2016 DELAWARE WETLANDS CONFERENCE

Educate • Connect • Protect

February 3 & 4, 2016

Wilmington, Delaware

Delaware Wetlands
Purify Provide Protect
http://de.gov/delawarewetlands

Delaware Department of Natural Resources and Environmental Control

Coastal Training Program
Delaware National Estuarine Research Reserve

Photo: Buttonbush (*Cephalanthus occidentalis*)

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Conference Committee

Wetland Monitoring & Assessment Program

Brittany Haywood
Alison Rogerson
Kenny Smith
Mark Biddle
Andy Howard

Delaware National Estuarine Research Reserve

Kelly Valencik
Maggie Pletta

Greetings Friends,

The 2016 Conference Committee would like to welcome you to the 7th Delaware Wetlands Conference hosted by the Delaware Department of Natural Resources and Environmental Control (DNREC). Over two days, there will be diverse presentations, abundant networking, and engaging workshops. The exhibition hall boasts over a dozen displays showcasing programs, products and opportunities as well as more than two dozen informative and attractive posters. This conference underscores the theme of "Educate, Connect and Protect", and fuels our collective mission to advance wetland science and conservation.

This conference is one of the largest events for wetlands on the Atlantic coast that brings together students, professionals and policy makers and this year we anticipate great things! DNREC's Wetland Monitoring and Assessment Program has once again teamed up with the Delaware Coastal Training Program to offer you a unique learning and networking experience. Hosting an event of this magnitude would not be possible without the programmatic support of the Environmental Protection Agency, the financial assistance of our generous corporate sponsors, and participation of over a dozen volunteers, roughly seventy-five presenters and of course you for attending and contributing to the experience. We thank you for your commitment to conserving wetlands.

We are biologists at heart, but every two years we shed our waders, roll up our sleeves and dedicate ourselves to hosting an enjoyable event that brings us together and leaves you with an enhanced sense of collaboration. We invite you to spend the next two days making new connections, visiting with familiar faces, diving into new ideas, and sharing your perspectives with others. After the conference comes to a close we hope this exchange will continue. With your participation, the Delaware Wetlands Conference will be a catalyst to grow and strengthen the wetland community in the Mid-Atlantic region. As usual, we welcome feedback on the venue, content and organization of the event, so please complete the survey found in your packet before you leave.

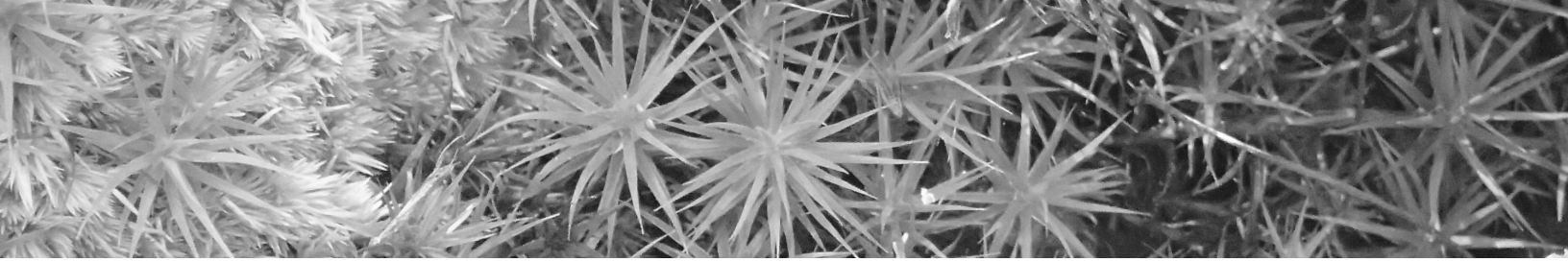
Enjoy the Conference!

Wetland Monitoring & Assessment Program (WMAP)
www.de.gov/delawarewetlands
Delaware Coastal Training Program (CTP)
www.de.gov/dectp

Name Tag Decoder*

	Sponsor		Presenter
	Volunteer		Professional
	Staff		Student

**Please wear your name tag at all times, and return them at the end of your stay.*



Important Reminders:

Conference Highlights

- 43 oral presentations
- 28 poster presentations
- 24 exhibitors
- 2 communication focused workshops
- Complimentary beverages, morning and afternoon snacks and lunch
- Ample networking opportunities

New for 2016!

Eat, Drink & Connect

Join us for **Happy Hour on the second floor of Iron Hill Brewery from 4:00 –7:00 PM on Wednesday**. Enjoy a great atmosphere, complimentary light hors d'oeuvres and a cash bar while catching up with old and new friends alike.

Iron Hill Brewery is a 4 minute walk north of the Chase Center on the Riverfront. This networking event is sponsored by Moffatt & Nichol.

Tips For Teams

Divide and Conquer! Plan your time at the conference as a collective unit and strategize how to maximize your learning experience. Outline your expectations of the team before the conference and mentor individuals to help them network, participate fully and report back to your team or school. Find a special spot in the convention center to gather and debrief each day.

Posting to Social Media? Use the hashtag: **#DEWetlandsConference**.

Session Timing

Each presentation will be 15 minutes. The audience will have an additional 5 minutes to ask questions followed by a 5 minute lapse. Please feel free to move between sessions during this time.

Refreshments

Drinks and snacks will be available to you throughout the conference in the Lobby. Don't forget to bring your refillable water bottle and recycle when you can.

Connect to the Wi-Fi

ChaseCenter Wi-Fi is free and available for you to connect to.

Professional Credits

Professional credits are available for attending this conference. **American Institute of Certified Planners**—10.5 hours of certification maintenance credits. **Certified Floodplain Managers**—7.5 continuing education credits. For more information please contact Kelly Valencik at 302-739-6377 or Kelly.Valencik@state.de.us.

Have a Question?

Do you need a special accommodation or have a question? Ask one of the attendants at the registration desk or someone with a purple badge.

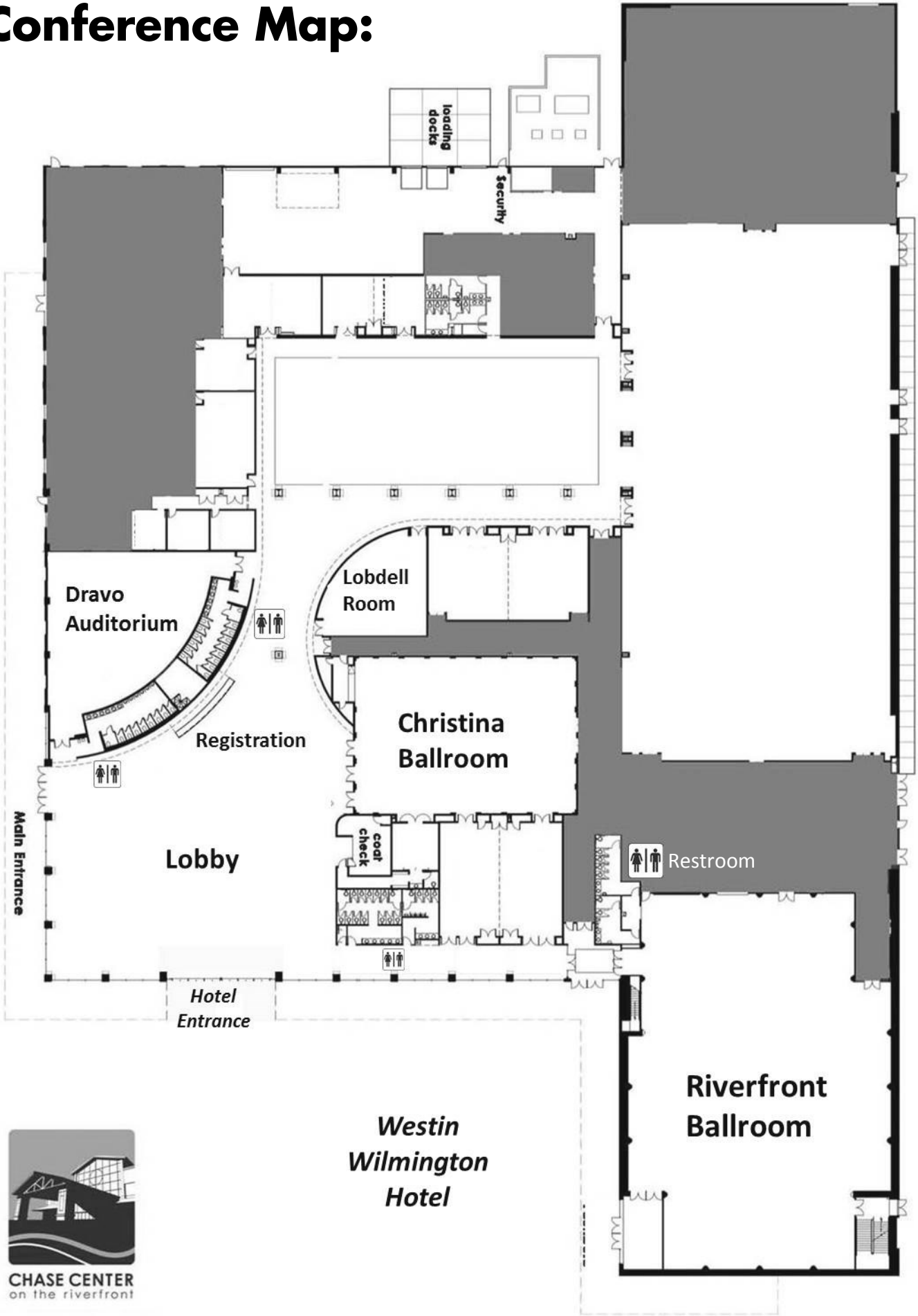
We Need Your Help!

At the end of your stay with us, please fill out and return your survey to the registration desk. Your input is vital in determining future efforts for this conference.

Follow Us for Conference Updates

Follow us on **Twitter** (@DE_Wetlands) or **Facebook** (facebook.com/DelawareWetlands) to stay up-to-date with the latest conference information.

Conference Map:



A Message From U.S. Senator Tom Carper

Welcome to the Delaware Wetlands Conference.

DNREC Secretary David Small and U.S. Senator Tom Carper (from left to right) discussing the importance of Delmarva Bays at Huckleberry Pond near Milton, Delaware in the summer of 2015.

Everyone assembled here today understands that protecting our watersheds in Delaware and across the nation helps ensure our drinking water is safe and our vital habitats maintained, while investing in a resource that fuels both our local and national economies. The federal government's best tools for accomplishing these goals are the authorities granted to it by the Clean Water Act. Since its enactment in 1972, the Clean Water Act has led to significantly cleaner water in this country. Before this law, only about 30 percent of our nation's waters were safe to swim and fish. But today, that number has doubled to 60 percent. This is tremendous progress, but our work is not complete. Many waters in this country still fail to meet our health standards and need to be cleaned up further.

We know that small streams and wetlands are where many of our rivers, bays, and coastal waters begin. Protecting these small streams and wetlands from pollutants and other harmful substances can have a huge impact on the safety of our drinking water. Providing that protection must be a top priority. After all, these water sources can reach more than 100 million people. But that's not our only important concern. These small streams and wetlands provide critical habitats for fish and wildlife, provide water for our crops and livestock, and protect communities from rising floodwaters. We know the key to protecting these water sources is to start from the top. The precautions we take upstream result in healthy water downstream. However, protections for upstream water sources have dwindled over the past two decades as a result of court decisions that have created uncertainty, and due to the failure of Congress to provide clarity on the law.

In an effort to ensure that the federal government is doing what it should to keep our water clean and safe, the Environmental Protection Agency (EPA) recently finalized the Waters of the United States rule. It seeks to clarify which wetlands and streams are critical upstream water sources that must be protected under the Clean Water Act in order to maintain safe quality standards in our rivers, bays and coastal waters. To finalize this rule, the EPA held a lengthy comment period resulting in more than one million comments to the rule. In addition, the EPA and Army Corps of Engineers held more than 400 meetings with stakeholders across the country and visited farms in nine states. All of which helped shaped the final rule for the better. In the final rule, the administration further clarified what streams and wetlands would be regulated, provided additional protections to the agriculture community, and focused protections on streams not ditches. I truly believe that this input helped strike a balance between protecting the environment, public health, our agriculture communities, and our continued economic recovery.

Some may believe that we must choose between a cleaner environment and a strong economy. I believe this is a false choice. Our state and the country has proven over and over again that we can have robust protections for our environment and public health without hampering the private sector's ability to create jobs – and clean water protections are no different.

Tom Carper

- United States Senator Tom Carper

2016 Schedule—Wednesday, February 3

8:00	Registration & Refreshments—***Lobby***		
9:00	Opening Remarks—Alison Rogerson, DNREC—**Riverfront Ballroom**		
9:05	Welcome—DNREC Secretary David Small		
9:20	Invited Speaker—Money and People – Do They Have a Place in Wetland Conservation? *Elizabeth Schuster, TNC*		
Room:	***Dravo Auditorium***	***Christina Ballroom***	***Lobdell Room***
Title:	**Restoration**	**Climate Change**	**Mapping, GIS & Modeling**
10:20	Nanticoke Tax Ditch Restoration Fawn Road to Redden Road *Brian Jennings, U.S. Fish & Wildlife Service*	Increasing Salt Marsh Acreage & Resiliency for Blackwater National Wildlife Refuge *David Curson, Audubon Maryland-DC*	EPA Grant: Tracking Mitigation Sites and Mitigation Banks in the State of NJ *Anika Andrews-Spilman, NJDEP*
10:45	Urban Wetland Restoration in the South Wilmington Wetland Park *Justin Reel, RK&K*	Variability of Organic Carbon Accumulation in Delaware Tidal Marshes *Kaitlin Tucker, University of Delaware*	An Overview of the NFWF Post-Sandy Bombay Hook Project: Numerical Modeling & In-Situ Measurements *Ali Abdolali, University of Delaware*
11:10	Strategies for Assessment & Restoration of Resilient Urban Tidal Wetlands *Christopher Haight, NYC Parks*	Studying Sea Level Rise & Coastal Forests with Dendrochronology *Stephanie Stotts PhD, Wesley College*	Modeling Wind Waves in a Confined Tidal Flat Area: Bombay Hook National Wildlife Refuge, Delaware *Mithun Deb, University of Delaware*
11:35	Mirror Lake Remediation & Restoration: The First Full-Scale Application of Activated Carbon - Dover, Delaware *John G. Cargill, IV, DNREC*	New Maps & Guidance for Flooding & Sea Level Rise Can Help Plan Wetland Conservation & Restoration *Susan Love, DNREC*	Marsh Futures: Assessment & Mapping of Salt Marsh Vulnerabilities to Guide Restoration at the Local Scale *Danielle Kreeger, Partnership for the Delaware Estuary*
12:00	Lunch & Networking - ***Riverfront Ballroom***		
12:45	Poster Viewing, Networking & Dessert - ***Lobby***		
Title:	**Planning & Conservation**	**Tidal Plants & Animals**	**Workshop**
1:30	Cultural Resources Conundrums: Navigating Section 106 Review in Wetlands Projects *John McCarthy, RPA, DNREC*	Developing Seashore Mallow as an Alternative Crop on Salinized Soils Along the Delaware Bayshore & Investigating its Use as a New Source of Poultry House Bedding *Kate Hackett, Delaware Wild Lands, Inc.*	Communicating Climate Change Workshop - Part 1 Sarah Nuss, *Chesapeake Bay National Estuarine Research Reserve,* Melanie Reding, *Jacques Cousteau National Estuarine Research Reserve*
1:55	Minimizing Marsh Impacts: Permitting & Construction of the Milford Emergency Pole Replacement Project with the St. Jones Research Reserve Marsh *Andrea Knauer & Emily Dolbin, McCormick Taylor*	Geospatial Variation of Ribbed Mussel (*Geukensia demissa*) Ecosystem Services Across the Salt Marsh Landscape *Joshua Moody, Partnership for the Delaware Estuary*	
2:20	Establishment of Wetlands for Permit Mitigation: The Process and Lessons Learned *Bruce Workman, T.E.S. Inc.*	An Early Juvenile (Age 0-1) Atlantic Sturgeon Abundance Estimate and Habitat Usage within the Delaware River Estuary, USA *Edward Hale, DNREC*	
2:45	Break & Refreshments—***Lobby***		
3:00	Delaware's Category 1 Wetlands; A Priority for Conservation *William A. McAvoy, DNREC*	Estimating Tidal Marsh Bird Population Sizes & Identifying Priority Areas for Conservation in the Northeast USA *Greg Shriver, University of Delaware*	Communicating Climate Change Workshop - Part 2 (*Must attend Part 1 to attend Part 2.)*
3:25	"Not Your Father's Tax Ditch" Enhancing Delaware's Drainage Network Through the Use of Natural Channel Design Techniques *Sara B. Esposito, P.E., DNREC*	The 2015 Delaware Wetland Management Plan - Ready For Action *Alison B. Rogerson. DNREC*	
4:00	Eat, Drink & Connect at the Iron Hill Brewery: 4:00—7:00PM ~ Sponsored by Moffatt & Nichol (Optional)		

Invited Speaker Biography:

Elizabeth Schuster

Environmental Economist, The Nature Conservancy

Wednesday, February 3, 9:20 AM

Elizabeth Schuster is among the first environmental economists to be hired in one of The Nature Conservancy's state-level operating units. While the field of environmental economics has been in existence for many decades, the full integration of economics into conservation organizations is fairly new, leading to many great opportunities to contribute to a rapidly expanding discipline. Elizabeth joined the New Jersey Chapter in 2013 and has been working with the Coastal and Freshwater programs to develop economic strategies to further our conservation work. Her current work combines research and analysis with collaborative on-the-ground efforts to find practical solutions to pressing conservation problems.

Communicating Climate Change Workshop

Wednesday, February 3, 1:30 PM

Lobdell Room

Workshop Leaders

- Sarah Nuss, *Chesapeake Bay National Estuarine Research Reserve*
- Melanie Reding, *Jacques Cousteau National Estuarine Research Reserve*

Part 1— Our climate is changing and so is the story we're sharing with our audiences. The National Network of Climate Change Interpreter's (NNOCCI) goal is to establish a national network of professionals who are skilled in communicating climate science to the American public. Join educators from the **Jacques Cousteau and Chesapeake Bay Virginia NERRs to learn about the NNOCCI study circles** – what it is, why it's useful, and some basic tips to use with your audiences. Participants will be introduced to the elements of strategic framing – a research-based communication tool. Strategic framing helps you tell a story about climate change, to engage audiences in thinking productively, and to overcome traditional barriers when thinking about solutions.

Part 2— *(Attendance in Part 1 is recommended to attend Part 2)* After receiving an introduction to the NNOCCI project, **participants in this hands-on session will explore best practices for communicating climate change** as we dive deeper into strategic framing. Participants will be introduced to and practice using values, metaphors, solutions, and casual chains to draft a message to take back to your classroom or institution. By the end of the session, participants will be more confident in their ability to overcome barriers to interpreting climate change issues.

NNOCCI is a collaborative effort led by the New England Aquarium with the Association of Zoos and Aquariums, the FrameWorks Institute, the Woods Hole Oceanographic Institution, the National Aquarium in Baltimore, Monterey Bay Aquarium, the New Knowledge Organization in partnership with Pennsylvania State University and the Ohio's Center for Science and Industry. With support from the NSF Climate Change Education Partnership program, NNOCCI's goal is to establish a national network of professionals who are skilled in communicating climate science to the American public.

Eat, Drink & Connect

Happy Hour on the second floor of Iron Hill Brewery from 4:00 –7:00 PM on Wednesday. Complimentary light hors d'oeuvres and a cash bar. Sponsored by Moffatt & Nichol.

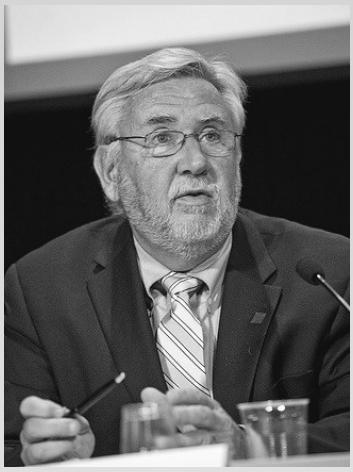
2016 Schedule— Thursday, February 4

8:00	Registration & Refreshments—***Lobby***		
9:00	Opening Remarks—Alison Rogerson, DNREC—**Riverfront Ballroom**		
9:05	Invited Speaker—The Science and Politics of Wetlands in the U.S. and the World. William Mitsch		
Room:	***Dravo Auditorium***	***Christina Ballroom***	***Lobdell Room***
Title:	**Shoreline Restoration**	**Monitoring & Assessment**	**Education & Outreach**
10:10	Living Shorelines Mythbusters—Addressing Assumptions & Misconceptions About Living Shorelines *Douglas Janiec, Sovereign Consulting Inc.*	Duration & Magnitude of Changes in Marsh Hydrology & Salinity Due to Hurricane Sandy Surges on Eastern Shore Maryland Ditched & Unditched Marshes *Dorothea Lundberg, University of Maryland*	Improving Climate Literacy Through Hands-On Mock Marsh Transect *Sarah Nuss, CBNERR & Margaret Pletta, DNREC*
10:35	Application of an Innovative Living Shoreline Technique at the Bethany Loop Canal *Robert Collins, Delaware Center for the Inland Bays*	Virginia Department of Environmental Quality's Wetland Monitoring & Assessment Program - Development of a Wetland Condition Assessment Tool (WetCAT) & Policy Implications *Michelle Henicheck & Dave Davis, VA DEQ*	You Mean I Can Get Help Doing This? Engaging Volunteers to Achieve Mission & Objectives *Glen Stubbolo, DNREC*
11:00	Shoreline Stabilization Along the Delaware River Using Wave Attenuation Devices *Ryan Rupprecht, Cardno*	Monitoring Response of Estuarine Wetlands to Anthropogenic Disturbance in the St. Jones Reserve *Christina Whiteman, DNREC*	Delaware Children in Nature Coalition & the Delaware Environmental Literacy Plan *Cheryl Pittenger, Delaware Children in Nature*
11:25	Floating Wetland & Oyster Islands to Improve Water Quality & Habitat in an Impaired Residential Canal *Marianne Walch, Delaware Center for the Inland Bays*	Quantifying the Value of Tidal Wetland Ecosystem Services in Delaware *Amanda Santoni, DNREC*	Putting the Band Together: Citizen Scientists are Rock Stars of the Monitoring World *Beth Wasden, Nanticoke Watershed Alliance*
11:50	Lunch & Networking - ***Riverfront Ballroom***		
12:35	Poster, Networking & Dessert - ***Lobby***		
Title:	**Non-Tidal Plants & Animals**	**Prime Hook National Wildlife Refuge (PHNWR)**	**Workshop**
1:20	The Delaware Wildlife Action Plan: Keeping Today's Wildlife from Becoming Tomorrow's Memory *Anthony Gonzon, DNREC*	PHNWR's Recovery & Ecosystem Restoration: Implementation & Monitoring *Bart Wilson, & Susan Guiteras, U.S. Fish and Wildlife Service*	Reaching Your Audience: Accelerating Wetland Restoration Workshop (Part 1) *Steve Raabe, OpinionWorks* *Amy Jacobs, The Nature Conservancy* *Erin McLaughlin, Maryland DNR*
1:45	Bird Use of Delaware Wetlands During Fall Migration Based on Weather Radar Observations *Jeffrey Buler, University of Delaware*		
2:10	How to Help Prevent the Spread of Amphibian and Reptile Diseases in Four Simple Steps *Holly Niederriter, DNREC*	Monitoring Marsh Birds & Vegetation in the Delmarva Peninsula *Timothy Freiday, University of Delaware*	
2:35	Break & Refreshments—***Lobby***		
2:50	Biological Control of Purple Loostrife (*Lythrum salicaria*) at the Glenville Wetland Mitigation Bank, New Castle County, Delaware *Christie Bonniwell, DelDOT*	Identifying Groundwater Discharge Locations in PHNWR using Environmental Thermography and Distributed Temperature Sensing *Thomas E. McKenna, University of Delaware*	Reaching Your Audience: Accelerating Wetland Restoration Workshop (Part 2)
3:15	A Comparison of Woody Plant Survival Rates Following Transplantation into Created Wetlands *Amy J. Nazdrowicz, Landmark Science & Engineering, Inc.*	Investigating Wetland Flows and Sediment Fluxes at PHNWR *Christopher Sommerfield, University of Delaware*	

Invited Speaker Biography:
William Mitsch

Director, Everglades Wetland Research Park

Thursday, February 4, 9:05 AM



Dr. William J. "Bill" Mitsch has been Eminent Scholar and Director, Everglades Wetland Research Park, and Sproul Chair for Southwest Florida Habitat Restoration and Management at Florida Gulf Coast University since October 2012. His research and teaching have focused on wetland ecology and biogeochemistry, wetland creation and restoration, ecological engineering and ecosystem restoration, and ecosystem modeling. In August 2004 he was awarded the 2004 Stockholm Water Prize by King Carl XVI Gustaf of Sweden. He has also been awarded the Ramsar Convention Award for Merit (2015), an Einstein Professorship from the Chinese Academy of Sciences (2010), the Lifetime Achievement Award from the Society of Wetland Scientists (2007), and the Theodore M. Sperry Award from the Society for Ecological Restoration International (2005).

Reaching Your Audience: Accelerating Wetlands Restoration in the Chesapeake *and Beyond Workshop*

Thursday, February 4, 1:20 PM

Lobdell Room

Workshop Leaders

- Steve Raabe, *OpinionWorks*
- Amy Jacobs, *The Nature Conservancy*
- Erin McLaughlin, *Maryland Department of Natural Resources*

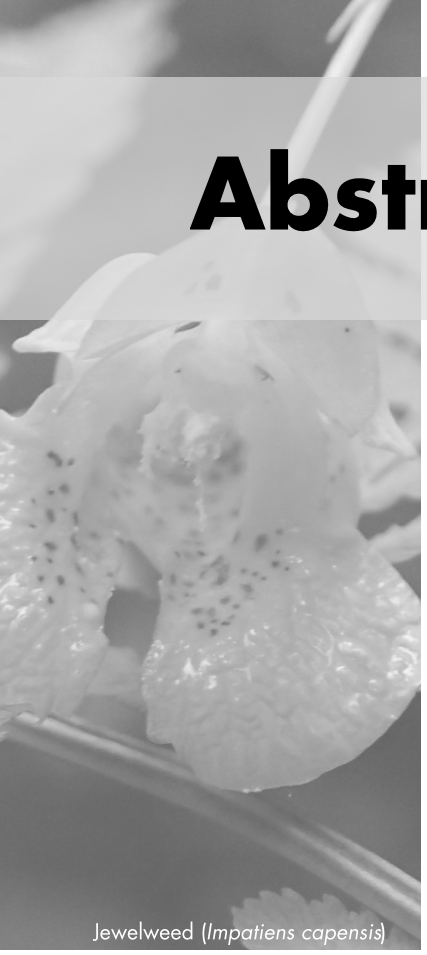
Background –Accelerating wetland restoration across the Chesapeake Bay watershed is critical to achieving clean water and enhancing habitat for aquatic and wetland wildlife. The Chesapeake Bay watershed states committed to restore over 100,000 acres of wetlands on agricultural lands by 2025. The Nature Conservancy and Ducks Unlimited spearheaded an effort to identify ways to increase wetland restoration in four states of the Chesapeake Bay watershed: Pennsylvania, Delaware, Maryland and Virginia. The result was a stakeholder interview report (October 2015) which compiled interviews from more than 70 partners across all four states, identifying the complexity of obstacles, offering related solutions, and implementing new ideas and processes to reach restoration goals.

One solution was to develop better marketing strategies. In 2015 Opinion Works used results from a survey of over 200 landowners and a series of focus groups across southern Pennsylvania and the Eastern Shore of Maryland to develop a social marketing plan for increasing participation in wetland restoration programs. This plan is being unveiled to offer recommendations and take feedback.

Part 1 – Participants will gain an understanding of landowner and practitioner-based road blocks and barriers preventing participation in wetland restoration programs and how a social marketing plan can be applied to help reach program goals.

Part 2 – Participants will review examples and give feedback on the social marketing plan developed from the results in Part 1 to address barriers and increase wetland restoration program enrollment.

Abstracts



Jewelweed (*Impatiens capensis*)

Thank you to all of our presenters. This conference would not have been possible without you!

Restoration

Day 1, AM —Dravo Auditorium

Nanticoke Tax Ditch Restoration Fawn Road to Redden Road

***Brian Jennings**, USFWS*

The U.S. Fish and Wildlife Service (USFWS), Delaware Department of Natural Resources and Environmental Control (DNREC), and the Nanticoke River Tax Ditch Association will use a Natural Channel Design approach along 4,342 linear feet of the Nanticoke River Tax Ditch to restore sediment transport, create stream bed habitat diversity, and increase flood storage. Past and current ditching maintenance practices create an oversized channel that loses its capacity to transport sediment. The reduction in sediment transport capability results in aggradation and the loss of flood storage. Furthermore, as the channel fills in with sediment, repeated dredging is required at a great cost financially as well as ecologically. Restoring water quality and habitat, as well as enhancing resiliency for future weather events are top priorities of the project. Elimination or reduction of the dredging maintenance will reduce maintenance cost and avoids negative impacts to the stream. The ability of the river to move sediment and have access to its floodplain wetlands provide valuable services to residents of the watershed including flood retention and water quality improvement.

Urban Wetland Restoration in the South Wilmington Wetland Park

***Justin Reel**, RK&K*

The City of Wilmington's South Wilmington Wetland Park Project demonstrates the compromises and challenges associated with urban wetland restoration. The project is located in a degraded brownfield wetland with elevations well below MHW of the nearby Christina River and is surrounded by light industrial and residential development. One goal of restoring tidal connectivity to the Christina River was limited by a tidal flooding study of the surrounding properties that indicated that only the lowest portion of the tidal prism could be safely allowed into the site, and a tide regulation system would be required. An inundation duration study determined that the vegetated marsh plain had to be set above limit of tidal influence. Extensive surface and ground water monitoring was conducted to document the existing flooding conditions on adjacent properties and provide the baseline for the hydraulic model of proposed conditions. Storm event inundation frequency was used to determine the elevations for emergent, shrub-scrub, and forested wetland communities as well as upland communities. Site grading was influenced by the need to provide adequate stormwater storage capacity and to reduce costs associated with contaminated soil disposal. Stormwater forebays, passive park amenities and powerline access are significant components of the final design. Despite limitations and challenges this project will provide ecological uplift, stormwater storage, recreation, and educational opportunities in a highly developed urban environment.

Strategies for Assessment and Restoration of Resilient Urban Tidal Wetlands

***Christopher Haight**, Ryan Morrison, Rebecca Swadek, Marit Larson, NYC Parks; Helen Forgione, Natural Areas Conservancy (NAC)*

New York City and partners have invested in the restoration of hundreds of acres of tidal wetlands across the city since 1990; however there has never been a city-wide assessment to examine the condition of these sites. Such an assessment is essential in the context of continued wetland loss and need for restoration of these systems in NYC. The objective of this project is to quantify ecological conditions and functions in restored marshes of varying types and ages in order to: (1) compare restorations to one another and to existing salt marshes; (2) develop salt marsh restoration design guidelines that account for sea level rise and climate change; (3) review and refine restoration monitoring guidelines. We developed a protocol to quantify the functions of Habitat, through measurements of vegetation percent cover, stem heights, aboveground plant biomass, and fauna counts, and Marsh Structural Stability through belowground biomass sampling, soil characterization, and a desktop analysis of change in marsh area since restoration. A simplified protocol only examining percent cover and fauna was applied to 16 restored sites across the city in June and July 2015. A more intensive protocol that included biomass collection and soil cores was applied to 8 restored sites and 6 reference sites in August and September 2015. The findings from this sampling will be analyzed and compared across restored sites and with natural sites to determine statistical differences. The goal of this project is to use this information to help inform future salt marsh restoration monitoring and design.

Mirror Lake Remediation and Restoration - The First Full-Scale Application of Activated Carbon - Dover, Delaware

John G. Cargill, IV, *DNREC, New Castle; Richard W. Greene, DNREC, Dover; Mark A. Biddle, DNREC, Dover; Upal Ghosh, UMBC, Baltimore, MD*

The St. Jones River in Kent County, Delaware has been contaminated by PCBs, dioxins and furans, organochlorine pesticides, PAHs and mercury from various sources, mostly in the past. Mirror Lake is part of the St. Jones River and is located just downstream from the head of tide in historic Dover, DE. In Fall 2013, activated carbon, in the form of SediMite™ pellets, was delivered directly to the surface of the lake to reduce the bioavailability of site contaminants. At the time of field application, the project represented the first full scale remediation project in North America to use SediMite™, and was the first State-led project of its kind anywhere in the USA. The remediation project was also coupled with habitat restoration activities. Approximately 80 tons of SediMite™ was broadcast into the 5-acre Mirror Lake project area over a ten day period. A new intertidal wetland, two flow diversion rock vanes, 800 linear feet of coir logs, and over 6,000 wetland plants were concurrently installed. The effectiveness of the AC treatment is being evaluated by monitoring bulk sediment, sediment porewater and surface water contaminant concentrations over time, as well as benthic invertebrate and fish tissue bioaccumulation. Comparisons between pre- treatment sampling and year one post-treatment sampling show over 70% reduction in sediment porewater and surface water PCB concentrations, and over 60% reduction in fish tissue PCB concentrations of resident fish. Restoration of the intertidal wetland reduced nuisance resident waterfowl, increased habitat, and will add to improved water quality over time.

Notes:

Increasing Salt Marsh Acreage and Resiliency for Blackwater National Wildlife Refuge

David R. Curson, *Audubon Maryland-DC; Erik Meyers, The Conservation Fund; Matthew W. Whitbeck, USFWS; Albert McCullough, Sustainable Science, LLC; Charles Walker, USGS*

Blackwater National Wildlife Refuge in Maryland lies at the heart of one of the largest tidal marsh complexes in the northeastern United States, which is recognized as an Important Bird Area (Southern Dorchester County IBA) supporting globally important populations of Black Rail and Saltmarsh Sparrow. Rapid sea level rise threatens the survival of this ecosystem during the current century. Strategies to increase resiliency of Blackwater's marshes are being implemented by a nonprofit-public agency partnership as part of a larger climate adaptation project that was established in 2011. Current projects underway include the sediment enhancement of 40 acres of disintegrating, high value tidal marsh using locally sourced material, and a detailed study of hydrological issues that are causing erosion of tidal marsh that has recently transitioned from former agricultural uplands in an effort to halt or slow its continued decline. Sites for these projects were identified from prior work involving strategic Sea-Level Affecting Marshes Model (SLAMM) assessment combined with bird survey data and various land attributes to identify and prioritize both a Marsh Conservation Zone where marsh resilience work will be focused, and also marsh migration corridors to conserve for future tidal marsh development. The assessment was the basis for a comprehensive set of adaptation strategies that included identification of priority marsh migration corridors for application of land conservation approaches that help deflect poor land use choices, BMPs for facilitating marsh migration and BMPs for enhancing resilience of existing marsh to sea level rise in the project area.

Variability of Organic Carbon Accumulation in Delaware Tidal Marshes

Kaitlin J. Tucker, *Christopher K. Sommerfield, University of Delaware; David Velinsky, Drexel University*

Organic carbon sequestration in tidal marshes is considered an important means to mitigate the impacts of greenhouse gas emissions on climate change. Coastal and estuarine marshes are an important sink for atmospheric carbon dioxide, but there are unanswered questions regarding how carbon accumulation varies spatially and temporally. This study quantified carbon accumulation rates for saline and brackish marshes of Delaware Estuary in order to establish the time dependence of carbon burial, which has not been systematically investigated in this region. Radionuclide chronometry (137Cs, 210Pb, 14C) for 24 short cores and 5 long cores was used to compute carbon accumulation rates averaged over decadal to millennial time-scales. Based on 137Cs geochronology, carbon accumulation rates ranged from 28-440 g C m-2 yr-1 and are within the reported range of rates for other US Atlantic coast marshes (21-482 g C m-2 yr-1). In comparison, carbon accumulation rates based on 14C dating ranged from 53-113 g C m-2 yr-1. Changes in mineral and organic inputs to a marsh system, as well as continued decomposition of organic matter, will vary carbon burial over time and thus carbon accumulation rates are lower over longer timescales (14C) compared to shorter time-scales (137Cs, 210Pb). Understanding the time dependence of carbon accumulation rates in Delaware tidal wetlands will provide important geological context for assessments of carbon sequestration regionally.

Studying Sea Level Rise and Coastal Forests with Dendrochronology

Stephanie Stotts *PhD, Wesley College; Lihoshimar Gonzalez, Wesley College*

Sea level rise is of great concern in Delaware and will undoubtedly impact low lying coastal forests, which are important for nutrient filtration and storm surge protection. Dendrochronology uses the width of annual tree rings to determine the dating of events. This powerful tool has been used to study drought history, river flow, coastal storm frequency, changes in temperature and precipitation, and changes in other environmental variables. It is conceivable that dendrochronology could also be used to study sea level rise and its impact on coastal forests, but this avenue of research has been given little attention. In this project, we created a difference chronology between trees growing above and bellow 0.5 m in elevation at the St. Jones Reserve in Dover, DE, allowing us to compare the ring structure between the two groups. The next step in the project is to look or correlations between the difference chronology and environmental variables (e.g., sea level, coastal storm events, surge events, etc.). The results of this study could lead to the development of a new tool for studying sea level rise in areas without long-term tidal gauges and allow for predictions regarding coastal forest response to future increases in sea level.

New Maps and Guidance for Flooding and Sea Level Rise Can Help Plan Wetland Conservation and Restoration

Susan Love*, DNREC Division of Energy and Climate; Michael Powell, DNREC Division of Watershed Stewardship*

State agencies in Delaware have been directed by their governor to take climate change into consideration by avoiding construction of structures and infrastructure in areas that could be subject to flooding now or in the future and minimizing potential of flood risk where avoidance is not feasible. They were also directed to take climate change into consideration for long-range plans for land management, land-use and capital spending. A new guidance document is available that steps users through a process of avoiding and minimizing risk of flood damage to structures and infrastructure. New maps depicting areas that could be susceptible to the 1% chance storm with 3 feet of sea level rise, dubbed the Flood Risk Adaptation Map, are a component of this guidance. This presentation will highlight the how the guidance document and Flood Risk Adaptation Map can be used by wetland professionals for wetland conservation and restoration. It will include a demonstration of the different mapping products that can be used by all wetlands professionals to gauge existing and future flooding issues on a parcel or in a region and highlight several examples of projects that have used the principles in the guidance document to prepare for future flood risks.

EPA Grant: Tracking Mitigation Sites and Mitigation Banks in the State of NJ

Anika Andrews-Spilman*, NJDEP*

New Jersey has a long history of establishing regulatory protection of coastal and freshwater wetlands. Under the Coastal Wetlands Act of 1973 (N.J.S.A 13:9A-1 et seq.) and the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) and subsequent implementation rules, the Department established defined criteria and standards for permitting wetland impacts and compensatory mitigation. Past analysis of these regulatory efforts has identified areas of process (Torok et al. 1996) and areas in need of enhancement (DSRT 2002). Consistent with the Department's initiatives, we proposed the following actions: The first action is to develop a Wetlands Mitigation module within the Department's enterprise information management system (NJEMS) and migrate information from the Department's wetland mitigation database (WETMIT) into NJEMS. The second action is to develop a GIS data layer of wetland mitigation site locations, bank locations and bank service areas for use by Department staff, sharing with Federal agencies and the general public via the Department's interactive website. Outcomes of this effort include the development of a standardized integrated data structure and submission and collection process and applied GIS practices to ensure consistency in data retention for all mitigation sites, improved monitoring and tracking ability of individual mitigation sites, activities and overall success rates at the state level, increased public access to mitigation data through our integrated public-facing reporting portal Data Miner, and improved Federal reporting capabilities for our assumed wetland program to the federal agencies including the ability to develop and implement NEIEN data flows from our existing Exchange Network Node.

Marsh Futures: Assessment and Mapping of Salt Marsh Vulnerabilities to Guide Restoration at the Local Scale

Danielle Kreeger*, Joshua Moody, PDE; Moses Katkowski, TNC; Diana Rosencrance, NLT; Martha Maxwell Doyle, BBP; Rick Lathrop, Rutgers University*

Storm damage from Superstorm Sandy appeared reduced in communities that were buffered by coastal wetlands. Since wetland loss is pervasive and funding remains elusive, it is vital that wetland restoration efforts target crucial sites with strategically timed and chosen tactics. Tools are being developed based on remote sensing datasets to guide restoration however, higher resolution topographical and ecological condition indiscernible to remote sensing can affect performance of tactics such as living shorelines and thin-layer sediment application. Therefore, on-the-ground data may be necessary to guide the specific location and design of projects aimed at offsetting wetland erosion and drowning. Marsh Futures refers to a two-step effort to 1) assess and map local conditions in areas where wetland restoration is sought, and 2) produce maps to guide the timing, sequence and types of suggested restoration activities. This approach was tested at the three areas in 2014 and in two areas within three regions in 2015. Field assessments consisted of surveys of elevation (RTK-GPS) and plant health metrics. Maps of "elevation capital" were then produced for the marsh platform; i.e., vulnerability to drowning due to rising sea level. Edge retreat rates were used to estimate vulnerability to horizontal erosion. A weighted measures risk assessment approach was used to score sub-areas for various threats. Vulnerability maps were contrasted with inventories of restoration tactics to develop spatial and temporal recommendations for conservation, enhancement or restoration options at the three pilot areas.

An Overview of the NFWF Post-Sandy Bombay Hook Project: Numerical Modeling and In-Situ Measurements

***Ali Abdolali**, James T. Kirby, Edward C. Davis Professor, Fengyan Shi, Guoxiang Wu, Christopher K. Sommerfield, Conor Mcdowell, Center for Applied Coastal Research (CACR), University of Delaware*

The Bombay Hook National Wildlife Refuge protects one of the largest remaining expanses of tidal salt marsh in the Mid-Atlantic region along Delaware Bay. Over the past century, various natural and anthropogenic alterations to the natural marsh system have been made. In this project, we are investigating various hydrodynamic processes and sediment transport in the marsh system, including the effects of net tidal circulation in the multiple-inlet system, and the effect of tidal asymmetry on marsh/bay exchange mechanisms. We have implemented a high resolution unstructured grid model of the entire marsh system using the FVCOM model. The model is driven by current and surface elevations derived at open boundaries from a large-domain structured grid ROMS model output. The large Delaware Bay model incorporates archived HYCOM model results in order to ensure the accurate subtidal surface gravity wave and volume flux generated by storm and local wind. The marsh geometry has been resolved with detailed bathymetric survey and Lidar data set. Parallel to modeling efforts, we have deployed Aquadopp ADCP's to assess tidal, subtidal and residual circulation through the a system of channels within the marsh interior. We have also deployed pressure gauges to examine flooding and draining pattern over the marsh, and to measure wave conditions in the largest open tidal flat within the marsh system. In this talk, we will present a synthesis of model and field results aimed at testing the hypothesis that sediment is being lost from the wetland system.

Modeling Wind Waves in a Confined Tidal Flat Area: Bombay Hook National Wildlife Refuge, Delaware

***Mithun Deb**, Ali Abdolali, James T. Kirby, Edward C. Davis Professor, Center for Applied Coastal Research (CACR), University of Delaware*

Wave erosion at exposed marsh boundaries is recognized as a driver for marsh edge degradation. The collapse of marsh platform and formation of variably-inundated tidal mud flats within the confines of the marsh additionally exposes the marsh to potential erosive effects from within, which can speed the rate of marsh collapse and further extend regions of open water. We describe an ongoing study of wave climate in a tidally-inundated flat contained within the Bombay Hook National Wildlife Refuge. The study employs field measurements and numerical modeling in an attempt to estimate the long term potential for wave-driven shoreline erosion and resulting enlargement of the tidal flat. We use two RBR pressure sensors, located on the tidal flat, to continuously record tidal elevation and superposed short wind waves at a frequency of 16Hz. Measurements have been collected for most of 2015 and will continue for the duration of the project. Wave modeling has been carried out using the SWAN model, first in order to examine wave growth in idealized conditions, and then as a model of time varying depth and wind conditions as determined from observed conditions, using a model DEM taken from our larger scale hydrodynamic simulations of the entire Refuge. The model is shown to predict a reasonable estimate of spatially varying wave period and height at field measurement locations, and is thus potentially useful as a tool for quantifying shoreline wave climate and erosion rates as a function of wind and water level climatology.

Planning & Conservation

Day 1, PM —Dravo Auditorium

Cultural Resources Conundrums: Navigating Section 106 Review in Wetlands Projects

***John McCarthy**, RPA, DNREC, State Parks*

Wetland creation and restoration projects invariably involve federal permits and/or funding. As such, these activities are "undertakings" subject to review under Section 106 of the National Historic Act, as amended, and the implementing regulations of the Advisory Council for Historic Preservation published at 36 CFR 800. In this talk, veteran cultural resources specialist, John McCarthy, RPA, explains the Section 106 process and shares hints and tips to help keep your project moving smoothly through this review and compliance process. Central to this is the understanding that Section 106 review is a consultative process of compromise and accommodation rather than an adversarial regulatory process. John will draw on his nearly 40 years of experience in the fields of cultural resources management and historic preservation in discussing case studies and examples to illustrate the points he makes.

Notes:

Minimizing Marsh Impacts: Permitting and Construction of the Milford Emergency Pole Replacement Project within the St. Jones Research Reserve Marsh

***Andrea Knauer**, **Emily Dolbin**, McCormick Taylor*

The Cedar Creek Substation to Milford Substation 230 kV Circuit is approximately 43 miles long, spanning between Smyrna, DE in southern New Castle County, crossing Kent County, and terminating in Milford, DE in Sussex County. This infrastructure is owned and operated by Delmarva Power (DPL). Within the limits of this circuit, Structure 427 within the St. Jones Research Reserve was in urgent need of replacement due to dangerous and precarious structural deficiencies. The proposed Cedar Creek to Milford Emergency Pole Replacement Project consisted of rebuilding Structure 427 and 5 additional structures within the St. Jones Research Reserve marsh, and reconfiguration of two structures outside the marsh on the edges of the Reserve. This project was presented twice before the agencies (12/4/2014 and 1/28/2015), to include representative of DNREC, DNERR, Coastal Zone Program, and DNR. Considering feedback from the agencies at these meetings, DPL engineering proposed and executed a plan to utilize a helicopter, and strategic placement of matting to install poles and minimize impacts to the marsh. Permits were obtained on a "fast-track" pace, and included a DNREC W&SLS Permit, USACE Nationwide Permit 12, and a County E&S permit. The project went to construction in early April 2015 and was completed successfully with temporary impacts to surrounding resources. Environmental concerns included avoiding stands of Spartina high salt marsh, nesting ospreys, avoiding biomonitoring plots located throughout the right of way, and minimizing compression and compaction of the tidal wetland soils.

Establishment of Wetlands for Permit Mitigation: The Process & Lessons Learned

***Bruce S. Workman**, Senior Environmental Scientist at T.E.S., Inc.*

Yes – it can be done! Wetland establishment (i.e., creation) in upland areas for the purpose of satisfying permit mitigation requirements can be readily and successfully accomplished. Established wetlands can be designed and constructed that effectively replace – and often exceed – the functions and values lost by wetlands unavoidably impacted by land development activities. However, establishment success does not happen without due and proper effort. The exercise of basic and sound planning measures coupled with competent execution of the wetland establishment plan will ensure the attainment of stated goals and objectives. A sound wetland establishment plan will contain integral parts that are well thought out and complete. The first crucial part is the statement of establishment goals that are realistic and attainable. Functioning as the "mission statement" of the establishment effort, the stated goals will direct all parts of the plan that follow and will act as a guide to keep the effort on track. Other integral parts of the wetland establishment plan include hydrology analyses (including a basic "water budget" at minimum), site selection evaluation, sub-surface (soils) investigation, construction drawings (plans and profiles), a planting plan (that includes consideration of existing "nuisance" plant species that could affect the establishment site), and a construction monitoring plan (that includes effective communication with site personnel – i.e., "the guy on the dozer"). This presentation will detail the preparation of effective wetland establishment plans and will review real-world mitigation efforts where these plans have been applied with success.

Delaware's Category 1 Wetlands: A Priority for Conservation

***William A. McAvoy**, DNREC, Div. of Fish & Wildlife*

Wetlands in Delaware identified as Category 1 include: Black Ash Seepage Swamps, Inner-dune Depression Meadows, Piedmont Stream Valley Wetlands, Peat-land Fens, Bald Cypress Swamps, Atlantic White Cedar Swamps, and Coastal Plain Seasonal Ponds. These wetland types are designated as such due to their distinctive ecological qualities and the rare species they often support. The uniqueness of Category 1 wetlands makes them a valuable component of the state's natural heritage and are priority resources for conservation and protection.

Enhancing Delaware's Drainage Network Through the Use of Natural Channel Design Techniques "Not Your Father's Tax Ditch"

***Sara B. Esposito, P.E**; Brooks P. Cahall, Matthew T. Grabowski, DNREC Program Manager; Melissa A. Hubert, DNREC Environmental Planner*

A tax ditch is a governmental subdivision of the State formed through Superior Court. Traditionally these systems were constructed to provide drainage benefit to low lying areas and agricultural fields. Delaware has over 230 Tax Ditch organizations responsible for managing over 2,000 miles of channel that deliver drainage to over one third of the State. However, after channelization many of these ditch systems were disconnected from adjacent floodplains and forested wetlands. In addition, the combination of channel construction, hydrologic changes, and highly erodible soils has resulted in loss of ditch banks and increased sediment deposition. Permanent rights-of-way established adjacent to the ditches provide access for maintenance practices that typically include annual mowing to control vegetative growth, rip rap bank repairs, and ditch dip outs to maintain drainage. The DNREC Drainage Program with assistance from interagency partners and Tax Ditch managers are working to improve Delaware's drainage. Utilizing natural channel design techniques not typically found in Tax Ditches, our partnership has begun to enhance floodplains, restore wetlands and habitat, and stabilize ditch banks using "green" techniques in lieu of riprap. Small projects have included use of compost and coir logs with live stakes for bank stabilization and two-stage channels with floodplain benches. Also, major stream restoration projects are transforming traditional Tax Ditches into natural systems by creating riffles, pools, and structures for grade control stabilization and habitat. These types of projects sustain essential drainage while helping to meet water quality goals by reducing pollutants including nitrogen, phosphorus, and suspended solids.

Did You Know ?
The Delaware Wetlands program has a free quarterly e-newsletter? *Sign up for the Delaware Wetland Connection Today!*

Tidal Plants & Animals

Day 1, PM — Christina Ballroom

Developing Seashore Mallow as an Alternative Crop on Salinized Soils Along the Delaware Bayshore and Investigating its Use as a New Source of Poultry House Bedding

***Kate Hackett**, Delaware Wild Lands, Inc; Jennifer Volk, University of Delaware (UD), College of Agriculture and Natural Resources, Cooperative Extension; Dr. Jack Gallagher, Dr. Denise Seliskar, UD, College of Earth, Ocean, and Environment; Bill Brown, UD, College of Agriculture and Natural Resources, Cooperative Extension*

Salt water that washes over agricultural fields during storm events and extreme tides can severely degrade a soils' ability to produce traditional crops like corn and soybeans. An alternative, salt tolerant crop that may be able to sustain the productivity of these impacted lands is being investigated. Seashore mallow (*Kosteletzkya pentacarpos*) is a perennial, non-invasive wetland plant native to the east and gulf coasts of the US. UD researchers have been studying the plant, its ability to be cultivated as an alternative agriculture crop, and potential marketable products. Most interesting and applicable to Delaware and the Delmarva Peninsula is the excellent absorbent capacity of the milled stems, which make ideal bedding for small animals, such as chickens. A recent small pen study has shown that the chipped stem material proves promising as a new, local, source of poultry house bedding. If additional research and assessment support these findings, there is great potential for the use of seashore mallow by this regions poultry industry, as the traditional bedding material, pine shavings, have decreased in availability and increased in cost. Seashore mallow also provides environmental benefits such as carbon sequestration, erosion control, air and water filtration, and suppression of invasive *Phragmites*. Thus, if able to be utilized as an alternative crop on salt-impacted lands (while enabling coastal farmers sustained productivity for a period of time), seashore mallow will also ultimately allow for adaptation to sea level rise as wetland communities migrate inland.

Notes:

Geospatial Variation of Ribbed Mussel (*Geukensia demissa*) Ecosystem Services Across the Salt Marsh Landscape

***Joshua Moody**, Danielle Kreeger, PDE; Elizabeth Watson, Academy of Natural Sciences of Drexel University*

Ribbed mussels are ubiquitous in Mid-Atlantic salt marshes where they help maintain clean water, improve habitat and potentially help marshes keep pace with sea level rise. In the Delaware Estuary, ribbed mussels are the functionally dominant bivalve, potentially filtering more water than all other native bivalves combined. Although abundant, their densities and demographics are not consistent across the marsh platform, affecting the distribution of mussel mediated ecosystem services. Ribbed mussel densities, seasonal clearance rates and seston nutrient concentrations were quantified in three habitats: low marsh along large rivers, low marsh along small creeks, and high marsh in four representative marshes (3 NJ, 1 RI). Nutrient removal services were represented by the filtration rate of particulate nitrogen, normalized for mussel dry tissue biomass and spatial variation in mussel densities. Ribbed mussels were estimated to filter between 41 and 237 metric tons of TSS/ha/yr in the four studied salt marsh systems, averaging 92.6 tons/ha/yr overall. If mussel feces were displaced evenly across the marsh surface, they would contribute 5.6 mm/yr to surface accretion rates. Additionally, ribbed mussel populations were estimated to remove an average of 476 kg/ha/yr of particulate nitrogen. These services were concentrated in creeks despite higher acreage of high marsh and the similarity of river habitat, suggesting that marshes with high edge erosion rates lose nitrogen removal services despite being suitable habitat. Therefore, conservation and restoration actions aimed at water quality enhancement should prioritize tactics that stem the loss of mussel habitat where ecosystem services are concentrated.

An Early Juvenile (Age 0-1) Atlantic Sturgeon Abundance Estimate and Habitat Usage within the Delaware River Estuary, USA

***Edward A. Hale**, Ian. A. Park, DNREC, DFW, Matthew T. Fisher, VIMS, Richard A. Wong, Michael J. Stangl, John H. Clark, DNREC, DFW*

The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus)* is a long lived, highly fecund and late maturing anadromous fish that historically supported a significant commercial fishery along the eastern coast of North America. Overfishing led to significant population declines with contributions from other anthropogenic impacts which continue to impede recovery. Despite the 2012 endangered species listing of five distinct Atlantic Sturgeon population segments, including the New York Bight population segment, to which the Delaware River spawning stock belongs, relatively little is known about the current population status of natal river populations. The adult population within the Delaware River Estuary is estimated to be less than several hundred individuals. Our work is the first to estimate the abundance of Delaware River Estuary early juvenile (age 0-1), resident Atlantic Sturgeon. Using the Schumacher and Eschmeyer mark-recapture estimator for multiple censuses, we estimated 3,656 (95% confidence interval [CI] = 1,979-23,895) individuals used the Delaware River Estuary as a natal nursery in 2014. Further, we identified key habitat areas where age 0-1 juveniles spend considerable amounts of time including the Marcus Hook area within the Delaware River Estuary using a passive acoustic receiver array.

Estimating Tidal Marsh Bird Population Sizes and Identifying Priority Areas for Conservation in the Northeast USA

***Greg Shriver**, Whitney Wiest, University of Delaware, Chris Elphick, University of Connecticut, Brian Olsen, University of Maine*

Tidal marsh bird communities will require innovative conservation strategies to persist over the coming decades as sea level rise affects tidal marsh habitat quantity and quality. Tidal marsh bird distributions and population sizes are generally unknown, but are critical for implementing effective conservation plans. We established a regional marsh-bird monitoring platform and collected baseline data for species breeding in the Northeast USA (Maine – Virginia). We sampled 1,780 locations during the 2011 – 2012 breeding seasons and used the survey data to develop Bayesian network models to estimate population sizes for: Clapper Rail (*Rallus crepitans*), Willet (*Tringa semipalmata*), Nelson's Sparrow (*Ammodramus nelsoni*), Saltmarsh Sparrow (*A. caudacutus*), and Seaside Sparrow (*A. maritimus*). We modeled species occurrence and density as a function of covariates at the site, local, landscape, and regional scales. The models predicted that Nelson's Sparrow was similarly distributed in Coastal Maine and Cape Cod – Casco Bay and the four other species were most common in Long Island (Saltmarsh and Seaside Sparrows), Delaware Bay (Clapper Rail), and Coastal Delmarva (Willet). We estimated 109,994 (±395 95% CI) Clapper Rails; 111,184 (±267) Willets; 6,623 (±55) Nelson's Sparrows; 59,796 (±341) Saltmarsh Sparrows; and 233,773 (±237) Seaside Sparrows in the Northeast. These abundance estimates can be used to identify priority conservation areas at multiple geographical scales and the flexible Bayesian network models can be incorporated in adaptive management frameworks for long-term tidal marsh bird management.

The 2015 Delaware Wetland Management Plan-Ready for Action

***Alison B. Rogerson**, DNREC*

Delaware is a state rich with wetland resources ranging from the forested vernal ponds inland, to the highly productive salt marshes along the Delaware Bay, to the unique Bald Cypress Swamps on its southern border. As stewards of these great resources it is our task to slow the loss of wetland acreage and function, improve the health of remaining wetlands and work together to better understand and truly value wetlands for what they provide. In this update of the 2008 Delaware Wetland Conservation Strategy, DNREC and the Delaware Forest Service teamed up to create a guiding document that identifies new goals and action items for improving wetland conservation and management in Delaware 2016-2020. The plan is intended to be used by any entity working in wetlands to encourage collaboration, facilitate project sharing and reduce redundancy. Based on the advice of a team of professionals and a literature review of numerous related strategies, plans and surveys, seven goals and forty-five underlying action items encompass how to further develop an effective and efficient wetland program in Delaware. This presentation will introduce the plan and highlight opportunities to address some of the threats and gaps through collaboration in the upcoming years.

Shoreline Restoration

Day 2, AM —Dravo Auditorium

Living Shorelines Mythbusters – Addressing Assumptions and Misconceptions About "Living Shorelines"

***Douglas Janiec,** Sovereign Consulting Inc.*

Delaware has emerged as one of the most proactive states in the Union regarding the technical development and advancement of living shorelines. DNREC, two DE National Estuary Program's, municipalities, practitioners, and communities are working together, implementing pilot projects, streamlining the regulatory process, securing funding, providing outreach, and so on. Unfortunately, there are still some significant misconceptions regarding living shorelines, even within the technical circles. This presentation will touch upon a select group of reoccurring misconceptions regarding living shorelines. Such misconceptions which will be discussed include how: all hybrids are alike; a hybrid living shoreline is just another type of breakwater; living shorelines cannot be deployed in higher energy systems; living shorelines are more expensive than traditional armoring tactics, and so on. The goal of this presentation is to provide the audience with a clearer understanding of what living shorelines are, and how they represent a unique and often complimentary approach to shoreline stabilization relative to, and working with, traditional approaches.

Application of an Innovative Living Shoreline Technique at the Bethany Loop Canal

***Robert Collins**, Marianne Walch, Delaware Center for the Inland Bays, Doug Janiec, Sovereign Consulting Inc.*

A demonstration living shoreline (LSL) was installed in spring 2015 on the Bethany Beach Loop Canal, at the south end of Salt Pond. A portion of the land is tidal marsh, and smaller upland portions are the remnants of old spoil berms from the construction of the Loop Canal approximately 100 years ago. The banks and marsh have experienced significant erosion on the northern (Salt Pond) side due to wave activity. To stop the loss of shoreline and restore lost tidal marsh, this LSL project used a unique "hybrid" of onshore/offshore practices, all made from natural materials, including tree logs and coir fiber logs. The tree logs were placed in patterns to break up wave energy just offshore and to create "cells" along the shoreline that will trap sediment and begin the marsh rebuilding process. The project is intended to stabilize approximately 350 feet of eroding shoreline and restore 0.4 acres of degraded tidal wetlands. Multiple partners were involved in its funding and construction. Due to a variety of constraints and challenges encountered in the field, some of the materials and construction techniques called for in the original design plan had to be changed during installation. The completed project has worked as designed to dissipate wave energy and deposit sediment. However, some damage occurred when an extended nor'easter associated with hurricane Joaquin dislodged a portion of the logs. The challenges and lessons learned from this project will be discussed in the presentation.

Shoreline Stabilization Along the Delaware River Using Wave Attenuation Devices

Ryan Rupprecht, *Chris Pfeifer, Cardno, Scott Bartkowski, Living Shoreline Solutions*

Shoreline along the Delaware River behind the Delaware City Refining Company (DCRC) docks is being eroded predominantly by storm-driven waves. Recognizing that shoreline erosion has reached a point that now threatens facility infrastructure, DCRC pursued a shoreline stabilization project using Wave Attenuation Devices (WADs). WADs are hollow, three-sided, pyramid-shaped concrete structures with triangular openings on each facet. Unlike breakwaters or sills, which deflect or refract wave energy, WADs dissipate the majority of concentrated wave energy as waves pass through the structures. This technology directly addresses a primary cause of shoreline erosion by intercepting and attenuating wave energy prior to landfall. Converting higher energy shorelines into lower energy systems will reduce or arrest shoreline retreat and promote sediment accretion and natural shoreline rebuilding. The DCRC project involved placement of a double row of WADs parallel to the shoreline near the mean low tide line between the docks and shoreline for a distance of approximately 2,700 linear feet. The project will include three years of post-construction monitoring to assess the effectiveness of WADs in preventing additional erosion and document changes in shoreline geomorphology and vegetation. This presentation will review key aspects of project implementation including construction and deployment of the WADs, monitoring, and lessons learned. Wave attenuation is a newer technology that is drawing increasing interest as an alternative shoreline stabilization approach alone or in combination with living shoreline techniques. This is the first project in the Delaware River Basin to implement this technology for shoreline erosion control.

Floating Wetland and Oyster Islands to Improve Water Quality and Habitat in an Impaired Residential Canal

Marianne Walch*, Robert Collins, Delaware Center for the Inland Bays*

Dead-end canals are common features of residential developments in Delaware's Inland Bays. These canals generally are poorly flushed, and the water has very long residence times. Previous studies have shown that dead-end canals lead to poor water quality, poor sediment quality, and low diversity in the biological community. Solutions to improving the water quality in these residential canals generally have focused on pollution control and stormwater quality retrofits within the canal watersheds. Little effort has been devoted to solutions within the canals themselves. Bulkheads along residential canals provide opportune locations to explore how living or green shoreline restoration techniques can be applied to improve water quality. In spring of 2015, the Center for the Inland Bays (CIB) deployed 'islands' of oyster cages and floating treatment wetlands (FTW's) along the bulkhead in a South Bethany canal. A neighboring canal with no treatment serves as a control. The experiment will be monitored for two years. We hypothesize that these treatments will increase nutrient removal and filtration of the water - resulting in less algae growth and increased dissolved oxygen (DO) – and also provide habitat for aquatic invertebrates. DO, temperature and salinity data have been collected continuously from both canals. Data are also being collected on nutrients, chlorophyll, plankton communities, and oyster health and survival. Data will be presented from the first season of monitoring, and some of the challenges and successes of the project so far will be discussed.

Notes:

Monitoring & Assessment

Day 2, AM —Christina Ballroom

Duration and Magnitude of Changes in Marsh Hydrology and Salinity Due to Hurricane Sandy Surges on Eastern Shore Maryland Ditched and Unditched Marshes

***Dorothea Lundberg**, University of Maryland (UM); Brian Needelman, UM; Karen Prestegaard, UM*

Between October 22 and October 31, 2012, Hurricane Sandy brought high winds, rain, and storm surges that affected much of the U.S. East coast. Marshes have the potential to reduce the magnitude of storm surges through several mechanisms, including vegetative drag on the surface, vegetation drag within ditches, water absorption and displacement/dampening, and the sheltering of low lying surface winds. We evaluated the effects of two pairs of ditched and unditched research sites already established for research that captured the effects of the storm on Eastern Shore Maryland, Chesapeake Bay and Atlantic Coast areas. The rainfall during Hurricane Sandy was 25 cm over which was the highest rainfall event during the overall research project from 2011-2015. Wind speeds, which reached a maximum speed of 88.5 km/hr was a main driver combined with rain. Measurements in tidal marshes indicated high water levels in tidal creeks and sustained marsh flooding. The flood surge left behind upland organic matter (pinecones, tree branches) and uprooted marsh vegetation (Phragmites), vegetation burial by sediments at nearby sites. Bay and Atlantic Coastal Inlets NOAA gages showed an increase roughly 2 feet higher than normal tidal heights on October 29, 2012. The rise of the storm hydrograph showed it reached peak after 32.5 hours within the sites. At most sites, water levels were higher for 2 days post storm, but water levels declined to a new baseline water level which lasted a few days before another tropical storm occurred.

Notes:

Virginia Department of Environmental Quality's (DEQ's) Wetland Monitoring and Assessment Program - Development of a Wetland Condition Assessment Tool (WetCAT) and Policy Implications

***Michelle Henicheck**, Development of WetCAT; **Dave Davis**, Policy Implications; Kirk Havens, VIMS*

DEQ's Office of Wetland and Stream Protection (OWSP), in collaboration with the Virginia Institute of Marine Science (VIMS), has developed a wetland monitoring and assessment protocol to provide an ongoing assessment of the status of the Virginia's wetland resources and the success of both wetland regulatory and voluntary programs. The assessment consists of a three-tiered approach using comprehensive coverage of all mapped non-tidal wetlands to achieve a GIS based analysis of remotely sensed information (Level I). Level I scores wetland types based on the habitat and water quality stressors associated with surrounding land use types. Levels II and III are intended to calibrate and validate the model. DEQ staff will be able to make better permit decisions by using a validated tool that measures wetland quality as a function of habitat and water quality parameters. DEQ will also be able to measure how well we are protecting the function of our wetlands by comparing the condition of wetland habitat and water quality parameters, as a function of the assessment scoring over time. The data has been compiled into an online GIS-based wetland data viewer identified as the Wetland Condition Assessment Tool (WetCAT). WetCAT allows users to overlay and run various geoprocessing tools to visualize cumulative impacts, downstream flow, and upgradient drainage areas. The goal of WetCAT is to support DEQ's regulatory decision-making, allow reporting of wetland condition, and provide information for policy development. This information can guide policy discussions on general land use management, stormwater, and land use planning.

Monitoring Response of Estuarine Wetlands to Anthropogenic Disturbances in the St. Jones Reserve

***Christina Whiteman**, Drexel Siok - Delaware Coastal Programs, Lyndie Hice-Dunton, Ph.D. - DNERR*

In April 2015, Delmarva Power & Light (DP&L) began an emergency pole replacement project that impacted portions of the DNERR Vegetation Monitoring site. Following pre-permit planning meetings, DP&L reached an agreement with DNREC's Wetlands and Subaqueous Lands section, the Division of Fish and Wildlife and the DNERR to have all power line replacement work completed with low impact equipment instead of heavy machinery to reduce the disturbance of marsh habitats. Equipment used during the project included a helicopter, an airboat and an Argo (amphibious off-road vehicle) to move construction workers across the marsh and matting to create a stable installation area around the power poles. Once the pole replacement was completed in May 2015, DNERR staff assessed the area and determined that impact of construction was greater than expected and post-project monitoring was needed. The goal of the new monitoring project is to document the level of disturbance and how the marsh recovers or changes over time. This will be captured by monitoring vegetation, soil bearing capacity, and aerial photography via a helikite. Due to its close proximity to the vegetation monitoring site, the area of disturbance will be compared to the nearby transect as a control site.

Quantifying the Value of Tidal Wetland Ecosystem Services in Delaware

Amanda Santoni, *DNREC, Delaware Coastal Programs*

It is well known that tidal wetlands provide many valuable services, including water quality improvement, storm surge protection and wildlife habitat, which support a wide range of commercial and recreational activities. However, between 1992 and 2007 alone Delaware experienced a loss of 580 acres of estuarine vegetated wetlands, 83% of which was due to conversion to open water. Tidal wetlands are further threatened by future rates of sea level rise. Although tidal wetlands provide important ecosystem services, wetland acquisition and management programs must contend with many other important issues for attention and funding from local stakeholders and decision makers, particularly given current economic limitations. This study uses choice valuation methods to quantify the monetary value of tidal wetland ecosystem services in Delaware, and builds an informed argument for funding conservation and management programs. Our approach includes a coupling of natural science and economic methodologies, which integrates knowledge of state natural resource experts, economists as well as public input.

Education & Outreach

Day 2, AM —Lobdell Room

Improve Climate Literacy through Hands-On Mock Marsh Transect

Sarah Nuss*, Chesapeake Bay National Estuarine Research Reserve, VA;* ***Margaret Pletta****, Delaware National Estuarine Research Reserve*

Understanding changes in sea level and inundation, and the associated responses of critical habitats and coastal communities are key to the east coast. Relative sea level rise rates and the associated impacts within the southern Chesapeake Bay region represent some of the highest reported along the Atlantic coast. Educators from the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR) and Delaware (DENERR) are improving climate literacy within local schools by advancing the use of locally relevant environmental data and information in classroom curriculum. New curriculum focuses on broad aspects of climate change, sea level rise, water quality, and community impacts. Attendees will be introduced to the Mock Marsh Transect, a hands-on activity interpreting elevation and changes. Participants will learn how to use the data provided by NERR educators to create this activity in their classroom or schoolyard. At the conclusion of the session, the completed lesson and guiding questions to help students better understand the impact of climate change on the natural ecosystem and coastal community will be available to participants. A demonstration of the activity will be shown during the poster session.

You Mean I Can Get Help Doing This? Engaging Volunteers to Achieve Mission and Objectives

Glen Stubbolo*, DNREC, Jill Friedman Fixler, Sandie Eichberg, and Gail Lorenz, CVA, Boomer Volunteer Engagement: Collaborate Today, Thrive Tomorrow; Jonathan McKee and Thomas W McKee, New Breed: Understanding & Equipping the 21st Century Volunteer; Rick Lynch, Paradigm Shift; Jill Friedman Fixler, Boomer Volunteer Engagement; Femida Handy, University of Pennsylvania; Debbie Haski-Leventhal, Israeli Center for Third-Sector Research, Ben-Gurion University and Lesley Hustinx, Centre for Sociological Research, Katholieke University*

Everyone thinks they know how to work with volunteers. The volunteer world has changed. Volunteer expectations and characteristics have redefined how best to utilize this often underutilized or overlooked resource. This workshop explores the growing body of research that guides best practices in volunteer management. Using current research in social sciences and volunteer management, this workshop examines ways to understand and engage volunteers to achieve agency mission and objectives in an environmental application. *Outcome:* Participants will increase awareness regarding potential of volunteers in meeting mission and objectives. *Objectives:* a. Participants will understand the different types of volunteers and what their role is in engaging volunteers to meet park/program needs b. Participants will consider thoughtful and meaningful ways to engage volunteers in day to day work of park/program c. Participants will better understand why and how to successfully engage volunteers.

Delaware Children in Nature Coalition and the Delaware Environmental Literacy Plan

Cheryl Pittenger*, Delaware Children in Nature Coordinator; Tonyea Mead, DDOE, co-chair CIN ELP committee; Helen Fischel, DNS, co-chair CIN ELP committee*

When you were growing up, did you imagine how difficult it would be to coax today's children outdoors and into nature? Children today spend only a few minutes a day outdoors and their interaction with nature is often limited. Not only can this impact their health, but it limits their understanding of the world, making it harder for them to face the challenges and opportunities of the 21st century. We have another tool in our efforts. Governor Markell just announced the completion of the Delaware Environmental Literacy Plan (ELP). Why should you care? What is the ELP? How can you use it? How can it serve as a tool for science teachers? How about teachers in other subjects? How can it help home schoolers, teacher naturalists, interpreters, parents and other educators in teaching environmental literacy and getting kids outdoors? This plan provides criteria and goals for creating outdoor and environmentally literate learning. For instance, we'll talk about Meaningful Outdoor Experiences (a broader form of MWEE-Meaningful Watershed Educational Experiences). The plan was created by a committee of the Delaware Children in Nature Coalition, meeting an objective of the Children in Nature/No Child Left Inside Initiative Taskforce Report of 2012. The Children in Nature Coalition was formed to improve environmental literacy, create opportunities for children to participate in outdoor experiences, promote healthy lifestyles and provide better access to green space through schools and community programs. We'll discuss what else we're doing and how we might align with your efforts.

Putting the Band Together: Citizen Scientists are the Rock Stars of the Monitoring World

***Beth Wasden**, Nanticoke Watershed Alliance*

With staff support, program partners, and adequate resources, well-trained citizen scientists like the Nanticoke Creekwatchers provide high-quality, long-term data and increase the capacity of organizations and staff. Learn about the Nanticoke Creekwatchers and what you need to put together and maintain a top-tier, volunteer-driven water quality monitoring program.

Non-Tidal Plants & Animals

Day 2, PM —Dravo Auditorium

The Delaware Wildlife Action Plan: Keeping Today's Wildlife from Becoming Tomorrows Memory

***Anthony Gonzon**, DNREC; Karen Terwilliger, Terwilliger Consulting Inc.; Matthew Sarver, Sarver Ecological, LLC.; Shannon Alexander, Alexander Environmental Consulting, LLC*

Delaware is home to a diversity of wildlife and habitats and the Delaware Wildlife Action Plan provides a blueprint for maintaining that diversity. The Plan presents Delaware's Species of Greatest Conservation Need (SGCN), key habitats, issues and research needs, conservation actions, and how the Department of Natural Resources and Environmental Control (DNREC) will monitor effectiveness, coordinate with conservation partners, and foster public participation in wildlife conservation. A dynamic document intended for all audiences interested in conservation of Delaware's biodiversity, the Plan provides guidance to resource agencies, conservation partners, state, county and municipal governments, and private landowners to best address the needs of 692 SGCN and the habitats they use. Statewide issues affecting Delaware's wildlife include climate change and severe weather, invasive species, and habitat loss. Conservation actions to address these issues are presented at the state level, habitat level and SGCN ecological group level. Monitoring Delaware's SGCN, key habitats, and the effectiveness of the conservation actions provides important and necessary information for Delaware and actions can be refined based on their effectiveness in aiding the state's SGCN and key habitats. Brief case studies will illustrate the utility of the Plan for use at local, state and regional scales and provide examples of how the Plan can be put into action by the public, local governments and conservation organizations, state and federal agencies, academic institutions and others that implement strategies outlined in the plan to keep common species common and preserve Delaware's natural heritage.

Bird Use of Delaware Wetlands During Fall Migration Based on Weather Radar Observations

***Jeffrey Buler**, University of Delaware (UD); Tim Schreckengost, UD; Jaclyn Smolinksy, UD; James McLaren, UD; Deanna Dawson, USGS Patuxent Wildlife Research Center' Eric Walters, Old Dominion University*

Identifying important stopover sites is a critical step in development of comprehensive regional conservation plans for migratory birds. We used weather surveillance radar (KDOX in Dover, DE) observations of migrating birds at the onset of nocturnal migratory flights to map their stopover distributions within Delaware during autumns of 2008 through 2014. Comprehensive radar observations summarized across years provided coverage throughout much of the state. Migratory birds stopover in the highest densities within forested wetlands, particularly those near the Delaware Bay coast. Emergent marshes however, harbor low densities of migrating birds. We also estimated linear trends in bird stopover density over 7 years and found concentrated declines in bird stopover use in wetlands around Woodland Beach and Prime Hook National Wildlife Refuge. These declines are consistent with anecdotal observations of waterfowl use in these areas. Weather radar provides a valuable remote-sensing tool to evaluate the value of wetlands to migrating birds.

How to Help Prevent the Spread of Amphibian and Reptile Diseases in Four Simple Steps

***Holly Niederriter**, Delaware Division of Fish and Wildlife*

Amphibian and reptile diseases, including some recently documented in Delaware and other northeastern and Mid-Atlantic States, can cause widespread mortality and local extirpations. Chrytrid fungus, ranavirus, upper respiratory tract infection, herpes virus and snake fungal disease are all diseases/pathogens that occur in our region. In 2013 and 2014, Delaware participated in a multi-state project to determine the extent of ranavirus in our region. In Delaware, ranavirus was detected in 13 of 23 (57%) ponds tested in 2013 and woodfrog (*Lithobates sylvaticus*) die-offs associated with ranavirus were documented in two of those ponds. In 2014, ponds that tested positive for ranavirus were tested again and ranavirus was detected in 8 of 13 ponds (62%); five of which included woodfrog die-offs. Additionally, other pathogens, such as mycoplasma bacteria and herpes virus have been detected in Delaware turtles. Although animals are likely the main vector for spreading disease, humans that visit freshwater wetlands on a regular basis may be increasing the rate of spread and may be taking the pathogens to locations the animals would not be able to take them. In this presentation, we provide simple, easy instructions for disinfecting boots and gear in an effort to decrease the spread of wildlife diseases likely to be tracked from wetland to wetland on boots and gear.

Did You Know ?

Representatives from Delaware, New Jersey, Maryland, D.C., New York, Pennsylvania and Virginia are attending this conference. Share what's going on in your state at our networking events scheduled each day.

Biological Control of Purple Loosestrife (*Lythrum salicaria*) at the Glenville Wetland Mitigation Bank, New Castle County, Delaware

Christie Bonniwell, *Ken Dunne, DelDOT Environmental Studies Office*

Due to the silty nature of the soils coupled to the anticipated hydrologic regime, early dominance by Purple Loosestrife (*Lythrum salicaria*) was thought likely. Over the long term, the trajectory of secondary plant succession will be the establishment of forest community and not an emergent marsh. The thought was after forest canopy closure, the *Lythrum* would be stressed and slowly decline. In Year 5, a dry year without flooding, biological controls established themselves without human introduction. There are four beetles from Europe that forage on the plant, *Galerucella pusilla, Galerucella calmariensis, Hylobius transversovittatus, and Nanophyes marmoratus*. Since Year 5, the amount and size of the *Lythrum* has dramatically reduced. Vegetative measurements have been taken over a course of two years to determine the extent of the damage from the beetles. Effective biological control will not eradicate *Lythrum*, but reduces the dominance and cover and should result in increased plant diversity.

A Comparison of Woody Plant Survival Rates Following Transplantation into Created Wetlands

Amy J. Nazdrowicz, *Landmark Science & Engineering, Inc.*

Wetland creation is commonly executed for compensatory mitigation and wildlife management. The establishment of a wetland vegetative community and attracting wildlife are often important goals. Therefore, installation of hydrophytic trees and shrubs into created wetlands is usually a key project component. In fact, regulatory agencies often require mitigation projects to achieve minimum 85% survival of the planted woody material. Wildlife usage is also considered by agencies when assessing mitigation performance. However, woody species differ in their transplantation resiliency and ability to attract wildlife. We maintain a database tracking species survival over time of trees and shrubs that we planted into created wetlands. Percent survival (2-5 years post-planting) was compared between 11 species commonly planted into created wetlands. All wetlands included have similar hydroperiods and water depths. All woody plants were obtained from the same nursery, placed by knowledgeable scientists, and planted/overseen by the same planting crew. Mean survival for all 11 species was 79.8% (s = 14.0%). Species with highest mean survival were *Betula nigra* (98.0%), *Quercus bicolor* (94.9%), and *Quercus palustris* (90.1%). Species with lowest mean survival were *Acer rubrum* (75.3%), *Viburnum dentatum* (69.3%), and *Alnus serrulata* (43.2%). Trees of the genus *Betula* and *Quercus* also support the greatest numbers of Lepidopteran species, a valuable food source for birds (400 and 532, respectively; list compiled by D. Tallamy, University of Delaware). Viburnum is host to a relatively low number (104 species). To maximize survival rates and wildlife usage of created wetlands we recommend planting *Betula nigra* and *Quercus species*.

Prime Hook National Wildlife Refuge

Day 2, PM —Christina Ballroom

Prime Hook National Wildlife Refuge's Recovery and Ecosystem Restoration: Implementation and Monitoring

Susan Guiteras, Bart Wilson, USFWS

Prime Hook National Wildlife Refuge has been facing substantial management challenges in wetlands previously managed as coastal freshwater impoundments. Although once salt marshes, these wetlands were altered and eventually converted to freshwater impoundments in the 1980's as habitat for migratory birds. Beginning in 2008, a series of storms led to dramatic overwash and saltwater intrusion into the impoundments, a subsequent collapse of wetland vegetation and conversion of large areas to open water resulted. Hurricane Sandy further exacerbated the situation, creating additional breaches in the wetland shoreline. The refuge's Comprehensive Conservation Plan set forth an ambitious plan for proactive tidal marsh restoration in 4000 acres of the former freshwater impoundment complex. The Recovery Phase of the project involves closing the large dune breaches using material dredged from a nearby offshore borrow area. This will also create a back barrier marsh platform where vegetation will be planted. The Resilience Phase of the marsh restoration project involves the creation of a network of over 30 miles of historic tidal channels throughout the wetland complex to improve circulation and distribution of salinity and sediment. Material that is dredged during this process will be sprayed directly from the channels into un-vegetated areas to improve marsh elevation capital. A comprehensive data collection and restoration monitoring partnership has been in place with numerous partners since the wetland management challenges first arose, throughout ongoing restoration, and will continue into the future. This marsh restoration project represents one of the largest such restoration projects ever on the east coast.

Notes:

Monitoring Marsh Birds and Vegetation in the Delmarva Peninsula

Tim Freiday, *Greg Shriver, Ph.D. University of Delaware*

Marshes are an ecosystem facing a multitude of threats, from sea level rise to nutrient loading and pollution. Secretive marsh birds are a guild under threat, and further improvements to monitoring are necessary to obtain reliable population trends for this group. The threats that this guild faces are numerous, and many species of secretive marsh birds show declining population trends, especially the King Rail. Despite facing these threats and in many instances population declines, marsh ecosystems and the species that inhabit them are comparatively understudied. In 2014 and 2015, we surveyed tidal marshes on the Delmarva Peninsula for secretive marsh birds to estimate the factors that affect occupancy, abundance, and detection rates for these species. Surveys were conducted at 131 points in in 2014, and 328 points were surveyed in 2015 in the marshes of DE and MD. In 2014, Clapper Rails were detected at 59 sites (45%) and King Rails were detected at only 13 sites (9.9%). Birds were surveyed using the National Marsh Bird Monitoring Protocol which employs marsh bird playback in order to boost detection rates. King Rails were sampled adaptively by increasing monitoring effort by adding secondary sampling units (points) in primary sampling units (hexagons) where King Rails were detected. Additionally, adaptive neighborhood transects were conducted upon detection of King Rails. Vegetation was surveyed using rapid ocular assessment, and USFWS transect protocols on NWRs. As part of this effort, we surveyed Prime Hook NWR to monitor the response of vegetation and birds to restoration actions.

Identifying Groundwater Discharge Locations in Prime Hook National Wildlife Refuge Using Environmental Thermography and Distributed Temperature Sensing

Thomas E. McKenna, *University of Delaware, Delaware Geological Survey*

Environmental thermography (ET) and distributed temperature sensing (DTS) are used to identify groundwater discharge at Prime Hook National Wildlife Refuge (PH). A saltmarsh restoration includes dredging channels to increase circulation and lower water levels. The dredged sediment is spread in a thin layer to increase bed elevation. Identifying groundwater discharge locations around these areas is important as they lower salinity and moderate temperature, contributing to a more diverse habitat. Fieldwork was conducted in April 2015, with groundwater warmer than surface water. Two ET aerial surveys were conducted with thermal and visual imagers operated by the author. ET only records the skin temperature of water, so discharge into wet tidal channels may not be seen unless discharge is large. A DTS, consisting of a logger, processor, and fiber-optic cable, resolves this issue. In DTS, a laser light pulse is fired into the cable. Light scatters in the cable, dependent on temperature, and the scattering is detected by the processor. The temperature is resolved every meter along the cable. This identifies anomalous temperature zones. In this study, a 2-kilometer cable was deployed in Prime Hook Creek. Most discharge areas in the marsh appear to be located in ponds and channels that were parts of Open Marsh Water Management projects. One discharge area is the abandoned Prime Hook Creek channel near the estuarine barrier. Other discharge areas appear to be in upland ponds. Splays of warmer water leaving Prime Hook Creek near the upland boundary indicate the breaching of the creek banks.

Investigating Wetland Flows and Sediment Fluxes at Prime Hook National Wildlife Refuge

Christopher Sommerfield, Zac Duval, University of Delaware; Michael Mensinger, Robert Scarborough, DNREC Coastal Programs

Tidal wetlands require a steady supply of organic and mineral sediment to support vegetative growth and drive vertical accretion of the marsh platform. The rate of accretion must be sufficient to maintain the marsh surface elevation between mean tide level and mean high water. Suspended sediment contributes to marsh accretion by stimulating below-ground biomass growth and creating soil volume. The long-term stability of natural and restored marshes can be evaluated through careful studies of sediment-transport rates (fluxes) in adjacent wetland waterways. To help inform the ongoing restoration at Prime Hook National Wildlife Refuge, we are investigating flow and suspended-sediment fluxes using time-series measurements from an array of sensors throughout four management units. The monitoring array was initially deployed in fall 2014, and consists of acoustic Doppler current meters, water level sensors, salinity and turbidity sensors, and ISCO water samplers. The time-series data are being analyzed to determine the relative influences of tides, wind, and freshwater discharge on suspended-sediment concentration and flux. This information will help establish the sensitivity of these ecologically relevant parameters to seasonal and extreme weather conditions. The array will be maintained through the early phases of the restoration, including the channel dredging work and breach closure, to track the evolving effects on wetland flows, salinity, and sediment concentration. Quantifying the amount and temporal variability of sediment entering and exiting the units is an ultimate goal of the project. In this presentation some preliminary results and their implications will be discussed.

Posters

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1 **Virginia Balke**
Delaware Technical Community College

Collaboration in the Blackbird Creek Ecosystem for Student Experiential Learning at Delaware Technical Community College. *Virginia Balke, Amy Mann, Delaware Technical Community College, Gulnihal Ozbay, Karuna Chintapenta, Laurieann Phalen, Mathew Stone, Delaware State University*

2 **Josh Barth**
Wesley College

Assessing the Use of Nano-Tags to Determine Temporal and Spatial Distribution of Red Knots Throughout Aquaculture Areas in the Delaware Bay. *Joshua N. Barth, Dr. Stephanie Stotts, Dr. Lawrence Niles, Wesley College, Dr. Christopher Heckscher, Dr. Kathleen Curran, Delaware State University*

3 **Matthew Boone**
University of Delaware

Change in Stopover Use of Migratory Birds in the Mid-Atlantic After Hurricane Sandy. *Matthew E. Boone, Jeffrey J. Buler, Univeristy of Delaware, Deanna K. Dawson, USGS Patuxent Wildlife Research Center*

4 **Sandra Burton**
LINNE Industries

The Peril of Pond Scum: Using a New Delaware Manufactured Solar Energy Technology to Reduce the Impact of Nonpoint source Pollution in Wet Stormwater Retention Ponds. *Sandra Burton, Craig Burton, LINNE Industries*

5 **Jennifer de Mooy**
DNREC, Division of Energy And Climate

Green Infrastructure Primer for Delaware. *Jennifer de Mooy, Susan Love, DNREC, Division of Energy & Climate, Miriam Balgos - UD, Mangone Center for Marine Policy, Michael Skivers - Wesley College*

6 **John Dougherty**
Wesley College

Delaware Wetland Restoration Strategies: Does Planting Make a Difference After 15 Years? *John H. Dougherty, Environmental Science, Stephanie Stotts, Ph.D., Assistant Professor of Environmental Studies and Science, Wesley College*

7 **Corina Fernandez**
Pennsylvania State University

Characterizing Pennsylvania Mapped Wetlands with Landscape Indicators. *Corina Fernandez, Joseph Bishop, Robert Brooks. Riparia Center, Department of Geography, Pennsylvania State University*

8 **LeeAnn Haaf**
Partnership for the Delaware Estuary

Mid Atlantic Coastal Wetland Assessment Update: Long Term Monitoring of the Tidal Marshes in the Christina and Broadkill Rivers, Delaware. *LeeAnn Haaf, Angela Padeletti, Tracy Elsey-Quirk, Danielle Kreeger, Partnership for the Delaware Estuary*

9 **Christopher Heckscher**
Delaware State University

Range Extension of *Pyractomena ecostata* (LeConte) (*Coleoptera: Lampyridae*) into the Delaware Estuary with a Modern Day Record from New Jersey. *Christopher M. Heckscher, NOAA-EPP Environmental Cooperative Science Center, Department of Agriculture and Natural Resources, Delaware State University, James E. Lloyd, Entomology and Nematology Department, University of Florida*

10 **Todd Klawinski**
Caesar Rodney School District

Designing an Immersive Outdoor Education Program on a Public School Campus. *Todd Klawinski, Caesar Rodney School District*

11 **Conor McDowell**
University of Delaware

Salt Marsh Sediment Accumulation and Morphologic Change at Bombay Hook National Wildlife Refuge. *Conor McDowell, Christopher Sommerfield, James Kirby, University of Delaware*

12 **Jeanette Miller**
University of Delaware

Preparing Future Environmental Leaders: Education Programs Designed to Broaden & Engage. *Jeanette Miller, Assoc. Director, Delaware Environmental Institute, University of Delaware*

13	**Joshua Moody** Partnership for the Delaware Estuary	**A Goal Based Scientific Monitoring Framework to Gauge Living Shoreline Outcomes.** *Joshua Moody, Partnership for the Delaware Estuary, Andrew Howard, Wetland Monitoring & Assessment Program, DNREC, Danielle Kreeger, Partnership for the Delaware Estuary, Alison Rogerson, Wetland Monitoring & Assessment Program, DNREC*
14	**Joshua Moody** Partnership for the Delaware Estuary	**Marsh Futures: Technical Evaluation of GIS and In-Situ Data to Guide Assessment of Site Specific Marsh Vulnerabilities.** *Joshua Moody, Danielle Kreeger, Partnership for the Delaware Estuary, Martha Maxwell Doyle, Barnegat Bay Partnership, Rick Lathrop, Rutgers University*
15	**Chelsea Morton** Delaware State University	**Differences in the Activity of Eastern Red Bat (*Lasiurus borealis*) Among Coastal Regions and Mainlands.** Chelsea Morton, Lori Lester, Christopher M. Heckscher, Lyndie A. Hice-Dunton, Kevina Vulinec
16	**Sarah Nuss** CBNERR	**Improve Climate Literacy Through Hands-On Mock Marsh Transect.** Sarah Nuss, Chesapeake Bay National Estuarine Research Reserve (CBNERR) in VA, Margaret Pletta, Delaware National Estuarine Research Reserve (DNERR)
17	**Gulnihal Ozbay** Delaware State University	**Saltmarsh Habitat of Blackbird Creek and Impact of Climate Change and Land Uses.** *Gulnihal Ozbay, Latadevi Karuna Chintapenta, Matthew L. Stone, Kris P. Roeske, Laurieann Phalen, Departemen of Agriculture & Natural Resources, Delaware State University*
18	**Angela Padeletti** Partnership for the Delaware Estuary	**Delaware Estuary Living Shoreline Initiative (DELSI): 2014 Installation Updates and Analysis.** *Angela Padeletti, Danielle Kreeger, Joshua Moody, Partnership for the Delaware Estuary, Alison Rogerson, Andrew Howard, Wetland Monitoring and Assessment Program, DNREC*
19	**Katherine Pijanowski** University of Delaware	**Patterns and Rates of Historical Shoreline Change in the Delaware Estuary.** *Katherine Pijanowski, Christopher K. Sommerfield, University of Delaware*
20	**Chris Pfeifer** Cardno	**Living Shoreline Restoration of Petroleum-Impacted Salt Marsh in Delaware's Inland Bays.** Chris *Pfeifer, Stephanie Briggs, Cardno, Lisa Pfeifer, Pepco Holdings, Inc., Cheryl Hess, Calpine*
21	**Alison Rogerson** DNREC	**Delaware Wetland Management Plan, A Guiding Document for Prioritizing Wetland Research, Education, and Conservation.** *Alison Rogerson, Wetland Monitoring and Assessment Program, DNREC*
22	**Fengyan Shi** University of Delaware	**Subgrid Modeling Geomorphological and Ecological Processes in Salt Marsh Evolution in Delaware.** *Fengyan Shi, James T. Kirby, University of Delaware, Guoxiang Wu, Ocean University of China, Mithun Deb, University of Delaware*
23	**Drexel Siok** DNREC, Delaware Coastal Programs	**State Wide Coverage: Delaware's New Network of Height Modernization Benchmarks.** *Drexel Siok, Delaware Coastal Programs, DNREC, Kenny Smith, Div. of Watershed Stewardship, DNREC, Alan Dragoo, Maser Consulting P.A., Bob Scarborough, Delaware Coastal Programs, DNREC*
24	**Hannah Small** Delaware State University	**Vernal Pool Ecosystems at the Delaware National Estuarine Research Reserve.** *Hannah Small, Lori Lester, Christopher Heckscher, Delaware State University*
25	**Matthew Stone** Delaware State University	**Tidal Tale: Bi-Directional Waterway Reveals Nutrient Runoff from Cropland.** *Matthew L. Stone, Gulnihal Ozbay, Department of Agriculture and Natural Resources, Delaware State University*
26	**Brooke Thompson** Wesley College	**Water Quality Comparison Between the Input and Output of Silver Lake.** *Brooke Thompson, Stephanie Stotts, William Kroen, Wesley College*
27	**Anne Wright** VCU	**Discovering Virginia's Public Pools.** *Anne Wright, Virginia Commonwealth University (VCU), Susan Watson, VA Department of Game and Inland Fisheries*
28	**Marian Young** BrightFields, Inc.	**South Wilmington Wetland Environmental Characterization & Remediation.** *Marian Young, Jenna Harwanko, Ken Hannon, BrightFields, Inc.*

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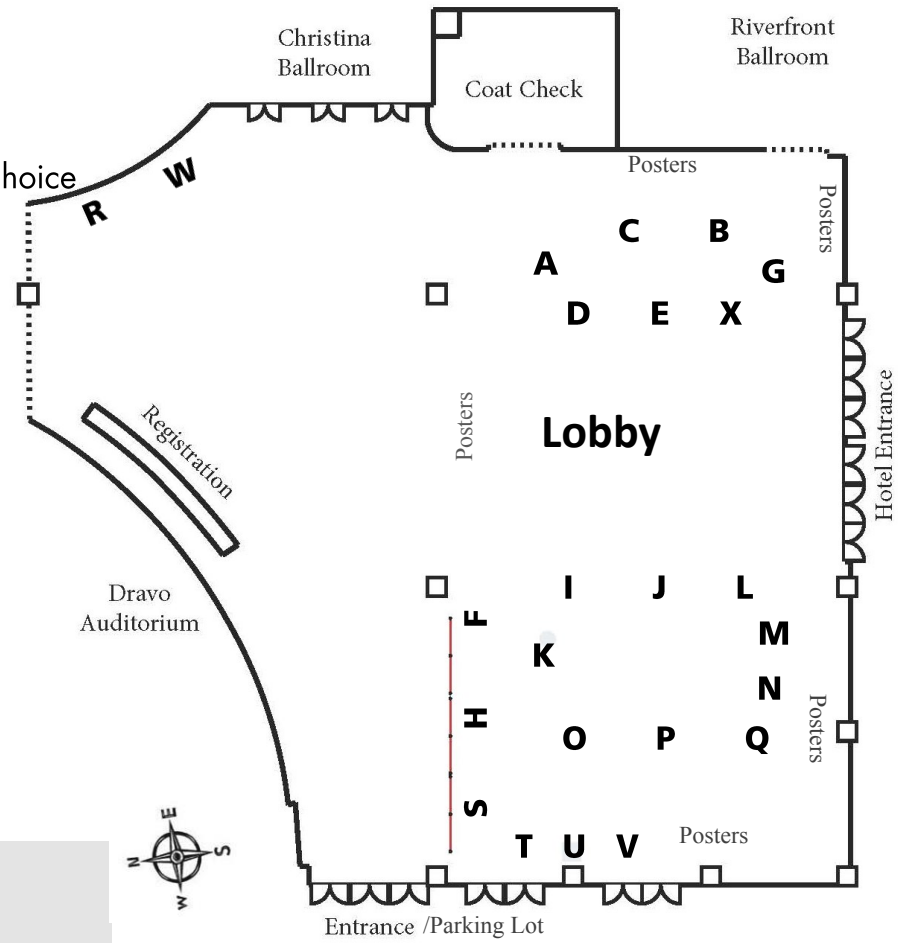

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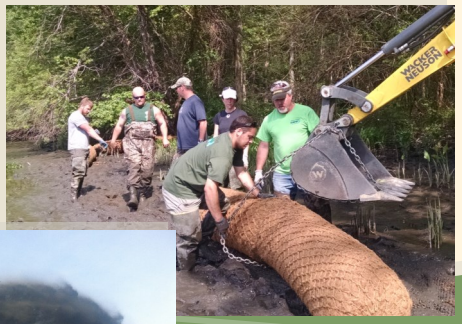

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