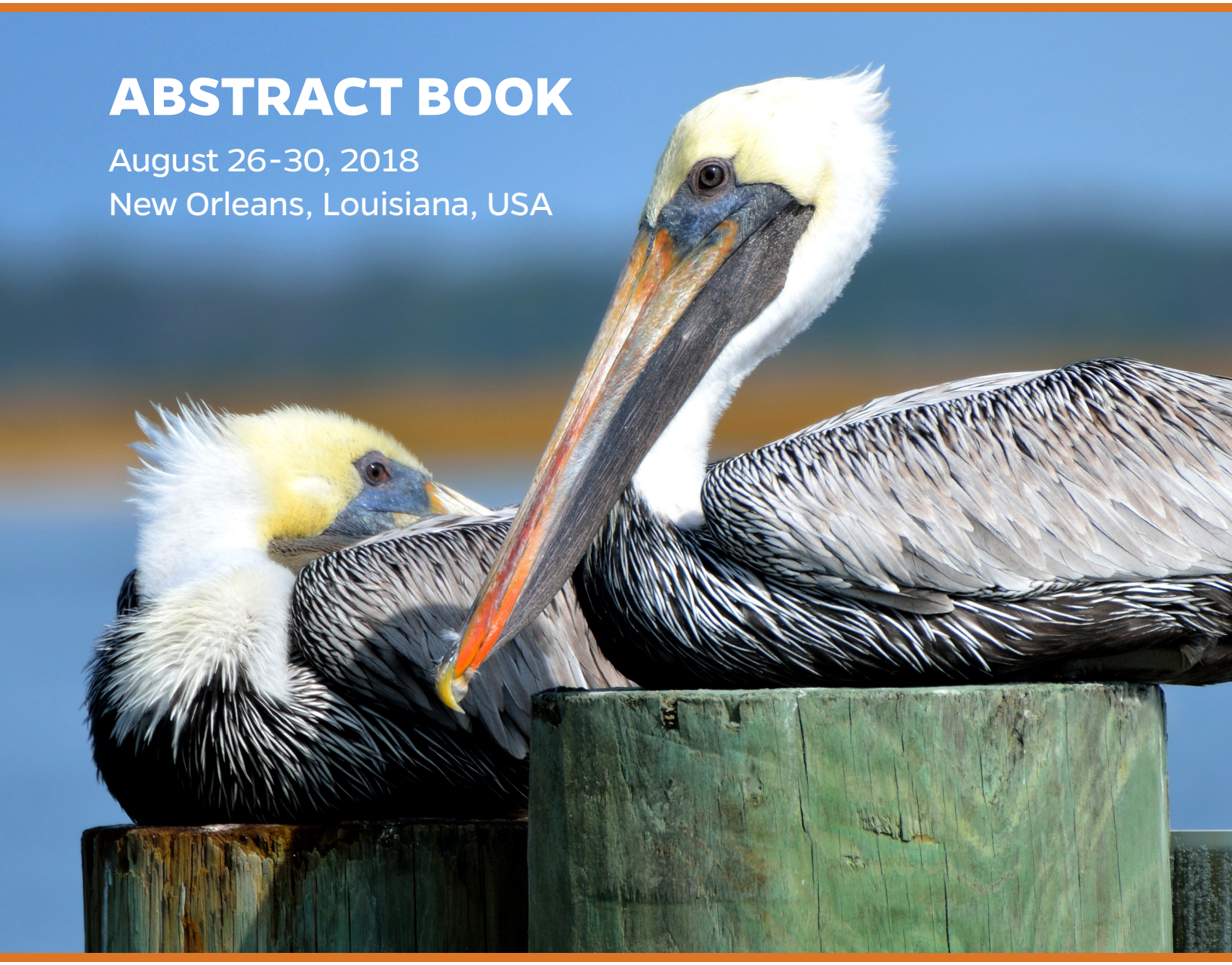
NCER 2018

National Conference on Ecosystem Restoration

Building connections from the local to the landscape scale

ABSTRACT BOOK

August 26-30, 2018
New Orleans, Louisiana, USA



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NCER 2018

National Conference on Ecosystem Restoration

Building connections from the local to the landscape scale

August 26-30, 2018

New Orleans, Louisiana, USA

www.conference.ifas.ufl.edu/NCER2018

In Honor of

Paul Anthony Conrads

(1957 – 2017)

A celebration of the contributions of an inspiring member of the restoration community...

Paul Conrads, 60, passed away suddenly on December 2, 2017. For the past 30 years, Paul Conrads worked with the U.S. Geological Survey in the South Atlantic Water Science Center in a variety of activities. He served as the Surface-Water Specialist in South Carolina. Principally, he was responsible for data collection, data analysis, and hydrodynamic and water-quality model applications, and Total Maximum Daily Load (TMDL) development. He assisted many water utilities, state agencies, universities and non-profits in making science-based decisions in water-resource management. He was on the cutting edge of science with regard to "big data" and data mining. He was one of the pioneers of Artificial Neural Networks, a science that utilized the real-time data of the USGS with a means to understand the effects of drought, which are challenging to quantify adjacent to the ocean. His work in this field was recognized internationally.

Paul also developed models for the majority of the river systems in South Carolina, provided technical assistance to U.S. Environmental Protection Agency (USEPA) Region IV TMDL Program and was a member of the Federal Technical Review Team of the development of the hydrodynamic and water-quality models developed for the Savannah Harbor Expansion Project. For the past 11 years, he worked on various projects in the Florida Everglades. He studied coastal drought and the influence of increased salinity stress on the structure and function of ecological habitats, and had recently developed a unique coastal drought index using salinity data.

Paul grew up in suburban Washington, D.C. and received a degree in History and American Studies from Connecticut College. He attended Landon School, Connecticut College. He was a huge Gamecock supporter in all sports and an avid follower of the Baltimore Orioles and the Washington Redskins. He was also a Peace Corps volunteer and spent two years in West Africa building potable water supply and sanitation systems in the neighborhoods of the capitol city of Liberia. After returning to the US, he earned an undergraduate and Master's degrees in Civil Engineering at the University of South Carolina.

Paul loved his work but also his fishing, gardening, cooking and anything new he could conquer. As one colleague wrote, "Paul was truly special in a way that very few people are. It was easy to love him — his zest for life, his intelligence, his endless willingness to help, his love of good food and wine, his mischievous way and so much more. *I can honestly say that I know no one who compares to his integrity of spirit.*"

NCER and GEER conferences will not be the same without Paul being there. He will be sorely missed.

About NCER

NCER is an interdisciplinary conference on large-scale ecosystem restoration presenting state-of-the art science and engineering, planning and policy in a partnership environment. The first NCER, held in Orlando, FL (2004), lead to successful conferences in Kansas City, MO (2007), Los Angeles, CA (2009), Baltimore, MD (2011), and Chicago (2013). NCER brings together scientists, engineers, policy makers, planners and partners from across the country actively involved in large-scale ecosystem restoration. Since its inception, NCER has become the preeminent conference on ecosystem restoration in the US.

Today, we are in a new era, where resources are tight. Renewed vigilance on the use of public funding requires that we demonstrate progress in achieving restoration goals, clearly prove its value, efficiently and effectively share lessons learned and provide better coordination among all stakeholders ensuring the best use of future funding to achieve results.

Centuries of unsustainable activities have damaged and/or eliminated the freshwater, marine and terrestrial environments that provide vital services to our economies, societal values and support a diversity of wildlife and plants. This conference aims to provide a venue for ecosystem restoration professionals to convene over efforts to reverse environmental degradation by renewing and/or restoring degraded or destroyed ecosystems and habitats.

Progress in restoring various ecosystems and habitat types has been made around the nation in the 14 years since the first NCER conference was held. NCER 2018 is a forum to share results on what restoration fundamentals and practices have worked and bring new focus on those challenges that remain. It will also allow for collaboration across agencies, non-governmental organizations and the private sector, bringing together in one location the nation's leading experts in ecosystem restoration to ford new insights and advances to restore and protect ecosystems and habitats nationwide.

We are glad you could be a part of NCER 2018 and we encourage you to get involved in future NCER's by organizing a session and contributing to program development. **Thank you for joining us.**

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NCER 2018

National Conference on Ecosystem Restoration

Building connections from the local to the landscape scale

Welcome to the 7th National Conference on Ecosystem Restoration (NCER 2018)

NCER is an interdisciplinary conference on large-scale ecosystem restoration presenting state-of-the art science and engineering, planning, and policy in a partnership environment. The first NCER was held in 2004 in Orlando, FL. Since then, it has been held across the country, and we are happy to bring NCER to New Orleans in 2018. NCER brings together scientists, students, engineers, policy makers, planners and partners from across the country actively involved in large-scale ecosystem restoration.

The theme of NCER 2018 is "Building connections from the local to the landscape scale." Advancing restoration on the national scale and beyond requires connecting projects to restore ecosystem functions that ignore jurisdictional boundaries. "Small-scale" restoration projects can collectively become large-scale ecosystem restoration. Restoration downstream depends on improving conditions upstream. The theme resonates across the NCER 2018 program, with sessions ranging from technical aspects of restoration to stakeholder engagement and determining the collective impact of on-the-ground actions. These seemingly isolated components of restoration are increasingly being integrated, with exciting results.

Our location in New Orleans provides a perfect opportunity to explore critical issues surrounding restoration of the Mississippi River watershed and the Gulf of Mexico, arguably one of the greatest restoration challenges of our times. As one of the largest water bodies in the world, the Gulf provides habitat to a vast array of marine organisms. The Gulf Region contains half the coastal wetlands in the entire United States. Recent disasters in the Gulf region have driven home the link between ecosystem wellbeing and that of human communities, highlighting the critical need for ecological restoration. Now, more than ever, we see the value of healthy ecosystems, not only in terms of ecological and societal health, but also in terms of the nature-based defense they can provide from disasters. To that end, NCER 2018 aims to facilitate sharing of critical knowledge and tools to improve the success of restoration in the Gulf Region and beyond.

This starts with Monday's all-day plenary session on ecosystem restoration in the Gulf of Mexico. The special plenary session features four consecutive panel discussions with distinguished speakers capped off with an afternoon keynote by Susanne Torriente, Assistant City Manager and Chief Resiliency Officer for the City of Miami Beach, FL. Each panel in the series will focus on a different aspect or component of restoration, with panelists representing a diverse cross-section of disciplines including scientists, decision-makers, restoration planners, and funders, from the Gulf Region and across the nation. This series is designed to provoke new ideas by engaging audience participants and facilitating dialogue among panel experts, furthering our understanding of restoration challenges, lessons-learned, and future opportunities. In keeping with the broader conference theme, what successful ecosystem restoration looks like will be examined from the local to national level, with a focus on identifying, measuring, achieving, and communicating restoration goals. These discussions will also explore how restoration in the Gulf is influenced by work done elsewhere and how lessons learned in the Gulf might apply to other regions. Check out the detailed Gulf of Mexico Plenary Agenda on page 34.

We are pleased to introduce a special feature on this year's program - a two-part session (21 & 27) on using drones as an ecosystem restoration tool and how to analyze drone data. Moreover, we are sure you will agree there is no shortage of technical sessions and interactive panels to choose from throughout three days of concurrent sessions.

Advancing the practice of restoration requires building and improving connections between scientists and practitioners across landscapes. This is what NCER is all about. We encourage you to connect with conference attendees outside of your geography or area of expertise. The most valuable lessons learned are often those least expected.

We are grateful to those who gave of their time and expertise to organize and moderate sessions, and of course, those who submitted abstracts, are giving talks, presenting posters, and participating as panelists. Furthermore, we would be remiss without thanking the many individuals recognized on pages 10 and 11 who volunteered their personal time and energy to organize and plan this conference, and those who are serving as volunteers during sessions. A special shout out goes to Amber Inggs for overseeing the SER-LERS Student Competition and to the many attendees who volunteered their time to judge student presentations. This conference would not be possible without the dedication and efforts of a large number of people and we applaud each and every one of you.

Finally, we would like to thank the team at the University of Florida's IFAS Office of Conferences and Institutes (OCI). Their expert management of conference details throughout the planning process is what makes bringing us together at NCER possible.

We hope that you have a great week in New Orleans, renewing old connections and making new ones that will help our community grow as we advance the practice of ecosystem restoration.

Sincerely,

Matt Grabau

Conference Chair

Science Coordinator, Desert Landscape Conservation Cooperative, and

President, Large Scale Ecosystem Restoration Section (LERS) of the Society for Ecological Restoration

Tucson, AZ

Ryan Clark

Conference Co-Chair

Research Scientist, The Water Institute and

Immediate Past President, Large Scale Ecosystem Restoration Section (LERS) of the Society for Ecological Restoration

Baton Rouge, LA

Planning Committee & Organizers

Planning Committee

- **Nick Aumen**, *Regional Science Advisor*, South Florida, US Geological Survey, Davie, FL
- **Darcy Austin**, *Program Manager II*, Delta Science Program, Delta Stewardship Council, Sacramento, CA
- **Ryan Clark**, *Conference Co-Chair*, Research Scientist, The Water Institute, and Immediate Past President, and President, Large Scale Ecosystem Restoration Section (LERS) of the Society for Ecological Restoration, Baton Rouge, LA
- **Matt Grabau**, *Conference Co-Chair*, President, Large Scale Ecosystem Restoration Section (LERS) of the Society for Ecological Restoration, Tucson, AZ
- **Matthew Harwell**, *Chief*, Ecosystem Assessment Branch, Gulf Ecology Division, National Health and Environmental Effects Research Laboratory, US EPA, Office of Research and Development, Gulf Breeze, FL
- **Ann Hijuelos**, *Ecologist*, US Geological Survey, New Orleans, LA
- **Beth Miller-Tipton**, *Director*, UF/IFAS Office of Conferences and Institutes (OCI), Gainesville, FL

Gulf of Mexico Plenary Organizers

- **Brie Bernik**, *Gulf Research Program Science-Policy Fellow*, Gulf Coast Ecosystem Restoration Council, New Orleans, LA
- **Alyssa Dausman**, *Vice President for Science*, The Water Institute of the Gulf, Baton Rouge, LA
- **Debbie DeVore**, *Gulf Restoration Manager*, Department of the Interior, Fairhope, AL
- **Justin Ehrenwerth**, *President and CEO*, The Water Institute of the Gulf, Baton Rouge, LA
- **Jessica Henkel**, *Science Advisor and Coordinator*, Gulf Coast Ecosystem Restoration Council, New Orleans, LA
- **Brad Inman**, *Chief*, *Projects and Restoration Branch*, New Orleans District, U.S. Army Corps of Engineers (USACE), New Orleans, LA
- **Bethany Carl Kraft**, *Senior Program Manager*, Gulf Region, Volkert, Inc., Mobile, AL
- **Denise Reed**, *Professor Gratis*, University of New Orleans, New Orleans, LA
- **Gregory D. Steyer**, *Science Advisor*, Gulf of Mexico, USGS Southeast Region, Baton Rouge, LA

Gulf of Mexico Panel Organizers, Moderators & Panelists

- **Toby Baker**, *Commissioner*, Texas Commission on Environmental Quality (TCEQ), Austin, TX
- **Holly A. Bamford**, *Chief Conservation Officer*, National Fish and Wildlife Foundation (NFWF), Washington, DC
- **Don Boesch**, *Professor of Marine Science*, University of Maryland Center for Environmental Science, Annapolis, MD
- **John Callaway**, *Lead Scientist*, Delta Science Program, Delta Stewardship Council, Sacramento, CA
- **Bethany Carl Kraft**, *Senior Program Manager*, Gulf Region, Volkert, Inc., Mobile, AL
- **Mike Chotkowski**, *San Francisco Bay-Delta Science Coordinator*, U.S. Geological Survey (USGS), Sacramento, CA
- **Alyssa Dausman**, *Vice President for Science*, The Water Institute of the Gulf, Baton Rouge, LA
- **Debbie DeVore**, *Gulf Restoration Manager*, Department of the Interior, Fairhope, AL
- **Heida Diefenderfer**, *Team Leader*, Ecosystems Research, Pacific Northwest National Lab (DOE) Coastal Sciences Division, Sequim, WA
- **Justin Ehrenwerth**, *President and CEO*, The Water Institute of the Gulf, Baton Rouge, LA
- **Neil Ganju**, *Research Oceanographer*, Woods Hole Coastal and Marine Science Center (USGS), Woods Hole, MA
- **Barry Gold**, *Environment Program Director*, Walton Family Foundation, Washington, DC
- **Holly Greening**, *Executive Director*, Tampa Bay Estuary Program (TBEP), Parrish, FL
- **Bren Haase**, *Chief*, Engineering and Research Division, Lousiana Costal Protection and Restoration Authority (CPRA), Baton Rouge, LA
- **Matthew Harwell**, *Special Assistant*, Ecologist EPA, Gulf Ecology Division, Gulf Breeze, FL
- **Brad Inman**, *Chief*, Projects and Restoration Branch, New Orleans District, U.S. Army Corps of Engineers (USACE), New Orleans, LA
- **Tanner A. Johnson**, *Director*, Gulf Environmental Benefit Fund, National Fish and Wildlife Foundation (NFWF), Baton Rouge, LA
- **David Kidwell**, *Program Manager*, NOAA National Centers for Coastal Ocean Science (NCCOS), Silver Spring, MD
- **Ehab Meselhe**, *Vice President for Engineering and Professor at Tulane University*, The Water Institute of the Gulf, Baton Rouge, LA
- **Denise J. Reed**, *Professor Gratis*, University of New Orleans, New Orleans, LA
- **Fred H. Sklar**, *Director and Section Administrator*, Everglades Systems Assessment (ESA) Section, South Florida Water Management District, West Palm Beach, FL
- **Gregory D. Steyer**, *Science Advisor*, Gulf of Mexico USGS Southeast Region, Baton Rouge, LA
- **Susanne Torriente**, *Assistant City Manager and Chief Resiliency Officer*, City of Miami Beach FL, Miami Beach, FL
- **Mark R. Wingate**, *Deputy District Engineer for Programs and Project Management Executive Office*, New Orleans District, U.S. Army Corps of Engineers (USACE), New Orleans, LA

*see detailed Gulf of Mexico plenary agenda for more information, pages 34-37

Session Organizer Recognition

A large number of sessions were organized by individuals who shouldered the responsibility to confirm appropriate speakers and manage a session. Having such a diverse group of professionals representing multiple disciplines assist with this effort is what allows NCER to feature extensive content, and to capture emerging issues and new ideas. We would like to express a hearty thanks to those who dedicated their time and expertise in helping form the program agenda.

1..... **Darcy Austin**, Delta Stewardship Council, Sacramento, CA

3 ..... **John Tull**, Great Basin Landscape Conservation Cooperative/US FWS, Reno, NV

4 ..... **Shimrit Perkol-Finkel**, ECOncrete Tech Ltd, Tel Aviv, Israel

5 ..... **Todd Erickson**, University of Western Australia, Crawley, Australia

7, 13..... **John Nyman**, Louisiana State University, Baton Rouge, LA

8 ..... **Todd Caplan**, GeoSystems Analysis, Inc. Albuquerque, NM

9 ..... **Genevieve Johnson**, Desert Landscape Conservation Cooperative/US BOR, Boulder City, NV

11..... **Craig Fleming**, USACE, Yankton, SD

12 ..... **Jason Drake** and **Paul Medley**, USDA Forest Service, Tallahassee, FL

14 ..... **Rebecca Allee**, National Oceanic and Atmospheric Administration, Stennis Space Center, MS

15 ..... **Cary Ehrman**, Ramboll Environ, Dublin, OH

16 ..... **John Stille**, Toronto and Region Conservation, Toronto, Canada

17..... **Chris Warn**, Environmental Science Associates (ESA), Tampa, FL

18 ..... **Stuart Lowrie**, Long Island TNC, East Hampton, NY

19 ..... **Judith Schofield**, CSRA, Alexandria, VA

20..... **Heida Diefenderfer** and **Gary E. Johnson**, Pacific Northwest National Laboratory, Sequim, WA

21 ..... **Joe Baustian**, The Nature Conservancy, Baton Rouge, LA

25 ..... **Craig Palmer**, CSRA, Alexandria, VA

26 ..... **David Hanson**, HansonRM, Blaine, WA and **Alexis Baldera**, Ocean Conservancy, Austin, TX

27..... **Daniel Staley**, Arbor Drone, LLC, Aurora, CO

29 ..... **Matthew Harwell** and **Craig Beatty**, Gulf Ecology Division, Gulf Breeze, FL

31 ..... **Peter Skidmore**, Walton Family Foundation, Denver, CO

32 ..... **Brad Inman**, New Orleans District, US Army Corps of Engineers, New Orleans, LA

34..... **Michael Donahue**, AECOM, Traverse City, MI

36 ..... **Matthew Grabau**, Desert Landscape Conservation Cooperative/US FWS, Tucson, AZ

37 ..... **Justin Ehrenwerth**, the Water Institute, Baton Rouge, LA

38 ..... **Craig Goodwin**, USDA Natural Resources Conservation Service, Washington, DC

39 ..... **Bruce Vogt**, NOAA Chesapeake Bay Office, Annapolis, MD

40..... **Andrew LoSchiavo**, U.S. Army Corps of Engineers, Jacksonville, FL

41 ..... **Ryan Clark**, The Water Institute, Baton Rouge, LA

42, 47..... **Lynn Wingard**, USGS, Reston, VA and **Michael Savarese**, Florida Gulf Coast University, Fort Myers, FL

44..... **Elizabeth Murray**, USACE, San Francisco, CA

45..... **Lisa Wainger**, University of MD Center for Environmental Science, Solomons, MD

48..... **Kirsten Lackstrom**, Carolinas Integrated Sciences & Assessments (CISA), Columbia, SC

50..... **Ehab Meselhe**, The Water Institute of the Gulf, Baton Rouge, LA

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Abstract Compilation

Abstracts are sorted alphabetical by presenting author's last name. Presenting author names appear in **bold**.

MONITORING URBAN FOREST STRUCTURE AND FUNCTION AFTER HURRICANE AND ASSESSING ECOSYSTEM SERVICES FOR LOUISIANA CITIES

Kamran Abdollahi[1]*, Zhu Hua Ning*[1]*, Puskar Khanal*[2] *and Thomas Legiandenyi*[3]

[1]Southern University Agricultural Research and Extension Center, Baton Rouge, LA, USA
[2]Clemson University, Clemson, SC, USA
[3]Mississippii State University, Okibbeha County, MS, USA

Hurricane Gustav was the second most destructive hurricane of the 2008 Atlantic hurricane season. In Baton Rouge, Louisiana the wind damage from Gustav was the worst of any storm in memory. Thousands of urban forest trees were uprooted and snapped in half by Gustav's fierce winds. The damage was severe enough to effectively shut the city down for over a week. A post hurricane analysis of the Baton Rouge's urban forest ecosystem was conducted using i-Tree Eco software application and based on the Urban Forest Effects Model (UFORE). The analysis revealed that this area has about 1,036,175 trees with tree canopies that cover 44.6 % percent of the city. The analysis reveals a significant tree canopy reduction. The city has more than 45 tree species. The most common tree species are *Quercus virginiana* (9.5%), *Liquidambar styraciflua* (8.8%), *Pinus taeda* (7.0%), *Carya spp*. (6.5%), *Taxodium distihum* (5.9%), *Quercus nigra* (5.6%), *Quercus phellos* (5.1%), *Magnolia grandiflora* (5.1%), and *Lagerstroemia indica* (5.4%). Trees are currently store about 2 million tons of carbon per year with an associated estimated value of $ 41 million per year. In addition, these trees remove about 178,354 tons of CO_2 per year with an associated estimated value of $1.1 million per year. Baton Rouge's trees are estimated to reduce annual residential energy costs by $8.0 million annually and reduce air pollution (ozone, particulate matter, sulfur dioxide, and nitrogen dioxide) by 860 tons per year with an associated estimated value of $6.2 million per year. The structural value of the trees is estimated at $ 6.2 billion. With the increase in climate variability, increased frequency and intensity of storms, and urbanization pressure, more trees need to be planted and maintained to sustain the current level of structural values and ecological services.

PRESENTER BIO: Dr. Abdollahi is a Professor and senior project director with more than 30 years of experience in forest ecophysiology, urban forestry, and climate change assessment. He has extensive experience with biomass and bioenergy and has led more than 10 projects dedicated to urban forest and natural resources conservation.

USE OF ECOLOGICAL EXPERTISE FOR COMMUNICATING SOUND MANAGEMENT ADVICE

***Becky Allee*[1]*, Kathy Goodin*[2]*, Ruth Carmichael*[3]*, Renee Collini*[4]*, and Kelly Darnell*[5]

[1]National Oceanic and Atmospheric Administration, Stennis Space Center, MS, USA
[2]NatureServe, Arlington, VA, USA
[3]Dauphin Island Sea Lab, Dauphin Island, AL, USA
[4]Northern Gulf of Mexico Sentinel Site Cooperative, Dauphin Island, AL, USA
[5]Gulf Coast Research Laboratory, the University of Southern Mississippi, Ocean Springs, MS, USA

Ecosystem restoration research and use of ecological standards, data, and knowledge support understanding and effective stewardship of coastal systems. However, assessing ecosystems and communicating results to resource managers and the public can be challenging for the scientists who perform those assessments. Many scientists simply do not have the necessary relations with resource managers or regular contact with the public. Yet, without access, comprehension, and trust, decision-makers are unable to apply available data and knowledge. Further, stakeholder engagement is essential to the flow of information between researchers and decision-makers to help identify real management needs versus researchers playing a guessing game. Regular communication with, and inclusion of, the management community in collaborative restoration projects helps ensure projects are relevant and results are translated to application. The purpose of this panel is to open a dialogue about communicating ecosystem science to natural resource managers and other decision-makers. Panelist will discuss the inclusion of stakeholders throughout project conception and implementation and the transition of ecological knowledge to coastal managers to help identify suitable restoration sites and improve coastal resiliency. Additionally, the panel will discuss how data and new science can be integrated into daily decision-making processes at the local and regional levels.

PANELIST BIOS

Dr. Becky Allee is a fisheries biologist and senior scientist for the National Oceanic and Atmospheric Administration's Office for Coastal Management-Gulf Region with more than 20 years of experience in ecosystem assessment and characterization.

Ms. Kathy Goodin is the Chief of Staff of the Conservation Science Division and Director of the Marine Program at NatureServe. She coordinates the development of national and international standards for terrestrial and marine ecological habitat classification, characterization, condition assessment, data collection, and analysis. She also works with stakeholders to develop solutions for data aggregation, management, and delivery.

Dr. Ruth Carmichael is a Senior Marine Scientist at the Dauphin Island Sea Lab and an Associate Professor of Marine Sciences at the University of South Alabama. She has been conducting applied and basic research for more than 2 decades, specializing in scientific communication and routinely gives workshops to professional groups on scientific communication.

Ms. Renee Collini is a Coordinator for the Northern Gulf of Mexico Sentinel Site Cooperative and Program Manager of the Alabama Real-time Coastal Ocean Observing System. She has expertise in stakeholder engagement, science communication, project management and coordination, and meeting development and facilitation.

Dr. Kelly Darnell is an Assistant Research Professor at The University of Southern Mississippi and the Deputy Director of the Mississippi Based RESTORE Act Center of Excellence. She uses a combination of laboratory and field experiments and surveys to address hypothesis-driven questions related to coastal and benthic processes, and her research is often framed in a management, conservation or restoration context.

SOILS AND MARSH CREEK EVOLUTION AT A MARSH AUGMENTATION PROJECT IN SEAL BEACH, CA

Richard F. Ambrose
University of California, Los Angeles, CA, USA

Coastal wetlands are vulnerable to the effects of climate change, particularly sea level rise (SLR). Although salt marshes can respond to SLR by adjusting their elevations, their capacity to accommodate SLR is limited. Current projections indicate that most salt marshes in southern California will not be able to adjust to the SLR predicted over the next 80 years, with much of the salt marsh habitat predicted to convert to mudflat or subtidal habitat by 2110. Management actions for preserving salt marsh habitats are limited, but one promising technique is thin layer sediment augmentation, where sediment is added to the salt marsh plain to increase its elevation.

A pilot experiment using thin layer sediment augmentation over 3 ha of salt marsh has been implemented in the Seal Beach National Wildlife Refuge (SBNWR). SBNWR is a particularly appropriate test location because oil and gas extraction at this location has resulted in 28 cm of subsidence, effectively replicating the relative SLR expected by mid-century. This increase in relative sea level has negatively impacted cordgrass (*Spartina foliosa*) populations, and consequently populations of the endangered light-footed Ridgway's rail (*Rallus obsoletus levipes*). In early 2016, sediments dredged from a nearby harbor were spread over the salt marsh using a spray nozzle.

The target augmented sediment depth of 25 cm was generally achieved, although there were substantial differences in added sediment depth in different regions of the project area. There was some changes in sediment depth over time, with the sediment depth of northeast region of the site generally getting thinner by as much as 6 cm while the sediment depths in the southwest portion of the site getting thicker by as much as 6 cm. Added sediment was coarser than expected. The proportion of sand in sediment samples increased slightly over time, but overall there was little change in sediment characteristics after sediment placement. Some tidal creeks that were buried by the added sediments started to re-form one year after sediment augmentation, but drainage of the marsh plain seemed to be inhibited by sediment control structures (e.g., sand bags) installed during sediment addition to reduce the amount of suspended sediments leaving the site, and as a result creek formation appears to have been inhibited. Many control structures were partially removed in February 2018, two years after sediment addition, and the evolution of tidal creeks is being monitored. Post-augmentation monitoring will continue for five years to document the success of this climate change adaptation technique and provide information that could be used for future applications.

PRESENTER BIO: Richard F. Ambrose is Professor in the Department of Environmental Health Sciences and the Institute of the Environment and Sustainability at UCLA. His research includes the restoration of degraded coastal habitats, especially wetlands, monitoring change in rocky intertidal habitats, and natural treatment systems for stormwater management.

FROM SHORELINE TO STATE LINE: INTEGRATING MARINE RESOURCE RESTORATION, ENHANCEMENT AND PROTECTION INTO LOCAL GOVERNMENT PLANNING PROCESSES

Thomas T. Ankersen[1]*, Michael Allen*[2]*, Emma Pistole*[2]*, Alexandra Barshel*[3]*, Samantha Sanders*[3]*, Brittany Scharf*[4] *and Keith Kolasa*[5]

[1]University of Florida College of Law, Gainesville, FL, USA
[2]University of Florida & Nature Coast Biological Station, Gainesville, FL, USA
[3]University of Florida College of Law Conservation Clinic, Gainesville, FL, USA
[4]Florida Sea Grant, University of Florida IFAS Extension, and Hernando County, Brooksville, FL., USA
[5]Hernando County, Brooksville, FL, USA

In Florida and many other states, local government comprehensive planning serves as the foundation for county and municipal efforts to address long term growth and development. Florida law requires coastal local governments to include a coastal management element in their comprehensive plans. These elements typically address coastal and near shore concerns but do not venture far from the water's edge, even though county boundaries extend 9 nautical miles to the state line on the Gulf, and 3 miles on the Atlantic. Attorneys, scientists and students from the University of Florida College of Law's Conservation Clinic and UF's Nature Coast Biological Station partnered with Hernando County on Florida's Gulf Coast to amend the County's comprehensive plan to specifically and comprehensively address its marine resources – from shoreline to state line. The amendment, adopted in March 2018 by the County Commission, provides a blueprint for the County's efforts to restore, enhance and protect its marine waters, and will guide the implementation of projects funded by the Deep-Water Horizon oil spill settlement and Restore Act. The amendment creates a "Strategic-Marine Area Plan," with six explicit goals including shoreline stabilization, oyster reef restoration, artificial reefs, seagrass and hardbottom protection, recreational and commercial fisheries, navigation and water access. Each goal is supported by objectives and strategies. A unique feature of the Plan is the explicit integration of science and policy, through a science plan, and project implementation flow chart for each goal. The project team included faculty and students from the UF College of Law, the Nature Coast Biological Station and Florida Sea Grant. Stakeholder engagement occurred under the auspices of the Hernando County Port Authority, an advisory body to the County Commission. The Authority reports that the Plan has already assisted the County in the acquisition of restoration permits, as well as funding priorities associated with Restore Act processes. The Hernando County Strategic Marine Area Plan can serve as a model for other local governments seeking to extend their long-term planning processes into marine waters where they have jurisdiction to do so. On Florida's Gulf Coast, the advent of a dedicated source of funding for an extended time period under the Restore Act, which counties receive directly, argues for long range planning to ensure the funds are well-spent.

PRESENTER BIO: Thomas T. Ankersen is a legal skills professor and Director of the Conservation Clinic at the University of Florida College of Law. He also serves as Florida Sea Grant's statewide legal specialist. He has extensive experience designing policy frameworks for resource protection and restoration, while engaging law and graduate students in the process through experiential learning.

NEW YORK CITY OVERCOMES ECOSYSTEM RESTORATION CHALLENGES IN CURRENT ECONOMIC LANDSCAPE BY CONSTRUCTING ITS FIRST MITIGATION BANK AS A MEANS TO RESTORE DEGRADED URBAN WETLANDS

*Peg McBrien[1], **Sachin Apte[1]**, Matthew Holthaus[1] and Jennifer Cass[2]*
[1]Louis Berger Group, Morristown, NJ, USA
[2]New York City Economic Development Corporation, NY, USA

Background/Objectives. New York City, in collaboration with State and Federal agencies, is proving mitigation banking is possible in America's most urbanized physical environment. To pilot this effort, the City is in the process of establishing and constructing a tidal wetland mitigation bank on Staten Island adjacent to Saw Mill Creek. The City expects that the Saw Mill Creek Pilot Wetland Mitigation Bank, the first ever established in New York City, will facilitate larger wetland restoration projects in the City's ecologically sensitive coastal areas while also directing more public and private funds for restoration of damaged ecosystems. In the New York Harbor estuary, regulatory agencies are now requiring that proposed ecological restoration projects improve the sediment ecology rather than just the plant ecology. Due to the urban nature of the estuary, the cost of improving these sites to meet ecological sediment criteria is significant.

The Site is located in an area that contains a mixture of industrially developed land adjacent to salt marsh and coastal forest. Extensive dumping of trash/debris and fill occurred throughout the Site for decades. Soil and sediment samples indicated that prior to restoration, the Site posed an ecological risk to wildlife due to the presence of metals, pesticides, PCBs, and organic compounds. Post construction sampling is being conducted to document the improvement of sediment ecology.

Approach/Activities. Mitigation banking is the restoration, creation, enhancement and/or preservation of a wetland, stream, or habitat area to offset permitted impacts to similar nearby regulated ecosystems. Multiple federal and state permits and approvals were obtained to establish the mitigation bank in the City. In accordance with these requirements, ecological, topographical, hydrologic and other baseline studies were conducted to support the restoration design plans and specifications. Restoration actions have removed contaminated soils and debris including over 14 truckloads of tires and 13 truckloads of other debris from 54 acres of the Site to create tidal channels and marshland that are being planted with native wetland vegetation. The pilot project is improving water and sediment quality, plant diversity, and wildlife species abundance/diversity in the Staten Island Borough of New York City.

Results/Lessons Learned. After Hurricane Sandy, the City faced billions in infrastructure damage and a challenging task on how to rebuild with greater resiliency. Wetlands will play an important part in a larger recovery strategy. The Saw Mill Creek pilot project is part of a strategy to protect the property of residents and businesses by enhancing and protecting the city's coastal resources and restoring damaged wetlands. Lessons learned at the pilot wetland bank will be applied to other degraded urban habitats.

KATY PRAIRIE STREAM RESTORATION: AN ILLUSTRATIVE USE OF STREAM RESTORATION TO CREATE RESILIENT ECOSYSTEMS

J. George Athanasakes
Stantec Consulting Services Inc., Louisville, KY, USA

The impact of anthropogenic changes including agricultural practices and urbanization on our stream systems is well documented. These impacts include encroachment into the riparian corridor, channel alteration, construction of infrastructure, channelization, and straightening of stream channels. Collectively these modifications to hydrologic and hydraulic regimes have created highly disturbed stream systems out of balance with the water and sediment supply delivered by the watershed. Extreme flood events further exacerbate the disturbance resulting in head-cuts, bank and channel erosion, damage to infrastructure, and increased flooding. The practice of stream restoration, when performed through the proper application of fluvial geomorphologic principles, can reverse the impact of past agricultural practices and urbanization, creating resilient stream systems that are stable through a variety of flow events including extreme flooding.

The geomorphic approach to stream restoration was recently applied on a large scale in Katy, Texas immediately northwest of Houston on land managed by the Katy Prairie Conservancy as part of a stream mitigation bank. This project included reconstruction of over 18 miles of stream restoration along eight reaches of stream. Goals of this project were to correct overall stream function by addressing the fundamental processes of channel incision and bank erosion driving instability. Secondary effects included reestablishment of wetlands along the riparian corridor to improve water quality, enhance flood attenuation and expand near-stream habitat; re-introduction of wood into the channel to increase in-stream habitat and support the creation of perennial pools in an intermittent stream; and systemic improvements to the landscape to provide compensatory mitigation credits. To inform the design process, a geomorphic assessment was completed at the site to assess the processes driving stream impairments.

Natural channel design techniques were utilized to restore the streams at Katy Prairie. The design included consultation of reference reach parameters coupled with sediment transport analyses to design a stable, self-maintaining stream system. The design for the project focused on restoring floodplain access by reconnecting the stream to the floodplain, re-distributing energy throughout the cross section, and providing grade control to prevent future channel incision. The design also focused on re-establishing habitat within the channel and throughout the adjacent floodplain by re-creating kettle wetland features.

The resiliency of this site was recently tested during Hurricane Harvey. It is estimated that the hurricane produced an approximate 500-year flow event near the site. Results of monitoring indicate that the site withstood the event with minimal evidence of erosion or other indicators of instability. This talk will discuss the design of stream restoration to promote resilient ecosystems and will present the design approach and results of monitoring for the Katy Prairie project.

PRESENTER BIO: George has a broad range of experience in Ecological Restoration including stream and wetland restoration, watershed master planning and dam removal. George serves as the Ecosystem Restoration Services Leader for Stantec with responsibilities throughout the US. George holds Bachelor's of Science and Master's of Engineering Degrees from the University of Louisville.

DEVELOPING AN ADAPTIVE MANAGEMENT PROGRAM FOR CALIFORNIA ECORESTORE

Lauren Hastings, Karen Kayfetz, Maggie Christman, Eva Bush, and ***Darcy Austin***
Delta Stewardship Council, Sacramento, CA, USA

This is the second talk of the session entitled, California EcoRestore: Collaborative Science for Restoring 30,000 Acres in the Sacramento-San Joaquin Delta and Suisun Marsh (California Delta). The California EcoRestore initiative calls for the restoration and enhancement of 30,000 acres of habitat, primarily floodplain and tidal wetlands, in the Delta, Suisun Marsh, and Yolo Bypass regions of the California Delta by 2020. As part of this initiative, the Interagency Adaptive Management Integration Team (IAMIT), comprising agency and stakeholder scientists and technical management staff, developed a white paper describing existing adaptive management resources, how those resources link together, and what resources are currently lacking. The white paper concludes with a series of recommendations for developing a complete, integrated, and financially supported adaptive management program for EcoRestore. The desired outcome of implementing these recommendations is a program that 1) supports individual restoration projects, 2) considers local and system-scale effects, 3) sets a stage to evaluate impacts of restoration actions at multiple time and spatial scales, and 4) has an organizational structure wherein acquired knowledge is effectively communicated and used for management. The EcoRestore Adaptive Management Program will provide a strong foundation for robust, long-term adaptive management for habitat restoration in the region.

OXBOW RESTORATION: RE-ESTABLISHMENT OF HABITAT AND RECREATION ON THE ROUGE RIVER

Alice Bailey *and John O'Meara*
Environmental Consulting & Technology, Inc., Ann Arbor, MI, USA

The Rouge River Watershed occupies 467 square miles and runs through the most densely populated and urbanized land in the State of Michigan. More than one million people live in the watershed that encompasses 48 communities and three counties. As a result, over the past century, the Rouge River has suffered from declining water quality and increasing flood conditions. To address this flooding, the U.S. Army Corps of Engineers straightened approximately six miles of the Rouge River in the 1970s, constructing a four-mile concrete channel. With this, destruction of much of the aquatic habitat precluded the passage of most fish from the Detroit River to the upper reaches of the Rouge River.

To provide the much-needed habitat, resting locations for migratory fish, recreational opportunities and restored wetland areas, restoration of an historic oxbow adjacent to the concrete channel was identified. The Henry Ford, a national historic landmark, provided the setting for the 2,200-foot channel riverine wetland system, ten acres of restored upland woodlands and meadows and associated trail system, programmatic amenities and educational opportunities.

Understanding the four elements of restoration: economic, engineering, environmental sciences, and social (public involvement), the Oxbow Restoration project was successfully implemented. The main objective of the project was to restore valuable fish and wildlife habitat and functioning riverine wetlands that were lost due to channelization of the river. Secondary objectives included improvement of water quality, increased floodplain storage, enhanced educational/interpretative opportunities, and improved aesthetics.

This presentation will tell the story of the Oxbow Restoration project, which was completed in three phases, spanning nearly two decades and made possible by the collaboration and dedication of a variety of champions and project stakeholders. The project is an excellent example of restoration in an urban watershed that not only restores habitat, but provides valuable recreational, programmatic, and educational opportunities. These various project attributes will be discussed, with explanation of the project from conception through post implementation with focus on the elements that contributed to the project's success.

PRESENTER BIO: Alice Bailey, P.E.: Ms. Bailey is a staff engineer with 17 years of experience serving in technical leadership roles in habitat restoration, dam removal, streambank stabilization, and stream restoration projects. Ms. Bailey has experience in project planning, site evaluation, designing, permitting, community outreach, stakeholder participation facilitation, construction cost estimating, construction document preparation, as well as construction administration and inspection of a variety of projects in southeast Michigan. Serving as lead designer, Ms. Bailey was instrumental in the successful completion of habitat restoration projects in multiple watersheds within the Great Lakes region. Ms. Bailey has a bachelor's and a master's degree in civil and environmental engineering from the University of Michigan. She is a registered professional engineer in Michigan and Florida.

ADAPTING A MODEL OF SEDIMENT CONSOLIDATION FOR USE IN MARSH THIN LAYER PROJECTS

***Susan Bailey**, Zachary Tyler, and Tim Welp*
US Army Engineer Research & Development Center, Vicksburg, MS, USA

In designing constructed wetland or marsh nourishment projects, elevation is critical to marsh function. However after hydraulically-placed dredged material is deposited as a slurry, it consolidates over time to a lower elevation. Depending on site-specific conditions, the substrate may also consolidate to a significant degree. Placing material to a proper initial elevation in order to achieve a desirable elevation for marsh function over the long term is essential to project success.

Laboratory testing and modeling tools are available to predict consolidation and can be useful for designing thin layer placement projects. These tools were originally designed for dredged material placement in confined disposal facilities (CDFs), but can be adapted for placement on a marsh surface. The Primary Consolidation, Secondary Compression and Desiccation of Dredged Fill (PSDDF) model has been used to evaluate the elevation change over time for dredged material placed on a marsh, but differences between marsh processes and CDFs must be considered.

Laboratory and field work results that evaluate the ability of the PSDDF model to predict consolidation of dredged material following thin layer placement on a marsh surface will be presented, in addition to a description of ongoing research and development activities that investigate the role of vegetation and tide or seasonal water table fluctuations on the wetland consolidation processes.

The PSDDF model was applied to a thin layer placement project at Avalon, NJ. Field investigation of the consolidation process at Avalon includes time-series Lidar scanning, water table well monitoring, and sediment coring. Laboratory analysis of the core samples examined the geotechnical properties of the placed dredged material as well as the underlying marsh surface over time.

Preliminary results of laboratory, field, and modeling investigation indicate the importance of characterizing the existing marsh platform and proposed fill material. With the proper assumptions, PSDDF can be reasonably applied to estimate consolidation for application to marsh nourishment.

PRESENTER BIO: Ms. Bailey is a research civil engineer with more than 15 years of experience working with dredged material and sediment management. She has experience with modeling dredged material behavior, including consolidation of dredged material placed for wetland creation or marsh nourishment.

BUILDING CONSENSUS, BUILDING A SHORELINE: A STAKEHOLDER-DRIVEN PROCESS TO ADDRESS EROSION ALONG CEDAR KEY'S DAUGHTRY BAYOU

Savanna C. Barry[1], *Mark W. Clark*[2], *Wendy-Lin Bartels*[2], *Jonathan Dain*[2]
[1]University of Florida, Cedar Key, FL, USA
[2]University of Florida, Gainesville, FL, USA

The coastal areas next to G Street and Airport Rd. in Cedar Key, FL have been steadily eroding since the 1970s. Now, high tides often reach the sidewalk and further erosion threatens the integrity of the roads and utility pipes buried underneath. Recreational use of these areas will be more difficult and less enjoyable as erosion progresses. There are many options available to address coastal erosion, each with benefits and drawbacks. Selecting and planning erosion control projects for these roads is very complex given the diverse recreational uses, needs of coastal homeowners, and responsibility of local governments to protect and provide services. Therefore, we teamed up to devise a stakeholder-driven process to help the Cedar Key community address urgent erosion concerns. This process aimed to assist the community in making an informed decision in a participatory framework.

The overall objective for this work was to build consensus around a project design for each roadside area. In a series of four workshops and several individual meetings, we presented a range of erosion control options to stakeholders, crafted a set of design options using community input, refined the preferred designs with further input, and obtained the level of buy-in necessary to permit and implement the projects. During this stakeholder process, we gained new insights into the perception of and barriers to living shoreline implementation on Florida's Gulf of Mexico coast. We also employed several stakeholder engagement tools that were instrumental for integrating the social, environmental, and economic considerations for designing erosion control projects such as living shorelines. This project demonstrates one approach that might be applied in other coastal areas to obtain synergistic benefits of living shoreline implementation across multiple properties. We believe the need for projects that incorporate multiple stakeholders and span more than one property will increase as coastal erosion becomes a more urgent concern.

PRESENTER BIO: Dr. Barry is a Regional Specialized Extension Agent with Florida Sea Grant based at the UF IFAS Nature Coast Biological Station in Cedar Key, Florida. Her background is in seagrass ecological research and she currently focuses on extension and research projects dealing with Florida's coastal habitats, including mangroves, seagrasses, and marshes.

IMPLEMENTATION OF LARGE-SCALE RIVER DIVERSIONS: COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA'S PERSPECTIVE.

*Brad L. Inman[1], Jeffrey Varisco[2], Mel Landry [3], **Brad Barth**[4], Eddy Carter[5]*

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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 implement two cornerstone projects of the 2017 Coastal Master Plan - the Mid-Barataria and Mid-Breton Sediment Diversion projects. This presentation will discuss the challenges of the project implementation from the State of Louisiana's perspective.

Not only will construction of Large-Scale Sediment Diversions be a major undertaking by the State of Louisiana, but also the pre-construction challenges will not be like any project the State of Louisiana has implemented. The Large-Scale Sediment Diversion Program currently estimates the implementation budget on the order of $2.3 Billion. This presentation will focus in on the challenges of the pre-construction services including the regulatory/permitting process including construction funding through the Louisiana Trustee Implementation, land acquisition, engineering and design, and Construction Manager at Risk (CMAR).

The regulatory/permitting process to acquire the Section 10/404 permits and the Section 408 permission nests the EIS into an 'all for one EIS' approach. This EIS approach accommodates multiple federal decisions for different agencies with different charges and may allow a decision to utilize National Resource Damage Assessment (NRDA) funds from the BP Oil Spill to fund the construction of the Mid-Barataria Sediment Diversion.

Pre-construction services, estimated in excess of $200 Million, will require EIS evaluation/support, land acquisition, operations and adaptive management, scheduling and cost estimating, and final engineering and design (E&D). The E&D effort requires complex hydrology and hydraulic (H&H) analyses of restoring the Mississippi River to natural processes while engineering controls maintain flood risk reduction to the community. This presentation will highlight the timing challenges to the pre-construction services to implement such complex project schedules.

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 projects. A CMAR of this complexity and magnitude will serve as another challenge to the State of Louisiana as it will be the first under the State of Louisiana's CMAR revised statute.

PRESENTER BIO (50-word maximum): With more than 20 years of experience in Engineering and Project Management, Mr. Barth, a registered professional engineer, holds the position of Program Manager for the Mid-Basin Sediment Diversion Program for CPRA. Mr. Barth received a M.S. in Civil Engineering (Geotechnical) from the University of Cincinnati in 1997.

BEST PRACTICES USING REEF BALLS FOR LIVING SHORELINES

Jame W. McFarlane[1], ***Larry Beggs***[2]
[1]University of Florida Retired, Gainesville, FL, USA
[2]Reef Ball Foundation, Sarasota, FL USA

By surveying comparative living shoreline applications since 1996, this research will identify best practices for living shorelines. Shoreline comparisons will include concrete block, wood, WADS, Castle Blocks oyster shell bags, granite riprap and other materials and designs use on the project sites. Site surveys will be conducted from Connecticut around south Florida, the five Gulf States and California.

Photos and analysis of project data will provide insight into best practices for successful living shoreline projects. Factors such as water depth, anticipated wave energy, and the type of organisms will dictate the materials used. The Reef Balls have shown better oyster recruitment than other materials. Placing Reef Balls in multiple rows or using taller Reef Balls will increase the wave attenuation. Placement of Reef Balls can provide a large surface area, and the structure of the Reef Ball creates small eddy currents ideal for spat settlement, and for filter feeders. Aesthetics are important particularly when it is in a homeowner's backyard. When following best practices, you will increase wave attenuation, providing for better growth of marsh grasses, and submerged aquatic vegetation. Reef Balls were shown to provide excellent relief for oyster growth as well as essential fish habitat. Placed properly Reef Ball, provide a great asset to a living shoreline and best of all they stay were there put.

PRESENTER BIO: Larry Beggs is the Vice President of the Reef Ball Foundation, As President of Reef Innovations he has trained groups in construction and deployment of Reef Ball sites around the world. Since 1990's he has been at more Reef Ball sites than anyone else.

RESILIENCY IN DESIGN: THE RBD MEADOWLANDS PROJECT

Christopher Benosky
AECOM, New York, NY, USA

To address the region's flood and resiliency vulnerabilities the United States Department of Housing and Urban Development (HUD) launched in 2013 a Rebuild by Design (RBD) competition inviting communities to craft pioneering resiliency solutions. HUD awarded $150 million to the State of New Jersey for the "RBD Meadowlands Flood Reduction Project" located in the municipalities of Carlstadt, Little Ferry, South Hackensack, Moonachie and Teterboro.

The RBD Meadowlands Project is a real-time iterative design process balancing social, environmental, and community benefits while realizing flood risk reduction and increased resiliency for communities located within 100-year floodplains.

This approach requires transdisciplinary collaboration between engineers, urban planners, landscape architects, ecologists, environmental scientists, and economists to develop innovative, replicable and scalable ideas. These ideas include potentially utilizing Low Impact Development (LID) measures to achieve a reduction in stormwater runoff, improved interior drainage with enhanced conveyance and storage to mitigate local flooding, retrofits and reinforcements of existing infrastructure, wetland/ecosystem restoration, as well as tidal surge/flood protection alignments reinforcement.

The goal is to design a flood control project that can be constructed using the awarded funding that incorporates multi-benefit combinations of green and grey infrastructure, improved public access, and defensible space during storm events.

PRESENTER BIO: Mr. Benosky is a Vice President of AECOM, he is also the firms NY Metro Water Resource Market Sector Lead, North America Stormwater Resilience Lead, and one of AECOM's global Technical Practice Leaders for the firms Coastal and Ecosystem Restoration Services.

Mr. Benosky has over 25 years of experience in flood protection and risk management, coastal engineering, ecosystem restoration design, dam and levee engineering, hydrologic, hydraulic, and hydrodynamic modeling and analyses, stormwater management system design, geotechnical engineering, construction cost estimation, and construction management.

Mr. Benosky holds a Bachelor of Science and a Master of Science degree in Civil Engineer from the Ohio State University and he is a Licensed Professional Engineer in New Jersey and New York. He is also a nationally Certified Floodplain Manager and the AECOM Program Manager for the Rebuild by Design Meadowlands and Hudson River projects.

DEVELOPING AND LEVERAGING A PUBLIC-PRIVATE PARTNERSHIP FOR A LARGE-SCALE STREAM AND WETLAND RESTORATION ON FEDERAL PROPERTY

Brett Berkley[1]*, Patrick Phillips*[1] *and Kirk Mantay*[2]
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GreenVest, LLC, developed a Public-Private Partnership (P3) with Federal, State, and County agencies and Non-Profit organizations and leveraged the partnerships' resources to complete the restoration of a headwater stream and wetland complex on a 25-acre former Spray Irrigation Field (SIF) at the federally-owned Beltsville Agricultural Research Center (BARC) located in Beltsville, Prince George's County, Maryland. The P3 partners contributed land, funding, materials, and ecological restoration expertise to create a large-scale stream and wetland restoration project in the highly urbanized Anacostia River watershed.

GreenVest, LLC (GV) initially partnered with GreenTrust Alliance, Inc. (GTA) and the U.S. Department of Agriculture, Agricultural Research Service (ARS) to pursue grant funding from the Chesapeake Bay Trust and Maryland Department of Environment (CBT-MDE) through their Nontidal Wetland Grant Program. The proposed restoration of over 13 acres of the BARC SIF site was awarded the single largest grant in the history of the program and the P3 became official. The restoration project successfully deployed grant funding collected from in lieu fees in the Anacostia Watershed and helped ARS meet federal requirements under Executive Order (EO) 13508 at no cost to USDA.

It was quickly recognized that leveraging the partnership would create opportunities to expand the restoration project to include the balance of the SIF site. A large-scale restoration project in an urban setting would create greater ecological uplift, wildlife habitat, and water quality benefits than individual isolated projects. The partnership expanded to include Prince George's County Department of Public Works and Transportation (PG DPWT) and the Maryland State Highway Administration (SHA). Both entities anticipated unavoidable stream and wetland impacts associated with road safety improvement projects proximate to the BARC SIF site. The partnership facilitated the restoration of an additional 12 acres at the BARC SIF site to provide advanced stream and wetland mitigation to fulfill the PG DPWT and SHA permit requirements. This provided the partnership with greater economy of scale that resulted in more cost-effective restoration and additional progress toward ARS' EO 13508 goals.

The partnership secured a total of $4.5M in funding and constructed the 25-acre restoration in two phases. The first phase included the nontidal wetland grant program restoration project and the PG DPWT advanced stream and wetland restoration project and was constructed in 2017. The second phase included the construction of the advanced stream and wetland mitigation project for the MD SHA and was constructed in 2018. In total, the partnership has successfully created or restored 6,573 linear feet of stream and created or enhanced 19.2 acres of wetland.

PRESENTER BIO: Brett Berkley is the Senior Vice President at GreenVest, LLC where he is responsible for the identification, design, approval, and implementation of ecological asset development projects. Mr. Berkley has over 20 years' experience in ecosystem restoration design and implementation, threatened and endangered species ecology, and sustainable land use and redevelopment.

EVALUATION OF A BENEFICIAL USE BANK TO PROMOTE THE BENEFICIAL USE OF FEDERAL DREDGED MATERIAL

Robert Bendick[1], ***Joseph Berlin***[2]
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The Nature Conservancy (TNC) managed a study to test the feasibility of establishing a "beneficial use bank" to promote the beneficial use of dredged material from federal navigation projects. Specifically, the TNC hypothesized that "The cost for the restoration project of the beneficial use of dredged materials will be sufficiently lower than the cost of otherwise obtaining fill material to allow repayment of the loan at 2-3% interest while still accomplishing the restoration at a net savings to the restoration entity." In brief, this hypothesis states that such an arrangement would result in a net savings to the restoration entity while also providing a reasonable return on investment to another entity loaning the funds required for the restoration activity. The arrangement would also increase the beneficial use of federal dredged material from maintaining navigation channels, which is frequently disposed of in the least cost environmentally acceptable method (Federal Standard).

Hypothesis testing entailed three steps: the identification of three restoration projects of varying geography, scale, and completion where the beneficial use of dredged material may be feasible; a comparison of the cost of restoration (i.e., purchasing and transporting dredged material) with the cost of beneficial use of material from nearby federal dredging projects; and a determination as to whether the cost differential is sufficient to allow repayment of a loan from the beneficial use bank while reducing the net cost of the transaction to the restoration entity. Case studies of projects in Texas (Pierce Marsh), Louisiana (Hopper Dredge Disposal Area), and New York (Jamaica Bay) were selected.

The analysis demonstrated that the beneficial use of federal dredged material provides an economic benefit to the non-federal sponsor managing the environmental restoration project, as well as the U.S. Army Corps of Engineers. The non-federal sponsor benefits from a lower dredged material cost, and USACE benefits by not exhausting the capacity of its authorized disposal areas. The analysis of the three case studies found that that the existence of a beneficial use bank could have merit, in selected instances, in facilitating environmental restoration projects that entail the beneficial use of federal dredged material. *However, the analysis found that there are numerous other impediments to the beneficial use of federal dredged material that must first be addressed and resolved before the full potential of a beneficial use bank can be realized.* These impediments include project scheduling challenges, the suitability of the dredged material, and the ability of non-federal project sponsors to assume maintenance costs.

The Study found that the formation of a beneficial use bank is not advisable until these impediments are resolved so that the full potential of a bank can be realized. In the interim, the beneficial use of federal dredged material can be promoted by assisting non-federal sponsors with the preparation of Project Cooperation Agreements, feasibility studies, permit applications, and environmental assessments, and advocating for state and federal policy and legislative changes.

Presenter Bio: Joseph Berlin is an economist specializing in cost-benefit analyses of environmental restoration projects, and civil works projects. He has developed models and has experience with the standard models used for estimating the benefits of water projects, and environmental restoration projects. He holds an M.A. in Economics from U.N.M.

PROMOTING RESILIENCY THROUGH SCIENCE-BASED ECO-ENGINEERING IN A COASTAL LOUISIANA PARISH

Mart J. Black
Office of Coastal Restoration & Preservation, TPCG, Houma, LA, USA

Terrebonne Parish, Louisiana strives to build a resilient coastal environment through the development and employment of a "multiple lines of defense" strategy utilizing both natural and manmade features. While only few people in the parish actually reside near the Gulf of Mexico, the areas outside the parish's hurricane protection levee (manmade) serve to protect the urban environment which is situated more inland. Nevertheless, the parish's vast oil and gas infrastructure is vulnerable without this lines of defense strategy which employs six distinct elements:

1. The parish's barrier island chain. These are natural features which have greatly diminished in size over the years do the effects of hurricanes and other storms. The parish is adamant about the need to restore all these islands (7) in the chain to a level of functionality that will effectively absorb a certain amount of storm surge energy. Restoration strategies include sand pumping, segmented rock barriers and vegetative plantings.
2. The parish's coastal marshes and lake and bay rims. Salt water intrusion coupled with significant wave fetch have worked to diminish/destroy some of these areas which play an important role in reducing storm surge. Restoration work in these areas, while critical, hasn't been entirely successful.
3. The Morganza to the Gulf (MTG) Hurricane Protection Levee is the "spine" of the parish's resiliency strategy. While this levee system is manmade, it contains a number of environmental structures, which can shut off the flow of salt water into the system and allow fresh water to flow out. This element is coupled with a series of planned / constructed flood gates and lock features on the parish's major waterways that function to cut off storm surge and saltwater intrusion while allowing the near continuous flow of marine traffic under almost all environmental conditions.
4. The parish's internal fresh marshes. Over the years, many of these areas have been adversely impacted by saltwater intrusion, but with the partial completion of MTG, hydrologic changes, and freshwater diversion projects, many of these areas are showing signs of life.
5. The parish's vast system of local flood risk reduction levees and pump stations - a manmade system that helps to keep communities dry and pump freshwater into adjacent marshes which are now beginning to respond to these freshwater inputs.
6. Structure elevations, set at least two feet above the BFE helps to ensure resiliency and the timely return of residents who are not faced with rebuilding after a storm.

All elements of the parish defensive resiliency strategy work together synergistically based on sound environmental engineering. However, no one element is sufficient to guarantee resiliency.

PRESENTER BIO: Mart Black, AICP, a planner with 40+ years of experience, is Director of Coastal Restoration & Preservation for Terrebonne Parish, Louisiana. He directs local efforts to implement collaboratively a resiliency strategy based on multiple lines of defense incorporating green engineering for marsh restoration and nourishment as well as barrier island preservation.

CALCULATING NET ECOSYSTEM SERVICE BENEFITS FOR THE LIGHTNING POINT LIVING SHORELINE, BAYOU LA BATRE, ALABAMA

Eldon C. Blancher[1]*, Meg Goecker*[1]*, Mary Kate Brown*[2]*, Judy Haner*[2] *and Jonathan Hird*[3]

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[2]The Nature Conservancy, Mobile, AL, USA
[3]Moffatt & Nichol, Baton Rouge, LA, USA

As part of the Natural Resource Damage Assessment (NRDA) process the responsible party (RP) must make the public whole by paying for the costs of lost resources. The emphasis is usually on the cost of the restoration effort necessary to offset the injury, and does not set a monetary value for the injured resource. The Deepwater Horizon (DWH) Early Restoration agreement between the Federal and State Trustees and Responsible Party (RP) presents a unique case where the two parties intensely negotiated both the ecological benefits (services restored) of restoration projects, and costs the RP was willing to pay for those benefits.

As part of the baseline and injury assessment, a team of specialists adapted the EPA ecotoxicologic fate and effects ecosystem model AQUATOX, to represent nearshore habitats of the Mississippi and Alabama coasts. With this model, primary, secondary and higher level productivity estimates can be made for specific habitats, taxa, or trophic-level guilds. AQUATOX outputs for productivity can be utilized in Habitat Equivalency Analysis and Resource Equivalency Analysis and then combined this with willingness-to-pay information from Early Restoration to arrive at ecosystem services monetary values for restoration projects.

At Lightning Point, we applied this methodology to calculate not only the supporting ecosystem services benefits but the estimated monetary value these services would generate. This information which was provided to the funding agency (National Fish and Wildlife Foundation, NFWF), is useful in demonstrating both ecological and fiscal accountability for the project. In this case, the project generated a 4:1 net benefit from an ecosystem service benefit, and at least a 3:1 economic benefit. We will demonstrate the methodology and data used to develop these metrics that can be used for numerous Gulf Coast restoration efforts funded by multiple DWH restoration programs such as NRDA, RESTORE and the NFWF-Gulf Environmental Benefit Fund.

PRESENTER BIO: Dr. Blancher is Supervisory Coastal Scientist with more than 35 years of experience planning, designing, and implementing restoration projects. He has extensive experience with coastal restoration and habitat creation, and has led more than 25 projects dedicated to restoring and creating coastal habitats.

GUIDANCE FOR THE APPLICATION OF QUALITY ASSURANCE AND QUALITY CONTROL PRINCIPLES TO ECOLOGICAL RESTORATION PROJECT MONITORING

Louis J. Blume[0], *Craig J. Palmer*[2], *Lynn Walters*[2], *Joan Cuddeback*[2], *Brick M. Fevold*[2], *Molly Middlebrook Amos*[2], *Timothy E. Lewis*[3], *Martin A. Stapanian*[4]

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Considerable resources are needed to plan and implement ecological restoration projects and, after restoration activities have been implemented, additional resources are needed to assess their effectiveness in achieving the desired outcomes. The success of each project depends on a number of factors, not the least of which is the quality of the ecological data that are used to 1) defined pre-restoration conditions, 2) ensure planned activities are implemented correctly, and 3) assess post-restoration success. Although practitioners and decision makers rely heavily on the quality of these data, ecological data collection activities are inherently difficult to control and little guidance exists on strategies for mitigating this challenge in the field or determining if the resulting data are reliable enough to support sound decisions. In June 2012, U.S. Environmental Protection Agency convened an interagency committee to address this challenge. The committee developed a complete draft of a guidance document intended to encourage and facilitate the adoption of effective quality assurance (QA) and quality control (QC) strategies in support of ecological restoration projects. After completion of a draft in June 2017, an extensive review was undertaken and important suggestions incorporated into the next version of the guidance.

This guidance is intended to assist managers of ecological restoration projects with developing and implementing effective QA/QC strategies. If designed and implemented properly, such QA/QC approaches will improve the quality of the data collected, increase the certainty of project decision making, and ultimately save time and money. This document provides guidance on how to 1) apply basic QA/QC concepts, 2) establish quality goals and objectives, 3) implement QA/QC practices to achieve quality objectives, 4) monitor the quality of data collection activities, 5) verify and validate the quality of data collected, 6) incorporate quality management principles into data analysis and reporting activities, 7) apply adaptive management approaches, and 8) implement best practices for information management.

The purpose of this presentation is to provide an overview of the guidance document and introduce some of the key concepts described in the guidance document.

PRESENTER BIO: Louis Blume is Quality Manager of the U.S. EPA's GLNPO, a position he has held since 1995. Since the advent of the GLRI in 2009, he has led the development of quality-related trainings, conferences, interagency workgroups, tools, and more to assist collaborators with incorporating quality strategies into projects and programs.

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**, 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.

CRMS IN THE CLASSROOM: ECOSYSTEM MONITORING DATA IN PHENOMENON-BASED INQUIRY

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Since 1990 the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) has developed and constructed wetlands restoration projects in coastal Louisiana to counter the highest levels of wetland loss in the nation. To assess the effectiveness of these projects and monitor ecological trends across the coast, the Coastwide Reference Monitoring System (CRMS) was established in 2003 to systematically collect soil, elevation, floristic, water, and other environmental data at 390 sites. The CRMS viewer accesses graphs, charts, site photos, and an overall report card so that users can look at monitoring data in series, as specific points in time, and in conjunction with other data groups to understand past and current environmental conditions. Because these data are available for public viewing and use, we explore the value of using CRMS data to educate students about the causes and consequences of wetland loss through a phenomenon-based approach.

CRMS data offer windows into environmental conditions over daily, seasonal, and yearly cycles across the Louisiana coast, encouraging students to recognize links between trends in data and the disappearing land in their own backyards. Students can use these data to explain observed changes in vegetative composition, land area, and wildlife communities. CRMS data can elevate classroom discussion from simple statements such as "Louisiana is losing coastal wetlands," to a series of inquiries based on the observable phenomenon that current maps of Louisiana's coast are very different from maps drawn 100 years ago. Investigative questions could include: What factors have contributed to that difference? What influenced water metrics during a specific week versus the last decade, and how does that connect to wetland loss? How does water quality and salinity impact marsh health? Environmental monitoring data such as CRMS give students the opportunity to make connections between science instruction and personal experience and observation, which fosters deeper understanding and engagement.

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.

A RESILIENCE ASSESSMENT OF THE UPPER MISSISSIPPI RIVER SYSTEM

***Kristen L. Bouska**, Jeffrey N. Houser and Nathan R. De Jager*
U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI, USA

Dynamic river-floodplain systems are able to maintain their function and structure in the face of natural disturbances. As anthropogenic pressures accumulate, the capacity of these ecosystems to absorb disturbances and maintain their structure and function may decline. There is an interest in operationalizing resilience concepts in natural resource management, but large-scale assessments of ecological resilience remain rare. In support of the Upper Mississippi River Restoration program, we are undertaking a resilience assessment of the Upper Mississippi River System (UMRS). We will provide an overview of our approach, which includes developing a shared understanding of the basic structure and function of the UMRS across a multi-agency partnership, quantifying broad-scale resilience indicators, evaluating relationships between valued resources and associated controlling variables, and conceptualizing how restoration projects might be used to influence resilience. We will highlight preliminary results from our assessment, lessons learned thus far, and how we anticipate the assessment will assist natural resource managers to better recognize the system's ability to adapt to existing and new stresses.

Presenter Bio: Dr. Bouska is an ecologist with more than 10 years of experience studying river and stream ecosystems. Her research interests include ecological resilience, river ecology, watershed science, restoration ecology and fisheries ecology.

BENEFIT INDICATOR TOOLS FOR ASSESSING RESTORATION PROJECTS BASED ON WHO BENEFITS FROM RESTORED ECOSYSTEM SERVICES

Justin Bousquin[1]*, Marisa Mazzotta*[2]*, Marc Russell*[1]*, David M. Martin*[2]*, and Leah Sharpe*[1]

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Ecological restoration projects are often performed to reestablish the flow of Ecosystem Goods and Services (EGS) that provide valuable benefits to people. However, the realized benefits people actually receive and how they value those benefits may differ even when production of EGS is the same at several restored sites. Explicitly identifying the people who would benefit from restored EGS and characterizing the relative value of the restored benefits can help managers better allocate scarce resources among potential restoration projects. Economic valuation studies can monetize the value of EGS, but such studies are often too resource intensive for the localized decisions that commonly need to be made. We present a rapid assessment approach that provides non-monetary benefit indicator metrics to compare and optimize restoring alternative sites based on their benefits to people. These benefit indicators are based on economic concepts, such as extent of market and scarcity, and reflect the factors that contribute to economic value. We designed these benefit indicators to complement existing ecosystem goods and services assessments, which focus primarily on evaluating ecosystem functions or the production of ecosystem services, to provide a more complete picture of both supply and demand for potential restored ecosystem services. We provide an overview of the tools currently available for applying benefit indicators for freshwater wetland restoration sites and give examples of communities where these tools have been applied. With adjustments, the general approach is transferable for assessing additional ecosystems and ecosystem services.

PRESENTER BIO: Justin is a social scientist at the EPA Office of Research and Development's Gulf Ecology Division.

THE ROLE OF INDEPENDENT SCIENTIFIC REVIEW IN RESTORATION EVALUATION PLANNING, IMPLEMENTATION, AND ADAPTIVE MANAGEMENT FOR THE KISSIMMEE RIVER RESTORATION PROJECT

Steve Bousquin
South Florida Water Management District, West Palm Beach, FL, USA

Planned in the 1980s and 1990s and jointly implemented starting in 1999 by the U.S. Army Corps of Engineers (USACE) and South Florida Water Management District (SFWMD), the Kissimmee River Restoration Project (KRRP) has the ambitious goal of restoration of ecological integrity to a large portion of the Kissimmee River and its floodplain between Lakes Kissimmee and Okeechobee in south Florida, USA. Ultimately, KRRP will backfill 35 km of the C-38 flood control canal, reestablish flow in 65 km of historic and reconstructed river channel, and implement historic hydroperiods to over 10,000 ha of floodplain. Federal planning documents, produced in the 1990s, included as part of this partnership a comprehensive program of ecological monitoring to collect data on biological communities and populations (vegetation, invertebrates, fishes, birds) as well as abiotic components of the ecosystem (hydrology, geomorphology, channel stability, water quality). The approach addressed emerging thought in the scientific literature in the late 20th century that the uncertainty inherent in restoration demanded scientific monitoring to provide data both for evaluation of the success of construction projects in meeting their environmental goals including establishment of cause-and-effect relationships between construction and ecosystem responses; and to allow adaptive management of the recovering ecosystem. Project planning for KRRP took place as restoration ecology was emerging as a discrete science, but before peer-reviewed papers with titles containing the term river restoration began appearing in mainstream scientific journals. Few restoration projects completed prior to the 1990s had included monitoring and evaluation protocols that could serve as examples for KRREP. Thus, much of SFWMD's work in development and implementation of the Kissimmee River Restoration Evaluation Program (KRREP) was pioneering and has served as a model for many later restoration efforts.

In development of the KRREP, SFWMD enlisted the assistance of external Science Advisory Panels (SAPs) composed of external experts working in various biological disciplines. Vital contributions were made by these panels in helping to organize and implement the set of required studies, including recommendations to develop performance measures to predict expected outcomes; use Reference (pre-degradation) and Baseline (pre-restoration) conditions to establish targets; rigorously design studies to allow statistical evaluations of changes due to restoration construction; use Before-After-Control-Impact (BACI) designs; and use monitoring to feed back into management of the recovering ecosystem.

This paper will trace development of the KRREP approach to restoration evaluation and the role of independent scientific review in development and implementation of KRREP.

PRESENTER BIO: Dr. Bousquin leads the Kissimmee River Restoration Evaluation Program (KRREP) and manages the team of scientists evaluating ecological responses to the Kissimmee River Restoration Project for the South Florida Water Management District.

MAPPING COASTAL LAND USE, ELEVATION, AND WETLAND VEGETATION WITH UAS (DRONE) IMAGERY

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Recent developments in Unmanned Aircraft Systems (UAS) are improving our ability to capture hyperspatial (1-3 cm), multispectral (4+ bands) data. This influx of big data brings, in turn, a processing challenge. How does one transform the new data into meaningful information? Here, we demonstrate the ability of UAS technology to collect hyperspatial, multispectral 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 UAS products coupled with OBIA methods could be readily applied in multiple urban and coastal settings and could support other project operations and monitoring needs. Examples include land use land cover mapping, flood mapping, disaster response, and long-term monitoring of elevation and vegetation 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.

HYDRODYNAMIC, SALINITY, AND MORPHOLOGIC MODELING OF BASIN-SIDE EFFECTS ASSOCIATED WITH PROPOSED MISSISSIPPI RIVER SEDIMENT DIVERSIONS USING THE ADAPTIVE HYDRAULICS MODEL COUPLED WITH THE SEDLIB SEDIMENT TRANSPORT LIBRARY

Gary L. Brown[1], *Jennifer N. McAlpin*[1], *Kimberly C. Pevey*[1], *Phu V. Luong*[1], *Cherie P. Price*[2], *Barbara A. Kleiss*[3]

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The Mississippi River Hydrodynamic and Delta Management Study was a joint initiative of the State of Louisiana and the New Orleans District of the Corps of Engineers. The overarching purpose of the study was to evaluate the existing Mississippi River system below the Old River Control Structure (ORCS), and to properly assess the operation of the Lower-most Mississippi River system with respect to water and sediment transport, flood control and navigation. As part of this study, multi-dimensional numerical models were developed and validated. These models were then used to address a specific proposed alteration of the system: the models were used to perform scenario analyses in order to evaluate several proposed combinations of sediment diversions, to assess their effects on both the River and the Delta.

This presentation provides a summary of the results of one of these model analyses. The Adaptive Hydraulics Model (AdH), coupled with the SEDLIB sediment transport library, was used to investigate the hydrodynamic, salinity, and morphologic effects (including effects on marsh vegetation) associated with two of the proposed sediment diversions: the Mid-Barataria and Mid-Breton Diversions. The model results will be presented, together with some discussion of results associated with a parallel modeling effort conducted by the State of Louisiana. The value of using multiple models for predictions associated with complex systems is illustrated by comparison and contrast with this parallel modeling effort. Lessons learned from the study, and how these lessons learned continue to inform the ongoing analyses of these proposed diversions, are discussed.

PRESENTER BIO: Gary L Brown is a Research Hydraulic Engineer with the Coastal and Hydraulics Laboratory, Engineer Research and Development Center, Vicksburg, MS. He has over 20 years of experience in river and estuarine modeling and model development. He has worked on coastal restoration projects in multiple estuaries throughout the USA.

FLORIDA'S LONGLEAF PINE ECOSYSTEM, EVALUATING A HALF CENTURY OF CHANGE AND ITS RECOVERY STATUS

Mark J. Brown
USDA Forest Service, Southern Research Station, Knoxville, TN, USA

Longleaf pine is an important keystone species in the unique longleaf pine-bluestem range ecosystem which covered 10.2 million acres, or 47 percent, of Florida's forests in the State's first forest survey of 1936. These surveys are conducted by the USDA Forest Service Forest Inventory and Analysis (FIA) program. FIA surveys provide important forest condition data valuable to assessment and management decisions. By the middle of the 20th century, longleaf pine ecosystems had dwindled to 7.3 million acres in Florida. A decade later, its area was reduced to 4.2 million acres, and by 1970 it was down to 1.3 million acres. The severity of decline slowed during the early part of the next half century to a low of 0.9 million acres in 1987 where the focus of efforts aimed at restoring this unique and valuable ecosystem became more urgent. From the 1987 low, Florida's longleaf pine ultimately recovered to more than 1.2 million acres by 2012 due to restoration efforts. However, by 2015 the area of longleaf pine accretion in Florida had slowed or plateaued at less than 1.2 million acres. Further indication of this "slow down" was Florida's population of longleaf pine trees at least 1-inch in diameter at breast height that rose from a low of 171 million trees in 1987 to 221 million trees by 2012, only to decrease to 214 million trees by 2015. This paper investigates reasons behind the recovery pause, and it evaluates changes since 1970 regarding catalysts of loss, effectiveness of alternative restoration methods, and degrees of progress achieved based on parameters of ownership category, regeneration method, tree size population, and biomass (volume) estimates.

PRESENTER BIO: Mark Brown is a resource analyst with more than 30 years of experience interpreting forest survey data from the southern United States. He is the principal analyst for the forest surveys of Florida and is responsible for monitoring and reporting on trends and impacts to the forests of the State.

QUANTIFYING ECOSYSTEM SERVICES OF RESTORED OYSTER REEFS

David G. Bruce
NOAA Chesapeake Bay Office, Oxford, MD, USA

Largely caused by over-exploitation and disease mortality, Chesapeake Bay oyster populations have experienced precipitous declines since the early 1900s. To remedy these losses, the multi-jurisdictional Chesapeake Bay Watershed Agreement of 2014 is supporting large-scale oyster habitat and population restoration in ten Bay tributaries. These projects are generally located in sanctuary (non-harvest) areas, and focus on augmenting reef ecosystem habitat, promoting water filtration services, and conserving mature oyster brood stocks to provide a steady source of larval oysters to colonize surrounding areas that are open to commercial harvest.

The National Oceanic and Atmospheric Administration (NOAA) has funded nine projects in the States of Maryland and Virginia that are focused on quantifying ecosystem services at oyster restoration sites. Research commenced in 2014 and data acquisition was largely completed during 2017 field season. This work is being conducted by Morgan State University, the NOAA Chesapeake Bay Office, the Smithsonian Environmental Research Center, the University of Maryland, Virginia Commonwealth University, and the Virginia Institute of Marine Sciences.

Project objectives include quantifying denitrification rates and nutrient fluxes, modeling oyster reef mediated particle removal and nutrient cycling, identifying relationships between oyster density and macrofaunal abundance, assessing trophic linkages and habitat utilization of restoration sites by finfish and crabs, and modeling fisheries production and economic return resulting from restoration activities.

Observed rates of benthic respiration rates and nitrogen cycling were significantly greater on restoration sites than on unrestored reference sites. Older restoration sites have higher nutrient cycling rates than younger ones. Denitrification rates are positively related to oyster density and appear to be associated with oysters themselves rather than with reef interstitial sediments.

Many species of vertebrates and invertebrates have been observed on oyster restoration sites and reef community composition is related to the salinity regimen at each location. Strong positive relationships between oyster density and macrofauna abundance been observed among oyster reef obligate taxa.
Daily consumption rate and diet composition have been linked to oyster reef habitat for some fish species. Several projects have determined that numerous larger mobile species utilize restored oyster reef habitats, but it has proven difficult to identify significant differences in fish abundance between restored reefs and un-restored reference sites.

PRESENTER BIO: David Bruce is an Ecologist with NOAA Fisheries/Office of Habitat Conservation. He has 17 years of experience mapping benthic habitat and providing GIS support for natural resource management and restoration planning in the mid-Atlantic region.

MISSOURI RIVER RESTORATION: SCIENCE AND DECISION STRATEGIES FOR LONG-TERM RECOVERY

Kate E. Buenau[1]*, Craig J. Fischenich*[2]*, Craig A. Fleming*[3]*, Robert B. Jacobson*[4]*, and David Marmorek*[5]

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The Missouri River Recovery Program (MRRP) is initiating a new plan to adaptively manage three federally listed species: the piping plover (*Charadrius melodus*), the interior population of the least tern (*Sternula antillarum*), and the pallid sturgeon (*Scaphirhynchus albus*). The plan was developed by the US Army Corps of Engineers (USACE) and US Fish and Wildlife Service (USFWS) to remove obstacles to long-term success. Those obstacles include management programs that are overly narrow, a lack of accountability for science-based decision-making, high uncertainty and variability, rigid governance processes, and lack of stakeholder support. The Science and Adaptive Management Plan (SAMP) emphasizes evidence-based decision making and long-term strategic planning for both management
and research.

Development of the SAMP was preceded by an Effects Analysis (EA) which looked at a wide range of potential actions and hydrographs and their effects on the species. The EA provided the evidential basis for alternatives evaluated, along with their constraints, in the Environmental Impact Statement. Actions not selected are kept in reserve in case they are later shown to be necessary. Past restoration has been hindered by a lack of accountability; the SAMP includes research pathways and associated decision trees that lead to action. The science plan is especially important for pallid sturgeon management, as high uncertainty has made identifying actions that would preclude jeopardy to the species difficult. Four levels of research lead to implementation and target-setting, providing assurance to the USFWS that the USACE has a commitment to act based on research outcomes. For plovers and terns, the uncertainties about species needs are less, but decisions are challenged by considerable natural variability, uncertainty about the necessary magnitude of actions, and their potential costs. Numerical modeling is the primary tool for synthesizing the science, quantifying targets, planning management actions, identifying research needs, and then updating targets and plans in response to evidence. Even science-based AM plans can be defeated by institutional resistance to change. Development of the SAMP included extensive engagement with agency staff to develop a governance structure and processes that would promote evidence-based decisions and accountability while still meeting the institutional requirements. Governance teams produce longer-term, programmatic strategic plans in addition to budgeting and planning projects. Stakeholder engagement and support is critical in the Missouri River basin, so the EA, EIS, and SAMP development processes have been conducted with transparency, eliciting and incorporating stakeholder input throughout. Stakeholders are invited to participate on species teams to develop and update the strategic plan, with the expectation that scientific engagement and a focus on the 3-5 year planning horizon is the most effective way to help shape the future of the MRRP.

PRESENTER BIO: Dr. Buenau is a quantitative ecologist and modeler in the Coastal Sciences Division of the Pacific Northwest National Laboratory. She has expertise in habitat restoration, population ecology, and adaptive management for large rivers and nearshore marine ecosystems.

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 assist CPRA in determining the effectiveness of the river re-introduction project and inform its operations, monitoring, and adaptive management, a Technical Advisory Group (TAG) for the project was formed. The TAG established five a priori performance measures based upon their 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.

PRESENTER BIO: Ms. Buras is a senior coastal resources scientist, botanist, and Master Naturalist with 20 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.

PLANNING AND DESIGNING RESILIENT SHORELINE STABILIZATION SOLUTIONS – CASE STUDY: THREE SISTERS SPRINGS

Michael A.G. Burton[1] *and Sky Notestein*[2]
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This presentation will examine a shoreline stabilization solution at Three Sisters Springs in Crystal River, Florida that provides a sustainable, resilient bank while addressing safety, preservation of riparian forest, threatened wildlife habitat, stakeholder and user needs, and a naturalized aesthetic appearance.

Three Sisters Springs, located approximately 80 miles north of Tampa, is part of the second largest springs group in Florida, with more than 70 spring vents scattered across the 600-acre Kings Bay area. A National Wildlife Refuge (NWR), the Crystal River/Kings Bay system is the largest winter sanctuary for manatees (*Trichechus manatus latirostris*) on the Florida Gulf Coast. Three Sisters Springs is a critical winter habitat for threatened manatees in northwest Florida, a region that supports up to 17% of the entire population of this subspecies. The high concentration of manatees that depend on these springs for survival during winter and the tourists that come to see them were undermining the shoreline bank, causing erosion, creating siltation in the spring and the spring run, resulting in tree falls and causing an unsafe condition that could force closing the springs.

Manatees were grazing on exposed tree roots and scraping their bodies against the shore, contributing to erosion. Combined with human activity and tidal fluctuation, as much as 1,200 feet of shoreline was eroding, threatening a total loss of riparian habitat and degrading springs. Trees had fallen into the spring, sediment was accumulating over the spring vents, and safety of visitors was becoming a major concern. Stakeholders sought a solution to stabilize the shoreline, but demanded a naturalized structure that would contribute to the beauty of this unique resource. Project requirements zeroed in on sustainability and protection of the shoreline; natural aesthetic appearance; and the ability to construct the solution without additional damage to the shore, existing trees, and vegetation.

Designers applied knowledge of stream restoration techniques to this challenge. Solutions required filling voids under the bank with soil to preserve shoreline trees without degrading the spring and spring run. Further, the bank had to be reconstructed at a slope of 1:1 to meet regulatory constraints; such a steep slope would not allow for the natural repose of riprap. The selected solution used earth filled Envirolok™ bags, small diameter pebble bedding and interfacing, and large limestone rock in a stacked formation. Plantings of native hammock, riparian, and wetland vegetation were added to the design to soften and naturalize the look of the stabilization project.

PRESENTER BIO: Mike Burton is an ecologist with Stantec, with experience in subtropical coastal ecosystems, including mangroves, coral reefs, and seagrasses. Recent projects he has led include coastal restoration and habitat creation projects including saltmarsh, coastal forests, mangroves, seagrass, dunes, and springs/spring runs totaling hundreds of acres and miles of shoreline.

ENVIRONMENTAL FLOWS IN TEXAS: SUCCESSES AND LESSONS LEARNED

Dave Buzan
Freese and Nichols, Austin, TX, USA

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.

FACTORS TO CONSIDER IN DEVELOPING A STRATEGIC MONITORING NETWORK OF SET-MH STATIONS IN THE NORTHEAST UNITED STATES

Donald R. Cahoon *and Glenn R. Guntenspergen*
United States Geological Survey, Patuxent Wildlife Research Center, Laurel, MD, USA

To evaluate the impacts of Hurricane Sandy on coastal wetlands of the northeast United States, we used surface elevation table – marker horizon (SET – MH) data available from individual researchers and coastal land managers across the region. This opportunistic (i.e., not strategic) network of 965 data stations allowed us to compare elevation change trends before and after this stochastic storm event in relation to the storm track, storm surge, geomorphic setting, and wetland type. After completing these analyses, we took the further step of using the regional inventory of SET – MH stations to identify limitations in the opportunistic network that can inform decisions on locations of future SET – MH stations in an effort to create a more strategic monitoring network. The goal would be to improve our understanding of coastal marsh resilience to the impact of climate change phenomenon (e.g., sea-level rise, storms) on coastal wetlands. The current location of SET – MH stations was compared with the amount and distribution of estuarine emergent marsh across the region. Two additional risk factors were included in the regional analyses: hurricane return interval and storm surge footprint. This spatial evaluation of the northeastern region assemblage of SET – MH stations revealed that the geographic coverage of stations is limited (i.e., low density of stations and low percentage of marsh patches with stations) and clumped. In addition, coverage of the two dominant marsh settings (estuarine marsh and backbarrier lagoonal marsh) in a sub-region was often skewed to one of the settings. Furthermore, the distribution of stations in wetlands with a high probability of storm strikes and surge impacts was often limited and uneven.

These analyses can be used to address priority regional concerns such as a broader geographical understanding of the vulnerability of coastal marshes to relative sea-level rise and the impacts of storms on wetland resilience. The priority concerns will have to be determined by regional policymakers and resource managers charged with maintaining critical biological resources. The strategic network can provide data that better inform the development of management and adaptation plans. Other issues to be considered during planning for a strategic distribution of stations include financial and infrastructure support. A regional monitoring network requires not only financial investment in equipment but also in personnel to install stations and collect and manage data over the long term.

PRESENTER BIO: Dr. Cahoon is a senior research ecologist with more than 30 years' experience investigating tidal wetland elevation dynamics and vulnerability to climate change effects (e.g., sea-level rise and storms). His research focuses on the processes and external drivers that control wetland elevation dynamics and wetland sustainability across a broad spectrum of coastal environmental settings.

UPPER CLEAR CREEK WETLAND MITIGATION AND FISH CONSERVATION BANK DEVELOPMENT

***Joe Callaghan**, and Shawn Mahugh*
GeoEngineer's, Inc., Tacoma, WA, USA

The Port of Tacoma Upper Clear Creek Mitigation Site is restoring lost ecological functions on over 40 acres of wetlands, stream, and floodplain habitat in the lower Puyallup River watershed. The site has historically been used by native fish and wildlife, including endangered Chinook salmon. The lower Puyallup River floodplain, which includes the lower Clear Creek basin, attracted farmers with its nutrient rich soils and flat uniform land ideal for farming. As a result, Clear Creek was diverted into a straight, excavated ditch along the western boundary of the site and isolated from its historic path with a levee. The side-cast berm levee impeded surface water connectivity between the historic floodplain and Clear Creek during low to moderate flood flows. During larger floods the creek and floodplain became connected. However, as flood receded, the side-cast berm levee would trap return flows behind the berm, disconnecting the creek from floodplain and trapping fish. Removal of past agricultural features, re-establishment of wetlands and realignment of the creek through the historic floodplain have improved and increased instream habitat, restored floodplain connectivity, rehabilitated riverine wetland processes and created off-channel habitat. The restoration actions have also reduced the amount of invasive plants, increased habitat diversity with a diverse assemblage of native trees, shrubs and emergent species, provided standing snags and downed-wood structures, and provided hummocks for additional habitat interspersion. The project was initially proposed as advance mitigation, but through a request by the Corps of Engineers it was shifted to a wetland mitigation and fish conservation bank. The use of the bank platform allows greater flexibility in the use of the site for mitigation including the sale of credits, but requires a greater level of review from the Interagency Review Team (IRT). Coordination and negotiation of the bank has been challenging, but consensus among stakeholders improves the long-term ecological viability of the site.

PRESENTER BIO: Mr. Callaghan is a habitat biologist with more than 20 years of experience planning, designing, and implementing fisheries and wetland habitat restoration and mitigation projects in the Pacific Northwest. His experience includes complicated agency negotiations for large scale projects such as mitigation banks.

ADVANCES IN ESTABLISHING SCIENCE-BASED INFLOW AND OUTFLOW GOALS IN THE SACRAMENTO-SAN JOAQUIN RIVER DELTA

Rainer Hoenicke[1] and Mike Chotkowski[2] *Presented by:* ***John Callaway***

[1]Delta Stewardship Council, Science Program, Sacramento, CA, USA
[2]USGS, Sacramento, CA, USA

The Sacramento-San Joaquin River Delta is not only part of the largest estuary on the west coast of the Americas, but also one of the largest water works in the world and the hub of a statewide water re-distribution system jointly managed by local, state, and federal agencies. Two-thirds of California's population depends on the Delta watershed for some portion of their water supply, and so does the largest agricultural economy in the US. More often than not, water supply and demand are out of balance. The interrelated stressors on economic, ecological, water infrastructure, and organizational systems makes the problem of allocating freshwater flows "devilishly wicked."

Exploratory efforts are currently underway to use an integrated ecosystem-based approach using adaptive management principles to manage and restore freshwater flows, tides, and landscapes. Existing regulatory programs are under review within the management context of the "coequal goals" of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals, as prescribed by the California legislature, must be met in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

Examples of these restoration and management efforts include a more systematic application of relatively new science governance approaches, closer integration of stakeholders in co-production of scientific products (including natural resource managers and regulators), and integrating models from both the natural and social sciences to be used for forecasting as well as scenario-planning purposes and capable of daylighting tradeoffs among ecosystem services and change adaptation strategies.

PRESENTER BIO: Dr. John Callaway is an expert in wetland restoration, specifically wetland plant ecology and sediment dynamics, and he currently serves as the Lead Scientist for the Sacramento Delta, overseeing the Delta Science Program. His recent research has focused on carbon dynamics in tidal wetlands, as well as the potential impacts of climate change on tidal wetland ecosystems in the San Francisco Bay; this experience provides valuable knowledge and scientific leadership for his current position, as the Delta Stewardship Council works to implement both the Delta Plan and the Delta Science Plan. John received his PhD from Louisiana State University and is a Professor in the Department of Environmental Sciences at the University of San Francisco.

THE ICASS PLATFORM: NINE PRINCIPLES FOR LANDSCAPE CONSERVATION DESIGN

Robert M. Campellone[1]*, Kristina M. Chouinard*[2]*, Nicholas A. Fisichelli*[3]*, John A. Gallo*[4]*, Joseph R. Lujan*[5]*, Ronald J. McCormick*[6]*, Thomas A. Miewald*[7]*, Brent A. Murry*[8]*, D. John Pierce*[9]*, and Daniel R. Shively*[10]

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[3]Schoodic Institute at Acadia National Park, Winter Harbor, ME, USA; Climate Change Response Program, National Park Service, Fort Collins, CO, USA
[4]Conservatin Biology Institute, Corvallis, OR, USA
[5]National Wildlife Refuge System, U.S. Fish and Wildlife Service, Albuquerque, NM, USA
[6]Environmental Quality and Protection, Bureau of Land Management, Washington, DC, USA
[7]North Pacific Landscape Conservation Cooperative, U.S. Fish and Wildlife Service, Portland, OR, USA
[8]Caribbean Landscape Conservation Cooperative, U.S. Fish and Wildlife Service, San Juan, PR, USA
[9]Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA, USA
[10]Watershed, Fish, Wildlife, Air & Rare Plants Program, U.S. Forest Service, Washington, DC, USA

The Anthropocene presents society with a super wicked problem comprised of multiple contingent and conflicting issues driven by a complex array of change agents. Super wicked problems cannot be adequately addressed using siloed decision-making approaches developed by hierarchical institutions using science that is compartmentalized by discipline, nor can they be managed under the assumption that environmental conditions are stable. Adaptive solutions will rest on human ingenuity that fosters transformation towards sustainability. To successfully achieve these objectives, conservation and natural resource practitioners need a paradigm that transcends single-institution interests and decision-making processes. We propose a platform for an emerging and evolutionary step change in sustainability planning: landscape conservation design (LCD). We use existing governance and adaptation planning principles to develop an iterative, flexible innovation systems framework—the "iCASS Platform." It consists of nine principles and five attributes—**i**nnovation, **c**onvening stakeholders, **a**ssessing current and plausible future landscape conditions, **s**patial design, and **s**trategy design. The principles are organized around four cornerstones of innovation: people, purpose, process, and product. The iCASS Platform can facilitate LCD via processes that aim to create and empower social networks, foster stakeholder involvement, engender co-production and cross-pollination of knowledge, and provide multiple opportunities for deliberation, transparency, and collaborative decision-making. Our intention is to pivot from single-institution, siloed assessment and planning to stakeholder-driven, participatory design, leading to collaborative decision-making and extensive landscape conservation.

PRESENTER BIO: Rob is the National Wildlife Refuge System's Policy Advisor in landscape conservation with more than 25 years of experience in sustainability planning and design. He has conducted tours of duty in Alaska, Hawaii, Minnesota, New Mexico, and California…and for the last five years, has worked in the Fish and Wildlife Service's headquarters office in Falls Church, VA.

SIMULATED POPULATION TRENDS OF FLORIDA MANATEE UNDER ANTHROPOGENIC AND CATASTROPHIC EVENTS

Katherine Carbajal, *Paola Camposeco, Jasmin Diaz-Lopez, Hsiao-Hsuan Wang, and William E. Grant*
Department of Wildlife & Fisheries Sciences, Texas A&M University, College Station, TX, USA

One of the most endangered marine mammals in the coastal areas of the United States is Florida manatee (*Trichechus manatus latirostris*). The Florida manatee population has been increasing and decreasing since 1991 along the east and west coast of Florida, respectively, and has a present population of about 6,250. However, the populations had been dramatically fluctuated due to various anthropogenic factors. Causes of manatee deaths can be broken down into five categories: watercrafts, crushed/drown by flood gate or canal lock, entanglement, perinatal, and other natural factors (such as disease and natural catastrophe). Unfortunately, three among these five categories are associated with human. Hence, we aimed to estimate and compare anthropogenic and natural catastrophic effects on the manatee population dynamics. We conducted a literature review to obtain the basic demographic data and then developed a stage-structure population dynamics model of Florida manatee during this summer. We then used the data from Florida Fish and Wildlife Conservation Commission synoptic surveys to calculate average mortality rates of those for four scenarios including baseline, anthropogenic threats, cold stress, and oil spill. We simulated each scenario with the average effects from each of their mortality rates for 20 years.

When comparing all four scenarios based on our results, the leading factors affecting the manatee population are cold stress followed by human factors and oil damage. The population size stayed stable around 4900 without any disturbance. While the model ran with a probability of cold stress occurring 35% of the time based on the temperature averages in Florida for the past 10 years, the population decreased 24% from 4900 to 3750. When the probability of another oil spill occurring was approximated at a 10% chance, the population dropped about 1% from 4900 to 4850. Because the human disturbance was constant in Florida with a 90% chance of occurring, the population decreased 7% from 4900 to 4550. Even though the Florida manatee was reclassified from an endangered to a threatened species under the federal Endangered Species Act in early 2017, the long-term monitoring and effective protection are still need to ensure an increasing population.

PRESENTER BIO: Katherine Carbajal is a senior Wildlife & Fisheries Sciences major at Texas A&M University, who has been conducting research for two years in the Ecological Systems Laboratory under Hsiao-Hsuan Wang and William E. Grant.

CAN EVERY STAKEHOLDER FEEL HEARD IN LARGE-SCALE, MULTI-RESOURCE PROGRAMS? LESSONS FROM THE GULF OF MEXICO

Katherine Powelson[1], John Tull[1], ***Bethany Carl Kraft***[2]
[1]US Fish and Wildlife Service, USA
[2]Volkert Inc., Mobile, AL, USA

Achieving conservation and restoration goals often requires coordination beyond jurisdictional boundaries. Increasing the geographical scale of projects requires coordination between stakeholder groups, which can include federal and state agencies, private landowners, non-profit organizations, tribes, and international governments, and often relies on additional expertise from scientists and academia.

This presentation will focus on the elements of meaningful stakeholder engagement with non-governmental organization and the public when implementing large-scale restoration activities. Specific examples from the restoration erts in the Gulf of Mexico region following the 2010 BP *Deepwater Horizon* oil spill will be discussed with a focus on the following questions:

1. How can stakeholders living in different states and across multiple landscapes feel invested in restoration efforts?

2. Are there novel ways to meaningfully engage stakeholders in large-scale, multi-year restoration efforts?

3. When restoration needs far outweigh available resources, how should restoration decision-makers approach expectation-setting as well as project prioritization?

4. Can stakeholder values be useful in large-scale restoration efforts?

PRESENTER BIO: Bethany Carl Kraft has over 17 years experience working at the intersection of science and policy in conservation, working on the Gulf Coast. Her experience includes project planning and implantation as well as adaptive management. In 2014, Carl Kraft served a one-year detail to the Gulf Coast Ecosystem Restoration Council as Director of External Affairs.

BENEFICIAL USE OF DREDGED MATERIAL – A TEXAS PROJECT CASE STUDY WITH PUBLIC/PRIVATE PARTNERSHIP BENEFITS AND FUTURE PLANS

Mike Carloss[1]*, and Todd Merendino*[2]
[1]Ducks Unlimited, Lafayette, LA, USA
[2]Ducks Unlimited, Richmond, TX, USA

In the U.S., several hundred million cubic yards of dredged material is excavated from shipping ports, harbors, and waterways every year to maintain channel depths for navigation. Concurrently, thousands of acres of coastal marsh are lost each year due to erosion, subsidence, saltwater intrusion, and sea level rise. There are many opportunities to beneficially use this dredged material for habitat creation, enhancement, restoration, and provide for coastal resiliency. A coordinated plan for beneficial use of dredged material will ensure the material is used to protect our coastal wetlands through projects including bathymetric recontouring, marsh creation and enhancement, sustaining barrier islands, and creation of bird islands.

Ducks Unlimited (DU) coordinated a 1,300 acre marsh restoration project using dredged material on the J.D. Murphree Wildlife Management Area (WMA) near Port Arthur, Texas. It was one of the largest beneficial use projects, with over two million cubic yards of dredged material conveyed from Golden Pass Liquefied Natural Gas (LNG) terminal dock along the Sabine Neches Waterway to designated areas within the Salt Bayou Unit of the WMA. As much as 24 inches of dredged material was used to increase marsh elevations of subsiding marsh. Increased elevation of the Salt Bayou marsh optimized the re-establishment and growth of native wetland vegetation that has been degraded or lost due to erosion, subsidence, saltwater intrusion, and tidal scouring. The dredged material was silty sediment, consisting of more than 95 percent water. The material was removed from a ship berthing area using a hydraulic dredge that pumped the material more than three miles to various deposit locations within the project area. The beneficial use project was made feasible by a National Oceanic and Atmospheric Administration, Hurricane Ike Recovery Grant awarded to the Texas Parks and Wildlife Department, whom partnered with Golden Pass LNG.

The project successfully restored 1,300 acres of coastal marsh and provides a suite of benefits for wildlife, the economy and people. The restored coastal marsh provides for coastal resiliency by buffering storm surge and related damage to infrastructure. In addition, fish and wildlife species benefit from the habitat restoration thereby enhancing the public use of the site for waterfowl hunters, fishermen, etc.

DU is also currently engaged in efforts to develop a master plan for the Texas coast to provide for programmatic implementation of its coast-wide beneficial dredged use plan. Funding for the program has been approved by the Texas Trustee Implementation Group and RESTORE. This effort will seek to identify and prioritize possible recipient sites for beneficial dredge use and to perform survey and design work to facilitate project implementation. The program will ensure continuous implementation of beneficial dredge use and that every cubic yard of material is used to restore coastal marshes for wildlife habitat and storm surge resiliency.

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.

THE ROLE OF THE USDA-NRCS PLANT MATERIALS PROGRAM IN ECOSYSTEM RESTORATION

Brandon Carr
USDA-NRCS Plant Materials Center, Knox City, TX, USA

The success of large-scale restoration depends on many variables, some of which are out of our control. One important variable which is within our control is the use of tested and proven seed sources. The USDA-NRCS Plant Materials Program was established to develop techniques for conservation planning and planting, evaluate native plants that can be used throughout different regions to address various resource concerns, and supply the commercial market with proven seed sources. Currently, the Plant Materials Program maintains hundreds of native seed sources to ensure the commercial industry can meet the restoration needs.

The importance of plant diversity in healthy ecosystems is critical for ecosystem restoration. This presentation will focus on the NRCS plant evaluation, selection and release process as well as highlight considerations which are important in broad-scale ecosystem restoration.

PRESENTER BIO: Mr. Carr serves as the manager at the James E. “Bud” Smith Plant Materials Center. He has ten years of experience in the Plant Materials Program evaluating plant species and developing technology to address changing conservation goals.

RESTORATION MONITORING – A SPECTRUM OF QUESTIONS, INTERESTS, AND AUDIENCES

*Eloise Kendy[1], and **Edgar Carrera**[2]*
[1]The Nature Conservancy, Helena, MT USA
[2]The Nature Conservancy, Mexicali, B.C. Mexico

Habitat restoration is an outcome-oriented learning process at multiple scales under influences both within and beyond practitioners' control. It can be an expensive and even controversial process, with a range of stakeholders highly invested in the outcomes. Accordingly, effective restoration monitoring programs collect data and report metrics to meet multiple objectives simultaneously. Large, multi-stakeholder restoration programs face numerous challenges coordinating overlapping monitoring efforts.

Riparian and estuarine restoration monitoring in the Colorado River Delta in México is a case in point. There, private donors, foundations, and two federal governments fund and guide several restoration projects along the Colorado River riparian corridor and upper estuary, which are managed on the ground by non-governmental organizations (NGOs). Minutes 319 and 323, formal agreements between México and the United States, provide significant funding and oversight. Metrics and monitoring for different audiences meet different learning objectives:

1. The Minutes mandate a binational science team consisting of university, federal, independent, and NGO scientists to assess hydrologic and ecological responses to environmental water deliveries. When properly resourced – as exemplified by the 2014 pulse flow – the team documents implementation of the Minutes and informs adaptive management of habitat restoration and water deliveries. Operating at the scale of the entire riparian corridor and upper estuary, this team also identifies and tracks potential confounding factors such as regional groundwater depletion. The binational team prepares formal reports to the federal governments biennially and communicates informally with restoration teams on an ongoing basis, thus using science to inform both federal and local decision-making.

2. NGO teams monitor their respective restoration sites to further evaluate progress and guide adaptive management. The "ecological success" metrics they report inform both donors and practitioners about the quality of habitat restoration to benefit birds and other wildlife, and may be rolled up into a simple scorecard to track long-term trends.

3. Raise the River, a formal coalition that coordinates fundraising and communication among the NGOs, annually reports basic implementation metrics, such as size of the area restored, quantity of environ-mental water acquired, and social benefits realized, to private donors and other interested parties.

Under Minute 319, the challenges of coordinating diverse entities with different mandates, setting realistic expectations under constrained budgets, sharing sensitive data between countries, and providing useful feedback to varied interests proved difficult to surmount. The signing of Minute 323 has galvanized binational commitments to improve collaboration and achieve greater learning from future monitoring.

PRESENTER BIO: As a Colorado river delta coordinator with The Nature Conservancy, M. Eng. Carrera works to secure water for the Colorado River delta wetlands in which depends highly endangered species. He has more than 10 years of experience in the Delta with Autonomous University of Baja California, Sonoran Institute and TNC.

POTENTIAL BENEFITS TO WAVE ATTENUATION, SEDIMENT PROCESSES, AND SAV HABITAT FROM TERRACE RESTORATION (SHREDS)

***Tim Carruthers**, Mead Allison, Mike Brasher, Alyssa Dausman, Edwin Elias, Diana Di Leonardo, Andrea Jerabek, Megan LaPeyre, Marie Mathews, Leland Moss, Andrea Jerabek, Kazi Sadid, and Hoonshin Jung*
The Water Institute of the Gulf, Baton Rouge, LA, USA

With an ongoing need for coastal restoration to increase resilience of coastal communities, a wide range of actions are being implemented, including ecosystem based restoration actions of terracing/shreds, marsh planting, and marsh creation. The potential benefit of ecosystem based restoration is that in addition to delivering a primary goal, such as wave reduction or reducing shoreline erosion, these actions can provide secondary ecosystem functions. Secondary ecosystem functions can include; creation of habitat for SAV, support for fish, shellfish and sediment infauna species, increased nutrient and/or carbon cycling and storage, improved water quality, and increased rates of sedimentation.

Creation of segmented fields of marsh terrace ridges (shreds) through placement of dredged material, that are manually planted with marsh vegetation, is a widely-practiced restoration and protection strategy along the northern Gulf of Mexico. According to a 2015 study by Ducks Unlimited, over 80 projects (>4,320 individual ridges, 673 km combined length) have been constructed in Louisiana and Texas since 1990, funded through an array of Federal, State, NGO, corporate, and community-based programs and partnerships. These projects have been promoted as relatively low-cost, rapid impact on achieving State- and basin-scale restoration and protection goals, limited negative impact on coastal communities or infrastructure, and multiple ecosystem benefits. Marsh terrace ridges create a high edge: water ratio and have been observed to create habitat for SAV, potentially providing high value habitat for both juvenile nekton and water birds. By reducing fetch, and promoting local save energy dissipation, terraces/shreds have the potential to reduce shoreline erosion and increase local sedimentation rates. However, as more of these projects are implemented, there is an ongoing need to better quantify these benefits and develop tools to inform both design and planning to maximize effectiveness and sustainability of these restoration efforts.

In January 2018, Ducks Unlimited commenced construction of a marsh terrace project in Bayou Monnaie, Terrabonne Bay, Louisiana. Along with engineering plans for terrace/shred restoration projects, this site and an adjacent site completed in 2017 were used to develop a hydrology and wave attenuation model in hypothetical model space to test a series of project scenarios. Continuous wave height data, turbidity, and current velocity data were collected during early spring, to provide data as on site boundary conditions for model runs. A range of vegetation structures were also characterized to import to the model. Model scenarios were developed, including different boundary conditions (such as severity and direction of storms), different terrace/shred designs and formations, and differences in emergent vegetation type and structure. Model results were used to assess potential benefits to wave attenuation, sediment dymanics, and to apply a coastwide SAV habitat suitability model down to a restoration site scale. Project outputs will be further developed into a modeling tool that can inform planning and design of terrace/shred creation projects, through an understanding of potential project benefits.

PRESENTER BIO: Dr. Carruthers, Director of Coastal Ecology, has worked for more than 20 years in coastal ecosystems around the world, focusing on human impacts and management. From assessment of ecosystem condition to coastal marine policy, he has run coastal adaptation and restoration projects in the Pacific Islands and Coastal Louisiana.

IMPLEMENTATION OF LARGE-SCALE RIVER DIVERSIONS: A CONTRACTOR'S PERSPECTIVE

Eddy Carter
G.E.C., Inc., Baton Rouge, LA, USA

Mr. Carter will provide a perspective of the third party contractor preparing the Environmental Impact Statement for the Mid-Barataria Sediment Diversion. A recap of the request for proposal solicitation, building the G.E.C., Inc. (GEC) Team, and contract execution will be provided.

GEC is working in coordination with the USACE and other cooperating agencies preparing a public involvement plan, conducting public scoping meetings and hearings, conducting alternative screening analyses and evaluating impacts, and preparing documentation in compliance with other laws, regulations, and Executive Orders as required by the permitting process.

PRESENTER BIO: Mr. Carter is a vice president with G.E.C., Inc., and has over 25 years of environmental planning and engineering experience for government and non-government clients.

COOKING UP THE COAST: HOW CHEFS CAN HELP RESTORATION EFFORTS

Samantha Carter
Outreach Manager, National Wildlife Federation, Mississippi River Delta Restoration

New Orleans and Louisiana are renowned for their unique culinary culture, one that is informed by the bounty of the region's waterways. Changes to the environment and the coastline are having a profound impact on our food supply and cuisine. Chefs are at the forefront of these changes. They have the power to educate consumers, re-train palates, and develop markets for more sustainable species.

The New Orleans chefs are a particularly high-profile group of stakeholders who can act effectively as spokespeople to the public and liaisons to the seafood industry. Their local celebrity status makes them trusted and influential to residents, fishermen, tourists and local decision makers. As business owners they have a stake in the local economy, particularly in the longevity of the tourism and seafood industries, and therefore to the resiliency of the city and the region. Their ties to the food, people, and economies that make up the culture of Southeast Louisiana place them in an ideal position to support the long-term sustainability of the surrounding environment, which provides the food resources they showcase on a daily basis.

Since 2014, the National Wildlife Federation (NWF) has been actively working to educate key professionals in the restaurant industry on the importance of the coast to Louisiana's seafood industry, their businesses and their communities. The success of this work has been demonstrated by the action taken by local Chefs in advocating for coastal restoration and being spokespeople to the public, the media, and influencers. Through field trips, presentations, one on one meetings and public events NWF has established meaningful relationships with over 30 of the city's top culinary leaders, several food writers and members of the media. These relationships have helped further the goals of NWF through direct advocacy for coastal restoration and through creative engagement opportunities that have elevated restoration issues in the public sphere.

PRESENTER BIO: As Outreach Manager, Samantha Carter works to develop and implement outreach and engagement strategies to advance Mississippi River Delta restoration for the National Wildlife Federation. In New Orleans, she engages community leaders and other key stakeholders, including elected officials to address the alarming loss of coastal wetlands in Louisiana.

USING DECISION SUPPORT RELATIONSHIPS TO IMPROVE ECOSYSTEM MANAGEMENT

*Scott W. Phillips[1], Nicholas G. Aumen[2], and **Michael Chotkowski**[3]*

[1]U.S. Geological Survey, Baltimore, MD, USA
[2]U.S. Geological Survey, Davie, FL, USA
[3]U.S. Geological Survey, Sacramento, CA., USA

Delivering effective environmental science for informing resource management and policy requires on-going dialogue between scientists and stakeholders across the entire lifespan of research, mitigation, or restoration projects. Developing and maintaining decision-support relationships between scientists and stakeholders, is a prerequisite to develop high-quality science that directly addresses the stakeholder needs and helps them consider innovative approaches to effectively manage the competing demands in different ecosystems.

USGS scientists, who are working with a range of stakeholders in different landscapes across the Nation, gathered in 2017 to discuss ways to improve interaction with decision makers. Information was gathered from an analysis to develop ideas for collaboration improvement. Two interesting findings were (1) many scientists are not good at relating information to managers in a way that is most useful to those managers, and (2) there are methods and opportunities to better integrate the end user into the beginning of the research process. Potential approaches to improve, develop, and maintain decision-support relationships include:

1. Establish a structure for stakeholders and scientists to interact. An adaptive management framework is needed to provide structured interaction between scientists and stakeholders. The framework will allow all parties to define issues, set goals, develop management approaches, monitor and evaluate changes, and make adjustments to both management and science approaches based on learning. A governance structure is required that brings scientists and stakeholders together during the entire lifespan of the process. The interaction will help reduce uncertainty as all parties better understand the factors affecting the landscape and the influence of management approaches.
2. Develop decision-support relationships that are both issue focused and responsive to local resource management needs. While strong decision-support relations are needed in specific resource management areas, an approach is also needed to address issues at a broader regional and national scale. Many issues related to land and water management occur across multiple landscapes. Therefore topical teams of national decision makers interacting with scientists should be established to (a) transfer lessons learned between multiple locations, and (b) develop more integrated tools and approaches to solve national issues.
3. Improve the ability of scientists and stakeholders to communicate and interact on decisions. Scientists and stakeholders need to become more familiar with, and utilize, structured decision making to ensure interaction and should get training in science communication and synthesis.

The talk will present case studies of where these concepts have been implemented and improved decision making, including Chesapeake Bay, Everglades, and San Francisco Bay.

PRESENTER BIO: Scott Phillips is the USGS Chesapeake Bay Coordinator with more than 30 years of assessing, monitoring, and synthesizing science to inform decision making.

LINKING SCIENCE TO DECISION-MAKING THROUGH SYNTHESIS AND COMMUNICATION IN CALIFORNIA'S SACRAMENTO-SAN JOAQUIN DELTA

***Maggie Christman**, Darcy Austin, and Lauren Hastings*
Delta Stewardship Council, Sacramento, CA, USA

The Sacramento-San Joaquin Delta (California Delta) lies at the center of a complex and transformed landscape within the San Francisco Estuary. Challenges to ecosystem restoration and environmental management in the system stem from multiple stressors, coequal goals for the environment and water supply reliability, and the lack of a central authority to coordinate efforts across multiple agencies and their individual missions. Despite legislative mandates and policies calling for its implementation, adaptive management in the California Delta is still largely in the planning phase. As 30,000 acres of habitat are planned to be restored under the California EcoRestore initiative, the challenge will be to fully complete the adaptive management cycle through evaluation and communication of new information gleaned about the system so that responses or adaptations can be made.

A crucial component of adaptive management involves linking science to decision-making. Communication of knowledge gained through research and monitoring is a key step for informing and equipping policy-makers, managers, stakeholders, and the public to appropriately respond and adapt. The key to successful communication is a skilled and dedicated interdisciplinary team who understands the technical information learned, the functional needs of decision-makers, and how to best transmit this information. In the California Delta, the Delta Science Program serves in this capacity with a mission to provide the best possible scientific information for water and environmental decision-making. The Delta Science Program fulfils this mission by leading synthesis efforts, facilitating public workshops, and supporting integration through interagency collaborative efforts, among other functions. Ongoing synthesis efforts that support adaptive management include *The State of Bay-Delta Science*, a collection of synthesis articles focusing on topics of high management concern. In addition to periodic public workshops, the Delta Science Program is planning to hold the system's first Adaptive Management Forum in the fall of 2018 to provide an opportunity for practitioners, managers, scientists, and funders, both local and from other systems, to exchange ideas and discuss challenges in more depth. Promoting all stakeholders to engage in these processes will be necessary for successful adaptive management of the California Delta.

PRESENTER BIO: Dr. Christman is a senior environmental scientist at the Delta Science Program, where she is an adaptive management liaison for ecosystem restoration projects in the California Delta. She has over 15 years of experience working in science-based restoration, primarily in wetland and desert systems throughout California.

IMPLEMENTATION: TECHNOLOGY AND FUNDING

Chris Clapp
The Nature Conservancy, East Hampton, NY, USA

To achieve a full and long-lasting restoration of our coastal resources, and thus the region's coastal resiliency, we must stop the pollution degrading those resources at the sources. In Suffolk County the single greatest source of pollution is the predominant use of outdated cesspools and septic systems. To overcome such a challenge would require either hooking hundreds of thousands of homes up to sewage treatment plants or upgrading individual properties to advanced treatment septic systems. Three critical components are needed to achieve success, technologies that can reliable reduce the primary pollutants, Nitrogen, funding to incentivize and enable homeowners to act, and policies that enable the use of those technologies and promote their use.

This portion of the session will first focus on how science is driving what types of technologies are most needed and where those technologies best suited. From sewer district expansions to onsite treatment for individual homes and shared systems to control nitrogen pollution from wastewater, and Permeable Reactive Barriers, wetlands and ecosystem restoration to remove pollutants already in the system.

Local funding sources, such as the Community Preservation Fund, a 2% fee on real estate transfers at the town level was originally designed to protect open space and now recently revised to allow for 20% of the fund's annual income to be utilized for water quality Improvement projects. This recurring funding stream serves as an additional incentive for homeowners to relieve themselves of chronic cesspool failures while simultaneously restoring coastal resources.

PRESENTER BIO: Christopher Clapp is a Marine Scientist who has worked for the Nature Conservancy for approximately 15 years, initially restoring estuarine habitats through traditional field projects. The data compiled from those projects has led his work out of the water and into the watersheds.

USE OF ECOLOGICAL SITE DESCRIPTIONS FOR RESTORATION AND CONSERVATION PLANNING

Stacey L. Clark
USDA-Natural Resources Conservation Service, St. Paul, MN, USA

To address conservation and ecological restoration needs, the U.S. Department of Agriculture's Natural Resources Conservation Service is developing a universally applicable management technology based on climatic, geomorphic, and edaphic features of the landscape. These "ecological sites" (ESs) provide a conceptual division of the landscape and a consistent framework for stratifying and describing land units, including their soil, vegetation, and abiotic features, thereby delineating units that share similar capabilities to respond to management activities or disturbance processes.

Ecological site descriptions (ESDs) integrate a variety of information, including inventory data, that link plant communities to soil profiles and landscape position, historical reconstructions, and management considerations based on local knowledge, assessment, and monitoring data. Specifically, ESDs can provide land managers the information needed for evaluating suitability of the land for various land-use activities, the capability to respond to various management activities or disturbance processes, and the ability to sustain productivity over the long-term.

In this session, land managers will learn how to access, interpret, and utilize ESDs, with examples of how the different components of an ESD can be used as a basis for providing information and guidance on restoration and conservation planning.

PRESENTER BIO: Stacey Clark is a Regional Ecologist for the USDA-NRCS, covering Soil Science Divisions 10 & 11 (Northern Glaciated Plains & Great Lakes States). She has a Master's degree in forest ecology, with a focus on riparian areas.

TRIBUTARY SCALE OYSTER RESTORATION IN THE CHESAPEAKE BAY: SETTING GOALS DRIVES MARQUEE COLLABORATION

Susan Conner[1] *and Stephanie Westby*[2]

[1] US Army Corps of Engineers, Norfolk District, Norfolk, VA, USA

[2]National Oceanic and Atmospheric Administration, Annapolis, MD, USA

The 2014 Chesapeake Bay Watershed Agreement, which guides the work of the Chesapeake Bay Program, calls for state and federal partners to “restore native oyster habitat and populations in 10 Bay tributaries by 2025, and ensure their protection.” Eight Chesapeake Bay tributaries have been selected for oyster reef restoration: Harris Creek, the Little Choptank River and the Tred Avon River in Maryland, and the Great Wicomico, Lafayette, Lower York, Lynnhaven and Piankatank rivers in Virginia. The oyster reef restoration under this goal represent an unprecedented level of effort, coordination and partnership. Each state, working with the National Oceanic and Atmospheric Administration (NOAA) and US Army Corps of Engineers (USACE), coordinates planning efforts to achieve this outcome by creating tributary specific plans, which lay out science based restoration goals, reef construction plans and monitoring. East state has workgroups comprised of federal, state, local, academic and non-governmental organization oyster restoration practitioners to draft the tributary plans. Each is working to set tributary-specific restoration goals and develop plans describing how the tributaries will be restored, consistent with standards described in the Chesapeake Bay Oyster Metrics Report. The oyster metrics report was formally adopted in December 2011. It provides a scientifically based and peer reviewed set of metrics to measure oyster restoration performance in the Chesapeake Bay, both at the reef and the tributary scales.

Each of these tributaries is at a different level of progress in a process that involves developing a tributary restoration plan, constructing and seeding reefs, and monitoring and evaluating restored reefs. The last phase of this process will determine success in meeting this outcome, but will not be completed until after 2025, as a tributary must be monitored at three- and six-year intervals following reef construction and seeding before it can be deemed restored. In Maryland, 563.9 acres of oyster reefs are considered “complete.” In Virginia, 445 acres of oyster reefs are considered "complete." In both states, some of these reefs have undergone restoration as part of the progress toward this outcome, while others have undergone previous restoration work or, due to naturally occurring reefs and oysters, already meet the criteria for a restored reef. This presentation will cover how science based goals are driving tributary scale restoration, how each partner brings value to the effort, and how lessons learned are adaptively applied to ongoing implementation.

PRESENTER BIO: Susan Conner is Chief of the Planning & Policy Branch at the Norfolk District, USACE. Ms. Conner has 15 years of Environmental Restoration experience – nine of those years working with the Everglades and six years working with the Chesapeake Bay on topics including oyster, wetland, and SAV restoration. She is currently the program manager for USACE oyster restoration in Virginia.

MEASURING THE RESILIENCE OF SALT MARSHES INTEGRATED INTO LIVING SHORELINE AND OTHER NATURE-BASED EFFORTS TO PROTECT COASTAL INFRASTRUCTURE

***Carolyn A. Currin**, and Jenny Davis*
NOAA National Ocean Service, National Centers for Coastal Ocean Science, Beaufort, NC, USA

Salt marshes occupy the land-water interface along estuarine shorelines, and are valued for their ability to provide fish habitat, improve water quality, and reduce the impacts of storms and flooding on coastal communities. Salt marshes also have the ability to 'keep up' with sea level rise (SLR) by increasing the elevation of the marsh via sediment trapping and biomass production. This ability conveys resilience to marsh habitats and adjacent estuarine ecosystems, as well as coastal communities. Further, these capabilities have been a primary impetus for utilizing salt marshes as Living Shorelines for erosion protection. However, another primary mechanism for marsh resilience to SLR is landward migration, which is maximized in areas with a low slope and absence of built infrastructure. Although marshes may keep up with SLR over a period of decades, most long-term models suggest that transgression, or marsh migration into upland habitats, is the primary mechanism that will sustain marsh habitat in the future. Evaluation of Living Shoreline projects, in terms of both resilience and provision of ecosystem services, should include a consideration of whether the project site would allow marsh migration.

The application of a thin-layer of dredged sediment to low-lying and fragmented marshes has gained increasing interest as an adaptive management technique for restoring and adding resilience to marsh habitats. Adding sediment to marshes may convert low marsh to high marsh, or ponded areas to vegetated marsh habitat. These changes can increase the resilience of the marsh ecosystem to SLR, but also represent a habitat trade-off. We discuss the impact of increased marsh elevation on a number of ecosystem services to prompt discussion of valuing thin-layer application projects.

PRESENTER BIO: Dr. Currin is an estuarine scientist investigating ecosystem structure, function and response to environmental change. Recent work has addressed the response of salt marshes to sea level rise, and assessed green infrastructure approaches, including Living Shorelines, as a means to provide coastal communities with a resilient solution to shoreline erosion and wave protection.

FAUNAL MONITORING IN RESPONSE TO HARBOR DREDGING IN THE PORT OF MIAMI AND NORTH BISCAYNE BAY

Andre Daniels[1]*, Rachael Stevenson*[2]*, Erin Smith*[2]*, Dr. Michael Robblee*[3] *(Emeritus)*

[1]U.S. Geological Survey, Wetland and Aquatic Research Center, Davie, FL, USA

[2]Nova Southeastern University, Dania Beach, FL, USA

[3]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

Seagrass communities are highly productive and ecologically important global ecosystems, providing primary productivity, water quality maintenance, and serving as feeding and nursery grounds. However, they are extremely susceptible to anthropogenic impacts. Dredging in the Port of Miami was implemented in 2014-2015 to accommodate larger commercial ships. The Faunal Monitoring in Response to Harbor Dredging (FMHD) project monitored the effects of dredging on the seagrass habitats near Port of Miami (POM) and nearby North Biscayne Bay (NBB). Kendall's tau correlations showed that seagrass density was negatively correlated with turbidity ($p<0.001$, tau= -0.21). Both locations had significant increases in turbidity ($p<0.001$) when comparing measurements from 2014-2016 and 2015-2016 with subsequent significant decreases in seagrass densities ($p<0.05$) between 2014-2016 and 2015-2016. The peak turbidity for both locations occurred during the dry season directly after the dredging and persisted through 2016. Seagrass communities may need substantial time to recover from dredging operations and additional monitoring is needed to understand long-term effects.

Presenter Bio: Andre Daniels is a Fisheries Biologist with more than 25 years of experience in monitoring seagrass communities in South Florida. He has extensive knowledge of the South Florida faunal communities.

NATIONAL WEATHER SERVICE SUPPORT FOR ECOLOGICAL RESTORATION IN THE OHIO VALLEY AND LAKE ERIE DRAINAGE BASIN

Brian Astifan, Jim Noel, and ***Abram DaSilva***
U.S. National Weather Service – Ohio River Forecast Center, Wilmington, OH, USA

Known for issuing weather forecasts, the U.S. National Weather Service (NWS) is less known for producing hydrologic products such as daily river forecasts, and the agency's involvement in ecological restoration may be even more under-the-radar. This poster highlights the involvement of the NWS in ongoing work aimed at preparing for and improving issues of ecological concern within the Ohio Valley and Lake Erie drainage basin by better linking our science to public decision-making. Currently, the NWS provides support for the development of the following decision-making tools:

Runoff-Risk Advisory Forecast
Provides farmers and other land managers with real-time forecasting guidance for fertilizer application to ensure maximum nutrient retention on fields and to minimize non-point source pollution to aquatic ecosystems

Ohio River Harmful Algal Bloom Prediction Model
Uses real-time hydrologic and water quality data from multiple locations along the Ohio River to forecast when conditions are suitable for harmful algal blooms such as the wide-spread toxic bloom experienced in 2015

Lake Erie Harmful Algal Bloom Forecasts
Provides early warning to water treatment plant operators, environmental managers, and other users of Lake Erie in order to minimize negative impacts from toxins produced by harmful algal blooms

The support provided for these Ohio Valley and Lake Erie drainage basin decision-making tools exemplifies how the NWS, once known primarily for its weather forecasting services, can continue to expand and improve its public services through involvement in ecological restoration projects.

PRESENTER BIO: Abram DaSilva is a hydrologist at the NWS-OHRFC. He has previously worked on hydrologic and ecological projects for the USGS, USFWS, USACE, and Florida International University, and has a M.Sc. from Louisiana State University and a B.Sc. from the University of North Texas.

USING GEOSPATIAL HABITAT SUITABILITY MODELS TO PRIORITIZE ESTUARINE AREAS FOR CONSERVATION OR RESTORATION OF BIVALVE SHELLFISH BEDS

Theodore H. DeWitt[1]*, Nathaniel S. Lewis*[2]*, and Eric W. Fox*[3]

[1]US Environmental Protection Agency, Newport, OR USA

[2]ORISE Fellow stationed at the US Environmental Protection Agency, Newport, OR USA

[3]Department of Statistics, California State University East Bay, Hayward, CA USA

Habitat suitability (HS) models can aide in forecasting how environmental changes may affect the distribution of species of interest. This information can then be used to prioritize habitats for conservation or restoration. Here, we demonstrate the use of HS models to identify areas of high suitability for harvested species of bivalves that might change due to reduced precipitation or sea level rise. Estuarine managers might use this information to initiate mitigation, restoration or conservation actions to ensure continued production of this valued ecosystem service. Rule-based HS models were constructed in a GIS for five bay-clam species (*Clinocardium nuttallii*, *Mya arenaria*, *Tresus capax*, *Saxidomous gigantea*, and *Leukoma staminea*) that are recreationally and commercially harvested in NE Pacific estuaries. Tolerance limits of each species to four habitat variables (wet-season mean salinity, bathymetric depth, sediment grain size, and burrowing shrimp presence/absence) were determined based on natural history literature. Spatially explicit maps for each habitat variable were then produced for Yaquina and Tillamook estuaries (Oregon) using empirical data from multiple studies (1953-2015). These maps served as inputs in each species' HS model, which produced HS classes ranging from 0-4 (lowest to highest suitability). HS models were then validated using bay-clam occurrence data from previous benthic community studies (1996-2012). Results showed that bivalves in the field had the greatest presence probabilities within habitats of highest predicted HS, except for *M. areneria* in Tillamook Bay. We demonstrate how HS model results can be used to forecast changes in the availability of suitable bivalve habitat by incorporating projected changes in salinity and bathymetric depth. The advantage of this approach is that disparate, independent sets of existing data are sufficient to parameterize the models, as well as produce and validate HS maps. Resource managers can transfer this approach to data-poor systems with modest investment, which can be useful for prioritizing estuarine land-use decisions (i.e., conservation or restoration siting) and estimating the vulnerability of this valued ecosystem service to changes in habitat quality and distribution.

PRESENTER BIO: Ted is an estuarine ecologist and the Chief of the Pacific Coastal Ecology Branch of the US EPA, located in Newport, Oregon. His research focuses on quantifying and modeling estuarine ecosystem services, such as shellfish production and nutrient removal. He also co-leads a national ecosystem services project for EPA.

INTEGRATION OF DESIGN FACTORS INTO POST-CONSTRUCTION ECOLOGICAL RESTORATION QA/QC

Raymond D. D'Hollander
Parsons, Syracuse, NY, USA

Ecological restoration is unusual in the construction industry because the completion of physical construction is just the beginning of its biological development. A properly designed project needs to be constructible, survive the initial establishment period, and then proceed through generations of growth and successional stages. The design must address numerous factors that will be faced by the post-construction development of the site. The post-construction quality assurance and quality control (QA/QC) program needs to provide a bridge from the design concepts and intentions to the real-world performance of the post-construction ecological system.

Post-construction monitoring is the final QA/QC of the planning, design, and construction process because it verifies if the original goals, objectives, design assumptions, and implementation were correct and appropriate. The presentation will discuss approaches for monitoring the interplay between the planning and design assumptions and the actual conditions measured and documented during the monitoring and maintenance program.

For evaluating if the project goals and objectives have been met and for Adaptive Management to be successful, it is necessary for the monitoring program and the QA/QC process to focus on why the system is functioning as it is as well as measuring what it is. The presentation will show some key project elements that generally need to be monitored with discussion of QA/QC of the data collection.

The presentation will discuss strategies that can be used during the design phase to provide for a smooth monitoring transition from the planning and construction phases to post-construction monitoring. The importance of documenting accurate baselines of the pre-construction and end of construction period will also be discussed.

The use of bio-diverse planting schemes to identify potential variations from expected conditions to provide guidance for future adaptive management will be presented. Integrating a sampling of diverse habitat zones into the design can also identify future opportunities for adaptive management. These planting designs can be used to evaluate if the appropriate reference habitats are being used for the project.

PRESENTER BIO: Ray D'Hollander is a senior project manager with over 36 years of experience in geotechnical and geoenvironmental engineering with a focus on environmental remediation and restoration, including wetlands and streams. He has been the engineer-of-record on numerous design and construction projects, including responsibility for QA/QC.

APPROACHES TO DEMONSTRATING THE CUMULATIVE EFFECTS OF LARGE-SCALE ECOSYSTEM RESTORATION

Heida L. Diefenderfer[1], *Gary E. Johnson*[2], *Kate E. Buenau*[1], *Andrew J. Loschiavo*[3], *Gregory D. Steyer*[4], *and Elene Trujillo*

[1]Pacific Northwest National Laboratory, Sequim, WA, USA
[2]Pacific Northwest National Laboratory, Portland, OR, USA
[3]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[4]U.S. Geological Survey, Lafayette, LA, USA
[5]Puget Sound Partnership, Seattle, WA, USA

Evaluating the cumulative effects of large-scale ecosystem restoration programs is essential to inform adaptive management and ensure that overall, the interactions between parts of the program generate positive net ecosystem improvement. Restoration programs must account for differing types of restoration projects, different locations of projects across the landscape, and multiple stakeholders guiding the goals and objectives of each project. To date, however, most models for restoration assessment are based on individual project sites, and standardized methods for programmatic cumulative-effects assessments have not been widely adopted. The purpose of this session is to discuss emerging methods that large-scale ecosystem restoration programs nationwide are developing to evaluate the cumulative effects of multiple restoration actions at ecosystem and landscape scales. Panelists representing the Florida Everglades, Gulf Coast, Missouri River and Puget Sound will share emerging methods to evaluate cumulative effects of restoration projects across coastal and fluvial landscapes. We will seek understand of the challenges of evaluating the cumulative effects of ecological restoration that are common among these and other regions, as well as factors that differentiate restoration programs. The discussion will build on Monday's plenary session: "How do you assess cumulative effects of regional restoration efforts and evaluate success?" We encourage participants to bring questions regarding cumulative effects research and management for any restoration programs of interest. This panel discussion will be useful to restoration managers, modelers, and researchers.

PANELISTS BIOS:

Dr. Diefenderfer and Mr. Johnson are senior research scientists with expertise in coastal and river ecosystems. They collaborated for over a decade to develop and implement an evidence-based method to evaluate the cumulative effects of the Columbia Estuary Ecosystem Restoration Program.

Dr. Buenau is a quantitative ecologist and modeler who works on large-scale restoration planning, effectiveness evaluation, decision support and adaptive management.

Mr. Loschiavo is a supervisory biologist for the U.S. Army Corps of Engineers and has 18 years of experience in natural resource management, 11 of which are in the planning, design, and implementation of Everglades ecosystem restoration.

Dr. Steyer is the Gulf of Mexico Regional Science Advisor for the U.S. Geological Survey, and has spent over 25 years developing comprehensive monitoring programs, adaptive management approaches, and ecological and landscape models for use in Gulf restoration decision support.

Ms. Trujillo is a fishery biologist with over a decade of scientific research and statistical experience connecting data and recovery actions to help refine restoration strategies in the Puget Sound.

REACH BASED RESTORATION CONSTRUCTION PRACTICES: SUCESSES AND LESSONS LEARNED FROM DECADES OF IMPLEMENTATION

***John DiRocco** , John Stille, Ralph Toninger*
Toronto and Region Conservation, Ontario, Canada

Toronto and Region Conservation has implemented a significant amount of restoration projects over the years making us one of the leaders in habitat restoration in Southern Ontario. As such, there have been many successes and lessons learned regarding implementation design and construction. Over time, restoration practices have evolved to reflect a more integrated approach where multiple techniques are utilized to achieve greater gains in overall natural system health. Current restoration objectives are rooted in improving ecological function, increasing natural cover and providing new habitat opportunities for wildlife. Previous restoration practices often focused on rehabilitating isolated features to solve a singular issue with little consideration for associated cover types or features within surrounding areas. For example, a stream erosion project might have focused only on hard stabilization treatments to protect against severe erosion without including the benefits of associated habitat features or including flood mitigation through upstream wetland restoration. A more holistic approach to ecological restoration is critical to achieving strengthened natural system resiliency especially in urban and near urban land-uses. A reach based approach to restoration includes design and implementation considerations that include bank stabilization, wetland construction, headwater reforestation, storm water management, habitat structures, trails and riparian planting. This discussion will look at TRCA's approach to reach based restoration implementation by providing an overview of current design considerations and construction practices. Examples will include shoreline and valley restoration to demonstrate how different techniques are applied in overall design and construction to achieve successful project outcomes.

PRESENTER BIO: John DiRocco is a Restoration Project Manager within the Restoration Projects team of Toronto and Region Conservation (TRCA) with 20 years of experience planning, designing, and implementing a variety of ecological restoration construction projects. He has extensive experience restoring a variety of habitats including wetlands, streams, forest, coastal, and riparian cover types. His particular focus is on shoreline and stream restoration where he oversees large construction projects.

FLOOD PROTECTION AND ECOSYSTEM RESTORATION IN AN URBAN ENVIRONMENT: THE DALLAS FLOODWAY EXTENSION, DALLAS, TEXAS

Lynde L. Dodd[1]*, Gary. O. Dick*[1]*, Aaron Schad*[1]*, and Jon Loxley*[2]

[1]U.S. Army Research and Development Center, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX, USA

[2]U.S. Army Corps of Engineers Fort Worth District, Fort Worth, TX, USA

Integrating functional infrastructure and ecosystem restoration in a riverine system can be challenging, especially in an urban environment. Hydrology, herbivory, stakeholder conflict resolution, and invasive species can all play a significant role in achieving pre-determined performance measures and ultimately influencing restoration end goals. To counter these challenges, utilization of an adaptive management approach incorporates flexibility into project management and provides an avenue to accomplish realistic goals and objectives.

The Dallas Floodway Extension is located in Dallas, Texas along the Trinity River. This is a federally authorized flood protection project and is funded through a cost share agreement with the local sponsor, the City of Dallas, who will inherit the project in perpetuity upon completion. The project footprint consists of 3.7 miles of levees, contiguous constructed herbaceous wetlands, and associated grasslands that serve to provide overbank flowage capacity for Trinity River flood waters, ensuring reduced flood risk to the City of Dallas. Technically considered a novel ecosystem, these constructed wetlands and managed grasslands provide valuable habitat to wildlife that utilize the Trinity River and the surrounding bottomland hardwood forest. Improved habitat includes a total of 271 acres: 123 acres of emergent wetlands, 45 acres of open water, and 102 acres of grasslands. Mitigated portions of the project consist of 926 acres of bottomland hardwood forest within the City of Dallas' Great Trinity Forest. As a recreational component, trails were built along the constructed wetlands linking the area to exiting recreational areas and public open spaces, allowing access for birders, naturalists, and local residents adjacent to the property.

Considering the scope and breath of the Dallas Floodway Extension within its three focus areas: flood protection, ecosystem restoration, and recreation - it's important to recognize the ecological implications of the physical, chemical, and biological functions the constructed wetlands and associated grasslands provide. Properly maintained and operated, these features will continue to provide a sustainable aquatic ecosystem that provides a multitude of ecosystem goods and services.

This presentation will address challenges and lessons learned in a federal urban flood protection project where environmental components required an adaptive management approach to achieve project goals; additionally we will discuss the ecological implications of this project as it serves to provide valuable habitat for wildlife within the Trinity River Basin.

PRESENTER BIO: Lynde Dodd is a Research Biologist with 16 years of experience of invasive aquatic plant species management and aquatic ecosystem restoration with emphasis in native aquatic and riparian species suitability and restoration implementation techniques. Ms. Dodd's recent research efforts have been focused on invasion and restoration ecology of freshwater macrophytes.

IS IT WORKING? EVALUATING SUCCESSES AND CHALLENGES IN IMPLEMENTING ADAPTIVE MANAGEMENT IN THE CHESAPEAKE BAY PROGRAM PARTNERSHIP

Laura Drescher[1]*, David Goshorn*[2]*, Gina Hunt*[2]*, Kristin Saunders*[3]*, Doreen Vetter*[1]*, Julie Winters*[1]

[1]Chesapeake Bay Program Office, US EPA, Annapolis, MD, USA
[2]Maryland Department of Natural Resources, Annapolis, MD, USA
[3]University of Maryland Center for Environmental Science, Cambridge, MD, USA

The Chesapeake Bay Program is a unique regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983. The partnership is currently guided by the 2014 Chesapeake Bay Watershed Agreement, which includes 10 Goals and 31 Outcomes covering a broad range of topics within Fisheries, Habitat, Water Quality, Land Conservation, Public Access, Stewardship, and Climate Resiliency. Previous NCER presentations (session 7, NCER 2016) have described the Agreement, its vision for adaptive management in the Program, and the need to create a framework of the kinds of information needed to adaptively manage. This presentation would continue that story by describing how the Chesapeake Bay Program Office has implemented a Strategy Review System to facilitate adaptive management across the partnership.

This presentation follows on the presentation *The Chesapeake Bay Partnership "Strategy Review System": Developing an Adaptive Management System for Restoring the Chesapeake Bay*, which provides an overview of the Strategy Review System that provides tools and timing to apply the logic of the Decision Framework, the Program's blueprint for adaptive management. Initiated in February 2017, the System is already generating some successes. Including different disciplines in a single cohort creates an opportunity for more holistic management of the partnership through identification of common factors and issues. For example, the first cohort of teams in the land and habitat areas coalesced around a common goal: to provide local planners with timely resources to consider natural resource co-benefit areas in their upcoming development of Watershed Implementation Plans (WIPs) focused on achieving nutrient and sediment reductions. As a result, tools were created for WIP developers to consider areas like fish habitat, protecting land, and maintaining healthy watersheds, and the positive or negative impact the actions in the WIP could have on those other goals. Another example: given the recurrence of finance as an issue identified as a result of this process, a pilot project is underway to engage regular and non-traditional partners in addressing funding gaps. The partnership will apply the project's framework and associated lessons learned to other areas. Both of these examples, as well as others, will be explored further in the presentation.

Implementation of the system has illuminated long-standing challenges within the partnership. A diverse partnership has a steep adaptive management learning curve, and there is a need to expand this knowledge of adaptive management outside of the Program staff into the workgroup membership. Processes created to foster thinking in adaptive management can create an additional workload, and decision makers within the partnership continue to grow more familiar with the concept and requirements of adaptive management, as well as their role in this process. This presentation will showcase some attempts to address these challenges and, as appropriate, evaluate their success.

PRESENTER BIO: As Strategy Review System Coordinator at the Chesapeake Bay Program, Laura supports the planning team designing, implementing, and maintaining the System. Her role requires extensive coordination with all stakeholders, including state and federal agencies, academics, and non-profits to build consensus toward implementing a vision of adaptive management for the Partnership.

REPLICATING FOR GREATER IMPACT: ADAPTING FOR SUCCESS IN LONG ISLAND SOUND

Holly Drinkuth
The Nature Conservancy in Connecticut, New Haven, Connecticut, USA

Connecticut and New York have made great investments over the past 20 years to clean up Long Island Sound, meeting a goal to reduce nitrogen discharged from sewage treatment facilities by nearly 58.5 percent in 2016. There is evidence that the size and duration of hypoxia in open waters has diminished. However, monitoring and research show reductions at sewage treatment facilities are not enough to address water quality problems in Long Island Sound's coastal waters. Since technology upgrades at treatment plants began, nitrogen inputs from septic tanks and fertilizers have stayed steady or increased. Serious impacts like harmful algae blooms, fish kills and thick mats of seaweed still occur near the shore where people live, work and enjoy the Sound.

To expand awareness and support for solutions in the Sound's at-risk harbors and bays, The Nature Conservancy is building on Long Island's successful **communications efforts,** using comprehensive social science and evidence to:

- Assess geographic, socio-political and public opinion similarities and differences
- Link community and economic values with water quality management practices
- Adapt and scale the **Critical Path model** for impact and success on the Sound's north shore

PRESENTER BIO: Holly Drinkuth is Director of Outreach and Watershed Projects for The Nature Conservancy's Connecticut Chapter and serves as the Connecticut Co-Chair of the Long Island Sound Study Citizens Advisory Committee. She has worked across the northeast for 17 years to improve understanding of the interactions between land, water and people. She currently leads the Conservancy's bi-state Long Island Sound Program coastal clean water strategy.

PHOSPHORUS RETENTION VARIES WITH SEICHE ACTIVITY AMONG GREAT LAKES COASTAL WETLANDS

***Michael Eggleston**, Kurt P. Kowalski*
United States Geological Survey, Great Lakes Science Center, Ann Arbor, MI, USA

The shoreline of the North American Laurentian Great Lakes once supported extensive coastal wetland areas that sustained many beneficial ecological functions including nutrient cycling, critical habitat for many plant and wildlife species, and sediment retention. These functions are driven by the hydrologic exchange between coastal wetlands and the open lakes. Hydrologic exchange results from the daily oscillations of water within the lake (seiche activity) that is mainly driven by wind and storm events. The extent that water is forced into the wetlands and subsequently drained out is based on the duration, frequency, and magnitude of seiche activity in the lakes. This seiche activity is a main driver of phosphorus cycling and potential phosphorus retention in wetland areas as it determines the residence time of lake water containing nutrient-rich sediments.

Lake Erie, the shallowest of the Great Lakes, experiences the greatest seiche-driven water-level change of all lakes. Lake Erie also historically supported extensive coastal wetlands, however since the 1800s the U.S. shoreline of Western Lake Erie has lost over 95% of the original wetlands through conversion to agriculture. Those that remain adjacent to the lake are heavily managed and separated hydrologically by levees and dikes. Therefore, these wetlands no longer able to play a role in phosphorus cycling and retention, increasing nutrient concentration in open waters and contributing to harmful algal blooms.

The Great Lakes Restoration Initiative (GLRI), is a congressionally supported effort to restore the Great Lakes, including an emphasis on the restoration of coastal wetlands and nutrient retention. We know that the magnitude of retention or release of phosphorus in Lake Erie coastal wetlands depends upon their exchange with seiche-driven water. However, it is unclear how phosphorus retention capability varies among different coastal wetland areas. Therefore, we monitored seiche activity and phosphorus retention at multiple coastal wetlands and found that retention patterns varied through time and location based on the level of seiche activity. This suggests retention dynamics are not static among individual wetlands. Results will be used to inform the Western Lake Erie Restoration Assessment (WLERA: https://glcwra.wim.usgs.gov/) and efforts to model nutrient retention at a landscape scale.

PRESENTER BIO: Michael Eggleston is an Ecologist at the USGS Great Lakes Science Center. His current projects focus on coastal wetland restoration in the Western basin of Lake Erie, specifically seiche driven phosphorus transport between coastal wetlands and Lake Erie.

ASSESSMENT OF ACTUAL RESTORATION BENEFITS

Gretchen Ehlinger[1]*, April Patterson*[1]*, Patricia Gorman*[2]*, Andrew LoSchiavo*[1]

[1]U.S. Army Corps of Engineers, Jacksonville, Florida, USA

[2]South Florida Water Management District, West Palm Beach, Florida, USA

Monitoring for ecosystem restoration programs can be classified into five categories: (1) mandated (*i.e.,* regulatory); (2) project operations (e.g. DO, nutrients, or flow); (3) project-level performance including the application of adaptive management (AM); (4) research; and (5) restoration assessment. In the Comprehensive Everglades Restoration Plan (CERP), the first four types of monitoring are typically conducted at the project-level. The fifth is the primary tool utilized by the systemwide science program of CERP, REstoration COordination and VERification (RECOVER), to assess CERP performance.

RECOVER provides essential support to CERP in meeting its goals and purposes. RECOVER does this by applying a system-wide perspective to the planning and implementation of the CERP. RECOVER is a multi-agency team of scientists, modelers, planners and resource specialists who organize and apply scientific and technical information in ways that are most effective in supporting the objectives of CERP. The RECOVER team conducts scientific and technical evaluations and assessments for improving CERP's ability to restore, preserve and protect the south Florida ecosystem while providing for the region's other water-related needs. RECOVER communicates and coordinates the results of these evaluations and assessments to managers, decision makers and the public.

Monitoring is currently being conducted to identify and evaluate environmental change that occurs across spatial and temporal scales to document restoration progress and implement an AM program. CERP is based on extensive existing scientific knowledge of the Everglades and associated estuaries, understanding of the problems and opportunities, and the evaluation of projects and estimation of the potential project restoration performance. The CERP AM and Monitoring Program identifies project level and system wide monitoring information needed to inform CERP implementation. The system wide monitoring conducted by RECOVER is documented in the RECOVER Monitoring and Assessment Plan (MAP). RECOVER also has a programmatic AM plan that complements the project-level AM plans. Each CERP project has a project-level monitoring plan that consists of an adaptive management plan, hydrometeorological monitoring plan, water quality monitoring plan, and an ecological monitoring plan.

PRESENTER BIO: Dr. Ehlinger is a senior biologist with more than 13 years of experience in Everglades restoration and system-wide science. She is a long-time manager for the RECOVER program which is primarily responsible for establishing a framework for measuring and interpreting system-wide responses to the Comprehensive Everglades Restoration Plan.

PUBLIC-PRIVATE-NGO PARTNERSHIPS FOR ENHANCING RESILIENCE OF THE WORKING COAST VIA ECOSYSTEM RESTORATION

Justin Ehrenwerth[1]*, Ian Voparil*[2]*, Joni Tuck*[3]*, Simone Maloz*[4]*, Mead Allison*[1]*, and Leah Brown*[5]

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[3]Greater Lafourche Port Commission, Cut Off, LA, USA
[4]Restore or Retreat, Inc., Thibodeaux, TX, USA
[5]Chevron, New Orleans, LA, USA

A Public-Private-NGO Partnership (P3+) was formed to combine the resources and expertise of public, private, andpublis to enhance coastal habitat and provide protection to critical infrastructure and communities, to use dredged material created by port expansion at Port Fourchon, Louisiana. Advanced science and engineering are being used to optimize the protective and habitat services provided by these restored ecosystems. This approach can serve as a model for collaborative planning and shared funding to construct nature-based defenses to manage risks to infrastructure and communities.

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. 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 forested ridges, restored wetlands and islands constructed of dredged material may be less expensive to emplace and require less maintenance than grey infrastructure, and often provide additional ecosystem service benefits such as expanded ecological habitat for commercial fisheries 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.

PANELIST BIOS:

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.

Dr. Voparil is the Coastal Issues Manager at Shell Deepwater Gulf of Mexico. He developed and leads Shell's team on coastal change, representing all the Shell companies in Louisiana. Business Opportunity Manager responsible to address the continuity risks to Shell's businesses. That includes projects to make our assets more resilient, commercial strategies that provide mitigation, and creation of partnerships.

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 deep water oil production, and plays a strategic role in furnishing about 18% of the United States oil supply.

Ms. Maloz is Executive Director of Restore or Retreat, Inc. She works daily on the local, state and federal levels to advocate for the needs of the disappearing Louisiana coast, specifically the Barataria and Terrebonne Basins. She serves on the Governor's Advisory Commission on Coastal Protection, Restoration and Conservation.

Dr. Allison is an expert on river, deltaic and coastal sedimentary processes. He has researched river delta systems for nearly 25 years. He is one of the foremost experts on the Mississippi River's sediment transport processes. In addition to his responsibilities at the Institute, Dr. Allison is Professor and chair of the Department of River-Coastal Science and Engineering at Tulane University in New Orleans.

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

CASE STUDY: CONSULTING LOCAL COMMUNITIES TO ASSESS IMPACTS AND PROMOTE AWARENESS AND PARTICIPATION, PORT OF PORT MORESBY RELOCATION, PORT MORESBY, PAPUA NEW GUINEA

Cary Ehrman
Ramboll US Corporation, Columbus, OH, USA

After 140 years of operation port facilities at the headlands of Fairfax Harbor in the capital city of Port Moresby, Papua New Guinea, the CBD had reached operational capacity and had become plagued by traffic congestion and growth issues, forcing the Government to seek a viable solution that would assist in the long-term development of the city. A 1998 Feasibility Study supported the decision to relocate the Port of Port Moresby to Motukea Island, privately owned land with an existing port in operation that could be expanded for PNG Ports Corporation to play a larger role in trans-shipment and underpin economic development. Located 12 km from Port Moresby, Motukea Island is a 106-ha development site that could provide expanded storage and wharf capacity, two international berths for increased container traffic, and additional space for future development and expansion.

Historically, major development projects have adversely impacted the lives of the Motu Koitabu people, a group of indigenous people in seven villages living in and around the National Capital District, who are the traditional owners of the land on which Port Moresby is situated. The Motu Koitabu number approximately 30,000 of the city's 250,000 people. The central issue in many of these projects related to land ownership and the lack of participation of the Motu Koitabu in various developments taking place on their traditional land. In terms of political representation, the Motu Koitabu have been under-represented at the provincial and national government levels and have had limited means under constitutional reforms to participate in the decision-making processes at the local level.

As the port relocation had the potential to affect the livelihoods of the Motu Koitabu people, many of whom rely solely on marine and coastal resources for subsistence, a significant component of the 2014-2015 Environmental Impact Assessment was to undertake meaningful consultation. The presentation will focus on the program of engagement that was developed to consult with these local communities, to help assess impacts and to promote awareness and participation. Methods of engagement will be presented, including:

- Surveys/questionnaires designed to collect marine resource and mangrove data in the community setting.
- Development of project description information, EIA process, and visualization materials, including physical aspects likely to generate environmental and social risks and impacts.
- Use of interpreters and mediators.
- Methods for collection of comments and concerns.

PRESENTER BIO: Cary Ehrman, CEnvP, IAP2, is a Senior Managing Consultant with over 30 years' experience in managing environmental and social impact assessment, permitting, sustainable development, site investigation, remediation and planning projects. She is the Impact Assessment Service Leader for the Americas for Ramboll US Corporation, and works on ESIA projects globally.

RECENT ADVANCEMENTS IN RESTORATION-ENGINEERING AND SEED ENHANCEMENT TECHNOLOGIES FOR USE IN MINE REHABILITATION

Todd E. Erickson[1,2], *Andrew L. Guzzomi*[2], *Matthew D. Madsen*[3], *Mitch Thacker*[3], *Olga A. Kildisheva*[1,2,4], *Shane R. Turner*[1,2], *Jeremy J. James*[5], *Scott R. Abella*[6], *Miriam Muñoz-Rojas*[1,2,7], *David J. Merritt*[2,1]

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[2]Kings Park Science, Department of Biodiversity, Conservation and Attractions, Kings Park, Western Australia, Australia
[3]Brigham Young University, Provo, UT, USA
[4]Plant Biology and Conservation, Chicago Botanic Garden, Glencoe, IL, USA
[5]Sierra Foothill Research and Extension Center, University of California, Browns Valley, CA, USA
[6]School of Life Sciences, University of Nevada (Las Vegas), Las Vegas, NV, USA
[7]School of Biological, Earth & Environmental Sciences, University of New South Wales, Sydney, New South Wales, Australia

Restoration engineering is a swiftly developing field that partners biological research with innovative ecologically-guided engineering solutions. From a plant recruitment perspective, best-practice use of seeds can be coupled with the invention and modification of seeding equipment needed to deliver native seeds at scale. Improving seed use efficiency through seed enhancement technologies is one approach that has gained recent attention in dryland restoration. Techniques including precision flash flaming, hydro- and osmo-priming, polymer-based seed coating, and extruded seed pelleting, all aim to improve the germination and establishment potential of seeds under sub-optimal conditions. When combined with modifications to existing mechanical seeders or with new-builds, these technologies are one potential solution to overcome major inefficiencies in dryland seeding efforts (i.e. >90% of seeds failing to establish). For instance, 'flash flaming' is a technique that removes unwanted hairs and appendages of bulky and fluffy seed batches (e.g. Winterfat / *Krascheninnikovia lanata*). After removal, seed batch volume is vastly reduced, while the flow properties of seeds through cleaning equipment and mechanised seeders are vastly improved. This recent Australian invention allows many species that are historically hard-to-handle, and/or deliberately avoided, to be used in large scale restoration programs.

Continued research aims to: (1) advance the application of flash-flaming technology to remove unwanted seed appendages to a wider range of species, (2) combine the optimised flash-flaming treatments with additional seed enhancement technologies (priming, pelleting, and coating), (3) critically evaluate the limitations of current mechanised seeding techniques used in rehabilitation (e.g. mining operations) and large-scale cropping to guide engineering modifications or new designs to improve precision-delivery of native seeds in adverse rocky, uneven and sloped landforms, and (4) design, construct, and test a prototype direct seeding machine(s) that can accommodate and efficiently deliver a wide range of seeds that differ in shape, size, and weight, at the scale required.

In this presentation we will highlight some key findings for a selection of our *restoration engineering* approaches that include the benefits of flash flaming in Australian and US species, polymer-based seed coating combined with priming of seeds, and discuss the modes of treatment applications across large-scale, high-impact mine restoration scenarios. Outcomes of these programs are applicable to degraded lands requiring restoration across the United States, Australia, and other semi-arid global regions.

PRESENTER BIO: Since 2008, Dr Erickson has been investigating seed recruitment limitations in dryland mining environments of Western Australia. He has co-managed two 5-year research projects affiliated with large-scale iron ore mining operations and now co-directs a 4-year eco-engineering research program in the same arid biome working closely with three US partners.

DETERMINING PRACTICLE KEY PERFORMACE MEASURES FOR ECOLOGICAL RESTORATION PRACTITIONERS: CHALLENGES AND CONSIDERATIONS

***Patrick Esson**, Andrew Ramesbottom, John Stille, Karen McDonald*
Toronto and Region Conservation, Ontario, Canada

Evaluating restoration success is critical to fostering support for current and future restoration practices, but can be difficult to confidently quantify. Ecological restoration practices are rooted in both broad based regional goals and reversing acute local impairments. Determining key performance indicators can be a challenge in this regard due to different temporal and spatial indices and fluctuating open system variables. As such, considerations need to be made in-terms of determining what metrics can most meaningfully demonstrate the degree to which gains in natural system health are being achieved. Restoration prioritization metrics in the Greater Toronto Area are based on utilizing ecological monitoring data and GIS layers that report on watershed health to identify areas most in need of remediation natural heritage gains can be maximized. Those same metrics can be used to track changes over time and can help to measure the trajectory of watershed health trends as they relate to restoration efforts. There are a variety of factors to be considered in order to determine key performance measures. The challenge is to select measures that: are the best surrogates for demonstrating watershed health; can effectively inform and assess existing restoration prioritization methods; and will guide future restoration prioritization decisions. Based on these criteria, TRCA is developing a suite of performance metrics that will quantify restoration success in the Greater Toronto Area. This discussion will highlight the challenges related to understanding and determining performance measures by providing examples at both local project and regional program scales.

PRESENTER BIO: Patrick Esson is a Project Manager with the Restoration Projects team of Toronto and Region Conservation (TRCA) with over 6 years of experience planning, designing, and implementing a variety of ecological restoration construction projects. He has extensive experience in collecting restoration opportunities planning information and prioritization of restoration projects.

PRIVATELY FUNDED MARSH CREATION UTILIZING DREDGE MATERIAL FROM THE MISSISSIPPI RIVER

*Worth Creech[1], **Gregg Fell**[2], George Howard[1]*
[1]Restoration Systems, LLC – Raleigh, North Carolina, USA
[2]Natural Resource Professionals, LLC - Baton Rouge, Louisiana, USA

The Jesuit Bend Mitigation Bank (JBMB), completed by Restoration Systems, LLC, is the only privately funded marsh creation project in Louisiana utilizing dredge material from the Mississippi River. Constructed from August-December 2015, approximately 1.3 million cubic yards of sediment was deposited and over 211,000 Plants were installed by hand throughout the ~240 acre marsh creation/restoration area. Five waterways were also constructed to maintain essential fish habitat and allow for daily hydrologic exchange. During the five year design and permitting process, strong partnerships were developed to overcome significant regulatory challenges such as coordinating bald eagle and colonial bird nesting seasons, securing the dredge location within the Mississippi River, and crossing both federal and non-federal protection levees. The Sponsor considered geotechnical data, local and regional subsidence, sea level rise, organic accretion, and daily water levels to develop a target elevation for the dredge material, which was critical to meet the rigorous performance standards required by the Corps of Engineers and Interagency Review Team. In addition, the JBMB is protected by a perpetual conservation easement and will be monitored and maintained through a seven-year escrow account and long-term financial endowment.

The primary need in all of Coastal Louisiana is to restore wetland habitat and develop a sustainable approach to land-use. This is due to the many ecological functions and values that wetlands provide, in addition to the significant socioeconomic benefits that impact the entire country. While billions of dollars are being allocated for coastal wetland restoration projects, there is still a need to support the residents, businesses, and culture that have flourished in this area. As a mitigation bank, the JBMB will compensate for impacts to wetlands that are authorized by the Clean Water Act, Section 404 Permitting Program, ensuring that the federal “no-net loss” of wetlands policy is met. Therefore, the JBMB will contribute to the economy of Louisiana by facilitating the issuance of Permits and will contribute to the environment by providing a variety of biotic and physical functions to the Barataria-Terrebonne Estuary.

Throughout the planning, permitting, and construction of the Bank, the Sponsor has involved multiple private, public, and non-governmental organizations to accentuate the future role the private sector can play in addressing coastal land loss and restoring wetland habitat, and will continue to do so throughout the future monitoring of the Bank. The JBMB is a “state scale project” in both magnitude and complexity using the practice of land-building with Mississippi River Sediments which is the preferred method in the Louisiana Coastal Master Plan.

PRESENTER BIO: Gregg Fell Biography – Gregg Fell has 10 years’ experience as a wetland consultant, specializing in the establishment of wetland mitigation banks and securing Section 404 Permits. Gregg hopes that projects like Jesuit Bend can highlight the role that the private sector can play in the restoration of wetlands in Louisiana.

A DATA MANAGEMENT PLAN TEMPLATE FOR ECOLOGICAL RESTORATION AND MONITORING

Brick M. Fevold[1]*, Judy Schofield*[1]*, Rob Sutter*[1]*, Craig Palmer*[1]*, Elizabeth Benjamin*[1]*, Molly M. Amos*[1]*, and Louis Blume*[2]

[1]CSRA, LLC, Alexandria, Virginia, USA

[2]U.S. Environmental Protection Agency, Chicago, IL, USA

Data management planning is a fundamental component of managing ecological restoration projects. For federally funded projects, data management planning is mandated by executive order, effectively placing the burden of data management planning on federal agencies and collaborators working on their behalf. However, federal guidance is limited for developing a data management plan (DMP) that can serve as both a comprehensive yet practical planning tool for ecological restoration projects. A variety of DMP templates are available but they often reflect the needs of a specific program or institution and lack essential standard elements for comprehensive data management planning.

In this presentation, a DMP template specific to ecological restoration projects will be discussed. Template elements are based on best practices instituted in policies by select academic and government sources, and include those necessary to meet USEPA requirements for quality documentation (i.e., quality assurance project plans). The order of template elements loosely follows a workflow of a generalized project data lifecycle, addressing key topics such as project (or program) description and administration; data acquisition and collection; organization, storage and security; data processing and analysis; quality assurance; documentation and content standards; preservation and archiving; sharing and reuse; and policy-based legal and ethical requirements. This template can be used by project planners to promote data quality, informed decision making and data reuse by ensuring data management activities are addressed across all phases of the project life cycle.

PRESENTER BIO: Brick Fevold is an integrative ecologist and research scientist advisor with CSRA with more than 20 years of experience planning and implementing project-level data management solutions for federal, state and private non-profit organizations. Brick has extensive experience with wildlife and habitat monitoring, including design, installation, and monitoring of shoreland restoration.

OPPORTUNITIES AND LIMITS FOR STREAM RESTORATION TO IMPROVE WATERSHED FUNCTIONS AND INCREASE RESILIENCE

Solange Filoso
University of Maryland Center for Environmental Science, Solomons, MD, USA

Watersheds are dynamic areas linking land and water, which not only serve as a focal point for human activities but also provide important ecosystem services to society. However, as human activities intensify, watersheds lose a wide array of ecosystem functions that support essential ecosystem services such as water infiltration and purification capacity, and erosion control. The impacts are usually detected by changes in the quality and quantity of runoff in streams, and decreased ecosystem resilience to extreme conditions. Consequently, stream restoration is often chosen as a mitigation tool to reverse the negative impacts of human activities on streams and compensate for the loss of essential watershed ecosystem functions.

In this paper, I examine whether restoration of urban streams in highly developed watersheds of Chesapeake Bay results in measureable improvements in stream water quality and flow dynamics, and increased resilience to extreme weather patterns expected with climate change. I assess restoration impact by comparing pre- and post-restoration loads of nutrients and total suspended solids (TSS), and by analyzing temporal patterns of discharge. I also quantify the contribution of upland stormwater best management practices (BMPs) and determine the difference between implementing stream restoration alone or in conjunction with upland stormwater BMPs. Results are discussed in terms achieving Total Maximum Daily Load goals (TMDLs) and increasing watershed resilience in light of future climate scenarios predicted for the Chesapeake Bay region. Given the large-scale implementation of stream restoration currently underway in the region, it is paramount that watershed managers and stakeholders understand how combining stream restoration and upland BMPs can help attain and maintain TMDL goals and also improve watershed resilience in anticipation of a progressively wetter climate throughout this century.

PRESENTER BIO: Dr. Filoso is an Associate Research Professor specialized in biogeochemistry and freshwater ecosystems. She has more than 20 years of experience studying the impacts of human activities and management practices on riverine ecosystems. For the past 10 years, the focus of her research has been on stream restoration.

EVOLUTION OF ADAPTIVE MANAGEMENT FOR THE MISSOURI RIVER RECOVERY PROGRAM

*Dr. Kate Beunue[1], Dr. Craig Fischenich[2], **Craig Fleming**[3]*

[1]Pacific Northwest National Laboratory, Sequim, WA, USA
[2]Environmental Research Development Center, Vicksburg, MS, USA
[3]Corps of Engineer, Yankton, SD, USA

In 2003 the USFWS included Adaptive Management (AM) in the Biological Opinion they provided to the USACE on the Missouri River Operations. Since then the USFWS and USACE have been attempting to define and implement this concept for the endangered species listed within the Missouri River Basin.
There have been a host of starts and fits, and we have embraced failure as a step towards success. We have learned from our failures (failing forward) as best we could to get to where we are. Developing and Implementing AM is difficult as we all have different ideas and understanding of what AM is and how it can get us what we want. The difficulty is confounded as there are functioning structures and cultures within our agencies and stakeholders that are averse to change. In the Missouri River Basin we have sought to achieve a working AM program through continual engagement and dogged persistence, supportive senior leadership and a commitment to address system operations as well as species needs.

This talk will highlight those things we have done to get to where we are today (testing the governance process as a dry run and within 6 months of a new Biological Opinion, the Final Environmental Impact Statement for the Missouri River Management Plan and Adaptive Management Plan for the Missouri River). It will include failures and struggles we experienced along the way and how we grew from those experiences.

PRESENTER BIO: Craig Fleming is the Adaptive Management Project Manager for the USACE on the Missouri River Recovery Program and works within the Integrated Science Program. Craig has worked on AM for the Corps for 11 years. Craig is a biologist who has worked for the USFWS in California on out-migrating salmon issues and as a Habitat Restoration Coordinator for the Anadromous Fish Restoration Program.

GUIDING COORDINATED BIRD MONITORING DECISIONS THROUGH STRUCTURED DECISION MAKING

***Auriel Fournier*[1], *James Lyons*[2], *Evan Adams*[3], *Janell Brush*[4], *Robert Cooper*[5], *Steve DeMaso*[6], *Melanie Driscoll*[7], *Peter Frederick*[8], *Jeff Gleason*[9], *Randy Wilson*[10], *Mark Woodrey*[1,11]**

[1]Coastal Research and Extension Center, Mississippi State University, Biloxi, MS, USA
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[3]Biodiversity Research Institute, Portland, ME, USA
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[5] Daniel B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA, USA
[6]U.S. Fish and Wildlife Service, Gulf Coast Joint Venture, Lafayette, LA, USA
[7]Independent
[8]Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA
[9]U.S. Fish and Wildlife Service, Gulf Restoration Program, Chiefland, FL, USA
[10]U.S. Fish and Wildlife Service, R4 Migratory Bird Program, Jackson, MS, USA
[11]Grand Bay National Estuarine Research Reserve, Moss Point, MS, USA

The Deepwater Horizon oil spill presented a wide variety of challenges, as well as unique opportunities for the Gulf of Mexico bird conservation community, including demonstrating the many values and goals of the diverse stakeholders and funders who are invested in the Gulf of Mexico ecosystem and highlighting the need for Gulf of Mexico-wide information on birds and their habitats. The Gulf of Mexico Avian Monitoring Network used structured decision making to provide a framework for prioritizing bird monitoring decisions and meet the bird conservation communities' common objectives in a transparent way. We first created a quantitative system for assigning a benefit score based on the bird conservation community's values to monitoring proposals. With the benefit scores and estimated costs, we show how to select an optimal combination of proposals to maximize benefit of monitoring investments yet meet any constraints on the decision maker (such as budget), such as may occur after a request for proposals. Second, we also used the bird conservation communities' values to prioritize questions about management actions, status and trends, and ecological processes. While our structured decision-making process has been focused on birds that use the Gulf of Mexico, these methods are not specific to that area or to birds, and these two ways of using structured decision making to inform bird monitoring strategies could be used to address challenges in other systems, taxa and geographies.

PRESENTER BIO: Dr. Fournier is a postdoctoral research associate with the Gulf of Mexico Avian Monitoring Network (gomamn.org) at the Coastal Research and Extension Center at Mississippi State University. Her expertise includes wetlands, marsh birds, migratory connectivity and structured decision making.

KEEPING UP WITH THE TIDE - RESTORATION DESIGN CONSIDERATIONS IN THE SOFT SOILS OF COASTAL LOUISIANA

Brett Geesey
HDR Engineering, Inc., Lafayette, LA, USA

State, Federal, and local governments, as well as private interests, have established many restoration techniques stabilizing eroding shorelines, restoring degraded and eroding marsh complex and barrier islands, and reducing salinity impacts through hydraulic restoration. Although each of these project types face multiple challenges from planning through design and construction, these projects all face a similar challenge – working in Louisiana's soft soils. Soft foundation soils present design challenges including structural stability issues and excessive settlement, but working through these challenges typically increases project costs. Soft soils also make project construction more difficult, with contractors having to develop unique in-field solutions to maintain safety and construct the project. Over the years, these challenges have presented learning opportunities for designers and construction contractors to innovate solutions for future projects.

This presentation will focus on specific design and construction challenges for coastal projects in the soft soils of Louisiana. Several project examples will be presented to highlight the unique challenges and the lessons learned through managing these challenges, improving design techniques, and innovating construction methods for success in future projects.

PRESENTER BIO: Mr. Geesey is a coastal engineer with HDR Engineering, Inc. with over 12 years 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.

LYGODIUM MICROPHYLLUM IN THE NORTHERN EVERGLADES: EXPANSION, CONTROL, AND IMPACTS

Rebekah Gibble[1]*, Andrew Eastwick*[1]*, and Donatto Surratt*[2]

[1]US Fish and Wildlife Service, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Boynton Beach, FL, USA

[2]National Park Service, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Everglades Program Team, Boynton Beach, FL, USA

The Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) is the last remnant of the once vast northern Everglades. The Refuge is over 141,000 acres of historically ombrotrophic freshwater marsh habitat consisting of sawgrass ridges, tree islands, wet prairies, sloughs, and cypress stands. This unique landscape supports Threatened and Endangered species such as wood storks (*Mycteria americana*) and snail kites (*Rostrhamus sociabilis plumbeus*), as well as other trust resources such as American alligators (*Alligator mississippiensis)* and white-tailed deer (*Odocoileus virginianus).* There are many stressors that threaten the structure and function of the ecosystem, including nutrient enrichment resulting from adjacent land use, altered hydrology and hydroperiods, and invasive species.

The Refuge is threatened by several non-native invasive plant species, including the 'paperbark tree,' *Melaleuca quinquenervia* and 'Old World Climbing Fern,' *Lygodium microphyllum*. *Lygodium* is of particular concern because it can quickly smother critical tree island habitats. This fern also changes fire behavior which can also have devastating impacts, in particular, to tree island habitats. There is not currently a consistently effective control method. Treatments as frequent as every six months are recommended for eradication, however, *Lygodium* populations in the Refuge and the Everglades has surpassed the potential for eradication and there is a need for a better understanding of long-term management requirements to minimize treatment costs and ecological impact.

Ongoing studies are investigating *Lygodium* recovery rates following herbicide treatment to determine the minimum retreatment frequency required to meet habitat objectives, as well as the effectiveness of aerial treatments without follow-up ground treatments for the worst infestations. Preliminary results suggest that aerial treatments of infestations of the worst infestations - greater than 75% cover in the canopy - reduce the density of *Lygodium* and allow some recovery of native species, for a limited, but important amount of time. This strategy, referred to as 'triage' treatments, temporarily controls the growth of *Lygodium*, particularly in the canopy, and can temporarily delay the collapse of heavily infested islands until ground treatment can be scheduled, contingent upon available resources. Early estimates of optimal retreatment frequency based on growth rates and treatment cost suggest areas retreated 2 to 3 years after a treatment would have similar cost and ecological impacts to those treated earlier post-treatment, and that hydrology is an influencing factor.

PRESENTER BIO: Dr. Gibble is the Senior Biologist at the Arthur R. Marshall Loxahatchee National Wildlife Refuge with more than 12 years of experience planning, designing, and implementing habitat conservation projects in and around the Refuge. Her work has focused, in particular, on controlling invasive non-native plant species found on the Refuge, as part of overall efforts to conserve Refuge habitats to represent the historic northern Everglades.

USING STAKEHOLDER ENGAGEMENT, TRANSLATIONAL SCIENCE AND DECISION SUPPORT TOOLS FOR ECOSYSTEM BASED MANAGEMENT IN THE FLORIDA EVERGLADES

Rebekah Gibble[1]*, Matthew C. Harwell*[2]

[1]U.S. Fish and Wildlife Service, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Boynton Beach, FL, USA

[2]U.S. Environmental Protection Agency, Gulf Ecology Division, Gulf Breeze, FL, USA

With 133 threatened and endangered species (excluding plants) and more than 10 species of water birds of importance actively managed in the Greater Everglades, managing water for competing human and environmental demands is a multi-dimensional challenge. In this presentation we examine approaches for navigating multi-agency governance models, competing stakeholder visions, and using socio-ecological science to address other practical and theoretical challenges for managing these freshwater coastal wetlands. In this presentation, stakeholder engagement for ecosystem based management is examined at three spatial and temporal scales of governance. In the northern Everglades, daily-scale water management involves three primary stakeholders, whereas longer temporal scales (e.g., quarterly, seasonally) involves twice as many stakeholders. At a larger spatial scale, water coordination for ecosystem based management and restoration across the larger Everglades landscape involves even more stakeholders, so the use of translational science and decision support tools (e.g., the Species Climate Outlook, assorted Habitat Suitability Indices, and numerous hydrologic/climate forecast model projections), effective stakeholder engagement and communication becomes paramount. By examining best practices in stakeholder engagement and linking translational science with multiple, science-driven decision support tools to manage the complex freshwater aquatic ecosystems of the northern Everglades, important lessons learned can be carried forward in an effort to continually improve governance and collaboration for ecosystem management and restoration.

PRESENTER BIO: Dr. Gibble is the Senior Biologist at the Arthur R. Marshall Loxahatchee National Wildlife Refuge with more than 12 years experience planning, designing, and implementing habitat conservation projects. As part of overall efforts to conserve Refuge habitats, her work has focused on identifying ways to best manage water and trust resources found on the Refuge and northern Everglades.

ADAPTIVE MANAGEMENT ACTIONS TO IMPROVE RESTORATION OUTCOMES

Howie Gonzales[1], *April Nudo Patterson*[1], *Andrew LoSchiavo*[1], *Gretchen Ehlinger*[1], *Fred Sklar*[2], *Patricia Gorman*[2], *Steve Traxler*[3], *and Agnes McLean*[4]

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[3]U.S. Fish and Wildlife Service, Vero Beach, FL, USA
[4]Everglades National Park, Homestead, FL, USA

In the implementation of the Comprehensive Everglades Restoration Plan (CERP), scientists and managers are coming together to better understand through Adaptive Management (AM) how the ecosystem response may change the way projects are built or water management structures are operated. AM is a structured management approach to address uncertainties about restoration planning, design, and operations. REstoration COordination VERification (RECOVER), the system wide science body for CERP, used AM principals to develop a Programmatic AM Plan in 2015. The Programmatic AM Plan connects uncertainties about how the system will function with ongoing monitoring and quantitative evaluation tools. When working in complex systems, Everglades physical and biological scientists conduct hypothesis testing during operational tests by implementing large-scale physical models to gain additional understanding. RECOVER informs managers when this information points to improvements in project function or identifies enhancements to water management regimes.

The CERP Program is currently planning, designing, and constructing restoration projects and includes essential monitoring and feedback to decision makers from RECOVER. RECOVER is made up of regional groups of scientists within the Everglades who conduct monitoring and perform physical model assessments. RECOVER maintains leadership representation from ten agencies and two tribes. Howie Gonzales manages all USACE Everglades restoration efforts and coordinates with the federal, state, local, and tribal interagency leaders. Howie Gonzales will discuss how program managers are receiving the RECOVER information and working through systematic challenges to move project actions forward to improve restoration outcomes. This happens because of collaboration between project and system-wide scientists that identify information critical to restoration and develop recommendations for AM actions and the challenges in implementing the necessary actions. Mr. Gonzales will share some examples of collaboration and ways in which programmatic changes are being worked through to help resolve these restoration challenges.

PRESENTER BIO : Howie Gonzales is a Program Manager with the U.S. Army Corps of Engineers Jacksonville District. He provides expert leadership to project managers and teams to ensure successful accomplishment of the planning, design, and construction of South Florida Ecosystem Restoration (Everglades Restoration) program, including the Comprehensive Everglades Restoration Plan (CERP).

POWER LINE HABITAT RESTORATION PROGRAM – A SUCCESS STORY

Cecilia Meyer Lovell and ***Alonso Gonzalez Cabello***
AECOM, San Diego, CA , USA

How does one go about restoring 250-plus acres, over 117 miles, six eco-regions and 20 vegetation communities? Over the past 7 years, AECOM has implemented habitat restoration, including special-status plant restoration, for temporary impacts associated with the a 117-mile long transmission line in southern California. This split 230kV/500kV transmission line extends from the deserts of Imperial County, over the mountains to western San Diego County, conveying electricity from renewable energy facilities. The team started planning for restoration early, with the foresight to begin a native seed collection program in 2010, before construction began. Seed for various annual and perennial species was targeted for collection, with seed for additional species opportunistically collected. The team conducted pre-construction surveys to document baseline conditions for restoration, coordinating cactus salvage, topsoil salvage, decompaction, and re-contouring during construction to support restoration efforts. Site-Specific Restoration Plans were prepared, including pre-construction data and success standards for each site, as well as site-specific seed mixes tailored to the vegetation communities present. Restoration implementation occurred in the winter of 2012/2013. The 5-year Maintenance and Monitoring Program completed in October 2017 with higher success rates than anticipated for this complex project. At the end of year 5, 231 of the 233 restoration areas have achieved success and been signed off by key agencies, including BLM, USFS, and CDFW. An effort this large can be challenging, but incorporating best practices for ecological restoration, such as upfront planning and foresight, establishing appropriate success standards, and ongoing adaptive management, success can be achieved.

A COMMUNITY MEETS A RIVER: THE COLORADO RIVER DELTA RESTORATION PROJECT

Gabriela González-Olimón[1]*, Dzoara Rubio-López*[1] *and Fátima Luna*[2]
[1]Sonoran Institute, Mexicali, Baja California, México
[2]Sonoran Institute, Tucson, AZ, USA

A primary goal of the Sonoran Institute Colorado River Delta Program is to restore riparian, marsh, and estuarine habitat in the Colorado River Delta region located in Northwest Mexico; however, we recognize that community engagement and education is critical to long-term restoration success and stewardship of restored ecosystems. We conduct restoration not only to promote the recovery of species and ecosystems, but to revive and strengthen the connection between communities and their environment.

Our community engagement approach includes the following components: 1) environmental education workshops at restoration sites with K-12 schools and universities in the Mexicali Valley; 2) training and hiring local community members to implement restoration and ecological monitoring; 3) promoting eco-tourism job opportunities for local community members; 4) hosting annual tree planting volunteer events; and 5) restoration site tours and activities with government agencies from the US and Mexico, NGOs, and international visitors.

Over the past two years, nearly 7,000 people from all ages have visited our restoration sites, participated in restoration, or learned about the Colorado River Delta system through in-school workshops. Additionally, we currently employ 22 local community members, who are now highly skilled and knowledgeable in a diverse range of riparian restoration techniques, vegetation and hydrological monitoring, and wildlife and plant identification.

The value of social benefits of restoration has become an important consideration for the dedication of future environmental flows to the Colorado River Delta. One significant lesson learned during the 2014 “pulse flow” release to the Delta under US-Mexico agreement, Minute 319, was the positive impact of such flows for local community members. Now, under the new binational agreement, Minute 323, signed September 2017, the goals of environmental flow deliveries and restoration activities in the Delta will not only include ecological benefits, but also social ones. More than ever, Sonoran Institute and partners must promote community awareness, support, and participation in restoration activities to foster long-term stewardship of restoration sites by local communities and government agencies and successfully scale up restoration activities over the next decade.

PRESENTER BIO: Gabriela is the Environmental Education Coordinator for the Colorado River Delta Program. With a B.S. in biology, she has implemented environmental education programs in Baja California and at Grand Canyon National Park in Arizona. In the Delta, Gabriela promotes ecological restoration by reconnecting communities to the river.

STORM DAMAGE REDUCTION BENEFITS OF NATURAL INFRASTRUCTURE IN THE JACQUES COUSTEAU NERR

*Jarrod Loerzel[1], **Matt Gorstein**[1], Ali M. Rezaie[2], Sarah Ball Gonyo[1], and Chloe S. Fleming[1]*
[1]NOAA National Centers for Coastal Ocean Science, Charleston, SC, USA
[2]George Mason University, Fairfax, VA, USA

Healthy ecosystems provide an array of benefits and services ("ecosystem services") to people, including food, carbon storage, protection from natural disasters, and places to recreate. Ecosystem service valuation provides natural resource managers with the ability to place values on natural ecosystems and to more completely assess the costs and benefits of different management alternatives. This study focuses on the coastal habitat ecosystem (e.g. marshes), which operates as natural infrastructure, and can benefit coastal communities, other types of human development, and economic activity by reducing the impacts of coastal hazards.

For this project, we estimated the economic benefits of shoreline protection provided by marshes to areas in and around the Jacques Cousteau National Estuarine Research Reserve (JC NERR) using a combination of storm, coastal wave, and marsh migration models (i.e. ADCIRC+SWAN and SLAMM). The economic benefits of natural infrastructure in the area were estimated by first identifying and mapping shoreline habitats in relation to developed land areas vulnerable to environmental threats such as storm surge and sea level rise. Then, we estimated the amount of shoreline protection provided to those areas by existing shoreline habitats in a select number of storm and marsh migration scenarios. Finally, we calculated the value of damages avoided (e.g., from storm surge and sea level rise) to coastal communities due to the presence of natural infrastructure using three storm scenarios coupled with current and future marsh migration. Additionally, a second, market-based, method was used to quantify the value of open space preservation (OSP) in terms of its effect on flood insurance premiums. This included insurance premium savings made possible by the preservation of open space through the National Flood Insurance Program (NFIP) Community Rating System (CRS). By utilizing CRS credit point and NFIP discount data for the communities within the area of interest, the economic impact of individual expenditures resulting from flood insurance premium savings due to OSP (as defined by the CRS) was calculated.

Using the assembled data and results, additional analyses may help determine locations for future nature-based infrastructure projects to increase any coastal community's resilience to future environmental or climate-based disturbances.

PRESENTER BIO: Matt Gorstein is a natural resource economist with NOAA NCCOS, sitting at the Hollings Marine Lab in Charleston, SC. Much of his work is focused on economic valuation and statistical analysis, as well as data collection and data management. Matt is interested in indicator development, ecosystem service valuation, and in using numbers to tell stories.

THE CHESAPEAKE BAY PARTNERSHIP'S "STRATEGY REVIEW SYSTEM": DEVELOPING AN ADAPTIVE MANAGEMENT SYSTEM FOR RESTORING THE CHESAPEAKE BAY

David Goshorn[1], *Laura Free*[2], *Carin Bisland*[2], *Kristin Saunders*[3], *Doreen Vetter*[2]

[1]Maryland Department of Natural Resources, Annapolis, MD, USA
[2]Chesapeake Bay Program Office, US EPA, Annapolis, MD, USA
[3]University of Maryland Center for Environmental Science, Cambridge, MD, USA

The Chesapeake Bay Program Partnership is a unique regional partnership consisting of six states, the District of Columbia, the federal government, the Chesapeake Bay Commission, and numerous local government, non-profit, and citizen organizations that has led the restoration of the Chesapeake Bay since 1983. Since the signing of the 2014 Chesapeake Bay Watershed Agreement, the Partnership has sought ways to measure and improve progress toward achieving the 10 Goals and 31 Outcomes described in the Agreement, which include a broad range of topics such as Fisheries, Habitat, Water Quality, Land Conservation, Public Access, Stewardship, and Climate Resiliency. Previous NCER presentations (Session 7, NCER 2016) have described the Agreement and its vision for adaptive management within the Partnership. This presentation will continue that story by describing how the Partnership has now developed and begun implementation of a robust adaptive management process.

A key component of the 2014 Chesapeake Bay Watershed Agreement is the commitment to implement an adaptive management process, "at all levels of the Partnership to foster continuous improvement." The Partnership has devoted much effort and resources over the past several years to developing that process. The resulting "Strategy Review System," which began full implementation in February 2017, provides the tools and process for applying the logic of the "Decision Framework" (the Partnership's blueprint for adaptive management) to biennial reviews of each Outcome in the 2014 Agreement. Workgroups involve their members in a process of critical evaluation of past successes and failures, re-evaluation of basic assumptions, and consideration of recent developments in the scientific, fiscal and policy arenas. This process leads to identification of recommended adaptations which are then presented to the appropriate decision-makers for discussion, decisions, and eventual incorporation into revised Strategies and Workplans to guide the next two years' efforts.

Implementation of this system has required a unique cooperation among scientists, implementers, decisions-makers, and data analysts to agree on common goals, as well as growth of a grassroots understanding of adaptive management that sets the stage for effective leadership. This presentation will explain defining characteristics of the System, the collaborative process followed to develop it, and lessons learned along the way.

The System is already generating some successes and illuminating some challenges. A complementary presentation entitled "Is It Working? Evaluating Successes and Challenges in Implementing Adaptive Management in the Chesapeake Bay Program Partnership" will go into more detail on the evidence of success and provide examples of ways to address challenges across a diverse partnership.

PRESENTER BIO: David Goshorn received his Ph.D. in marine biology from University of Delaware. Since 1992 he has held various positions at Md Department of Natural Resources, including Assistant Secretary and currently Senior Bay Restoration Coordinator. Dave is Chair of the Chesapeake Bay Program's "Enhance Partnering, Leadership, and Management" Goal Implementation Team.

MITIGATING ANTHROPOGENIC WATER MANAGEMENT TO RESTORE RIPARIAN AREAS IN THE SOUTHWEST

Matthew R. Grabau[1]*, Todd Caplan*[2]*, and Chad McKenna*[3]
[1]US Fish and Wildlife Service, Tucson, AZ, USA
[2]GeoSystems Analysis, Inc., Albuquerque, NM, USA

Riparian areas worldwide have been severely impacted by land use changes, flow regulation, and river diversion. The resulting disconnection of floodplains prevents the natural disturbance required for establishment of new vegetation. In the Southwest, these changes encourage dominance by non-native vegetation that out-competes native trees and shrubs in desertified, sometimes saline, floodplains where wildfire is increasingly prevalent. Early riparian restoration attempts consisted of simply re-planting native vegetation. However, without hydrologic restoration, these efforts largely failed. Restoration practitioners have moved toward re-establishment or mimicry of natural hydrology to increase the abundance of water on historic floodplains and promote long-term vegetation success. This presentation provides two case studies that illustrate approaches in the Southwest under differing levels of baseline floodplain disconnection.

Along the Middle Rio Grande in New Mexico, the primary limitations for native riparian plant recruitment are river channelization, flood control, declining groundwater, and dense non-native species. However, existing levee setbacks provide sufficient low-elevation area for inundation with a modest level of earthmoving. The US Army Corps of Engineers has completed a series of restoration projects within Albuquerque with a major emphasis on improving river-floodplain connectivity through construction of “willow swales.” This approach consists of mechanical lowering of the floodplain using heavy equipment followed by planting of native trees and shrubs. Floodplain lowering was designed to reduce groundwater depth and promote inundation at two-year return intervals. This approach has been largely successful, although drought in early years post-construction limited initial inundation and slowed the expansion of willow stands.

Conversely, on the lower Colorado River, many areas lack levee setbacks and farms and municipalities occupy the historic floodplain. Where levee setbacks do exist, river levels are far below the land surface, making floodplain reconnection impractical. This presents a significant challenge for creating thousands of hectares of native vegetation communities required under the Lower Colorado River Multi-Species Conservation Program. To overcome this challenge, restoration relies heavily on irrigation using farming infrastructure and delivery from irrigation districts. This approach has been largely successful in achieving habitat creation goals, but sustainability of vegetation will requires long-term irrigation commitments.

PRESENTER BIO: Dr. Grabau is a science coordinator for the US Fish and Wildlife Service Southwest Region Science Applications Program. Matt has extensive experience with on-the-ground riparian restoration in the southwestern US and northern Mexico, but has spent the last two years focused on communication and coordination of conservation science.

REEFBLK TM – OYSTER REEF BIOENGINEERING, MAD ISLAND PRESERVE, TEXAS: A CASE STUDY

Hunter Guidry
Coastal Environments, Inc., Baton Rouge, LA, USA

ReefBlk$_{TM}$ is a system that uses vertical, triangular-shaped, welded steel rebar structures filled with cultch (oyster shell, limestone, or concrete) to create a living shoreline and aid in the growth of new marsh. Each structure promotes oyster recruitment with an open space in its center that provides maximum surface area and water filtration. When aligned and securely linked together, these structures create linear, intertidal breakwater oyster-reef habitats. ReefBlk $_{SM}$ living shorelines have been deployed in nine locations throughout the Gulf of Mexico, with success in reducing shoreline erosion and accreting sediment and new shell material shed from the reef. This allows for the creation of new marsh to develop between the reef and the existing shoreline.

Information on ReefBlk$_{TM}$ projects located on land managed by The Nature Conservancy at the Mad Island Preserve in Matagorda County, Texas in 2004 will be presented.

PRESENTER BIO: Mr. Guidry is a Project Scientist with 20 years of experience as a project manager in multi-discipline environmental settings. He has extensive experience with ecological projects in wetland regulations and design, Biological Assessments and habitat analysis for mitigation compliance as well as coastal restoration permitting and project management.

INNOVATIVE WATER RESTORATION IMPROVEMENT OPPORTUNITIES THROUGH ENGAGEMENT WITH THE PUBLIC, PRIVATE, AND NON-PROFIT SECTORS

France Guertin[1], ***Todd Guidry***[1], *Thomas Polzin*[1] *and Martha Rogers*[2]
[1]Dow Chemical Company, Midland, MI, USA
[2]The Nature Conservancy, Minneapolis, MN, USA

Dow Chemical Company (Dow) and The Nature Conservancy (the Conservancy) have been engaged in a unique public-private collaboration since 2011. This collaboration has produced ground-breaking research on opportunities for companies to optimize green infrastructure[1] and, more recently, the announcement of Dow's 2025 Valuing Nature Goal.[2]

In this presentation, we will review how the Collaboration has combined both parties' unique knowledge sets, along with the public sector, to implement innovative solutions to addressing water quantity and quality issues. Water quantity and quality are one of the key components of Dow's Valuing Nature Goal as water is a critical input to Dow's production process. We will present three separate solutions developed within Dow's Valuing Nature Goal and implemented across the company to demonstrate the case.

First, we will discuss Dow's implementation of a reverse osmosis membrane in Tarragona, Spain. Dow's plant in Tarragona, Spain sits in an industrial complex that handles over 19,000 m^3 per hour of water, including fresh water from the UNESCO-protected Ebro River Basin. Dow, through funding with the European Union's DEMOWARE initiative, developed a reverse osmosis membrane treatment. As of 2016, Dow's cooling tower used 40% reclaimed water and made over 200 m^3 per hour of additional fresh water available for the municipality. Second, we will discuss Dow's continued upkeep and use of a constructed wetland that was installed to treat wastewater in Seadrift, Texas in the mid-1990s. The constructed wetland continues to treat Dow's wastewater at the site today. We will present how Dow has collaborated with the Conservancy in Texas to design managed burns on the wetland to naturally restore the health and functioning of the wetland ecosystem. Finally, we will present Dow's innovative treatment of zinc in the water at an old mining site in Hot Springs, Arkansas. Dow created a limestone-lined canal that effectively treated the zinc. This natural treatment of zinc has allowed Dow to restore the rest of the area to its natural habitat, which will eventually be sold back to the city and used for a community park.

PRESENTER BIO: France Guertin serves as Dow's Engineered Natural Technologies Program Manager. In this role, France works with manufacturing sites and businesses to invest in smarter, more productive ways that fit seamlessly within Nature. She is a member of the Dow-Conservancy collaboration and Dow's Nature Team, responsible for implementation of Dow's 2025 Valuing Nature Goal.

[1] Sheila MW Reddy Gregory Guannel, Robert Griffin et al., "Evaluating the Role of Coastal Habitats and Sea-Level Rise in Hurricane Risk Mitigation: An Ecological Economic Asessment Method and Application to a Business Decision," *Integrated Environmental Assessment and Management*, 2015 (vol. 12 no. 2): pp. 328-344; Timm Kroeger, Francisco J. Escobedo, José L. Hernandez, "Reforestation as a Novel Abatement and Compliance Measure for Ground-Level Ozone," *PNAS*, September 8, 2014; Sheila MW Reddy, Robert McDonald, Alexander S. Maas et al., "Finding Solutions to Water Scarcity: Incorporating Ecosystem Service Values into Business Planning at The Dow Chemical Company's Freeport, TX Facility," *Ecosystem Services*, 2015 (vol. 12): pp. 94-107.
[2] Heather Clancy, "Dow's Plan to Bank $1 Billion on Natural Capital by 2025," *GreenBiz*, April 15, 2015, available at https://www.greenbiz.com/article/dow-chemical-thinks-it-can-generate-1-billion-valuing-nature.

RESTORATION-ENGINEERING – A BLENDED SCIENCE-ENGINEERING MODEL

Andrew L. Guzzomi[1], *Todd E. Erickson*[2,3], *Monte Masarei*[1], *David J. Merritt*[2,3]

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[2]School of Biological Sciences, the University of Western Australia, Crawley, Western Australia, Australia
[3]Kings Park Science, Department of Biodiversity, Conservation and Attractions, Kings Park, Western Australia, Australia

Whilst the scientific community's ability to establish native plants in lab-type environments is advanced, our inability to implement those outcomes in practice at scale is self-evident. To date the bulk of engineering focus has been on the geotechnical aspects of mine closure such as the stability of earthworks. However, engineering research and development focussed specifically on achieving restoration success is not common. Given the increasing demand for ecosystem restoration, coupled with the lack of skills and techniques to restore ecosystems effectively and authentically, there exists a significant opportunity and urgent need for engineering to broaden its impact and facilitate efficient restoration at scale.

In order to successfully restore the vast degraded areas, engineering and ecology should be integrated throughout all stages of the restoration process. Engineers need to move toward establishing authentic topographies and developing the mechanised and automated seeding technologies for the delivery of enhanced native seed. Such an approach should facilitate the establishment of self-sustaining ecosystems in authentic landscapes at the scales required.

This presentation aims to highlight the unique framework we have adopted that focusses on a blended science-engineering approach to restoration. It will draw attention to the issues facing large-scale restoration in arid environments, demonstrate how it is possible to leverage agricultural engineering approaches and mechanical design expertise to render lab science practical and ultimately achieve better restoration outcomes.

PRESENTER BIO: Dr Guzzomi heads the agricultural engineering activity at The University of Western Australia. Over the past 5 years he has been working closely with Kings Park Science and in 2016 he was awarded the WA Innovator of the Year for the flash flaming technology co-developed with Kings Park Botanic Gardens.

CHANGING THE LOCAL SCENERY BY RESTORING HERNANDO'S COAST

Brittany J. Hall-Scharf[1], *Joshua T. Patterson*[2], *Savanna C. Barry*[3], *Scott E. Taylor*[1], *and William J. Lester*[1]

[1]University of Florida, IFAS Hernando County, Brooksville, FL, USA
[2]University of Florida, School of Forest Resources and Conservation, Center for Conservation, Apollo Beach, FL, USA
[3]University of Florida, Nature Coast Biological Station, Cedar Key, FL, USA

In 2015, Hernando County updated its Noxious Plant Control ordinance to require removal of lead tree (*Leucaena leucocephala*) and Brazilian pepper tree (*Schinus terebinthifolia*) within the county. These invasive species can be detrimental to native vegetation. To date, the County has removed 4,367 lead trees and 1,212 Brazilian pepper trees; additional removals are scheduled. Unfortunately, removing these trees from coastal areas can lead to shoreline erosion. Prompt reestablishment of native vegetation is needed at these removal sites to restore important ecosystem services such as storm protection, pollution filtration, and wildlife habitat.

In response, Florida Sea Grant, UF/IFAS Extension Hernando County, and Master Gardeners partnered with local schools to grow native coastal vegetation for the County's designated removal sites. A community event sponsored by Florida Sea Grant, UF/IFAS Extension, Hernando County Government was held to raise funds. The Future Farmers of America's Living to Serve and Florida Department of Environmental Protection's Coastal Partnership Initiative grants were awarded in support of the project. Intertidal plants were donated by the Florida Fish and Wildlife Conservation Commission's Stock Enhancement Facility and coastal upland plants were sourced from Master Gardeners. Local clubs and businesses donated additional funds for nurseries and educational materials.

To facilitate the growth of intertidal and coastal upland plant species upon removal of the invasive trees, two types of plant nurseries were constructed at local schools. Master Gardeners and parent volunteers were trained by Florida Sea Grant on intertidal plant nursery construction while an agriculture class completed construction of the coastal uplands nursery. Throughout the 2017-2018 school year, volunteers and students dedicated over 740 hours (valued at $16,798.00*) caring for 700 upland plants and 1,000 intertidal plants. These plants will be installed to create vegetated buffers at ten County removal sites to reduce erosion in May 2018 and will be monitored by an intern and citizen scientists. Curriculum developed incorporating the intertidal nursery was adopted by the local school and students from this program taught 13 adults of the Florida Master Naturalist Restoration Course about the importance of the project. After viewing a video created about the intertidal nursery, a neighboring county expanded the program into their area for local living shoreline projects. By participating in hands-on-habitat restoration activities, students will understand the value of maintaining a healthy environment and learn the skills needed to properly operate and sustain these nurseries for future classes.

*Calculation according to 2016 Florida data from Independent Sector

PRESENTER BIO: Brittany is a Florida Sea Grant Agent for UF/IFAS Hernando County with +10 years of experience in fisheries/marine science. She is currently a Co-PI on multiple restoration projects involving oysters, marshes, and seagrasses and a recreational scallop project. Additional experience includes work as an FWC biologist and cooperative research coordinator.

VISUALIZING STRATEGY FOR STAKEHOLDER ENGAGEMENT AND BUY-IN

Daniel Halsey
SouthWoods Ecosystems/ HCSI, Inc., Prior Lake, MN, USA

Ecological design and ecosystem restoration projects have continued to expand in scope across political, geographic, and the boundaries of numerous involved disciplines. With the inclusion of an ever-expanding list of stakeholders involved in funding, feasibility, economic impact, cultural viability, and governmental oversight; data visualization is increasingly displayed to stakeholders less familiar with engineering and scientific presentation. There is an ever-growing pressure to communicate in succinct and visually adept styles to gain immediate stakeholder understanding with reduced eye fatigue and visual noise. Corporate communications have developed systems and graphic standards for ensuring the brand identity and viewer interface that incites greater investment of time and interest.

The visual strategy in developing a brand image and more pleasant experience for stakeholders is defined prior to the development of the designs. Baseline standards help ensure that elements that deter clear understanding are eliminated during presentation development. Recognition of these improvements in design are immediate and appreciated.

Template and formats for each type of visualization reduces production time, leaving margins for later embellishment as needed. Each project will have its site-specific style built on a core of graphic standards to support consistent graphic quality.

Communicating strategy, patterns, and implementation detail without creating client fatigue requires making the visual presentation a pleasant experience; regardless of the stakeholder training, language, culture, or education. In this presentation we will define the causes of Eye Fatigue, Extraneous Elements, and Visual Noise. Then review the elements in a design to enhance the viewer experience.

1. Background and Foreground Contrast.
2. Graphic Standards and Developing a prototypical style
3. Color Palette
    a. High Saturation vs Moderated tones.
    b. Natural Hues and Earth Tones
    c. Site Defined Color Palette.
    d. Color Depth
4. Text and Detail
    a. Type Faces and the “Easy Read”.
    b. Call-outs and
5. Opacity and Layering
6. References: Edward Tube

PRESENTER BIO: Daniel Halsey is a professional agro-ecosystems designer. Daniel has a Bachelor of Science degree in Temperate Climate Polyculture Design and a Masters of Professional Studies in Horticulture from the University of Minnesota. He is hired nationally and internationally to design agro-ecosystems, botanical preserves, and ecological restoration initiatives. Dan is also managing director of PRI/USA and the Natural Capital Plant Database.

MEASURING SUCCESS OF MULTIPLE GULF COAST RESTORATION PROGRAMS: ACCOUNTABILITY FOR LONG-TERM SUCCESS

David A. Hanson[1]*, Buck Sutter*[2]*, Robert Moorhead*[3]*, Rost Parsons*[4]*, and Jeffrey Talley*[5]

[1]HansonRM, Blaine, WA, USA
[2]Buck Sutter, RESTORE Council, New Orleans, LA, USA
[3]Northern Gulf Institute, Mississippi State University, Starkville, MS, USA
[4]NOAA National Centers for Environmental Information, Stennis Space Center, MS, USA
[5]IBM Global Markets and University of Southern California, Scottsdale AZ, USA

The scope of activities associated with funding from Deepwater Horizon (DWH) oil spill response and settlements (e.g., GoMRI, NRDA, RESTORE Act, and NFWF Gulf Environmental Fund) is unprecedented in terms of the amount of research and restoration focused on the northern Gulf of Mexico and the level of collaboration among researchers and restoration managers. Restoration managers have committed to monitor the performance of individual restoration projects as part of an adaptive management approach to restoration. In addition, researchers, resource managers, and restoration professionals are committed to collect and provide vast amounts of environmental data in a format that is available for future use for understanding the complex elements and interactions of the Gulf ecosystem. Despite the extensive levels of research and restoration, DWH settlement funding will be insufficient to fully address wetland loss and degraded habitat, declining water quality, and the conservation and restoration of living coastal and marine species associated with non-DWH stressors. This raises the question whether we can expect the public to fund research and restoration at significant levels as DWH settlement funding is exhausted, especially if we are prepared to show meaningful benefits from the current unprecedented levels of funding. The time to think about how we might measure the overall effects of multiple DWH settlement-based programs is now, before the bulk of the funding has been spent.

This panel discussion brings together experts to discuss innovative approaches to measuring the cumulative success and benefits from multiple restoration programs while focusing on (1) the challenges and opportunities associated with meta-analysis of the massive amount of data generated from DWH settlement activities; and (2) how advancements in technology can be incorporated in the effort to understand overall restoration success when the focus on funding monitoring activities is on project performance.

PANELIST BIOS:

Mr. Hanson is the Principal of HansonRM and provides consulting services to complex environmental challenges based on the integration of environmental, economic, and cultural considerations using decision support systems. He has co-authored Gulf of Mexico focused publications on the use of decision support frameworks for project selection, as well as the identification of ecological indicators to assess the cumulative success of multiple restoration programs.

Mr. Sutter is the Deputy Executive Director for the RESTORE Council where he is responsible for implementation of the RESTORE Act funding associated with habitat and water quality restoration and the conservation of living coastal and marine species. He also led the development of the Long-term Ecosystem Restoration Strategy for the Northern Gulf Coast that is incorporated heavily into NRDA and RESTORE Act restoration programs.

Dr. Moorhead is the Director of the Northern Gulf Institute (NGI) and the Geosystems Research Institute (GRI) at Mississippi State University. He leads NGI's academic partners research on understanding human's impacts on Gulf ecosystems and associated economies. He also leads GRI's research on the application of technology to natural resource management.

Dr. Rost Parsons is the Deputy Director for the Center for Coast, Oceans, and Geophysics (CCOG) under NOAA's National Centers for Environmental Information (NCEI). Dr. Parsons leads a diverse scientific staff directed at full range of stewardship of the nation's oceanographic, coastal and geophysical environmental data.

Lt. General (retired) Jeffrey Talley is a Vice President for IBM's Global Public Sector where he focuses on the use of expert systems and artificial intelligence in emerging global markets associated with emergency response, water resources, and national security. His is also a Professor in the Price School of Public Policy and the Viterbi School of Engineering at the University of Southern California. Dr. Talley retired in 2016 as the Commanding Chief of the Army Reserves.

EVALUATING RESTORATION EFFECTIVENESS: A TIDAL WETLAND MONITORING FRAMEWORK FOR CALIFORNIA'S SACRAMENTO-SAN JOAQUIN DELTA

***Rosemary Hartman**, Stacy Sherman, and Dave Contreras*
California Department of Fish and Wildlife, Stockton, CA, USA

Restoration of tidal wetlands in California's Sacramento-San Joaquin Delta is a wicked problem. With multiple mandates, multiple stakeholders, multiple at-risk species, and more challenges than solutions, it is hard to implement projects, much less determine whether they are making progress toward their goals. To help integrate the multitude of disparate projects and organizations monitoring tidal wetlands, the Interagency Ecological Program's (IEP) Tidal Wetland Monitoring Project Work Team has developed the Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary. This framework intends to standardize effectiveness monitoring of restoration for the benefit of at-risk fishes, specifically salmonids, Delta Smelt, and Longfin Smelt.

Through a three-year process of open, collaborative, interagency meetings, the group clarified their conceptual models of wetland function, listed hypotheses for how tidal wetlands might have the expected outcomes, and determined which metrics and methods would be most useful for testing the hypotheses. The Framework includes information on permitting requirements for conducting monitoring activities, data analysis methods, existing data sources, use of reference sites, and specific standard operating procedures for each of the suggested methods. Together, the Framework is intended to be a "menu" from which monitoring teams can develop a monitoring plan with hypotheses and methods suited to their specific restoration goals.

Each step in the process of constructing the Framework involved collaboration amongst the top scientists in IEP's nine member agencies, with contributions from university scientists, contractors, stakeholders, and project designers. While there are multiple challenges facing construction and monitoring of restoration sites, the Framework is designed to provide multiple tools to evaluate project goals and objectives – going beyond the question "Did we build a wetland?" to the question "Is our wetland functioning the way we want?"

PRESENTER BIO: Dr. Hartman is a Senior Environmental Scientist with the Fish Restoration Program's Monitoring Team. She landed in the wetlands of California after working with frogs in mountain lakes, wading birds in Florida, and trout in Idaho. Her favorite California native fish is the Tule Perch.

DECISION SUPPORT TOOLS AS OPPORTUNITIES FOR ENGAGEMENT AND COMMUNICATION

Leah Sharpe, Susan Yee, ***Matthew C. Harwell***
U.S. Environmental Protection Agency, Gulf Breeze, FL, USA

Decision support frameworks create structure for the numerous steps involved in making a decision. Many frameworks include elements for incorporating stakeholder input into the decision process. By helping decision makers to take a more structured and transparent approach at key points within the decision process, the use of decision support tools (DST) also provides support for the communication efforts of ecosystem restoration practitioners by setting up clear opportunities for stakeholder engagement and consistent messaging regarding the decision process. In this presentation, we discuss our experiences with decision support tools for applications in ecosystem services as they inform both stakeholder identification and engagement processes, and aid valuable communication efforts. Our main target audience for this presentation includes decision makers (e.g., land managers and community decision makers), however, our focus on elements of stakeholder engagement and communication in structured decision making is relevant for a range of ecosystem restoration practitioners.

PRESENTER BIO: Matt has spent two decades working on restoration science in multiple systems including Chesapeake Bay, Lake Okeechobee, South Florida and the Greater Everglades, and the Gulf of Mexico. Matt's areas of specialization include ecosystem assessment, integration and communication of science for decision makers, and adaptive management and ecosystem restoration.

EFFECT OF WATER DEPTH ON GERMINATION AND GROWTH OF FEDERALLY ENDANGERED TEXAS WILD RICE

Leah Murray and ***Christopher R. Hathcock***
U.S. Fish and Wildlife Service, San Marcos Aquatic Resources Center, San Marcos, TX, USA

Zizania texana is a federally endangered aquatic macrophyte restricted to the first 4.3 km of the spring-fed, thermally constant San Marcos River in San Marcos, TX, USA. It occurs from shallow, low-velocity water (< 30 cm deep, flows < 1.3 m^3/s) to deep, high-velocity water (> 4 m deep, flows > 5.7 m^3/s). Although the current population appears to be stable, *Z. texana* is highly vulnerable to catastrophic events, as well as direct and indirect impacts from intense human recreation, invasive species, and river-bank erosion. To mitigate this, unified efforts by city, state, and federal partners, through the Edwards Aquifer Authority Habitat Conservation Plan, are underway to manage and restore the natural population. As part of these efforts, *Z. texana* is propagated from seed at the U.S. Fish and Wildlife Service's San Marcos Aquatic Resources Center for transplantation into river restoration sites.

The optimal depth for germination and early seedling growth of *Z. texana*, both in the wild and within propagation tanks, is unknown. Further, although viable seeds and vegetative reproductive parts are frequently observed in the wild, their ability to become established at the site to which they are dispersed may be limited by the water's depth at that site. Understanding this influence would allow more effective restoration-site selection and management, as well as greater productivity in the greenhouse. We measured germination and early growth of *Z. texana* at three distances from the water surface (64 cm, 38 cm, and 14 cm) under controlled conditions in 3,400 L fiberglass aquaculture tanks. Among all depths, germinability ranged from 33.3 to 62.5% and mean germination time ranged from 9.2 to 54.2 days ($N = 72$). We detected no significant difference in germinability, mean germination time, germination time variability, or uncertainty of the germination process among water depths (one-way ANOVA; $P \geq 0.05$); however, compared to plants at each of the other two levels, average longest-leaf growth was much greater for the deepest-level plants and mean absolute biomass was slightly greater for mid-level plants (two-way ANOVA; $P \leq 0.05$). Results suggest that, under our experimental conditions, *Z. texana* exhibits similar germination rates at various depths but develops greater vegetative growth in deeper water. Therefore, increasing the water depth at which plants are propagated could aid in producing larger, more robust plants prior to their transplantation into restoration sites. Larger transplants would likely have greater establishment success compared to smaller transplants. Also, unlike smaller transplants, they could be effectively transplanted into deeper parts of the river, which afford better protection from catastrophic events and recreational activities.

PRESENTER BIO: Mr. Hathcock has more than 15 years of experience, working for both the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service, in designing, implementing, and managing habitat restoration projects in Texas, with a focus on riparian woodlands and associated riverine systems.

PLANT INVASION ACROSS SPACE AND TIME: CHINESE TALLOW RANGE EXPANSION IN SOUTHEAST UNITED STATES

***Samantha Heldman*[1]**, *Christopher Vazquez*[2], *Yovana Marinkovic*[3], *Miranda Peterson*[4], *Zakary Derouen*[5], *Alexandra Bishop*[1], *Leonilla Chilongo*[4], *Hsiao-Hsuan (Rose) Wang*[6], *Tomasz Koralewski*[5], *William Rogers*[5], *William Grant*[6]

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Chinese tallow, *Triadica sebifera* (L.) Small, a native tree of China and Japan, was introduced to South Carolina in the 1700's and distributed in the 1900's as a commercial crop widely regarded for its attractive ornamental characteristics. Chinese tallow is an especially aggressive woody invader, disrupting the native ecosystem structure by forming monotypic stands. Due to its high fecundity and relatively quick maturation, the Chinese tallow has become one of the most prevalent invasive species in the southeast United States. The invasion of non-native species contributes to the modification of biogeochemical cycles, inhibition of natural regeneration of native species, and the loss of ecosystem biodiversity and productivity. Hence, the objective of this study is to identify potential determinants of invasion and quantify the relative importance of each factor for the purpose of providing valuable information upon which to base effective control strategies and mitigation plans. We documented the recent range expansion of Chinese tallow in southeastern U.S. based on field data (SNIPET) collected by the US Forest Service on fixed plots during two cycles. We then superimposed FIA data and bird survey information on the data. We finally quantitatively identified a set of potential factors affecting the invasion using multiple linear regression.

Chinese tallow generally spread northward, with the number of sample plots in which Chinese tallow was detected approximately doubling (from 616 to 1226) and mean percent coverage of Chinese Tallow in sample plots increasing significantly (t-test = 7.27, P-value < 0.05) during this period. Distances to the nearest known propagule source ranged from 0.8 km to 37km, with a mean (± SE) of 20.54 km (± 1.27 km) during the two cycles. Our results of multiple linear regression indicated that the invasion was positively associated with elevation, adjacency to water bodies and negative associated with forest age and management activities. By identifying the potential factors of Chinese tallow invasion, our analyses should provide land managers with useful information to plan proactive management strategies for the locations most likely to be invaded.

PRESENTER BIO: Samantha Heldman is a senior biology undergraduate at Texas A&M University. As an Applied Biodiversity Science Conservation Scholar and Aggie Research scholar, she conducts systems analysis research in the Ecological Systems Laboratory and plans to pursue a career in conservation ecology and natural resource management in the future.

INCORPORATING LOCAL KNOWLEDGE INTO ECOLOGICAL RESTORATION ASSESSMENTS – CASE STUDIES IN COASTAL LOUISIANA

Scott A. Hemmerling *and Monica Barra*
The Water Institute of the Gulf, Baton Rouge, LA, USA

Reducing the risk of exposure to coastal hazards requires engagement with residents and stakeholder groups likely to be affected by policy actions and those who are especially vulnerable to risk. Beyond simple engagement, however, coastal residents who are most at risk should be given ample opportunity to actively participate in reducing the risks to which they are exposed through active, direct participation in the restoration and protection planning process. Community members hold perceptions of risk that shape their preparedness and mitigation activities, such as which places in their community are dangerous, and which are thought to be safe. Such local knowledge and environmental perceptions are often geographically explicit and exert powerful influences on behavior. It is therefore incumbent on planning agencies to provide a variety of pathways for citizens to learn about and participate in the coastal restoration process, including small group gatherings, web offerings, direct communication with local and state governments, and public meetings. The state of Louisiana has established a set of outreach and engagement principals highlighting the importance of public participation in the restoration planning process. Yet, because the state's restoration planning process relies heavily on numerical models to optimize project selection and location, methodological challenges exist in integrating locally gathered community knowledge into the coastal protection and restoration framework.

Recently, however, participatory social science has become a more prominent component in resource management and human-environment research. Several mixed-method and multi-disciplinary strategies for incorporating local understanding of environmental and social change resulting from ecological restoration projects were piloted in coastal Louisiana, a region that has historically experienced globally high rates of wetland loss due in part to a combination of sea level rise, subsidence, saltwater intrusion, and reduced sediment inflow. Researchers developed and implemented several distinct research protocols framed around recent natural and human-induced environmental changes designed to elicit local understanding of what ecological restoration has historically achieved as well as a suite of potential short- and long-term outcomes of emerging ecological restoration projects.

The methods presented here represent advances in rigorous, replicable, and accessible forms of collecting local knowledge to assess and monitor the social value of ecological restoration. Qualitative research methods such as local knowledge mapping, scenario building, and social value assessment have been used to translate and quantify local knowledge, allowing researchers to incorporate these data into ecological restoration project impact assessments. Each of these strategies enable researchers to consider a wide range of values, knowledge, and perspectives and incorporate them into collaborative problem-solving frameworks allowing researchers to refine restoration practices holistically as a set of relations between social and ecological systems.

PRESENTER BIO: Scott Hemmerling, Ph.D. is the Director of Human Dimensions for The Water Institute of the Gulf, focusing on research related to climate adaptation and community resilience. He has more than fifteen years of experience investigating anthropogenic alterations to the landscape and the impacts of development on coastal communities.

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

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

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[4]U. S. Geological Survey, Southeast Region, Baton Rouge, LA, USA
[5]U. S. Fish and Wildlife Service, Fairhope, AL, USA

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. One of the programmatic goals established in the Trustees' Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (PDARP/PEIS) is to "Provide for Monitoring, Adaptive Management, and Administrative Oversight to Support Restoration Implementation" to ensure that the portfolio of implemented restoration projects provides long-term benefits to the resources and services injured by the spill. A MAM approach to restoration will allow the Trustees to evaluate restoration effectiveness, address uncertainties related to project planning and implementation, and provide feedback to inform future restoration decisions.

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 make recommendations on effective evaluation of restoration outcomes at project, resource, and programmatic scales. On behalf of the Trustee Council, the Cross-TIG MAM work group has developed a MAM Procedures and Guidelines Manual (MAM Manual) Version 1.0. The MAM Manual is intended to guide MAM efforts conducted by the Trustees and provides recommended 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 also provided for the restoration of coastal wetlands, beaches, dunes, barrier islands, water quality, and recreational use opportunities. 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. The MAM Manual is intended to serve as a resource for the TIGs and future versions of the MAM Manual may include additional MAM topics beyond the project scale, such as approaches for resource-level and programmatic monitoring and evaluation.

PRESENTER BIO: Mrs. Hijuelos is an ecologist with over 10 years of experience. Hijuelos' research is focused on the planning and implementation of adaptive management programs, including the development of science-based tools to inform restoration decisions and the assessment of monitoring needs for large-scale restoration programs in the Gulf of Mexico.

ASSESSMENT OF TREATMENTS AND LONG TERM SUCCESS IN RESTORING COMMON REED (*PHRAGMITES AUSTRALIS*) DOMINATED MARSHES ON DELAWARE BAY, 1996-2017

Raymond L. Hinkle[1]*and Brenda Q Evans*[2]
[1]AECOM Technical Services, Inc., Clifton, NJ, USA
[2]PSEG Nuclear, Hancocks Bridge, NJ, USA

The Salem Generating Station, in response to its New Jersey Pollutant Discharge Elimination System (NJPDES) permit, embarked on an unprecedented effort to help restore a portion of the Delaware Estuary in New Jersey and Delaware (USA) by establishing the Estuary Enhancement Program (EEP) in 1994. Today, the EEP is recognized as the largest privately funded program of its kind in the US, with more than 20,000 acres of salt marsh and adjacent uplands being restored, enhanced and/or preserved.

Included in the areas that are being restored under the EEP restored are 4,200 acres of brackish marsh located in New Jersey and Delaware that were dominated by monotypic stands of invasive Common Reed (*Phragmites australis*). The objective of the restoration efforts at the *Phragmites*-dominated sites was to induce the re-establishment of smaller channels, improve the quality of fish habitat, decrease the availability of *Phragmites* seed and the potential for spread of *Phragmites* by rhizomes, provide a suitable substrate for colonization by more desirable species, such as *Spartina alterniflora*, and reduce
shading of the developing desirable plant species.

Initial restoration was achieved by aerial and ground application of glyphosate-based herbicide followed by prescribed burning the following winter to remove standing culms form the prior growing season and expose the marsh plain. Topographic mapping was then completed to assess marsh plain elevations relative to mean tide levels and assess channel geomorphology.

Significant regrowth of *Phragmites* occurred following initial treatments, triggering the implementation of an extensive Integrated Pest Management (IPM) program that assesses available mechanical and biological alternatives to continued herbicide treatments. The effectiveness of treatments was assessed through collection of ground measurements of percent coverage within quadrats as well as interpretation of aerial photography to assess overall vegetative coverage within Test Areas.

Annual treatments have continued to date in order to maintain *Phragmites* coverage at the established coverage goal of 4 percent. Annual vegetation cover mapping and geomorphological analysis document the success of this long term *Phragmites* restoration.

PRESENTER BIO: Mr. Hinkle, Principal Ecologist at AECOM, has more than 30 years of experience planning, designing, and implementing wetlands construction projects. He has provided restoration services to the PSEG Estuary Enhancement Program since 1993 and is a member of the Adaptive Management Team established for this project.

COMBINING CULTURAL/RECREATIONAL BENEFITS WITH ECOSYSTEM RESTORATION – THE DELAWARE BRANCH CANAL TRAIL PROJECT

Raymond Hinkle[1]*and Kevin Donnelly*[2]
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[2]New Castle Conservation District

The Delaware City Branch Canal Pedestrian and Bicyclist Trail was designed to establish a linkage between the Delaware City Promenade and the existing Michael Castle Trail along the Chesapeake & Delaware Canal. The 2,300 foot wide area between these two points was adjacent to a degraded berm along the Branch Canal that had failed and allowed tidal flooding of low lying areas that were supporting a wetland community dominated by a range of wetland species, including *Phragmites australis.* Historical mapping and aerial photography indicate that this area was previously a freshwater wetland system. Also within this area is the historic African Union Cemetery, the burial place of 5 members of the US Colored Troops who served on the side of the Union in the Civil War. The Delaware City Mobil Home Park occupies the immediately adjacent area.

The design of the trail took into account providing protection for and stimulated restoration of the African Union Cemetery as a landmark along the trail, provided a level of flood protection for the adjacent residential community, and allowed for the reestablishment of a resilient emergent and forested freshwater wetland system. The project was authorized under a US Army Corps of Engineers (ACOE) Permit that requires implementation of compensatory mitigation for this project to establish a diverse freshwater wetland ecosystem, include the following: (1) creation of 0.28 acres of forested wetlands along with forested wetland restoration/enhancement (plantings) of 2.87 acres of existing emergent wetlands to provide for creation of 3.15 acres of non-tidal forested wetlands; (2) creation of 1.46 acres of non-tidal aquatic bed coupled with enhancing 1.05 acres of existing wetlands to provide 2.51 acres of aquatic bed; (3) restoration/enhancement (through plantings) of 1.16 acres of emergent wetlands to a non-tidal scrub-shrub wetlands; and, (4) restoration/enhancement of 3.13 acres of tidal wetlands to a non-tidal wetland.

The Delaware City Branch Canal Pedestrian and Bicyclist Trail project represents an example of combining cultural/recreation improvements with ecosystem restoration in a manner that is compliant with regulatory permitting guidelines and incorporating resiliency into a restoration design that increases wetland diversity in the region.

PRESENTER BIO: Mr. Hinkle, Principal Ecologist at AECOM, has more than 30 years of experience planning, designing, and implementing wetlands construction projects. He has extensive experience with wetland restoration and habitat creation, and has led projects involved with both freshwater and tidal restorations in the northeastern USA.

BINATIONAL COOPERATION IN RESTORING THE COLORADO RIVER DELTA – STAKEHOLDER AND GOVERNMENT ENGAGEMENT ACROSS BORDERS

Osvel Hinojosa-Huerta[1]*, Jennifer Pitt*[2]*, Carlos de la Parra*[3]*, and Peter Culp*[4]

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[2]National Audubon Society
[3]El Colegio de la Frontera Norte
[4]Culp & Kelly, LLP

In the 1980s, the Colorado River delta was considered a dead ecosystem, dried-out by water diversions throughout the basin. However, agricultural return flows and inadvertent releases triggered a partial recovery of the delta, generating a binational initiative for the restoration of this region. A key element has been the engagement of stakeholders and governments in the US and Mexico. Science and conservation planning were critical initial steps, generating a common understanding of this ecosystem and a shared vision on the restoration goals, in an adaptive process. Research on social, economic, legal and policy issues helped to develop effective mechanisms for restoration, from water acquisition and land protection protocols to riparian and wetland restoration techniques.

With these tools in place, a binational coalition of environmental organizations have reached-out to agencies and water users. In Mexico, we have collaborated with federal agencies to elevate the Colorado delta as a national conservation priority and to develop the institutional frameworks to facilitate the allocation of water for the environment. At the local level, we have worked with farmers and water managers of the Mexicali Valley to design the restoration mechanisms that fit their views and needs. In the US, we have built a relationship with federal and state agencies as well as water authorities and users, understanding their perspectives and facilitating cooperation across the border. This has allowed the environment to be part of the binational dialogue in the framework of the International Boundary and Water Commission (IBWC). In 2012, the US and Mexico, with the participation of the environmental groups, signed a 5-year agreement, Minute 319 of the 1944 U.S.-Mexico Treaty, defining a new era of cooperation in the basin. In addition to establishing mechanisms for addressing the drought and developing water conservation projects, the minute included an environmental component which allocated 195 million cubic meters of water for the delta, provided jointly by the US, Mexico, and the environmental groups. The minute also provided $3 million dollars for restoration projects and facilitated a binational monitoring and research effort.

The Environmental Workgroup of the Minute included the participation of federal and state agencies, environmental groups, water users, and an advisory committee of scientists. The results included the release of an unprecedented “pulse flow” of water into the delta, which flowed down to reach the tides of the Gulf of California, attracting international media interest and generating strong local support for the recovery of the river. Minute 319 expired in December 2017, and to continue the collaboration across the border, the US and Mexican Commissioners of IBWC signed Minute 323 on September 2017, extending the cooperative measures into 2026. Again, the agreement includes an environmental component, now with a minimum of 259 million cubic meters of water for the environment, $9 million dollars for restoration, and $9 million dollars for science and monitoring. Through collaboration at multiple levels, the binational restoration of the Colorado River delta is becoming a worldwide model to protect and recover shared rivers, even under complex legal and institutional frameworks.

PRESENTER BIO: Osvel Hinojosa-Huerta is the Director of the Water and Wetlands Program for Pronatura Noroeste and a National Geographic Explorer. He has been working in the restoration of the Colorado River delta and other critical wetlands of Northwestern Mexico since 1997.

CONSIDERATION OF SMALL-SCALE STREAM AND WETLAND RESTORATION EFFORTS IN AN URBAN ENVIRONMENT

Isaac Hinson
City of Charlotte Storm Water Services Division

By definition, urban ecosystem restoration efforts are limited by multiple constraints and limited functional potential. The City of Charlotte (North Carolina) has multiple municipal programs that seek to implement ecosystem restoration measures to meet various goals. Goals include clean water, green space, recreation, and wildlife habitat. Restoration projects include aquatic (streams and wetlands) and terrestrial (Piedmont Prairie) systems.

One of Charlotte's main environmental focal points is improving the city's surface water quality, which is generally impaired due to past impacts and ongoing development. Charlotte has a stream and wetland restoration initiative that is a component of a greater water quality program. This program includes a municipal stream and wetland mitigation bank that seeks to improve water quality and maximize the amount of stream and wetland impacts that are mitigated locally. Project site selection for the mitigation bank has historically been based on a large-scale analysis of project benefit and feasibility. The program is transitioning to a methodology that incorporates watershed-based planning, includes mitigation bank and non-mitigation restoration, and pilots new designs and techniques.

This presentation will cover the strategies, challenges and benefits of implementing small-scale stream and wetland restoration in an urban environment. Discussion points will include ecosystem function, community engagement, and project collaboration opportunities (and challenges).

PRESENTER BIO: Isaac Hinson works for the City of Charlotte's water quality group. He supervises the group's watershed restoration team and is responsible for water quality project implementation, including stream and wetland restoration and storm water control measures (a.k.a. BMPs). Isaac is a Professional Wetland Scientist, has B.S and M.S. degrees in biology, and has over 15 years of experience in stream and wetland management.

ESTIMATING CHARACTERISTICS OF FORESTS IN THE APALACHICOLA REGION USING REMOTELY SENSED IMAGERY AND FIELD SAMPLES

John Hogland[1], *Nathaniel Anderson*[1], *Jason Drake*[2], *Paul Medley*[2], *David Affleck*[3], *and Joseph St. Peter*[3]

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[2]USFS, National Forests in Florida, Tallahassee, FL, USA
[3]University of Montana, Missoula, MT, USA

Accurate information is critical for effective management. Within forestry, key information related to forest characteristics used to inform management include stand metrics such as species composition, tree basal area (per acre, BAA), and tree density (trees per acre, TPA). Quantifying those metrics accurately, in spatial detail, across broad landscapes is important to inform the management process. However, the financial cost of acquiring this type of information at fine spatial resolutions across large extents significantly limits the amount of spatial detail that can be quantified and used to inform the forest planning process.

In large part these costs can be attributed to the techniques employed to quantifying BAA and TPA by species. The classical approach to quantifying these metrics uses a probabilistic sampling design that records tree measurements for small subsets (the plot) of an area of interest and summarizes those plot measurements to estimate a mean and measure of variation for that area. While this technique is well documented and used throughout forestry, the number of samples required to precisely and accurately describe a forest at the spatial scale of a project using field plots alone is generally cost prohibitive.

Alternatively, fine grained remotely sensed data, can be used in combination with far fewer field plots to precisely and accurately quantify forest metrics such as BAA and TPA at fine spatial resolutions, across large extents. This methodology leverages the broad coverage and temporal, spectral, and spatial resolutions of remotely sensed data with the detailed forest information collected at plots by drawing mathematical relationships between remotely sensed data and plot measurements and using those relationships to estimate mean plot values across the extent of the imagery.

As part of the Apalachicola Regional Restoration Initiative, we are developing and implementing a study tailored specifically to capitalize on the relationships between fine grained remotely sensed data and field plots. This includes developing a practical field protocol that takes into consideration the locational accuracy of both field and remotely sensed data while insuring a sample design that provides ample representation of the forested and remotely sensed condition. Leveraging our field protocol, newly developed sample design, remotely sensed data, and the measurements collected at our plot locations, we will produce fined grained spatially explicit estimates of the forested condition across the Apalachicola region which in turn provides the detailed information needed to address cost effective, project level forest restoration planning and monitoring.

PRESENTER BIO: John Hogland is a Biological Scientist with the USFS, Rocky Mountain Research Station. His research has focused on quantifying forest characteristics across broad landscapes, developing new methodologies and applications that integrate spatial, machine learning, and statistics modeling concepts into geographic information systems, and creating efficient “Big” data processing techniques.

SEDIMENT MANAGEMENT FOR DAM REMOVAL: A REVIEW OF REGULATIONS, GUIDANCE, AND BEST PRACTICES

Lisa Hollingsworth-Segedy[1]*, Serena McClain*[2] *and Brian Graber*[3]

[1]American Rivers, Pittsburgh, PA, USA
[2]American Rivers, Washington, DC, USA
[3]American Rivers, Nevada City, CA, USA

In 20 years of focused implementation, the removal of dams has proven to be an effective means of reconnecting aquatic habitat, eliminating public safety hazards, retiring obsolete infrastructure, restoring natural form and function, and improving access for angling and boating. However, one of the thorniest issues in planning for and designing a dam removal is sediment management. It has a huge impact on dam removal design and construction costs, and there is significant variability in sediment management requirements from state to state. The level of effort required for sediment data collection and analysis is commonly not directly connected to actual risk of impacts associated with sediment release. The Bureau of Reclamation's recently released "Dam Removal Analysis Guidelines for Sediment" is directed at informing both regulations and practices in an effort to match the level of data collection, analysis, and mitigation against the risk of potential sediment impacts resulting from dam removal.

In addition to addressing risk of potential sediment impacts, American Rivers supports the consideration of habitat benefit that carefully timed sediment release can provide to downstream reaches where the presence of a dam has altered the normal sediment transport regime. This talk will highlight discrepancies in state dam safety regulations regarding sediment data collection and analysis, review the guidelines provided by Subcommittee on Sedimentation, and compare the results of sediment management strategies from dam removal implementation across the nation.

PRESENTER BIO: Lisa Hollingsworth-Segedy is a Director for River Restoration in American Rivers' Pennsylvania Field Office. In the past decade, she has been involved in more than 150 dam removal projects in Pennsylvania and West Virginia.

EVERGLADES RESTORATION AND THE SOUTH FLORIDA NATURAL RESOURCE CENTER: THE SCIENCE DIVISION OF EVERGLADES NATIONAL PARK

Tonya Howington
Everglades National Park, Homestead, FL, USA

The South Florida Natural Resources Center (SFNRC) engages in applied science and on-the-ground management to restore and protect the natural resources of Everglades National Park. Our science provides key information to National Park Service (NPS) managers and to the Everglades Restoration community, so that projects are designed and operated to benefit Everglades National Park as an important place within the Greater Everglades ecosystem. Since its establishment in 1978, the SFNRC has managed well over 800 applied science projects. Over one-third of those projects are funded by the Critical Ecosystem Studies Initiative (CESI), which is a Congressional science program aimed at supporting Everglades restoration and natural resource management on federal lands in South Florida. The Department of Interior gave responsibility for the management of the CESI program to Everglades National Park (ENP) via the SFNRC in 1997.

SFNRC scientific projects specifically focus on assessing and informing Everglades restoration infrastructure and operations projects, including Modified Water Deliveries, the Tamiami Trail Next Steps bridging project, and Comprehensive Everglades Restoration Plan (CERP) projects (especially C-111 Spreader Canal Western Project and Central Everglades Planning Project). We also focus on more local restoration and management projects within ENP, including the plugging of Cape Sable canals and the implementation of a new ENP General Management Plan.

An important challenge, and usually the goal of most of the SFNRC Applied Science activities, is to synthesize, or distill and recommend how to apply the compelling concepts of the restoration science being performed by different agencies, universities, non-profits, and businesses for restoration planners and decision-makers. Current projects SFNRC Applied Science is working on include CERP's Central Everglades Planning Project, the second phase of bridging Tamiami Trail, as known as Next Steps II, as part of the Modified Waters Deliveries project, the second phase of Cape Sable Dams Restoration, and acquisition of the remainder of lands needed for restoration of the northeastern section of Shark Slough within EVER.

This presentation will go over specific science project as examples of the breadth of science the SFNRC has funded and managed.

PRESENTER BIO: Dr. Tonya Howington is the Permit Coordinator for Everglades and Dry Tortugas National Parks. She is also the Critical Ecosystems Initiative Studies (CESI) Project Management Specialist. She has studied rivers, lakes, and wetlands, which led to a Doctorate and Masters of Science in Environmental Engineering Sciences from the University of Florida

MEASURING RESILIENCE DERIVED FROM HABITAT CONNECTIVITY TO IMPROVE ESTIMATES OF RESTORATION BENEFITS

Kristen Hychka[1]*, Lisa Wainger*[1]*, Elizabeth Murray*[2]*, and Elizabeth W. Price*[1]

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Benefits to species from ecological restoration depend on site and landscape conditions that determine both the likelihood of success and the relative ecological impact of restoration. Landscape condition can set limits on restoration benefits by constraining the types of restoration that are possible and controlling the degree to which a site becomes part of a network of habitat that can sustain populations over the long term. These two aspects make up the landscape resilience of a site: the potential for self-sustaining effectiveness of the restoration and the contribution of the restoration to population-scale biodiversity.

Incorporating landscape resilience metrics into restoration site assessment can improve the capacity to quantify the value of restoration by: (1) adjusting for the probability of success of restoration by capturing landscape-level influences on restorability; and (2) capturing the lift associated with restoring a site that has the potential for broad, population-level enhancements by reducing barriers to connectivity and/or providing stepping stones between core habitats.

We reviewed the literature to identify metrics of landscape resilience to measure benefits generated by environmental restoration of wetlands and riparian systems. Our specific focus was to identify metrics that could be used when comparing a set of alternative available restoration sites as opposed to selecting optimal sites. The talk will present example tools and case studies that demonstrate the multiple approaches being used to screen sites and quantify potential benefits. Further, we will present a suite of landscape resilience metrics identified for population-level effects (those that identify barriers or pinchpoints, contribute to regional connectivity, and provide stepping stones) and site-level restorability metrics (those that capture local landscape connectivity and identify intermediate resilience sites that may be more restorable). We will present an application of these metrics to the evaluation of benefits from projects under the environmental restoration program of the U.S. Army Corps of Engineers.

PRESENTER BIO: Dr. Hychka is a geographer who builds metrics and tools that incorporate landscape ecology principles into decision making. She primarily focuses on wetlands and riparian systems.

STRATEGIC PLACEMENT OF DREDGED SEDIMENT TO NATURALLY ACCRETE IN SALT MARSH SYSTEMS

Jamil S. Ibrahim[1], *Jeremy Lowe*[2], *Amy Richey*[2], *Tom Cancienne II*[1], *and Tasmin Brown*[1], *and Craig Connor*[3]

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Several recent studies in the San Francisco Bay (Bay) have identified the vulnerability of tidal marshes and mudflats to accelerating sea-level rise (SLR) and a diminishing suspended sediment supply from the Sacramento-San Joaquin Delta (Delta), necessitating augmentation of the natural sediment accretion rates in marshes and mudflats as sea level rises. Strategic placement of dredged sediment in the Bay at locations would help restore or enhance the sustainability of tidal marshes and mudflats in response to SLR, for both habitat conservation and flood-risk management. This presentation provides a framework for strategic placement of dredged sediment to naturally accrete in salt marsh systems, and identifies and examines the potential impacts of methods that could be implemented to maintain ecosystem functions and enhance the Bay's resiliency to climate change.

The overall goal of this study is to assess the feasibility of increasing marsh accretion rates with minimal negative impacts as sea level rises. The study reviews the potential effectiveness and feasibility of the methods of beneficial reuse; outlines the potential beneficial and adverse effects these methods may have on habitats and biota where sediment is placed; identifies the pathway to accretion on marshes; and outlines the logistics, regulatory compliance, and equipment that would be required. These methods include the placement of dredged sediment in several alternative locations in and around tidal marshes by various means—in shallow water, in tidal channels, and directly onto the marsh surface. This presentation critically reviews and synthesizes available information, presents a conceptual model of the near-shore Bay system, and makes specific recommendations for further investigations, including research necessary to support implementation.

The strategic-placement methods described in this presentation—shallow-water placement, water-column seeding and marsh spraying—aim to take advantage of the range of natural processes, from the resuspension of sediment in the Bay, through the transport by tidal currents to mudflats and marshes, and the subsequent deposition of sediment onto the marshes. The methods vary both in the degree of emulation of natural processes and in the certainty of frequency and rate of accretion in the marsh.
A phased approach is proposed that gradually increases the scale, and potential effects, of placements. Information gained during earlier steps in the process should allow the evaluation of the effectiveness and impacts of the methods, and will inform the necessary decision-making process that would address the inevitable tradeoffs between ecological benefits and effects of the placement methods. By exploring the mechanisms of sediment accretion in the Bay, synthesizing available information, and addressing the feasibility of marsh and mudflat accretion techniques, this presentation provides key information for managers and regional planners to identify the most effective methods for use in their planning process.

PRESENTER BIO: Mr. Ibrahim is a hydrologist/water resources planner with more than 20 years of experience for ecosystem restoration, flood risk management, water supply reliability, and navigation improvement projects. He specializes in planning for multiple objective projects requiring technical and political understanding of the federal, state, and local water resources management systems.

REGIONAL RESTORATION PLANNING: A CASE STUDY IN COLLABORATIVE RESTORATION SCIENCE AND PLANNING

Campbell Ingram
Sacramento-San Joaquin Delta Conservancy, West Sacramento, CA, USA

To be more strategic in thinking about how to effectively restore ecological functions in the Sacramento-San Joaquin Delta system, the Delta has been broken up into ecologically distinct and significant sub-regions. In a perfect world, our current restoration efforts would be guided by systemwide, science based restoration targets, and regionally specific strategies that identify where restoration investment would generate the greatest contributions to measurable improvement in ecological function and resilience. And, there would be general understanding and support among the Delta community for restoration objectives. It's not a perfect world. EcoRestore provides clearly defined restoration targets for the Delta, but they are arguably more negotiated than science based, and we lack entirely the locally-supported, regionally-specific strategies. The Delta Conservancy has attempted to create forums in two priority Delta sub-regions where this type of planning can occur. The objectives are to work with all interested parties to develop science based restoration strategies that are developed in consideration of ongoing viability of current land-use (largely agriculture), flood protection and water supply. The process has attempted to incorporate several innovative technologies and approaches to facilitate better collaborative and science based planning outcomes. The planning forums include participation from Federal, State and local government officials, water supply and flood protection professionals, NGO partners, and farmers. This talk will explore the development and structure of two ongoing sub-regional planning efforts and share successes, failures, challenges and lessons learned.

PRESENTER BIO: Campbell Ingram became the first Executive Officer of the Sacramento-San Joaquin Delta Conservancy in 2011. The Conservancy is tasked with being a lead State agency for ecosystem restoration in the Delta and supporting efforts that advance environmental protection and the economic well-being of Delta residents.

ECOSYSTEM VULNERABILITY IN A CHANGING WORLD: THE CASE OF COASTAL LOUISIANA

Krista L. Jankowski[1,2]*, Torbjörn E. Törnqvist*[2]*, Anjali M. Fernandes*[3]*, Jaap Nienhuis*[4]*, and Molly Keogh*[2]

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[4]Florida State University, Tallahassee, FL, USA

Low elevation costal zones (LECZ) are among some of the most densely populated and economically productive areas worldwide. Coastal wetlands located in these LECZ are critical for both ecosystem services and protection from storm surge, and their response to accelerated sea-level rise is a key issue in long-range coastal management planning. It is important that coastal restoration policy decisions be made after considering the most robust scientific data available to maximize potential impact and efficacy, yet large-scale monitoring efforts are limited. Over the past century, the state of Louisiana has lost ~5,000 km^2 of wetlands and, understandably, concern exists whether remaining wetlands will persist while facing some of the world's highest rates of relative sea-level rise (RSLR) (~ 13 mm/yr). Here we use a regionally and temporally extensive, publically funded and available data set known as the Coastwide Reference Monitoring System (CRMS) to track changes in surface elevation over time. Derived from 274 rod surface-elevation table-marker horizon (RSET-MH) stations, this data set allows comparisons between present-day vertical accretion rates and RSLR rates at the land surface (mean present-day RSLR rates range from ~9-13 mm/yr) to understand ecosystem vulnerability to accelerated sea-level rise. We find that 35% of wetlands in the Mississippi Delta do not keep pace with RSLR, whereas in the Chenier Plain that number rises to 58% of sites, rendering much of this area highly vulnerable to RLSR. While this data set includes considerable variability, it is clear that ecosystems are vulnerable to modern conditions and there is great promise in the ability of large-scale monitoring efforts to better guide decision-making processes to protect these systems in the future.

PRESENTER BIO: Krista L. Jankowski is a Gulf Research Program Science Policy Fellow working with the Louisiana Coastal Protection and Restoration Authority. She has over a decade of experience at the intersection of science and policy, including work on coastal and deltaic systems, climate change adaptation, and disaster risk reduction.

CONNECTING ECOSYSTEM SERVICES TO HUMAN & WILDLIFE RESILIENCY

***Deborah January-Bevers**, Lindsey Roche, and Lauren Harper*
Houston Wilderness, Houston, TX, USA

Natural landscapes and organisms serve our wellbeing in a great variety of ways: water purification, flood protection, aquifer recharge, protection from damage by storms and hurricanes, pollution reduction, carbon capture, recreation and wildlife enhancement. Identifying and understanding the services provided by local ecosystems can lead to cost-effective solutions to infrastructural and environmental problems while also creating enhanced wildlife habitat in urban/suburban areas. For the storm-prone 8-County Galveston Bay-Houston region, which encompasses 10 distinct ecoregions, there is a critical need to better connect the ecosystem services contained in the diverse assemblages of forests, prairies, bottomlands, wetlands, riparian waterways and shorelines to maximize the economic and social benefits to humans and wildlife which rely heavily on those services. These diverse ecosystems provide habitat to many key species including thousands of migratory birds and butterflies, native alligators, bats, deer, armadillos, and five endangered species. This presentation is based upon Houston Wilderness' *Ecosystem Services Primer* which discusses ways for determining ecosystem service land-use analysis/values using 6 different study/valuation methods depending on the goals and/or impacts of a decision-maker. Local and regional Gulf of Mexico area case examples are discussed, where ES valuation options between gray and nature-based infrastructure were analyzed and the natural solutions were chosen and implemented. Case examples include corporate use of tertiary treatment wetlands, increased use of native filtering features in major waterways, levee-based wetlands implemented for hurricane and erosion protection and large-landscape prairie lands for water absorption and flood prevention. Each of these examples of nature-based infrastructure creation and enhancement also provide additional habitat for the native and migratory wildlife. In an expanding urban core such as the 8-County Galveston Bay-Houston Region, which is larger than the entire State of New Jersey in America. There is a critical need to: (1) Engage in more region-based studies on ecosystem services to better understand the value of natural benefits and the cost-effective infrastructure policies; (2) Compare the economic value of ecosystem services to other alternative approaches when making public policy decisions regarding land-use and infrastructure; and (3) More fully incorporate ecosystem services into infrastructure decisions. The presentation will also briefly discuss the eight-county *Gulf-Houston Regional Conservation Plan* and its recent kickoff of a "*24% By 2040 Land-Use Strategy*" to improve ecological and economic resiliency in the 8-County region through preservation/enhancement of 24% of undeveloped land in the 4.8 million acres of land cover by the year 2040 – an additive of 15% over the current 9% in preserved green space in this region (See maps and more information at www.GulfHoustonRCP.org, and see the Ecosystem Services Primer at http://houstonwilderness.org/ecosystem-services/.)

PRESENTER BIO: Deborah January-Bevers became President & CEO of Houston Wilderness in 2013. A native Houstonian, Deborah has been involved with public policy and research in Houston and the State of Texas on issues ranging from environmental issues and ecosystem services to urban streetscape design, urban forestation and land conservation for 30 years.

HISTORIC NATURAL COMMUNITY MAPPING AND RARE PLANT SURVEYS IN THE APALACHICOLA REGION

Amy M. Jenkins
Florida Natural Areas Inventory, Tallahassee, FL, USA

Understanding the historic conditions and habitats in a region is a vital first step to planning restoration and management activities. The Florida Natural Areas Inventory (FNAI) used aerial photography from as far back as the 1930's, coupled with soils data, LiDAR, rare plant occurrences, and GPS'd ground-truthing points to develop an historic vegetation map of several large conservation lands in the Apalachicola region. These maps cover a large portion of the region and are a vital baseline for ecological and hydrological restoration efforts by managers across property boundaries. Additionally, historic vegetation maps can be used on a smaller scale when planning silvicultural projects. In the Apalachicola National Forest, we used the historic map to identify areas to search for rare plant species in an area called Beasley Pond. In areas of historic wet prairie, new populations of the federally-listed Florida Skullcap (*Scutellaria floridana*) were discovered during the field surveys and the USFS and FNAI developed a monitoring plan to quantify effects of upcoming management activities on this rare plant and the groundcover around the populations.

PRESENTER BIO: Ms. Jenkins is the Senior Botanist at the Florida Natural Areas Inventory with more than 20 years of experience working in Florida field ecology and conservation. She has extensive experience working in rare plant conservation and historic vegetation mapping throughout Florida, and holds primary responsibility for management of FNAI's state-wide rare plant conservation database and tracking list.

INTRODUCTION AND OVERVIEW OF ECOLOGICAL SITE DESCRIPTIONS AND THEIR HISTORY

Jamin Johanson
USDA Natural Resources Conservation Service, Dover-Foxcroft, ME, USA

People manage and restore natural landscapes according to their understanding of ecosystem structure and processes in an effort to satisfy human needs and values. Because ecosystems are infinitely complex and human comprehension is limited, people employ simplified mental models to help conceptualize and communicate about components of natural systems, how they fit together, and how to best manage and restore important ecosystem services. In an effort to formalize these conceptual models of ecosystem structure and process, the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) partners with other agencies to develop ecological site descriptions (ESDs) and state-and-transition models (STMs), which serve as technical references for ecosystem management and restoration.

STMs are box and arrow diagrams that describe the effects of land history on ecosystem structure and processes, including a reference state (i.e., ecological benchmark condition) and alternative ecological states resulting from management and disturbance. The narratives that accompany STM diagrams describe the resilience limits of various states which an ecosystem exhibits, as well as common drivers of ecosystem change. When resilience limits are breached due to management or natural disturbance, the system transitions to a new state with distinctive ecological structure and processes, and may or may not be able to be restored to pre-disturbance conditions. Ecological sites are critical for interpreting STMs because they define the ecosystem to which a STM applies.

ESDs are reference documents which define distinctive ecosystems based on the kinds and amounts of vegetation produced, as well as the ability of the ecosystem to respond to disturbance, management, and restoration practices. Thus, ESDs provide spatial context and STMs provide temporal context for compiling ecological knowledge into an accessible framework for accessing reliable ecological reference information.

This session is an introduction to ESDs and STMs as a framework for organizing ecological knowledge into technical references. It includes a brief history of ESD and STM development efforts and theory, and provides examples of field application of ESDs and STMs to guide management and restoration efforts.

PRESENTER BIO: Jamin Johanson received his B.S. and M.S. degrees in Range Science from Utah State University, where his research focused on ecological site and state-transition model development. He began his professional career in Utah developing ecological site concepts for rangelands and riparian areas of the Great Basin, Wasatch Mountains, and Colorado Plateau regions. Jamin is currently developing ecological sites for the forests, coasts, and wetlands of northern New England. He is stationed in Dover-Foxcroft, Maine, and services all of Maine, Vermont, New Hampshire, and the Adirondacks region in upstate New York.

A LESSONS-LEARNED TOOLBOX FOR COLLABORATIVE CONSERVATION AND ADAPTATION STRATEGIES

Genevieve Johnson[1], *Matthew Grabau*[2], *Megan Friggens*[3] *and Ashlee Simpson*[4]

[1]US Bureau of Reclamation, Boulder City, NV, USA
[2]US Fish and Wildlife Service, Tucson, AZ, USA
[3]USDA Forest Service Rocky Mountain Research Station, Albuquerque, NM, USA
[4]University of Arizona, Tucson, AZ, USA

A common issue identified by restoration practitioners and the larger conservation community is the difficulty in sharing lessons learned from both successful and unsuccessful resource management actions across large geographies and jurisdictions. Consequently, resource managers are losing valuable knowledge gained during implementation, especially for projects that face similar obstacles or use similar methodologies.

In order to promote learning and project efficiencies, partners of the Desert Landscape Conservation Cooperative worked to create an information-sharing platform for the Mojave, Sonoran, and Chihuahuan Desert regions of the southwestern United States and northern Mexico. The US Bureau of Reclamation, US Fish and Wildlife Service, and US Forest Service are addressing this need by creating a user-friendly web portal to catalog and synthesize lessons-learned from on-the-ground actions, partnership and collaboration activities, monitoring, and adaptive management strategies intended to achieve conservation goals.

The Collaborative Conservation and Adaptation Strategy Toolbox helps organize lessons learned from restoration and conservation activities according to landscape-scale stressors, specific resources, geographies, and methodologies. Partners developed a standard approach and template for capturing this information so that future managers can benefit from successful methodologies and protocols, as well as avoid possible pitfalls. Future steps for the Toolbox include synthesizing case study information for common topics to further help connect managers to information they need. Lastly, this Toolbox stores information in an easily-accessible format for future sharing and dissemination. Through the Desert LCC's collaborative partnership, we seek to broadly disseminate and communicate key information from managers implementing on-the-ground actions to leverage conservation knowledge and limited resources.

PRESENTER BIO: Ms. Johnson is an environmental planner with more than 15 years of experience leading land use planning and conservation efforts, including building and maintaining collaborative relationships to accomplish mutual goals, and linking science and management needs to facilitate decision-making across jurisdictions.

A STAGE-STRUCTURED POPULATION MODEL FOR DEEPWATER HORIZON OIL SPILL: POTENTIAL IMPACTS OF DEEPWATER HORIZON OIL SPILL EVENT

***Madeline L. Jones**, Hannah Gerke, Hsiao-Hsuan Wang and William E. Grant*
Texas A&M University, College Station, TX, USA

Deepwater Horizon (DWH) was the largest offshore oil spill in US history. This significantly affected the Gulf of Mexico and surrounding beaches, including threatened and endangered marine life such as the loggerhead sea turtle. Both federal and state agencies charged with overlooking U.S. natural resources conducted numerous assessment activities to quantify the adverse effects of oil and its consequences on wildlife resulting in a DWH Natural Resource Damage Assessment. Short and long-term effects to juvenile and adult loggerheads result from catastrophic oil spills, such include oil adhesion, over-heating, and oil ingestion which can lead to egg mortality, developmental defects, and impacts to the skin, blood, salt glands, and digestive and immune systems. Hence, we conducted a thorough literature review to obtain the demographic data and developed a stage-structured stochastic population dynamics model using STELLA® 7.0.1 for loggerhead sea turtles. Three conservation scenarios were modeled along with a baseline scenario. Conservation scenarios were then subjected to added oil mortality. We then used the model to quantify the potential effects of oil spills on the population of loggerhead sea turtles for the next decade.

The results of the baseline model without oil effects show a decrease in the population from 119 in 1987 to 23 in 2016, implying the possibility of the population's extinction without any conservation efforts. All three conservation scenarios without oil effects show an increase, with conservation scenario 2 showing the greatest population growth (645%) over 30 years. Conservation scenarios after added linearly decreeing oil mortality from 2010 to 2014 all decreased about 60% in 2013 and then gradually recovered after year of 2013. Continued conservation efforts and assessments of loggerheads will ensure population numbers continue to recover following Deepwater Horizon.

PRESENTER BIO: Madeline Jones is a senior Wildlife & Fisheries Sciences major with an emphasis in wildlife conservation and management. She has been researching in Dr. Wang and Dr. Grant's Ecological Systems Laboratory since Summer 2017.

FORECASTING GULF OF MEXICO HYPOXIA UNDER SCENARIOS OF WATERSHED AND RIVER MANAGEMENT

Dubravko Justic *and Lixia Wang*
Louisiana State University, Baton Rouge, LA, USA

Freshwater diversions on the Lower Mississippi River play a central role in the proposed 50-billion, 50-year strategy for restoring the Louisiana's coast. Under the proposed 2017 Coastal Master Plan, four large-scale river diversion projects are being considered that would convey an order of magnitude more water compared to existing river diversions. The effects of existing and proposed future diversions on nutrient transport pathways and hypoxia were investigated using a high-resolution, three-dimensional, coupled hydrodynamic-biogeochemical model (FVCOM-LATEX). The numerical model domain covers most of the Alabama-Mississippi-Louisiana-Texas continental shelf and includes high resolution (on the order of 20 meters) nested grids in Barataria and Breton Sound estuaries. The model was driven by tidal and subtidal forcing at the open Gulf of Mexico boundary, freshwater and nutrient loads from rivers and river diversions, and surface wind stress. A number of different diversion scenarios were assessed, including a concurrent operation of four river diversions with a combined flow of 5,947 cubic meters per second (210,000 cfs).

Numerical modeling results indicate that, depending on the scenario considered, the proposed large-scale river diversions would have the potential to strongly influence hydrodynamics and estuarine-shelf exchanges, which in turn could profoundly affect nutrient transport pathways and hypoxia in the northern Gulf of Mexico.

PRESENTER BIO: Dr. Justic is Texaco Distinguished Professor in the Department of Oceanography and Coastal Sciences at Louisiana State University. He has studied low oxygen zones for over 30 years and has employed various types of simulation models to describe controls of environmental factors on hypoxia and predict consequences of management actions.

HIGBEE BEACH RESTORATION PROJECT – RESTORATION BUILT ON THE SHOULDERS OF COLLABORATION

*Jennifer Brunton[1], Matthew Holthaus[1], **Shaddi Kamel**[1] and Mark Walters[2]*
[1]Louis Berger US, Morristown, NJ, USA
[2]NJDEP Office of Natural Resource Restorations, Trenton, NJ, USA

The New Jersey Department of Environmental Protection Office of Natural Resource Restoration engaged in an ambitious project to restore tidal marsh and upland habitat to a large portion of the Higbee Beach Wildlife Management Area, located within one of the most important migratory bird concentration areas in the world. The project will create a rich mosaic of habitats including 200+ acres of restored tidal marsh, flanked by large expanses of protected freshwater emergent marshes and restored maritime forests on coastal dunes along Delaware Bay. Public access to this optimized wildlife habitat area will be enhanced with trails through the interior of the marsh, with blinds and other features to improve viewing opportunities.

Louis Berger was contracted to complete baseline studies (habitat mapping, wetland delineations, salinity screenings, reference marsh assessment, topographic and bathymetric surveys, and hydrologic, hydraulic, and hydrodynamic modeling, cultural resource assessments, T&E assessments, site characterization, geotechnical analysis and structural analysis), conceptual design selection, final site design and bid package development, regulatory permitting, and construction administration. In addition to developing a technically sound design, a critical element of project success centers on advancing the project with stakeholder support and regulatory conformance, which involved over 40 stakeholder and regulatory collaboration meetings. Through an iterative process of defining, modeling, and refining the design through stakeholder input, Louis Berger developed a marsh restoration plan that includes an inlet modification with a berm to maintain flood protection. This presentation will include a discussion of how the project goals, baseline studies, and subsequent design balances the interests of the devoted birding community, Cape May County Department of Mosquito Control, New Jersey Audubon, and other stakeholders. In addition, the presentation will detail the iterative discussions and coordination with the Federal and State regulators and agencies, through Joint Permit Processing Meetings, for permit application submissions and approvals for construction. The Higbee Beach Restoration Project is set to begin construction in Fall/Winter 2018.

PRESENTER BIO: Mr. Shaddi Kamel is a civil/environmental engineer with 2 years of experience developing eco-restoration projects. His expertise includes meshing the principals of engineering and ecology to enhance natural and built environment with a focus on wetland and stream restoration. He has worked on restoration projects mainly throughout the Northeast region of the United States.

DECREASES OF CARBON AND NITROGEN IN THE SOILS OF A 20-YEAR CHRONOSEQUENCE OF RESTORED WETLANDS, WASHINGTON STATE, USA

Colleen S. Kroe
King County Department of Permitting and Environmental Review, Snoqualmie WA USA

Freshwater wetland restoration is intended to replace both area and function as part of compensatory mitigation, including restoration of biogeochemical soil processes. This study examined the amount of carbon (C) and nitrogen (N) in the soils of twenty-two wetland restoration sites in the Puget Sound region of Washington State. The purpose was to assess whether vegetative strata, hydrologic regime, hydrogeomorphic class, and soil type influenced C and N accumulation rates. Soil samples and data regarding vegetative strata, hydrologic regimes, and soil characteristics were collected in July and August 2015, and additional soil samples and hydrologic data was collected in December 2015. Soil characteristics such as color and texture were used to divide soils into upper and lower soil layers. The soil layer distinction was a significant variable in assessing trends of C, N, and bulk density (g cm-3).

Overall, total C decreased over time, with an estimated rate of -0.70 Mg C ha^{-1} yr^{-1} ($p = 0.03$) while total N did not have a significant relationship over time. There were no statistically significant relationships between the amount of C or N in the soils and hydrogeomorphic class, hydrologic regime, or soil type.
However, bulk density (gr cm-3) was found to increase with increasing time on forested restoration sites ($p = 0.04$). The C:N ratio had a negative relationship with increased age, ($p = 0.02$), suggesting that C loses were greater than N losses through time.

This study reports the surprising result that rather than increasing over time as is common in natural ecosystems, restoration processes can lead to an initial decrease in average soil C. The results suggest that C and N are not specifically influenced by distinct restoration site design components (i.e., vegetation, hydrology, soil type), but that soil amendments added to wetland restoration sites may influence soil biogeochemical processes in unexpected ways.

PRESENTER BIO: Ms. Kroe is a senior environmental scientist with 13 years of experience working as wetland scientist, project manager, and regulator in the Pacific Northwest. She recently completed her master's degree in ecology at Norwegian University of Life Sciences in Aas, Norway, and is particularly interested in wetland restoration processes.

TRACKING CHANGES IN THE HISTORICAL ECOLOGY OF FLORIDA'S FRESHWATER SPRINGS AND RIVERS USING RECENT AND FOSSIL MOLLUSKS

Kristopher M. Kusnerik[1]*, Guy H. Means*[2]*, Roger W. Portell*[1]*, and Michal Kowalewski*[1]
[1]Florida Museum of Natural History, Gainesville, FL, USA
[2]Florida Geological Survey, Tallahassee, FL USA

The aquatic communities of Florida's freshwater ecosystems have been studied by ecologists for over 50 years. In contrast, the death and fossil assemblages, which preserve molluscan-components of past communities and can provide unique historical and ecological perspectives, have received limited attention. These historical approaches, including faunal composition, biodiversity, and spatial structuring of regional faunal associations can be used to quantify recent ecosystem changes due to recent environmental and anthropogenic changes. The multi-millennial perspective afforded by the most recent fossil record may also improve conservation planning and assist in developing more informed restoration goals for Florida's freshwater systems under threat.

To address these issues, three types of samples were collected from Florida's Silver, Ocklawaha and Wakulla Rivers: living mollusks (life assemblages), surficial shell accumulations (death assemblages), and *in situ* river bank sediments (fossil assemblages). One hundred and three samples collected so far yielded 27,967 specimens representing 20 species of mollusks.

Quantitative analyses indicate that diversity is highest in death assemblages, intermediate in fossil assemblages, and lowest in life assemblages. Many live and dead samples are dominated by recent invasive taxa, such as *Corbicula fluminea* and *Melanoides tuberculata*, while fossil samples include species that are rare or absent in life and death assemblages, suggesting changes in these mollusk communities that predate modern ecological research. Nonmetric multidimensional scaling indicates that, for all three rivers, fossil assemblages are more similar in faunal composition to those fossil assemblages of the other systems rather than to their counterpart life assemblages from the same system. Life assemblages from the adjacent Silver and Ocklawaha Rivers are similar to one another, but distinct from those of Wakulla River.

These results tentatively indicate that, when compared to past ecosystems, present-day mollusk associations shifted notably in faunal composition, display depressed diversity, and are more regionally heterogeneous in faunal composition. A potential cause of this increased heterogeneity may be the uneven regional success of recent invasive taxa which alter the underlying, endemic molluscan communities. Comparisons of live, dead, and fossil mollusks may be used to quantify recent shifts in biodiversity, composition, and spatial structuring of freshwater communities impacted by anthropogenic changes.

PRESENTER BIO: Kristopher Kusnerik is a third-year doctoral student at the Florida Museum of Natural History in the Invertebrate Paleontology Division. His research focuses on conservation paleobiology, using the fossil record of mollusks and other invertebrate taxa to better inform conservation and restoration efforts in aquatic environments.

CLIMATE-SMART CONSERVATION: AN ASSESSMENT OF STATE WILDLIFE ACTION PLANS FROM THE SOUTHEASTERN UNITED STATES

Kirsten Lackstrom[1]*, Erika Chin*[1]*, Kaly Clark*[2]*, Kirstin Dow*[1]*, Patty Glick*[3]*, Nils Peterson*[2]*, and Bruce Stein*[4]

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[2]North Carolina State University, Raleigh, NC, USA
[3]National Wildlife Federation, Sunriver, OR, USA
[4]National Wildlife Federation, Washington, DC, USA

The southeastern U.S. is experiencing high rates of population growth, urbanization, and land use change, which with climate change, present considerable challenges to the health and sustainability of the region's fish and wildlife populations. A shared, regional conservation vision represents a key step towards addressing these challenges, and State Wildlife Action Plans (SWAPs) provide an opportunity to collectively articulate this shared vision. To support the Southeast Conservation Adaptation Strategy (SECAS), we examined the SWAPs across 15 southeastern states, the Virgin Islands, and Puerto Rico to begin documenting the regional vision for conservation. SWAPs are required in order for states and territories to be eligible for State and Tribal Wildlife Grants (SWG) funding. The first editions of the plans (due in 2005) typically did not consider climate change. Since then, more state agencies not only recognize the need to prepare for a changing climate but now have access to a multitude of resources, tools, and guidance documents designed to assist them assess climate impacts and develop adaptation options. Project objectives were to 1) identify the various approaches used to address climate change in the recent (2015) SWAP updates, 2) highlight key commonalities and differences among the states, and 3) improve understanding of the challenges and opportunities that state agencies face as they address climate change risks. Methods included detailed review of the SWAPs and follow-up interviews with SWAP coordinators. An adapted version of the "climate-smart planning cycle" (Stein et al.) provided the conceptual framework for the data analysis. Key findings include the following:

- Although all states recognized the climate change threat, they exhibited a diversity of planning approaches. Factors such as staff capacity and expertise and consistency with other planning processes influenced the methods and extent to which the SWAPs integrated climate change.
- Few states conducted climate change vulnerability assessments expressly to inform their SWAPs. Many interviewees suggested that interstate collaboration and resources to conduct regional-scale assessments would enhance the current, limited use of impact and vulnerability assessments.
- Climate adaptation strategies tend to be stated in general terms and few examples of implemented actions exist thus far. Acting with intentionality (i.e., linking specific strategies to climate impacts) and developing Southeast-specific resources for monitoring change and the effectiveness of conservation actions could enhance the uptake of novel management strategies.
- Overarching conservation goals as articulated in the SWAPs tend to be persistence-oriented, although some "behind the scenes" conversations are considering how climate change will affect the future feasibility of conservation strategies designed with static climate conditions in mind.

Reference: Stein, B., et al., eds. 2014. *Climate-Smart Conservation: Putting Adaptation Principles into Practice*. National Wildlife Federation: Washington, D.C.

PRESENTER BIO: Dr. Lackstrom is a research associate with the Carolinas Integrated Sciences & Assessments (CISA; cisa.sc.edu) program. She leads applied research projects to improve understanding of climate risks and impacts in the Carolinas and works with stakeholders to integrate climate information into decision making.

COASTAL DROUGHT AND THE NEED FOR A COASTAL SALINITY INDEX

Kirsten Lackstrom *and Lauren Rouen*
Carolinas Integrated Sciences & Assessments, University of South Carolina, SC, USA

Scientists and resource managers increasingly recognize the necessity of defining drought within an ecological context. Ecological drought refers to a "deficit in water availability that drives ecosystems beyond thresholds of vulnerability, impacts ecosystem services, and triggers feedbacks in natural and/or human systems." (Crausbay et al. 2017) Using an ecological drought framework and examples from the Carolinas, this presentation discusses the unique phenomenon of coastal drought and the need to fill data and information gaps for environmental management decisions.

In coastal areas, drought conditions are produced not only by a lack of rainfall in the coastal region itself, but also by a lack of freshwater inflow from upstream and interactions with other coastal conditions (e.g., wind, tidal regimes, sea level rise, estuarine processes and geomorphology). Drought conditions primarily affect the availability and timing of *freshwater* and are often manifested through higher-than-normal salinity levels and the migration of the freshwater-saltwater interface. Drought can have significant effects on estuarine species and communities with particular salinity preferences or tolerances. Combined with anthropogenic water management or climate change, longer-term droughts may contribute to irreversible habitat alterations (e.g., marsh dieback or migration, loss of freshwater tidal wetlands). Ecological impacts include changes to nutrient loading, water quality, primary productivity, food web dynamics, and habitat suitability. These direct impacts can lead to diverse effects on ecosystem services. For example, fluctuating salinity levels affect the movement, location, and abundance of many estuarine species, thereby affecting their accessibility for commercial and recreational fishing. On managed lands, drought conditions increase fire risks and make impoundments unsuitable for waterfowl and fish, thereby affecting conservation objectives and limiting recreational use of those areas.

One challenge for drought monitoring and resource management in coastal areas is that commonly used drought indicators incorporating rainfall, streamflow, and soil moisture data may not be the most suitable for characterizing coastal conditions. To address this issue, the National Integrated Drought Information System (NIDIS) is supporting the Coastal Carolinas Drought Early Warning System (DEWS) program. A major component of this effort has been long-term engagement with coastal resource managers, researchers, and the drought monitoring community to develop drought information and tools relevant to the management issues unique to coastal environments. The Coastal Salinity Index (CSI) has been developed to monitor changing salinities, the key stressor associated with coastal drought. Ongoing work with Coastal Carolinas DEWS partners involves using the CSI to assess the linkages between drought and affected environmental resources and applying the CSI to ecosystem monitoring, management, restoration activities.

Reference: Crausbay, S. D., et al. 2017. Defining Ecological Drought for the Twenty-First Century. *Bulletin of the American Meteorological Society* 98, 2543-2550. https://doi.org/10.1175/BAMS-D-16-0292.1

PRESENTER BIO: Dr. Lackstrom is a research associate with the Carolinas Integrated Sciences & Assessments (CISA; cisa.sc.edu) program. She leads applied research projects to improve understanding of climate risks and impacts in the Carolinas and works with stakeholders to integrate climate information into decision making.

IMPLEMENTATION OF LARGE-SCALE RIVER DIVERSIONS: A NATURAL RESOURCE DAMAGE ASSESSMENT (NRDA) TRUSTEE'S PERSPECTIVE

Mel Landry
NOAA Restoration Center, Baton Rouge, LA, USA

The Louisiana Trustee Implementation Group (LA TIG) is responsible for restoring the natural resources and services within the Louisiana Restoration Area that were injured by the Deepwater Horizon oil spill (DWH oil spill). The purpose of restoration is to make the environment and the public whole for injuries resulting from the DWH oil spill by implementing restoration actions intended to return injured natural resources and services to baseline conditions and compensate for interim losses, in accordance with the Oil Pollution Act of 1990 (OPA) and associated Natural Resource Damage Assessment (NRDA) regulations.

The U.S. Army Corps of Engineers (Corps) is developing an EIS to evaluate the potential environmental impacts of the Mid-Barataria Sediment Diversion project. The Corps will use the EIS to inform its decision-making for permits and permissions for the project.

In April 2017, the LA TIG announced that we were conducting two phases of restoration planning for Louisiana's Barataria Basin. The first phase prepared a Strategic Restoration Plan for the Basin. The second phase will initiate restoration planning for projects or a suite of projects selected in the Phase 1 plan, potentially including the Mid-Barataria Sediment Diversion.

The Strategic Restoration Plan evaluated a suite of restoration types and example projects including the Mid-Barataria Sediment Diversion to determine the most appropriate approach for restoring injuries from the Deepwater Horizon oil spill. If we do select the Mid-Barataria Sediment Diversion in the Strategic Restoration Plan for further evaluation in a Phase 2 restoration plan, we anticipate using the Corps' EIS to inform that future draft Phase 2 restoration plan.

In anticipation of the potential to use the Corps' EIS to support the NRDA decision making process, the LA TIG has been engaged in the development of the Mid-Barataria Sediment Diversion EIS.

PRESENTER BIO: Mel Landry is the Restoration Area Lead in Louisiana for the NOAA Restoration Center. As NOAA's lead on the LA TIG, Mel works with a team of resource and policy specialist to select and implement approaches to restore for injuries caused by the Deepwater Horizon Oil Spill.

ACTIONABLE SCIENCE IN THE GULF OF MEXICO: CONNECTING RESEARCHERS AND RESOURCE MANAGERS

Julien Lartigue[1]*, Frank Parker*[1]*, Becky Allee*[2]*, and Caitlin Young*[3]

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The National Oceanic and Atmospheric Administration (NOAA) RESTORE Science Program was established in the wake of the Deepwater Horizon oil spill to carry out research, observation, and monitoring to support the long-term sustainability of the Gulf of Mexico ecosystem, including its fisheries. Administered in partnership with the US Fish and Wildlife Service, the Science Program emphasizes a connection between science and decision-making. This emphasis translated into an engagement process that allowed for resource managers and other users of information about the ecosystem to provide direct input into the science plan for the program. In developing funding opportunities, the Science Program uses structured conversations with resource managers and other decision makers to focus competitions on specific end user needs. When evaluating proposals for funding, the Science Program uses criteria that focus on applicability of a project's findings and products, end user involvement in project planning, and the approach for transferring findings and products to the end user. By including resource managers alongside scientific experts on its review panels, the Science Program ensures that these criteria are assessed from both the researcher and end user perspectives. Once funding decisions are made, the Science Program assigns a technical monitor to each award to assist with identifying and engaging end users. Sharing of best practices among the technical monitors has provided the Science Program insight on how best to bridge the gap between research and resource management and how to build successful scientist-decision maker partnerships. During the presentation, we will share two case studies: 1) design of a cooperative (fisheries scientist, fisheries managers, and fishers), Gulf-wide conservation and monitoring program for fish spawning aggregations and 2) development of habitat-specific ecosystem indicators for use by federal and state resource managers.

PRESENTER BIO: Dr. Lartigue directs the NOAA RESTORE Science Program, which supports research, observation, and monitoring in the Gulf of Mexico. Julien uses his experience working at academic institutes and government agencies across the Gulf States to connect the information needs of resource managers to the problem-solving capacity within the research community.

HOW TO DEAL WITH UNCERTAINTY AND OBJECTIVES: PALLID STURGEON CASE STUDY

Todd Gemeinhardt
U.S. Army Corps of Engineers, Kansas City, MO, USA

Presented by: ***Eric A. Laux***
U.S. Army Corps of Engineers, Omaha, NE, USA

The U.S. Army Corps of Engineers (USACE), in collaboration with the U.S. Fish and Wildlife Service and a large stakeholder group, the Missouri River Recovery Implementation Committee (MRRIC), has embarked on the development and implementation of a comprehensive and collaborative adaptive management process aimed at guiding the Missouri River Recovery Program, a program focused on guiding USACE actions to meet Endangered Species Act requirements, including actions directed at benefitting pallid sturgeon. Given the lingering uncertainties regarding which management actions are likely to be effective at increasing pallid sturgeon recruitment (a fundamental objective provided by the USFWS during consultation) and the needed scale of those actions, a progressive AM program aimed at accelerated learning including focused experimentation and hypothesis testing, was needed to ensure effective and efficient identification and implementation of management actions. A Pallid Sturgeon Framework was developed which outlines four levels of implementation including targets, decision criteria, and timelines which guide progression through those levels of implementation. The four levels of implementation are: focused research (Level 1), in-river testing (Level 2), scaled implementation (Level 3), and implementation at the ultimate scale required to meet objectives (Level 4). The initial level of implementation for a given management action depends on several factors including current understanding of the benefits to sturgeon, uncertainty regarding benefits and impacts to other river users, ability to resolve those uncertainties and associated timelines and costs, and urgency related to pallid sturgeon. With this approach, we sought to strike a balance between taking action and decreasing uncertainty. For example, taking action without strong evidence of effectiveness could be costly and use limited resources, which could be used more effectively elsewhere. On the other hand, significant steps in learning may require going beyond retrospective studies of past data and analysis of the current system and instead benefit from careful implementation of actions with a focus on learning. A structured approach, done collaboratively with USFWS and stakeholders, was needed to strike the appropriate balance. This presentation will explain the approach with some current examples.

INFLUENCES OF COASTAL ISLAND RESTORATION ON SEABIRD POPULATIONS AND THEIR NEST PREDATORS

Paul Leberg[1], *Mirka Zapetal*[1,2], *Scott T. Walter*[3], *and Juita Martinez*[1]

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[3]Texas State University, San Marcos, TX, USA

Coastal islands represent a primary target for restoration in regions including the northern Gulf of Mexico. Yet there is a limited understanding of effects of common restoration approaches in providing habitat for nesting seabirds. 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. Choices of vegetation plantings or project scale might create conditions that favor predator populations or other conditions that 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 understand how seabirds respond to a shifting mosaic of available islands with changing vegetation and predator communities.

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. We have been using a decade-long study of brown pelicans, as well as shorter investigations of predators and other seabirds to better understand the specific impacts of restoration on coast avifauna. Additionally, we are using surveys of seabird nesting colonies, conducted intermittently over the last 30 years, to understand how patterns of island use have been influenced by restoration practices. Our study sites are located throughout the Barataria-Terrebonne estuary system of southern Louisiana.

Our work suggests that restoration has the potential to affect seabird populations in unexpected ways. For example, we found that variance in vegetation composition at restored sites is associated with both nest success and island resistance to tropical storms and other sources of erosion pressure. Furthermore, populations of mammalian nest predators, primarily raccoons and coyotes, greatly limit the usefulness of islands to seabirds. As occupancy of an island by a predator is influenced by island area, elevation, and vegetation density, restoration projects that expand island size with dense vegetation cover are likely to reduce seabird use. Bird use of restoration sites also seem to be tied to whether those sites have been historically used by the species prior to the restoration treatment, with very few examples of seabirds in our study area occupying newly restored sites on islands that were not former colony sites. Furthermore, the vast majority of nesting sites of pelicans and other seabirds occur on islands with no history of restoration or on sites where the restoration treatment is over two decades old. There are a number of explanations for these patterns but they suggest that restoring islands to some former state may be insufficient to promote their use as nesting habitat for seabirds.

PRESENTER BIO: Dr. Leberg is a biology professor with more than 20 years of experience studying wildlife populations in coastal Louisiana. He has extensive experience with seabird use of coastal islands and he and his students have been examining how restoration practices affect the island use as nesting habitat.

MARKET-BASED STRATEGIES FOR ENSURING FRESHWATER INFLOWS IN TEXAS

Sharlene Leurig
Texas State University, San Marcos, TX, USA

Texas recognizes environmental flows as a beneficial use of water. Yet few water rights include environmental flow conditions, creating the need for market-based strategies for ensuring freshwater flows in our river basins, bays and estuaries. The talk will explore the many forms that transaction structures may take, including water contracts, source swaps and water rights acquisition, and will discuss the way that transaction design and financial method should be informed by the environmental need the transaction is intended to meet.

PRESENTER BIO: Ms. Leurig is Project Director of the Texas Environmental Flows Initiative, a collaborative effort to demonstrate voluntary market-based transactions as a tool for ensuring environmental flows in Texas. She is a water finance expert with a decade of experience in sustainable water infrastructure design, long-range planning and transaction development.

SEDIMENT TRANSPORT AND INFILLING PROCESSES OF DREDGE PITS ON THE LOUISIANA SHELF

Haoran Liu[1,2], *Kehui Xu*[1,2], *Samuel J. Bentley*[1,3], *Chunyan Li*[1,2], *Michael D. Miner*[4], *Carol Wilson*[1,3], *Zehao Xue*[1,3]

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Barrier islands protect the mainland coast and interior wetlands from meteorological and marine forcings and help to regulate estuarine conditions. It has been reported that barrier islands in coastal Louisiana experience the highest rates of land loss in the nation. A major component of the State of Louisiana's effort to manage coastal land loss is to restore degraded barrier shorelines by dredging sand resources from offshore borrow sites to supplement a deficit in the active coastal sand budget. At present, major sand resources on Louisiana shelf are submarine sandy shoals, such as Ship Shoal, Tiger and Trinity Shoals, and Sabine Bank. These sandy shoals are under the combined influence of wind-driven currents, storm waves, tides, sediment transport, seabed morphology, and the dynamic Atchafalaya and Mississippi River dispersal systems. Long term observational data show Ship Shoal borrow areas can trap both muddy and sandy sediment from pit wall adjustment and sediment transport processes, and if the sand content is high these borrow sites might be reused for future restoration projects. In addition, the change from sandy to muddy (or even mixed) substrate may influence the activities of fish species and benthic communities. Another type of sand resource offshore Louisiana are sandy paleo-channels. Most of these paleo river channels are now covered by muddy overburden associated with recent shelf transport processes. Evolution of borrow areas on the sandy shelf is compared to the evolution observed at three study areas where paleo-channel deposits were dredged in muddier shelf environments. Our hypothesis is that sandy pits are more prone to wall slope adjustment and have higher pit wall migration rates than muddy pits. The results are important to develop best practices for utilization of sand resources and minimizing impacts to sensitive seafloor habitat and potential submerged cultural resources.

PRESENTER BIO: Haoran Liu is a Ph.D. student from LSU. His research interests are geomorphologic change with sediment transport, sediment modeling, and applied machine learning in geoscience.

THE RECOVERY OF SEDIMENT NUTRIENTS IN RESTORED OYSTER REEFS IN THE INDIAN RIVER LAGOON, FL

***Bryan Locher**, Nia Hurst, Lisa G. Chambers*
University of Central Florida, Orlando, FL, USA

Globally, oyster reefs have declined in significant numbers due to factors such as disease, overharvesting, and habitat degradation. Within the northern Indian River Lagoon, FL there are ongoing efforts to restore degraded reefs by providing substrate for oyster spat through shell mats. Although prior studies on oyster reef restoration have focused on the effects of oysters on water clarity and habitat creation in coastal water bodies, few have assessed the impact on nutrient cycling or the timeframe in which restoration effects nutrient cycling. Oyster reefs provide a critical ecosystem service of linking nutrients in the water column to the benthic environment by filter feeding and releasing feces and pseudofeces into the sediment below.

This study aims to analyze the effects of restoring an oyster reef on sediment and surface water nutrient cycling within the first year of oyster growth. The observed changes in this study will help to predict the timeframe in which a dead intertidal oyster reef can reach the functional capacity of a live reef after its restoration. Using a before-after-control-impact design, sediment cores and surface water sample were taken on each of four dead, restored, and natural/reference reefs to observe changes in physiochemical (bioavailable nitrogen and phosphorous and dissolved organic carbon; total carbon, nitrogen and phosphorous pools; bulk density; and sediment pH) and microbial (extracellular enzymes) properties. Samples were collected before restoration, and one week, one month, six months, nine months and twelve months post-restoration. We hypothesize that biogeochemical properties on the restored reefs will respond rapidly to oyster colonization, reaching levels comparable to natural/reference reefs within one year.

Preliminary results indicate that natural/reference reefs display significantly higher sediment bioavailable nitrate and ammonium concentrations, and lower pH, than dead and recently (less than six months) restored reef sediments. Before restoration, the restored reef sediments show bulk density, pH, extractable ammonium and phosphate levels that were not significantly different from dead reefs, as both represent a pile of loose, disarticulated shells. By one month-post restoration, sediment pH on restored reefs was significantly lower than dead reefs, suggesting calcification decreasing pH. Extractable ammonium concentrations on restored reefs reached live reef concentrations by six months post-restoration, which corresponds with a rapid increase in oyster growth during that timeframe. By six months post-restoration, bioavailable phosphate on restored reefs was also approaching the concentrations of live reefs. Continuous monitoring over the next several months will improve the understanding of nutrient storage and cycling on oyster reefs and the time after restoration required to restore their biogeochemical functions.

Presenter Bio: Bryan Locher is a M.Sc. student at the University of Central Florida in Dr. Lisa Chambers' Aquatic Biogeochemistry Lab. His research interests include the functioning of coastal ecosystems and how to create cleaner, healthier coastal waters. He aspires to continue working in coastal restoration for a career.

COASTAL RESTORATION ON LONG ISLAND: GETTING TO SCALE

Stuart R. Lowrie
The Nature Conservancy, East Hampton, NY, USA

Nitrogen Load modeling on Long Island demonstrated that the bulk of coastal ecosystem degradation here comes from residential waste water and its loading of nitrogen in our bays and harbors. The Nature Conservancy, through public opinion research, identified effective ways to communicate the actual problem, and the need to fix it, to key target audiences: elected and appointed officials, civic and business leaders, other community opinion leaders and the local media.

To guide our thinking and actions we used a Critical Path model, underpinned by communications efforts, that leads to ecosystem restoration:

1. Assess the nitrogen problem
2. Build a nitrogen reduction plan
3. Take action to deduce nitrogen
4. Track nitrogen reduction progress
5. Adjust actions to reduce nitrogen pollution

Parallel activities can and should occur within each portion of the critical path – for example, many “no regrets N-pollution reduction actions” began while detailed systemwide planning is still incomplete. This model and our communications-based approach may be broadly applicable in other jurisdictions.

Though large-scale tangible “ecosystem recovery” will take years, Long Island-wide planning is underway, with detailed nitrogen load modeling for Suffolk County already completed, the ecological endpoint discussion is well-underway, considerable progress has been made in policy changes, and new funding and programs have been established to replace traditional septic systems with “innovative/alternative” systems with low nitrogen outputs. In addition, concerning point source STP outfall pipes are scheduled and funded to be moved or repaired in the next several years, adding to the general non-point source nitrogen pollution abatement.

PRESENTER BIO: Dr. Lowrie is the Water Quality Program Director for The Nature Conservancy’s Long Island Chapter. He has worked on Long Island for The Nature Conservancy for over 24 years, helping deliver public funding and policy change to enhance conservation outcomes across Long Island.

SER CERTIFICATION PROGRAM FOR ECOLOGICAL RESTORATION PRACTITIONERS

Jen Lyndall *and Bethanie Walder*
Society for Ecological Restoration, Washington, D.C., USA

Over the last several decades, the field of ecological restoration has rapidly grown, both in number of projects and in number of practitioners. However, professional standards for practitioners are minimal at best, resulting in inconsistent project quality. As one way of addressing this problem the Society for Ecological Restoration (SER) launched a new Certified Ecological Restoration Practitioner (CERP) program to create a high professional standard for practitioners throughout the world. Certification is based on a combination of knowledge and experience, and also requires adherence to the SER code of ethics and an understanding of SER's foundational documents. By promoting practitioner standards, SER hopes to improve ecological restoration and the associated benefits on the ground. Certification will also have numerous other benefits: 1) individuals can improve their professional status through formal recognition of their training and experience, 2) academic institutions with ecological restoration degree programs can use the knowledge requirements to evaluate curricula so that graduates will have the core competencies specific to the field; and 3) employers, agencies, organizations, and the general public will benefit by easily being able to identify those practitioners who meet the high standard set by SER. You can find out more about the program benefits and requirements at http://www.ser.org/certification.

PRESENTER BIO: Jen Lyndall has a background in marine biology and toxicology, but for the last 16 years she has focused on restoration in the context of Natural Resource Damage Assessments and settlements. She has worked for federal agencies and private consultants before joining the Society for Ecological Restoration in 2016.

THE SOUTH CAROLINA FLOODS: ENHANCING COMMUNITY RESILIENCY WITH ADAPTIVE RISK MANAGEMENT STRATEGIES

Chris Mack
AECOM, N. Charleston, SC, USA

Prior to October 2015, a false sense of South Carolina's flood risk had developed, because the last Presidentially declared flooding event for South Carolina was in 2004. The flooding that has occurred in the past three years has highlighted South Carolina's true vulnerability to flooding. Many communities have asked where do we go from here? The SCDNR Flood Mitigation Program has used the information gathered in all of the resent flood events to assist communities with relaying true flood risk, weeding through the misinformation regarding flooding and flood frequency, and enhancing information available to first responders.

This presentation will use lessons and examples from the 2015 Flood event, Hurricane Matthew and Hurricane Irma to illustrate how SC is moving toward resiliency leveraging Adaptive Risk Management Strategies. This presentation will provide an overview of Adaptive Risk Management strategies for flood mitigation. The SC flood lessons learned provide a backdrop for applying ARM techniques and the sequence/thought-process that a designer or engineer might follow to apply ARM methods for flood mitigation and resiliency. A comparison of non-structural, structural, and hybrid solutions will be presented.

PRESENTER BIO: Chris has over 27 years of experience in public and private sector coastal and water resources planning, engineering, design, program and project management. He has four degrees within Water Resources Engineering, Coastal Engineering, Software Engineering, and Business Administration from NC State University, College of Charleston, and The Citadel. Chris Currently serves as a coastal engineering Technical Director, Strategic Business Developer, and Coastal-Marine Technical Practice Group Leader for a staff of coastal engineers and scientists in Charleston, SC. Chris is a licensed professional engineer in several southeast states and is a certified Project Management Professional.

USE OF SEED ENHANCEMENT TECHNOLOGIES FOR OVERCOMING ABIOTIC AND BIOTIC LIMITATIONS TO NATIVE PLANT ESTABLISHMENT

Matthew D. Madsen
Brigham Young University, Provo, UT, USA

Rangeland degradation and desertification is a global problem, with many regions of the world experiencing declines in ecosystem goods and services and biodiversity. Often the only means of restoring these lands involves seeding with native species. The sagebrush steppe ecosystem of western North America is an example of a desert system that is undergoing rapid ecological change as wildfires and other disturbances remove native perennial plant communities and convert the system to an exotic annual grassland. Land practitioners currently do not possess the tools needed to consistently reestablish native plants into these degraded landscapes. In this presentation, we will examine limiting factors impairing seedling establishment and show how seed enhancement technologies have the potential to overcome these identified barriers to restoration success. We will specifically share how seed enhancement technologies have the potential to improve seed delivery, protect seeds from predation and pathogen attack, improve seed germination timing, minimize mortality from freezing soils, preserve seed energy levels, and enhance seedling vigor to promote survival under drought conditions. These seed enhancement strategies have the potential to dramatically improve the effectiveness of seeding treatments that are intended to protect or restore the diversity and productivity of arid land ecosystems.

PRESENTER BIO: Dr. Madsen is an assistant professor in the Department of Plant and Wildlife Sciences at Brigham Young University, where he teaches classes on rangeland restoration and improvement. His research is focused on developing seed enhancement technologies to overcome the limiting factors imparing native plant establishment.

FINANCING LOUISIANA'S COAST: MAXIMIZING AND LEVERAGING COASTAL FUNDING

Simone Maloz
Restore or Retreat, Thibodaux, LA, USA

As the result of the Deepwater Horizon oil spill settlements and the maturation of the Gulf of Mexico Energy Security Act (GOMESA) into Phase II, the Louisiana Coastal Protection and Restoration Authority expects to have several billion dollars available over the next fifteen years to advance large scale projects. The majority of the funds, nearly $8 billion starting in 2010, have resulted from the Deepwater Horizon oil spill. Louisiana will also begin seeing much larger revenues from the Gulf of Mexico Security Act (GOMESA), but this funding source is unstable and unpredictable at times. Outside of spill-related and offshore revenue funding streams, there is also a growing interest in alternative project delivery methods that can provide financial advantages over the traditional pay as you go method that can be useful tools to state and local governments.

Currently, CPRA can match the projected price tags of these essential projects to a total anticipated dollar amount; however, complications still abound. On the revenue side, each oil-spill related funding stream has its own list of restricted uses, its own payout schedule, its own process for getting funding decisions approved, and finally, its own method for actually drawing down those dollars. On the project side, CPRA must determine which projects to build when, coordinate permitting and engineering and design timelines, and then factor in the length of construction to draw a map of the financial needs of the agency. Along the way these project schedules must be matched up with anticipated cash flows.

This presentation will discuss the innovative partnership between Restore or Retreat and CPRA, with the support of major philanthropy, to investigate both traditional and non-traditional funding streams and scenarios that could allow Louisiana to maximize and leverage its available funding to provide a firm foundation for additional long-term revenue resources to be sought while providing the best value-for-money approach to leveraging funds and providing flood risk reduction through strategic, science-based project selection.

BIO:
Simone Theriot Maloz is Restore or Retreat's Executive Director, and is currently the project manager for the "Financing the Coast" report in partnership with the State, as well as a partner on LSU's GOMESA forecast and a member of the Governor's Advisory Committee for Coastal Activities.

RIVERBANK STABILIZATION ON THE CONNECTICUT RIVER: LESSONS LEARNED FROM 25 YEARS OF RESTORATION

Mickey Marcus
SWCA Environmental Consultants, Amherst, MA, USA

This paper discusses the successful implementation of using engineered log structures, coarse woody debris, soil bioengineering, and tree stumps to stabilize 4095 linear feet (1248 meters) of eroding river bank on the Connecticut River in Massachusetts, USA. The goal of this work was to provide near natural riverbank restoration using coarse woody debris and bioengineering techniques, without the use of stone or other hard armor. The Connecticut River has a watershed area of 11,000 square miles (2,848,987 ha) and has a bankfull width of over 800 feet (244 meters). Annual flows exceed 100,000 cubic feet/second (2,831,685 liter/second) causing significant bank failures and soil erosion.

To eliminate the use of stone, and to provide natural shoreline habitat, demonstration projects were initiated in 2009 to stabilize the eroding river shoreline using engineered woody debris. One of the goals of using the woody debris was to capture sediment during high flow storm events. An emergent wetland bankfull bench was incorporated into the design plan to provide fisheries and wildlife habitat. There are several rare dragonfly species which are found along this reach of the river and use the riverbank during emergence. The sediment deposition was monitored using bank pins, scour chains and staff gauges, and have been monitored for nine years to measure the rate of bank erosion and the sediment deposition which was captured by the woody debris.

Engineered woody debris log jams were built at a spacing of approximately 120 feet (36.5 m) on center and secured into the banks to anchor the planned sediment accretion formations. Native willow shrubs and emergent and aquatic vegetation were planted between the log jams to help in the retention of sediment, and to provide wildlife and fisheries habitat. Staff gages, and scour chains were installed vertically along the project's aquatic bench to measure accretion or deposition. To measure bank erosion, bank pins consisting of metal welding rods were installed horizontally into the banks. During the first year of monitoring, the woody debris structures accumulated as much as 30 inches (76 cm) of new sediment by reducing water velocity along the shoreline during flood events. Tropical Storm Irene on August 28, 2011 was a bankfull event which exceeded 110,000 cfs (3,114,853 lps) and submerged the bank and woody structures for over two weeks. Following the storm significant sediment was deposited and retained by the wood structures; there was no measured horizontal bank erosion. The accumulated sediment has permitted emergent vegetation to become established, which further protects the adjacent river banks.

PRESENTER BIO: Mr. Marcus is a Certified Ecological Restoration Practitioner and Professional Wetland Scientist with more than 30 years of experience in ecosystem restoration. He has a passion for the restoration of wetlands and large river systems.

RECOVER APPLIED SCIENCE FRAMEWORK SUPPORTING EVERGLADES RESTORATION IMPLEMENTATION

Jenna May[1], *David Rudnick*[2], *Agnes McLean*[2], *Jed Redwine*[2], *Fred Sklar*[3], *Phyllis Klarmann*[3], *Andrew Rodusky*[3], *Thomas Dreschel*[3], *Patti Gorman*[3], *Patrick Pitts*[4], *Miles Meyer*[4], *Michael Simmons*[1], *Gretchen Ehlinger*[1]

[1]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[2]South Florida Natural Resources Center, Everglades National Park, Homestead, FL USA
[3]South Florida Water Management District, West Palm Beach, FL, USA
[4]US Fish and Wildlife Service, Vero Beach, FL, USA

The REstoration, COordination and VERification (RECOVER) program provides essential support to the Comprehensive Everglades Restoration Plan (CERP) in meeting its goals and purposes by applying a scientific, system-wide and integrative perspective to the planning and implementation. RECOVER conducts scientific and technical evaluations and assessments for improving CERP's ability to restore, preserve, and protect the South Florida ecosystem while providing for the region's other water-related needs.

Scientists who helped establish the RECOVER program provided a foundation for understanding the state and dynamics of the Everglades ecosystem by developing conceptual ecological models (CEMs). The CEMs informed the development of restoration performance measures and the design of the RECOVER Monitoring and Assessment Plan (MAP), including MAP Hypothesis Clusters. The MAP is an integrated system-wide monitoring and assessment plan that: (1) provides a framework that supports measurement of system-wide responses to determine how well CERP is achieving its goals and objectives; and (2) supports and enables adaptive management for updating and improving CERP, when needed.

Over the past 15 years, South Florida scientists have developed an increased understanding of the Everglades ecosystem and its vulnerability to well-recognized stressors such as water levels, flows and quality and impacts of other, important but less studied drivers, like climate change, sea-level rise, and nonnative invasive species. In order to better integrate and incorporate new scientific knowledge into restoration planning and assessment across the entire greater Everglades system, RECOVER has initiated an effort to update the CEMs and MAP Hypothesis Clusters and conduct an ecological vulnerability analysis to identify areas, species, habitats, and processes that are most vulnerable to known stressors.

The combined effort of updating CEMs and hypotheses, and analyzing vulnerability is expected to help refine restoration performance measures, focus future monitoring and assessment (the MAP), and inform our adaptive management process. By improving these scientific tools and applying them, we will enhance the ability of Everglades Restoration programs and projects to restore and sustain the Greater Everglades Ecosystem.

PRESENTER BIO: Jenna May is a biologist and a RECOVER regional coordinator for the Greater Everglades region. She has more than 5 years of experience with Everglades Restoration science.

DREDGED MATERIAL SETTLEMENT FROM MARSH CREATION PROJECTS CONDUCTED IN COASTAL LOUISIANA

Thomas McGinnis
Coastal Protection and Restoration Authority, Lafayette, LA, USA

Marsh creation is a popular restoration strategy because it immediately addresses the issue of elevation deficits in degrading marshes. Most restoration projects nominated to the Coastal Wetland Planning Protection and Restoration Act program have some marsh creation component. Marsh creation projects also have flexibility in the sources of dredged material used to fill receiving areas: borrow areas from adjacent water bodies, maintenance dredging for navigation channels, and offshore shoals.

Each marsh creation project has a targeted surface elevation which is determined during project planning. The approach is to identify a target elevation that will remain in the intertidal for as long as possible during the project duration based on the marsh type. To determine how much dredged material is required, soil cores are collected to measure geotechnical parameters from the borrow and receiving areas. Parameters such as percent moisture, bulk density, porosity, and sediment size are used to determine the anticipated settlement of the dredged material and compaction in the receiving area to estimate the amount dredged material required to reach the fill elevation. Settlement curves are typically established for different fill elevations to establish the target elevation. Subsequent elevation surveys are conducted after construction to provide empirical data to compare to the settlement curve over time. Settlement plates, instrumentation deployed on the marsh surface prior to filling the receiving area, in concert with elevation surveys are beneficial for parsing out settlement of the fill material and compaction of the underlying soil. Settlement is predicted to be fastest in the first few years after installation. Elevation surveys should be conducted at construction, no later than three years after construction, and in five year intervals thereafter to determine when target elevation has been reached and subsequent elevation changes.

In this presentation, settlement curves and surveyed elevation change will be compared from marsh creation projects in different marsh types and dredge material sources to demonstrate the variety of conditions encountered across coastal Louisiana.

PRESENTER BIO: Mr. McGinnis is a wetland ecologist with 12 years of coastal wetland research and 10 years of restoration monitoring experience in a variety of coastal wetland types from marshes to mangroves. He has been the monitoring manager for 12 restoration projects involving a variety of restoration techniques.

LOCATION MATTERS: HABITAT MAPPING AND GIS TOOLS IMPROVE OYSTER RESTORATION SITING AND SUCCESS

Andrew McGowan
NOAA Cheasapeake Bay Office, Annapolis, MD, USA

The NOAA Chesapeake Bay Office, a Habitat Conservation office under NOAA Fisheries, has been utilizing acoustic underwater survey techniques to classify habitat and inform restoration in the Chesapeake Bay since 2003. Survey data collected by the field staff is edited and analyzed to determine the location and quality of existing oyster habitat in areas of interest within the Chesapeake Bay. Restoration efforts for oyster reefs in the Chesapeake are being undertaken at tributary level scales.

For tributary wide oyster habitat characterization, sidescan sonar backscatter products are used in order to define benthic habitat boundaries. Singlebeam sonar which is evaluated for the character of the return signal is used to classify those habitat boundaries. These classifications are ground truthed with sediment grabs to tie the readings we observe to physical bottom types. These bottom types are then defined within the confines of the Coastal Marine Ecosystem Classification Standard Substrate Component (CMECS – SC). These data types can then be used to inform oyster restoration plans. Most oyster restoration efforts within the bay consist of two main restoration types; oyster plantings on top of a constructed reef or oyster planting without a constructed reef, Constructed Substrate with Seed or Seed Only respectively. Areas with sustainable densities of live oysters are selected as seed only sites since they show an ability to allow oysters to thrive in that location already. Areas with low live oyster densities are designated as sites eligible for a constructed reef to provide vertical relief off of the bottom. In order to designate restoration type an oyster abundance survey is necessary.

The sidescan habitat polygons are used to inform an initial patent tong survey in order to determine the oyster populations within the habitat polygons. With these findings there are enough data layers to overlay them into GIS and develop a draft Restoration Blueprint. This document defines the location, shape, and restoration type of all the oyster restoration planned as well as accounting for other spatial restrictions. Habitat polygons designated for restoration are surveyed with multibeam, singlebeam, and sub-bottom profiling sonar prior to the construction of any reefs. These yield a bathymetric surface of the area and provide data to assess whether the site is deep enough to build on and solid enough to support a reef. Multibeam surveys are completed after the construction or planting of the reefs in order to provide a baseline bathymetric surface for tracking the reefs structural metrics over time.

Through multiyear project tracking in several oyster restoration tributaries we have found that this large-scale survey followed by targeted fine scale survey is an efficient means to finding high quality oyster restoration bottom in a large area of survey coverage. Over the course of five years of monitoring on three-year intervals we have not had any sites fail our structural analysis metrics. We also found that the construction material matters. We are observing higher live oyster densities on the reefs constructed of stone, which provide more structure, surface area, reef complexity, and relief than on reefs constructed out of a crushed shell substrate.

PRESENTER BIO: Andrew McGowan is the Lead Hydrographic surveyor at NOAA Chesapeake Bay Office. He has 5 years of experience conducting sonar surveys in the Chesapeake Bay to support oyster restoration and 10 years of experience in acoustic survey.

USING WILDLIFE HABITAT MODELS TO EVALUATE MANAGEMENT ENDPOINTS FOR OPEN PINE WOODLAND AND SAVANNA

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Woodlands and savannas with a canopy stratum dominated by pine were once common across the landscape of the southern U.S. and provided habitat for a unique suite of wildlife species adapted to this vegetative structure. Today, open pine systems are rare and under-represented on the landscape; less than 4 percent of the historic longleaf pine acreage and about 8 percent of the historic shortleaf pine acreage remains. As a consequence, many of the wildlife species associated with open pine are of conservation concern and are federally listed as endangered or threatened, with additional species considered "at-risk" and currently under review for listing.

Interest in restoration and conservation of open pine has grown substantially in recent years, with major initiatives for both longleaf and shortleaf pine launched in the last decade. Substantial investments of both public and private funding have been made in restoration through these initiatives, and will presumably continue to be made, with the hope that these investments will yield benefits in the form of population responses from wildlife species of interest. As site-level restoration efforts for open pine move forward, either from afforestation or improvement of existing stands, managers need guidance as they implement treatments to develop suitable habitat structure for wildlife species of interest.

Over the last few years, several efforts have worked to refine suggested parameters for several elements of vegetative structure in open pine, including basal area, canopy cover, midstory shrub cover, and herbaceous understory cover. These parameters were summarized in the Gulf Coastal Plain and Ozarks Landscape Conservation Cooperative Integrated Science Agenda. This research project compared these parameters to empirical data collected from a 29,000 acre second growth longleaf pine forest in Southwest Georgia. Vegetation data from permanent monitoring plots were analyzed along with faunal presence/absence data for 17 species collected from a variety of research projects conducted over the last 20 years. This analysis suggests that parameters for stocking, canopy cover, and herbaceous cover could be broadened and forests with these characteristics would still provide suitable habitat for open pine wildlife species of interest. Broader ranges of structural parameters for suitable habitat for species of conservation interest can offer greater flexibility for managers while still maintaining conservation values.

PRESENTER BIO: Kevin McIntyre is the Education and Outreach Coordinator for the Joseph W. Jones Ecological Research Center, where he has worked on longleaf pine related issues since 2001. Prior to that, he worked for 16 years in conservation and land management for several organizations in the Southeast U.S.

INFORMING WATER MANAGEMENT DECISIONS IN LARGE SCALE RESTORATION PROGRAMS: THE USE OF ECOLOGICAL MODELS IN THE EVALUATION OF PROJECT PLANS

Agnes McLean
National Park Service, Homestead, FL, USA

In its third biennial review of progress towards Everglades restoration, the National Research Council's Committee on Independent Scientific Review of Everglades Restoration Progress (CISRERP 2010) concluded that concluded that "Improved species models… are urgently needed to provide more rigorous scientific support for water management decisions". First employed during the 2013 Central Everglades Planning Plan (CEPP) process, several ecological planning tools, or models, were used to quickly visualize and evaluate alternative project plan effects on Everglades wildlife and vegetation.

Efforts to employ ecological models and/or habitat suitability indices in Everglades restoration planning reach back to the mid-1990s and the formulation of the Comprehensive Everglades Restoration Plan (CERP). In the intervening years, an increasingly rich data set from field monitoring and research, funded through RECOVER's Monitoring and Assessment program as well as other agency and non-agency partners, has allowed for the development of much more sophisticated tools. The ecological models now routinely used in restoration planning provide a strong linkage to the ecological effects of alternative plans from simulated hydrology.

These tools, also used in the development of water control plans, include effects on the ecology of oysters, submerged aquatic vegetation in both the northern and southern estuaries of south Florida, American alligators, apple snails (as a proxy for the Everglade snail kite), wading birds (Great Egret, Wood Stork, White Ibis), Everglades landscape vegetation, marl prairie habitats, prey fish and large fish (bass), spotted seatrout and juvenile crocodiles.

PRESENTER BIO: Agnes McLean is the RECOVER Project Coordinator for the South Florida Natural Resources Center, Everglades National Park (ENP), Homestead FL. At ENP, for the last 11-1/2 years, Agnes has coordinated the efforts of staff in the various RECOVER activities, and is currently the ecological subteam lead for the development of the Combined Operational Plan (COP).

CONTROLS ON SUCCESSFUL MARSH RESTORATION WITH DREDGED SEDIMENT-SLURRIES

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We assessed the use of hydraulically dredged sediment-slurries to restore and rehabilitate a brackish marsh system in Louisiana's Mississippi River delta complex, a region in which 25% of coastal wetlands have degraded to open water since 1932. The effects of sediment-slurry application on temporal changes in vegetative cover, hydrology relative to marsh elevation, soil quality, vegetation establishment and growth, and several important ecological functions within deteriorating interior brackish marshes were quantified with high-resolution aerial imagery and on-the-ground sampling. Sediment-slurry application was either confined (enclosed within low-lying spoil banks) or unconfined (allowed to flow freely with no artificial restrictions). Response variables in sediment-slurry restored marshes were compared to a Degraded Reference marsh, which was highly fragmented and in a state of deterioration, similar to project marshes before sediment application. Also, a 'Healthy' Reference marsh was employed, in conjunction with the Degraded Reference marsh, for ground assessments.

In 2008, prior to sediment-slurry application, habitat types were limited and consisted of 62.4% water and 37.6% vegetation. From 2008 to 2012, the study area increased in vegetative cover by 71%, decreased surface water areas by 81.8%, and added 198.7 ha (24.9%) of elevated unvegetated soils. In comparison, the un-treated Degraded Reference marsh lost 41.8% of its 2008 vegetative cover, increased its open water area by 29.9%, and added 3.8 ha (5.1%) of elevated, but unvegetated soils. Sediment-slurry application to deteriorated brackish marshes altered soil physico-chemistry, plant recruitment, and ecosystem function, but the intensity and direction (positive or negative) of effects depended on the marsh elevation achieved and the particular response variable. We conclude that the restoration marshes have not yet reached ecological equivalency with reference marshes for many of the variables and processes measured in this research. However, the restored marshes are now very different for a number of response variables, including total vegetated land cover, compared to the Degraded Reference marsh, which was highly ponded and consisted of few plant species. Thus, sediment-slurry application was successful in converting degraded fragmented marshes into marshes with contiguous vegetative cover and high species richness, more closely resembling the Healthy Reference marsh than the Degraded Reference marsh. Nonetheless, more time for functional development of the restoration marshes is necessary before ecological equivalency with the surrounding higher-quality natural marshes is completely achieved, at least relative to the response variables measured in this research.

PRESENTER BIO: Dr. Mendelssohn is a Professor Emeritus at Louisiana State University with more than 40 years of research experience in coastal plant ecology, including wetland restoration. He has published extensively on the use of hydraulically dredged sediment-slurries in restoring the ecological structure and function of coastal wetlands.

ECOLOGICAL RESTORATION IN YUCATÁN: A STRATEGY FOR IMPLEMENTATION, DEVELOPMENT AND MONITORING OF RESTORATION PROCESS IN A NETWORK OF PRIORITY SITES

Anny K. Meneses-Mosquera[1], *Javier Enrique Sosa-Escalante*[2], *Enrique Martinez-Meyer*[1]

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Globally, the change in economic activities and the use of natural resources have affected biological diversity and human stability. In response to this dynamic of change, processes and disciplines such as ecological restoration has been developed to improve the conditions of the natural areas or elements of diversity affected. However, it is a complex issue to approach, due to the lack of information that exists at different temporal and spatial scales. In Mexico, some states deal conservation problems caused by productive activities and the constant change of land use and vegetation. The ecological restoration has been the protagonist as a solution, to compensate the damage in many states. The restoration processes, which have been developed mainly at the local level, with interests and needs specific to the areas. Yucatan has been considered as a state with a large part of its surface of disturbed plant cover and despite successful efforts of small-scale ecological restoration, there is no strategy for the restoration of ecology in the state. For this reason, a strategy was developed for the restoration in the state, which included the planning at the regional level of priority zones and the local evaluation of these zones, with two objectives, to contribute to the restoration of disturbed ecosystems and to contribute to the regional policy of restoration in Yucatan.

The strategy was divided into three phases. **1. Analysis of the panorama of disturbance in the state.** Changes and trends of fragmentation and vegetation cover and land use were identified between five periods, from 1970 to 2011, using FRAGSTATS V. 4.2 and the IDRISI Terrset Land change modeler module, this information was used for the second phase. **2. Identification of priority areas to apply restoration processes,** the zones were represented in a network of planning units (PUs) of 5 km^2 each, a total of 520 PUs were identified, grouped into three types of zones with different priority, high, medium and low at the regional scale, at the landscape level through a multi-criteria analysis. 5 types of criteria were considered: disturbance, social, biological, climatic, economic-political, each criterion was represented by different attributes, in total 16 attributes were used. This analysis was done with the tool Model builder of ArcGIS 10.4. **3. Selection of areas with high priority, to carry out restoration actions.** The structural characteristics of the landscape of all the zones with high priority were evaluated, through satellite images, to find those zones that due to their spatial characteristics benefit the recovery of the coverage and connectivity between remnants of vegetation, this analysis was done with the QGIS V. 3.0. A total of 60 PUs was identified. These zones are important not only because of their spatial characteristics and because through their management, they contribute to the restoration of disturbed ecosystems in the Yucatan.

PRESENTER BIO: M. Sc. Anny Meneses is a doctoral student in biological sciences. For 4 years, she has been working with spatial analysis, planning and diagnosis of possible areas to carry out restoration processes. Currently, she is developing a strategy to find these areas in Yucatan, Mexico.

ADDRESSING LIMITATIONS TO SEED RECRUITMENT IN LARGE SCALE RESTORATION

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Large-scale, precise use of seeds of wild species underpins landscape-scale restoration. The poor conversion of seeds into established seedlings is currently a significant limitation to the effectiveness of restoration programs that are reliant on seeds of a diverse range of native species. In seasonally dry systems across a range of habitats, it is common for less than 10% of seeds delivered to site to result in an established seedling.

Factors that can contribute to failed seed recruitment include poor seed collection and/or post-harvest handling and storage practices, a lack of consideration of the requirements for seed dormancy break and germination, and inadequate seed delivery techniques. Co-ordinated seed science underpinned by ecological principles, and the adaptation of advances in seed technology to wild species, is necessary to address these issues and to fulfil restoration targets. The strengthening of interactions and synergies between seed scientists, ecologists, agricultural engineers, and restoration practitioners will help to ensure that seeds are deployed to their full potential in landscape-scale restoration.

With a focus on studies conducted on species of drylands of Australia, where seeds for restoration are sourced almost exclusively from wild-plant populations, this presentation will highlight the role that seed science can play in identifying and addressing barriers to seed regeneration.

PRESENTER BIO: Dr. Merritt is a senior research scientist with 20 years experience in seed and conservation sciences. He manages the seed science programs of Kings Park Science, which encompass fundamental and applied aspects of seed science for conservation and restoration of native plant species across the diverse ecosystems of Western Australia.

WORKING WITH LOCAL COMMUNITIES TO DEVELOP A NATURE-BASED DEFENSE ASSESSMENT AND SOLUTION TOOL

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Coastal hazards such as flooding and land loss has demanded natural and nature-based solutions from local communities for their protective services as well as co-benefits compared to typical engineered approaches. Natural solutions are those that consider conserving existing habitats such as salt marshes and the nature-based solutions are those created by humans, such as created marshes. These solutions support important ecosystem processes, such as wave attenuation, nutrient assimilation, primary production in nursery habitats for fisheries, and carbon storage. Quantifying these ecosystem processes and their related ecosystem services overtime with management actions has been limited but needed to assess how natural and nature-based solutions are impacting local communities.

The goal of this research is to co-develop a natural and nature-based defense assessment and solutions tool with local communities. The tool will help capture feedback of the ecological and physical characteristics of ecosystem via an ecosystem model, encompass the needs and knowledge of local communities, and will be applicable and transferable to other ecosystems. Our main research questions are: What is the contribution of natural and nature-based solutions to wave attenuation, fish habitat, nutrient assimilation, and carbon storage? Can collaborative approaches to modeling with communities potentially produce innovative solutions or tools for reducing coastal risk?

A Competency Group was created that includes engineers, social and natural scientists, and local community members that interact frequently (at least five meetings scheduled over a 12-month period) to discuss existing and proposed natural and nature-based defenses in Breton Sound Estuary, coastal Louisiana. The Competency Group meetings are organized and facilitated by social scientists where the ecosystem modeling and analysis is led by engineers and ecologists. An Integrated Biophysical Model (Delft3D flexible mesh) that represents the local hydrodynamics, morphodynamics, nutrient dynamics and vegetation dynamics was adjusted for this estuary and input from the local community about the preferred natural and nature-based defenses was applied. Scenarios that included extreme conditions such as hurricane-force winds and water levels and drought conditions were considered by the Competency Group and run with the ecosystem model to include areas with and without natural or nature-based solutions. The results from the scenarios consider how these solutions influence wave attenuation, nutrient assimilation, primary production in nursery habitats for fisheries, and carbon storage. This project suggests a novel approach to modeling ecosystem-based defense strategies through a collaborative planning process with researchers and local communities who stand to benefit from ecosystem-based restoration projects.

PRESENTER BIO: Dr. Meselhe is the vice president for engineering at the Water Institute of the Gulf, and a Professor at the River-Coast Science and Engineering, Tulane University. His research interests are focused on wetland hydrology, sediment transport, and computer modeling of inland watersheds, coastal wetland, estuarine, and riverine systems.

A NETWORK OF NETWORKS: BUILDING OUT THE RESTORE COUNCIL'S MONITORING AND ASSESSMENT PROGRAM

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Relevant information is required for managers operating at different geographic scales to make informed decisions to effectively manage ecosystem resources across the Gulf of Mexico. A spatially and temporally comprehensive environmental monitoring network for habitat and water quality is a foundational element of science-based decision making. Such a network will provide essential information to support the development, selection, and application of effective management and restoration project alternatives, and inform adaptive management decisions at the local, state, and regional levels.

The RESTORE Council Monitoring and Assessment program, initially funded for 3 years and administered jointly by the US Geological Survey and National Oceanographic and Atmospheric Administration, will develop some of the foundational components of a Gulf region-wide monitoring network for two of its five restoration goals in order to measure impacts of RESTORE Council investments in restoration. Through collaboration with the Gulf States, federal, and local partners, academia, non-governmental/non-profit organizations, and industry, the program set up a structure and several working groups to leverage, existing resources, capacities, and expertise. This collaborative organizational structure incorporates: RESTORE Council members through an interagency Council Monitoring and Assessment Working Group (CMAWG); Gulf restoration funders and implementers through a Monitoring Coordination Committee (MCC); and the larger monitoring and science community through a monitoring Community of Practice (CoP) facilitated by the Gulf of Mexico Alliance (GOMA).

The basic approach to building the Gulf habitat and water quality monitoring network is to: develop a comprehensive inventory of existing habitat and water quality observations and monitoring programs (building on existing efforts where possible); evaluate the suitability/applicability of each program to be used at a Gulf-wide scale; coordinate appropriate existing observations and monitoring systems to form a regional monitoring network with an integrated data management structure; identify information gaps; and prepare recommendations to strategically supplement existing observations and monitoring programs to fill the acknowledged gaps with available capabilities of regional partners. We will describe RESTORE CMAP progress to date, working groups' activities and integration plans, and coordination with other DWH related programs and activities.

PRESENTER BIO: Michelle Meyers is an ecologist with experience in ecosystem restoration and Deepwater Horizon Oil Spill programs. She serves as technical lead for monitoring and adaptive management for multiple projects and programs and as Gulf Science Liaison coordinating science to support large scale restoration in the Gulf of Mexico.

MANAGING NATURAL RESOURCE CONFLICTS WHILE IMPLEMENTING LARGE-SCALE ECOSYSTEM RESTORATION

Corey Miller
Coalition to Restore Coastal Louisiana, New Orleans, LA, USA

The best chance to maintain the largest footprint of wetlands in Southeast Louisiana for the foreseeable future involves reconnecting the Mississippi River to the adjacent basins through sediment diversion structures. These wetlands help buffer the impacts from storms and hurricanes to cities and communities near the coast and provide habitat for a diversity of species. A host of anthropogenic factors contribute to the current degraded state of these wetlands. Within those, disconnecting the river and its alluvial deposits from the estuaries via levees to prevent flooding is arguably the most disrupting. The resulting unnatural, altered environment now provides habitat for commercially significant fisheries that migrate inland with ever-encroaching saline conditions. While sediment diversions address the systemic problem of the degrading wetlands, they also reverse the conditions that facilitated the inward migration of brackish and saltwater species (brown shrimp, oysters, and speckled trout- to name a few). The sediment, nutrients, and fresh water resources that sediment diversions deliver to restore the estuary pose potential conflicts with the current locations where much of these commercial fisheries resources are harvested.

This presentation describes efforts by the Coalition to Restore Coastal Louisiana, an environmental non-governmental organization, to engage members of Louisiana's shrimp fishery in preparation for addressing the conflicting environmental conditions that are likely to accompany sediment diversions. The successes and lessons learned from these efforts relate to a much broader need for collaboratively engaging diverse stakeholder interests as communities across the globe address ecosystem restoration in the face of climate adaptation. A series of 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; an effort to compile the current state of knowledge about Louisiana shrimp, shrimping, and shrimpers; and the development of an app to collect fisheries-dependent effort.

PRESENTER BIO: Corey leads CRCL's community engagement efforts with a focus on working with fishing-dependent communities utilizing a social science perspective to improve resiliency in the face of a degrading landscape and increasing flood risk.

POTENTIAL EFFECT OF MORBILLIVIRUS EXPOSURE FOLLOWING THE DEEPWATER HORIZON OIL SPILL ON BOTTLENOSE DOLPHIN POPULATION

***Annie M. Montgomery**, Hsiao-Hsuan Wang, and William E. Grant*
Ecological Systems Laboratory, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX, USA

Deepwater Horizon (DWH) was the largest offshore oil spill in the petroleum industry's history. DWH significantly altered the ecology and biology of the Gulf of Mexico and its surrounding areas, including many species of threatened and endangered marine life and habitat quality. Following the oil spill in April 2010, an unusual mortality event occurred in the Gulf of Mexico in cetaceans, primarily bottlenose dolphins (*Tursiops truncatus*). Dolphin morbillivirus (DMV) was investigated to be the cause of this event. DMV is a well-recognized paramyxovirus that causes dolphin deaths worldwide from acute viral pneumonia, viral encephalitis, or from fungal or bacterial infections from immunosuppression. Therefore, the objective of our research was to determine how the event of oil spills affects the exposure of bottlenose dolphins to morbillivirus. We conducted thorough literature reviews to obtain the demographic data for different age categories in order to develop an age-structured model using STELLA® 7.0.1 to determine morbillivirus exposure in bottlenose dolphins. We then used the model to quantify the effects of DWH on the morbillivirus exposure to bottlenose dolphins' population dynamics into the future 30 years.

The results of the baseline model without dolphin morbillivirus effects show a slight increase in the population from 218 to 262 individuals within 30 years. All age classes gain a negative trend after applying the different DVM mortality rate percentages, implying the possibility of endangering the population's current conservation status. The graph with 30% DMV shows the most intense decrease of up to 72.07%, but even the lower percentages of DVM (10% and 20%) show significant population declines up to 25.84% and 39.22%, respectively.

PRESENTER BIO: Annie Montgomery is a senior at Texas A&M University majoring in Wildlife and Fisheries Sciences. She has been a member of the Ecological Systems Laboratory under the supervision of Dr. Wang and Dr. Grant since June 2017 and hopes to continue doing research in the field of ecology.

LOWERMOST MISSISSIPPI RIVER MANAGEMENT PROGRAM

Jennifer J. Mouton[1], *Brian M. Vosburg*[1], *Ehab A. Meselhe*[2], *Mead A. Allison*[2]
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This large-scale program will build the technical knowledge base needed to develop a plan that moves the nation toward a more holistic management scheme for the Lower Mississippi River, which seeks to both enhance the great economic value of the River while also elevating the importance of ecological maintenance and restoration of the landscape through which it flows. This planning effort will advance the science developed under the Louisiana Coastal Area (LCA) Mississippi River Hydrodynamic and Delta Management Study (MRHDMS) to form the foundation for any future river management analysis by creating an integrated science-based management strategy for the Lower Mississippi River to improve navigation, reduce flood risk, and provide for a more sustainable deltaic system.

The program includes a full and objective assessment of the benefits and costs of the current management scheme for the Lower Mississippi River, including both the significant economic benefits, as well as future unintended adverse impacts to the coastal environments. The plan will evaluate alternatives to the current management scheme that would meet the aforementioned goal. It will also evaluate the benefits and costs of maintaining the current management scheme within a range of predicted futures, based on climate change, sea level rise, and subsidence.

The program includes five technical elements and a program management component. These elements are: 1) Extended applications of the Mississippi River Hydrodynamic Modeling Tools; 2) Subsidence Investigations; 3) The Impacts of Coastal Features on Storm Surge; 4) Genesis, Stability and Fate of Subaqueous Lateral Bars; and, 5) Dredged Material Management. The state and their contractors will develop a detailed Scope of Work for each of the technical elements. This program will further develop the science needed to adequately inform decision makers on future LMR management and will include establishing existing and future without project conditions, and develop alternative river management schemes based on numerical modeling tools and other analyses developed under MRHDMS. These management schemes could include alternative and/or key elements developed during the conduct of the Changing Course Competition as well as any other alternatives that optimize a balance between navigation, flood risk management, and ecosystem restoration.

Public engagement using established CPRA processes for stakeholder involvement and an additional annual opportunity for program update and discussion with key stakeholders such as the navigation sector and nongovernmental environmental organizations, as well as the general public, will ensure openness and transparency throughout the process.

PRESENTER BIO: Ms. Mouton is a coastal resource scientist with more than 20 years of experience in environmental protection and wetland restoration and hurricane damage risk reduction. She has been involved in such projects as the Deepwater Horizon NRDA assessment, sea level rise policy, and large scale long term restoration projects.

RECENT COASTAL GEOMORPHOLOGICAL CHANGES OF THE OLD BRAZOS RIVER DELTA: MORPHODYNAMIC PROCESSES AFFECTING HABITAT ADAPTATIONS

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The Brazos River Delta (BRD) in Texas is subject to natural and anthropogenic pressures due to changes occurring in the long-term environment (relative sea level rise, lack of sediment supply and Gulf shoreline retreat) and in the short-term environment (recent storms and anthropogenic development). These drastic transformations to the deltaic environment can be seen by examining historical aerial photography over the last 80 years that exposes the implications of human-induced hydrologic manipulation of the former main delta channel, which has led to an imbalance of the water and sediment budgets (riverine and littoral), and salinity intrusions across the entire deltaic geomorphological system.

Historically, salinity intrusions have been qualitatively measured on other segments of the Brazos River by examining the conversion of freshwater wetlands to brackish and saline marsh communities and by drastic changes in fish habitat. Recently, Gulf salinity intrusions were measured by U.S. Geologic Survey on the main Brazos River channel (BRC) at the bridge of Brazoria County FM 1462, approximately 33 miles from the river mouth. These salinity values show how far inland the estuarine processes are occurring today.

Additional to the large-scale salinity intrusions, coastal and inland flooding are also controlling the dynamics of the now called Old BRD (OBRD). We applied concepts of deltaic geomorphological evolution and coastal vulnerability after the impacts of Hurricanes Ike and Harvey and relative sea level rise scenarios to identify how these drastic changes are adversely impacting ecosystems, industrial and urban development and the maritime industry. We also combined our data analysis with the information on the type of projects that federal and state agencies, local municipalities and the private sector are applying to respond to the deltaic changes and played with different scenarios. We have concluded that some portions of the OBDR are undergoing a process called “reversed geomorphology”. The processes associated with reversed geomorphology include: rapid or transitional changes from fluvial-dominated environments to intertidal-dominated environments, rapid retreat of river banks, marsh disintegration, salinity intrusions on small intertidal creeks, migration of ecological habitats, increased coastal and inland flooding, and rapid gulf shoreline retreat. Our hypothesis is that the recent drastic changes occurring on the BRC, more than 50 miles from the river mouth are a response to the changes in the OBRD. These recent geomorphological adjustments along the OBRD are inducing catastrophic flooding on specific areas of the OBRD forcing drastic adaptation of the coastal habitats and creating a cycle of cause-effect processes that is constantly changing.

PRESENTER BIO: Dr. Moya is a senior geomorphologist with more than 27 years of experience working with coastal projects. For more than 15 years has worked on the planning and management of restoration projects and worked with elected officials and communities on issues related to the changes to the Brazos River Delta.

INNOVATIVE STRATEGIES FOR RESTORING FUNCTIONALITY OF RECONSTRUCTED SOILS IN DRYLANDS

Miriam Muñoz-Rojas[1,2,3], *Todd E. Erickson*[1,2], *Amber Bateman*[1,2], *Tayla Knneller*[2,3], *Shane R. Turner*[1,2] *and David J. Merritt*[1,2]

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Global environmental changes and other anthropogenic impacts are rapidly transforming the structure and functioning of ecosystems worldwide. These changes are leading to land degradation with an estimated 25 % of the global land surface being affected. In the resource-rich biodiverse semi-arid Pilbara region of Western Australia hundreds of thousands of hectares are disturbed due to established and emerging iron-ore mine operations. The need to develop cost-effective large-scale solutions to restore these landscapes becomes imperative to preserve biodiversity and achieve functionality and sustainability of these ecosystems. The Restoration Seedbank Initiative (RSB) is a five-year multidisciplinary research project that aims to build knowledge and design strategies to restore mine-impacted landscapes in the Pilbara and other arid and semi-arid landscapes worldwide. Within the soil program of the RSB, a series of laboratory and glasshouse studies, and field trials, have been conducted in the last four years to advance our knowledge on soil limitations and to provide solutions to effectively overcome these challenges in arid ecosystem restoration. These studies include (i) the analysis of the influence of climate and edaphic factors in the recruitment of arid zone seedlings and (ii) the evaluation of soil physicochemical and microbiological indicators to assess functionality of restored soils in degraded semiarid ecosystems and (ii) the development of nature-based strategies based on bio-tools, e.g. soil biocrust cyanobacteria inoculation and organic amendments addition, to enhance soil functionality. Here, we summarize our latest results in the soil program of the RSB, and propose recommendations for integrating soil science in cost-effective landscape-scale restoration practices in ecosystems worldwide.

PRESENTER BIO: Dr Miriam Muñoz-Rojas leads the Soil Program of the Restoration Seedbank Initiative, a major industry-based research project that focus on developing science to drive landscape restoration of biodiverse degraded ecosystems. Her research explore the functioning of natural and restored ecosystems, with a particular focus on soil ecology, combining ecophysiological, biogeochemical and molecular techniques with experimental and modelling approaches.

DEFINING NATURAL INFRASTRUCTURE PERFORMANCE AND TRACKING RESILIENCE CHANGE OVER TIME IN COASTAL ENVIRONMENTS

Peter S. Murdoch[1], *Richard O. Bennett*[2], *Susan M. Taylor*[3], *Kim M. Penn*[4], *Bhaskar Subramanian*[5]

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Damage from multiple large storms in the fall of 2017 has amplified the need for information to support increased environmental and socio-economic resilience of the Nation's coasts. Defining baseline conditions, tracking the effects of mitigation actions, measuring the uncertainty of resilience to future extreme events, and improving performance metrics for assessing the success or failure of projects implemented to build resilience are essential so that the best management practices can be determined. Federal, State, and NGO partners have been developing recommendations for a small set of core environmental and socio-economic measurements to assess project performance and overall coastal resilience over time and at multiple spatial scales.

Efforts undertaken after Superstorm Sandy have improved information to help plan, implement, and assess mitigation efforts for more recent storm events. New models of inundation, overwash, and erosion that were developed during the Superstorm Sandy projects have already been applied to coastlines before and after the 2017 storms. Results from wetland, beach, back-bay, estuary, and built-environment projects funded in the wake of Hurricane Sandy have improved models of inundation and erosion from surge and waves. Tests of nature-based infrastructure for reducing risk to coastal ecosystems and communities yielded new concepts for resilience best practices. Follow-up studies of ecological and socio-economic measurements being tested for detecting disturbance, tracking recovery, and assessing project performance provide baseline data critical to early detection of vulnerabilities. The recommended measurements and strategies for their implementation will enable cost-effective management for more resilient coastal regions and help define best practices before more costly mitigation or restoration efforts are required.

Presenter Bio: Pete Murdoch is a biogeochemist at the USGS with more than 35 years of research, monitoring, and decision-support experience. He is currently the USGS Science Advisor for the Northeast Region, and was chair of the DOI Metrics Expert Group that developed resilience measurements for the DOI Hurricane Sandy Response Program.

MAINTAINING SALT MARSHES IN THE FACE OF SEA LEVEL RISE: THIN LAYER PLACEMENT OPPORTUNITIES, PRACTICE AND CHALLENGES.

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Salt marshes are among the most productive, abundant, and fertile coastal habitats on earth, and they are reported as providing more ecosystem services to coastal populations than any other environment: from fish nursery habitat supporting commercial fisheries to endangered species habitat, carbon sequestration, and storm risk reduction. Modern salt marshes established themselves approximately 2,000 years BP due to a decrease in sea level rise rate (less than 1 mm/yr), a continuous sediment supply, and biogenic processes that maintain the habitat and increase diversity in microhabitats and species richness.

Recently, however, climate change has induced sea level rise and erosion from stronger storms, while land use patterns have often cut off sediment supply and affected hydrology such that the biogenic processes maintaining marsh elevation maintenance and integrity are compromised. As a result, many marshes are losing integrity and are subject to high rates of *relative* sea level rise, beyond the global rates. Studies in the North Atlantic, Gulf, and Southern California have all compared projected sea level rise and plausible accretion rates and found that without intervention, severe losses of coastal wetlands are anticipated over the next 50-100 years, causing not only a loss in habitat but coastal resilience.

Because the supply of sediment is a factor in the maintenance of marsh elevations, and natural sources of sediment have often been cut-off by dams, river channelization, levees, and other forms of water control, one intervention currently being investigated is artificially delivering sediment to marshes. One method, thin layer placement of dredged material on the marsh surface, is currently being piloted in a number of areas across the country.

The U.S. Army Engineer Research and Development Center is partnering on the monitoring of several of these projects — Narrow River, RI, Avalon, NJ, and Seal Beach, CA — and is also working to develop tools to assist in the design and implementation of future efforts. As these pilots mature, best practices, challenges, and data gaps are coming to light that will inform future projects and research priorities.

PRESENTER BIO: Ms. Murray is a Principal Investigator in the Wetland and Coastal Ecology branch of ERDC's Environmental Laboratory, with 25 years of experience in wetland assessment and ecology. Her current interests include utilizing coastal ecosystems as adaptations to sea level rise, and measuring the breadth of services provided by these ecosystems.

THE ECOLOGY OF DAM REMOVAL – A NATIONAL LOOK AT ECOSYSTEM RESTORATION CHALLENGES AND OPPORTUNITIES FOR REMOVAL OF RIVER BARRIERS

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The frequency of dam removal has increased across the U.S. in recent years with dams being removed for a multitude of reasons including owner liability, dam safety, fish and aquatic organism passage, sedimentation, flood resiliency, and water quality. While Pennsylvania, Wisconsin, and California have removed the most dams since 1916, all but a handful of states have had dams removed (American Rivers). Engineering and modeling challenges exist for designing the actual removal and deconstruction of the dam, but some of the biggest challenges often exist in other aspects of dam removal including impounded sediment, rare plant and animal species, historical and archaeological resources, hydrology and wetlands, and public perception and opinion. Along with these challenges also come opportunities for holistic ecological restoration and species-specific habitat restoration.

This talk will focus on the challenges and opportunities that practitioners and others encounter when working to restore ecological form and function through the removal of stream barriers. Using examples from dam removals in New England, the mid-Atlantic, the Midwest, and the west coast, we will discuss some of the challenges that arise, including sediment management, active versus passive channel construction, large woody habitat installation, changes to regulated resource areas, rare species management, and invasive species management. This talk will provide examples of how these challenges have been addressed and the opportunities for ecological restoration that have resulted.

PRESENTER BIO: Nick Nelson is a fluvial geomorphologist and regional director for Inter-Fluve, Inc., a nationally recognized river and wetland restoration engineering firm. Nick has been involved in dozens of dam removal projects throughout the country and has led more than a dozen dam removals in MA and New England.

INFORMING GULF COAST (DWH-NRDA) ECOLOGICAL RESTORATION OPTIONS WITH THE RECOVERY POTENTIAL SCREENING TOOL

Douglas J. Norton[1]*, Amy Newbold*[2]*, Erika Larsen*[1] *and Andrew Somor*[3]

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After 2010's offshore oil spill in the Gulf of Mexico, the Deepwater Horizon Natural Resource Damage Assessment (DWH-NRDA) process was carried out to evaluate impacts. A settlement was reached to resolve liability for natural resource injuries through several billion dollars in restoration funding over 15 years, to be administered by 16 federal and state natural resource trustee agencies. The magnitude and complexity of this regional scale restoration challenge called for a broad variety of tools, including comparative screening tools that could facilitate "discussion support" among trustee agencies jointly charged with considering restoration strategies and project proposals in the coastal zones of several Gulf states. Among the many models, assessments and processes that contributed to planning and implementing DWH-NRDA restoration, the U.S. Environmental Protection Agency's Recovery Potential Screening (RPS) Tool played a unique role in informing multi-disciplinary groups of relative differences in conditions and options among coastal watersheds. The RPS Tool scores hydrologic units (HUC12) with multi-metric indices addressing ecological resilience, stressor magnitude, and social context factors affecting restoration prospects for success. Indices are based on indicators most relevant to the specific screening purpose, user-selected from a menu of 460 indicators compiled nationwide and supplemented by state-specific parameters. The RPS Tool's embedded indicator dataset enabled customized pairing of watershed ecological attributes of interest along the Gulf coast with stressor-specific metrics needing remediation, usually across hundreds of HUC12s at a time. Further, the tool's map-based visualizing of individual watershed attributes closely associated with specific stressors and restoration practices enabled working groups to see where proposed techniques might be most appropriate. As a rapid screening-level tool, RPS supported numerous, even daily iterations and changes as requested for the Trustee Implementation Groups (TIGs) involved. Multiple RPS analyses of coastal HUC12s were contributed to Florida, Louisiana, and Texas TIGs to help them discuss and evaluate many options for restoration project support. The presentation focuses on RPS support for comparative evaluation of ecologically-driven options for nutrients-related restoration projects in Louisiana.

PRESENTER BIO: Doug Norton is a watershed ecologist and the EPA Office of Water's Healthy Watersheds Coordinator in Washington, DC. He co-developed the Recovery Potential Screening Tool and has applied it in comparative watershed assessment and prioritization projects in 37 states and territories over the past 14 years.

CREATED MARSHES COULD SUPPORT MORE FISH AND CRUSTACEANS IF THEY WERE DESIGNED WITH LOWER ELEVATION AND MORE EDGES

***John Andrew Nyman**, Scott Harlamert*
Louisiana State University Agricultural Center, Baton Rouge, LA USA

Constructing wetlands with dredged material is an increasingly common restoration technique. Most research to improve the efficiency of diversions and created wetlands focuses on vegetation. However, restoring coastal wetlands almost always is justified on the basis of fish and wildlife that use wetlands. None-the-less, relatively little research is designed to optimize the effects of restoration on fish and crustaceans (i.e., nekton). We compared habitat for fish and crustaceans as well as abundance of fish and crustaceans in that habitat between created and natural wetlands. That comparison led us to identify strategies to improve the contribution of created wetlands to coastal fish and crustacean populations.

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.

HOW TO CONSTRUCT ESTUARINE WETLANDS HIGH ENOUGH TO REMAIN VEGETATED FOR DECADES WITHOUT DELAYING FISH AND WILDLIFE FUNCTIONS

John Andrew Nyman
Louisiana State University Agricultural Center, Baton Rouge, LA USA

Constructing wetlands from dredged material is an increasingly common restoration technique in estuarine areas. Most research to improve the efficiency of estuarine wetland restoration focuses on vegetation. A focus on vegetation combined with a lack of understanding regarding marsh vertical accretion appears to contribute to constructed wetlands being constructed at an elevation that delays rather than extends wetland functions.

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 because marsh vertical accretion rates are assumed to be zero.

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 at levees. Detailed hydrologic and economic modelling is needed to determine the hydrologic and economic conditions that justify increasing the elevation of constructed wetlands rather than increasing elevation of 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 increases costs while also delaying rather than extending 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.

IMPROVING WATER QUALITY THROUGH INTENSIVE COMMUNITY ENGAGEMENT

John O'Donnell[1]*, Brady Skaggs*[1]*, Elizabeth D. Smythe*[2]*, Kevin Caillouet*[3]

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The Lake Pontchartrain Basin Foundation (LPBF) has worked to restore water quality utilizing a unique watershed-based restoration methodology. LPBF projects address both point-source and non-point source pollution in rivers listed by the Louisiana Department of Environmental Quality (LDEQ) as impaired for nutrients, dissolved oxygen, and coliform bacteria. Historically, many of Louisiana's surface water impairments have been the result of the prolific installation of home sewer systems and small commercial systems that discharge into surface waters. LPBF partners with the local parish and works to fix the problem through several approaches: door-to-door inspections, local inspector education, and homeowner education. To date, this program has collected more than 9000 water quality samples at greater than 120 sites on North shore rivers and worked with more than 1000 commercial and 2500 home Waste Water Treatment Plants (WWTPs). This work resulted in subsegments of the Bogue Falaya River, Tchefuncte River, and Tangipahoa Rivers being removed from the EPA's Impaired Waterbodies List, and declared safe for "primary contact recreation" (i.e. swimming). The program has also led to reductions in fecal pollution on more than 10 waterways.

LPBF is working with St. Tammany Parish to help continue similar work in other watersheds. LPBF has increased the scope of the monitoring program to include monthly water quality sampling of influent and effluent parameters including coliform bacteria, nutrients, BOD, and TSS. The water quality monitoring sites are also collocated with sites that St. Tammany Mosquito Abatement District monitors. *C. Quinquefasciatus* (southern house mosquito) is commonly monitored in this region as it is a vector for West Nile, equine encephalitis, and the zika virus. *C. Quinquefasciatus* prefers highly organically polluted water for breeding. Data is also interpreted in a GIS overlay, allowing the Parish government to make science-based decisions for protecting residents, restoring watershed quality and planning.

LPBF has inspected over 1400 homes so far in the current program, and will inspect 2400 by project end with educational materials passed out to every home inspected. We have assisted over 300 homeowners in education and repairs to their systems. Less than 50 percent of home systems passed initial inspection. After assistance, more than 80 percent of home systems pass inspection. Our current sampling data suggests a BOD reduction of 55 percent compared to pre-inspection sampling with some sites showing a 400 percent improvement. Further study will seek to compare mosquito populations pre and post inspections with our water quality monitoring data.

This pollution source tracking program is ideal for a rural area that rapidly developed population density without the benefit of centralized sewer in the aftermath of Hurricane Katrina. This partnership itself is the result of a water quality task force LPBF hosts to share concerns and project results on water quality issues in the parish. It is attended by various state, local, and non-profit agencies.

PRESENTER BIO: John O'Donnell is a water quality specialist with the Lake Pontchartrain Basin Foundation. A MSPH graduate of the Tulane School of Public Health, he has worked on water quality and wastewater issues in New Orleans and the North Shore of Lake Pontchartrain for the past 5 years.

IMPLEMENTATION OF COASTAL HABITAT IN THE DETROIT AREA OF CONCERN - STONY AND CELERON ISLANDS

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Over the past two centuries the Detroit River has experienced considerable degradation of fish and wildlife habitat. With the implementation of the Stony and Celeron Island Habitat Restoration Projects, significant strides are made to restore this important coastal habitat.

The Detroit River is a 32-mile international connecting channel linking Lake St. Clair and the upper Great Lakes to Lake Erie and the lower Great Lakes. In 1815, the Detroit River shoreline consisted of coastal wetland up to a mile wide. Since 1815, channel modification, encroachment of the river, hardening of the shoreline, addition of steel and concrete walls, fill material, development, and contamination have led to dramatic changes. In 1815 there were approximately 10.687 square miles of coastal wetlands. By 1982, this number has decreased to only 0.12 square mile. Other types of habitat have also seen this loss due to removal of bedrock limestone spawning grounds for whitefish, loss of wooded areas to agriculture, and contamination from waste effluents. Subsequently, under the Great Lakes Water Quality Agreement, the Detroit River was designated as an Area of Concern (AOC). In response, the Detroit River Public Advisory Council (PAC) has become focused on the removal of the AOC's Beneficial Use Impairments (BUIs). The PAC has identified Stony and Celeron Islands as primary habitat restoration sites listing them in the AOC's delisting guidance document to address the BUIs for loss of fish and wildlife habitat, degradation of fish and wildlife populations and degradation of benthos.

Stony and Celeron Islands were identified for their capacity to provide tremendous fish, spawning habitat and nursery grounds. The islands' existing complex emergent, shrub and palustrine, and wetland habitats has been home to many wildlife species, providing a very productive spot for rare and transient waterfowl. The restoration will prevent continued degradation of this remaining habitat, allow for recovery of areas that have seen loss, and stimulate quality habitat expansion. With completion of these projects a major step in habitat re-construction among the islands in the lower part of the Detroit River is realized, resulting in more acreage of habitat restoration completed in the Detroit River than any previous restoration effort. In addition to the habitat improvement, significant positive recreational and economic impacts are anticipated that will enhance quality of life for residents of southeast Michigan and northwest Ohio and further strengthen the Great Lakes fishery.

Construction completed with funding from the Great Lakes Restoration Initiative (GLRI) provided 6,000 linear feet of habitat shoals, 75 acres of backwater habitat restored and protected, 250 habitat structures, and 1500 linear feet of nesting barrier beach.

PRESENTER BIO: A principal engineer with more than 25 years of experience, Mr. O'Meara specializes in natural systems planning, design, and construction. He understands a successful and sustainable restoration project must incorporate a variety of disciplines and a project must find the synergy between engineering/science, environmental considerations, costs, and social considerations.

LET THE OYSTERS DO THE WORK: A PROPOSAL FOR CREATING TRULY BIOGENIC STRUCTURES FOR RESILIENCE AND RESTORATION

Tyler R. Ortego[1], *Matthew Cambell*[1,2], *and Steven Hall*[2]
[1]ORA Technologies, LLC, Metairie, LA, USA
[2]North Carolina State University, 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.

THE ROLE OF DATA MANAGEMENT IN QUALITY ASSURANCE OF ECOLOGICAL RESTORATION DATA

Craig J. Palmer[1], *Brick M. Fevold*[1], *Robert D. Sutter*[1], *Judith A. Schofield*[1], *Louis Blume*[2]
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Ensuring the quality and integrity of data is a key consideration of any ecological restoration project or program. This presentation will describe how quality assurance activities can occur during each step in the data management lifecycle leading to more reliable data for restoration decision-making.

Data Management Planning – The development of a data management plan provides an opportunity for project planners to identify how their data management strategies can assist with project quality assurance activities during data collection, data review, data analysis and reporting, and across the entire project life cycle. If data management planning is not conducted, the reliability of the data can be reduced and project costs can increase when trying to understand collected data.

Data Acquisition - Data management tools can assist in improving the quality of data collected in the field during data capture. For example, drop-down lists, range checks or completeness checks can be built into field data recording devices to help ensure valid and complete data entry by field staff. Consequently, it is important to incorporate data management into staff training programs to help ensure accurate and consistent data recording and version control of data files. During and after the field season, regular field crew debriefings also should include a review of the data management process to gain insight into what is working well and what needs to be improved.

Data Processing – Ensuring transparency of procedures when calculating and reducing data to a usable format is an important quality assurance strategy and facilitates informed secondary use of the data. Automated and semi-automated procedures help to ensure the consistent application of routine processing steps for data review including data verification and validation procedures. In cases where hand-written data recorded on paper data forms need to be manually entered into a database management system, the strategy of requiring two individuals to perform 'double- entry' of all completed data forms is essential so that any discrepancies can be easily identified, reconciled and corrected.

Data Summary & Analysis – Data management strategies should include quality control checks to confirm that planned data analysis and documentation strategies were applied correctly, any deviations from those plans were appropriate and approved, and all conclusions drawn from the data analysis activities are scientifically sound.

Data Preservation, Sharing & Publishing – Strategic planning, acquisition, processing and analysis of project data are of little value if data are lost or corrupted. The effective management and preservation of project data for primary and secondary uses are, by definition, quality assurance strategies – to preserve is to protect. Data protected are data that can be shared.

PRESENTER BIO: Dr. Palmer has extensive experience developing ecological research and monitoring programs. He has managed numerous projects involving field data collection, quality assurance and data management for these programs. Craig is currently providing quality assurance support to the U.S. EPA GLNPO with the implementation of the Great Lakes Restoration Initiative.

TURNING OVER A NEW LEAF: LONG-TERM MONITORING FOR IMPROVED ECOLOGICAL RESTORATION

*Samantha J. Capon[1], Guy Castley[2], **Gary J. Palmer**[1], Simon Linke[1], Daniel J. Schmidt[1]*
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Monitoring and evaluation of ecological restoration projects is essential for assessing their success and improving planning and implementation of interventions. Despite this, monitoring of restoration projects is notoriously limited. When it does occur, restoration monitoring is typically focused on a local scale and over short time periods. However, current ecological understanding and emerging management paradigms increasingly demand assessment of restoration efforts over larger spatial scales (e.g. cumulative effects of multiple projects) as well as over longer time periods (e.g. legacy effects or responses to extreme events/climate change etc.), especially with respect to reporting on and prioritising limited investment opportunities. In Australia, the federal government has recently invested in the development of a long-term ecological monitoring and evaluation framework to assess and inform improvements to a regional landcare partnerships program which aims to achieve environmental outcomes related to Ramsar sites, endangered ecological communities, World Heritage Areas and threatened species. Here, I present the results of this project which aimed to develop a robust and flexible monitoring and evaluation framework over multiple hierarchical levels of organisation and time horizons. Outcomes of the knowledge synthesis phase informing this project will also be presented, highlighting limitations and successes of a range of ecological monitoring and evaluation programs investigating restoration efforts in Australia.

PRESENTER BIO: Dr. Palmer is a Post-doctoral Research Fellow currently conducting research examining relationships between hydrology and wetland vegetation dynamics in a large Ramsar wetland. He is also part of a team developing a long-term ecological monitoring program for Australian land care, and has a strong interest in practical conservation and restoration research.

LINKING LANDSCAPE SCALE CONSERVATION PLANNING TO EFFECTIVE ECOLOGICAL RESTORATION

***Aviva Patel**, Kata Bavrlic, Kate Hayes and Rod Krick*
Credit Valley Conservation, Ontario, Canada

Landscape scale conservation plans provide guidance to restoration practitioners on where to restore. Practitioners carry out restoration actions based on these plans, but capacity for long term monitoring and assessment of cumulative project success is limited. The challenge for watershed management agencies lies in assessing success in translating their landscape-scale conservation plans into on-the-ground restored ecosystems. We present ways in which our agency, managing an urban-rural watershed, facilitates collaboration between science staff and restoration practitioners to assess cumulative outcomes of restoration projects over time. Such collaboration can help improve long term success rates of restoration projects and close the loop on adaptive environmental management.

PRESENTER BIO: Dr. Aviva Patel is a Senior Manager of Landscape Science, Inventory and Monitoring programs at Credit Valley Conservation. Over her 25 years of experience in ecology she has worked on landscape conservation plans and developing ecosystem monitoring programs. More recently her team contributes to monitoring plans for restoration project effectiveness.

A RABBI, A PRIEST AND AN IMAM GET ON BOAT: ENGAGING THE FAITH COMMUNITY IN LOUISIANA'S LAND LOSS CRISIS

Helen Rose Patterson
National Wildlife Federation, Restore the Mississippi River Delta, New Orleans, LA, USA

Efforts to restore Louisiana's rapidly disappearing coast have been a heated topic of conversation for the last several decades. There are serious questions about how large scale restoration will impact existing coastal industries and communities, alongside an understanding that with or without restoration Louisianans will have to fundamentally change the way they live in the landscape. These questions inherently raise serious challenges around stakeholder engagement, communication and conflict resolution. Engaging with faith leaders in coastal communities is proving to be an effective strategy for having conversations that are often challenging for state and federal agencies, and non-government organizations to navigate.

In Louisiana, the faith community has been participating the restoration process in one form or another and to varying degrees since the conversation began. Faith communities are often most involved in the aftermath of hurricanes which have becoming increasingly severe as coastal Louisiana washes away. There is however a desire on the part of many leaders in the community to take a more proactive approach, to engage in advocacy and facilitate some of the tough conversations.

Since 2015 National Wildlife Federation has been working with faith leaders in the Greater New Orleans Area and giving them the tools they need to effectively communicate about complex science and policy and the space they need to bring a moral/ethical dimension to the conversation. We have used field trips, workshops and one on one meetings to prepare faith leaders to make public comment in support of restoration projects, engage with legislators, communicate the urgency of restoration to their congregations and write about the issues in terms their community can understand. These models for engagement and advocacy can provide a road map for other restoration professionals who are attempting to navigate complex sociology and restoration science.

PRESENTER BIO: As the Greater New Orleans Outreach Coordinator for Restore the Mississippi River Delta, Helen Rose works to build strong, vocal support for coastal restoration ensuring that funding for restoration is secure and effectively spent. She has worked on Louisiana coastal issues since 2008.

LAND USE CHANGE AND RESTORATION EFFORTS TO MINIMIZE COASTAL POLLUTION IN GREAT EXUMA, THE BAHAMAS

Kathleen Sullivan-Sealey and ***Jacob Patus***
University of Miami, Coral Gables, FL, USA

Since 2009, ecologists from the University of Miami Coastal Ecology Lab have been working with residents of Great Exuma, The Bahamas to restore the natural wetland environment around Lake Victoria (aka Victoria Pond) in the center of the settlement of George Town. Victoria Pond was the largest and deepest of a series of connected mangrove lakes that provided critical habitat for wildlife such as tarpon, bonefish, herons, egrets, and osprey. Yet, the pond has suffered for over 200 years from a lack of coordinated management and poor coastal development practices which have resulted in pollution and physical alteration of the lake by the construction of roads and the filling of wetlands.

The Victoria Pond restoration project was developed to demonstrate that a highly altered, coastal wetland can be restored and can regain ecological function; demonstrating that people can live alongside mangroves and their associated wildlife. The goals of the project were to establish and delineate a local mangrove preserve that includes the pond, to clean up and excavate to restore the natural drainage and tidal flow of water through the preserve system, to develop long-term community outreach and stewardship programs, and to document measurable improvements in coastal water quality and near-shore fish habitats in and around Victoria Pond.

The water quality has improved in Victoria Pond since the restoration efforts have taken place, as evidenced by higher dissolved oxygen and lower turbidity measurements that have been recorded after the efforts were instituted. The restoration project has experienced three hurricanes in the past three years (2015 to 2017), and the resulting flooding extended primarily to the restored wetlands. The response of the restoration area to three extreme flooding events provided new information for expanding and altering the project.

PRESENTER BIO: Jacob is a graduate student with experience working in coastal areas of the Caribbean. He has participated in wetlands restoration and hurricane impact projects, and is currently interested in modelling the effects of nutrient pollution on community dynamics of nearshore marine ecosystems.

GAM MODELING OF ALLIGATOR NEST SIGHTING AS AFFECTED BY HYDROLOGIC, HABITAT, METEOROLOGICAL AND ANTHROPOGENIC (CANALS AND ROADS) VARIABLES

*Dilip Shinde[1], **Leonard Pearlstine**[1], Amy Nail[2], and Mark Parry[1]*
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The American alligator (*Alligator mississippiensis*) is a keystone species within Everglades marsh systems whose activity structures the landscape increasing the diversity of habitat that is critical to many wildlife populations dependent on them as nesting, resting, or foraging sites. Alligators are affected by spatial and temporal patterns of water fluctuations that influences courtship and mating, nesting, and habitat use. Alligator abundance, nesting effort, growth, survival, and body condition serve as indicators of the health of the Everglades marsh system.

Alligators now are most abundant in the central sloughs and canals of the current Everglades landscape (Kushlan 1990, Morea 1999) and are absent or rare in the peripheral wetlands, which have been lost to development or altered hydrologically (Mazzotti et al. 2009). To reverse past environmental degradation and restore habitat for wildlife such as the alligator, the largest environmental restoration project in the world is being undertaken in the Everglades ecosystem. The Modified Water Deliveries Project and the Comprehensive Everglades Restoration Plan are two of the most significant Everglades restoration programs. Development of ecological modeling tools that can evaluate the effects of restoration on key components of the Everglades ecosystem, including alligators' habitat and their presence/absence, thus is of keen interest to natural resource managers, restoration, and conservation planners.

This presentation describes the development of a multivariate logistic-regression generalized additive model (GAM) of the probability that an alligator nest will be built in a given spatial grid cell within Everglades National Park (Park) in a given year as a function of predictor variables which describe hydrology, habitat, meteorology, and structural elements of the landscape. Data from the annual systematic reconnaissance flight (SRF) nest surveys within the park is used to develop the model. Other independent predictor variables used are classified into alligator hole variables, space-time variables, distance variables (from canals and roads in and around the park; anthropogenic effects), hydrological variables (water depths during breeding, courtship and mating, nest building periods, hydroperiod, and several others derived from water depths), meteorological variables (rain and temperature), and habitat variables (canals, water edge, marsh, upland etc.). This model investigates the influence of these variables on alligator nest sighting (presence/absence) in the Park on SRF grid cells over the period of record. This will provide useful insight on the changes park has experienced during the restoration efforts and the influence of predictor variables on alligator nest sightings (presence/absence) over the Park's spatial domain.

PRESENTER BIO: Dr. Pearlstine is Landscape Ecologist at Everglades National Park. He has 30 years' experience with spatial analysis, ecological and wetlands modeling. Previously, Leonard was research faculty in the University of Florida, Department of Wildlife Ecology and Conservation and the USGS Cooperative Fish and Wildlife Research Unit.

PROBABILISTIC SIMULATION OF VEGETATION DYNAMICS IN THE EVERGLADES VEGETATION SUCCESSION MODEL (ELVES)

Leonard Pearlstine[1], *Lu Zhai*[2], *Jay Sah*[2] *and Mike Ross*[2]
[1]National Park Service, Homestead, FL, USA
[2]Florida International University, Miami, FL USA

In the Everglades, plant community structure and composition are primarily determined by ecological processes associated with three major environmental drivers: hydrology, nutrients, and fire. The environmental drivers and the degree of interaction among them vary spatially and temporally. Temporal changes in these drivers often result in a shift in community distribution and determine the trajectories of plant community dynamics. However, the rate and direction of shifts in species composition depend on the magnitude of changes in these drivers, and the ability of a community to withstand the effects of the alterations.

The Everglades Landscape Vegetation Succession model (ELVeS) is a spatially-explicit simulation of vegetation community change over time in response to changes in environmental conditions. The model uses empirically-based probabilistic functions of vegetation community niche space and temporal lags to evaluate plant community dynamics within the model's domain. We evaluate updates in ELVeS including a recent Bayesian formulation for the modeling and focusing on the Everglades short hydroperiod marl prairie communities.

ELVeS has been developed to provide scientists, planners, and decision makers a simulation tool for Comprehensive Everglades Restoration Project (CERP) landscape-scale analysis, planning, and decision making. The model is also may be integrated with wildlife models to provide a temporally dynamic vegetation input layer. ELVeS is designed for continuous improvement to its performance based on inputs from researchers and users. The ELVeS plant community definitions and parameterizations are user accessible components of the model. This design framework encourages updates to the modeled relations as new information becomes available and has the potential to simulate vegetation dynamics for any set of plant communities when provided with the dynamic behavior of their major environmental drivers.

PRESENTER BIO: Dr. Pearlstine is Landscape Ecologist at Everglades National Park. He has 30 years' experience with spatial analysis, ecological and wetlands modeling. Previously, Leonard was research faculty in the University of Florida, Department of Wildlife Ecology and Conservation and the USGS Cooperative Fish and Wildlife Research Unit.

THE APALACHICOLA REGIONAL RESTORATION INITIATIVE: PRINCIPLES OF PARTNERSHIP

Brian Pelc
The Nature Conservancy, Tallahassee, FL, USA

Alliances between habitat conservation entities can be a very effective way to improve restoration quality and quantity in large conservation landscapes, with a few caveats. The Apalachicola Regional Stewardship Alliance (ARSA) is currently working cooperatively to manage nearly 1.5 million acres in the eastern portion of the Florida panhandle, including National Forest, National Wildlife Refuge, Air Force and numerous state and private owned conservation lands with an emphasis on managing and improving longleaf pine and associated embedded natural communities. This region has been recognized as a biodiversity hot spot making land protection and ecosystem function on a large scale another major priority. In 2017 ARSA completed a 10-year Longleaf Conservation Plan, a milestone in cooperation establishing this guiding document to prioritize needs and tackle challenges to conservation goals. Numerous action items were identified, including improving the quality and quantity of prescribed fire operations, invasive species control and influencing local leadership. One partner, The Nature Conservancy, brings particular skills/assets to the alliance through grant writing and fielding a team of prescribed burners and equipment to increase capacity on burn days; all partners bring a particular focus and skill set to the alliance and understanding those assets is essential to the duration and resilience of the partner-relationship. However, all relationships have inherent costs and benefits which are best identified at the outset.

PRESENTER BIO: Brian Pelc is Restoration Project Manager for The Nature Conservancy's North Florida Program. Within this role Brian is also the coordinator for the Apalachicola Regional Stewardship Alliance (ARSA) Local Implementation Team (LIT) for America's Longleaf Restoration Initiative. Partnerships and the direct conservation and restoration work that result from them are the foundation for much of the work in the North Florida Program. Brian holds a Master's Degree in Applied Plant Ecology from the University of Minnesota and has worked for The Conservancy's North Florida Program, based in Bristol, for nine years.

BRINGING CONCRETE TO LIFE: HARNESSING BIOLOGICAL PROCESSES FOR BUILDING RESILIENT COASTAL INFRASTRUCTURE

Shimrit Perkol-Finkel[1]*, Ido Sella*[1] *and Andrew Rella*[2]
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With nearly 50% of the human population concentrated around coastlines, alongside with threats from sea level rise and increased storminess, coastal development and changes to natural coastlines are inevitable**.** Unfortunately too often coastal and marine structures like breakwaters, seawalls, and revetments, take the place of highly divers and productive intertidal and subtidal habitats, replacing them with barren, unproductive urban habitats. Not only that these hard defenses have significantly lower environmental value compared to natural coastal habitats, they are also less resilient and adaptive compared to natural barriers like coral or oyster reefs, which organically grow with time.

Following the growing interest in living shorelines and nature based solution for coastal protection, in recent years a complementary approach of eco-engineering coastal and marine infrastructure. The latter aims to provide an environmentally sensitive solution in areas that do not allow for living shoreline solution due to heavy urbanization or lack of horizontal width that they typically require. Eco-engineering solutions strive to enhance the biological performance and ecological value of engineered solutions, without compromising their functional and operational capabilities.

Here we present a more advanced approach, in which eco-engineering aims not only to enhance biological performance for the sake of the environment, but to harness natural processes such as growth of flora and fauna in general and of biocacification in particular, for increasing the strength, durability, adaptivity of the infrastructure itself. Using a case study of ECOncrete bio-enhanced seawall panels deployed for 12 month in a highly active marina in the Mediterranean Coastline of Israel, we provide quantitative data of biocalcification processes and compare them to those developing on standard “gray” seawalls. Results clearly show the ability of bio-enhanced structures to enhance growth of calcifying organisms thus enhancing natural growth of habitat forming species and ecosystem engineers that have the potential to increase the resilience and adaptivity of the structure.

The talk will present key results from the case study, discuss the key role of multidisciplinary collaborations in such projects, and relate to future implications and knowledge gaps in this emerging field.

PRESENTER BIO: Dr. Perkol-Finkel, co-founder and chief scientist of ECOncrete, specializes in eco-engineering of coastal & marine infrastructure. Shimrit focuses on building thriving urban marine environments that are resilient, adaptive, and robust. With > 20 years of experience in various marine environments, Dr. Perkol-Finkel has led numerous projects dedicated to restoring and enhancing urban coastal habitats.

PLANTS ON THE MOVE: THE TREND OF JAPANESE HONEYSUCKLE INVASION IN SOUTHEAST UNITED STATES

***Miranda Peterson**, Zak Derouen, Alexandra Bishop, Yovana Marinkovic, Samantha Heldman, Christopher Vazquez, Leonila Chilongo, Hsiao-Hsuan Wang, and William E. Grant*
Texas A&M University, College Station, TX USA

The invasion of non-native species contributes to the modification of biogeochemical cycles, inhibition of natural regeneration of native species, and the loss of ecosystem biodiversity and productivity. Even though introduced in the early 1800s, Japanese honeysuckle (*Lonicera japonica*) was first recorded outside of cultivation along the Potomac River in 1882. The Japanese honeysuckle is a vigorous invader of the southeast United States. It experiences rapid growth, phenotypic plasticity for response to herbivore damage, leaf phenology, and plant growth form and structure, evergreen or semi-evergreen leaves, and early flowering for long durations.

Hence, our objective is to understand the historical trend in range expansion of the Japanese honeysuckle and identify potential determinants of invasion. We documented the two most recent sets of field measurements of Japanese honeysuckle in southeast U.S. through Southern Nonnative Invasive Plant data Extraction Tool (SNIPET). We then compared the empirical results with predictions of existing models, which were based on less-recent data. Potential rate of spread was calculated using distance from the nearest known propagule source. We finally associated the SNIPET data with data from Forest Inventory and Analysis (FIA) using multiple linear regression to identify potential determinants of invasion.

Our results indicate the Japanese honeysuckle generally spread southward. During the survey period, the number of sample plots in which Japanese honeysuckle was detected approximately increased 50% in number. Mean percent coverage of Japanese honeysuckle in sample plots increased significantly (P-value < 0.05) during this period. Our empirical results supported the general trend of southward expansion predicted by existing models, which were based on less-recent data. Our results of multiple linear regression suggested that the invasion of Japanese honeysuckle was positively associated with adjacency to water bodies, temperature and species diversity and negative associated with slope, forest stand age, distance to the nearest road, and fire disturbance. Our model provided important insights into the management of Japanese honeysuckle, which threatens to continue its invasion throughout southeastern U.S. forests, as well as other, recently invaded, areas. Armed with knowledge of current and potential future high risk areas and, hence, likely paths of invasion, forest managers can develop long term monitoring and control strategies for effectively slowing range expansion and mitigating its effects.

PRESENTER BIO: Miranda Peterson is an undergraduate research leader at the Ecological Systems Laboratory at Texas A&M University. Majoring in Environmental Studies, she has experience in spatial data analysis as it pertains to ecosystem restoration and management. Her recent research focus is in invasive species distribution and implications.

MONITORING DROUGHT ALONG THE GULF OF MEXICO AND THE SOUTHEASTERN ATLANTIC OCEAN USING THE COASTAL SALINITY INDEX

*Paul A. Conrads[1], **Matthew D. Petkewich**[1], Kirsten Lackstrom[2], Lauren Rouen[2], and Bryan J. McCloskey[3]*

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Coastal droughts have a different dynamic than upland droughts, which are typically characterized by agricultural, hydrologic, meteorological, and (or) socio-economic impacts. Drought uniquely affects coastal ecosystems due to changes in salinity conditions of estuarine creeks and rivers. The location of the freshwater-saltwater interface in surface-water bodies is an important factor in the ecological and socio-economic dynamics of coastal communities. The location of the interface determines the freshwater and saltwater aquatic communities, fisheries spawning habitat, and the freshwater availability for municipal and industrial water intakes. The severity of coastal drought may explain changes in *Vibrio* bacteria impacts on shellfish harvesting and occurrence of wound infection, fish kills, harmful algal blooms, hypoxia, and beach closures. To address the data and information gap for characterizing coastal drought, a coastal salinity index (CSI) was developed using salinity data. The CSI uses a computational approach similar to the Standardized Precipitation Index (SPI). The CSI is computed for unique time intervals (for example 1-, 6-, 12-, and 24-month) that can characterize the onset and recovery of short- and long-term drought. Evaluation of the CSI indicates that the index can be used for different estuary types (for example: brackish, oligohaline, or mesohaline), for regional comparison between estuaries, and as an index of wet conditions (high freshwater inflow) in addition to drought (saline) conditions. The following three activities being completed in 2018 that enhance the use and application of the CSI will be presented:

1) A software package was developed for the consistent computation of the CSI that includes preprocessing of salinity data, filling missing data, computing the CSI, post-processing, and generating the supporting metadata.
2) The CSI has been computed at sites along the Gulf of Mexico (Texas to Florida) and the Southeastern Atlantic Ocean (Florida to North Carolina); and
3) Using telemetered salinity data, the real-time computation of the CSI has been prototyped and disseminated on the web.

PRESENTER BIO: Matthew Petkewich is a hydrologist with the U.S. Geological Survey, South Atlantic Water Science Center. During his 26 years with the USGS, he has participated in a broad variety of water-quality investigations related to surface- and ground-water resources. For the past 10 years, he has been a part of the Everglades Depth Estimation Network (EDEN) team that supports ecological and biological assessments within the Greater Everglades.

INNOVATIVE DESIGN TO DEVELOP A NOVEL ECOSYSTEM

***Patrick Phillips*[1], *Brett Berkley*[1] *and Kirk Mantay*[2]**
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GreenVest, LLC (GV) has successfully established a Public-Private-Partnership (P3) for a large-scale stream and wetland restoration project at the Beltsville Agricultural Research Center (BARC) in Beltsville, Prince George's County Maryland. The restoration site is a former agricultural field that has been in production since prior to 1900. It was converted from agricultural use to a Spray Irrigation Field (SIF) that received effluent from the facility wastewater treatment plan. The conversion of the field from agricultural production to the SIF configuration included removal of the soil A horizon, compaction of surface soil, and the construction of a ditch network. The field was an active SIF until the late 1980's when the practice of spraying the wastewater effluent was discontinued. The SIF remained in the same configuration until the stream and wetland restoration project was implemented in 2017.

The SIF was initially identified as a potential restoration site due to its landscape position and presence of wetlands within the ditches and in low points of the field. Baseline data collection activities confirmed there was little topsoil remaining and identified an area of shallow pressurized groundwater underlying the field. These unique conditions, coupled with a small drainage area, required an innovative approach to design and implement a successful stream and wetland restoration project at the site. The design focused on reconstructing A horizon soils and making connections to the pressurized shallow groundwater at key locations.

The reconstruction of A horizon soils was achieved through importing and blending composted wood mulch, topsoil, and other organic amendments including Bloom™ - a soil amendment derived from Class A Exceptional Quality Biosolids generated at the DC Water Blue Plains Advanced Wastewater Treatment Plant. The field was excavated to subgrade elevation and the constructed topsoil was placed on the subgrade. A deep tilling machine was used to mix the constructed soil and subsurface soils to a depth of 12 to 14 inches, forming a de-compacted organic and nutrient rich soil layer above low-permeability subsurface soils.

Connections to shallow pressurized groundwater were made at five points located in upgradient wetland cells connected to constructed stream channels. Water elevations in these cells are controlled by stream grade control structures which ensure sufficient water is retained to achieve wetland hydrology. Downstream of the aquifer connection points, connectivity of the stream channel to the adjacent wetlands and wetland to wetland connections provide stream and wetland hydrology.

The combination of the complete reconstruction of the soil A horizon and the establishment of groundwater to ground surface connections have created a novel headwater stream and wetland ecosystem at the SIF site.

PRESENTER BIO: Patrick Phillips is a Senior Environmental Scientist at GreenVest, LLC where he focuses on the planning and implementation of stream and wetland restoration projects in Maryland. Mr. Phillips has over 15 years of experience as an environmental scientist and program manager for various consulting and engineering firms.

A CHANGING CHESAPEAKE BAY: A NEW PARADIGM FOR STAKEHOLDER ENGAGEMENT

Lucinda Power
US EPA Chesapeake Bay Program Office, Annapolis, MD USA

There is perhaps no better example in the United States of the ecological, economic, and socio-cultural complexity of estuaries than the Chesapeake Bay. The rich geographical and ecological diversity of the Bay is impressive, but these characteristics acquire even greater significance and meaning when viewed from the perspectives of the Bay's multiple stakeholders. For several decades, voluntary and limited regulatory efforts have strived to restore and protect the Chesapeake Bay's abundant natural and cultural resources – resources that face considerable challenges through increased nonpoint source pollution, greater housing density and growth, and a changing climate. The Chesapeake Bay Program (CBP) partnership is a dynamic and intricate network of federal, state, nonprofit, and private stakeholders built on the principles of collaboration, scientific inquiry, and adaptive management to restore and protect the Chesapeake Bay, and has served as a critical driver towards Bay watershed restoration.

The Chesapeake Bay Total Maximum Daily Load (Bay TMDL), released by EPA in 2010, introduced a unique, collaborative approach for the CBP partnership to undertake in implementing regulatory measures to meet water quality goals, while operating under a governance structure that is consensus-driven and constantly evolving as new information, technology, and stakeholder needs arise. Over the past 7 years of Bay TMDL implementation, the CBP partnership has encountered and addressed a vast array of both implementation and technical challenges that have – and continue to be – addressed through collective and locally-driven solutions.

The CBP partnership is well positioned to explore the barriers and opportunities for stakeholder engagement by better understanding (1) how this engagement has changed since the release of the Bay TMDL; (2) the need for state-led restoration priorities to address local conditions, needs and opportunities; (3) how strengthening this engagement has shown a recovering ecosystem across the watershed; (4) ways to strengthen local engagement and capacity-building as an essential component to achieve shared water quality goals; and (5) the lessons learned as a result of these efforts as the CBP partnership enters the next stage of watershed restoration.

PRESENTER BIO: Ms. Power is an applied anthropologist with EPA's Chesapeake Bay Program Office specializing in estuarine and coastal policy, and the local social systems needed for sustainable environmental management. Ms. Power has extensive experience coordinating state- and locally-driven watershed restoration planning and project implementation.

JULIA TUTTLE SEAGRASS MITIGATION SITE: IF WE PLANT THEM WILL THEY GROW?

*Martha L. Robbart[1], Kristian Rogers[1], Ryan Fura[1], **Bill Precht**[1], Becky Hope[2] and Terri Jordan-Sellers[3]*

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[3]USACE, Jacksonville, FL USA

The Miami Harbor Phase III Federal Channel Expansion Project was designed to widen and deepen the channel to increase access to the Port of Miami by larger vessels, including post-Panamax vessels. Seagrass restoration was completed as part of environmental mitigation and included the filling and planting of an historic borrow hole north of the Julia Tuttle Causeway. A 16.6-acre historic borrow hole was filled according to the FDEP permit and United States Army Corps of Engineers (USACE) specifications.

Once construction of the site was complete, seagrass planting was conducted over 14.3 acres in a grid pattern. Annual monitoring commenced in 2016. In 2016 large mats of drift algae were documented across the site, but seagrass was also present and thriving. From 2016 to 2017 percent cover of monospecific and mixed beds of *S. filiforme*, (the planted species and dominant species within the basin) increased from 53.2% to 62.5%. Percent cover of non-planting-unit-associated volunteer species (*i.e. H. wrightii, H. decipiens,* and *H. engelmanni*) were also present. Drift algae decreased between 2016 and 2017. Bare substrate decreased between 2016 and 2017(Figure 21).

In 2016 a seagrass die-off was documented affecting northern Biscayne Bay, north of the mitigation site (Buck 2017, Staletovich 2017). The actual source of the die-off is still under investigation. Reference sites were located north of the mitigation site, within the die-off affected area. At the reference sites, percent cover of *S. filiforme* decreased from 95.6% to 52.8%, between 2016 and 2017. In the same period, *H. wrightii, H. decipiens,* and *H. engelmanni* increased from 3.4% to 8%. Bare substrate at the reference sites increased from 0.9% to 38.4% over the period.

Overall, despite the recent seagrass die-off (Buck 2017, Staletovich 2017) and the passage of a major hurricane immediately preceding the 2017 survey (Irma September 10, 2017), seagrass abundance and density within the Julia Tuttle mitigation site continues to follow a positive trend. In contrast, the reference transects experienced a sharp decline in abundance, density, and short shoot density, which is likely due to the seagrass die-off that affected portions of northern Biscayne Bay where these transects are located. There are currently no published peer-reviewed studies available that outline a direct or indirect cause of the die-off. The results of the 3-year survey should elucidate these findings and further outline the trends of seagrass growth and distribution that are occurring at the mitigation and reference sites.

ECOLOGICAL SITE CONCEPTS FOR WET AREAS

Sarah Quistberg
USDA Natural Resources Conservation Service, Ogden, UT, USA

Ecological sites (ES) provide a conceptual division of the landscape and a consistent framework for delineating and describing land. Ecological site descriptions (ESDs) link soil, climate, and other abiotic features to plant communities. ESs are valuable sources of information for effective land management decision-making, monitoring, assessment, and policy. ES concepts are traditionally based on correlations between soil properties and vegetation, however, these are not sufficient for the ES concept development for wet areas.

Wet areas, including wetlands, riparian corridors, floodplains, and coastal wetlands, are much more affected by offsite conditions through water inputs than upland sites. ES concepts for wet areas require a greater emphasis on hydrology and energy while considering several aspects that also influence site dynamics, including geomorphology, climate, physiochemical environment, vegetation, and wildlife.

An interagency workgroup is currently updating the Natural Resources Conservation Service National Ecological Site Handbook to include guidance on developing ES concepts for wetland and riparian areas. This session provides an overview of the guidance for developing wet ESs, including how the degree of wetness, water chemistry, and water energy are foundational in wet ESD characterization.

PRESENTER BIO: Ms. Quistberg is a rangeland management specialist with more than 10 years of experience in ecological site development.

PALEOECOLOGICAL ASSESSMENT OF THE ORIGIN AND DEVELOPMENT OF VERNAL POOLS IN CENTRAL PENNSYLVANIA

Shauna-kay D. Rainford *and Patrick J. Drohan*
Department of Ecosystem Science and Management, Pennsylvania State University, University Park, PA, USA

Here, a paleoecological assessment of vernal pools located in different physiographic regions of Pennsylvania will be conducted to investigate the impact of geomorphology on ecosystem succession and carbon (C) sequestration. As differences in ecosystem succession may have prompted distinct plant community compositions and rates of C sequestration in these areas, we aim to investigate the origin and development of vernal pools in Central Pennsylvania. This multidisciplinary paleoecological study will quantify and compare the pollen, charcoal, pollutant metal, and soil organic carbon (SOC) content of vernal pools located in the Appalachian Plateau and Ridge and Valley, two physiographic regions of Pennsylvania that differ in topography and parent material. More specifically, this project aims to develop stratigraphic indices of ecosystem succession at vernal pool sites using a multi-proxy approach to reconstruct spatial and temporal dynamics of vernal pool genesis and development. We predict that past disturbance has impacted vegetation dynamics, which led to differences in the quantity and distribution of labile and recalcitrant SOC fractions in vernal pools. This study will be used to date and reconstruct the soil and vegetation history of an important, but often overlooked habitat. Results gathered from this study will assist in the determination of long-term ecosystem development; records which are useful to policymakers, land managers, and others within the scientific community.

THE LA, MS, AL COASTAL SYSTEM (LMACS) COMPREHENSIVE ESTUARINE ASSESSMENT & RESTORATION IMPLEMENTATION PLAN

Carl Ferraro[1], James W. Pahl[2]., ***George S. Ramseur Jr.[3]***

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[3]Mississippi Department of Marine Resources (MDMR), Biloxi, MS, USA

The LMACS is a function-based analytical assessment and restoration planning area that spans from Lake Borgne to Mobile Bay and is held apart from the Gulf of Mexico by the Biloxi Marsh in LA and the Gulf Islands in MS and AL. The overall principles of cooperation and restoration for this multi-state initiative grew out of long standing partnerships developed in the Gulf of Mexico Alliance. One of the foremost tasks is to compile any ongoing monitoring or research as well as existing or pending data that are directly relevant to the restoration of fundamental historic functions within the LMACS estuary. Progress has already been made in linking the ongoing monitoring programs of the Lake Ponchartrain Basin Foundation with similar efforts being conducted by MDMR. We're also looking for ways to support more uniform data collection and distribution across the three-state area.

The primary goal 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 anthropogenic changes in the LMACS over time with the intent of prioritizing restoration approaches that will best 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 RFSF is intended to guide restoration project development, prioritization, and implementation focused on a 50-year horizon to improve coordination and exploit efficiencies of scale with the Louisiana Coastal Master Plan and long-term restoration priorities in Alabama.

The geomorphic history and anticipated future trajectory of the LMACS estuarine barrier is a primary area of focus for our team. Ongoing erosion and fragmentation of the Biloxi Marsh and the barrier islands are driving increasingly marine conditions and more aggressive erosional losses in the LMACS. This geomorphic instability or geologic instability means that the primary restoration goals for the LMACS will almost certainly be different than restoration priorities in similar class estuaries such as the Galveston and Chesapeake Bays.

At this time, LMACS and related planning efforts are being developed with state and Gulf of Mexico Alliance resources.

PRESENTER BIO: Mr. Ramseur has directed MDMR's Office of Coastal Restoration and Resiliency since 2014 and led landscape scale restoration efforts in coastal Mississippi for 20 years. He attended the University of the South in Sewanee, TN and is a graduate of Tulane University (B.S., Geology and Anthropology).

APPLICATION OF DATA MANAGEMENT AND DECISION SUPPORT TOOLS TO SUPPORT COASTAL WETLAND MANAGEMENT IN THE LAURENTIAN GREAT LAKES

Todd M. Redder[1]*, Donald G. Uzarski*[2]*, Valerie J. Brady*[3]*, Matthew J. Cooper*[4] *and Thomas K. O'Donnell*[5]

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The Great Lakes Coastal Wetland Monitoring Program (CWMP) was launched in late 2010 under the Great Lakes Restoration Initiative (GLRI) funded through the USEPA Great Lakes National Program Office. Subject to continued GLRI support, a total of ten years of assessing coastal wetland status and trends is expected to be completed by 2020 through the CWMP. The primary objective of the CWMP is to implement a standardized basin-wide coastal wetland monitoring program that will inform decision-makers on coastal wetland conservation and restoration priorities throughout the Great Lakes basin. More than 750 individual wetland sites have been monitored to date, and most sites are resampled at a minimum interval of 5 years to provide information on site-specific ecological trends. Ecological data types sampled include: vegetation species and zonal data, macroinvertebrates, fish, anurans, and birds. In addition, water quality parameters, including nutrient levels, are measured.

Managing the extensive ecological datasets collected by the CWMP presents a significant challenge, and successfully addressing this challenge is critically important to meeting the program's objective to inform decision-makers regarding coastal wetland conservation and restoration priorities. A custom data management system (DMS) was developed to address the diverse needs of the program, providing tools that facilitate a unified data storage and entry approach, support for QA/QC of datasets, and automated dissemination of raw data and ecological indicator results to researchers and managers, respectively. The DMS includes a relational database and a web-based interface that supports user interaction with the database at a variety of levels (http://www.greatlakeswetlands.org). An account access system provides five different tiers of user access, ranging from general users to managers to project researchers and administrators. Data entry, editing, and retrieval tools are provided by taxa type and provide validation of datasets as they are entered.

In addition to supporting all data management aspects of the project, the CWMP DMS has served as the foundation for an interactive, map-based Coastal Wetlands Decision Support Tool (CWDST). The CWDST provides wetland site attribute filtering and ranking tools that allow Great Lakes coastal managers to compare key outcomes from the CWMP (e.g., indices of biological integrity) with site-specific spatial context, including surrounding land ownership and land use, and the presence of invasive species and manmade structures. This presentation will review key design components of the DMS and the CWDST and discuss "lessons learned" from the development and application of these tools to manage complex ecological datasets and to inform restoration and conservation priorities. An example case study for application of the CWDST will be reviewed to demonstrate the value provided by this approach.

PRESENTER BIO: Mr. Redder is a senior project engineer with 18 years of experience in ecological data and modeling evaluations and decision support tool development. He has broad experience in designing and implementing software solutions to support data and modeling management efforts, including developing customized tools for more than a dozen projects.

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EXTREME EVENTS: OBSTACLES AND OPPORTUNITIES FOR LARGE SCALE ECOSYSTEM RESTORATION

Denise J. Reed
University of New Orleans, New Orleans, LA, USA

Many restoration plans are founded on addressing problems caused by past action or making adjustments to account for long-term trends. This can provide a clear vision of success for decision makers and enables the use of deterministic analysis to predict future conditions. In many cases, analysis of multiple scenarios is used to account for uncertainties about future conditions, e.g., sea level rise rates. However, factoring the role of extreme events into large scale long-term planning presents challenges including uncertainties regarding the timing and magnitude of events, non-stationarity issues in relation to average frequency and duration, and the superposition of extreme events on changing base conditions, e.g., storm surge on top of sea-level rise.

This presentation will use lessons and examples from coastal Louisiana, south Florida and the California Bay-Delta to illustrate why considering the effects of extremes is critical albeit uncertain, and will outline potential approaches that can be used to convey the potential consequences of extreme events for restoration planning.

PRESENTER BIO: Dr. Denise Reed is a nationally and internationally recognized expert in coastal marsh sustainability and the role of human activities in modifying coastal systems with over 30 years of experience studying coastal issues in the United States and abroad.

EXAMINATION OF ALTERNATIVE OPERATION REGIMES FOR EXISTING FRESHWATER DIVERSION AND SIPHON STRUCTURES IN LOUISIANA, USA

Alisha Renfro
National Wildlife Federation, New Orleans, LA

Louisiana's 2017 Coastal Master Plan selected ten sediment diversion projects for inclusion in the blueprint for coastal restoration. Using the power of the river to divert sediment to build and maintain vital wetland habitat has long been recognized as a key restoration strategy in Louisiana. A few sediment diversion projects are currently moving through the process from planning, to design to, eventual, implementation, the question of how these sediment diversions will be operated is a frequently asked question at public meetings. No detailed operation plans have been released for any of the planned diversions. However, in 2015-2016, an independent Sediment Diversion Operations Expert Working Group of diverse expertise was convened to provide input and recommendations about environmental, economic and community considerations for operational strategies.

The Davis Pond and Naomi Siphon are two existing structures on the west bank of the Mississippi River that can divert freshwater and sediment from the river to adjacent wetlands. Davis Pond began operation in 2002, but the ponding area required modification for the diversion to be operated at its full capacity, 10,650 cubic feet per second. The Davis Pond Diversion is operated to control salinities in Barataria Basin, but a small delta splay has developed in the diversion's ponding area. Construction on the 2,000 cubic feet per second capacity Naomi Siphon was completed in 1993. The goals of the project are to stabilize salinity, enhance marsh habitat and improve growing conditions for marsh vegetation. However, in recent years, this project has rarely been operated. While these projects were not designed or currently operated to maximize sediment capture, they do have the potential to capture more sediment under different operational strategies.

This presentation will examine the sediment capture potential of the Davis Pond Freshwater Diversion and Naomi Siphon under different operational strategies recommended by the Sediment Diversion Operations Expert Working Group. Small adjustments to the operation of these structures could increase land building and maintenance benefits of these projects as larger sediment diversion projects wind through the process from plans to implementation. Sustainable coastal restoration in Louisiana requires strategically and effectively using all the tools available in the restoration toolbox which includes thinking about using existing projects more effectively.

PRESENTER BIO: Dr. Renfro is a Coastal Science with the National Wildlife Federation with more than 15 years of experience working in coastal environments examining sediment transport and deposition. Her work in Louisiana has focused on using the best available science to inform coastal restoration efforts in Louisiana.

EVALUATION OF LOUISIANA ECOTYPES OF SALTGRASS FOR SELECTION AND USE IN SALT MARSHES OF THE COASTAL ZONE OF LOUISIANA

Curt J. Riche' *and Garret Thomassie*
USDA-NRCS Golden Meadow Plant Materials Center

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.

AN ASSESSMENT OF LIVING SHORELINES/NATURAL INFRASTRUCTURE SOLUTIONS - TOWARDS IMPROVING ECOSYSTEM RESILIENCY

Thomas F. Ries
Environmental Science Associates, Tampa FL, USA

Living Shorelines, Natural Infrastructure, Nature based solutions are all buzz words for the treatment of the water/land interface. Judicious shoreline management is critically important to protect property and ecosystems; however, the traditional solution of hardening these interfaces has been shown to not function as envisioned and that these approaches actually do real and extensive damage to the affected ecosystem. Living shorelines, if designed appropriately, protect ecosystem services while controlling erosion and providing the resiliency necessary to accommodate sea-level changes. There are numerous definitions of a Living Shoreline; one of the most recognized national definitions, is as follows:

A living shoreline is any erosion control management system that does not introduce a fixed interruption of a natural water/land continuum and that is designed to protect or restore natural shoreline ecosystem services; it includes natural elements and may incorporate manmade elements.

The use of living shorelines can be successfully implemented if the appropriate designs elements are employed to address the erosional issues while still providing the ecosystem services. These solutions will then also help adapt to the shifts brought about by climate change, especially sea level rise.
There are many elements (energy forces, bank slopes, sediment characteristics, water depths, tidal regimes, vegetation palettes, and construction access/cost) that must be considered when selecting the most appropriate erosional defense approach while also providing opportunities for functional ecosystem services. These physical elements and the multifaceted resultant design solutions will be reviewed. A summary of what has worked well and examples of failures, along with an assessment of why these systems to failed, will be presented so that these lessons can be used for future design considerations.

PRESENTER BIO: Thomas Ries is a senior scientist with more than 35 years of experience in the implementation of ecosystem restoration projects in the SE US. He has overseen over 100 coastal restoration projects and over 30 livings shoreline design solutions; many of which have won awards of environmental excellence. He was also the recipient of 2013 National Wetlands Award for Conservation and Restoration (Environmental Law Institute).

DOS RÍOS CONSERVATION COLLABORATIVE: A STAKEHOLDER-DRIVEN APPROACH TO ACHIEVING LANDSCAPE-SCALE OBJECTIVES

Aimee Roberson[1], *Matthew Grabau*[2], *Genevieve Johnson*[3]

[1]Rio Grande Joint Venture, Alpine, TX, USA
[2]US Fish and Wildlife Service, Tucson, AZ, USA
[3]Bureau of Reclamation, Boulder City, NV, USA

The borderlands of the Chihuahuan Desert in the region of La Junta de los Ríos, or the confluence of the Rio Conchos with the Rio Grande, preserve some of the largest tracts of unfragmented land in North America. A landscape composed of large ranches and protected areas preserves some of the highest levels of biodiversity and endemic species among the world's arid ecosystems. Pronghorn still migrate across vast swaths of functional grassland and the rivers and streams of the region still harbor a relatively intact fish and invertebrate community.

The Dos Ríos Conservation Collaborative is using Landscape Conservation Design to collaboratively develop measurable objectives for shared biologic goals (such as biodiversity and habitat connectivity) and socio-ecologic goals (ecosystem functions that benefit human communities, such as productive rangelands and clean water) across large landscapes. Partners want to ensure sustainable economies and healthy communities but the questions and challenges in this region are far-reaching, span numerous prior planning efforts, and cross jurisdictional boundaries across two countries. To help solve these complex problems, the Collaborative is identifying critical common natural resource and social values among partners, along with related conservation goals and measurable objectives which will lead to collective implementation strategies. Throughout this process, we have worked to develop critical information that supports management actions by fostering broad-scale, coordinated efforts. We have learned how to support collaboration across large geographies and how to create an action-oriented process that focuses on implementation rather than producing more planning documents.

To date, partners have seen increased opportunities for funding conservation projects, increased sense of community, and an increased ability to share information and effectively address large scale, complex problems. To further support conservation actions, we are collaboratively developing geospatial tools to make data and information more accessible to managers and the public. By building community connections and doing the hard work of thinking across boundaries, we are promoting effective long-term collaboration and leveraging resources to achieve lasting conservation outcomes in the Chihuahuan Desert.

PRESENTER BIO: Aimee Roberson coordinates the Rio Grande Joint Venture. Her experience includes more than 20 years in the field of conservation, including building and nurturing partnerships, facilitating decision making on complex and controversial issues, and fostering effective linkages between science and management with partners in the U.S. and Mexico.

OVERVIEW OF THE RESTORE ACT STATE EXPENDITURE PLAN FOR THE STATE OF FLORIDA

Doug Robison
Environmental Science Associates, Tampa, FL USA

The 2010 Deepwater Horizon oil spill was an ecological and economic disaster for the Gulf of Mexico and the myriad of stakeholders who depend on the Gulf for their livelihood. In 2010 Congress passed the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economy of the Gulf Coast Act (RESTORE Act) that provides a mechanism to hold the responsible parties financially accountable for restoring the Gulf in the wake of the oil spill. The RESTORE Act was signed into law in 2012, and in July 2015 a settlement was reached with BP, the primary responsible party. The passage of the federal RESTORE Act established an unprecedented funding source and a unique opportunity for Gulf Coast states and local governments to implement coastal zone projects over the next two decades that address five strategic goals: Restore and Conserve Habitat; Restore Water Quality and Quantity; Replenish and Protect Living Coastal and Marine Resources; Enhance Community Resilience; and Restore and Revitalize the Gulf Economy

Among the five affected states, Florida is unique with regard to the large geographic extent of its coastline and the associated diversity of ecosystems and affected communities. In addition, implementation of the Spill Impact Component of the Act is the designated responsibility of a consortium of the 23 Florida Gulf Coast counties rather than a single state agency. The Gulf Consortium is an organization composed of an elected official from each of Florida's 23 Gulf Coast counties, and six Governor-appointed representatives, working under a Memorandum of Agreement (MOA) with the State of Florida. Pursuant to this MOA the Gulf Consortium is responsible for the development and implementation of the Florida State Expenditure Plan which describes the projects, programs and activities to be funded by its $293 million Spill Impact Component allocation.

This presentation will provide an overview of the Florida State Expenditure Plan. A total of 69 projects, programs and activities are specified in the plan, which address a wide range of both local and regional issues and priorities. The most dominant project type in the Florida State Expenditure Plan is septic to sewer conversions in coastal communities. Although this project type involves major infrastructure improvements, the Restoration Council considers these to be environmental rather than infrastructure projects if their primary objective is to address legacy pollution and water quality impairments. Improving public access to the coastal zone is another major project type, including new boat ramps and fishing piers. A third major project type is physical and/or hydrologic restoration/enhancement of coastal habitats, including the restoration of altered freshwater discharges to, and salinity patterns in, Gulf Coast estuaries; as well as construction of living shorelines, oyster reef restoration and augmentation of artificial reefs. The variety of projects and the proposed implementation approach described in the Florida State Expenditure Plan will be summarized.

PRESENTER BIO: Doug Robison is a senior marine scientist and vice president with Environmental Science Associates (ESA) in Tampa, Florida. Mr. Robison has over 36 years of experience in the development of lake, watershed, and coastal management plans, and the execution of related scientific investigations, assessments and monitoring programs. Mr. Robison served as the consulting Project Manager for the Gulf Consortium in the development of the Florida State Expenditure Plan.

DEVELOPING A SCIENCE AND MONITORING STRATEGY TO ASSESS RECOVERY OF FISHERIES HABITATS AND POPULATIONS IN THE ST. CLAIR-DETROIT RIVER SYSTEM

Edward F. Roseman[1]*, James Boase*[2]*, Justin A. Chiotti*[2]*, Robin DeBruyne*[3]*, Richard Drouin*[4] *and Todd Wills*[5]

[1]USGS Great Lakes Science Center, Ann Arbor, MI, USA
[2]US Fish and Wildlife Service
[3]University of Toledo
[4]Ontario Ministry of Natural Resources and Forestry
[5]Michigan Department of Natural Resources

The St. Clair-Detroit River System (SCDRS) contains the St. Clair River, Lake St. Clair, and the Detroit River connecting Lake Huron to Lake Erie in the densely populated Detroit/Windsor metropolitan areas. The waterway is a major navigational and recreational resource with over $80 billion in trade takes place annually. The SCDRS boasts world-class walleye, smallmouth bass, and muskellunge fisheries while also supporting imperiled fishes such as northern madtom and lake sturgeon. However, losses of fish habitat and other perturbations resulted in the designation of portions of the SCDRS as Great Lakes Areas of Concern with loss and degradation of fish habitat designated as a Beneficial Use Impairment. Efforts to remediate and delist this BUI have focused on restoring habitat for native fishes and overall aquatic ecosystem health. To date, many investigations have focused on site-specific effectiveness of restored habitats with only a few long-term aquatic community assessments. While these investigations have done well to provide site-specific validation of the success of individual restoration projects, they lack a credible long-term measure of fish population trajectory in response to habitat improvements. As part of a large collaborative initiative, we implemented a process to develop a scientific strategy for coordinated research and monitoring that incorporates a long-term vision for ecosystem recovery and to measure the response of the system to restoration and management actions. Our approach involved a series of planning workshops to create an inventory and database of assessment programs. We used a viability analysis to determine the state of knowledge for the system, allowing prioritization of new research and assessment initiatives. Priority restoration and monitoring objectives were developed by consensus and are evaluated using a numerical scorecard system. Our approach capitalizes on the collective impact concept to measure progress and make efficient use of limited resources available for restoration programs.

PRESENTER BIO: Dr. Roseman is a research fish biologist with more than 20 years' experience planning, designing, and implementing freshwater fisheries investigations. He has extensive experience with fish spawning reef restoration, shoreline habitat restoration, and restoration monitoring.

CORTEZ COMMERCIAL FISHING VILLAGE USES GRASSROOT EFFORTS TO FUND LARGE SCALE HABITAT RESTORATION

Dianne Rosensweig
ESA Scheda, Sarasota, Florida, USA

Cortez Fishing Village is one of the last fishing villages in Florida. Located an hour south of Tampa on Sarasota Bay, this small, timeless community truly embraces its maritime heritage and the need to protect and enhance native habitat. Because of its strong linkage of Community/Place/Occupation the residents of the historical Cortez Fishing Village have a long memory and a world view that is ecologically centered on the water that surrounds them.

"As a smart fisherman will keep a weather eye on clouds on the distant horizon, the community pulled together when large scale waterfront development loomed" Roger Allen (F.I.S.H. historian). In 1991 they combined a cultural organization, the Cortez Village Historical Society, and a commercial fishing organization, the Organized Fishermen of Florida, and became an activist organization: Florida Institute for Saltwater Heritage (F.I.S.H.). The grass roots not-for-profit was established and received its IRS 501(c)(3) status in 1991 with a mission statement that commits it to preserving the character and heritage of Florida's traditional waterfront communities within the natural environment that has nurtured people in fishing communities for thousands of years. Funds for the first mortgage payment on the 100 acres of waterfront property was raised from donations made by ordinary citizens and conservation minded companies. A succession of annual Cortez Commercial Fishing Festivals, traditionally held in February of each year, and donations from their more than 700 members and a host of friends all over the country enabled F.I.S.H. to pay off the mortgage in 2005. With such a strong financial base and the anticipated community support, the project goal became a reality.

Since the founding of F.I.S.H., and with an enlightened purpose that should be a model for all communities; hard work, community spirit and people working together have resulted in a series of major preservation accomplishments: 1. Cortez Village is registered on the State and Federal lists of Historic places with establishment of an historic overlay district, meant to protect the unique historic structures that make up most of the Village 2. To preserve the maritime material culture of traditional Gulf Coast communities the group formed a successful partnership with Manatee County Government to purchase the 1912 Cortez School house, renovate the building and occupy it with the Florida Maritime Museum at Cortez. 3. To preserve the natural habitat upon which the commercial and recreational fishing industry depends; encompassing 95 acres of environmentally sensitive land immediately east of Cortez (F.I.S.H. Preserve).

Despite the lack of restoration funding available, F.I.S.H. has successfully leveraged their fundraising dollars to develop an overall large scale habitat restoration plan and acquire federal, state, and local grants to successfully restore 50% of the Preserve. Additional grants have been recently awarded and/or submitted to complete the restoration of the entire F.I.S.H. Preserve. I would like to present the results of the first 50-acre restoration effort and to illustrate the plan for the other half of the project.

PRESENTER BIO: Ms. Rosensweig is a senior scientist with more than 30 years of experience. She specializes in the planning, design, permitting, construction oversight, and monitoring of habitat restoration projects, living shorelines, oyster and artificial reefs. She has worked on over 30 restoration projects.

MISSOURI RIVER RECOVERY PROGRAM ADAPTIVE MANAGEMENT GOVERNANCE AND THE COLLABORATIVE PROCESS

Mary S. Roth[1]*, J. Craig Fischenich*[2]*, and Craig A.Fleming*[3]
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[3]U.S. Army Corps of Engineers, Omaha District, Omaha, NE, USA

Design of the management and decision-making structure and processes for the Missouri River Recovery Program Adaptive Management Plan considered important principles and attributes of good governance; the range of decisions that may be encountered during implementation; the roles, responsibilities, and authorities of the primary entities involved; and existing processes and statutory requirements. Governance includes a consideration of authority, administration, decision-making, and accountability and describes the approach for converting knowledge into improved management through decision-making.

Implementation of AM governance for natural resource management in general has not been easy and the Missouri River basin has more challenges than most. With the wide geographic extent of the Missouri River basin and basin stakeholders' diverse interests, long-standing differences, lack of trust, and lack of experience with AM, development of a governance process for the MRRP benefitted from engagement with the Missouri River Recovery Implementation Committee (MRRIC). MRRIC was authorized by the Water Resource Development Act of 2007 and provides recommendations to the US Army Corps of Engineers on the implementation of the MRRP. MRRIC members, through work group participation, were heavily engaged in developing the collaborative governance process.

Developing and implementing AM strategies requires interactive and timely deliberations. Three permanent work groups were established to support MRRIC and provide recommendations through MRRIC's consensus approval process. The main role of the Bird, Fish, and Human Considerations work groups is to understand the science, technical, and human-use issues that relate to the actions being taken by MRRP to avoid jeopardizing the continued existence of the three protected species, piping plover, least tern, and pallid sturgeon. The work groups are responsible for keeping the full MRRIC informed and bringing forth issues for formal recommendations.

The governance process has been designed to provide updates on scientific progress, implementation goals, and human consideration impacts on a recurring yearly cycle. The initial test of that engagement cycle is currently underway and lessons learned are being incorporated back into the AM governance structure.

An Independent Advisory Panel, consisting of scientific and socio-economic experts, has been convened and will continue, as necessary, to provide review of work products or analysis and interpretation of data. The Panel provides objective review or advice on specific topics originating from the agencies and / or MRRIC and interaction typically occurs through the appropriate MRRIC work group. The value of having thoughtful feedback from independent scientists and experts to a skeptical stakeholder group cannot be overstated. MRRP has also benefitted greatly from the Panel's advice while crafting the AM Plan, designing monitoring plans, and evaluating results. Continued use of the Panel will be key to successful AM implementation.

PRESENTER BIO: Ms. Roth is the Corps' Special Assistant for Missouri River Programs. In her more than 37 years with the Corps, she has worked with water management; levee and embankment design; hazardous, radioactive, and toxic waste remediation; and endangered species compliance. She has a BS in civil engineering and an MBA.

ASSESSING ECOSYSTEM SERVICES SUPPLY FOR RESTORATION SCENARIOS

***Marc Russell**, Justin Bousquin, Richard Fulford, and Leah Sharpe*
U.S. Environmental Protection Agency, Gulf Breeze, FL, USA

One of the challenges for current restoration efforts is to adequately evaluate and communicate the values of restoration to the public. An ecosystem services approach helps translate environmental changes into human benefits by putting restoration into relatable value terminology. This helps the public understand the value of restoration efforts to their overall wellbeing, relative to the values for alternative land uses. Here we demonstrate a simple to use, publically available ecosystem services assessment tool developed by the US EPA Office of Research and Development in open source QGIS. Several types of restoration alternatives along the Gulf of Mexico Coastline are compared to baseline conditions for ecosystem functions such as excess nitrogen removal, storm water retention, carbon burial, and atmospheric pollution removal. These processes benefit humans by maintaining downstream water quality, mitigating floods, helping to mitigate emissions effects, and by reducing respiratory health care costs. The tool translates benefits into monetary units using common valuation techniques such as marginal replacement, social, and health care costs with default and adjustable valuation coefficients. Users can define new scenarios by substituting land use/cover types and/or changing transportation networks, which influence travel times for accessing greenspaces for recreational activities, for an area of interest. The basic user interface allows users to visually explore a database for an area via an interactive map and to generate reports for the specific location of interest summarizing the extent of ecological features of interest and the monetary value of the four beneficial ecosystem functions noted above. The advanced user interface setting allows the user to define land use and transportation network change scenarios and compare ecosystem service values and transportation times side by side in a report. The ecosystem services supply valuation approaches in our tool complement our other rapid assessment approaches that provide non-monetary benefit indicator metrics based on human demand and access, to compare benefits of restoring different sites.

PRESENTER BIO: Marc is a landscape ecologist and assistant lab director for U.S. EPA Office of Research and Development's National Health and Environmental Effects Research Laboratory.

SEA-LEVEL RISE RATES, PROJECTIONS, AND EFFECTS IN SOUTHERN FLORIDA: CONNECTING SCIENCE TO NATURAL AND URBAN RESOURCE MANAGEMENT

Michael Savarese[1] *and G. Lynn Wingard*[2]

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[2]U.S. Geological Survey, Eastern Geology and Paleoclimate Science Center, Reston, VA, USA

Southeast and Southwest Florida (SE & SW FL) encompasses an urban and natural systems mosaic with expansive public lands of the Greater Everglades in the interior of the peninsula and urban landscapes along the coast. Consequently, management of the entire landscape for sea-level rise (SLR) adaptation requires cooperation and conflict resolution at local levels (e.g., county and city governments). Fortunately, both SE and SW FL have developed collaborative efforts to combat the problem by bringing county, city, and natural resource stakeholders together. Southeast Florida has established its Southeast Florida Regional Climate Change Compact, which unites 4 counties with numerous municipal and nonprofit partners. The Compact has successfully developed planning mitigation and adaptation strategies, jointly advocated at the national and state levels for funding, and implemented engineering and policy solutions to deal with SLR effects. Collier County in SW FL, in cooperation with its municipalities and natural resource managerial agencies, is collaboratively joined through a three-year funding effort from NOAA-NCCOS to bring the best predictive science into the hands of decision makers, and intends to pursue an RFP for formal adaption planning in the near future.

Driving adaptation needs is accelerating SLR, exacerbated by the impact of tropical storms. SLR in Southern Florida over the last century has been at the global average (~3-4 mm/year) and is not complicated by regional subsidence or uplift. Oceanographic circulation, through shifts in the Gulf Loop Current or the Atlantic Gulf Stream, can have seasonal to annual effects. Future alteration of the earth's geoid due to continental ice mass loss may have a significant impact later in this century. Research, reconstructing Holocene environmental change in both SE and SW FL, has generated reliable sea-level curves for the last 5000 years and demonstrates SLR rates and patterns similar to what has occurred elsewhere in North America and the Caribbean. Assuming current SLR rates accelerate into the 22nd century, significant geomorphic changes to Southern Florida's coast will result. These changes will likely include coastal transgression, loss of oyster reef-founded islands within interior bays, and extensive barrier island erosion and overwash. Incipient effects within the natural system already exist, including the landward migration and aerial expansion of mangroves, the loss of graminoid marshes through replacement by mangroves, or their wholesale loss due to pocking (i.e., peat loss resulting in deflation of the marsh surface to subtidal conditions). Additionally, greater lengths of "critically eroded beaches" are documented statewide in each successive year. Incipient effects of SLR on the urban landscape are more obvious in SE FL than in SW FL, and include more frequent "sunny day" tidal flooding and storm water management difficulties. For responsible urban and resource management in the 21st century, it is essential that decision-makers incorporate this current scientific information into their decadal planning.

PRESENTER BIO: Michael Savarese is a Professor of Marine Science currently co-leading a NOAA-funded effort with regional government and resource managers to address future impacts associated with sea-level rise.

HYDRAULIC AND VEGETATIVE MODELING FOR THE RESTORATION DESIGN OF THE UPPER REACH OF CATALPA CREEK, AN IMPAIRED STREAM IN NORTHEAST MISSISSIPPI

***Timothy J. Schauwecker**, John J. Ramirez-Avila, Joby Czarnecki and Beth Baker*
Mississippi State University, Mississippi State, MS, USA

In the last two years, there has been an increased awareness on the part of the Mississippi Agriculture and Forestry Experiment Station (MAFES) administration and faculty that remedial actions must be taken to address erosion and flooding issues associated with the main outflow channel of the southern part of the Mississippi State University campus, Catalpa Creek. With the recent designation of this watershed as an EPA 319(h) priority watershed, there are expectations of monitoring and assessment. Many state agency personnel have identified a hydraulic model as a necessity before continuing with planning and implementation of conservation efforts on MSU-owned properties. This research will focused on the identification, assessment, evaluation, and prediction of in-stream processes within the study watershed, so that such a hydraulic model can be developed. This research will generate information and tools necessary to inform targeted placement of best management practices, as well as predict and monitor improvements to impairments within Catalpa Creek, enabling future efforts in demonstration, research, and experiential learning for MSU.

After rainfall events beginning in April 2017, 19 stream cross sections were surveyed to track changes in stream morphology. The cross section data, over time, identifies a section location-elevation to a 1-centimeter accuracy to model the slope and calculate the depth of the streambank and the differences between subsequent surveys. Our hydraulic and sediment budget model will be a supporting tool to identify the areas that are actively eroding or receiving deposition along the channel. With the data collected from cross sectional surveys, we can then identify the locations that erosion Best Management Practices will be implemented. Preliminary results of monitored events indicate that in-stream loads from active streambanks represent up to 5.7 to 6.7 metric ton per meter of stream length.

Vegetative cover was assessed at each of the cross section locations. Within the cross-section belt transects, vegetative cover was characterized as being located in the mowed area of the cross-section, in the ground/shrub layer of the unmowed areas of the cross section, or in the canopy layer. Invasive species are dominant in the mowed, shrub, and ground layers of the unmowed areas of the transects. A true tree canopy was found in 9 of 19 transects, which had a higher percentage of native species cover. The analysis of spatial and temporal variation of water quality and the assessment of dominant mechanisms driving sediment supply and exportation for the Catalpa Creek showed that: i) no-impairment for the stream was observed under baseflow conditions; ii) a flashy response hydrograph and increasing sediment concentrations and water turbidity occurred as flow rises, the latest caused by streambank erosion and sloughing processes; iii) tributaries contribute significant increases to flow and sediment loads during stormflow events; iv) channel adjustment is in progress in response to development along headwater areas; v) streambank erosion and runoff and erosion from the road system within the South Farm are the main sources of sediments along the main channel and tributaries of the Catalpa Creek; vi) the stream is in a channel evolution stage IV, representing stream degradation and widening identified by active streambanks along the channel length; vii) spatial variations of dissolved oxygen in the stream could represent biological activity related to the presence of high levels of nutrient concentrations; and viii) spatial variations in temperature evidenced a potential water quality impact caused by the lack of a forested riparian zone along the stream.

PRESENTER BIO: Dr. Schauwecker coordinates the Landscape Contracting and Management degree program in the Department of Landscape Architecture at Mississippi State University. As a MAFES researcher, his projects are focused on design for the restoration and management of biodiversity in degraded landscapes.

DEVELOPING A STRATEGY FOR RECONECTING THE COLORADO RIVER WITH THE SEA

Francisco Zamora Arroyo[1], Dale Turner[3], Tomas Rivas[2], ***Karen Schlatter[1]***

[1]Sonoran Institute, Tucson, AZ. USA
[2]Sonoran Institute Mexico A.C. Mexico
[3]The Nature Conservancy, USA

To enhance estuarine habitat in the Colorado River Delta, in 2008 a group of non-governmental organizations and academic institutions from Mexico and the US began collaborating to enhance the connectivity between the river and the sea. Based on the biological and hydrological characterization of the upper estuary, two key factors were found to be critical to restore the connectivity between the river and the sea: 1) increase the volume and frequency of instream flows, and 2) remove sediments from the river channel to allow the inflow of sea water through tides.

Since the construction of the last major dam in the early 1960s, the Colorado River has not regularly reached the sea. Currently the only flows reaching the estuary are a combination of agricultural return flows and treated effluent from the city of Mexicali. To address the need to increase freshwater flows, it was necessary to first determine the sites with restoration potential and implement a series of pilot water deliveries to investigate both the feasibility to use existing irrigation infrastructure to deliver flows and the magnitude of the flows required to reach the target areas. Results of the pilot water deliveries indicate that it is feasible to bring water to the upper estuary. The next step was to develop a hydrological model to evaluate several water delivery scenarios and their impact on inundation and water salinity. We will be presenting results of the pilot water deliveries and the hydrological model.

To enhance the physical connectivity between the river and the sea, in 2016 we removed sediments along 7 river miles to open a pilot channel 1.5 meters wide and 0.5 meters deep. This pilot channel was within the natural river channel that was filled with sediments resulting from the 2010 earthquake. Monitoring results indicate that the pilot channel has significantly increased the number of days the river is connected to the sea, allowing the mixing of freshwater and sea water.

The results of pilot water deliveries and enhancement of the physical connectivity are being used to refine an adaptive restoration strategy for the upper estuary of the Colorado River. This strategy will inform new water deliveries are being planned for the next few years as part of a new binational agreement between the US and Mexico.

PRESENTER BIO: Karen Schlatter is the Associate Director of Water and Ecosystem Restoration at the Sonoran Institute, with over seven years of experience implementing ecological restoration and monitoring in the Colorado River Delta in Mexico. Under US-Mexico agreements Minutes 319 and 323, she leads restoration efforts and co-leads the binational Science Team.

PROGRESS AND TRENDS IN RESTORATION PLANNING AND IMPLEMENTATION IN THE COLORADO RIVER DELTA

Karen J. Schlatter
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The Colorado River has not regularly reached the sea since the mid-1900s due to upstream dams and diversions. Although 90% of original riparian, marsh, and estuarine habitat in the river's delta region in Mexico was lost, habitat regeneration following historic floods demonstrated the Delta's resiliency and potential for restoration. Starting with small demonstration restoration projects in the mid-2000s, restoration efforts have grown in scale and scope over the past 10 years, with increasing participation from state, national, and binational governments, NGOs, scientists, community groups, and the private sector. Environmental flows and restoration funding have been committed via US-Mexico agreements Minute 319 and Minute 323, the latter of which extends through 2026. Yet, restoration in the Delta requires a unique approach, as large-magnitude floods needed to restore hydro-geomorphic-biological interactions in the river floodplain and estuary are unrealistic in our lifetime. Additionally, groundwater conditions along the river corridor are highly variable, ranging from <1 to 20 meters deep. In this context, restoration efforts must utilize scarce water resources innovatively and efficiently to restore ecosystem functions in target restoration sites in the Delta region.

Restoration planning efforts under the binational agreements are coordinated among NGOs implementing restoration in the Delta to achieve both landscape- and site-scale habitat goals. Restoration priority sites in the Delta were identified based on locations of remnant habitat, existing site conditions, potential benefits to target conservation species, and ability to enhance habitat connectivity along the corridor by creating habitat "islands" in areas with little or no native habitat. At the site-scale, riparian restoration designs are informed by groundwater conditions, soil salinity and texture, and access to water deliveries. Based on the combination of factors, designs feature a mosaic of habitat types (cottonwood-willow dominated forest, mesquite bosque, marsh, open water, and upland habitat) that meet site conditions while also satisfying landscape-scale restoration goals.

Site conditions also greatly inform the degree of management intervention required to restore habitat. Passive restoration methods such as environmental flow deliveries to flush salts and stimulate natural habitat regeneration can be appropriate in areas with favorable hydrological conditions and remnant habitat. Active restoration methods are needed in the majority of priority restoration sites, which can include removal of non-native species (primarily Tamarix spp.), revegetation with native plants, flood irrigation, and mechanical land reworking to construct off-channel wetlands with water control structures. The adaptive restoration approach in the estuary region includes sediment removal in river-tidal channels to improve freshwater-seawater connectivity coupled with experimental freshwater flow releases. As NGOs scale up activities along the corridor and in the upper estuary in the next nine years under Minute 323, they will increase the total amount of restored habitat from 1200 to 4300 acres.

PRESENTER BIO: Karen Schlatter is the Associate Director of Water and Ecosystem Restoration at the Sonoran Institute, with over seven years of experience implementing ecological restoration and monitoring in the Colorado River Delta in Mexico. Under US-Mexico agreements Minutes 319 and 323, she leads restoration efforts and co-leads the binational Science Team.

EFFECTS OF INCREASED SALINITY ON MICROBIAL PROCESSING OF CARBON AND NUTRIENTS IN BRACKISH AND FRESHWATER WETLAND SOILS

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Everglades coastal wetlands are exposed to saltwater intrusion from storms and sea-level rise (SLR), leading to uncertainties for the fate of belowground carbon (C). Soil microbial extracellular enzyme activities (EEAs) drive organic matter breakdown. Our objectives were to determine how microbial EEAs and root breakdown in freshwater and brackish water peat soils are affected by saltwater intrusion. We simulated episodic saltwater intrusion by monthly *in situ* dosing of wetland chambers (n = 6, 1.2 m diameter) with Instant Ocean®. Control wetland chambers (n = 6) were dosed with ambient site water. We deployed 5 root litterbags in brackish and freshwater chambers for approximately 2 years (retrieved after 1, 3, 6 9, 12 and 24 months). After each collection, we analyzed the remaining root litter for microbial EEAs, elemental stoichiometry (C:nitrogen, N, C:phosphorus,P) and breakdown rate.

At the freshwater site, root degradation was 30% within the first 30 days for both control and treatment chambers. After 30 days, the degradation rates slowed down within both the controls and treatments ended at around 50% remaining after 740 days. At the brackish site, root degradation was also 30% within the first 30 days for both control and treatment chambers. After 30 days, the percent dry matter remaining slightly decreased at both the controls and treatment chamber with dry matter ended at around 60% remaining after 740 days. The majority of mass loss occurred within the first 30 days. Interestingly, the majority of mass loss occurred within the initial 30 days.

We implemented a path analysis approach to quantify the relative importance of hypothesized factors contributing to root breakdown rate after short (30 days) and long-term (740 days) durations at both the freshwater and brackish site. We constructed four path models with eleven predictor variables for root breakdown: average phosphorous (P), sulfur (S), and C-acquiring enzymes, salinity, litter C: N, litter C:P,porewater dissolved organic C (DOC), porewater total dissolved N (TDN), porewater soluble reactive P (SRP) and SO_4^{-1}. Preliminary results from the path model indicate predictors ($P < 0.05$) of breakdown rates vary between short-term and long-term exposure and between sites. Freshwater short-term breakdown rates were best predicted (standardized coefficient) directly by labile C acquiring enzyme activity (0.51), salinity (-7.39), DOC (-0.50), SRP (0.35), and SO_4^{-} (7.045). Freshwater long-term breakdown rates were best predicted by salinity (-1.72), DOC (0.41), TDN (-0.79), SRP (-0.44), and SO_4^{-} (2.21). Brackish short-term breakdown rates were best predicted by P (0.17) and S (-0.14) acquiring enzymes, C:P content (-0.31), DOC (0.99), TDN (-0.66), and SO_4^{-} (0.50). Brackish long-term breakdown rates were best predicted by salinity (1.79), TDN (1.27), SRP (-0.79), and SO_4^{-} (-1.12). Overall, enzyme activities were not predicted to have direct effects on breakdown rates long-term. Porewater chemistry, particularly SO_4^{-1}, appears to be a good predictor of breakdown rates during short-term and long-term incubations and across sites. Site chemistry dominates breakdown rate likely because it both directly influences leaching and also may indirectly affect enzyme activities. Average enzyme activities across root liter collections may not be effective predictors of breakdown as they represent instantaneous microbial demand. Dosing experiments provide insights into critical peat formation and degradation mechanisms and will allow for better planning and water management decisions.

PRESENTER BIO: Shelby Servais is a Ph.D. candidate at Florida International University. Shelby will defend her dissertation in Summer 2018 and is interested to hear about any job or postdoc opportunities!

LONGLEAF PINE UNDERSTORY NATIVE PLANT DEVELOPMENT AT THE USDA NRCS EAST TEXAS PLANT MATERIALS CENTER

R. Alan Shadow

Unite States Department of Agriculture Natural Resources Conservation Service East Texas Plant Materials, Nacogdoches, TX, USA

The mission of the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) Plant Materials Program is to evaluate, select and release native plants to solve conservation problems. The USDA NRCS East Texas Plant Materials Center (ETPMC) in Nacogdoches, Texas plays an active role in native plant development for eastern Texas and western Louisiana, also known as the Western Coastal Plain, Major Land Resource Area, 133B. This region encompasses the western most expansion of the historic longleaf pine range. Native plants released by the ETPMC for application in longleaf pine understory restoration plantings include Harrison Germplasm Florida paspalum (*Paspalum floridanum*), Cajun Sunrise Germplasm ashy sunflower (*Helianthus mollis*), 'Nacogdoches' eastern gamagrass (*Tripsacum dactyloides*), and most recently Coastal Plains Germplasm little bluestem (*Schizachyrium scoparium*). The ETPMC is also collaborating with the United States Forest Service and East Texas Natives to increase native plant development in the region. The ETPMC is currently evaluating and selecting pinehill bluestem (*Schizachyrium scoparium* var*. divergens*), pineywoods dropseed (*Sporobolus junceus*), and swamp sunflower (*Helianthus angustifolius*) ecotypes for longleaf pine ecosystem restoration efforts.

PRESENTER BIO: Alan Shadow is the manager of the USDA NRCS East Texas Plant Materials Center. He has 12 years with the USDA Plant Materials Program and has worked with Plant Materials Centers in Louisiana, Texas, and Kansas developing plant releases and technology to use native plants to solve conservations problems.

LESSONS LEARNED FROM MARSH CREATION VEGETATION MONITORING – ASSESSING THE NEED FOR PLANTINGS AND REGIONAL VARIATION IN VEGETATION ESTABLISHMENT

Leigh Anne Sharp[1]*, Bernard Wood*[1] *and Danielle Richardi*[2]
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Beneficial use of dredged material for marsh creation has become a popular restoration technique in coastal Louisiana. Dozens of marsh creation projects have been completed and there are many more in planning. Projects constructed through the Coastal Wetland Planning Protection and Restoration Act (CWPPRA) have been monitored by CPRA, some for over twenty years. Monitoring includes observations of vegetation, elevation and soil properties.

There are lessons to be learned from the marsh creation vegetation data collection efforts. Many marsh creation areas self-vegetate within the first several years. Unless the site is in a particularly active wave environment, planting is not always necessary. There are a host of different species that emerge in marsh creation areas and those species vary by region and borrow source. Chenier Plain marsh creation areas tend to self-vegetate with *Salicornia virginica* followed by *Spartina alterniflora* and shrubs. Marshes created with sediments from the Mississippi River tend to self-vegetate with a variety of herbs, *Paspalum vaginatum* and *Typha domengensis*. Marshes created with offshore borrow sources are slower to vegetate.

Terminally flooded low elevation areas and mudflats created from dredge overflow vegetate more slowly than higher areas. In one instance on Sabine Refuge, a low spot in a marsh creation area and an adjacent mudflat remained unvegetated until the 2011 drought when they quickly became vegetated with what would appear to be a flood tolerant strain of *Spartina alterniflora*. The low elevation areas were never sub aerial but when they became shallow, they were quickly colonized.

Marsh creation projects are one of the main components of Louisiana's Coastal Master Plan. Over twenty years of existing vegetation monitoring data provides some insight into what we can expect from marsh creation projects in the future.

PRESENTER BIO: Leigh Anne Sharp is a wetland scientist with over fifteen years of experience monitoring and assessing Louisiana's coastal restoration effort. She currently manages scientific aspects of the CRMS program and leads CPRA's Lafayette Regional Office in their efforts to assess restoration projects and ecosystem processes on the Chenier Plain.

A TOOL FOR ASSESSING ECOSYSTEM GOODS AND SERVICES IN ECOSYSTEM RESTORATION – THE FINAL ECOSYSTEM GOODS AND SERVICES SCOPING TOOL

***Leah Sharpe**, Justin Bousquin, Matt Harwell, and Marc Russell*
U.S. Environmental Protection Agency, Gulf Breeze, FL, USA

One way of viewing ecosystem restoration projects is from a lens of reestablishing Ecosystem Goods and Services (EGS) that can provide valuable benefits from the environment to people. However, different restoration actions can result in restoring differing sets of EGS and, subsequently, people receiving differing sets of benefits. By working with those stakeholder groups most relevant to a restoration decision and identifying the EGS of greatest interest to them, managers can tailor their restoration actions to focus on restoring those EGS that are most desired. Too often, it is easy to focus on those EGS that are easily measured (e.g., land area available for recreation) or commonly discussed (e.g., carbon sequestration) without considering whether they are: (1) highly relevant to the restoration effort; (2) meaningful to or desired by stakeholders; and (3) of direct benefit to stakeholders. We propose the use of a structured decision making tool that allows community-level decision makers and restoration practitioners to take a transparent, repeatable, and defendable approach for identifying the highest priority EGS for their restoration actions. The structured decision making tool helps them explicitly identify and prioritize those benefiting from restored EGS and the EGS most relevant to those beneficiaries. This tool is designed to be applied in the early scoping stages of the decision-making process and used in an iterative fashion with input from stakeholders.

PRESENTER BIO: Leah is an interdisciplinary scientist focused on the development of decision support tools at the U.S. EPA Office of Research and Development's Gulf Ecology Division

ADAPTATION OF COASTAL URBAN AND NATURAL ECOSYSTEMS (ACUNE) IN SW FLORIDA

Peter Sheng[1], *Michael Savarese*[2], *Christine Angelini*[1], *Justin Davis*[1], *Vladimir Paramygin*[1], *Felix Jose*[2], *David Letson*[3], *Karen Thorne*[4], *Ken Krauss*[4], *Michael Barry*[5]

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This paper presents a project, funded by NOAA's National Centers for Coastal Ocean Science, which aims to develop a web-based interactive tool to help resource managers in Southwest Florida to plan for the future impacts of more intense storms and sea level rise. The project addresses urgent issues related to the vulnerability and resilience of Southwest Florida coastal communities and ecosystems. This region contains the largest area of tidally influenced public lands in the Gulf of Mexico (GOM) and the fastest growing urban landscape in Florida. Both the human and natural components of the regional ecosystem, like all coastal regions throughout the U.S., are under increasing risk due to the threats of a growing human population, tropical cyclones (TC) which are predicted to become more intense and frequent, and sea-level rise (SLR). Mangrove forests, salt marshes, and beaches, which provide fishery habitat and flood protection, are highly vulnerable to all these stressors. If these habitats are lost, coastal communities will be at much higher risk of flooding and wildlife/fisheries habitat will be impacted.
Local governments (Collier County, Naples, and Marco Island) and natural resource managers (Rookery Bay NERR, South Florida Water Management District, Ten Thousand Islands and Florida Panther National Wildlife Refuges, Picayune Strand, Big Cypress Basin, and the region's State Parks) in Southwest Florida partnered with the science team to craft the proposal and define the questions of greatest importance for future management.

To assist the local governments and natural resource managers, the project will generate two products. First, using a suite of coupled state-of-the-art coastal modeling system, the science team will create inundation maps, salinity distribution maps, habitat distribution maps, beach and barrier islands vulnerability maps, and economic impact maps for both current and future climates and for various sea-level rise scenarios specific to this region. Second, it will integrate the maps into an ACUNE web-based interactive decision-support tool that enables users to navigate to areas and map layers to identify areas of high vulnerability and use this information for coastal resiliency strategic planning. Ultimately ACUNE will allow end users to make decisions in coastal planning, zoning, land acquisition, and mangrove/marsh restoration based on models that are far more rigorous than those currently available.
The end-users will be actively engaged in the development of the ACUNE and employ it to develop management plans (1) to anticipate and manage the potential effects of SLR and TC on urban landscapes and infrastructure, (2) to preserve and restore the mangrove, marsh, and beach habitats, which offer wildlife and flood protection service to coastal communities, and (3) to anticipate the effects of salt water intrusion in estuaries and their associated habitats.

PRESENTER BIO: Dr. Peter Sheng is a research professor with more than 35 years of experience developing and applying hydrodynamic and ecosystem models to develop probabilistic coastal inundation maps and strategies for adaptation and restoration of coastal and estuarine ecosystems.

A TOOL FOR BEAVER DAM ANALOGUE DESIGN

F. Douglas Shields, Jr.[1], *Michael Pollock*[2], *Rocco Fiori*[3]
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Beaver populations can be powerful tools in restoring stream and riparian habitats since their dams control and influence fluxes of water, sediment and nutrients. Beaver dam analogues (BDAs) are channel-spanning structures built by humans that mimic or reinforce natural beaver dams, and in many cases are intended to be eventually utilized and enhanced by beaver. BDAs are constructed by driving posts in a row perpendicular to the channel, weaving a mat of willow stems to create a weir supported by the posts and placing a berm of sediment, stone and plant material on the upstream face of the weir. Like natural beaver dams, BDAs are porous, temporary features on the landscape with functions that change in response to the effects of flowing water, sediment, and beaver activity.

Although early BDA design and construction has relied on professional judgment, quantitative design can reduce the risk of premature failure and suboptimal use of available resources. To support and assist designers, we present a macro-enable Excel spreadsheet that may be used to perform simple analyses leading to computation of three safety factors. Material quantities and simple cost estimates are also presented as output. Key computational modules include hydrologic flow frequency analyses to support selection of design discharge and uniform flow computations to assess pre-construction hydraulics. Uniform flow hydraulics are performed using an adapted version of the popular Cross-section hydraulic analyzer excel spreadsheet developed by the USDA-NRCS. The design tool also includes spreadsheets to assist the user in inputting geometry of the channel cross-section and the basic BDA geometry. Post-construction hydraulics are based on critical flow over the BDA crest at design discharge. Using these inputs and analyses and estimates of bed material size input by the user, the design tool computes estimates of scour depth downstream from the BDA and then uses Brom's approach for noncohesive sediments to compute the required minimum embedment for the posts.

The design tool provides support for users in the form of default input values, tables of wood properties, soil properties and beaver dam dimensions, and a users' manual. The authors aspire to an improved version of the tool upon receipt of suggestions from users.

PRESENTER BIO: Dr. Shields is a hydraulic engineer and cbec project director with more than 40 years of experience in river and stream restoration. He has authored or co-authored more than 300 technical publications and has completed research dealing with large wood, floodplain vegetation, and channel stability effects on riverine ecosystems.

RESTORING ECOLOGICAL CONNECTIVITY ACROSS A FRAGMENTED 10,000 HA LANDSCAPE IN NORTHWEST INDIANA, USA. A PRELIMINARY ASSESSMENT

John Shuey
The Nature Conservancy, Indianapolis, IN, USA

The eastern tallgrass prairie biome of North American is shattered, largely converted to agricultural production with less than one percent of the original habitat remaining. Hidden away within such fragmented landscapes are remnant communities that support thousands of species dependent upon native ecosystem remnants for their survival. These species typically persist as small, isolated and widely dispersed populations that once occupied contiguous and widespread habitats.
The Efroymson Restoration at Kankakee Sands (located in NW Indiana, USA) was conceived as a strategy to physically restore connectivity between a series of ecosystem remnants supporting mesic – dry sand prairie, emergent wetland, and xeric oak barrens. These remnants collectively support most of the original biota, but many species persist as small, isolated populations threatened by fragmentation, reduced habitat size, and disrupted population structure. The site provides an opportunity to use restoration to restore connectivity between fragmented communities to create almost 10,000 ha of continuous habitat mosaic. For our 3,200-hectare restoration, we defined ecological communities to include all remnant-associated species (plants and animals, including invertebrates). We approached this by addressing "landscape attributes" across the restoration as defined by recognizable and repeating ecological communities arrayed across ecological gradients (primarily the near surface water table which undulates over and under the sandy soils of the site). This produced the following decisions:

- Near surface hydrology restored to maximize complexity of hydrologic gradients.
- All local genotype materials and the entire vascular plant community was "restored" (600+ species).
- Seed mixes emulate natural plant communities to match soil types and restored hydrology.
- Aggressive warm season grasses were planted at very low densities to enhance forb establishment.

In 2014, we conducted an extensive assessment of the restoration in comparison to adjacent remnant sand prairies and alternative land uses. We looked at both species composition and structure of plant communities, as well as the species composition of selected vertebrate and invertebrate communities that represent different trophic and taxonomic guilds. These assessments were designed to provide explicit insight into attainment of our original restoration goals at the site.

We found that the botanical restoration sorts into five recognizable community types defined by hydrologic gradients, but that remnant prairies remain statically district from restorations. Hydrologic gradient also predicts species richness and floristic quality across the restoration. We clustered botanical plant and animal communities based on Bray–Curtis, and performed Mantel tests between plant and animal matrices to determine if plant and animal communities respond similarly across the restoration to gradients - largely, they do. Interestingly pollinators (butterflies and bees) and small mammals and did not, suggesting that our sampled habitat "grain-size" was inadequate to assess how these communities respond to habitats across the site. We suggest that as plant communities heal over coming decades and converge more closely with remnant habitats, most animal communities will likewise converge, further alleviating fragmentation as a threat (at least inside this conservation area).

PRESENTER BIO: Dr. Shuey has guided the restoration of over 7,000 hectares of Indiana wetlands, grasslands and forests. He has extensive experience in designing restorations that increase ecological resilience in the face of climate change at high biodiversity sites. He leads the effort to assess ecological function of restorations in Indiana.

RECOVER EVALUATION OF RESTORATION BENEFITS FROM PROJECT PLANS

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Authorized by Congress in 2000, the Comprehensive Everglades Restoration Plan (CERP), one of the largest environmental restoration programs in the world, will restore, protect, and preserve the south Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection. CERP is comprised of 68 extensive restoration components which make up more than 50 restoration projects spread throughout south Florida. The objective of CERP is to find the correct balance among the flow types throughout all regions to ensure a healthy and sustainable natural and human environment. To ensure the implementation of CERP is continually based on the best available science the REstoration, COordination, and VERification (RECOVER) program was created and implemented via the Water Resources Development Act of 2000 and the 2003 Programmatic Regulations for CERP.

RECOVER is a multi-agency team of scientists, modelers, planners, and resource specialists who organize and apply scientific and technical information in ways that are most effective in supporting the objectives of CERP. The RECOVER team conductions scientific and technical evaluations and assessments for improving the ability of CERP to restore, preserve, and protect the south Florida ecosystem while providing for the region's other water-related needs. The goal of RECOVER is to ensure that the system-wide perspective is maintained throughout the implementation of CERP. In order to assess project impacts throughout the Everglades system in south Florida, RECOVER develops and utilizes performance measures as tools to measure the response of ecological indicators to project implementation.

Performance measures are tools based on a set of indicators used in project planning to evaluate the degree to which proposed alternative plans are likely to meet restoration objectives and to assess the success of implemented plans in meeting restoration objectives. Many RECOVER performance measures are based on the conceptual ecological models and hypothesis clusters for the Everglades restoration. RECOVER performance measures must: (1) address ecological indicators that represent attributes or stressors of natural or human systems that CERP is expected to affect; (2) have targets that reflect the desired restoration condition; and (3) must provide an understanding of system-wide responses relative to how CERP implementation is meeting its complex, system-wide goals, while maintaining its sustainability in the future. RECOVER uses its performance measures to assess the function and impacts of each project during the planning, construction, and post-construction phases.

PRESENTER BIO: Mr. Simmons has 15 years of natural resource management experience across federal, state, and local government agencies, focusing on coastal biology and ecology. He holds a Master's Degree in Biology from the University of North Florida (Jacksonville, FL) and Bachelor's of Science in Biology from Marian University (Indianapolis, IN).

ECOSYSTEM RESTORATION FOR THE US ARMY CORPS OF ENGINEERS IN A CHANGING "CLIMATE"- A NATIONAL PERSPECTIVE

Mindy Simmons
U.S. Army Corps of Engineers Headquarters, Washington, D.C., USA

At NCER in 2016, we discussed the status US Army Corps of Engineers' Aquatic Ecosystem Restoration Program, on which we typically have spent $300-400 million annually. Large, regional programs, such as the Everglades, Upper Mississippi River Restoration, and programs targeting endangered species recovery in the Pacific Northwest and Missouri River basin have typically comprised a significant portion of this program, combined with several smaller projects and programs throughout the nation.

In the past two years, not only has USACE had a significant role in responding to extreme climatic events, such as the recent hurricanes, fires and mudslides in California, and numerous flooding events, but it is learning to adapt to a changing political and social climate as well. Federal budgets for environmental efforts are decreasing, while concurrently, the nation is becoming keenly aware of the need to repair and invest in its infrastructure. Concurrently, leadership at all levels affecting USACE is changing. How can USACE position itself to continue to reliably invest in nationally significant ecosystems as we weather all of this change? What are the implications for our "traditional" USACE restoration programs, and what new restoration opportunities might unfold as a result?

This presentation will bring a national-level perspective to restoration opportunities that are unfolding in this changing "climate". In addition to USACE's portfolio of traditional restoration, we'll discuss unique collaborations between USACE and private industry, including with the Natural Infrastructure Initiative, a coalition involving Caterpillar, Inc., The Nature Conservancy, and many others, aimed at forging creative, sustainable, collaborative investments in natural capital. We'll also discuss emerging USACE initiatives, such as a pilot program for projects that beneficially use sediment dredged from our navigation channels, and increased attention on using natural and nature-based features and "Engineering with Nature" approaches to provide ecological benefits while also meeting other purposes, such as flood risk reduction.

Amongst this change, and now with significant federal appropriations for disaster relief and infrastructure looming in the near future, how can USACE lead the nation in creating and maintaining natural infrastructure in the form of healthy, resilient coastlines and river systems that provide services to the nation just as valuable as the transportation, waste water, energy infrastructure it's so focused on improving?

PRESENTER BIO: Ms. Simmons is a Senior Policy Advisor with the US Army Corps of Engineers, where she manages the Corps' Aquatic Ecosystem Restoration program nationwide. Her background is in fisheries science and civil engineering, with experience in the Pacific Northwest improving freshwater habitat and fish passage conditions primarily for ESA-listed salmonids.

LOOKING FORWARD: SCALE, SUSTAINABILITY, AND GOVERNANCE OPPORTUNITIES AND CHALLENGES IN THE COLORADO RIVER DELTA

Peter Skidmore
Walton Family Foundation, Bozeman, MT, USA

The Colorado River delta once supported 800,000 hectares of riverine, wetland and estuarine habitat but has contracted to less than five percent of this as result of water use upstream. Under the umbrella of the recent Minute 319 agreement, 445 hectares of active and passive restoration of mixed habitat was implemented along the river corridor and a new goal of up to 1300 hectares of additional restoration by 2026 is set for the new Minute 323 agreement. While active restoration represents a small fraction of historic habitat and may not be economically feasible at a much broader scale, it is demonstrating the value, for wildlife and local communities, of habitat parcels distributed across a desert landscape and carries forward the spirit of hope for broader restoration in the future.

Under the constraints of limited environmental water and constrained natural processes, restored areas cannot be expected to persist without stewardship including supplemental planting, managing invasives, and irrigation of restored sites. Long-term success will require ongoing management and substantial funding over decades. Where active restoration costs fall in the range of $13,000-30,000/ha, stewardship may require $1,600/ha annually over decades and ongoing water requirements will significantly add to these costs. Funding to date came predominantly from foundations and federal agencies. While these traditional sources are likely to support additional restoration under Minute 323, funding for long-term stewardship will be more challenging to secure. Current funders and partners are considering funding innovations such as voluntary offset fees for corporate water users, a tourist tax, pay for success models that include maintenance funds, and a capital campaign to build a stewardship endowment.

Scaling and stewarding restoration in the long-term will require heightened coordination among the NGOs, government partners, and funder entities. Implementation and fundraising are undertaken in the context of a unique three-way agreement (Minute 323) among the U.S., Mexico and a partnership of non-profit entities. While restoration at this scale warrants a many-partners framework, sharing of responsibility for fund raising, effective restoration implementation, and long-term management demands commitments from organizations and individuals that are often already at the limits of their capacity. Raise the River initially formed as a partnership to coordinate fundraising under Minute 319 but has evolved to encompass a broader role of coordination of restoration, monitoring, and long-term management. The commitment of a full-time coordinator, that is independent of the constituent organizations, will help to foster collaboration among not only environmental partners, but also federal agencies and both traditional and new classes of funders.

PRESENTER BIO: Peter Skidmore manages a grant portfolio focused on river restoration in the Colorado River Basin. Peter draws on 25 years' experience providing planning, review and guidance of restoration projects. He has chaired boards and founded non-profit organizations focused on protection and restoration of rivers across the US and internationally.

THE EVERGLADES: AT THE FOREFRONT OF TRANSITION

Fred Sklar
South Florida Water Management, West Palm Beach, FL, USA

The freshwater and coastal ecosystems of the Everglades provide many socio-economic benefits including important recreational and tourism opportunities, key fishery habitat, water quality improvements, flood and erosion mitigation, and mitigation of greenhouse gases through carbon storage and sequestration. Increasing pressures from sea level rise will influence the number, types and value of ecosystem services expected in the future. These pressures combined with the geological history of Florida put the Everglades at the "forefront of transition." In the peat-based portions of the Everglades, where water depths can be altered either by changes in water elevation due to sea level and rainfall or by changes in elevation of the peat surface due to biophysical processes, slight changes in the depth and period of inundation can influence the presence and distributions of plant species and communities. The present global rate of SLR is estimated at 3.4 mm yr^{-1}, but the south Florida regional rate could be as high as 9 mm yr^{-1}. As a flat, low-lying landscape, the conventional thinking is that Everglades coastal habitats will gradually migrate upslope with increases in sea level as a transgressive transition of saltwater into freshwater sawgrass marshes. Inland transgression of mangroves has been suggested as a means by which sub-tropical and tropical coastal landscapes will "adapt" to increasing SLR. However, erosion of coastal peats, inundation ponding and overstep (salt water encroachment too fast for all communities to retreat) has already been observed in the southeast saline Everglades. In several areas of coastal Everglades National Park, freshwater and oligohaline Everglades wetlands are expected to be exposed to increased duration and inundation of seawater, impacting processes that may lead to peat collapse. In some cases, the freshwater marsh has collapsed by some 0.5 m over a period of a few decades and have converted to an open-water, mangrove-free environment. If coastal communities cannot adapt to the salinity changes associated with increasing sea levels, then significant coastal wetland loss may occur, dramatically altering and increasing the vulnerability of the south Florida coastline. Without restoration of freshwater flow to the Everglades, saltwater intrusion-induced peat collapse may be enhanced and landward migration of mangroves into freshwater peat soils stymied.

PRESENTER BIO: Fred H. Sklar has a Masters in Oceanography and a Ph.D. in Wetland Ecology. He is the Director of the Everglades Systems Assessment Section of the South Florida Water Management District in West Palm Beach, FL. Dr. Sklar is an Associate Editor for the journal: Frontiers in Ecology and the Environment; a member of the National Environmental Advisory Board to the Chief of the US. Army Corps of Engineers; a member of the Louisiana Science and Engineering Advisory Committee for the Water Institute of the Gulf; and an executive member of the steering committee for the Florida Coastal Ecosystem LTER Program. His research is focused on adaptive management for coastal and wetland ecosystems, mangrove biogeochemistry, Everglades restoration, tree island ecology and landscape modeling. Dr. Sklar has published 100+ articles and reports on the impacts of hydrology on aquatic soil, plant and animal processes

BALANCING CERTAINTY OF ACTION FOR ESA COMPLIANCE AND SCIENTIFIC UNCERTAINTY THROUGH ADAPTIVE MANAGEMENT ON THE MISSOURI RIVER

Mike Snyder
U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO, USA.

The U.S. Army Corps of Engineers (USACE) operates the Missouri River Mainstem Reservoir System (System) consisting of six dams and reservoirs with a capacity to store 72.4 million acre-feet of water, the largest reservoir system in North America, and maintains a 735-mile navigation channel downstream of the System. A U.S. Fish and Wildlife Service 2003 Amended Biological Opinion provided the USACE a Reasonable and Prudent Alternative, which included actions to address impacts of System operations and channel maintenance to the pallid sturgeon (*Scaphirhynchus albus*), least tern (*Sterna antillarum athalassos*), and piping plover (*Charadrius melodus*). The Corps implements BiOp compliance activities under the Missouri River Recovery Program (MRRP). The MRRP is undergoing a transformation resulting from 2011 recommendations by an Independent Science Advisory Panel and the Missouri River Recovery Implementation Committee, a Congressionally-authorized stakeholder group. Development of an over-arching adaptive management strategy was recommended. The purpose of the Missouri River Recovery Management Plan and Environmental Impact Statement (MRRMP-EIS) is to develop a suite of actions that meets USACE ESA responsibilities for the pallid sturgeon, least tern, and piping plover. An Effects Analysis study established the best available scientific information and provided the foundation for developing alternatives and a draft Adaptive Management Plan (AM Plan) that addresses uncertainties and improves management decisions while implementing actions that avoid jeopardizing the three species. The AM Plan would provide the roadmap for implementation of a preferred alternative and for the identification of subsequent management needs should the initial suite of actions fail to meet objectives. USACE reinitiated formal ESA Section 7 consultation with USFWS in October 2017. In developing the proposed action, USACE worked to strike a balance between the reasonable certainty standard that ESA is grounded in with the AM approach recommended and developed as part of the MRRMP-EIS process. The USACE proposed action, which includes implementing the AM Plan, commits to a collaborative governance process supported by clear objectives, decision criteria, and a science program aimed at quantifying performance of an initial suite of actions to ensure success for the listed species while striking a balance between the reasonable certainty required of ESA and reducing critical uncertainties through AM. This presentation discusses the challenges in identifying a preferred alternative that balances taking immediate actions to benefit the species with the need to resolve lingering scientific uncertainties on species limiting-factors while collaborating with affected stakeholders. It also provides an overview of how National Environmental Policy Act and ESA compliance would be achieved as the AM process is implemented.

PRESENTER BIO: Mr. Snyder is an environmental resources specialist with the U.S. Army Corps of Engineers, Kansas City District. He is responsible for NEPA compliance on civil works and military projects and programs. He has 18 years' experience in environmental compliance including the National Environmental Policy Act and Endangered Species Act.

EFFICACY OF ABSCISIC ACID (ABA) IN DELAYING GERMINATION OF *PSEUDOROEGNERIA SPICATA* TO REDUCE SEEDING FAILURE IN SAGEBRUSH-STEPPE RESTORATION EFFORTS

***Travis Sowards*[1], *Zachary Aanderud*[1], *Steven Petersen*[1], *Samuel St. Clair*[1], *Stanley Kitchen*[2], *Bruce Roundy*[1], *Matthew Madsen*[1]**

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Rangelands are the most abundant form of terrain globally, comprising 70% of the world's dry-land. Half of all the terrain in the US is composed of rangelands, the greatest of which is the cold-desert of the Great Basin. The Great Basin Desert of North America has been identified as an area that suffers from elevated level of degradation, and is difficult to restore via seeding practices. Seeds sown in the fall to restore sagebrush-steppe plant communities can experience high mortality when they germinate early in the season and are exposed to cyclic freezing events, winter drought, pathogens, and other biotic and abiotic stressors. *Pseudoroegneria spicata* (bluebunch wheatgrass), a drought tolerant steppe system bunchgrass, is frequently used in restoration projects; however, fall seeding has shown germination occurring at 80% in sub-optimal winter conditions and greater than 90% seedling mortality.

Our research focuses on the efficacy of abscisic acid (ABA) to induce a physiological dormancy in *P. spicata* across the cold-desert of the Great Basin. Our study sites span the range of the Great Basin, from Oregon to Nevada and Utah. We coated *P. spicata* with varying levels of ABA and planted each treatment in a randomized block study at each of the five sites. Germination bags were randomized across the treatment blocks and retrieved monthly for germination and seed viability assessments. Individual seedling emergence, establishment, and survival is being monitored from spring to fall. We hypothesize that cultivars of *Pseudoroegneria spicata* augmented with ABA will achieve optimal germination timing and increased establishment success; avoiding the effects of freeze/thaw events, drought, and pathogens. We will present our findings on the efficacy of ABA enhancements to manipulate seed dormancy and impact on seeding establishment success.

PRESENTER BIO: Mr. Sowards is a PhD Candidate in Brigham Young University's Department of Plant and Wildlife Sciences and is a member of Dr. Madsen's seed technologies laboratory. He earned his BS in Forestry from Northern Arizona University and has worked as a Research Assistant with the USFS Pacific Southwest Research Station.

IMPACTS OF LARGE-SCALE BREAKWATERS ON SHORELINE VEGETATION IN HIGH WAVE ENERGY ENVIRONMENTS

Eric Sparks[1,2,3], *Nigel Temple*[1,3], *Sara Martin*[1], *Daniel Firth*[1,3], *Gillian Palino*[1], *Just Cebrian*[4,5]

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[2]Mississippi-Alabama Sea Grant Consortium, Ocean Spring, MS, USA
[3]Mississippi State University, Department of Wildlife, Fisheries, and Aquaculture, Starkville, MS, USA
[4]Dauphin Island Sea Lab, Dauphin Island, AL, USA
[5]University of South Alabama, Department of Marine Sciences, Mobile, AL, USA

Shoreline erosion is a major concern of coastal land managers. To combat erosion, land managers often install nearshore breakwaters to attenuate wave energy. These breakwater projects are often termed living shorelines, due to the perceived increase in secondary productivity around the breakwaters and preservation of natural shorelines. However, evaluations of the effectiveness of breakwaters at preserving natural shorelines are limited. To evaluate the effectiveness of large-scale breakwaters at enhancing shoreline vegetation in high wave energy environments, we conducted experimental plantings and a shoreline monitoring program landward of six year old breakwaters (OBW), recently constructed breakwaters (RBW), and reference no breakwater sites (NBW) along Bon Secour Bay, AL. The OBW, RBW, and NBW complexes cover 0.6km, 3km, and 1.2km of consecutive shoreline, respectively. Within the OBW and NBW sites, eight replicates of planted ($4m^2$ of nursery grown *S. alterniflora* sods planted in checkerboard pattern), natural stand, and no vegetation treatments were randomly distributed throughout each site. Within the RBW sites, an additional planted design was also established (clumped plantings), yielding four shoreline vegetation treatments. Each plot was visited quarterly with a suite of vegetative measurements taken, including: percent coverage, species diversity, biomass, porewater DIN, and soil organic matter. Additionally, the perimeter of all of the natural *S.alterniflora* patches within each site was field mapped using an RTK GPS to compare *S.alterniflora* area across breakwater treatments. Preliminary results indicate no significant positive effect of breakwaters for any of the measured metrics. If these resulting trends continue throughout the duration of the monitoring, they will show that large-scale breakwaters could have a small impact on preserving and enhancing shoreline vegetation in high wave energy environments.

PRESENTER BIO: Eric Sparks is an Assistant Extension Professor at Mississippi State University and serves dually as the Extension Program Leader and Coastal Ecology Specialist for the Mississippi-Alabama Sea Grant Consortium. His research and extension efforts broadly focus on estuarine and marine ecology, coastal wetlands, coastal restoration, environmental stewardship, and marine debris.

USING DRONES IN RESTORATION PROJECTS: A TWO-PART TRAINING SESSION

Dan Staley[1] *and Joe Baustian*[2]
[1]Arbor Drone LLC, Aurora, CO, USA
[2]The Nature Conservancy, Baton Rouge, LA USA

Unmanned Aerial Vehicles, or drones, are becoming increasingly popular tools in the fields of ecological restoration and research. Drones are extremely versatile and have a wide range of uses, but all that capability and complexity often comes with a hefty price tag. Consumer models are relatively inexpensive, come equipped with excellent cameras, and can give you a unique perspective of the landscape. Professional models are highly customizable and can have sensors to collect data on everything from vegetation to elevation. So how do you know what drone is right for you? And once you have a drone, how do you navigate the ever-changing regulatory landscape? We will explore these questions - and more - in two sessions.

The first session will give an overview of drone technology, operation principles, applicable laws, equipment costs and limitations, and training and testing time needed to become proficient to illustrate the usefulness of this technology for restoration and research professionals.

The second session will delve into the details of what research and restoration professionals need to know when considering how to collect and analyze data with a drone. Sensors ranging from visual to multispectral, hyperspectral and LiDAR will be discussed. Data analysis ranging from laptop programs, cloud-based subscriptions, and data analysis companies will be discussed. Attendees will also learn the issues surrounding data collection in the field, costs of data analysis, and view equipment and data from several widely differing missions.

Attendees will take away a thorough knowledge of drones, mission basics, and associated technology to make informed decisions on what equipment to use for research or restoration projects. There will be ample time to ask detailed questions to certified drone pilots at the end of each session.

PRESENTER BIOS:
Dan Staley is Principal of Arbor Drone, LLC, a green infrastructure firm in Aurora, CO. An FAA Certified Remote Pilot, he studied Environmental Horticulture and Urban Forestry at UC Davis, and urban planning and urban ecology at the University of Washington. He has over two dozen publications in several disciplines.

Joe Baustian is a wetland ecologist with The Nature Conservancy currently focusing on hydrologic restoration in the Atchafalaya River Basin. Joe manages TNC's water quality monitoring program in the Atchafalaya, and coordinates research activities with graduate students in TNC's Conservation Fellows program.

KEYS TO PLANNING, DESIGNING AND PERMITTING RESILIENT COASTAL RESTORATION PROJECTS

Matthew Starr *and Jeffrey Tabar*
Stantec Consulting Services Inc., Naples, FL, USA

A new set of challenges face our ability to plan, design and permit successful projects in the coastal environment. In no particular order – climate change, sea level rise, funding, extreme storms, regulatory policy, political pressures, and coastal zone management issues all introduce unique challenges to implementing a successful coastal restoration project. It is estimated that about 40 percent of the world's population lives within 60 miles of the coastline. This coastal population and the coastal infrastructure it relies on for economic viability is highly vulnerable in the face of global climate change. This vulnerability will be exacerbated by projected increases in the frequency of intense tropical storms.

More intense storms could result in more frequent barrier island overwash, storm damage to coastal infrastructure, shoreline retreat, loss of coastal wetlands, saltwater intrusion into aquifers, and increased coastal flooding. This presentation will provide an overview of these challenges, discuss their importance in today's political climate, and provide examples of projects that carefully maneuvered through these elements successfully. Restoration examples from Florida and other east/gulf coast locations will be provided. In particular, the largest post-Hurricane Sandy restoration project ($40 million) will be presented to demonstrate how the various phases of a project – from planning, design, permitting through construction were completed for this particular restoration project. Considering the very active 2017 hurricane season, the projected RESTORE funding for Florida can't come at a more important time in Florida's maintenance, preservation, and restoration of its coastline

Most importantly, the outcome of this presentation will provide NCER attendees with the framework to successfully plan, design and permit coastal restoration projects.

PRESENTER BIO: Matthew is a licensed Professional Geologist and coastal project manager with over 16 years of technical experience conducting projects across the United States and Caribbean related to coastal engineering, dredging, beach renourishment, marine facilities, coastal structures, hydrographic surveying, ecosystem restoration, asset management, natural resource mapping, water quality, and wildlife biology.

LONGTERM SCIENCE-MINING INDUSTRY PARTNERSHIPS DEVELOP PRACTICAL RESTORATION SCIENCE FRAMEWORKS FOR THE GLOBAL COMMUNITY

Jason Stevens[1,3]*, Ben Miller*[1,3] *and Vern Newton*[2]

[1]Kings Park Science, Department of Biodiversity, Conservations and Attractions, Perth WA AUSTRALIA
[2]Hanson Construction Materials, Perth WA AUSTRALIA
[3]School of Biological Sciences, University of Western Australia, Nedlands WA AUSTRALIA

Extreme pressures on biodiversity are occurring as global resource footprints for individual mining companies exponentially increase. Despite significant investment in restoration efforts by industry and increasing levels of environmental compliance, ecosystem restoration (matching the diversity, structure, dynamics and function of the reference state) is failing to achieve desired targets.

The gap between the immediate or short-term needs of restoration practitioners and the outputs of longer-term restoration science often limits the effectiveness of restoration programs. Here we present a comprehensive framework for the practical biophysical science needed for post-mining restoration. While the understanding developed for one site, region or biome may not directly apply to others, the broad framework of questions does. This enables long-term learnings from one site/system to be rapidly applied to others ensuring focused, efficient and successful restoration programs.

This presentation outlines the necessary research in five themes many of which have been developed in decadal partnerships with the mining sector in Western Australia and applied internationally: 1) Setting targets and planning for success, 2) Sourcing biological material, 3) Optimizing establishment, 4) Facilitating growth and survival, and 5) Restoring resilience, sustainability and landscape integration to assist restoration practitioners and scientists to identify knowledge gaps and develop strategic research focused on applied outcomes.

The application of this framework has enabled companies to achieve leading practice in mine-site restoration practice.

PRESENTER BIO: Dr. Stevens is a senior scientist with more than 10 years of experience in planning, designing, and implementing scientific programs to underpin native plant restoration projects. He has extensive experience with mine-site restoration across Mediterranean and semi-arid zones working with many mining industry partners.

FAUNAL MONITORING IN RESPONSE TO HARBOR DREDGING

Rachael Stevenson[2]*, Andre Daniels*[1]*, Erin Smith*[2]*, Dr. Michael Robblee*[3] *(Emeritus)*

[1]U.S. Geological Survey, Wetland and Aquatic Research Center, Davie, FL, USA
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[3]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

Dredging is known to damage seagrass beds, increase turbidity, and alter estuarine ecosystems. The Port of Miami Deep Dredge project was implemented in 2014-2015 to accommodate larger ships to access and utilize the port. The Faunal Monitoring in Response to Harbor Dredging project was designed to evaluate the impacts of dredging in the Port of Miami and an adjacent basin, North Biscayne Bay between 2014-2016. Turbidity, seagrass density, and animal totals were all significantly altered during the project. Both sampled areas had significant increases ($p<0.001$) in turbidity when comparing values from 2014-2016 and 2015-2016. Seagrass significantly decreased ($p<0.05$, $p<0.001$, respectively) in both basins between 2014-2016 and 2015-2016. There were significant decreases in caridean shrimp, penaeid shrimp, and fish populations in both basins throughout the study period ($p<0.05$), resulting in substantial declines of several genera of fishes (*Floridichthys, Lucania, Microgobius*) and carideans (*Hippolyte, Palaemonetes*) observed. Understanding the response of the ecosystem to dredging will require long term monitoring.

PRESENTER BIO: My name is Rachael Stevenson. I am a master's student in the Charismatic Megafauna and Oceanography lab at Nova Southeastern University, Davie, Florida. I work as a research assistant with the U.S.G.S. seagrass lab, monitoring Florida Bay, and as a surveyor for the Broward County Sea Turtle Conservation Program.

COLLABORATIVE PLANNING FOR APALACHICOLA RESTORATION IN HIGH RESOLUTION

*Cassandra M. Pallai[1], Michael Norton[1], **Colin Stief**[2] and Jeffrey Allenby[1]*
[1]Chesapeake Conservancy Conservation Innovation Center, Annapolis, MD USA
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A common goal across the U.S., improvement of water quality is a primary focus for stakeholders in the Chesapeake Bay watershed states. The Chesapeake Conservancy, a nonprofit organization based in Annapolis, MD, works to enable partners with innovative data and tools that assist with these restoration and conservation planning efforts. In particular, the Chesapeake Conservancy's Conservation Innovation Center (CIC) specializes in the creation of high-resolution, landscape-scale spatial data, such as land cover and enhanced flow path datasets, as well as in the customization of web-based data delivery platforms that empower stakeholders with any level of technical skills to access the power of high-resolution data. These materials are being used across the Chesapeake Bay watershed, and increasingly across the country, to aid stakeholders' restoration planning and prioritization efforts at federal, state, and local governments, non-profit organizations, academic institutions, and private corporations. For instance, the Chesapeake Bay Program Partnership (CBPP) has collaborated with the CIC to help generate 100,000 square miles of high-resolution land cover data, and to make the data open to the public. This information is 900x more specific than the alternative National Land Cover Dataset, and it provides complete coverage of all counties that touch or are within the watershed boundary. It is serving as the basis of CBPP's updates to their Total Maximum Daily Load (TMDL) pollution models.

Demand for the data is spreading to other regions of the country facing a host of issues, including water quantity and climate adaption planning. However, land cover is just one of the CIC's initiatives that is helping to push these conservation efforts toward precision and maximum impact per dollar spent. We have created a variety of web-based tools that leverage the land cover data, and couple it with Lidar-derived overland flow information, to allow counties to evaluate parcel-specific restoration opportunities, or to create reports about the treatment areas of stormwater restoration projects. Additionally, with our Nature's Network website developed for the North Atlantic Landscape Conservation Cooperative, we have given stakeholders the capacity to evaluate regional ecological and species distribution datasets, and decision-makers the ability to prioritize sub-watersheds for conservation action.

Land managers and planners in the Apalachicola region of Florida's panhandle are facing similar conservation and restoration challenges as well as increasingly limited resources to accomplish habitat and water quality improvement goals. Example questions that can be answered using these technologies are: 1) What are baseline conditions for land cover composition across the Apalachicola region? 2) Where should we, as a resource-strapped planning community, focus ecohydrology restoration projects to maximize the efficacy of our work? 3) What parcels are of the greatest concern for conservation? 4) How can collaboration among geographically disparate groups be made more efficient and effective? Unfortunately, barriers to answering these questions are high and pervasive; they include computing as well as staff time and expertise limitations, and expensive software licenses. What could be done to address these challenges? It is important to leverage innovative technologies that will streamline planning and increase impact. In this session, we will explore some of CIC's data and tools that have benefited the Chesapeake Bay cleanup efforts, and how they can be transferred into new geographies like the Apalachicola region with shared challenges.

INTEGRATED RESTORATION PRIORITIZATION: A STRATEGIC TOOL FOR IMPROVING NATURAL SYSTEMS IN THE GREATER TORONTO AREA

***John Stille**, Ralph Toninger, Andrew Ramesbottom and Namrata Shrestha*
Toronto and Region Conservation, Ontario, Canada

Ecosystem restoration planning requires an integrated approach considering many components of the natural system when prioritizing where and what to restore. Toronto and Region Conservation (TRCA) and partners have developed a strategic approach to restoration planning, using the concept of applied science to inform meaningful implementation decisions focusing on priority areas rather than opportunism. Through various long term monitoring and modelling initiatives, TRCA has amassed a wealth of knowledge and data on terrestrial biodiversity, aquatic ecosystems, and hydrology. Consolidating these data sets to compare discrete areas based on different parameters and thresholds have helped direct future restoration initiatives. The Integrated Restoration Prioritization (IRP) framework uses existing data to reflect different restoration goals, ensuring important habitats and corridor linkages are protected, enhanced or rehabilitated. This is achieved by identifying where impairments to ecological function are located and prioritizing upstream and local catchments that could contribute most to improving the existing natural heritage system. The IRP is a multi-benefit, multi-discipline approach to restoration planning, where entire reaches, or catchments, are considered for strategic implementation and monitoring. This approach has proven successful for garnering support through new partnerships and securing funding which has resulted in measurable improvements to the natural system. This presentation will demonstrate how IRP can be used as a tool to successfully achieve different natural resource planning objectives.

PRESENTER BIO: John Stille is Manager of the Restoration Projects team of Toronto And Region Conservation (TRCA) with 20 years of experience planning, designing, and implementing a variety of ecological restoration construction projects. He also has a particular focus on developing strategic restoration planning tools to be used by restoration practitioners. He has extensive experience restoring a variety of habitats including wetlands, streams, forest, meadow and riparian cover types.

POWERFUL PARTNERSHIPS PROMOTE COMMUNITY RESILLIENCE – THE ROLE OF NGOS IN COASTAL LOUISIANA

Leslie Suazo
Ducks Unlimited, Inc, Houma, LA, USA

For Ducks Unlimited (DU), a national organization dedicated to the conservation of critical wetland habitat, the on-going loss of Louisiana's Gulf Coast habitat is one of the greatest crises on the North American continent. This crisis has not only impacted waterfowl, but has had a tremendous impact on Louisiana's coastal communities and its residents, whose lives and livelihoods often depend upon the natural resources so abundant in these wetland habitats. As these available habitats have decreased due to erosion, subsidence, and sea level rise, the ability of communities to withstand and rebound from storm events has been compromised.

Because 75% of Louisiana's coastal area is privately owned, working with landowners to implement conservation projects is crucial to the success of Louisiana's restoration and protection efforts. As a non-governmental organization active in Louisiana's coastal restoration efforts, DU works with landowners, the state and local governments and other organizations to implement projects that restore and enhance high quality waterfowl habitat, while promoting the resilience of human and natural resource communities. These partnerships have been crucial to the success of its restoration efforts in Louisiana.

Ducks Unlimited' s unique collaboration with the ConocoPhillips Company is one example of how a non-governmental organization is able to leverage private resources with federal, state and local funds to implement on – the -ground restoration projects, providing increased habitat for natural resource communities, while providing natural features that reduce the erosive effects of wave action and storm surge.

Through this collaboration, now in its sixth year, DU and ConocoPhillips have utilized several "Living Shoreline" strategies to improve coastal resilience and increase natural capital; creating robust emergent marshes which increase habitat for migratory birds, fish and other wildlife, reduce storm surge and reduce saltwater intrusion.

These projects also support more resilient local economies, creating direct and indirect local jobs. In addition, local economies benefit from increased tourism revenues generated by hunting and fishing revenues, tax revenues, as well as maintaining and possibly increasing property values.

PRESENTER BIO: Leslie Suazo is a political science graduate with a variety of experience in public and private sector roles. She has applied her knowledge of governmental processes to secure funding for a variety of coastal restoration projects and to develop long-term community partnerships that result in positive project outcomes.

RESTORING RIVER ISLAND HABITAT IN THE ATCHAFALAYA RIVER, LA, USING ENGINEERING WITH NATURE PRINCIPLES

Burton C. Suedel[1]*, Christy Foran*[2]*, Jacob Berkowitz*[1] *and Jeff Corbino*[3]

[1]US Army Engineer Research and Development Center, Vicksburg, MS, USA
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[3]US Army Corps of Engineers New Orleans District, New Orleans, LA, USA

The US Army Corps of Engineers (USACE) New Orleans District used dredged material to nourish a sand bar that had naturally formed in the Atchafalaya River, LA. Over a 12-year period, dredged material was placed upriver of the island using shoal material removed from an adjacent Federal navigation channel during routine channel maintenance. The dredged material was dispersed downstream by river currents, thereby nourishing and self-designing the island. This project demonstrates the USACE Engineering With Nature (EWN) initiative, where environmental and other benefits associated with the created habitat are being quantified, enabling more sustainable delivery of economic, social and environmental benefits associated with restoring riverine habitat. Monitoring studies were performed to determine the river hydrology necessary to create the island via transport from dredged material strategically placed upstream. This beneficial use of dredged material has created nearly 100 acres of river island habitat. Ecological surveys of the island identified over 80 species of plants and over 20 faunal species, many native to the region. The benefits being realized by the Horseshoe Bend project communicate returns on investment (i.e., benefits) supporting the implementation of EWN concepts. The creation and development of Horseshoe Bend Island has resulted in the realization of benefits ranging from the existence of additional wildlife habitat to waterborne navigation enhancements. To account for the benefits associated with this strategic placement of dredged material the changes in ecosystem services based on available data were documented: 1) improve the environment or enhance ecosystem sustainability, 2) carbon sequestration, 3) nutrient sequestration, 4) research opportunities, and 5) navigation support and maintenance. These services capture a broad array of benefits associated with implementing EWN through the use of strategic placement of sediment for beneficial use of dredged material. Demonstration of this approach of restoring riverine habitat, and fostering its integration into USACE business practices of project design, helps expand the range of benefits provided through our water resources, coastal, and port infrastructure, which is producing more sustainable projects.

PRESENTER BIO: Dr. Suedel is a research biologist who investigates ways in which environmental enhancements can be incorporated into navigation and port infrastructure planning. He has received international recognition for applying the Engineering With Nature (EWN) initiative in practice to restore habitat at multiple USACE navigation and coastal projects nationwide.

HURRICANES, COASTAL RESTORATION AND CLIMATE FINANCE FOR SMALL ISLAND DEVELOPING STATES: STUDY OF THE BAHAMAS

Kathleen Sullivan Sealey[1]*, and Ray King Burch*[2]
[1]Biology Department, University of Miami, Coral Gables, FL USA
[2]Financial Analyst, Honolulu, HI USA

The Bahamian archipelago is made up of low-lying islands stretching 1200 kilometers in the Tropical Western Atlantic. Hurricanes Joaquin (2015), Matthew (2016) and Irma (2017) represented the worst possible storm scenario with multiple extreme storm events in successive years. These storms inflicted high winds and flooding conditions to the vulnerable southern coast of the most populous island of New Providence, destroyed entire communities on Grand Bahama (2016) and Ragged Island (2017). Much of the damage occurred in poorly developed coastal areas composed of filled wetlands. The lack of any Coastal Zone Management resulted in de-stabilized shorelines, loss of natural resources, and severe property damage. Recovery from the multiple hurricanes will require a focused plan on coastal restoration with improved management of the coastal development. The challenge is identifying the source of financing for coastal restoration and resilient infrastructure.

Rapid coastal land cover change through tourism development has had devastating and costly impacts on coastal ecosystems globally. These ecosystem changes, particularly changes in nutrient or hydrological cycles leading to eutrophication, represent the largest challenges in coastal management and restoration. Why are current mechanisms for financing tourism development largely devoid of any ecological or landscape scale considerations? The financial instruments now employed impact the sustainability of the coastal development, and threaten the long-term viability of tourism projects. Three important trends stand out: 1.) Rapid coastal zone change that is not coupled to revenue generation or population growth; 2) Increase in the island cost of living driven by loss of coastal resources available such as fish and conch, and 3.) Critical losses of wetlands, pollution of wetlands, and loss of essential ecosystem services increase property damage, and financial impacts from storms. All three of these changes have increased island vulnerability to longer-term climate change events (e.g. sea level rise).

At present, we have only a cursory understanding of finance's potentially important role in sustainable development and the restoration, of the natural environment. Understanding the interactions between finance and coastal systems from the standpoint of individual disciplines of social and natural sciences can direct new financial applications specifically to restoration after hurricane events; such conditions are already in place with a growing market in weather derivatives, catastrophe bonds, and carbon markets. More research on the dynamics of the coupled human finance and natural systems is critical, however, for future innovation in climate finance. The key element is to determine the scope and cost of large scale coastal restoration to understand the pricing and uses of these bond applications to finance island recovery.

PRESENTER BIO: Dr. Sullivan Sealey has 30 years' experience in marine and coastal ecology, she directs the UNESCO Ecohydrology Demonstration Project in Great Exuma, The Bahamas, and recently completed hurricane risk models for small islands. She has written ecological finance courses to integrate financial tools into coastal restoration programs.

A FUTURE FOR DATA: AN OVERVIEW OF DATA MANAGEMENT FOR ANALYSIS, DECISION-MAKING AND REUSE

Robert D. Sutter[1,2]*, Brick M. Fevold*[1]*, Craig J. Palmer*[1] *and Judith A. Schofield*[1]
[1]CSRA, Alexandria VA USA
[2]Enduring Conservation Outcomes, Savannah, GA USA

Successful multi-year ecological restoration projects are characterized by data collection with sufficient completeness, quality, and availability and supported by sufficient documentation to allow data analysis and interpretation by different users. Thus, data management is a fundamental component of successful ecological restoration projects. In this presentation, we will provide an operational definition of data management and a framework for understanding its components.

Data management is a formal, structured process that promotes data quality, availability, and preservation of data for analysis, informed decision-making and data reuse. Strategic data management is essential for analysis of data during the life span of a project as well as for resampling and reanalysis at future time periods. Especially significant is that data management ensures that data are available for decision-making, the ultimate purpose of restoration studies.

The key principles of data management are discoverability, accessibility, and usability. Discoverability is the ability of specific pieces of information to be found. Accessibility is the degree to which information is available to staff and secondary users and the ability to access accurate project information and data quickly. Usability is the extent to which information can be used with effectiveness, efficiency and satisfaction. Data must be accurate and sufficiently documented to use and interpret correctly.

In a guidance document being prepared under the EPA's Great Lakes Restoration Initiative on QA/AC for ecological restoration monitoring projects, data management is visualized as a lifecycle having six key phases. These include plan, acquire, process, analyze, preserve, and publish/share. Three activities for data management: describe and document, manage quality, and backup and secure – are conducted throughout the entire data management lifecycle process. The framework assists practitioners in the proactive integration of data management into monitoring studies. All the components of the lifecycle will be described in the presentation.

PRESENTER BIO: Rob Sutter is a conservation ecologist working with CSRA and the principal of Enduring Conservation Outcomes (ECO). Previous to ECO, Rob was an US Regional Scientist with The Nature Conservancy. His professional focus is conservation planning, strategic planning, monitoring and adaptive management, and designing long-term monitoring and research studies.

USING WATER-TEMPERATURE DATA TO DETERMINE GROUNDWATER SEEPAGE TO THE INDIAN RIVER LAGOON, FLORIDA

Eric Swain *and Scott Prinos*
U.S. Geological Survey Caribbean Florida Water Science Center, Davie, FL, USA

The Indian River Lagoon in Martin County, Florida is subject to nutrient loading from both surface-water and groundwater sources. Heat transport was hypothesized to be a surrogate for groundwater flux in the lagoon bed sediment. Time-series of water temperature observations were collected in the lagoon bed at 8 sites in the offshore Eau Gallie area of the Indian River Lagoon using self-contained temperature probes. These data were used to test computational methods to determine groundwater-flux rates based on the varying vertical water-temperature profile within the lagoon bed. Data was collected at one-hour intervals from March 23 to April 28, 2017, and from May 21 to November 3, 2017 at depths ranging from 2 centimeters (cm) above to 14.5 cm below the bed surface.

Two different modeling techniques were applied to the Indian River Lagoon temperature data to determine groundwater seepage rates from temperature profile data. The 1DTempPro program solves groundwater flow and heat-transport equations, and has an optimization method wherein individual parameters including groundwater seepage can be estimated. The other computational model used was VFLUX, which estimates one-dimensional vertical fluid flow in saturated porous media. It has several different solution methods that are based on isolating the fundamental signal in the water-temperature data (usually the diurnal cycle) using a Dynamic Harmonic Regression method, and utilizing the resulting amplitude and phase differences between sensor location in analytic formulations to determine vertical water flux.

The 1DTempPro and VFLUX models were applied to vertical heat-profile measurements recorded at multiple locations in the offshore Eau Gallie area of Indian River Lagoon. The two models indicates similar magnitudes of upward and downward seepage, and patterns of seepage-rate variations at 8 offshore sites, with the magnitudes of seepage for the March 23 to April 28, 2017 period under 10 cm/day. VFLUX had a 2-hour temporal resolution but 1DTempPro is executed independently for every time-step and was only solved for a daily mean seepage. Consequently, more variability was represented In the VFLUX simulation. Substantial net seepages were only represented within 25-35 meters from shore.

The May 21 to November 3, 2017 period contains hydrologically significant events, including Hurricane Irma. The VFLUX simulation of this period shows higher seepage rates, sometimes as great as 40 cm/day, with a large downward flux simulated during the hurricane followed by a reverse upward flux as the rainfall subsequently increased groundwater inflows. Substantial net seepage fluxes into the lagoon are seen more than 60 meters offshore, indicating that the subsurface flow distribution and dynamics differ between this wetter May-November period and the drier March-April period.

PRESENTER BIO: Dr. Swain is a research hydrologist at the Caribbean Florida Water Science Center office in Davie Florida. He has specialized in the development of numerical models of surface-water/groundwater flow as well as statistical analysis of hydrologic parameters and methodology for determining field parameters.

USING SCIENCE TO ENGAGE COMMUNITIES IN RESTORING ALABAMA'S COAST

Roberta A. Swann
Mobile Bay National Estuary Program, Mobile, AL, USA

The Mobile Bay Watershed is over 43,600 square miles and drains most of Alabama and parts of three other states. It comprises many subwatersheds classified numerically by the USGS into Hydrologic Unit Codes, or HUCs. For planning purposes, the EPA prefers a scale of 12-digit HUCs, the smallest scale used by USGS. There are ninety-eight 12-digit HUCs in Alabama's two coastal counties draining into receiving waters like Fowl River, Magnolia River and many others.

Towards developing a five-year ecosystem restoration strategy, MBNEP's Project Implementation Committee (PIC) adopted a protocol of watershed management planning at the 12-digit HUC level to guide science-based restoration actions. The PIC sought community input to prioritize coastal watersheds for comprehensive watershed planning and adopted a sediment analysis, watershed planning and implementation approach toward coastal conservation and restoration, focused primarily on those watersheds or basins with tidal influence. This methodology has provided the State of Alabama with a science-based foundation for investing in coastal restoration using the millions of dollars available resulting from Deepwater Horizon incident.

The requirements for watershed planning for each HUC 12 include capturing environmental issues and challenges, as well as opportunities related to culture and heritage, public access, and critical coastal habitats most threatened by anthropogenic stressors (freshwater wetlands; streams, rivers and riparian buffers; and intertidal marshes and flats); and identify vulnerabilities throughout the watershed from increases in sea level rise, storm surge, temperature and precipitation; and addressing EPA's Nine Key Elements.

Throughout a 12-15 month process, a team of scientists and engineers teaches community members and key stakeholders about how the watershed functions, what the environmental challenges are, which management measures will best address those challenges, and how to engage the community in monitoring watershed protection and restoration progress. By engaging stakeholders in watershed assessments and in developing actions to best achieve plan success, this process elevates a community's ability to participate in local watershed management decisions and provides a catalyst for new ways of collaboratively undertaking environmental restoration. With six watershed management plans actively being implemented, communities across coastal Alabama are learning new ways of achieving environmental protection and are adapting to a new paradigm in resource management- one based on drainage basins and not geopolitical boundaries.

PRESENTER BIO: As director of the Mobile Bay National Estuary Program, Ms. Swann leads a management conference of over 300 governmental, business, industry, academic and community leaders in identifying and undertaking restoration, community capacity building, and policy related initiatives to improve and protect Alabama's coastal resources and ecosystem services.

LINKING THE COASTAL SALINITY INDEX WITH FRESHWATER INFLOWS TO CHARACTERIZE SALINITY IN GULF OF MEXICO ESTUARIES

Christopher M. Swarzenski[1]*, Kirk D. Rodgers*[2]*, and Scott V. Mize*[1]

[1]US Geological Survey, Lower Mississippi Gulf Water Science Center, Baton Rouge, LA, USA

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Estuarine resources and habitat are shaped by the magnitude and variability of salinity in shallow freshwater. The salinity gradient is widely recognized as foundational in maintaining biological diversity and productivity of estuaries. Thus, a clear understanding of the factors controlling the magnitude and variability of salinity in these systems is essential for proper stewardship and long-term sustainability of ecological structure and function. The Coastal Salinity Index (CSI) is a new tool to characterize short and long-term trends in estuarine salinity. The U.S. Geological Survey Lower Mississippi-Gulf Water Science Center assessed the performance of the CSI to characterize trends in salinity in combination with variability in freshwater inflows as part of a funded RESTORE Council project. The long-term goal of this effort is to develop applied tools that will improve our understanding of how short and long-term trends in salinity influence living resources within an estuary.

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EARLY IMPLEMENTATION: LESSONS LEARNED FROM THE TULE RED RESTORATION PROJECT (SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA)

Ramona Swenson[1] *and Rob Capriola*[2]

[1]Environmental Science Associates, Sacramento, CA, USA
[2]Westervelt Ecological Services, Sacramento, CA, USA

The Sacramento-San Joaquin Delta, a highly modified inland river delta and estuarine ecosystem in northern California, supports myriad species including at-risk fishes and migratory waterbirds of the Pacific Flyway. Over 90% of historic tidal wetlands have been lost due to levees and conversion to agriculture or other uses. The California Delta also provides water to support 25 million people and a $45-billion agricultural sector. Agriculture is critical to California's economy, which is the sixth-largest in the world. The State seeks to manage this complex system to meet dual goals of reliable water supply and ecosystem restoration.

The EcoRestore initiative calls for the restoration and enhancement of 30,000 acres of habitat by 2020, primarily floodplain and tidal wetlands in the Sacramento-San Joaquin Delta and adjacent areas in Yolo Bypass and Suisun Marsh. One goal is to enhance productivity of the aquatic foodweb to support and recover listed fishes (Delta Smelt, Longfin Smelt, Chinook Salmon and Steelhead). Many individual projects make up the EcoRestore portfolio. The path from Delta-wide goals to regional priorities, and finally to implementation on the ground involves many challenges. This talk focuses on lessons learned from one project, and how it fits into the overall Delta ecosystem and EcoRestore program.

The Tule Red Tidal Restoration Project will restore and enhance 420 acres of tidal wetlands to benefit listed fishes. The project is a collaboration of the State and Federal Contractors Water Agency, California Department of Fish and Wildlife, and Westervelt Ecological Services. The project will breach the outer levee of a former duck club to allow tidal flows to naturally re-enter the site through newly constructed channels. Breach placement and channel configuration was adjusted, based on hydrologic modeling and expert input, seeking a hydrologic regime hypothesized to optimize primary (phytoplankton, algal) and secondary (zooplankton, benthic invertebrates) productivity. The interior levee will be broadened to create a gradually sloped area that can accommodate rising sea level, as habitat for salt marsh mammal and birds. Navigating the permitting hurdles took time and cooperation among many regulatory agencies, with support from EcoRestore managers. The project will complete interior construction of channels and a gradually sloped habitat levee in 2019, and will breach the levee in 2020. An essential element for long-term management is the Adaptive Management and Monitoring Plan (AMMP), which outlines metrics for evaluating effectiveness, hypotheses to address uncertainties, monitoring methods, and triggers for management responses. The AMMP and ongoing baseline monitoring are coordinated with the Interagency Ecological Program's (IEP) Tidal Wetland Monitoring Project Work Team. The Tule Red project highlights the importance of collaborations among state agencies, public water agencies, private landowners, and scientists to achieve ecosystem restoration.

PRESENTER BIO: Dr. Swenson is ESA's Restoration Ecology Program Manager. She has over 20 years' experience developing strategies for restoration, management and monitoring of wetlands and floodplain ecosystems. She earned a doctorate from the University of California at Berkeley studying the curious sex life of the tidewater goby, an endangered estuarine fish.

COMPARING CADMIUM TOLERANCE IN UNIALGAL AND ASSEMBLAGE EXPOSURES TO ASSESS WHETHER SINGLE-SPECIES EXPOSURES CAN PREDICT IF CADMIUM CONTAMINATION FAVORS HARMFUL ALGAL BLOOMS

Sabrina Tabassum-Tackett *and Paul L. Klerks*
Department of Biology, University of Louisiana at Lafayette, Lafayette, LA, USA

Heavy metals contribute a major part of anthropogenic pollution in marine and estuarine ecosystems. Phytoplankton species are first responders to most forms of metal pollution, and these include harmful algal bloom (HAB) species as well. A shift community shift favoring HABs will have consequences for the entire marine ecosystem. To assess whether Cd pollution is likely to result in a shift in species composition favoring HABs, we are studying the effects of Cd bioaccumulation and resulting toxicological effects in two HAB forming species *Heterosigma akashiwo* and *Akashiwo sanguinea*, and the diatom *Coscinodiscus sp*. Additionally, the study is investigating whether unialgal effects can be used to predict community level shifts, by comparing endpoints obtained from unialgal metal exposures to those obtained from metal exposures in assemblage.

Cultures were maintained in a modified f/2 culture medium without EDTA, at 20 ppt salinity, 18-19 °C, and a 12-12h light-dark cycle. Phytoplankton species were exposed (individually or in an assemblage of the three species) for 21-days to 0, 5, 25, 125, 625, and 3125 µg/L dissolved Cd. Sublethal endpoints measured were: specific growth rate via cell counts, chlorophyll-a pigment concentration, and photosynthetic yield (Fv/Fm). Additionally, cadmium bioaccumulation was quantified using atomic absorption spectroscopy, and a bioconcentration factor (BCF) was calculated. This research will provide insight into how cadmium pollution affects HAB species and the potential effects of metal pollution at a community level. 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. She graduated with B.S. in Microbiology from Marshall University, WV. She is interested anthropogenic pollution in aquatic ecosystems, HABs, and disease ecology, and wants to pursue an interdisciplinary PhD.

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SUSTAINING RESTORED OYSTER REEFS THROUGH CROSS-SECTOR PARTNERSHIPS

Lauren Taneyhill
ERT, Inc. /NOAA, Annapolis, MD USA

The large-scale oyster reef restoration in the Chesapeake Bay watershed has required large-scale resources. The range of environmental, economic and community benefits this major multi-stakeholder investment offers can be enhanced by improving water quality to maintain oyster habitat with suitable dissolved oxygen and limited sedimentation. The NOAA Chesapeake Bay Office coordinates and provides science in support of the oyster reef restoration. However, influencing water quality through land-based best management practices lies outside of the Office's scope. In the interest of supporting oyster habitat, collaborating with restoration stakeholders, and reaching local communities, the NOAA Chesapeake Bay Office utilized the collective impact framework to develop a network of practitioners within the Choptank Complex –first site of the large-scale oyster reef restoration.

The collaborative network of partners includes local citizens, local and regional nonprofits, and municipal, county, state and federal government agencies. With different but overlapping interests, the partnership is capable as a collective of implementing a systems approach to restoration. A systems approach, which affects multiple elements of the watershed from upstream to downstream, has the potential to provide multiple ecosystem improvements, including enhanced oyster habitat to sustain the restored reefs and compound the benefits reefs can provide through ecosystem services.

The collective impact framework recommends 5 core elements to forming successful collaborative partnerships – a backbone team to manage the group, consistent communication with partners, mutually reinforcing activities (each organization contributes their strengths to build collective capacity), a common agenda to keep partners moving toward the same goals, and common measures of progress. In this case, the NOAA Chesapeake Bay Office served as the backbone team, along with a third party facilitator, and catalyzed the formation of the collaborative as a dedicated support team. The facilitator provided consistent, unbiased communication by bringing the partners together in-person once per month over the course of 2+ years. As partners learned from each other, connected over common experiences and interests, found a sense of community in each other, and felt the impact of extra capacity created by the collective, a steering committee was born. United at the nexus of water quality, oysters, and habitat, the steering committee was successfully awarded a competitive grant to implement their first collaborative restoration project for the Choptank watershed – implementing water quality best management practices on agricultural and residential lands in support of restored oyster reefs the public oyster fishery. Taking early action on collaborative energy for a restoration project was key to sealing the formation of the cross-sector partnership, as is continued patience in formalizing a common agenda that is truly reflective of restoration stakeholder *and* community member priorities.

PRESENTER BIO: Ms. Taneyhill is an outreach specialist at ERT, Inc., contracting for NOAA as a strategic partnerships analyst and coordinator of the Choptank Complex Habitat Focus Area. She has nearly 10 years of experience in outreach, policy, and stakeholder coordination in relation to a range of challenges facing the Chesapeake Bay.

SEED COATING TECHNOLOGIES THAT REDUCE RODENT GRANIVORY DURING RANGLEAND RESEEDING

Justin Blake Taylor[1]*, Sam St. Clair*[1]*, Matt Madsen*[1]*, and Dean Pearson*[2]

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[2]University of Montana, Missoula, MT, USA

Reseeding is often the most cost-effective way to restore damaged landscapes, but in many ecosystems biotic and abiotic factors limit the success of seeding efforts. Consumption of seeds by rodents and other granivores has been identified as a limiting factor in the survival of seeds in many ecosystems. The Great Basin is one such ecosystem where rodent granivory has been shown to effect non-native plant invasions, and limit the survival of Native seed, making restoration efforts difficult. Seed coating technologies may hold the key to increasing restoration success by covering seeds with rodent deterrents that make planted seeds a less desirable food source and increasing seed survival. We tested a number of non-toxic plant-based compounds with known rodent repellant properties to see if they would be a viable option for application in wildland restoration. These compounds either had abrasive tastes such as ghost pepper powder, or irritating aromas such as pine oil. We also investigated coatings that limited rodent's ability to smell seeds. Rodents forage for seed primarily with their olfactory senses. Coating seeds with compounds such as activated carbon can absorb the natural smells emitted by the seed, allowing the seed to remain undetected until it can germinate.

PRESENTER BIO: Justin Taylor is a master's student at Brigham Young University studying Wildlife and Wildlands Conservation. He has six years of experience working in the Great Basin, Mojave Desert, and Montane ecosystems. His research interests include post-disturbance ecology, herbivore impacts, and plant succession. He is seeking a career in academics and hopes to one day conduct his research in the international sphere.

COASTAL RESTORATION ON LONG ISLAND: ASSESSING THE NITROGEN PROBLEM

Mary Anne Taylor
Vice President, CDM Smith, Woodbury, NY, USA

The impacts of nitrogen on Suffolk County's water resources have been studied for decades. Suffolk County's surface waters receive much of their fresh baseflow from groundwater, which can also carry a significant nitrogen load. As part of the Long Island Nitrogen Action Plan (LINAP) Suffolk County has developed a first-order quantification of the nitrogen loads introduced to their sole source aquifer system and transported to surface waters via groundwater baseflow. With approximately 360,000 unsewered residences and nearly 1,000 miles of coastline, the County is addressing nitrogen impacts to groundwater and surface water quality in a comprehensive, coordinated approach.

Understanding that it may take years, decades, or even centuries in some cases for nitrogen introduced at the water table to travel through the aquifer system to discharge – either at a public supply well or to a downgradient surface water body, three-dimensional computer models were used to synthesize the factors affecting groundwater flow, nitrogen loading and nitrogen transport. The initial quantification of nitrogen loads and three-dimensional simulation of nitrogen transport through the aquifer system helped to provide a better understanding of the relationships between nitrogen loads introduced at the water table, downgradient nitrogen concentrations in the aquifer and the nitrogen loads conveyed to ponds, streams and coastal surface waters via groundwater baseflow.

Existing models were updated and used to:

- Define the groundwater contributing area (subwatershed) to 191 individual surface water bodies;
- Estimate parcel-specific nitrogen loads introduced by sanitary wastewater, fertilizer, pet waste and atmospheric deposition, based on current conditions of land use and wastewater management;
- Based on the simulated equilibrium nitrogen concentrations in the aquifer, provide an initial approximation of the nitrogen load discharged to each surface water via groundwater baseflow;
- Estimate changes to nitrogen loads anticipated to result from future development.

Simulated nitrogen load, residence time, and key water quality indicators characterizing dissolved oxygen levels, nutrient concentrations, water clarity, chlorophyll 'a' and the presence of harmful algal blooms were used to rank the subwatersheds to establish the priority for nitrogen reduction via management of on-site wastewater systems and first order nitrogen reduction goals to restore water quality and achieve ecosystem recovery.

PRESENTER BIO: Mary Anne Taylor is a Professional Engineer with over thirty years of experience using computer models to better understand and manage ground and surface waters and managing large multi-disciplinary water resources, water management and wastewater projects.

BUILDING ECOLOGICAL AND COMMUNITY RESILIENCE AND MEASURING SUCCESS OF THE DEPARTMENT OF INTERIOR SANDY RESILIENCE AND MONITORING PROJECTS

Susan Taylor[1]*, Stacey Worman*[1]*, Rick Bennett*[2]*, Pete Murdoch*[3] *and Amanda Bassow*[4]

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The Department of the Interior (DOI) partnered with the National Fish and Wildlife Foundation (NFWF) to administer an external funding competition to support coastal resilience projects in the region affected by Hurricane Sandy. The projects complement the DOI Bureau-led projects, but are led by state and local governments, universities, non-profits, community groups, tribes, and other non-Federal entities. In total, the Hurricane Sandy Resilience Program invested over $350 million in approximately 180 projects to repair damage and improve the resilience of habitats, communities and infrastructure to future storms and sea level rise. Project activities include dam removals for fish passage and flood risk reduction, living shoreline, marsh restoration using thin layer deposition and water control structures, community resilience planning for shovel ready projects, data/mapping/modeling, beach and dune restoration, and sand resource assessments by states along the east coast.

DOI and NFWF initiated a resilience assessment in 2015 to evaluate the impact of this investment. The assessment began by clarifying the program's resilience goals and the development of ecological and socio-economic metrics across the project activities. An evaluation was conducted from Summer 2016 to April 2018 to assess the ecological and community outcomes and contributions to resilience, cost effectiveness of activities, improved scientific understanding, lessons learned and temporal and spatial scaling of benefits across resilience activities. Recognizing the unique opportunity afforded by the scale and distribution of projects, NFWF and DOI invested additional funds in monitoring through 2024 to better understand how these projects perform over time. This presentation will describe the evaluation approach and findings, including contributions to resilience and trajectories by project types, key programmatic and project (type) lessons, portfolio-scale impacts and outreach approaches. The long-term monitoring will also be described, specifically focusing on the approach to collect core ecological and socio-economic metrics, the established reporting framework and online metrics portal, and dissemination and relevance to other resilience projects, developing resilience performance guidance and use of the portal. This data repository and portfolio is the key to further assessment of the Sandy Resilience Program, ensures accountability of the Sandy program and demonstration, provides a mechanism for standardized PI reporting and further advances understanding of and improvement of coastal resilience project outcomes.

PRESENTER BIO: Dr. Taylor is an environmental engineer who conducts analytical and numerical modeling to emerging areas of research at the Earth's surface as well as rigorous programmatic and benefit evaluations. Much of her work has focused on the design and biophysical effects of natural infrastructure techniques, and how implementation of these practices can support community resilience.

PROJECT PLANNING TOOLS TO IMPROVE DATA QUALITY

Justin W. Telech[2]*, Louis J. Blume*[1]*, Craig J. Palmer*[2]*, Adam S. Bucher*[2]*, Molly M. Amos*[2]
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As with any project, preparation alone cannot guarantee success; however, advanced planning can help to minimize the chance of complications from occurring, while increasing the likelihood of achieving success. When it comes to ecological restoration projects involving environmental data collection, proper quality assurance (QA) and quality control (QC) planning can help to improve data quality, which can save time and money from potential rework, and support the ability to meet the data quality needs of the project. A lack of planning can lead to data quality issues related to, for example, improperly trained field crews, faulty field equipment, or incorrect sampling methods, which can ultimately increase the chances of incorrectly concluding whether a project was successful or not.

The U.S. Environmental Protection Agency's approach for QA/QC planning is to develop a QA Project Plan (QAPP), which is a project-level document that clearly identifies the QA and QC procedures planned to assist in providing reliable, scientifically sound data that are transparent and reproducible. Resources are available to assist project managers in QAPP development; however, ecological restoration projects present unique challenges in QA/QC planning. To address these challenges, a template and checklist have been developed as appendices to U.S. EPA's *Application of Quality Assurance and Quality Principles to Ecological Restoration Project Monitoring.* The template is designed to make documenting project-specific QA/QC strategies in a QAPP easier. It reflects recommendations provided throughout this main guidance document, and it includes cross-references to specific locations in the main guidance document where each topic is addressed. The checklist is designed to facilitate the review of such plans, but can also be useful as a final check for project managers. Both comply with *EPA Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003), but are tailored to better fit the needs of ecological restoration projects.

This presentation will (1) review the components of the template and checklist and how these tools can help project managers in QAPP development, and (2) discuss certain QA/QC topics addressed by these tools which are critical to data quality, yet tend to be difficult to properly plan for and document.

PRESENTER BIO: Justin Telech is an Environmental Scientist at GDIT with over 10 years of experience providing GIS, statistical, and QA support to the U.S. EPA. He has extensive experience in QA documentation review and development, and has created many helpful tools to streamline these tasks.

DECISION FRAMEWORK FOR UPLAND HARDWOOD AND GRASSLAND RESTORATION MONITORING: INTEGRATING INNOVATIVE SPATIAL TECHNOLOGIES

H. Theel[1], *M. Reif*[2], *N. Beane*[1], *J. Hinck*[3], *K. Grabner*[3], *K. Skrabis*[4], *S. Hammond*[1], *C. Saltus*[1], *E. Stroh*[3]

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[4]U.S. Department of the Interior, Washington, DC, USA

Restoration monitoring is generally perceived as costly and time-consuming, given the assumptions of successfully restoring ecological functions and services of a particular ecosystem or habitat. In addition, the concept of universal restoration monitoring metrics is trending, especially for evaluating restoration performance across various spatial scales, project boundaries and jurisdictional responsibilities. Therefore, a multi-agency team (U.S. Army Engineer Research and Development Center (ERDC), U.S. Department of the Interior (DOI), U.S. Geological Survey (USGS), and U.S. Fish and Wildlife Service (USFWS)), in partnership with U.S. Department of Energy's (DOE) Fernald Preserve, developed and field-tested a multi-tiered monitoring framework, illustrating a range of field and remote sensing techniques, from coarse and freely-available data to more resolute, higher-cost data collection alternatives (e.g. spaceborne, airborne, unmanned aircraft systems (UAS)). The project and supporting field campaign offer a unique, yet rare, opportunity to acquire and evaluate simultaneously collected, multi-scale/multi-platform data, providing critical value and new insights to assist with planning, implementing, and monitoring restoration progress and effectiveness. Additionally, we compared labor required to execute each tier of the framework, providing cost documentation for planning purposes. Though the aim is to inform monitoring and management of restored areas that had been injured, it is recognized that the methods therein could also be used to inform restoration monitoring practices in a broader context, benefiting the environmental stewardship mission of all project partners. As such, the project seeks to develop standardized monitoring methods, endpoints, and metrics to assist with restoration initiatives with reliable and defensible outcomes that may be used in restoration initiatives.

PRESENTER BIO: Ms. Theel is a Research Biologist in the Environmental Risk Assessment Branch of the Environmental Laboratory located in Vicksburg, MS. She currently manages ERDC's Natural Resource Damage Assessment and Restoration Science Network (NSN), focusing on the ecological impacts of physical and chemical stressors to natural resources as well as restoration of degraded habitats.

NATIVE PLANT SOLUTIONS FOR COASTAL RESTORATION ALONG THE GULF COAST

Garret Thomassie *and Curt J. Riche'*
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.

BRUNSWICK TOWN/ FORT ANDERSON – A LIVING SHORELINE ALTERNATIVE

Randy Boyd[1], ***Phillip Todd***[2]
[1]Atlantic ReefMaker, Wilmington, NC, USA
[2]North State Environmental, Winston Salem, NC, USA

Brunswick Town/ Fort Anderson (BTFA) is a state of North Carolina historical site. The BTFA historic site continues to experience rapid shoreline erosion from constant tide forces and dynamic wave action. The NCDCR seeks to halt the shoreline erosion in order to prevent additional buried colonial-era wharf destruction, the undermining of Civil War-era batteries and three other colonial era wharf sites.

The Cape Fear River was deepened and widened in 2006 to promote harbor development and maritime commercial ship access to Wilmington, NC. Erosion on the banks of BTFA was first noted in 2008, and, in 2012, the NCDCR attempted to arrest the shoreline erosion. The initial attempt failed, and the NCDCR struggled to protect these sensitive and historically significant resources from the high energy wave environment that it abutted.

North State Environmental identified the Atlantic ReefMaker (ARM) as a potential solution as it had been used successfully on the Gulf of Mexico to stabilize shorelines in high energy wave environments. The ReefMaker design was modified for the Atlantic coastal environment. In summer 2017, Phase I was implemented involving 220’ of ARM along the highest eroded area of BTFA site. Phase II of the project (240’) is scheduled to begin in April 2018.

This presentation describes past stabilization methods of the historic site, documents why the ARM was the best solution for the BTFA site in place of a rock sill, describes the monitoring of the ARM and adjustments made in Phase I in preparation for Phase II.

PRESENTER BIO: Phillip Todd is a project development coordinator at North State Environmental with over 24 years in the environmental industry. He has extensive experience in natural resources, environmental permitting, mitigation feasibility studies, mitigation planning, stream restoration, wetland restoration, stream restoration construction and wetland restoration construction.

ECOSYSTEM RESTORATION VIA REESTABLISHING HISTORICAL TIDAL PATTERNS

David A. Tomasko
Environmental Science Associates, Tampa FL, USA

Various estuaries worldwide have shown signs of significant improvement in water quality and ecosystem health after initiating steps to reduce the impacts of cultural eutrophication via reducing point and non-point source nutrient loads. Studies in Australia, the Netherlands and at multiple locations in the USA have shown that acting on nutrient loads can result in wide-scale ecosystem restoration. However, for urbanized estuaries in particular, cultural eutrophication is typically not the only stressor impacting these local waters.

In the San Juan Bay estuarine complex in Puerto Rico, the loss of tidal connections between San Juan Bay proper and San José Lagoon has resulted in reduced flushing of the lagoon, which has allowed for the development of bottom water hypoxia due to salinity stratification. The reestablishment of the historical tidal connection between the bay and the lagoon is expected to increase flushing, reduce salinity stratification, and thus reduce bottom water hypoxia throughout 700 acres of San José Lagoon.
In the Florida Keys, the removal of the 100-year old causeway across Lake Surprise, a marine embayment in Key Largo, was completed in 2009. Results from a Before and After, Control and Impact (BACI) monitoring program determined that the removal of the causeway improved water quality by reducing hypersalinity and levels of phosphorus, the limiting nutrient in eastern Florida Bay. Benefits were expressed across and area in excess of 300 acres.

In southern Tampa Bay, the reestablishment of historical tidal connections north of Mullet Key was determined by NOAA to have improved the health of seagrass meadows in an area of approximately 1,000 acres. In the northern portion of Tampa Bay, the replacement of a portion of an 80-year old causeway with a bridge is anticipated to commence construction in fall of 2018. This particular project is intended to address the major impacts to seagrass meadows in that part of the bay - artificially low and excessively variable salinities. A summary of the body of work involved in the diagnosis of the problems, and the recommended remedies to address these problems will be presented.

PRESENTER BIO: Dr. Tomasko is a senior scientist with more than 30 years of experience in the diagnosis of water quality and ecosystem health. His diagnostic studies have led to the design and implementation of ecosystem restoration projects in Florida, Virginia, California, the Caribbean Basin, and the Middle East.

UTILIZING COLLABORTIVE REGIONAL BASED PRIORITIZATION TO GARNER SUPPORT AND FUNDING FOR RESTORATION IMPLEMENTATION PROGRAMING

***Ralph Toninger**, John Stille, Andrew Ramesbottom*
Toronto and Region Conservation, Ontario, Canada

Toronto and Region Conservation uses a collaborative approach to strategize restoration planning based on targeting multiple objectives to achieve cumulative benefits to the natural system. This is critical to fostering support for restoration initiatives especially at a regional programming scale. Discrete natural areas and connected systems are identified against associated threats and environmental health monitoring with the goal of prioritizing restoration based on ecological function and natural capital resiliency with a particular focus on human induced pressures and the impacts of climate change. Fundamental restoration objectives are based on improving impaired hydrologic processes; increasing and enhancing natural cover; maximizing connectivity between natural heritage features; and restoring soils and soil processes. Strategic restoration prioritization tools are based on assessing the degree to which the above objectives can be achieved through direct intervention. The collaborative development of decision support tools to be used for a variety of ecosystem and land management decisions is the best way to align multi-stakeholders towards a common goal. Baseline metrics for prioritization can be refined with additional information layers that reflect multi-agency objectives at a regional scale. Combining fundamental restoration objectives with regional priorities can be used to facilitate strategic decisions regarding restoration that will have the greatest benefit to overall ecosystem health. This discussion will outline how such outputs can be utilized to develop partnership opportunities towards innovative resource management planning that direct restoration action and significant natural area gains.

PRESENTER BIO: Ralph Toninger is Associate Director of the Resource Management Projects team of Toronto and Region Conservation (TRCA) with over 20 years of experience planning, designing, and implementing a variety of ecological restoration and land management projects. He has extensive experience restoring a variety of habitats including wetlands, streams, forest, coastal, and riparian cover types.

RISK INFORMED DECISION MAKING IN AQUATIC ECOSYSTEM RESTORATION PROJECT PLANNING FOR THE US ARMY CORPS OF ENGINEERS

Jeff Trulick
U.S. Army Corps of Engineers Headquarters, Washington, D.C., USA

Risk Management and Risk Informed Decision Making (RIDM) is transforming the way that the U.S. Army Corps of Engineers makes enterprise-level as well as project-level decisions. Rather than focusing on water resource studies which produce and consume volumes of data, risk management is allowing the Corps to make decisions faster and with a lower study cost. Although not applicable to only aquatic ecosystem restoration projects, this new paradigm can present unique questions and needs when conducting a planning study for a restoration project.

This presentation will bring a national-level perspective to the impact of risk-informed decision making and will highlight the challenges and opportunities we've seen from around the US. It will also present hurdles to clear as we move forward to executing RIDM across the restoration mission.

PRESENTER BIO: Mr. Trulick is a Senior Policy Reviewer with the US Army Corps of Engineers, where he conducts water policy reviews on major planning reports from across the country. Prior to joining HQ, Jeff worked in the Regulatory Program as well as the Civil Works Planning program in Baltimore District as well as spending time working for Jacksonville District on various South Florida restoration projects. Jeff has also worked for three regional teams at Corps HQ.

RESULTS-ORIENTED GRAZING FOR ECOLOGICAL RESILIENCE: A CASE EXAMPLE OF CO-PRODUCING CONSERVATION-BASED OUTCOMES ON WORKING LANDS IN THE GREAT BASIN

John C. Tull
U.S. Fish and Wildlife Service, Reno, NV USA

The Results-Oriented Grazing for Ecological Resilience (R.O.G.E.R.) group was formed in 2016 out of a need to develop and improve relationships among agency staff and ranchers and to find effective and compatible solutions to range management and fish and wildlife habitat issues across the Great Basin. The purpose was to collaborate among ranchers and agencies to achieve land management objectives that conserve sagebrush ecosystems and support ranching. This purpose will be achieved through a process that includes: 1) developing a shared vision of on-the-ground conditions; 2) creating a common understanding of what it will take to achieve those outcomes; 3) identifying ways to provide ranchers needed flexibility on the ground; 4) documenting and sharing successes, failures, and lessons learned with this group and others.

The group vision is to seek opportunities to implement on-the-ground results that support greater sage-grouse and the sagebrush ecosystem while maintaining the economic viability of livestock operations. This is a positive and proactive public/private network that continues to meet, communicate, and build relationships while constructively engaging on issues, seeking agreement on problems and opportunities, and sharing experiences and lessons learned with others.

The group convenes quarterly to create a venue to bring various parties together to communicate, share information, ask the hard questions, struggle through disagreements, and learn in order to develop solutions to the problems at hand. The group functions as an information, learning and communication venue that supports individuals or groups of individuals experimenting in different ways.

The R.O.G.E.R. group is a work in progress to effectively demonstrate restoration success on the landscape, though tremendous progress has been made on the human dimensions front. The initial driver for this collaborative was a common desire to improve wildlife habitats while also improving management flexibility for ranchers operating under grazing permits on public lands because the status quo was simply not achieving desired results. This was further reinforced through land use planning that elevated sage-grouse habitats in land use decision making that had the potential to further constrain operational activities for ranchers.

Affecting conservation change in the Great Basin high desert, not unlike other landscapes, requires considerable time. Importantly, building trust and co-produced outcomes in a matrix of public and private lands is also a process that requires time. Progress to date on the successes and lessons learned will be shared in this presentation, including insights on group process, the challenge of western lands management, and the path ahead to achieve the vision of this broad stakeholder driven collaborative to build landscape-scale conservation successes.

PRESENTER BIO: Dr. Tull is a conservation biologist with the U.S. Fish and Wildlife Service. He has extensive experience in building and participating in collaboratives with broad stakeholder representation tackling challenging objectives. He has been working on landscape-scale conservation in the Great Basin for nearly 20 years.

THE ROLE OF INDEPENDENT SCIENCE REVIEW IN ADAPTIVE MANAGEMENT OF THE COLORADO RIVER IN GRAND CANYON

Scott VanderKooi
U.S. Geological Survey, Flagstaff, AZ, USA

The Glen Canyon Dam Adaptive Management Program, a federal advisory committee comprised of 25 stakeholder groups, makes recommendations to the Secretary of Interior regarding the effects of dam operations on Colorado River resources in Glen and Grand Canyons. In addition, the program advises the Secretary on implementation of management actions designed to protect natural resources in the Colorado River ecosystem downstream of Glen Canyon Dam and the execution of large-scale experiments to reduce uncertainty and test hypotheses in support of the ongoing adaptive management process. Key resources include the endangered humpback chub and other native fishes, nonnative sport fish like rainbow trout, the aquatic food base, sediment and sand bars, cultural resources, recreational opportunities, and hydropower. The program's research and monitoring efforts are overseen by the US Geological Survey's Grand Canyon Monitoring and Research Center. Monitoring activities provide information on resource status and trends while research is directed at achieving various goals such as furthering understanding of physical and ecological processes and minimizing or resolving key areas of uncertainty.

Independent science review was identified as a key element of science support for the Glen Canyon Dam Adaptive Management Program in the 1996 Environmental Impact Statement which established the program's organizational structure. Independent review panels were to periodically review specific monitoring and research programs and to make recommendations "regarding monitoring, priorities, integration, and management." In practice, independent science review has primarily been conducted by an external board, known as the "Science Advisors", established in 2001 and through Protocol Evaluation Panels. In their operating protocols, the Science Advisors were tasked to "provide independent scientific oversight and technical advice to ensure that the science programs are efficient, unbiased, objective, and scientifically sound." Protocol Evaluation Panels are periodically convened to assess the quality, comprehensiveness, and need for various research and monitoring programs and provide recommendations regarding long-term monitoring protocols, best practices, and program direction. Independent science reviews have provided valuable feedback and input to the science program in a number of areas including the development of annual and multi-year research and monitoring work plans, the design of ecosystem-scale experiments, and the implementation of improved methods for monitoring key resources like sand bars, native and nonnative fishes, and the aquatic foodbase.

PRESENTER BIO: Mr. VanderKooi is a Supervisory Biologist and Chief of the USGS Grand Canyon Monitoring and Research Center. He has been studying salmonids, catostomids and cyprinids in the western U.S. since 1991 and has extensive experience with endangered species and applied science and adaptive management in support of resource management.

USE OF INDEPENDENT SCIENCE REVIEW TO IMPROVE SCIENCE AND COLLABORATION DURING DEVELOPMENT AND IMPLEMENTATION OF ADAPTIVE MANAGEMENT ON THE MISSOURI RIVER

Joe Bonneau Presented by: ***Tiffany Vanosdall***
U.S. Army Corps of Engineers, Yankton, SD, USA

The U.S. Army Corps of Engineers (USACE), in collaboration with the U.S. Fish and Wildlife Service and a large stakeholder group, the Missouri River Recovery Implementation Committee (MRRIC), has embarked on the development and implementation of a comprehensive and collaborative adaptive management process aimed at guiding the Missouri River Recovery Program, a program focused on guiding USACE actions to meet Endangered Species Act requirements. Not only does the development of this adaptive management process stem from previous independent reviews of the MRRP, the continued use of independent review is a critical component to program success. Although the MRRP benefits from several types of review such as USACE-required District Quality Control reviews, Agency Technical Reviews, and Independent External Peer Reviews, the focus of this presentation is the use of a multidisciplinary Independent Science Advisory Panel (ISAP) to aid in the development and implementation of a collaborative AM process for the MRRP. The ISAP has provided guidance on several aspects of the MRRP including development of the Science and Adaptive Management Plan, a rigorous Effects Analysis, monitoring plans, research prioritization, and processes for incorporating new information. These reviews occurred in several forms and were instrumental in development of a programmatic EIS and Biological Assessment outlining USACE's proposed action to meet Endangered Species Act requirements. The ensuing draft Biological Opinion from the USFWS was also reviewed by the ISAP. Stakeholders and agency staff collaborated on identifying and prioritizing review topics and then in discussing, responding to, and incorporating review results as appropriate. The increased scientific rigor, program credibility, and stakeholder trust afforded by systematic and transparent independent reviews have been instrumental in progress to date and will remain paramount for ongoing program success and stakeholder support. Future roles of the ISAP will evolve as the MRRP needs evolve, likely including changing composition of ISAP disciplines to meet changing needs.

SOIL BIOGEOCHEMISTRY RESPONSE FOLLOWING THIN LAYER PLACEMENT IN A NEW JERSEY SALT MARSH

Christine M. VanZomeren[1], *Jacob F. Berkowitz*[1], *John R. White*[2], *and Candice D. Piercy*[1]

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There has been recent interest in wetland restoration utilizing thin layer sediment applications to combat subsidence and erosion associated with rising sea level and improve coastal resiliency. The current study evaluated the effects of a thin layer of sediment application to a degrading and fragmenting coastal marsh in New Jersey. Degraded and open water areas contained higher dissolved organic carbon and extractable ammonium prior to restoration, suggesting a shift in nutrient export between vegetated and degraded open water areas. Sediment additions resulted in placement thicknesses of 5-19 cm in vegetated marsh areas and 32-82 cm in open water areas. The applied sediment and buried marsh soils were evaluated for biogeochemical parameters after six months and 18 months. Surface bulk densities and active microbial cycling increased in buried soils after six months suggesting favorable physical (e.g., stabilization of the marsh surface) and chemical (e.g., available labile nutrients) changes occurred following restoration efforts. Short term biogeochemical responses suggest thin layer placement techniques may provide additional restoration benefits including the maintenance of the following: microbial communities, native vegetation seed sources, and rhizome community conditions compared to other restoration strategies. Soil biogeochemical processes, although frequently overlooked, respond rapidly to changing environmental conditions providing insight into restoration success for multiple microbial-driven ecosystem services particularly during the first two years following marsh restoration.

PRESENTER BIO: Dr. VanZomeren is a research ecologist with five years of experience in wetland restoration and creation. She has extensive experience with wetland research and has led more than five wetland restoration projects focused on wetland soil biogeochemistry.

IMPLEMENTATION OF LARGE-SCALE RIVER DIVERSIONS: A REGULATORY AGENCY'S PERSPECTIVE

*Brad L. Inman[1], **Jeffrey Varisco**[1], Mel Landry[2], Brad Barth[3], Eddy Carter[4]*

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This presentation will focus on the United States Army Corps Engineers' (USACE) role in the development, design, and decisions of the Mid-Barataria Sediment Diversion (MBSD) from a regulatory agency perspective. The MBSD project is a proposed 75,000 cfs sediment diversion that would bisect both USACE's Mississippi River Levees as well as the in-design New Orleans to Venice levee near Alliance, LA, approximately at river mile 60.7 and then connect to the Barataria Bay basin. While there are many expected benefits from the project, there are also a number of potential issues arising from operation of the diversion such as impacts to fisheries and oyster reefs. Due to the potential for significant effects in the Barataria Basin, an Environmental Impact Statement (EIS) is being developed to disclose all relevant environmental information to the public and to inform USACE's decision making for both Section 10/404 permits, as well as Section 408 permissions for those features of the State's project that have an impact on federally authorized USACE projects.

This will also highlight the key challenges involved with integrating USACE regulatory procedures in drafting the EIS with the potential funding arm of the project, the Trustee Implementation Group for Louisiana (LA TIG) as part of the BP Deepwater Horizon Oil Spill. The LA TIG proposes to use the EIS as part of their decision to fund the construction of the MBSD project. Many of the needs expressed by the LA TIG are not necessarily aligned with needs USACE may need for a complete EIS, but all parties have recognized the vital importance of delivering an 'all for one' EIS rather than development of many individual EISs that may not be congruent if accomplished separately.

Finally, this presentation will focus on the unique aspects of MBSD within USACE. It is the first project in the history of USACE has been added to the Federal Permitting Dashboard as part of the Fixing America's Surface and Transportation Act (commonly known as FAST-41) as a lead federal agency. In this role, USACE is responsible for coordinating across a number of federal and state agencies to deliver a coordinated project plan that clearly and reliably demonstrates regulatory timeframes and encourages efficient communication among all parties. This also requires quarterly updates to the permitting dashboard that must be agreed to by all parties on the timeline. MBSD has signed two Memorandums of Understanding as part of the FAST 41 process, one with the federal cooperators only, and another recently signed in January 2018 that formalizes the State's role as an applicant and as a proponent of the MBSD project.

PRESENTER BIO: Jeff Varisco is a project manager for USACE at the New Orleans District. He has 9 years of project management experience in civil works, regulatory, emergency management, and coastal restoration. He is a geographer by degree and a runner by choice.

ARE SEED COLLECTION ZONES NEEDED FOR SOURCING PLANT MATERIALS IN LONGLEAF PINE ECOSYSTEM RESTORATION?

Joan L. Walker[1]*, Anthony Savereno*[2]*, Saara Dewalt*[3]*, Jason Joines*[3]*, Shawna Reid*[1]*, and George Hernandez*[4]

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Native species are often sown or planted in ecological restoration projects, but successful establishment and persistence depend on the plant material provenance. The most reliable approach for seed sourcing may be to collect from nearby sites that match the restoration project site. This approach can work for small scale projects, but be limited by the availability of suitable sites. The development of "seed zones" provides alternative guidance for seed sourcing. Seed collection and deployment zones represent areas within which seed can be collected and sown and reasonably expected to survive. Seed zones for commercial tree species have been in used for decades, and more recently seed zones have been developed for selected shrubs and forbs. Widely accepted zones are based on the assumption that climate controls species distributions, and incorporate measures of temperature and precipitation. More recent mapping efforts incorporate ecoregions to account for ecological variation within areas of uniform climate. Though a model for generalized provisional seed zones for native plants has been proposed (Bower et al. 2014 Ecol. App.), its applicability has not been tested in eastern ecosystems. The longleaf pine ecosystem is especially interesting in this regard. This system is recognized for high numbers of narrow endemics, with groups of co-occurring endemic species forming distinct centers of endemism. The conditions that resulted in speciation and proliferation of narrow endemics may also represent conditions that produced geographically patterned variation in widely distributed species. Incorporating biogeographic patterns in the development of seed zones would produce zones that differ from the provisional zones. We report on the results of a common garden study common garden study designed to evaluate variation among populations of selected species that occur across much of the range of longleaf pine.

We studied functional traits of *Aristida stricta* and *A. beyrichiana*, *Solidago odora*, *Tephrosia virginiana*, and *Lespedeza capitata* exhibited in 10-14 populations growing in a common garden in Columbia, SC. The populations represent sites from the middle and south Atlantic coastal plains and fall-line sandhills. We also evaluated the genetic variation of three species growing in the garden, plus additional collections of *T. virginiana* from throughout the longleaf pine range. Patterns of variation among populations depend on the species and the traits. For example, growth and flowering phenology differed from norther and southern collections of *S. odora*, but not of others. Reproductive effort and the dependence on fire for flowering differed between northern and southern wiregrass populations. We discuss results in the context of the need for seed zones for longleaf pine ecosystem restoration in a changing world.

PRESENTER BIO: Dr. Walker is a research ecologist with more than 30 years of experience conducting research to inform longleaf pine ecosystem restoration and management. She has studied problems ranging from understanding factors influencing herbaceous communities and the role of fire in seed production, to developing silvicultural practices for restoration.

MONITORING AND MODELING OF WAVE AND CURRENT ENERGY REDUCTION BY LIVING SHORELINE STRUCTURES IN GANDY'S BEACH, NEW JERSEY

Hongqing Wang[1]*, Q. Jim Chen*[2]*, William Capurso*[3]*, Lukasz Niemoczynski* [4]*, Kelin Hu*[2]*, Gregg Snedden*[1] *and Moses Katkowski*[5]

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Living shoreline projects utilize a variety of structural and organic material such as oyster reefs, wetland plants, and submerged aquatic vegetation to stabilize shorelines and protect coastal marshes from erosion. The success of living shoreline restoration projects in response to hurricanes, Nor'easters and coastal storms requires a better understanding of how the living shoreline restorations reduce the impact of wave energy and storm-tide flood inundation on marsh edges in estuaries and bays. In Gandy's Beach along the New Jersey side of the Delaware Bay approximately 1 km of living shoreline and breakwater using oyster castles, shell bags, and Coir biologs were constructed and managed by US Fish and Wildlife Service (USFWS) and The Nature Conservancy (TNC) after Hurricane Sandy to restore salt marsh and adjacent uplands and improve the ability of the site to withstand storm-tide inundation and coastal erosion. U.S. Geological Survey (USGS) and the Northeastern University, in collaboration with US Fish and Wildlife Service (USFWS) and The Nature Conservancy (TNC), conducted field measurements of waves, currents, and sedimentation at multiple locations protected by the living shoreline structures and at controlled locations without structures during two winter months in February – March 2018. Wave characteristics (wave height and wave period) were measured by wave gages with sampling frequency at 10 Hz every 30 minutes. Current velocity was measured by Acoustic Doppler Velocimeter (ADV) and tilt current meters at the shallow-water project area nearshore and the deep water offshore locations. Sediment traps above 0.3 meter of bed surface and sediment deposition or erosion from bed were also measured during the monitoring period at locations with and without living shoreline structures along an elevation gradient. Field measurements of waves, currents and sediment accumulation were used to calibrate and validate the Boussinesq wave model FUNWAVE-TVD and the Delft3D-SWAN model to assess the wave height attenuation and wind/wave-driven currents with and without living shoreline structures at local and project scales. Sediment transport and morphological dynamics (sediment deposition and erosion) were simulated by the Delft3D model (Delft3d-FLOW and Delft3d-MOR) by coupling with the Delft3D-SWAN model that computes wave energy dissipation caused by bottom friction, wave breaking and vegetation effects as well as wave-current combined bottom shear stresses, the advection and diffusion of the sediment during winter the storm period. The model results of waves, currents and sediment deposition/erosion agreed well with field measurements. The integration of short-term field monitoring with long-term numerical modeling is an effective tool to assess the performance of nature-based features.

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.

ECOLOGICAL FLOW MODELING IN LOUISIANA & TEXAS ESTUARIES

Eric D. White
The Water Institute of the Gulf, Baton Rouge, LA, USA

Coastal Louisiana is home to a vast expanse of wetland ecosystems in a highly altered hydrologic landscape that is scattered with levees, shipping channels, oil and gas exploration and pipeline canals. There is a history of subsurface fluid extraction and the landscape is also subjected to periodic tropical cyclones. Over 30% of all estuarine herbaceous marshes within the United States are located in the Louisiana coastal zone and over 25% of the wetlands within the coastal zone of Louisiana have been lost to open water in the past 85 years; a loss of more than 4,850 km2 of coastal wetlands from 1932 through 2010. The magnitude and impacts of this historic wetland loss are well documented and are the result of multiple drivers including: anthropogenic effects of levee and spoil bank construction and subsequent channelization of sediment supply, canal dredging, and subsurface fluid extraction. To combat these factors, a prodigious and wide-reaching restoration program, the Coastal Master Plan, is being undertaken in Louisiana and will largely be funded by Deepwater Horizon financial penalties.

To aid in the planning and design of restoration projects, extensive numerical modeling exercises have been conducted across the coastal zone. This presentation will provide an overview of select modeling projects undertaken by the Water Institute of the Gulf which have examined the ecological and land-building impacts of hydrologic and marsh restoration projects. The project locations extend from the North Shore of Lake Pontchartrain in the easternmost portion of coastal Louisiana to as far west as the Chenier Plain of Texas located between Galveston Bay and Sabine Lake. Modeling was conducted across a variety of modeling software platforms, with several projects modeled at varying resolution levels from project-screening to detailed design optimization modeling.

Four modeling projects, each with distinct target objectives and unique locations will be discussed in this presentation. The first project will look at land-building potential of a sediment and freshwater flow diversion off the Mississippi River into the Barataria estuary in southeastern Louisiana; project impacts will be discussed from several different modeling platforms. The second project is an examination of a suite of restoration projects and altered hydrologic regimes within the Maurepas Swamp. The impacts upon ecologically important hydrologic parameters within this historic cypress-tupelo freshwater ecosystem northwest of New Orleans were analyzed. A third project to be discussed will examine the hydrologic impacts and flood mitigation potential of marsh and bottomland hardwood forest restoration projects currently under construction in the Fritchie Marsh, a marsh system located between Lake Pontchartrain and the city of Slidell, Louisiana. The final project included will examine a model of the Anahuac National Wildlife Refuge in the Texas Chenier Plain; a scenarios analysis was conducted to examine the efficacy of freshwater flow delivery in minimizing salinity stress in a hydrologically isolated wetland adjacent to the Gulf Intracoastal Waterway.

The modeled projects included in this overview will aim to highlight the importance of coupling traditional hydrologic and hydraulic models with ecological modeling in order to quantify the full suite of project benefits, costs and impacts.

PRESENTER BIO: Eric White, PE, is a research engineer with more than 10 years of hydrologic and hydraulic modeling experience. He primarily focuses on the development and application of planning-level and decision support numerical models for restoration and storm water management projects.

SALT MARSH SUSTAINABILITY IN NEW ENGLAND: PROGRESS AND REMAINING CHALLENGES

Cathleen Wigand *and Stephen Balogh*
US EPA, NHEERL, ORD, Atlantic Ecology Division, Narragansett, RI, USA

Notable progress has been made in assessing, monitoring, and managing coastal marshes in New England, because of strong cooperation and partnerships across agencies, universities, and other organizations. Natural resource managers, conservationists, and scientists have documented and begun to manage marsh loss and degradation in many coastal systems, and furthermore have gained a better understanding of coastal marsh vulnerability, resiliency, and sustainability. Significant relationships of accelerated sea-level rise and other anthropogenic stressors with coastal marsh loss (e.g., creek and channel widening; interior ponding; creek bank erosion) are reported. The adaptive management framework has new emphasis on incorporating a social-ecological systems approach when defining problems and restoration goals, selecting climate adaptation methods, and building coastal resiliency. We highlight the evolution of the climate adaptation framework to better understand the underlying social and ecological processes and dynamic feedbacks to sustain coastal marshes. Some remaining challenges for social and ecosystem scientists are development of predictive, dynamic models to forecast coastal marsh resiliency to sea level rise, storm surges, and multiple stressors, and the incorporation of socio-economic parameters into models and indicators of coastal resilience. Using ongoing restoration projects in New England as examples, we describe the process for selecting climate adaptation actions (e.g., thin layer placement; restoring hydrology) and the partnerships and engagement of community, non-governmental, state, regional, and federal groups in making these coastal restoration and sustainability projects a success.

PRESENTER BIO: My research interests include using an ecological and socioeconomic approach to engage stakeholders and to provide the science to assess tradeoffs for different management and restoration actions. In addition, I am interested in the monitoring of wetland condition and multiple stressor effects on the structure and function of ecosystems.

COASTAL PLANNING IN TEXAS

Tony Williams
Coastal Resources Division, Texas General Land Office, Austin, TX, USA

Hurricane Ike in 2008 and Hurricane Harvey in 2017 are stark reminders to Texans that the Texas coast is extremely vulnerable to storm surge, strong winds and inland flooding. As the steward of state-owned lands, the Texas General Land Office (GLO) is responsible for the management of the Texas coastline from tidally influenced streams and riverbeds, and out to 10.3 miles into the Gulf of Mexico. Recognizing that Texas does not have a state-sponsored coastal plan, Commissioner Bush directed his Coastal Resources Division to develop the Texas Coastal Resiliency Master Plan (Plan), which is in alignment with the GLO's mission to restore, enhance and protect the state's coastal natural resources.

The Plan, released in March 2017, highlights the value of the coast, its resources, and the hazards that endanger coastal communities. The 2017 Plan also presents resiliency strategies and recommended nature-based projects to mitigate the impacts of coastal hazards that threaten the vitality and productivity of the coastal region. The GLO recently began work on the 2019 version of the Plan, which has a broader scope to address the natural and built environments as they pertain to resiliency for coastal communities.

Additionally, the GLO partnered with The U.S. Army Corps of Engineers in November 2015 to begin an examination of the feasibility of constructing projects for coastal storm risk management and ecosystem restoration along the Texas coast. The Coastal Texas Protection and Restoration Feasibility Study, also known as the Coastal Texas Study, incorporates engineering, economic and environmental analyses on large-scale projects, which may be considered by Congress for authorization and funding. The feasibility study and report will be completed in 2021.

Given the environmental and economic impacts from Hurricane Harvey, both studies will be used by the GLO to guide coastal planning and future restoration work. State and local leaders also can use these studies to identify the most appropriate projects and actions to mitigate the impacts of tropical storms, hurricanes and other extreme weather events.

DYNAMIC SOIL PROPERTIES IN ORGANIC SOILS OF SOUTHEAST MICHIGAN: CASE STUDY IN USE OF ECOLOGICAL SITE CONCEPTS

***Skye Wills*[1], *Greg Schmidt*[2], *Matt Bromley*[2]**
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Ecological sites can be used as a framework for land management evaluation and restoration. Ecological sites differentiate kinds of land based on capacity and response to disturbance. Therefore, they can be used as part of resource management and assessment hierarchy.

In this presentation, the use of ecological sites and associated reference state to evaluate the success of wetland restoration in Michigan will be presented. The study site was in the Mucky Depression ecological site with organic soils that were historically often drained and manipulated for agriculture. All the soils sampled are Histosols and the reference state is a forested wetland with a range of woody and herbaceous species. Alternative conditions investigated were: active cropland, established wetland restoration, and recent wetland restoration.

To evaluate the efficiency of restoration, dynamic soil properties (DSPs) were compared at three sites for each condition. Vegetative cover differences were apparent for the cropland and reference conditions, but restoration sites were very similar (*Phalaris arundinacea* (reed canarygrass), an invasive species, dominated). The restoration site's nitrate and phosphorus showed the largest difference between conditions, but there was great variability across sites. Bulk density was highest in the cropland and established restoration, lowest in the reference wetland, and intermediate in the recent restoration. The equipment used in established restorations may have created bulk densities more similar to cropland.

A classification tree of all measured soil properties creates nodes that separate reference conditions from the restorations and cropland. Further work is needed to evaluate the links between water table, seed mixes, and soil nutrients. In most properties evaluated, the recent restoration matched the reference conditions more closely than established wetland.

The ecological site framework was successfully used to evaluate wetland restoration and support the continuation of recent restoration practices over those used in established restorations.

PRESENTER BIO: Dr. Wills is a soil scientists for dynamic soil properties with the Soil Science Division of USDA-NRCS working on the impact of land use and management of soil properties and how best to provide that information with soil survey. She has studied prairie soils in Kansas and Iowa, tidal marshes in Maryland, and semi-arid rangeland in New Mexico. Her work focusses on sampling and reporting approaches that balance scientific inquiry and soil survey information.

ESTIMATING PRE-20TH CENTURY HYDROLOGIC CONDITIONS FOR RESTORATION OF THE GREATER EVERGLADES ECOSYSTEM

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Twentieth-century construction of canals and other water management structures, increasing demands on the available water supply from a growing population and agriculture, and land use change have significantly altered the natural hydrology of the freshwater wetlands and estuaries of the Greater Everglades Ecosystem. The goal of the Comprehensive Everglades Restoration Plan (CERP) is to restore more natural freshwater flows through the wetlands and into the estuaries, but observed data on flow volumes, water levels, and hydroperiods in the freshwater wetlands and salinity in the estuaries are lacking for the period prior to significant anthropogenic alterations. In addition, hydrologic models of the Everglades, such as the Natural Systems Model (NSM) used by South Florida Water Management District do not perform well in some parts of the ecosystem, particularly near the coast. How can management agencies set realistic targets and performance measures for hydrologic restoration in the absence of pre-anthropogenic information and reliable models? The solution is to use pre-20th century paleoecologic data from the estuaries and wetlands to calibrate statistical model outputs. Sediment cores collected in Florida Bay, Everglades National Park, were analyzed to estimate paleosalinity by comparing molluscan faunal assemblages in the cores to data on species currently living in south Florida. The estimated paleosalinty data were used in statistical models to estimate salinity throughout Florida Bay for approximately 1900 CE, as well as flow and water levels needed to produce those salinities. Estimates based on the estuarine cores indicate that average flows through Shark River Slough (SRS) would have been approximately 2.1 times greater and water levels 25 cm higher than the average measured values for the decade between 1990 and 2000, in the absence of anthropogenic alterations; similarly, Taylor Slough (TS) flow would have been 3.7 times greater.

To provide additional verification of the estuarine-based freshwater flow and water level estimates, pollen assemblages in three sediment cores from the freshwater wetlands were examined. Average water depths and hydroperiods for the beginning of the 20th century were estimated by comparing the pollen in the cores to living species preferences. These estimates were used to calibrate the NSM 4.6.2, which incorporates temporal variability, to the pre-drainage water depths and hydroperiods at each core location. The results indicate that the pre-1900 water depths were greater than observed (1994-2000) conditions by approximately 15-20 cm and the hydroperiods were approximately 29 weeks longer, depending on the core location. When the results from the wetland cores are used in linear regression flow models, the model outputs indicate that flow through SRS was over two times greater than existing flows and TS flows were over four times greater than existing flows. These results at both SRS and TSB agree with flow estimates based on the estuarine cores. Our paleo-based salinity estimates for the basis of the targets restoration managers have established for Florida Bay, Everglades National Park. The estimated flows, water levels, and hydroperiods offer potential targets for restoration of the wetlands.

PRESENTER BIO: Dr. Wingard is a research geologist with more than 20 years of experience leading projects that apply paleoecologic analyses to understand the past coastal and marine ecosystems of south Florida in support of Everglades restoration. As part of this effort she has served on numerous science advisory teams.

IMPACTS OF HURRICANE IRMA ON FLORIDA BAY ISLANDS – CLUES TO FUTURE RESPONSES TO STORMS AND SEA LEVEL

G. Lynn Wingard[1], *Miriam C. Jones*[1], *Sarah Bergstresser*[1], *Marci Marot*[2], *Bethany Stackhouse*[1], *Andre Daniels*[3], *and Katherine Keller*[1]

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Hurricane Irma passed through the Florida Keys as a category 4 storm on September 10, 2017. As it moved northward along the western shore of Florida it impacted Florida Bay, Everglades National Park. In 2014, USGS researchers had collected cores from four islands in Florida Bay (Russell Key, Bob Allen Key, Buttonwood Key #7, and Jim Foot Key) to gain insight into rates and patterns of sea-level rise, sediment accretion/erosion patterns, and the role of storms in island formation and resilience. The subsequent passage of Hurricane Irma provided an opportunity to directly observe and document the effects of storms on these islands.

Satellite imagery was obtained from a few days before and after the storm and images of the islands were analyzed for apparent changes in land cover. Areas of potential change in the images were highlighted for field investigations conducted in January 2018. We revisited the 2014 core sites and re-measured elevations to determine if there was any net gain or loss between sampling periods. In addition, we re-cored the upper 50 cm of sediment to compare to the previous cores. The four islands have open mud-flats in their interiors, and are surrounded by vegetated berms. We hypothesize that the island berms serve an important function by trapping sediments and reducing sediment loss from the mudflats during storm surges. To test this theory, we also cored and took elevation measurements on several berms. We observed storm damage to island mangroves, but red mangroves (*Rhizophora mangle*) seemed essentially undamaged, while black mangroves (*Avicennia germinans*) were mostly denuded on all the islands examined. Over-wash deposits around the perimeters of the islands were sampled and varied in composition and thickness. On Jim Foot Key (the western-most island sampled and therefore closest to the eye of the storm and the open Gulf), 7.5 cm of mud was deposited by the storm; intermingled in the mud were relatively fresh seagrass blades indicating recent single-event deposition. Other islands had shell hash deposits, thick mats of mangrove leaves, deposits of stranded killifish, and in some cases algal crusts were beginning to form. These deposits will be analyzed for stable isotopes, naturally occurring and anthropogenic radionuclides, grain size, and faunal and floral composition to characterize the varied nature of storm deposition on these islands.

By applying the information obtained from Hurricane Irma to our analyses of the last 4000 years of south Florida history recorded in the 2014 Florida Bay island cores, we hope to gain insight that will assist in forecasting potential ecosystem effects under future storm, climate, and sea-level rise scenarios.

PRESENTER BIO: Dr. Wingard is a research geologist with more than 20 years of experience leading projects that apply paleoecologic analyses to understand the past coastal and marine ecosystems of south Florida in support of Everglades restoration. As part of this effort she has served on numerous science advisory teams.

SEA-LEVEL RISE: OVERCOMING THE PROBLEMS OF CONNECTING SCIENCE TO MANAGEMENT, PART 2 STRATEGIES

G. Lynn Wingard[1]***,*** *Michael Savarese*[2]***,*** *Jennifer Jurado*[3]*, David Kidwell*[4]*, Denise Reed*[5]*, and John Tirpak*[6]

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[3]Broward County, Natural Resources and Management Division, FL, USA
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[5]University of New Orleans, New Orleans, Department of Earth and Environmental Sciences, LA, USA
[6]U.S. Fish and Wildlife Service, Gulf Coast Restoration, Lafayette, LA, USA

Anticipated sea-level rise over the next century is an issue faced by urban planners and resource managers in all coastal communities. Scientists and modelers across the country are making advances in understanding factors impacting the rates of sea-level rise, determining potential ecological effects to coastal communities, and developing tools for managers to use. The purpose of this session is to identify strategies for effectively making the connection between scientists and modelers and the management agencies that need this information. Examples of effective applications of research to decision-making will be presented, and panel members will discuss tools and methods that have worked, and identify information gaps and areas for improvement. The session will present the perspectives of decision-makers and scientists and will encourage audience participation to identify a path forward.

PANELIST BIOS:

Dr. Wingard is a Research Geologist with more than 20 years of experience applying paleoecologic analysis to restoration through research in Holocene coastal ecosystems, sea level, and climate.

Dr. Savarese is a Professor of Marine Science currently co-leading a NOAA-funded effort with regional government and resource managers to address future impacts associated with sea-level rise.

Dr. Jurado is the Chief Resilience Officer for Broward County, FL where she coordinates climate mitigation and adaptation initiatives at local and regional levels with emphasis on application of science in policy and planning.

Mr. Kidwell is the Manager for Ecological Effects of Sea-Level Rise Program, which assesses impacts of sea-level rise and coastal storms on Gulf habitats through development of predictive models used for long-term planning.

Dr. Reed is a nationally and internationally recognized expert in coastal marsh sustainability and the role of human activities in modifying coastal systems with over 30 years of experience studying coastal issues in the United States and abroad.

Dr. Tirpak is Science Coordinator for Gulf Restoration and has more than 15 years of experience operating at the nexus of science and management to ensure landscape-level considerations are incorporated into local decisions.

ECOLOGICAL RESTORATION AT THE WARM SPRINGS NATURAL AREA IN MOAPA, NEVADA

Von K. Winkel
Southern Nevada Water Authority, Las Vegas, NV, USA

The Warm Springs Natural Area (WSNA) owned by the Southern Nevada Water Authority (SNWA), is situated in the Upper Moapa Valley, fifty miles north of Las Vegas, Nevada. The WSNA is the site of major thermal spring complexes that flow from a deep carbonate aquifer, into tributaries that form the Muddy River. These springs and streams once supplied water to ancient native-Americans, early explorers and pioneers, and later settlements throughout the Moapa Valley. The water sustains lush vegetation consisting of meadows, marshes, and thickets of mesquites and willows. The WSNA is a hot-spot of biological diversity; home to many unique species that occur here and nowhere else in the world.

The WSNA has been disturbed in the past by various human activities. Major impacts included the entrenchment of the Muddy River and its tributaries which lead to a lowering of the water table and subsequent changes in plant communities. The cultivation of hundreds of acres of flood plain destroyed valuable mesquite bosques and meadows. The need for irrigation water lead to the capping of springs and the diversion of streams. These actions severely impacted the Moapa dace fish and other endemic aquatic species. Other human disturbances included roads, ditches, fences, utility corridors, flood berms, corrals, and garbage dumps.

The SNWA is committed to restoring the disturbed lands on this property and managing the unique ecological systems that exist there. To this end, they have developed an ecological restoration program. The goal of this program is to identify and implement procedures to repair the damage caused by human activity to the diversity and dynamics of the Upper Muddy River ecosystem. Major tasks associated with ecological restoration include restoration plan development, restoration implementation and monitoring. Restoration implementation will include spring and stream channel restoration, facility decommissioning, cleanup, weed control, topsoil importation, land recontouring, soil decompaction, seeding, planting and irrigation.

Restoration implementation began in 2011. To date, twenty-five acres have been revegetated, one-half mile of streams inhabited by the endangered Moapa dace fish have been reconstructed and revegetated, one mile of the Muddy River has been revegetated and a ten-acre native landscape has been constructed in an area open to the public. In addition, over 10,000 plants produced in our nursery have been used in our restoration efforts. Over sixty restoration projects and tasks have been completed by volunteers.

PRESENTER BIO: Dr. Winkel, the Restoration Ecologist for the Southern Nevada Water Authority and Las Vegas Springs Preserve has more than 30 years of experience planning, designing, and implementing ecological restoration. He has spent the last 19 years helping to construct and manage the Springs Preserve and Warm Springs Natural Area.

ADAPTIVELY MANAGING THE CALIFORNIA DELTA: THE USE OF INDEPENDENT REVIEW

Edmund Yu[1], *Maggie A. Christman*[1], *Lindsay Correa*[1], *John Wiens*[2], *Yumiko Henneberry*[1], *Dylan Stern*[1], *Darcy Austin*[1], *and John Callaway*[1]

[1]Delta Science Program, Delta Stewardship Council, Sacramento, CA, USA
[2]Delta Independent Science Board, Sacramento, CA, USA

Adaptive management is a key part of managing California's Sacramento-San Joaquin Delta (Delta), which lies at the center of a complex and transformed landscape. The Delta provides water to more than 25 million Californians, supports a multi-billion dollar agricultural industry, and is home to over half a million Californians. However, human uses of the Delta have altered the landscape that has led to the ecosystem's decline, and over 50 native species found in the Delta are now listed under the United States or California Endangered Species Act. Since the 1980s, conflicts have arisen on how to improve the ecosystem's health, while maintaining a reliable water supply in California. Decisions are often contentious since there are over 230 agencies, institutions, and stakeholders with different agendas that are involved with managing the Delta. In light of major uncertainties facing decision-makers, adaptive management provides a flexible mechanism to manage and restore the Delta in this highly variable environment.

Although adaptive management is not applicable in every situation, the California legislature passed the Delta Reform Act in 2009, which legally requires adaptive management for restoration and water management actions in the Delta. In addition, the Delta Reform Act also established the Delta Independent Science Board's role to "provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic reviews" (California Water Code section 85280(a)(3)). The Delta Independent Science Board is made up of 10 scientists from across the United States and across disciplines. Members are appointed by the Delta Stewardship Council, which is tasked by the Delta Reform Act to advance the coequal goals of a more reliable water supply, while maintaining a healthy ecosystem that protects the Delta as an evolving place.

The Delta Science Program, housed within the Delta Stewardship Council, is charged with providing "the best possible unbiased scientific information to inform water and environmental decision making in the Delta" (California Water Code section 85280(b)(4)). To help accomplish this mission, the Delta Science Program supports the reviews of the Delta Independent Science Board, and coordinates independent scientific peer review of programs, plans, and projects through the use of independent scientific experts to ensure credible and legitimate science for water and environmental decision-makers. Both the recommendations from independent peer review panels convened by the Delta Science Program and the reviews by the Delta Independent Science Board have resulted in building consensus, managing scientific conflict, reducing uncertainties, and management changes within this complex system.

PRESENTER BIO: Mr. Yu is a Senior Environmental Specialist at the Delta Science Program, where he coordinates the reviews of adaptive management programs by the Delta Independent Science Board. Prior to this work, Mr. Yu worked on planning habitat restoration projects and implementing water management actions in the Delta.

PREDICTING LONG TERM PERFORMANCE AND RISK OF OYSTER REEF RESTORATIONS UNDER DEEP UNCERTAINTY IN CLIMATE AND MANAGEMENT POLICY

Simeon Yurek[1], *Mitch Eaton*[2], *William Pine III*[3], *Ed Camp*[3], *Hongqing Wang*[4], *Romain Lavaud*[5], *Peter Frederick*[3], *Julien Martin*[1], *Fred Johnson*[1], *and Rua Mordecai*[7]

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Oyster reefs are valued both as a harvestable fishery and as regulators of ecosystem properties, such as wave energy, estuarine hydrology, and water quality. Restoration of these services is growing in demand for coastal human communities, given recent patterns of marsh subsidence, exposure to major storms, sea level rise, and collapse of important fisheries. However, because harvest necessarily disrupts the ecology of the reef and its regulatory services, restoration practitioners are faced with the question of whether restored reefs can be opened for harvest or, alternatively, should be set as "no take" reserves. If harvest is permissible, what is the appropriate amount of time required for a reef to become established following restoration? Answering this question is complicated by uncertainty in the future of drought, precipitation, freshwater flows, storm frequency, and land use.

To address potentially confounding uncertainties of future climate and management outcomes, we developed two new models that simulate oyster reef building and coastal salinity regimes, to predict reef restoration performance, in units of biomass that can be harvested or left on the reef to build structure. We focused on drought as a critical climate factor by developing a set of simulations in which drought frequency and fishing pressure were varied, and compared these results to those predicted by the coastal salinity index (CSI). In this manner, predictions for both the fishery and salinity index could be tracked together. The goals of this modeling are to (1) understand the coupled dynamics of coastal salinity, oyster reef restoration, and fisheries management, and (2) estimate, in biological units, econometrics of expected return and risk to reef restorations, which summarize the variance of reef response across the modeled future scenarios, and represent viability for harvest.

Oyster reefs were simulated as three-dimensional structures composed of individual oysters, oyster shell substrate, and recruits. Previous models of oyster bioenergetics, shell longevity and budget, oyster reproduction, and population dynamics were compiled to build a new model of the reef system, based on modeling the energy budget of individual organisms. One critical variable impacting reef accretion is the turnover rate of shell "boxes", which are intact shell valves left behind post-mortality. Changes in this parameter affected the ability of the reef to accrete to its full potential, and resulted in changes to population size and age structure through time. These insights on the dynamics of oyster reefs are intended to support decisions on harvest management for improved sustainability.

PRESENTER BIO: Simeon Yurek is an ecologist working in collaboration with the USGS, USFWS, South Atlantic Landscape Conservation Cooperative, and DOI Southeast Climate Science Center, with a shared research focus of identifying optimal decision strategies for restoring coastal habitats and ecosystem services to meet multiple stakeholder objectives.

AN INTEGRATED HEC-RAS AND RIPARIAN VEGETATION SIMULATION MODULE SYSTEM AND ITS APPLICATION TO THE SACRAMENTO RIVER

Zhonglong Zhang[1]*, Billy Johnson*[2]*, Junna Wang*[3]*, Steve Piper*[4]*, and Mark Jensenr*[4]

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[4]USACE Hydrologic Engineering Center, Davis, CA USA

To support the riparian ecosystem management and restoration, there is a critical need for developing a physically based quantitative tool to predict riparian vegetation's response to fluvial processes, and to evaluate alternative operations and management plans. Most of existing riparian vegetation models have not linked their vegetation simulation with river hydraulics and sediment transport. The complex interactions between flow dynamics and riparian vegetation cannot be quantified with these models.

Under the U.S. Army Corps of Engineers ecosystem management and restoration research program, the polygon-based riparian vegetation simulation module (RVSM) was developed and integrated into HEC-RAS one-dimensional flow model to predict spatially-explicit seed germination, seedling establishment, plant growth and mortality in response to fluvial processes. The HEC-RAS – RVSM system was applied to the Sacramento River reach to evaluate its capability in modeling temporal and spatial changes of riparian vegetation and the interactions between flow and riparian vegetation dynamics. River hydraulics, groundwater level and five vegetation types of the study reach were simulated for the eight-year (1999–2007) period. Model results demonstrate that the HEC-RAS – RVSM system reproduced the coverage increase of cottonwood, riparian shrub, invasive species and grass as well as the coverage decrease in mixed forest over the eight-year. The RVSM was able to capture sites for cottonwood establishment observed on certain point bars. The modeled variations of cottonwood coverage in response to dynamic flow regime facilitated determining and managing environmental flow for riparian vegetation restoration. The height of capillary fringe and root growth rate were two key parameters influencing riparian vegetation distribution.

PRESENTER BIO: Dr. Zhang is a Senior Scientist with LimnoTech and has more than 25 years of experience in the development and application of various watershed and water resources models. For the past 15 years he conducted water quality modeling research and development for the U.S. Army Corps of Engineers. He has been the lead developer and primary author of a set of plug-in water quality modules for a variety of hydrologic and hydraulic models. He has been the co-developer of the riparian vegetation simulation module for HEC-RAS and SRH-1D.

ECOSYSTEM RESTORATION TOOLS

Robert Ziehr
USDA-NRCS Temple, TX USA

Ecosystem restoration requires many tools to be effective. Some tools are readily available and actively utilized during restoration efforts. Other tools may not be as well-known or utilized to the full extent. Still the need to continue to develop new tools is quite evident. USDA-NRCS has developed and utilizes many tools to help our nation's farmers, ranchers and rural communities. These tools are available for public use and can assist in successful restoration.

This presentation will focus on available and needed tools for successful ecosystem restoration. The intent of this discussion is to spark interest and conversations as to how we as a conservation community can work together with existing tools and help develop new tools.

PRESENTER BIO: Mr. Ziehr serves as the state plant materials specialist for USDA-NRCS in Texas. He supervises 3 USDA Plant Material Centers and provides state-wide technical guidance on plant use in conservation restoration activities. He has 21 years of experience in landscape conservation and restoration.

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