ft. over the past twenty years.

This analysis utilized a Delft 3D v4 fully coupled Wave and Hydrodynamics + Morphology Model. The Model Domain comprises a 153 cell x 92 cell, Curvilinear Grid that encompasses Mobile Bay and some of the adjacent water bodies. The cell density increases as the proximity to the project site decreases (with the minimum cell width being less than 1 meter). This model simulates hydrodynamics, wind driven wave processes, salinity, and sediment transport; the sediment transport is used to calculate bed changes with a morphological scale factor (MORFAC) of 50. Modeling scenarios included both Future Without Project (FWOP) and Future with Project (FWP) scenarios to develop design criteria and evaluate the effectiveness over a 50-year period.

The project, which comprises restoring approximately one mile of shoreline and the creation of thirty (30) acres of intertidal marsh, includes several Nature Based design features, with the intention of developing ecosystem restoration to return the function of this shoreline to conditions that were historically present. The restoration design includes placement of dredged sediments to restore the shoreline to its historical location, with connections to the property's main existing tidal creeks and a new network of smaller tidal creeks. Also included in the design is a series of overlapped, intertidal breakwaters to protect the restored shoreline. To encourage habitat creation and resilience, the intertidal breakwaters are constructed from interlocking, stackable concrete unit structures composed of concrete specially designed to encourage oyster colonization and growth to facilitate reef development. Though the area has been known to have supported healthy oyster populations in the past, the project looks to ensure that oysters colonize the structures by pre-seeding several of the individual wave attenuation units with oyster larvae/spat during construction.

<ins>PRESENTER BIO</ins>: Mr. Waldron is a coastal engineer with more than 10 years of experience planning, designing, and implementing coastal and water resources projects. He has extensive experience with hydraulics, hydrodynamics, hydrogeomorphology, ecosystem restoration and flood protection, and has provided modeling and design expertise to more than a dozen coastal projects.

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THE LOWERMOST MISSISSIPPI RIVER MANAGEMENT PROGRAM (LMRMP): SURGE MODELING WITH CSTORM MODELING SYSTEM

***Ty Wamsley**, PhD*

U.S. Army Corps of Engineers Mississippi Valley Division, Vicksburg, MS, USA

The Lowermost Mississippi River Management Program proposed to the Gulf Coast Ecosystem Restoration Council will continue to refine understanding of Mississippi River physical processes to improve navigation, reduce flood risk, and maximize river-based restoration benefits. The program builds upon and complements the Mississippi River Hydrodynamic and Delta Management Study (MRHDMS) and previous other studies funded to design the Hurricane Storm Damage Risk Reduction System (HSDRRS) for southeast Louisiana. The purpose of the surge modeling is to investigate various coastal Louisiana restoration scenarios in order to provide quantitative information on the effects of Mississippi River alterations and coastal feature restoration on storm surge and waves. In these evaluations, many assumptions about the role of wetlands and other coastal features have been made. Early investigations have demonstrated that generalizations and "rules of thumb" are inaccurate for evaluating the effects of coastal features on storm surge and wave propagation, and that the effects are best understood through application of high resolution multi-dimensional modeling techniques, such as the Coastal STORM Modeling System (CSTORM-MS). Preliminary modeling have shown that the presence of wetlands and other coastal features may either increase or decrease the height of storm surge, depending on the path, intensity, and duration of a storm. To date, only a few restoration efforts proposed in Louisiana have been evaluated using these high resolution tools. In this study, CSTORM-MS will be applied to quantify storm surge propagation up the river associated with different Mississippi River channel configurations under various SLR scenarios and river stages; estimate the change in peak storm surge and wave heights due to the potential wetlands created by sediment diversions, with specific emphasis on the proposed Mid-Barataria and Mid-Breton sediment diversions; and quantify how much peak storm surge levels from selected historic hurricane events change if the storms would have made landfall on a historic landscape. In addition, a proof of concept web-based dashboard will be developed that will demonstrate how state emergency managers can rapidly employ a surrogate model based upon the high-resolution numerical modeling results to get relevant information for decision making that was not previously possible.

PRESENTER BIO: Dr. Ty Wamsley is the Science and Technology Director at the U.S. Army Corps of Engineers Mississippi Valley Division (MVD) in Vicksburg, MS where he serves as the principal science advisor to MVD and the U.S. President-appointed Mississippi River Commission (MRC). Wamsley's experience includes serving as the hydrodynamic modeling team leader for the US Army Corps of Engineers (USACE) Louisiana Coastal Protection and Restoration Project and the Mississippi Coastal Improvement Project. Wamsley has authored numerous publications on a variety of topics, including storm surge and waves, wave transmission and long-term and storm induced shoreline responses. Wamsley holds a bachelor's degree in civil engineering from North Carolina State University, a master's in ocean engineering from Texas A&M and a doctorate in water resources engineering from Lund University in Sweden.

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CHANNEL SEDIMENT ACCUMULATION IN A HIGHLY ENGINEERED ALLUVIAL RIVER, THE LOWER MISSISSIPPI RIVER

***Bo Wang**, and Y. Jun Xu*

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Channel bars are a major depositional feature for sediment storage in alluvial rivers. Although their morphodynamics has been intensively examined over the past several decades, it is still not very clear how these bars respond to intensive river engineering in large alluvial rivers. For instance, we currently do not have a comprehensive understanding of channel bar dynamics in river reaches below dam construction and/or with intensive in-channel dike building. Such knowledge is not only scientifically interesting but is also practically relevant for the management of the long-term river stability. This is especially the case for a large alluvial river like the Mississippi River, where sediment transport and availability play a critical role in the river's estuarine reach and deltaic development.

In this study, we conducted an assessment on three-decadal morphologic changes of 30 emerged channel bars in the Lower Mississippi River approximately 730 kilometers upstream of its mouth in the Northern Gulf of Mexico. The bars stretched from a few hundred meters long to several thousand meters long within the 223-km reach from Vicksburg in Mississippi to the Mississippi-Atchafalaya River diversion in Louisiana. We used Landsat imagery and river stage data between 1985 and 2015 to characterize the bar morphologic features and quantify their changes. Based on estimated bar surface areas by the satellite images at different river stages, a rating curve was developed for each of the 30 bars to quantify their emerged volumes. We found that the highly engineered alluvial river favored the growth of mid-channel and attached bars, while point bars tended to degrade. Currently, the mid-channel and attached bars accounted for 38% and 34% of the total volume of the 30 bars, respectively. The average volume of a single mid-channel bar is over two times of that of an attached bar and over four times of that of a point bar. Overall, in the past 30 years, the total volume of the studied 30 bars increased by 110,118,000 m^3 (41%). Total dike length in a dike field was found mostly contributing to the bar volume increase. Currently, the emerged volume of the 30 bars was approximately 378,183,000 m^3. The total bar volume is equivalent to ~530 million metric tons of coarse sand, based on an average 1.4 t/m^3 bulk density measured from the bars. The findings show that these bars are large sediment reservoirs. As a potential resource for coastal protection and restoration, sediment stored on the bars should be mobilized downstream of the river through effective engineering practices in the future.

PRESENTER BIO: Bo Wang is a master student majoring in watershed hydrology. He works with Dr. Y. Jun Xu. His study focuses on riverine sediment transport, fluvial geomorphology, and hydrodynamic modeling.

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MODELING CHANNEL BED DEFORMATION DOWNSTREAM OF THE MISSISSIPPI-ATCHAFALAYA RIVER DIVERSION

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River diversions impose primary changes on water and sediment transport, affecting downstream channel morphology. About 25% of the flow of the Mississippi River is diverted into the Atchafalaya River through a complex hydraulic facility, the Old River Control Structure (ORCS), located 500 river kilometers (RK) upstream of the Head of Passes to the Gulf of Mexico. Recent studies reported channel bar growth and riverbed aggradation downstream of the ORCS over the past three decades, raising a serious concern over the long-term stability of the river diversion.

In this study, we used a three-dimensional computational fluid dynamics (CFD) model to simulate flow structure, sediment transport, and bed morphologic changes in the 30 km reach on the Mississippi mainstem downstream of the ORCS, i.e., the river reach between RK 500 and RK 470. A mesh block with a 45-m resolution was created to represent the channel geometry. Long-term field measurements, including bathymetric survey, Digital Elevation Model of the channel bed, river discharge, sediment concentration, and flow velocity above and below the ORCS, were used to set up boundary conditions and to parameterize and calibrate the model. Our preliminary modeling shows that flow deceleration downstream of the river diversion location occurs immediately and responds to the diversion volume of water non-linearly. The CFD model seems to simulate diversion flow very well, with an R^2 of 0.84 during low flows and an R^2 of 0.99 during high flows. On average, by losing 25% of the river water, flow velocity in the Mississippi mainstem reduces by 1 m/s immediately downstream of the diversion. Consequently, deposition occurs, causing riverbed aggradation downstream and increasing the risk of river avulsion. This study highlights the need to develop strategies helping sediment transport downstream of the diversion. Furthermore, the findings of the study have significant implications for other river diversions that have been and/or are being proposed for the Lower Mississippi River to restore coastal wetlands in Southeast Louisiana.

PRESENTER BIO: Bo Wang is a master student majoring in watershed hydrology. He works with Dr. Y. Jun Xu. His study focuses on riverine sediment transport, fluvial geomorphology, and hydrodynamic modeling.

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PREDICTING THE IMPACTS OF MISSISSIPPI RIVER DIVERSIONS AND SEA-LEVEL RISE ON SPATIAL PATTERNS OF EASTERN OYSTER GROWTH RATE AND PRODUCTION

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There remains much debate regarding the perceived tradeoffs of using freshwater and sediment diversions for coastal restoration in terms of balancing the need for wetland restoration versus preserving the production of eastern oyster (*Crassostrea virginica*). During diversions, sedimentation is increased and salinity is rapidly lowered, however, these are also key sources of mortality for oysters, which reduce their growth rate and overall production. Further complicating the issue, climate change-induced sea-level rise (SLR) and land subsidence are also expected to affect estuarine salinity patterns. Rising sea level likely causes increased stage and overbank flow downstream, thus increasing the duration of high salinity and leading to the reduced total area that is optimal for oyster production. In this study, we developed a process-based numerical modeling system that couples hydrodynamic, water quality, and oyster population dynamics. We selected Breton Sound Estuary (BSE) (~2,740 km^2) in the eastern Mississippi River Deltaic Plain to apply the model since it is home to several of the largest public oyster seed grounds and private leases for the Gulf Coast. The coupled oyster population model was calibrated and validated against field observed oyster monitoring data. We predicted the responses of oyster population in BSE to small- (142 $m^3\ s^{-1}$) and large-scale (7,080 $m^3\ s^{-1}$) river diversions at the Caernarvon Freshwater Diversion structure planned in Louisiana's 2012 Coastal Master Plan under low (0.38 m) and high (1.44 m) relative SLR (RSLR = eustatic SLR plus subsidence) compared to a baseline condition (Year 2009). Model results showed that the large-scale diversion had a stronger negative impact on oyster population dynamics via freshening of the entire estuary, resulting in reduced oyster growth rate and production compared to simulations with RSLR alone. Under the large-scale diversion, areas with optimal oyster growth rates (> 15 mg ash-free dry weight (AFDW) $oyster^{-1}\ wk^{-1}$) and production (> 500 g AFDW $m^{-2}\ yr^{-1}$) would shift seaward to the southeastern edge of the estuary, turning the estuary into a very low oyster production system. RSLR played a greater role than the small-scale diversion on the magnitude and spatial pattern of oyster growth rate and total production. RSLR would result in an overall estuary-wide decrease in oyster growth rate and total production, as a consequence of decreased salinities in the middle and lower estuary, because rising sea level will likely cause increased stage and overbank flow downstream along the lower Mississippi River.

PRESENTER BIO: Dr. Wang is a Research Ecologist with more than 20 years of experience in ecosystem modeling. His research areas include integrated modeling, monitoring and detecting changes in hydrodynamics, sediment transport, morphology, water quality, vegetation, biological population dynamics, and soil biogeochemistry in wetland ecosystems to support coastal protection and restoration.

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HARAHAN DRAINAGE PUMP STATION TO THE MISSISSIPPI RIVER PROJECT OPPORTUNITIES AND CHALLENGES

Michael Schmidt[1] *and* ***Jessica L. Watts***[2]
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As part of the southeast Louisiana (SELA) urban flood control program, Jefferson Parish has implemented the $150 million Harahan Pump to River project. The project was a funded by SELA and the Water Resource Development Act (WRDA). The objective of this project was to complement and enhance the Southeast Louisiana Project by providing additional flood protection to SELA projects in the East Bank of Jefferson Parish described in three previously approved New Orleans District U.S. Army Corps of Engineers (USACE) Reports.

The project consists of a new diesel-powered pumping station with a nominal capacity of 1,200 cfs, an intake suction canal comprised of two 12-ft by 14.5-ft reinforced box culverts (RBCs), and three 84-inch underground pipes that extend from the pumping station to the Mississippi River flood control levee, where they extend over the levee and terminate in a stilling basin. The project is contained completely within public rights-of-way owned by the City of Harahan and the Louisiana Department of Transportation and Development (LADOTD). Each pump train consists of vertical pumps (400 cfs each) and 3,000 hp diesel engines for emergency power supply.

Construction was substantially completed in late in 2016 and the project was online during the August storms and functioned as expected, providing valuable flood control in Harahan and Jefferson Parish.

This presentation will summarize key features, construction challenges, and performance success for this project, which is an example of the potential opportunity to augment existing flood control pump station capacity in the New Orleans metropolitan area with options to pump directly to the Mississippi River versus Lake Pontchartrain. These types of projects can significantly reduce the distance and costs for pump station upgrades.

PRESENTER BIO: Jessica Watts is a Professional Engineer, Certified Floodplain Manager, and Diplomate Water Resources Engineer with CDM Smith and has over 19 years of experience in engineering. She is currently actively working on multiple water resources projects in the Greater New Orleans area. Ms Watts is also serving as the President of the Greater New Orleans Section of the Society of Women Engineers.

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THE EFFECTS OF SHORELINE EROSION AT SITES 16SB47 AND 16SB153, ST. BERNARD PARISH, LOUISIANA

***Richard A. Weinstein*[1]*, Amanda M. Evans*[1]*, and Jessica A. Kowalski*[2]

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Archaeological sites 16SB47 and 16SB153 are located adjacent to one another on the southeastern shore of Lake Borgne in St. Bernard Parish, Louisiana. Investigations at the two sites by Coastal Environments, Inc., in 2010 and 2011, utilizing terrestrial subsurface probing, hand-turned augering, and controlled testing, plus offshore vibracoring and subbottom profiling, identified intact prehistoric shell mounds and extensive associated areas of subsided and drowned shell middens, both on land and beneath the lakebed. The investigations allowed for the reconstruction of the occupation sequence at the two sites, from ca. A.D. 300 to 1300, and for the identification of the now-subsided and submerged landforms on which the locales initially developed. It also was possible to determine the extent of shoreline transgression and erosion in the area and how those natural processes affected the sites. The research was sponsored by the New Orleans District, U.S. Army Corps of Engineers, and the Louisiana Coastal Protection and Restoration Authority.

PRESENTER BIO: Richard A. Weinstein is an archaeologist with over 45 years of experience in the southeastern U.S, including Louisiana, Texas, Mississippi, Arkansas, Florida, and Tennessee. He has directed large-scale excavations at both historic and prehistoric archaeological sites under contract to the U.S. Army Corps of Engineers, the U.S. National Park Service, and the Texas Department of Transportation. Several of these investigations involved sites located within the coastal zone.

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AUDUBON LOUISIANA'S MARSH CREATION BY SMALL DREDGE DEMONSTRATION AND COMPARISON PROJECT

Karen A Westphal[1], *Lindsay Nakashima*[1], *Timmy Vincent*[2], *Erik Johnson*[1] , *and Katie Percy*[1]
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Audubon's Small Dredge Program began in 2009 with the donation of a constructed mini-dredge (the "*John James*") by a local construction company and the goal to explore small dredge technology as a cost-effective method for landowners to address this challenge. The mini-dredge successfully created an acre of restored marsh at a minimal cost, and for comparison, another small dredge, the Amphibex 400, was contracted to fill in the adjacent 15 acres in October 2015. The Amphibex moved 24,312 cy from an adjacent canal, and the target fill site was monitored for elevation changes, vegetation recruitment, refill rate of the borrow area, retention in the receiving area and use by wildlife for two years.

The Amphibex 400 proved to be more efficient at moving material at a slightly greater cost per acre than the *John James*. However, with rapid infilling of fine-grained sediment slurry by the Amphibex 400, there was less control over the resultant topography than with the fill and settle routine of the *John James*, which may result in incomplete vegetation recruitment, thus increasing the resultant cost per acre. The *John James* filled 1.3 acres with slurry in 3 years that resulted in 1.5 acres of restored marsh after 6 years. Vegetation colonized 100% of the fill and is expanding. The Amphibex 400 filled 15 acres in 23 days with slurry that after 2 years has resulted in 12.1 acres of potential marsh habitat including 6 acres of restored marsh.

This work demonstrated that: 1) surrounding vegetated marsh used as natural containment benefited from sediment leakage from the target site, but also that constructed containment needs to be sufficient to hold sediment and protect that sediment from wave and water energy; 2) borrow areas can be reused once the rate of refill is established; and 3) small dredges are a useful and cost-effective tool for landowners for projects that are roughly 50 acres or less. Being relatively cost effective, mobile, and adaptable, small-dredge technology is a growing industry that has potential for increased use by landowners and land managers, which can fill an important gap to address coastal restoration needs in Louisiana and beyond.

PRESENTER BIO: Karen A Westphal is a Coastal Scientist with more than 35 years of experience in biogeomorphic research in the Louisiana marshes. For the last 8 years, she has designed, permitted, implemented and monitored marsh restoration projects in southwest Louisiana.

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WHAT ARE THE ECOLOGICAL CONSEQUENCES OF BACKFILLING CANALS? DEVELOPING MONITORING DESIGNS THAT SCALE ACROSS TIME, SPACE AND LEVELS OF BIOLOGICAL AND HYDROLOGIC ORGANIZATION

Julie L. Whitbeck

Jean Lafitte National Historical Park & Preserve, New Orleans, LA, USA

Located less than 25 km south of New Orleans, in the upper reaches of the Barataria Basin, the coastal wetland landscape of Jean Lafitte park's Barataria Preserve was created by a major distributary of the Mississippi River just 3000 to 1500 years ago. The Preserve protects levee ridge forests and swamps on its higher ground and a variety of marshes, including globally rare floating peat marsh, that spread toward shallow estuarine 'lakes'. Like much of this region, people have used these wetlands for natural resource extraction for generations, one consequence of which is the perforation of the landscape by canals. With diminished river influence, the canals now serve as major conduits delivering salt water and storm energy into the heart of the Preserve's – and the rest of this coast's – freshwater wetlands. Seeking to reduce seaward influence, and pursuing its legislative mandate to restore landscape-scale hydrology in the Preserve, the park has begun implementing canal backfilling at a small scale.

Backfilling canals moves material in canal spoilbanks, composed of dredged sediments and accumulated organic matter, back into the canal channel. Typically, this results in reduced canal depth and width, modifying flow dynamics and water column properties that shape biogeochemical processes. In many cases, native wetland vegetation colonizes former spoilbank terrain, reducing “upland” interruption of these habitats. We expect that decreasing spoilbank height also facilitates exchange of water, dissolved and suspended constituents and biota between canal channels and adjacent wetlands. We presume these changes impact wetland structure and function at a range of spatial and temporal scales and at levels of biological organization from organism to landscape. We anticipate that backfilling canals will diminish seaward influences, increase hydrologic connectivity among aquatic and terrestrial wetland ecosystems, and also sustain or enhance key resource values including species richness, biological productivity, nutrient assimilation and carbon sequestration.

Because our monitoring goals extend beyond guiding the park’s resource management strategies to informing land owner and regional restoration decisions and tactics, we wish to employ design, approach, and metric attributes relevant to a broad range of situations. Furthermore, we seek low cost and cost-effective approaches and designs and metrics that yield high signal-to-noise information. We must be able to discuss backfilling outcomes with the public and other stakeholders as well as with the scientific and resource management communities. Striving to balance these diverse goals, we are developing a monitoring program that 1) addresses our general hypotheses and objectives, 2) captures key topo-bathymetric, hydrologic and ecological state factor metrics, 3) focuses on a small group of biological guilds and communities, 4) measures integrative ecosystem and landscape properties, and 5) leverages prior backfilling work and existing environmental and ecological reference sites on the Preserve landscape.

PRESENTER BIO: Dr. Whitbeck is a terrestrial ecologist developing and applying ecological understanding in the service of managing natural resources. Her research and practice address whole plant to ecosystem scale responses to environmental variation, focusing on climate change and ecosystem restoration. She has worked in freshwater coastal wetlands for many years.

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UTILIZATION OF HISTORIC AND RECENT MONITORING DATA TO ASSESS VEGETATION TRAJECTORIES OF RESTORED LOUISIANA BARRIER ISLANDS

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Louisiana's barrier islands and headlands are highly valuable coastal formations that provide crucial ecosystem services including coastal protection, erosion control, and habitat provision. However, the highly dynamic nature of the Mississippi River Deltaic Plain necessitates periodic restoration activity to sustain these important coastal formations in the landscape. Barrier shoreline restoration projects undertaken by the State of Louisiana have included a vegetation monitoring component to assist in determining individual project results. Analysis of these vegetation datasets over time may provide greater insight into vegetation community trajectories, both in terms of understanding over what timeframe species assemblages occur and how different restoration scenario and settings may modulate this. An analysis of historic project monitoring data for selected habitat types of the Trinity Island, New Cut, and West Belle Pass restoration sites was utilized to evaluate the development of barrier island vegetation communities subsequent to restoration.

West Belle Pass, New Cut, and Trinity Island, dune habitat vegetation community characteristics appear to vary in an age-specific manner. For West Belle Pass and New Cut, which are more recent restoration sites, neither total live vegetation nor species richness differed significantly from 2013 to 2014. This suggests that New Cut, which was restored in 2007, may have reached an equilibrium in terms of its vegetation extent and community composition. This equilibrium may continue until either a significant acute perturbation, such as a tropical storm, or chronic erosive forces reach the vegetated dune habitat and begin reducing its areal extent. West Belle Pass also demonstrated consistent vegetation coverage and species richness in dune habitats over this one-year time frame, even though this site was restored in 2012. Thus, this area may also have reached an equilibrium in terms of vegetation extent and composition, even though average live vegetation cover is anecdotally about 10% lower than at the New Cut site. In contrast, the Trinity Island dune habitat, which was restored in 1999, displayed consistent total live vegetation cover from 1999 to 2001, but then displayed a significant reduction in 2003 prior to increasing to its highest level in 2014. Species richness at Trinity Island demonstrated a generally similar pattern. Although this suggests that the Trinity Island restoration project area is performing well in terms of dune habitat, substantial narrowing of the western portion of the island was noted during a 2014 sampling trip due to erosion of the back-barrier marsh component. Thus, even though the Trinity Island dune habitat currently displays substantial vegetation coverage, there is limited swale and back-barrier marsh area for the dune habitat to transition into as the barrier island migrates landward. Interestingly, an exploratory nonmetric multidimensional scaling ordination of Trinity Island dune habitats clearly delineated a gradient of age-post restoration, with cover from planted species of *Panicum amarum* and *Cynodon dactylon* decreasing through time, while cover of *Strophystyles helova* and *Rayjacksonia phyllocephala* have increased through time.

PRESENTER BIO: Dr. Willis is an assistant professor at Nicholls State University whose research focuses on the restoration of coastal plant communities and addressing pollution impacts to wetland vegetation.

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EXAMINATION OF CHEMICAL CONTROL OPTIONS FOR THE INVASIVE ROSEAU CANE SCALE, *NIPPONACLERDA BIWAKOENSIS*

***Blake E. Wilson**, Madeline Gill, Ian Knight, and Rodrigo Diaz*
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On-going research is being conducted to investigate potential insecticidal control of the invasive Roseau cane scale (*Nipponaclerda biwakoensis*) with the aim of protecting Roseau cane (*Phragmites australis*) along Louisiana's Gulf Coast from further die-off. Although insecticides which control scale insects in agricultural settings are available, numerous challenges exist in identifying chemical controls for this pest that would be appropriate for a sensitive aquatic ecosystem. Many insecticides which target the insect nervous system are highly toxic to aquatic invertebrates. Consequently, extreme caution must be taken to avoid detrimental effects to non-target species including economically important shrimp and oyster populations. In addition, the scale insect often feeds behind tightly wrapped leaf sheaths low in the canopy of dense Roseau cane stands making contact with foliar-sprayed insecticides difficult to achieve. Current research is examining insecticides and application methods which can provide effective suppression of scale infestations while reducing the risks of adverse effects on the coastal ecosystem. Preliminary research findings indicate that many foliar-applied products failed to reduce scale numbers in field trials and likely cannot adequately penetrate senescent leaf sheath tissue. Systemic and translaminar insecticides which are taken up by plant tissues have shown greater potential to provide control. Further on-going research activities are examining application methods which will contain chemicals within the Roseau cane tissues without leaching into the environment. Due to these various challenges and the substantial risk associated with chemical control in this system, emphasis is being placed on non-chemical management options including recolonization of affected areas with Roseau cane varieties that may be less susceptible to die-off.

Presenter Bio: Dr. Wilson is a field crops entomologist specializing in sugarcane and rice pest management. He has experience researching effective insecticidal control strategies as well as in invasive species ecology. He works closely with Louisiana's farmers and stakeholders to identify pest management solutions for established and emerging insect pests.

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RETROFITTING PRINCEVILLE, NORTH CAROLINA: CULTURALLY-RESPONSIVE BUOYANT FLOOD MITIGATION AND DISPLACEMENT PREVENTION

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Princeville, North Carolina, is the oldest town incorporated by African Americans in the United States. It was established by freed slaves in 1865, following the US Civil War, and incorporated twenty years later. This historic town in the floodplain of the Tar River has twice been devastated by "100-year" hurricane-related flooding in the past 17 years. Buoyant foundation retrofits of Princeville's important historic structures would both 1.) provide visually-unobtrusive protection from flood damage, and 2.) prevent the forced relocation (and erasure of history) of this culturally vibrant and historically significant African-American community. After close coordination with the community and city officials we propose that the Princeville Historic Museum, the Primitive Baptist Church and at least a dozen historic homes be retrofitted with buoyant foundations so that the next time the water rises they will "float when it floods”.

Princeville’s recent catastrophic flooding in 1999 and 2016 sparked local conversations about the town’s future, and how to strengthen its resilience. This begs the question about whether or not the town should relocate. As climate change, coastal erosion, and sea level rise continues to increase its impact in the United States, more and more communities will be faced with the same important questions and decision-making processes. What if there was an alternative approach? Buoyant foundation systems offer one such alternative with a subtle retrofit to existing structures that preserves community character while protecting a structure from a range of flooding events. Particularly for communities with complicated histories of ownership, relationship with and to land and “home,” knowing that there is a way to truly live with and accommodate the water — in place — has never been more important than it is now.

Currently, a proposal to expand Princeville’s town boundaries and move large portions of the community has been presented by FEMA. This process would involve buy-outs, teardowns, and displacement of a nationally historically significant town. Our poster presents an alternative to “displacement by climate change and climate-accelerated flooding.” Buoyant foundation retrofits will not solve all problems related to the increased impacts of climate change, but it will offer a viable alternative and hope to communities who have unbreakable relationships to place. From a financial perspective, a recent loss avoidance study conducted on a typical buoyant foundation prototype shows that even in a flooding event reaching no higher than the finish floor level, the loss avoidance ratio was greater than 1, meaning that in a single flooding event the retrofit saves the property owner money, while giving the residents confidence that their home and belongings are safe. The same methodology can be used as a tool for selecting flood mitigation strategies across coastal Louisiana and the Mississippi Delta. By assessing the financial viability of buoyant foundation retrofits against displacement, post-disaster repairs or alternate strategies such as permanent static elevation, design decisions for the retrofit can be made with a level of specificity to the existing structure and resources available to the owners.

PRESENTER BIO: Jeana C. Wiser is currently Program Director for the Buoyant Foundation Project and Co-Founder of Greyspace Collective, in New Orleans, Louisiana. Her areas of research include working at the intersection of community, resilience, and preservation, to help communities and cities navigate and adapt to an uncertain future.

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REFINING ESTIMATES OF OILED MARSH SHORELINE LENGTH FROM THE DEEPWATER HORIZON SPILL

Cameron Wobus*, Russell Jones, and Matthew Rissing*
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During the course of the *Deepwater Horizon* oil spill, Shoreline Cleanup and Assessment Technique (SCAT) teams working on response activities recorded oiling observations on paper maps and marked their positions with hand-held global positioning system (GPS) units in track mode. These raw field observations were then compiled as geographic information system (GIS) layers using a digital shoreline feature from 2008 as a spatial reference. The SCAT data were later combined with other observational datasets to generate a more comprehensive shoreline exposure database for the natural resource damage assessment (NRDA).

Although the 2008 shoreline was a readily available spatial reference for compiling Gulf-wide observational data during the response efforts, this feature represented the land-water interface at a relatively low tide, two years before the spill. As a result, the vegetated marsh edge where SCAT teams actually made their observations in 2010 was typically landward of this line, and was more complex than the representation of the shoreline from the 2008 GIS layer. In addition, because of the way the response information was initially compiled, some of the field data collected by SCAT teams may not have been fully utilized when assigning this information onto the 2008 shoreline. For all of these reasons, shoreline lengths based on the 2008 data layer underestimated the true length of the vegetated marsh shoreline, particularly in the most complex marsh habitats of Louisiana.

The goals of this study were to depict field observations of oiling using the best available digital representation of the shoreline, and to refine the estimates of oiled length for Louisiana marsh habitats. To do this, we used spatial analysis tools available in ArcGIS to restore the field-collected data to the 2010 shoreline feature, and to recalculate the total length of oiled marsh in Louisiana. Based on our analysis, the use of the 2008 shoreline consistently underestimated shoreline length compared to the more complex shoreline feature that was actually oiled in 2010. As a result, we found that the length of oiled shoreline in Louisiana was approximately 10–40% longer than the length estimated from the 2008 shoreline feature. We summarize the steps we took to complete this analysis, the resulting changes in oiled shoreline length, and uncertainties associated with our methodological choices.

PRESENTER BIO: Dr. Wobus is a principal scientist at Abt Associates, with expertise in geomorphology, numerical modeling, and geospatial analysis. He has more than 15 years of applied earth science expertise, and has supported the State of Louisiana in both injury assessment and restoration planning related to the Deepwater Horizon oil spill.

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RESTORATION EFFICACY ASSESSMENT OF COASTAL LOUISIANA

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The state of Louisiana has planned and constructed over 300 restoration projects in the last 30 years. The Coalition to Restore Coastal Louisiana (CRCL) is conducting an assessment of completed projects listed in the Coastal Protection and Restoration Authority's (CPRA) 2017 Annual Plan to develop methods of monitoring land change that accurately reflect the value of specific efforts and to identify factors that may be influencing success. 294 restoration projects encompassing all project types have been included in the analysis. The two part analysis focuses on project completion timeliness and an examination of land change within the project areas over time.

The purpose of evaluating the time to project completion is to gain a better understanding of how the time span of development affects performance within a project's specified area of influence. This information is useful in comparing outcomes of individual projects and between project types as a means of determining productivity and best practices for future restoration construction within Louisiana's coastal basins.

We are using ArcGIS to evaluate land change over time within each restoration project's area of influence. Project boundary shapefiles were acquired through the CPRA's public data library and projected against the most recent USGS land loss/gain imagery to quantify percent loss or gain within blocks of time since 1932. This analysis allows us to compare initial acres benefitted figures to observed land change before, during, and after construction. Land change values within project boundaries are then compared to land change values within that project's basin, and along the entire coast for the same time periods. This simple GIS analysis provides information regarding how our restoration projects are performing when compared to baseline loss or gain outside of prescribed boundaries and how those numbers have been changing over previous decades. Continual monitoring is the best means of determining the most effective use of resources in our efforts to restore land along a rapidly eroding coastline. The methods developed in this analysis will hopefully provide foundation for the advancement of more comprehensive monitoring in the future.

Presenter Bio: Jenny Wolff is the Science Program Assistant/ Americorps service member designated to geospatial investigations for the Coalition to Restore Coastal Louisiana. She has previously worked in Louisiana fisheries research and is currently pursuing a master's degree in environmental geospatial information systems through the University of Denver.

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IDENTIFYING THE RELATIONSHIPS AMONG FORESTED AND HERBACEOUS FLORISTIC QUALITY INDICES, AND BIOMASS IN LOUISIANA SWAMPS

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A Forested Floristic Quality Index (FFQI) has been developed using the Coastwide Reference Monitoring System (CRMS) network in Louisiana. The FFQI evaluates coastal forested sites on a continuum from degraded to pristine conditions and can assist in defining areas where restoration may be successful by generating a mechanism to evaluate the trajectory of local conditions. The FFQI has a representative value for the full range of coastal swamps and uses multiple CRMS data types to offer insight into the health of coastal swamps. The constituents of this index are basal area by species, herbaceous cover by species, and the percent of canopy cover present. The FFQI is modeled after the inverse relationship between basal area and canopy cover and the herbaceous community on the forest floor. The FFQI was compared to the herbaceous Floristic Quality Index (FQI) at the same CRMS sites to determine if an inverse relationship was shown. The FFQI was also compared to geographically similar above-ground forested biomass monitoring stations to evaluate and validate the FFQI's sensitivity to the same environmental parameters that drive variation in biomass annually. The comparison biomass stations are both temporally and spatially similar to the CRMS sites across four years and 11 paired locations in the upper Pontchartrain Basin of coastal Louisiana. However these metrics were not collected at the same locations, introducing some unaccounted for spatial variation due to the heterogeneity of these coastal forested systems. Overall the FFQI was both negatively correlated to the herbaceous FQI at the same monitoring stations and positively correlated to the above-ground biomass sampling of nearby stations. This suggests the FFQI is a reasonable proxy for above-ground biomass, using a less intensive sampling regime, and is a better metric for restoration planning and monitoring than the herbaceous FQI in swamps.

<u>PRESENTER BIO</u>: William Bernard Wood is a coastal resources scientist with more than 15 years of experience monitoring and conducting experiments in wetlands. He has extensive experience with forested wetland restoration and has worked all along the Louisiana coast monitoring and restoring wetlands.

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BUILDING PUBLIC SUPPORT AND UNDERSTANDING OF COASTAL RESTORATION THROUGH VOLUNTEERISM

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A Functional Approach in Identifying Motivations of Coastal Restoration Volunteers in Louisiana

In response to the complex land loss issues facing the Louisiana coast, local community members are spending hours volunteering their time to restore the coastal environments they value. For example, over 13,000 people have volunteered with the Coalition to Restore Coastal Louisiana's (CRCL) Habitat Restoration Program to restore coastal wetland ecosystems since the year 2000. Volunteers will be more likely to continue to participate in volunteer activities if they feel the volunteer event is fulfilling their motivation. Happy volunteers will also be more likely to share their experience with others and inspire more people to participate in the cause. Positive volunteer experiences can lead to behavioral changes, transformative learning experiences, and attitude changes which can lead to high volunteer retention and involvement in restoration events (Bruyer & Rappe, 2007). Although there are many benefits of volunteering, and volunteers make up a significant portion of those working towards coastal restoration in Louisiana, little research is done on what motivates these individuals to participate in coastal restoration volunteer events.

In this research, the Volunteer Functional Inventory was used to identify volunteer motivations for participating in CRCL's Habitat Restoration Program. Based on the idea that people can participate in the same volunteer event to fulfill different psychological functions, this approach identifies the social and personal processes that may cause people to volunteer (Clary & Snyder, 1999). After the completion of electronic surveys and face-to-face interviews, we identified seven common functional themes behind people's decision to volunteer with our organization: social fulfillment, protective, attachment to place, general environmental ethic, personal and professional development, environmental education, and to enhance or protect areas they live and recreate in.

Our results show that out of 175 volunteers surveyed, 27.7% participate in our events because of a general environmental ethic, 21.3% because they want to protect their home, city, or community through environmental restoration, 15.2% volunteer because of an attachment to Louisiana, 12.8% volunteer to gain personal or professional experience, 9.1% participate in our events for social reasons – including spending time with friends, spouses, or community groups, 6.4% volunteer to learn more about coastal wetland environments, and 5.8% volunteer to enhance areas they frequently live and recreate in. As our program better understands these motivations for volunteering, we can develop and implement coastal restoration projects that are attractive to volunteers while still building support for coastal restoration.

PRESENTER BIO: KACIE WRIGHT - Kacie is the Habitat Restoration Coordinator at the Coalition to Restore Coastal Louisiana where she has planned and organized over 30 volunteer events engaging over 400 volunteers. She has experience in engaging stakeholders in complex social-ecological systems which she uses to engage volunteers on coastal issues.

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SEDIMENT PRESERVATION AND REDISTRIBUTION OF MISSISSIPPI RIVER DISTRIBUTARIES AND THEIR IMPLICATION TO COASTAL RESTORATION

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Land loss is a challenging problem on many deltaic coasts around the world, and this is particularly true for the Louisiana coast over the past century. Over the past 7,000 years the Mississippi River has formed multiple large overlapping subdeltas and developed many complex distributaries, including Bayou Lafourche and Bayou Terrebonne. Bounded by these two large distributaries, Terrebonne Bay is now a shallow coastal estuary in Louisiana. Due to rapid relative sea-level rise and the lack of modern river input, land loss surrounding Terrebonne Bay has been at a very high rate in the past several decades. In order to address the land loss issue, our scientific community need to better understand what type (sand vs. mud) of sediment has deposited in the geological past, how much has been preserved, and how sediment has been reworked and redistributed in Terrebonne Bay.

In this study, a combined system of CHIRP sub-bottom profiler and side-scan sonar was used to collect surface and subsurface stratigraphy data in Terrebonne Bay. Our results show that the preserved sediment is generally coarse and thick (4-8 m) near the distributaries and around crevasses, and it becomes finer and pinches out laterally toward the middle of the bay. The top most part of preserved stratigraphy has been reworked by recent coastal processes, with an acoustically distinct layer of marsh mud. When combining our seismic data with recent extensive work on many sediment cores collected near Bayou Lafourche and Bayou Terrebonne, the spatial extent of southward progradation to these two distributaries can be delineated. This study provides new information of geological framework of Terrebonne Bay which can be used to better understand the land loss in coastal bays and estuaries of Louisiana.

PRESENTER BIO: Mr. Qihui Wu is a Ph.D. student at Wuhan University and a visiting student and research associate at Louisiana State University, with expertise in hydraulics, sedimentation, fluvial and coastal processes. He has experience in numerical and physical river and ocean modelling, and has contributed to around 9 applied and theoretical research projects.

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NRDA PROJECTS AND PATH FORWARD

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The Natural Resource Damage Assessment (NRDA) is the process used by Natural Resource Trustees to develop, on behalf of the public, claims for natural resource damages against the responsible parties for an oil spill. The overall goal of NRDA is to restore natural resources to pre-spill conditions, and to provide compensation for the loss of those resources from the date of injury through completion of restoration.

In April 2011, the *Deepwater Horizon* (DWH) Trustees and BP announced an agreement under which BP committed to provide $1 billion toward the implementation of restoration projects prior to the completion of the DWH natural resource damage assessment process. Louisiana received approximately $370 million of this funding for projects that restore marsh ($14.4M), oyster cultch ($15.6 M), and barrier island habitat ($318M), and provide and enhance recreational opportunities ($22M). Implementation of these projects is currently underway, with three completed to date.

In February 2016, the DWH Trustees released the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS). The PDARP/PEIS provides a framework for utilizing the $8.8 billion allocated for natural resource restoration, including at least $5 billion for Louisiana. The PDARP/PEIS will guide a series of project-specific plans, each of which will propose suites of projects intended to address DWH-related injuries for public consideration, and which will be periodically presented to the public over the 15-year payment period.

Louisiana's first project-specific restoration plan was released in January 2017 and approves $22.3 million in design work for six restoration projects. These projects will restore wetlands, coastal, and nearshore habitats; habitat projects on federally managed lands; and birds. Design of all six projects is currently underway. Once this work is completed, Louisiana will evaluate the feasibility of these projects and develop a restoration plan for their construction. If all six projects are feasible, construction is estimated to cost over $460 million.

In December 2017, Louisiana released two additional restoration plans, a project-specific Draft Recreational Use Restoration Plan and the Draft Barataria Basin Strategic Restoration Plan for Wetlands, Coastal, and Nearshore Habitats (Barataria Basin SRP). The Recreational Use Restoration Plan evaluates potential projects to restore recreational use within Louisiana by evaluating alternatives that could compensate for injuries to Louisiana's recreational fishing use. As such, the plan recommends seven alternatives totaling $22 million that would create or enhance recreational fishing infrastructure, enhance recreational fishing access or opportunity, and provide education and outreach that promote utilization and stewardship of the natural resources. The Barataria Basin SRP will identify habitat restoration components of Louisiana's 2017 Coastal Master Plan and habitat restoration components submitted by the public to restore wetlands, coastal, and nearshore habitats in Barataria Basin. Any project, or suite of projects, included in the Final Barataria Basin Strategic Restoration Plan will be further analyzed in subsequent phased project-specific restoration plans.

PRESENTER BIO: Mr. Wyble is a project management administrator with more than 16 years of experience planning and implementing coastal projects. He has extensive experience with master planning and project controls, and has led more than 10 projects dedicated to preserving and restoring wetlands.

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SEDIMENT TRANSPORT AND INFILLING PROCESSES OF DREDGE PITS ON LOUISIANA SHELF

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The shelf offshore Louisiana is characterized by a dominantly muddy seafloor with a paucity of restoration-quality sand proximal to shore. Two typical types of sand resources are discrete paleo river channels and large sandy shoals. Sand deposits associated with paleo rivers that incised the shelf during lower sea-level positions occur close to shore but contain a relatively small volume of sand. Several recent projects targeted paleo-river deposits comprising relatively deep (10 m) channel sands underlying a muddy overburden. Because of contrasting characteristics of cohesive vs. non-cohesive sediment and potential modern fluvial mud supply from the Mississippi and Atchafalaya Rivers, long term pit evolution is poorly understood. In contrast to paleo river sand, large sandy shoals contain a large volume of high quality sand but can be far from barrier island restoration sites. For instance, multiple sandy pits have been dredged on Ship Shoal of Louisiana for barrier system restoration in recent years.

Here we present geophysical and geological data (bathymetry, sidescan, subbottom, and radionuclide of sediment cores) and physical oceanographic data (hydrodynamics and sediment dynamics) collected at multiple dredge pits in paleo river channels and Ship Shoal on Louisiana shelf. Vessel-based ADCP profiling data show that spatially there are generally three layers of flow near the dredge pits: the sea surface flow is fast, the middle water column is at an intermediate speed and the flow inside pit is random and sluggish. In general, bowl-shaped collapse failures and retrogressive stair-stepped slumps are found near pit margins, and pit walls are morphologically rough and temporally stable. It seems that the 'mud caps' near paleo river channels prevent widespread pit wall collapse and help preserve the localized pit morphology. Those pits are also efficient sediment traps, with an averaged sediment infilling rate of ~0.5-1 m per year. These field data collections along with pre-existing data provide a time-series to capture pit evolution, and are used to compare with model predictions. Conceptual morphological models are developed for dredge pit evolution and testing effectiveness of setback buffers protecting regional pipelines, habitats, and cultural resources.

PRESENTER BIO: Dr. Kehui Xu is an associate professor of Department of Oceanography and Coastal Sciences and Interim Director of Coastal Studies Institute of Louisiana State University. His research areas are geological oceanography, coastal morphodynamics, observation and numerical modeling of sediment transport, bottom boundary layer, sedimentary geology, and coastal processes.

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SAND SETTLING THROUGH BORROW-PIT GENERATED TURBULENCE IN RIVERS

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Dredging is commonly used in large rivers to promote navigation and provide sediment for engineering projects. Channel bars typically have thicker, coarser sediment deposits than elsewhere on the channel bed and are often the focus of dredging projects. Bar dredging may create deep pits (“borrow pits”) that significantly alter flow and sediment transport. Locally, the pit acts as a large bedform, contracting and expanding the flow field and enhancing turbulence. At the reach scale, the pit acts as a new sediment sink and disrupts the sediment budget which may have consequences for channel stability and aquatic ecosystem health.

In this study, we focus on the local impact of the borrow pit and how it, similar to dunes, creates a turbulent wake within the downstream flow column. We hypothesize that this wake may have implications for the overlapping suspended-sediment transport fields. Efficient dredging operations requires the ability to predict channel infilling/recovery timescales and in large, sandy rivers, a substantial fraction of the sediment infilling results from the settling of suspended sediment. However, if the turbulent wake significantly alters pathways of sediment settling within the borrow pit, typical models of sediment deposition that do not account for the wake effects may not apply. To explore this problem, we use numerical modelling to predict sand behavior with and without resolving the effects of wake turbulence. Wake turbulence is resolved using detached-eddy simulation and sand settling is simulated using Lagrangian particle tracking. Our study area is a >1 km2 channel bar in the lower Mississippi River, which was dredged in October 2016. We used vessel-based measurements (MBES, ADCP) to characterize the post-dredge hydrodynamic environment. Study results indicate that the turbulent wake significantly impacted suspended-sand behavior as it entered the borrow pit and large eddies increased the vertical grain velocities, mean grain settling was reduced, and initial sediment deposition was reduced by up to 20%. Study results may be used to optimize dredging in a manner to reduce channel recovery time. In coastal environments, dredged sand is becoming an increasingly precious commodity, useful for construction as well as restoration purposes such as delta land building and beach nourishment.

PRESENTER BIO: Dr. Yuill is a research scientist/ hydrologist with The Water Institute of the Gulf.

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CARNIVORE DIET ON LOUISIANA BARRIER BEACHES

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Dietary analysis provides information on predator trophic roles. On Louisiana's coast where human-induced and natural disturbances create a highly dynamic system, predators may experience very different foraging conditions over short geographical and temporal distances. Mammalian carnivore diet may respond to a variety of environmental characteristics, and these responses may be species-dependent. We investigated the diets of coyotes and raccoons at eight barrier beach sites in coastal Louisiana 2014-2016, from Cypremort Point SP in the west to East Grande Terre in the east.

We analyzed 60 coyote and 41 raccoon scats across broad prey categories to reveal patterns in dietary breadth, evenness, and prey volume. Coyotes exhibited significantly greater dietary breadth than raccoons (Wilcoxon, X^2 = 4.30, df = 1, P = 0.038), but dietary evenness did not differ between species (Wilcoxon, X^2 = 0.067, df = 1, P = 0.80). Coyote diet was dominated by mammalian prey (especially lagomorphs), grasses, and other plant materials, while raccoons consumed crustaceans, insects, and grasses more than other types of prey. Coyote dietary breadth was significantly influenced by rabbit presence (Wilcoxon, X^2 = 3.97, df = 1, P = 0.046), suggesting that coyotes consumed fewer types of prey when rabbits were an available resource. We investigated changes in volume of prey in scats across environmental gradients (i.e. site size, vegetative complexity); as site size increased, raccoons consumed a greater volume of grass. Coyotes consumed smaller volumes of crustaceans and birds in sites with rabbits.

Our results suggest that carnivore diet varies by species and responds to habitat complexity and prey availability. These patterns have conservation implications in coastal Louisiana where prey species include managed seabird populations and rising sea levels will alter habitat and prey availability. Neither carnivore use of prey nor carnivore response to environmental conditions is 'one-size-fits-all', and carnivore management should employ species-specific strategies.

PRESENTER BIO: Mirka Zapletal is a doctoral candidate in the Biology Department of the University of Louisiana at Lafayette where she studies carnivore ecology on Louisiana's coast. Her Masters work was completed at Antioch University New England and focused on habitat use by hedgehogs in Asia.

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MODELING NATURAL SHALLOW COMPACTION OF MISSISSIPPI WETLANDS

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High rates of land subsidence are seriously threatening the long-term survival of the Mississippi Delta. The extensive loss of land elevation and the consequent exposure to flood hazards put at significant risk vulnerable and highly populated deltaic areas. Shallow compaction of the top soil is one of the major components contributing to the relative sea level rise. In the last decades, more subsidence measurements have become available and recent studies demonstrate that compaction of the Holocene strata is significant. It follows that quantification of the spatio-temporal evolution of shallow deposits is crucial to predict land subsidence and to support decision making on sustainable coastal management plans. Here we propose a novel application aimed at modeling the present-day shallow compaction due to consolidation processes in the top soil. Soil compaction is properly computed and accounts for the large soil grain motion and the delayed dissipation of pore-water overpressure. A groundwater flow simulator is coupled to a vertical geomechanical module where the soil properties may vary with the effective intergranular stress. The grain motion is described by means of a Lagrangian approach with an adaptive mesh. A calibration with available observations from rod surface-elevation table (RSET) enables the model to predict future scenarios.

PRESENTER BIO: Dr Zoccarato received her Ph.D. from the School of Civil and Environmental Engineering Sciences at the University of Padova where she is now working as a Postdoctoral fellow. One of the main research interests is the investigation of the processes driving natural and human-induced compaction in vulnerable transitional coastal environments.

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