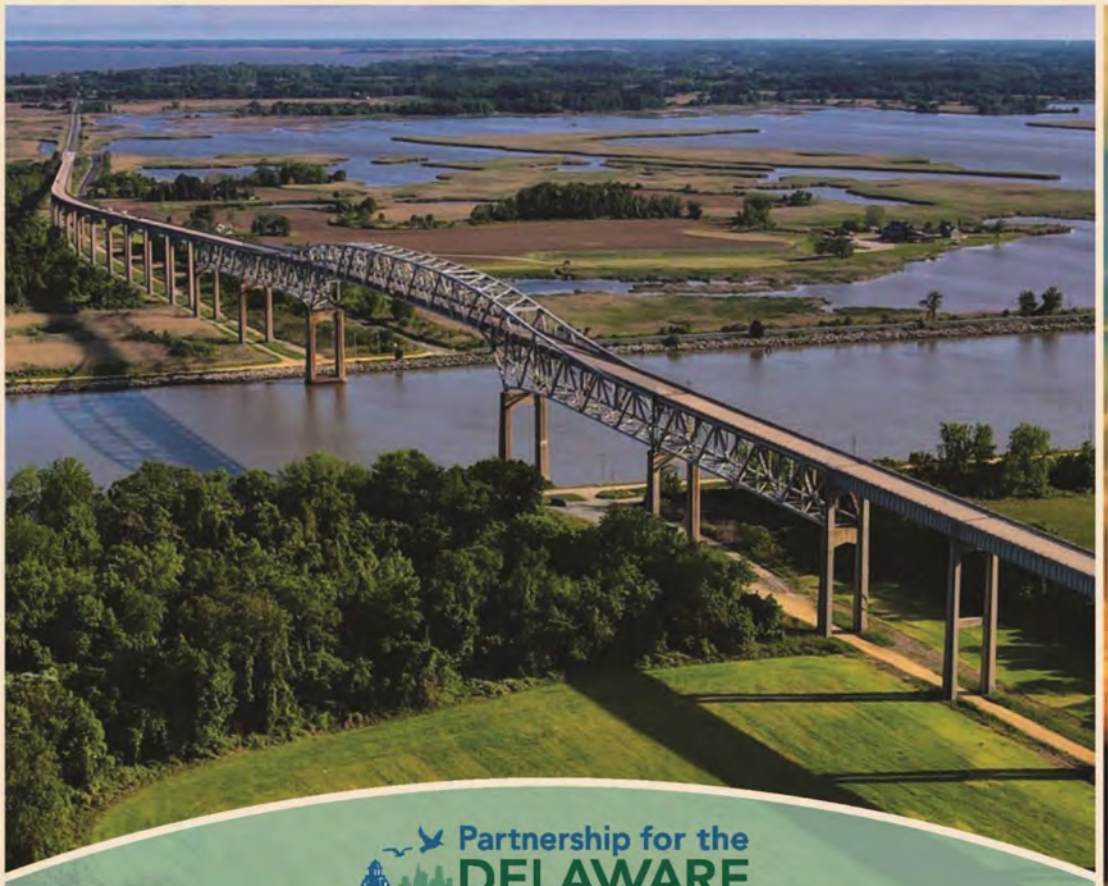
PROCEEDINGS



Partnership for the DELAWARE ESTUARY

Delaware Estuary Science & Environmental Summit 2023

"Estuary on the Rise"

January 30 – February 1, 2023
Atlantic City, New Jersey

For more information visit *www.DelawareEstuary.org*

Delaware Estuary Science and Environmental Summit Overview and Goals

Since 2005, the Partnership for the Delaware Estuary: a National Estuary Program (PDE), has convened the Delaware Estuary Science and Environmental Summit every two years as a forum to bring together researchers, resource manages, environmental practitioners and educators in a retreat-like atmosphere to share their latest research findings and experiences regarding the Delaware Estuary and Basin ecosystem. By gathering experts from diverse science, restoration, resource management, and outreach sectors, the Summit helps bridge the gaps among these sectors and areas of the watershed, thereby facilitating ecosystem-based management and awareness. The event spans 3 days and the 2023 meeting drew nearly 300 participants.

Following the first conference in 2005, PDE and partners used the conference proceedings to craft a "White Paper on the Status and Needs of Science in the Delaware Estuary". The 2005 White Paper was then used as a guidance document, capturing top actions and needs of the Delaware Estuary. Building on the successful 2005 conference, the Summit was held again in 2007, 2009, 2011, 2013, 2015, 2017, 2019, 2021, and 2023. In each more than 100 presentations were giving in various types of sessions such as:

- Regular science and management sessions for the presentation of any type of scientific topic relevant to the region;
- Special sessions that address matters of contemporary importance to the region's scientific and management community;
- Outreach and training sessions on effect science communications; and
- Thematic sessions and panels that pertain to the central theme of each biennial meeting.

2023 marked the 18th anniversary of the Summit and was the 10th Summit meeting. For each summit, a theme was chosen that captured contemporary interests and needs. Previous themes touched on enhancing the connectivity in the Delaware Estuary both ecologically and inter-personally and facilitating discussions to respond to environmental changes in the Delaware Estuary. A full list of the past themes are found below:

2005: The State of Science in the Delaware Estuary
2007: Linking Science, Management, and Policy
2009: Planning for Tomorrow's Delaware Estuary
2011: Connections – Land to Sea, Shore to Shore, Science to Outreach
2013: Weathering Change – Shifting Environmental, Shifting Policies, Shifting Needs
2015: Balancing Progress & Protection – 10 Years of Science in Action
2017: Reflecting on Progress, Charting the Future
2019: Estuary 2029: Saving Our System Through Collaboration
2021: No Theme, this Summit had special focus on climate change and the next generation. It featured Delaware River Basin Commission's Advisory Committee on Climate Change, "Climate Change in the Delaware Estuary" Forum
2023: Estuary on the Rise. The 2023 Summit also hosted the Delaware River Basin Commission's Climate Forum.

This document consists of the program schedule, abstracts, and notable awards for the 2023 Delaware Estuary Science and Environmental Summit. Proceedings of the previous Summit meetings are available from the Partnership for the Delaware Estuary website at: www.DelawareEstuary.org/Summit

Proceedings of the 2023 Delaware Estuary Science and Environmental Summit

On behalf of the Partnership for the Delaware Estuary (PDE), we are proud to present the proceedings from the 2023 Delaware Estuary Science and Environmental Summit in a new location and venue of Atlantic City, NJ! With nearly 300 in-person attendees and more than 85 presentations spanning this year's meeting, we covered a variety of topics over a short time period.

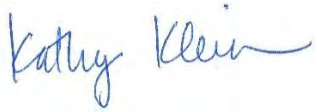
It's hard to believe that this was the 10th Summit! Like others before, the main goal was to bring environmental professionals together in a "winter retreat" type atmosphere. Attendees gathered from different areas of the watershed, sectors, and disciplines to share the latest science and results, and to make both ecological and professional connections. These linkages promote a better understanding of the ecosystem and foster ecosystem-based management and strategic investment.

For the second consecutive Summit, attendees gained more insight on climate change in our watershed during the one-day Forum held in partnership with the Delaware River Basin Commission's Advisory Committee on Climate Change. The Forum featured a fantastic speaker panel comprised of: Adam Ortiz, EPA Regional Administrator at EPA Region 3; Rohit Aggarwala, Commissioner of New York City's Department of Environmental Protection; Shawn LaTourette, Commissioner of the New Jersey Department of Environmental Protection; and Shawn Garvin, Cabinet Secretary at the Delaware Department of Natural Resources and Environmental Control. We are also incredibly thankful to have hosted a fabulous roster of keynote speakers this year, including: Dr. Ray Najjar, Professor of Oceanography at the Pennsylvania State University; Dr. Phillippe Hensel, Supervisory Geodesist at NOAA; and Catrin Einhorn, reporter at the New York Times' Climate Desk.

The 2023 Summit also featured a number of new special sessions. The State of the Watershed session provided detailed insight on a number of indicators in the recently published 2022 Technical Report for the Estuary and Basin; the Environmental DEIJ for Community Leaders' session provided a fishbowl-style panel for engagement with environmental leaders working in urban areas to advance DEIJ initiatives; and the Urban Waters Federal Partnership hosted Delaware River location partners to discuss their work on revitalization of urban waters and their surrounding communities. Oral and poster presentation contributors spanned a wide variety of captivating topics like but not limited to big-picture environmental ideas and shellfish ecology. We would also like to acknowledge all of the students who participated in the Summit and congratulate student award winners. Based on their creative ideas, insightful research questions, and passion for environmentally-focused inspirations, we are confident that these participants will continue to be impactful critical thinkers as they progress as young professionals.

Additionally, we are grateful for the sponsorship support we have received for the 10th annual Summit and send a big THANK YOU to everyone who helped make this meeting possible.
Thank you to those who attended, contributed to, and sponsored the 2023 Delaware Estuary Science and Environmental Summit. We are already looking forward to the 2025 Summit and continuing to foster opportunities to learn from our partners about the valuable work they are carrying out throughout our watershed.

Best wishes,



Kathy Klein
Executive Director

Danielle Kreeger
Senior Science Director

Honoring Lenape Land

We begin by acknowledging with respect that we gather today in Lenapehokink, traditional homeland of the Lenape people for tens of thousands of years. Sometimes translated as “Original People,” the Lenape were known as mediators and called “The Grandfathers" by the entire Agonquian Family Tree of languages. Encompassing the Delaware River Basin, Lenapehokink includes present-day New Jersey, most of Delaware, the Eastern parts of New York and Pennsylvania, and was home to 20,000 Lenape in three clans: the Wolf Clan in the mountains speaking Musnee dialect, Turtle Clan along the Rivers speaking Unami, and Turkey Clan by the Big Waters speaking Unilatchigo.

Within the first hundred years of foreign contact, 80% of the Lenape had already died from violent conflict and disease. In spite of the famous peace treaty between William Penn and Lenape Chief Tamanend at Shackamaxon, Europeans forced the Lenape westward and northward to Oklahoma, Wisconsin, and Ontario, where many Lenape descendants live today under the name of a British General, Thomas West, Lord De La Warr, now pronounced Delaware.

But some Lenape never left. Hiding in plain sight as “Keepers of the Land” the Lenape Indian Tribe of Delaware based in Cheswold, Delaware; Nanticoke-Lenni Lenape Tribal Nation in Bridgeton, NJ; Ramapough Lenape Nation in Mahwah, NJ are three of the thriving Lenape communities today.

Let us honor the historical and ongoing presence of the Lenape and the Nanticoke on this land where we now live, work and celebrate *“All Our Relations.”*

Written with Chief Dennis Coker
Cheswold, Delaware
Nov. 1, 2019

Student Presentation Awards

The Partnership for the Delaware Estuary (PDE) thanks all the undergraduate and graduate students who presented their original research findings at the 10th Biennial Delaware Estuary Science & Environmental Summit (January 20th – February 1st, 2023). We nearly 300 attendees giving 83 oral presentations, and 22 poster presentations.

Working with our many student judges to judge student presentations, PDE is pleased to announce the recipients of the student presentation awards. This competition is designed to recognize the important contributions that students make to the environmental sector in our watershed.

15 students presented this year. The judges chose a Best Talk Award and a Best Poster Award. Due to close scoring, the award of Best Poster Award was determined a tie between two presenters. The caliber of all presentations was very high, and all students should be commended for their outstanding contributions and presentations.

All 3 award winners are receiving:

- A Certificate of Excellence from the Partnership for the Delaware Estuary,
- An invitation to contribute to a feature article on their research to a future issue of *Estuary News*,
- A plush horseshoe crab

Best Talk Award

Meghana Parameswarappa Jayalakshmamma, New Jersey Institute of Technology
Microplastics in Stormwater

Best Poster Award (tie)

Matthew Gentry, Drexel University
Physiological Plasticity and Response to Food Availability of Two Native Freshwater Mussel Species

Sam Solomon, New Jersey Institute of Technology
Impact of Climate Change on the Salinization of Coastal Wetlands

Agenda at a Glance

Abstracts are available at: www.delawareestuary.org/summit or click here

Monday, January 30

8:00 AM **Registration and Breakfast** – Poster Hall (Avalon 14-17)

9:00 AM **Summit Welcome and Opening Remarks** – Main Ballroom (Avalon 23)
Welcome: Kathy Klein, Partnership for the Delaware Estuary
Keynote Address: Dr. Ray Najjar, PhD, The Pennsylvania State University

10:15 AM **Full Session**
Status and Trends of the Delaware Estuary and Basin – Main Ballroom (Avalon 23)

11:30 PM **Concurrent Sessions**
Monitoring & Assessment – Main Ballroom (Avalon 23)
Environmental DEIJ for Community Leaders – Breakout A (Avalon 20-22)
Big Picture Environmental Planning – Breakout B (Avalon 24-26)

12:30 PM **Lunch** – Poster Hall

2:00 PM **Concurrent Sessions**
Improving Dissolved Oxygen & Aquatic Life Uses in the Delaware River Estuary –Main Ballroom (Avalon 23)
Urban Ecology and Restoration – Breakout A (Avalon 20-22)
Living Resources I: Shellfish – Breakout B (Avalon 24-26)

4:00 PM **Concurrent Sessions**
Restoration & Conservation I – Main Ballroom (Avalon 23)
Urban Waters Federal Partnership – Breakout A (Avalon 20-22)

5:30 PM **Poster Session I** – Poster Hall (Avalon 14-17)

Tuesday, January 31

8:00 AM **Registration and Breakfast** – Poster Hall (Avalon 14-17)

9:00 AM **DRBC Climate Change Forum Keynote**
Speaker: Philippe Hensel, PhD, NOAA-Main Ballroom (Avalon 23)

10:30 AM **Concurrent Sessions**
DRBC Climate Forum Technical Session I: Building Foundational Science for Regional Impacts – Main Ballroom (Avalon 23)
Water Quality I

12:00 PM **Lunch** – Poster Hall (Avalon 14-17)

1:30 PM **DRBC Climate Change Forum**
Panel Conversation on Climate Planning and Adaption – Main Ballroom (Avalon 23)

2:45 PM **Partnership for the Delaware Estuary Keynote**
Speaker: Catrin Einhorn, New York Times Climate Desk-– Main Ballroom (Avalon 23)

4:15 PM **Full Session**
DRBC Climate Change Forum Technical Session II: Building Community-level Climate Resilience-Main Ballroom (Avalon 23)

6:00 PM **Poster Session II** – Poster Hall (Avalon 14-17)

Wednesday, February 1

8:00 AM **Registration and Breakfast –** Poster Hall (Avalon 14-17)

9:00 AM **Concurrent Sessions**
Living Resources II – Main Ballroom (Avalon 23)
Science Communication – Breakout A (Avalon 20-22)

10:30 AM **Concurrent Sessions**
Restoration & Conservation II – Main Ballroom (Avalon 23)
Water Quality II – Breakout A (Avalon 20-22)

11:30 AM **Lunch** – Poster Hall

1:00 PM **Concurrent Sessions**
Restoration & Conservation III – Main Ballroom (Avalon 23)
Physical & Chemical Processes – Breakout A (Avalon 20-22)

2:30 AM **Hot Topics** – Main Ballroom (Avalon 23)

3:30 PM **Awards & Closing Remarks** – Main Ballroom (Avalon 23)

10th Biennial Delaware Estuary Science & Environmental Summit

Estuary on the Rise

Harrah's Resort
Atlantic City, NJ
January 30rd – February 1st, 2023

Sponsors

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2023 Delaware Estuary Science & Environmental Summit-Detailed Agenda

Click on the presenter's name to access a digital PDF of the presentation or the associated poster abstract.
Note: Not all presentations are linked at the request of the presenter.

C Concurrent Session F Full Session M Meal S Special Event

JANUARY 30 • MONDAY

8:00am – 9:00am — **M Registration & Breakfast** — **Exhibitor Hall (Registration)**

9:00am – 9:15am — **F Summit Welcome, Opening Remarks** — **Main Ballroom (Avalon 23)**
Speakers: Kathy Klein, Damielle Kreeger

9:15am – 10:00am — **S Keynote: Dr. Ray Najjar, The Rapidly Changing Climate of the Delaware Estuary and Basin** — **Main Ballroom (Avalon 23)**
Moderators: Danielle Kreeger, Leah Morgan
Speakers: Raymond Najjar

Past and likely future changes in the climate of the Delaware Estuary and Basin (DEB) are presented. From a historical analysis of air temperature, precipitation, streamflow, sea level, and ice and snow indicators, an overall picture of dramatic and accelerating climate change in the DEB emerges, one that is largely consistent with expectations from increases in greenhouse gases. These climate trends are extremely likely to continue into the next few decades regardless of greenhouse gas emissions. Climate change beyond mid-century will depend strongly on the emissions pathway. Hence, a combination of aggressive local adaptation and global emissions reduction is needed to avoid the worst impacts of anthropogenic climate change in the DEB. Adaptation planning should compensate for unjust policies, such as redlining, that have led climate impacts to fall disproportionately on the most vulnerable communities.

Raymond Najjar is a Professor of Oceanography in the Department of Meteorology and Atmospheric Science at The Pennsylvania State University. Dr. Najjar has conducted research on a variety of topics in oceanography, climate science, and hydrology, with current interests focused on how coastal waters are influenced by climate change and pollution. In addition to synthesizing research on the climate of the Delaware Estuary and Basin as part of periodic assessments led by the Partnership for the Delaware Estuary, Dr. Najjar has studied long-term changes in the salinity, dissolved oxygen, and tides of the estuary.

10:00am – 11:00am — **F The State of the Watershed: Unveiling the 2022 Technical Report for the Delaware Estuary and Basin** — **Main Ballroom (Avalon 23)**
Moderators: Leah Morgan
Speakers: Jacob Bransky, Sarah Beganskas, Jenny Shinn, Andrew Homsey, LeeAnn Haaf, Danielle Kreeger

Every five years, the Partnership for the Delaware Estuary coordinates production of a State of the Estuary Report, working with many partners on behalf of the Delaware Estuary Program. To provide the scientific foundation for this report, the program's Scientific and Technical Advisory Committee also coordinates a companion Technical Report for the Delaware Estuary and Basin (TREB). The goal of TREB is to analyze the status and trends for more than 50 environmental indicators representing diverse facets of the natural ecosystem such as water quality, living resources, habitats and land cover. When considered together, these indicators provide a comprehensive picture of the current and trending environmental condition of the watershed. The analysis of each indicator includes a discussion of actions and needs, providing a blueprint for future science and management. The report also helps assess our progress in protecting, restoring and sustaining vital natural resources. This special session will unveil results from the 2022 TREB, which was completed in December, 2022.

For more info, see: https://www.delawareestuary.org/data-and-reports/state-of-the-estuary-report/

- 10:00 **Kreeger, Danielle & LeeAnn Haaf**, TREB Introduction
- 10:15 **Homsey, Andrew**, Chapter 1: Watersheds & Landscapes
- 10:30 **Beganskas, Sarah & Jake Bransky**, Chapter 3 & 4: Water Quality and Quantity
- 10:45 **Shinn, Jenny**, Chapter 7: Living Resources

Associated Poster:

- **Haaf, LeeAnn, Leah Morgan & Danielle Kreeger**, 2022 Technical Report for the Delaware Estuary and River Basin: Key Findings and Next Steps

11:30am – 12:30pm **C Big Picture Environmental Planning** **Breakout B (Avalon 24-26)**

Moderators: Gregory Lech, Meghan Rogalus

Speakers: Gerald Joseph McAdams Kauffman, Jr., Eileen Althouse, James Thompson, Kelsey Brooks

- 11:30: **Althouse, Eileen**, CDM Smith (consultant to Philadelphia Water Department); Overview of Receiving Water Modeling for Philadelphia's Year 10 Green City, Clean Waters Evaluation and Adaptation Plan (EAP) Report
- 11:45: **Brooks, Kelsey**, National Wildlife Federation; Delaware River Conservation Blueprint: Accelerating Strategic Conservation Gains in the Delaware River Watershed
- 12:00: **Kauffman, Gerald**, University of Delaware; Reconnaissance Study of Potentially Eligible National Wild & Scenic Rivers in Delaware
- 12:15: Q&A

11:30am – 12:30pm **C Environmental DEIJ for Community Leaders** **Breakout A (Avalon 20-22)**

Moderators: Elizabeth Brown, Erica Rossetti

Speakers: Melody Mason, Missy Frankil, Emily Rodden

In this discussion-based, fishbowl style, panel session, we will hear from environmental leaders and community members working throughout the urban corridor of the Delaware Estuary to learn how local groups are working to advance environmental justice in our cities. This is a chance to not only hear about the challenges and successes people are facing in urban environmental work in the region but also to identify collective research and technical assistance needs moving forward. Panelists for this session will be made up of the Urban Waters Delaware River Location's new Community Cohort across Camden NJ, Chester PA, Philadelphia PA, and Wilmington DE.

Associated Posters:

- **Akbar Buchanan, Ferry**, Environmental Protection Agency Region 3; Studying Cumulative Impacts in Underserved Communities in Southern Delaware

11:30am – 12:30pm **C Monitoring & Assessment** **Main Ballroom (Avalon 23)**

Moderators: Thomas Amidon, David Bushek

Speakers: Kenny Smith, Catherine Hughes, Kayla Clauson, Brittney Flaten

✎ to indicate student presentation

- 11:30: ✎ **Hughes, Catherine**, University of Delaware, Department of Earth Sciences; Identifying Potential Atlantic Sturgeon Habitat Post Dredging in the Delaware River: Side Scan Sonar and Bottom Sampling Analyses
- 11:45: **Clauson, Kayla**, Delaware DNREC, Watershed Assessment and Management Section; Using Wildlife Camera Traps as a Tool for Wildlife Habitat Monitoring
- 12:00 **Flaten, Brittney**, Delaware DNREC; Starting from Scratch: Building Delaware's Submerged Aquatic Vegetation Program
- 12:15: **Smith, Kenny**, DNREC-Delaware Department of Natural Resources and Environmental Control; Non-Tidal Wetland Health in the Brandywine Watershed, Delaware

Associated Poster:

- **Bransky, Jake**, Delaware River Basin Commission; Reducing Microplastics in the Delaware River Estuary

12:30pm – 2:00pm | **M Lunch** | **Poster Hall (Avalon 14-17)**

2:00pm – 3:30pm | **C Living Resources I: Shellfish** | **Breakout B (Avalon 24-26)**

Moderators: Chesa Blom, Joshua Moody

Speakers: Michelle Stuart, Taylor Hoffman, Heidi Yeh, Matthew Gentry, Jenny Shinn, Elizabeth Bouchard, Mike De Luca

✎ to indicate student presentation

- 2:00: ✎ **Yeh, Heidi**, Rutgers University, Haskin Shellfish Research Laboratory; Environmentally-driven Oyster Microbiome Dynamics in the Delaware Bay
- 2:15: **Shinn, Jenny**, Rutgers University; Intertidal Oyster Reef Development for Restoration in the Delaware Bay
- 2:30: ✎ **Bouchard, Elizabeth**, Rutgers Haskin Shellfish Research Laboratory; Effect of Oyster Farms on the Distribution of Horseshoe Crab Eggs and Other Rufa Red Knot Foraging Resources
- 2:45: **Gentry, Matthew**, Partnership for the Delaware Estuary; Overcoming Propagation and Juvenile Care Bottlenecks for Two Native Freshwater Mussel Species in a Novel Hatchery Setting
- 3:00 **Kreeger, Danielle**, Partnership for the Delaware Estuary; Incidence and restoration prioritization of rare and common species of freshwater mussels in the tidal Delaware River, USA
- 3:15: **De Luca, Michael**, and **Stuart, Michelle**, Rutgers University ; A GIS-Based Tool for Planning and Management of Shellfish Aquaculture and Restoration in New Jersey: A Rutgers University Project in Partnership with the New Jersey Department of Environmental Protection Supported by the National Sea Grant Program and Pew Charitable Trust

Associated Posters:

- ✎ **Ambrose, Alexandria**, Rutgers, the State University of New Jersey, Haskin Shellfish Research Laboratory; Video documentation of the marine community using an oyster farm as habitat near Barnegat Bay, NJ
- **Burt, Iris**, Rutgers University; Documenting Oyster Habitat in Tidal Creeks and Tributaries along Delaware Bay, NJ
- **Cheng, Kurt**, Partnership for the Delaware Estuary; Advances in Juvenile Freshwater Mussel Grow Out Techniques
- ✎ **Gentry, Matthew**, Partnership for the Delaware Estuary; Physiological Plasticity and Response to Food Availability of Two Native Freshwater Mussel Species

2:00pm – 3:30pm | **C Urban Ecology and Restoration** | **Breakout A (Avalon 20-22)**

Moderators: Rachael Phillos, Laura Craig

Speakers: Matthew Sarver, Hannah Sanders, Ella Rothermel, Jessie Buckner, Christiana Pollack, Lance Butler

ϟ indicates lightning talk

✎ to indicate student presentation

- 2:00: **Buckner, Jessie**, Resource Environmental Solutions; South Wetlands Park: A Case Study on Freshwater Tidal Ecological Restoration and Environmental Justice in the Urban Corridor of the Delaware Estuary
- 2:15: **Rothermel, Ella & Matt Sarver**, Partnership for the Delaware Estuary; Urban Ecological Restoration Planning on the Christina and Brandywine Rivers; Wilmington, DE
- 2:30: **Butler, Lance**, Philadelphia Water Department; The Aquatic Research and Restoration Center (ARRC): A Collaborative Approach to Addressing the Conservation, Restoration, and Enhancement of Key Aquatic Natural Resources in Urban Regions of the Delaware River Basin
- 2:45: **Sanders, Hannah,** US EPA, Region 3; Delaware River Watershed Seabin Aquatic Litter Collection and Monitoring Project– a private-public partnership between EPA, Partnership for the Delaware Estuary, and Seabin Project Ltd.

- 3:00 Q & A

Associated Posters:

- ✎ **Curley, Jenna,** Haddonfield Memorial HS; Biodiversity and Ecosystem Services in the Cooper River Watershed - Invertebrate Diversity in Suburban Gardens
- ✎ **Xiang, Galen**, University of Pennsylvania; Using Macroinvertebrate Indexes to Characterize the Impacts of Hydrologic Restoration in an Urban Philadelphia Watershed

2:00pm – 3:45pm **C Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary - hosted by the DRBC** **Main Ballroom (Avalon 23)**

Moderators: Kelly Somers, Mark Biddle

Speakers: Steve Tambini, John Yagecic, P.E., Namsoo Suk, Thomas Amidon, Chen Fanghui, Ph.D, P.E., Li Zheng, Sarah Beganskas

- 2:00 **Tambini, Steve,** Delaware River Basin Commission; Introduction: Why are we here?
- 2:10 **Suk, Namsoo**, Delaware River Basin Commission; How did DRBC address low dissolved oxygen in the Delaware Estuary - then and now?
- 2:20 **Yagecic, John**, Delaware River Basin Commission; Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know?
- 2:35 **Zheng, Li,** Delaware River Basin Commission; What is this estuary-wide eutrophication model and why do we need it?
- 2:50 **Chen, Fanghui**, Delaware River Basin Commission; What matters and what doesn't with regard to low dissolved oxygen events in the Delaware Estuary?
- 3:05: **Beganskas, Sarah,** Delaware River Basin Commission; What combination of wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary?
- 3:20 **Amidon, Thomas**, Delaware River Basin Commission; What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses?
- 3:35 DRBC Panel: Enhancing support for aquatic life uses in the Delaware Estuary

Associated Posters:

- **Yagecic, John**, Delaware River Basin Commission; Social and Economic Factors Affecting the Attainment of Aquatic Life Uses in the Delaware River Estuary
- **Suk, Namsoo**, Delaware River Basin Commission; Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary

4:00pm – 5:00pm **C Restoration & Conservation I** **Main Ballroom (Avalon 23)**

Moderators: Sarah Bouboulis, Bartholomew Wilson

Speakers: Douglas Janiec, Bob Collins

- 4:00: **Janiec, Douglas**, Sovereign Consulting Inc.; A Nature-Based Shoreline System New To The Barnegat Bay and State of New Jersey: A Case Study Of The Natural Resource Education Foundation of New Jersey - Lighthouse Center Living Shoreline Project.
- 4:15: **Janiec, Douglas**, Sovereign Consulting Inc.; A Hybrid Living Shoreline At The Rutgers University (Rutgers) New Jersey Aquaculture Innovation Center (AIC) - A New Jersey Agricultural Experiment Station (NJAES) – An Opportunity, An Idea, A Nature-Based Success
- 4:30: **Collins, Bob**, Delaware Center for the Inland Bays; Living Shoreline and Tidal Marsh Enhancement at Angola by the Bay
- 4:45: Q&A

Associated Posters:

- **Faller, Kelly,** Partnership for the Delaware Estuary; Evaluating change in marsh condition pre and post-restoration in two National Wildlife Refuges along the Delaware Bay
- **Tedesco, Lenore**, The Wetlands Institute; Seven Mile Island Innovation Laboratory: Projects, Goals and Outcomes of Beneficial Use Projects in New Jersey's Back Bays
- **Klinkam, Jessica**, Partnership for the Delaware Estuary; A living shoreline feasibility model to support successful restoration projects

4:00pm – 5:00pm | **C** | **Urban Waters Federal Partnership** | **Breakout A (Avalon 20-22)**

Moderators: Erica Rossetti (she/her), Ferry Akbar Buchanan

Speakers: Roberto Frugone, David Paul

The Urban Waters Federal Partnership is an environmental justice effort working to "revitalize urban waters and the communities that surround them." In this session we will hear from several Delaware River Location partners on the value of revitalizing and restoring urban lands and waterways for climate, stormwater management, public access and safety, and health and quality of life. Whether we are working on site remediation, sustainable development, living shorelines, supporting small community-led projects, or including health and housing in our investments, this session will feature more urban restoration projects that expand our definitions of environmental justice.

- 4:00 **Erica Rossetti, PDE** – introduction and overview of the UWFP Delaware River Location
- 4:15 **Roberto Frugone, HUD** – the importance of community planning and equitable, sustainable development
- 4:30: **David A. Paul, MD, FAAP (Department of Pediatrics Chair, ChristianaCare)** – health, quality of life, and environmental justice
- 4:45: Q &A

5:30pm – 7:00pm | **S** | **Poster Session I** | **Poster Hall (Avalon 14-17)**

JANUARY 31 • TUESDAY

8:00am – 9:00am | **M** | **Registration & Breakfast** | **Exhibitor Hall (Registration)**

9:00am – 10:00am | **D** | **DRBC Climate Forum Keynote - Dr. Phillippe Hensel, NOAA** | **Main Ballroom (Avalon 23)**

Moderators: Howard Neukrug,

Speakers: Philippe Hensel

The other part of relative sea level rise: vertical land motion and its intersection with environmental change

Philippe Hensel is the chief of the Project Analysis Branch within the Operations and Analysis Division at NOAA's National Geodetic Survey (NGS). Philippe oversees activities related to maintaining the integrity of the nation's database of survey control. Since 2019, he is also part of a multi-agency team investigating vertical land motion in the wider Chesapeake Bay region. Since coming to NGS in 2006, Philippe has worked to bring high precision surveying applications to coastal scientists and resource managers (advancing the "sea level rise sentinel site" concept). Prior to coming to NGS, Philippe was a post-doc wetland ecologist with the USGS, Patuxent Wildlife Research Center. Philippe has also been an adjunct faculty at Johns Hopkins University, teaching a course in wetland ecology and management. Philippe holds a PhD in coastal ecology and a Master's degree in applied statistics from Louisiana State University, and a master's degree in marine, estuarine, and environmental sciences from the University of Maryland.

Presentation abstract

Climate change is already leading to measurable increases in global sea levels, with experiencing more pronounced changes than others. Whereas most of the emphasis on climate-related sea level rise has justifiably focused on the response of the hydrology itself, relatively little attention has been paid on the contribution of vertical land motion (VLM) to the relative sea-level rise equation. Along the mid-Atlantic, we have an excellent network of long-term tide stations, but the long-term trends confound the hydrologic with the geologic signals. Within the Chesapeake Bay, local subsidence hotspots result in higher rates of sea-level rise. Whereas we talk of carbon sequestration and reducing our carbon footprint as a way to confront a warming climate and the resulting sea-level rise, what can we do about sinking land masses? The first step in answering this question is to better understand where land is moving vertically, and at what rates over time. This talk will focus on the intersection of sea level rise with vertical land motion along our coastlines, and will explore some recent efforts to better understand and respond to this phenomenon, so as to enhance coastal resilience in the face of a changing climate.

10:30am – 12:00pm **C Water Quality I** **Breakout A (Avalon 20-22)**

Moderators: Namsoo Suk, Ella Rothermel)

Speakers: Ramona McCullough, Zachary Garmoe, Katie Lavallee, Paula Kulis, Jean Malafronte

- 10:30: **Garmoe, Zachary,** Delaware Center for the Inland Bays; Continuous Water Quality Monitoring in the Inland Bays
- 10:45: **Lavallee, Katherine**, Woods Hole Group; Long Term Water Quality Monitoring in the Tidal Delaware River
- 11:00: **McCullough, Ramona**, Sci-Tek Consultants Inc.; Development of a Fecal Coliform Bacteria Model in the Tidal Fresh Delaware River – Lessons learned
- 11:15: **Kulis, Paula**, CDM Smith; Continued Data-informed Model Refinements for Philadelphia Water Department's Tidal Delaware Estuary Water Quality Model
- 11:30: **Labrum, Sara,** DELCORA; DELCORA's Water Quality Improvement Projects: Wastewater Tunnel & Multiport Diffuser Outfall
- 11:45: Q&A

Associated Posters:

✎ to indicate student presentation

- ✎ **Felker, Jill**, Penn State Berks; Superbugs Upstream of the Delaware River: Assessing the Antibiotic-Resistant Bacteria in the Blue Marsh Watershed
- ✎ **Supino, John**, Boston College; Evaluating anthropogenic influences on salt marsh carbon cycling at the Seven Mile Island Innovation Laboratory (SMIIL)
- **Willig, Anna**, Willistown Conservation Trust; Elevated Specific Conductivity and Chloride Concentration in the Headwaters of 3 Southeastern Pennsylvania Streams Linked to Impervious Surface Cover

10:30am – 12:00pm **D DRBC Climate Forum Technical Session I-Building Foundational Science for Regional Impacts Main Ballroom (Avalon 23)**

Moderators: Robert Scarborough, Ph.D, Sarah Beganskas

Speakers: Amy Shallcross, John Callahan, Chen Fanghui, Ph.D, P.E., Sean Fettrow, Brent Gotsch

- 10:30: **Callahan, John A**., University of Delaware; Latest Projections of US Mid-Atlantic Sea-Level Rise and an Update from the Coastal Effects Chapter of the Fifth US National Climate Assessment
- 10:45 ✎ **Fettrow, Sean**, University of Delaware; Salt Marsh Migration into Forests and Farms: Effect to Soil Biogeochemistry Along the Salinity Gradient.
- 11:00 **Shallcross, Amy, P.E.; Chen, Fanghui, PhD, P.E.; Preucil, Anthony;** Delaware River Basin Commission, Water Resource System Analyses - Planning for Climate Change and Sea Level Rise Impacts
- 11:30 **Gotsch, Brent**, New York City Department of Environmental Protection; Climate Change Impacts to the New York City Water Supply
- 11:45 Q & A

Associated Posters:

- **Goddard, Kathryn**, Ursinus College; Effects of storm conditions of increased temperature and decreased salinity on the North American non-reef building coral *Astrangia poculata*
- **Kessler, Hannah**, Hadonfield Memorial High School; Climate Change Impact on Biodiversity in the Delaware Estuary - Community Science, Curriculum Development and Education Initiatives

12:00pm – 1:30pm **M Lunch** **Poster Hall (Avalon 14-17)**

12:00pm – 1:30pm **M Mentor-Mentee Lunch** **Poster Hall (Avalon 14-17)**

D DRBC Panel Conversation on Climate Planning and Adaptation

Moderators: Steve Tambini, Kristen Bowman Kavanagh

Speakers: Adam Ortiz, Rohit Aggarwala, Shawn LaTourette, Shawn Garvin

This panel of high-level government leaders will provide updates from their municipal, state, and federal-level agencies on efforts to address climate change. What key climate-related challenges are they facing, and where have they seen success? How are their agencies addressing water equity and environmental justice? What are their climate goals for 2023 and beyond? Be prepared for a lively and interactive discussion. Audience questions are encouraged.

Panelists include:

Shawn Garvin, Secretary, Delaware Department of Natural Resources and Environmental Control

Shawn M. Garvin joined Governor John Carney's cabinet in March 2017 as Secretary of the Department of Natural Resources and Environmental Control, leading the agency tasked with protecting and managing Delaware's natural resources, protecting public health, providing outdoor recreational opportunities and educating Delawareans about the environment.

Secretary Garvin's career in intergovernmental affairs spans more than 25 years at the federal, state, and local levels. In November 2009, he was appointed by President Barack Obama to serve as Administrator of Region 3 for the U.S. Environmental Protection Agency (EPA), overseeing the agency's work in the Mid-Atlantic, which includes Delaware, Maryland, Pennsylvania, Virginia and West Virginia, as well as the District of Columbia.

Shawn LaTourette, Commissioner, New Jersey Department of Environmental Protection

Appointed by Governor Philip D. Murphy, Shawn M. LaTourette became New Jersey's Commissioner of Environmental Protection on June 14, 2021. He had served as Acting Commissioner since January 16, 2021. Commissioner LaTourette is responsible for formulating statewide environmental policy while directing programs that protect public health and ensure the quality of New Jersey's air, land, water, and natural and historic resources.

Guided by a deep commitment to equity and a professional philosophy that uniting economic development and environmental improvement promotes the public good, Commissioner LaTourette has been regarded as a consensus builder adept at achieving balance among competing priorities. His diverse background — in protecting vulnerable communities, facilitating the development of infrastructure and public works, managing business risk, promoting conservationist policies and advocating for equity — has made him a leading force in policy, program and project development, especially those at the complex juncture of economic development, energy and environmental protection.

Rohit "Rit" Aggarwala, Commissioner, New York City Department of Environmental Protection

Rohit T. "Rit" Aggarwala is a widely recognized expert on urban sustainability, technology, and mobility. He led the creation of the Mayor's Office of Long-Term Planning and Sustainability under Mayor Michael R. Bloomberg, founded the environmental grantmaking program at Bloomberg Philanthropies, and served as president of the Board of Directors of the C40 Cities Climate Leadership Group. He was part of the founding team at Sidewalk Labs—Google's urban technology startup—and more recently was a senior urban tech fellow at the Jacobs Cornell-Technion Institute. He has provided advice and assistance to a number of foundations and impact investment funds and chaired the Regional Plan Association's Fourth Regional Plan for the New York region. Aggarwala holds a PhD, MBA, and BA from Columbia University and an MA from Queen's University in Kingston, Ontario.

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Adam Ortiz serves as EPA's Mid-Atlantic Regional Administrator where he oversees federal environmental and public health protections in Delaware, Maryland, Pennsylvania, Virginia, West Virginia, the District of Columbia, and seven federally recognized tribes. Working with state partners and local stakeholders, Adam is focused on infrastructure, enforcement, climate change, environmental justice, and restoring the Chesapeake Bay.

Before coming to EPA, Adam was the Director of the Montgomery County, Maryland Department of Environmental Protection, where he launched programs boosting recycling, curbside compost collection, building energy efficiency standards, and watershed restoration projects with a focus on equity

2:45pm – 3:45pm **S** **PDE Keynote - Catrin Einhorn, New York Times Climate Desk** **Main Ballroom (Avalon 23)**

Moderators: Sarah Bouboulis, Kathy Klein

Speakers: Catrin Einhorn

Catrin Einhorn is a journalist who covers biodiversity, climate and the environment for The New York Times. She was part of a team of reporters that received the 2018 Pulitzer Prize for Public Service for exposing sexual harassment and misconduct in the American workplace.
Throughout her career, Ms. Einhorn has focused on narrative-driven work in print, film and audio. In July 2020, The Times and Netflix released "Father Soldier Son," the Emmy-winning documentary she directed and produced with Leslye Davis.
In 2016, Ms. Einhorn and Jodi Kantor wrote a series about everyday Canadians adopting Syrian refugees, documenting the surprises, challenges and intense relationships that arose over their one-year sponsorship periods.
Previously, she was part of a team that examined President Obama's troop surge in Afghanistan by telling the personal stories of one battalion's yearlong deployment in a multimedia series called "Year at War."
Before coming to The Times, Ms. Einhorn was a public radio reporter and a Fulbright scholar in anthropology.

4:15pm – 5:45pm **D** **DRBC Climate Forum Technical Session II-Building Community-level Climate Resilience**

Moderators: Marjorie Kaplan, Elizabeth Brown **Main Ballroom (Avalon 23)**

Speakers: Firas Gerges, Renee Reber, Daria Nikitina, Heather Wholey

- 4:15: **Nikitina, Daria**, West Chester University; Impact of Sea Level Rise on Cultural Resources in the Delaware Bay Region.
- 4:30 **Wholey, Heather**, West Chester University; Down By the Bay: A Human Story
- 4:45 ✎ **Gerges, Firas**, Princeton University, GIS-Based Framework for Measuring Disaster Resilience using Community and Infrastructure Capitals
- 5:00 **Reber, Renee**, National Parks Conservation Association; Climate's Rising Tide and Our National Parks
- 5:15 Q&A

6:00pm – 7:30pm **S** **Poster Session II** **Poster Hall (Avalon 14-17)**

FEBRUARY 1 • WEDNESDAY

8:00am – 9:00am **M** **Registration & Breakfast** **Exhibitor Hall (Registration)**

9:00am – 10:00am **C** **Living Resources II** **Main Ballroom (Avalon 23)**

Moderators: Jenny Shinn, Peter Rowe

Speakers: Nivette Perez-Perez, Amanda Lyons, Matthew Kenwood

- 9:00: **Pérez-Pérez, Nivette**, Delaware Center for the Inland Bays; Delaware Inland Bays' Diamondback Terrapin Survey
- 9:15: **Lyons, Amanda**, The Wetlands Institute; Use of a Radio Telemetry Receiver Grid to Study Movements and Habitat Use of Female Diamondback Terrapins (*Malaclemys terrapin*) in a Southern New Jersey Salt Marsh
- 9:30: ✎ **Kenwood, Matthew**, University of Texas Health Science Center at San Antonio; Species, Subspecies, and Pollution Resistance Analysis of the killifish *Fundulus heteroclitus* in Delaware Bay Tributaries
- 9:45 **Hoffman, Taylor,** University of Delaware; Sperm Limitation in the Delaware Bay Blue Crab Population

Associated Posters:

- **Collins, Samantha**, The Wetlands Institute; Investigating Use of Enhanced Saltmarsh Habitats by Seaside and Saltmarsh Sparrows in Southern New Jersey

9:00am – 10:00am | **C** | **Science Communication** | **Breakout A (Avalon 20-22)**

Moderators: Megan Mackey, Jana Savini

Speakers: Lauren McGrath, Ryan Beltz

- 9:00: **Beltz, Ryan**, Perkiomen Watershed Conservancy; The Floating Classroom STEM Education Program
- 9:15: **Beltz, Ryan**, Perkiomen Watershed Conservancy; Watershed Wide Open: Challenges, Solutions and Creating Communities that Care
- 9:30: **McGrath, Lauren**, Willistown Conservation Trust; Community Science Model for High Frequency Headwater Stream Monitoring in Southeastern Pennsylvania
- 9:45: Q&A

10:30am – 11:30am | **C** | **Restoration & Conservation II** | **Main Ballroom (Avalon 23)**

Moderators: Douglas Janiec, Taylor Beck

Speakers: Lenore Tedesco, Alison Rogerson, Kelsey Fall

- 10:30: **Rogerson, Alison**, DNREC Division of Watershed Stewardship; Monitoring a Tidal Wetland Beneficial Use Project in Delaware for Baseline Conditions and Project Design
- 10:45: **Fall, Kelsey**, US Army Corps of Engineers, Engineering Research and Development Center (ERDC); Impact of Strategic, Unconfined, Dredged Material Placement on Turbidity Within a Shallow Back Bay System: Observations from Seven Mile Island Innovation Laboratory, NJ
- 11:00: **Tedesco, Lenore**, The Wetlands Institute; Beneficially Using Dredged Sediments to Enhance Marshes, Build Resiliency and Restore Habitats in New Jersey's Back Bays
- 11:15: Q&A

10:30am – 11:30am | **C** | **Water Quality II** | **Breakout A (Avalon 20-22)**

Moderators: John Yagecic, P.E., Matthew Gentry

Speakers: Paula Kulis, Meghana Parameswarappa Jayalakshmamma, Vijay Bhatia

✎ to indicate student presentation

- 10:30: **Bhatia, Vijay**, Philadelphia Water Department; Comparison of Microplastic Pollution in Different Urban Creeks
- 10:45: ✎ **Parameswarappa Jayalakshmamma, Meghana**, New Jersey Institute of Technology; Microplastics in Stormwater
- 11:00: **Kulis, Paula**, CDM Smith; Algal Processes in the Urban Delaware River: A synthesis of available data
- 11:15: Q&A

11:30am – 1:00pm | **M** | **Lunch** | **Poster Hall (Avalon 14-17)**

1:00pm – 2:00pm | **C** | **Physical & Chemical Processes** | **Breakout A (Avalon 20-22)**

Moderators: Kelly Somers, Martha Maxwell-Doyle

Speakers: Philip Duzinski, Steven Goldsmith, Mike Armstrong

ϟ indicates lightning talk

- 1:00: **Duzinski, Phil**, Philadelphia Water Department; Mechanisms of Salt Intrusion in the Upper Delaware Estuary
- 1:15: **Goldsmith, Steven**, Villanova University; Long-term impacts of impervious surface cover change and roadway deicing agent application on chloride concentrations in exurban and suburban watersheds within the Delaware Watershed
- 1:30: ϟ **Armstrong, Mike,** Boston College; Suspended Sediment Flux in Tidal Channels at Seven Mile Island Innovation Lab, New Jersey
- 1:40: Q&A

1:00pm – 2:00pm | **C** | **Restoration & Conservation III** | **Main Ballroom (Avalon 23)**

Moderators: LeeAnn Haaf, Alison Rogerson

Speakers: Sarah Bouboulis, Jon Miller, Douglas Janiec

- 1:00: **Miller, Jon**, Stevens Institute of Technology; New Jersey Living Shorelines Engineering Guidelines Updates
- 1:15: **Janiec, Douglas**, Sovereign Consulting Inc.; Anchoring Of Materials In Coastal Restoration. Do We All Understand The Science Behind Anchoring, Or Is It More A "Monkey See Monkey Do" Thing?
- 1:30: **Bouboulis, Sarah**, The Partnership for the Delaware Estuary; Delaware Estuary Shell Recycling Program Background, Status, & Expansion
- 1:45: Q&A

2:30pm – 3:30pm | **F** | **Hot Topics** | **Main Ballroom (Avalon 23)**

Moderators: Danielle Kreeger, Katie Eberhart

Speakers: Thomas Mozdzer, Gerald Joseph McAdams Kauffman, Jr., Olivia Allread

- 2:30: **Mozdzer, Thomas**, Bryn Mawr College; A paradigm shift: Rethinking Phragmites management in the context of ecosystem resilience with insights from a meta-analysis of ecosystem services in North American tidal wetlands
- 2:45: **Alread, Olivia**, DNREC; Realtors and Wetlands: An Educational Partnership in Delaware
- 3:00: **Kauffman, Gerald**, University of Delaware; Indigenous, European, and American Place Names of Streams and Waterways in Delaware
- 3:15: Q&A

3:30pm – 4:00pm | **S** | **Awards and Closing** | **Main Ballroom (Avalon 23)**

Speakers: Danielle Kreeger

Poster Presentations by Topic Area

* = Student Poster

Click on the presenter's name to access a digital PDF of the presentation.

Note: Not all presentations are linked at the request of the presenter.

Climate Change

- **Goddard, Kathryn**, Ursinus College; Effects of storm conditions of increased temperature and decreased salinity on the North American non-reef building coral *Astrangia poculata*
- **Kessler, Hannah**, Hadonfield Memorial High School; Climate Change Impact on Biodiversity in the Delaware Estuary - Community Science, Curriculum Development and Education Initiatives
- ***Solomon, Sam,** New Jersey Institute of Technology; Impact of Climate Change on the Salinization of Coastal Wetlands

Environmental Justice

- **Akbar Buchanan**, **Ferry**, Environmental Protection Agency Region 3; Studying Cumulative Impacts in Underserved Communities in Southern Delaware

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary

- **Suk, Namsoo**, Delaware River Basin Commission; Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary
- **Yagecic, John,** Delaware River Basin Commission; Social and Economic Factors Affecting the Attainment of Aquatic Life Uses in the Delaware River Estuary

Living Resources

- ***Ambrose, Alexandria**, Rutgers, the State University of New Jersey, Haskin Shellfish Research Laboratory; Video documentation of the marine community using an oyster farm as habitat near Barnegat Bay, NJ
- **Burt, Iris**, Rutgers University; Documenting Oyster Habitat in Tidal Creeks and Tributaries along Delaware Bay, NJ
- **Cheng, Kurt,** Partnership for the Delaware Estuary; Advances in Juvenile Freshwater Mussel Grow Out Techniques
- **Collins, Samantha**, The Wetlands Institute; Investigating Use of Enhanced Saltmarsh Habitats by Seaside and Saltmarsh Sparrows in Southern New Jersey
- ***Gentry, Matthew**, Partnership for the Delaware Estuary; Physiological Plasticity and Response to Food Availability of Two Native Freshwater Mussel Species
- **Morgan, Leah**, Partnership for the Delaware Estuary, Implementation of a regional "Mussels for Clean Water Initiative" for the upper mid-Atlantic region

Monitoring & Assessment

- **Bransky, Jake**, Delaware River Basin Commission; Reducing Microplastics in the Delaware River Estuary

Restoration & Conservation

- **Faller, Kelly,** Partnership for the Delaware Estuary; Evaluating change in marsh condition pre and post-restoration in two National Wildlife Refuges along the Delaware Bay
- **Klinkam, Jessica**, Partnership for the Delaware Estuary; A living shoreline feasibility model to support successful restoration projects
- **Tedesco, Lenore**, The Wetlands Institute; Seven Mile Island Innovation Laboratory: Projects, Goals and Outcomes of Beneficial Use Projects in New Jersey's Back Bays

Urban Ecology

- ***Curley, Jenna**, Haddonfield Memorial HS; Biodiversity and Ecosystem Services in the Cooper River Watershed - Invertebrate Diversity in Suburban Gardens
- ***Xiang, Galen**, University of Pennsylvania; Using Macroinvertebrate Indexes to Characterize the Impacts of Hydrologic Restoration in an Urban Philadelphia Watershed

Water Quality & Quantity

- **Felker, Jill**, Penn State Berks; Superbugs Upstream of the Delaware River: Assessing the Antibiotic-Resistant Bacteria in the Blue Marsh Watershed
- ***Supino, John,** Boston College; Evaluating anthropogenic influences on salt marsh carbon cycling at the Seven Mile Island Innovation Laboratory (SMIIL)
- **Willig, Anna,** Willistown Conservation Trust; Elevated Specific Conductivity and Chloride Concentration in the Headwaters of 3 Southeastern Pennsylvania Streams Linked to Impervious Surface Cover

Other

- **Haaf, LeeAnn, Leah Morgan & Danielle Kreeger,** Partnership for the Delaware Estuary; 2022 Technical Report for the Delaware Estuary and River Basin: Key Findings and Next Steps

Featured Speakers

Dr. Ray Najjar, PhD.-Monday, Jan 30, 9:15–10:00am, Main Ballroom (Avalon 23)

Department of Meteorology and Atmospheric Science,
The Pennsylvania State University

Past and likely future changes in the climate of the Delaware Estuary and Basin (DEB) are presented. From a historical analysis of air temperature, precipitation, streamflow, sea level, and ice and snow indicators, an overall picture of dramatic and accelerating climate change in the DEB emerges, one that is largely consistent with expectations from increases in greenhouse gases. These climate trends are extremely likely to continue into the next few decades regardless of greenhouse gas emissions. Climate change beyond mid-century will depend strongly on the emissions pathway. Hence, a combination of aggressive local adaptation and global emissions reduction is needed to avoid the worst impacts of anthropogenic climate change in the DEB. Adaptation planning should compensate for unjust policies, such as redlining, that have led climate impacts to fall disproportionately on the most vulnerable communities.

Raymond Najjar is a Professor of Oceanography in the Department of Meteorology and Atmospheric Science at The Pennsylvania State University. Dr. Najjar has conducted research on a variety of topics in oceanography, climate science, and hydrology, with current interests focused on how coastal waters are influenced by climate change and pollution. In addition to synthesizing research on the climate of the Delaware Estuary and Basin as part of periodic assessments led by the Partnership for the Delaware Estuary, Dr. Najjar has studied long-term changes in the salinity, dissolved oxygen, and tides of the estuary.

Dr. Philippe Hensel, PhD.-Tuesday, Jan 31, 9:00-10:00am, Main Ballroom (Avalon 23)

National Geodetic Survey: Operations and Analysis Division,
NOAA

Philippe Hensel is the chief of the Project Analysis Branch within the Operations and Analysis Division at NOAA's National Geodetic Survey (NGS). Philippe oversees activities related to maintaining the integrity of the nation's database of survey control. Since 2019, he is also part of a multi-agency team investigating vertical land motion in the wider Chesapeake Bay region. Since coming to NGS in 2006, Philippe has worked to bring high precision surveying applications to coastal scientists and resource managers (advancing the "sea level rise sentinel site" concept). Prior to coming to NGS, Philippe was a post-doc wetland ecologist with the USGS, Patuxent Wildlife Research Center. Philippe has also been an adjunct faculty at Johns Hopkins University, teaching a course in wetland ecology and management. Philippe holds a PhD in coastal ecology and a Master's degree in applied statistics from Louisiana State University, and a master's degree in marine, estuarine, and environmental sciences from the University of Maryland.

Catrin Einhorn-Tuesday, Jan 31, 2:45–3:35pm, Main Ballroom (Avalon 23)

Climate Desk, New York Times

Catrin Einhorn is a journalist who covers biodiversity, climate and the environment for The New York Times. She was part of a team of reporters that received the 2018 Pulitzer Prize for Public Service for exposing sexual harassment and misconduct in the American workplace. Throughout her career, Ms. Einhorn has focused on narrative-driven work in print, film and audio. In July 2020, The Times and Netflix released "Father Soldier Son," the Emmy-winning documentary she directed and produced with Leslye Davis. In 2016, Ms. Einhorn and Jodi Kantor wrote a series about everyday Canadians adopting Syrian refugees, documenting the surprises, challenges and intense relationships that arose over their one-year sponsorship periods. Previously, she was part of a team that examined President Obama's troop surge in Afghanistan by telling the personal stories of one battalion's yearlong deployment in a multimedia series called "Year at War." Before coming to The Times, Ms. Einhorn was a public radio reporter and a Fulbright scholar in anthropology.

Special Sessions and Panels

The State of the Watershed: Unveiling the 2022 Technical Report for the Delaware Estuary and Basin-Monday, Jan 30, 10:00–11:00am, Main Ballroom (Avalon 24-26)

The State of the Watershed: Unveiling the 2022 Technical Report for the Delaware Estuary and Basin

Every five years, the Partnership for the Delaware Estuary coordinates production of a State of the Estuary Report, working with many partners on behalf of the Delaware Estuary Program. To provide the scientific foundation for this report, the program's Scientific and Technical Advisory Committee also coordinates a companion Technical Report for the Delaware Estuary and Basin (TREB). The goal of TREB is to analyze the status and trends for more than 50 environmental indicators representing diverse facets of the natural ecosystem such as water quality, living resources, habitats and land cover. When considered together, these indicators provide a comprehensive picture of the current and trending environmental condition of the watershed. The analysis of each indicator includes a discussion of actions and needs, providing a blueprint for future science and management. The report also helps assess our progress in protecting, restoring and sustaining vital natural resources. This special session will unveil results from the 2022 TREB, which was completed in December, 2022.

On balance, the results from this assessment suggest that the health of the Delaware Estuary and River Basin in 2022 was "fair," reflecting a mix of positive and negative trends. The status of many indicators was good, and others were not so good. Trends for some indicators appeared to be improving, while others appeared to be worsening. Although the overall assessment of "fair" health is unchanged from 2017, 2012 and 2008, it reflects substantial improvement compared to earlier decades for many key indicators. For example, advances in wastewater treatment and implementation of the Clean Water Act led to dramatic improvement in dissolved oxygen in the river's urban corridor over the past 40+ years. These improvements in many facets of water quality have supported healthier living resources, demonstrated by the propagation of signature species such sturgeon and increasing watersports interest by the public. Unfortunately, the continued loss and degradation of important habitats and increasing effects of climate change threaten to undermine the recent recovery. Future predictions for many of the key climate indicators in this 2022 TREB reflect a much higher level of certainty

compared to 2017, largely because of more robust datasets and stronger recent trends. For example, the pace of climate change appears to be quickening for some indicators, with likely severe consequences for some critical natural resources (e.g., tidal wetlands) that have non-linear responses due to tipping points. For more info, see: https://www.delawareestuary.org/data-and-reports/state-of-the-estuary-report/

Environmental DEIJ for Community Leaders-Monday, Jan 30, 11:30–12:30pm, Breakout A (Avalon 20-22)

In this discussion-based, fishbowl style, panel session, we will hear from environmental leaders and community members working throughout the urban corridor of the Delaware Estuary to learn how local groups are working to advance environmental justice in our cities. This is a chance to not only hear about the challenges and successes people are facing in urban environmental work in the region but also to identify collective research and technical assistance needs moving forward. Panelists for this session will be made up of the Urban Waters Delaware River Location's new Community Cohort across Camden NJ, Chester PA, Philadelphia PA, and Wilmington DE.

Urban Waters Federal Partnership – Monday, Jan 20, 4-5pm, Breakout A (Avalon 20-22)

The Urban Waters Federal Partnership is an environmental justice effort working to "revitalize urban waters and the communities that surround them." In this session we will hear from several Delaware River Location partners on the value of revitalizing and restoring urban lands and waterways for climate, stormwater management, public access and safety, and health and quality of life. Whether we are working on site remediation, sustainable development, living shorelines, supporting small community-led projects, or including health and housing in our investments, this session will feature more urban restoration projects that expand our definitions of environmental justice.

- 4:00 **Erica Rossetti, PDE** – introduction and overview of the UWFP Delaware River Location
- 4:15 **Roberto Frugone, HUD** – the importance of community planning and equitable, sustainable development
- 4:30: **David A. Paul, MD, FAAP (Department of Pediatrics Chair, ChristianaCare)** – health, quality of life, and environmental justice
- 4:45: Q &A

DRBC Panel Conversation on Climate Planning and Adaptation- Tuesday, Jan 31, 1:30–2:30pm, Main Ballroom (Avalon 23)

Moderators: Steven J. Tambini, Delaware River Basin Commission & Kristen Bowman Kavanagh, Delaware River Basin Commission

This panel of high-level government leaders will provide updates from their municipal, state, and federal-level agencies on efforts to address climate change. What key climate-related challenges are they facing, and where have they seen success? How are their agencies addressing water equity and environmental justice? What are their climate goals for 2023 and beyond? Be prepared for a lively and interactive discussion. Audience questions are encouraged.

Panelists include:

Shawn Garvin, Secretary, Delaware Department of Natural Resources and Environmental Control

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Rohit T. "Rit" Aggarwala is a widely recognized expert on urban sustainability, technology, and mobility. He led the creation of the Mayor's Office of Long-Term Planning and Sustainability under Mayor Michael R. Bloomberg, founded the environmental grantmaking program at Bloomberg Philanthropies, and served as president of the Board of Directors of the C40 Cities Climate Leadership Group. He was part of the founding team at Sidewalk Labs—Google's urban technology startup—and more recently was a senior urban tech fellow at the Jacobs Cornell-Technion Institute. He has provided advice and assistance to a number of foundations and impact investment funds and chaired the Regional Plan Association's Fourth Regional Plan for the New York region. Aggarwala holds a PhD, MBA, and BA from Columbia University and an MA from Queen's University in Kingston, Ontario.

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Before coming to EPA, Adam was the Director of the Montgomery County, Maryland Department of Environmental Protection, where he launched programs boosting recycling, curbside compost collection, building energy efficiency standards, and watershed restoration projects with a focus on equity.

Speakers, Moderators, and their Institutions

Rohit Aggarwala, NYC Environmental Protection
Ferry Akbar-Buchanan, US EPA
Olivia Allread, Delaware DNREC
Eileen Althouse, CDM Smith
Alexandria Ambrose, Rutgers Haskin Shellfish Research Laboratory
Thomas Amidon, DRBC
Mike Armstrong, Boston College
Taylor Beck, DNREC Division of Coastal, Climate and Energy
Sarah Beganskas, DRBC
Ryan Beltz, Perkiomen Watershed Conservancy
Vijay Bhatia, Philadelphia Water Department
Mark Biddle, Delaware DNREC
Chesa Blom, Partnership for the Delaware Estuary
Sarah Bouboulis, Partnership for the Delaware Estuary
Elizabeth Bouchard, Rutgers Haskin Shellfish Research Laboratory
Jacob Bransky, DRBC
Kelsey Brooks, National Wildlife Federation
Elizabeth Brown, Delaware River Basin Commission
Elizabeth Koniers Brown, DRBC
Jessie Buckner, RES LLC
Iris Burt, Rutgers University
David Bushek, Rutgers Haskin Shellfish Research Laboratory
Lance Butler, Philadelphia Water Department
John Callahan, University of Delaware
Kurt Cheng, Partnership for the Delaware Estuary
Kayla Clauson, Delaware DNREC
Bob Collins, Delaware Center for the Inland Bays
Samantha Collins, The Wetlands Institute
Julie Conroy, Ramboll
Laura Craig, E&LP
Jenna Curley, Haddonfield Memorial High School
Philip Duzinski, Philadelphia Water Department
Katie Eberhart, Orsted
Kelsey Fall, USACE ERDC
Chen Fanghui, Ph.D, P.E., DRBC
Jill Felker, Penn State Berks
Sean Fettrow, University of Delaware
Brittney Flaten, Delaware DNREC
Missy Frankil, Camden Community Partnership
Roberto Frugone, US Dept of Housing and Urban Development
Zachary Garmoe, Delaware Center for the Inland Bays
Shawn Garvin, Delaware Department of Natural Resources and Environmental Control
Matthew Gentry, Partnership for the Delaware Estuary
Firas Gerges, Princeton University
Kate Goddard, Ursinus College
Steven Goldsmith, Villanova University
Brent Gotsch, NYCDEP
LeeAnn Haaf, Partnership for the Delaware Estuary
Taylor Hoffman, University of Delaware
Andrew Homsey, University of Delaware
Catherine Hughes, University of Delaware
Douglas Janiec, Sovereign Consulting Inc.
Meghana Parameswarappa Jayalakshmamma, New Jersey Institute of Technology
Marjorie Kaplan, Rutgers University
Gerald Joseph McAdams Kauffman, Jr., University of Delaware
Kristen Bowman Kavanagh, DRBC
Matthew Kenwood, UTHSCSA
Kathy Klein, Partnership for the Delaware Estuary
Jecy Klinkam, Partnership for the Delaware Estuary
Danielle Kreeger, Partnership for the Delaware Estuary

Paula Kulis, CDM Smith
Shawn LaTourette, NJ Department of Environmental Protection
Katie Lavallee, Woods Hole Group
Gregory Lech, PA Fish & Boat Commission
Mike De Luca, Rutgers
Amanda Lyons, The Wetlands Institute
Megan Mackey, US EPA
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The Partnership for the Delaware Estuary, host of the Delaware Estuary Program, leads collaborative, science–based efforts to improve the Delaware River and Bay, which covers portions of Delaware, New Jersey, and Pennsylvania.

Partnership for the DELAWARE ESTUARY

Connecting people, science, and nature for a healthy Delaware River and Bay

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Drexel University College of Arts and Sciences — Biodiversity, Earth, and Environmental Science

NJCWRP New Jersey Corporate Wetlands Restoration Partnership

Pinelands Nursery & Supply

GEV Geography and the Environment

Designed by Frank McShane

Front panel sunset photo by Beth Baker, front panel bridge photo by Gavin Brown

Abstracts

Abstract Format Reference

Abstract Title

Presenter Last Name, Presenter First Name, Presenter Title, Presenter Institution, Presenter Address, presenter email; Co-Authors and their institutions

Session Title, Time and Location

Abstract

*All presenters are bolded

Studying Cumulative Impacts in Underserved Communities in Southern Delaware

Akbar Buchanan, Ferry, Life Scientist, Environmental Protection Agency Region 3, 1600 JFK Boulevard, Philadelphia, PA, 19103, AkbarBuchanan.Ferry@epa.gov; Kyle Buck, EPA Office of Research and Development; Katie Bennett, EPA Office of Research and Development

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Understanding how health disparities and exposures vary spatially across a watershed requires a clear picture of community members' concerns and priorities and must include historically underserved and disadvantaged communities, which are often already underrepresented in scientific and legislation policies.

These communities face challenges that can affect the health of their residents, including, elderly population, low income, and close proximity to Superfund and Risk Management Plant Facilities. Currently, there are approaches for characterizing cumulative exposures, cumulative risks, and cumulative health impacts. Although such approaches have merit, they also have significant constraints.

The aim of this project is to provide data to the Delaware Center for Inland Bays (CIB) in prioritizing communities based on social vulnerabilities identified. New developments in exposure mapping and epidemiology, especially when informed by community participation, have the potential to advance the science on cumulative impacts and to improve decision-making on the local and regional levels.

This study will work with the Bipartisan Infrastructure Law funding and represent an opportunity to ensure that the benefits of federal investment are shared equitably by all communities within the estuary program study area of CIB. Consistent with E.O. 14008, which sets a goal for 40% of the overall benefits of federal funding to flow to disadvantaged communities, Management Committees under CIB should prioritize projects which provide significant benefits that accrue for marginalized and overburdened communities within their watershed.

Beginning in summer 2022, researchers from EPA are looking into how environmental exposures may interact with social stressors, thereby worsening health outcomes. A community-engaged approach is used to develop and implement focus group discussions and compare environmental health concerns in inland vs coastal communities. The findings can help inform future efforts to study, understand, and effectively address environmental and social vulnerabilities that are particularly relevant to developing effective community-based strategies in underserved communities.

Realtors and Wetlands: An Educational Partnership in Delaware

Allread, Olivia, Education and Communications Specialist, DNREC's Wetland Monitoring and Assessment Program, 285 Beiser Blvd., Dover, DE, 19904, olivia.allread@delaware.gov

Hot Topics, Wednesday, 2:30 PM, Main Ballroom, (Avalon 23)

As the landowner's first contact, real estate professionals can educate clients and buyers to make wise choices about properties. DNREC's Wetland Monitoring and Assessment Program has built a partnership with realtors state-wide to provide education and training on wetlands, as well as promote tools to better navigate challenges involving these habitat types. This presentation will cover how and why the initiative was created, showcase targeted outreach materials, and explain coordination tactics for education in this sector.

Overview of Receiving Water Modeling for Philadelphia's Year 10 Green City, Clean Waters Evaluation and Adaptation Plan (EAP) Report

Althouse, Eileen, Project Manager, Water Resources Engineer, CDM Smith (consultant to Philadelphia Water Department), 1500 JFK Blvd, Suite 1208, Philadelphia, PA, 19102, althouseem@cdmsmith.com; Kinman Leung, Philadelphia Water Department; Ramona McCullough, Sci-Tek Consultants; Kimberly Artita, CDM Smith; Dwayne Myers, CDM Smith

Big Picture Environmental Planning, Monday, 11:30am, Breakout B, (Avalon 24-26)

Philadelphia Water Department (PWD), has recently prepared a report documenting the progress of the Green City, Clean Waters Combined Sewer Overflow (CSO) Long-Term Control Program from its inception in 2011 through 2021 (Year 10 of program implementation). This report was submitted as a requirement of the City's Consent Order and Agreement with the Pennsylvania Department of Environmental Protection. Water quality and hydrodynamic models of the tidal Delaware River and nontidal creeks, including Tacony/Frankford and Cobbs, were developed and utilized to simulate water quality conditions within these CSO receiving waters as of Year 10. This presentation will highlight the water quality model development and provide an overview of the analysis of the model results that are included in the Year 10 Evaluation and Adaptation Plan (EAP) Report. This presentation will also summarize the status of the implementation of CSO controls, including green infrastructure implementation, other infrastructure projects, and the resulting estimated CSO volume reductions.

Both the tidal Delaware River and the nontidal creeks were simulated using US EPA's Environmental Fluid Dynamic Code (EFDC). The Year 10 models were based on the models developed during an extensive model validation effort for the years 2012 and 2013 for fecal coliform bacteria and dissolved oxygen in the tidal Delaware River. Likewise, the nontidal creek models were based on similar model validation efforts for time periods where water quality data were available. In order to simulate the impact of CSO controls on the receiving waters, a model framework was established that focused on the contribution of CSO loads to water quality criteria exceedances in the receiving waters. The presentation will provide an overview of how the model scenarios were implemented in EFDC, the tools developed to compare the model results against applicable water quality criteria, and the results included in the Year 10 EAP report.

Video Documentation of the Marine Community Using an Oyster Farm as Habitat Near Barnegat Bay, NJ

Ambrose, Alexandria, Rutgers, the State University of New Jersey, Haskin Shellfish Research Laboratory, 6569 Miller Avenue, Port Norris, NJ, 08349, aa2130@hsrl.rutgers.edu, Daphne M. Munroe, Rutgers the State University of New Jersey, Haskin Shellfish Research Laboratory, Jenny P. Shinn, Rutgers the State University of New Jersey, Haskin Shellfish Research Laboratory

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Shellfish growers routinely observe fish and invertebrates interacting with their aquaculture gear. To quantitatively assess these observed interactions, point-of-view (GoPro) cameras were used to document fish activity in and around oyster cages, floating bags, and a natural marsh habitat on an oyster farm in the Little Egg Harbor region of Barnegat Bay, New Jersey in 2019. At least 30 species from 4 phyla were observed across all days and sites. Nekton abundance was determined using MaxN, defined as maximum number of individuals of a given species present within each 1-minute segment of video. Species of both ecological and economic importance in the local ecosystem utilized the farm gear as habitat. Young of the year and juveniles of a given species were observed, suggesting that the oyster farm may support the natural nursery function of the marshes. Atlantic Silverside (*Menidia menidia*), mummichog (*Fundulus heteroclitus*), and grass shrimp (*Palaemonetes spp*.) had the highest number of individuals observed among the 12 sampling days. Then MaxN was lower when there was farm activity occurring compared to observations collected when there was no farmers present. On average it took 2.25 minutes for fish to return to the gear after a human disturbance. This collaborative work is part of an ongoing effort initiated in Long Island Sound by the NOAA Milford Lab and is working towards a comprehensive regional network characterizing and evaluating fish habitat provisioning on offbottom oyster farms. This research is being used to help inform decision making in the permitting process of shellfish aquaculture leases, as the gear has the potential to mimic the function of natural surrounding habitats.

What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses?

Amidon, Thomas, Manager, Water Resource Modeling, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Thomas.Amidon@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

This presentation will address the second of two questions on which DRBC's analysis of attainability focused: 1) what combination of feasible load reductions will yield the best possible dissolved oxygen (DO) condition in the Delaware Estuary; and 2) what will the improved DO condition be under conservative design conditions, and will it support fish propagation throughout the estuary. As discussed in the previous presentation in this session, reducing effluent ammonia concentrations in nine wastewater plants, seven within the urban estuary from Philadelphia/Camden to Wilmington and two upstream of Philadelphia, to 1.5 and 5 mg/L, respectively, provides the most attainable improvement in DO.

Four additional factors were considered to establish the highest attainable DO under design conditions: 1) planned CSO reductions; 2) improved effluent DO; 3) seasonally variable wastewater ammonia concentrations; and 4) reserve capacity for future growth. The highest attainable DO condition will increase the trough of the DO sag (under design conditions) by 2.3 mg/L and eliminate the occurrence of DO levels below 4.3 mg/L, a level below which DO will not support propagation of one or more fish species. The highest attainable DO condition represents an estimate of the best DO condition that can be expected under critical conditions based on the physics, chemistry and biology of the system. Socio-economic factors were considered but did not impact the recommended scenario. Technological feasibility, represented by the lowest wastewater ammonia concentration (1.5 mg/L), drove the methodology but not the outcome to any significant degree.

Implementation of the recommended wastewater load reductions will improve DO such that both maintenance and propagation of resident fish will be supported throughout the Delaware River Estuary. The highest attainable DO condition will form the basis for rulemaking in which DRBC will propose a revised designated use and draft water quality criteria to protect that use.

Suspended Sediment Flux in Tidal Channels at Seven Mile Island Innovation Lab, New Jersey

Armstrong, Mike, Graduate Student, Boston College, 140 Commonwealth Ave, Chestnut Hill, MA, 02467, armstrmo@bc.edu; Noah P. Snyder, Boston College; Gail Kineke, Boston College; Jarrell Smith, Coastal and Hydraulics Laboratory, ERDC; Gregg Snedden, Wetland and Aquatic Research Center, USGS

Physical and Chemical Processes, Wednesday, 1:00 PM, Breakout A, (Avalon 20-22)

Salt marshes are hotspots for biodiversity, carbon sinks, provide pollutant filtration, and buffers which strengthen coastal resiliency. Detailed geomorphic and sedimentary observations are vital to understanding the stability and sustainability of natural and nature-based features (NNBFs) associated with sediment placement and restoration projects in salt marshes. Marsh stability is dependent on the suspended sediment and nutrients that are delivered to the marsh platform by meandering tidal channels. We study suspended-sediment fluxes at the mouth of Southeast Creek on Gull Island at Seven Mile Island Innovation Lab in coastal, southern New Jersey. The mesotidal, almost entirely low marsh, southern Gull Island received a recent dredge placement conducted by the USACE Philadelphia District in fall 2020 of approximately 30,600 cubic meters of sediment from the adjacent New Jersey Intracoastal Waterway. Wetland instrumentation platforms to monitor post-dredge conditions were deployed in treatment and control tidal channels (3) and a marsh pond (1) by an ERDC-led collaboration in summer 2021. We utilize instrumentation to measure current velocity and depth time series at all platforms, and suspended sediment concentration using acoustic backscatter techniques at the mouth of Southeast Creek. Our study is motivated by understanding the ongoing transport and deposition of dredged material placed on the marsh island. In our ongoing work, we will calculate suspended-sediment fluxes, which vary vertically and over time. We will estimate fluxes during normal tidal cycles, storm surges, spring-neap cycles, seasonally, and throughout a calendar year to determine whether tidal channels are importing or exporting sediment, and the dominant processes responsible for that transport.

What combination of wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary?

Beganskas, Sarah, Water Resource Scientist, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Sarah.Beganskas@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

An "Analysis of Attainability" (AA) was performed to identify which wastewater improvements yield the best dissolved oxygen (DO) outcome in the Delaware Estuary during critical environmental conditions. Sensitivity results (see previous presentation in this session) showed that summer (May–October) wastewater ammonia is the primary factor affecting low DO conditions in the 38-mile stretch of the Estuary currently designated for fish maintenance (i.e., not designated for fish propagation). Further testing allowed wastewater discharges to be divided into three classes based on the impact of their effluent ammonia on DO: Class A' (7 discharges) have a direct impact, Class A (2 discharges) have an indirect impact, and Class B (all other discharges) have de minimis impact.

AA scenarios varied in (1) the level of effluent ammonia reduction and (2) the class(es) of discharges with reduced ammonia. AA results show that effluent ammonia from Class A' discharges would need to be reduced to 1.5 mg/L in order for DO to remain consistently above 4 mg/L; further reducing total nitrogen to 4 mg/L is costly and provides no measurable benefit to DO.

Based on AA results, it is recommended that Class A' and Class A discharges reduce effluent ammonia to 1.5 and 5 mg/L, respectively, at a total cost of $153M/year in 2019 dollars. Infrastructure costs to achieve specific ammonia reductions were considered in making these recommendations but did not drive the recommendation.

The recommended wastewater improvements would increase DO from 2.2 to 4.0 mg/L at the lowest point of the "sag" and would shrink the spatial extent that experiences DO less than 5 mg/L at any time from 50 to 28 river miles. The recommended wastewater ammonia reductions are technically feasible and are expected to significantly improve DO conditions in the Delaware Estuary.

Watershed Wide Open: Challenges, Solutions and Creating Communities that Care

Beltz, Ryan, Executive Director, Perkiomen Watershed Conservancy, 1 Skippack Pike, Schwenksville, PA, 19473, Rbeltz@perkiomenwatershed.org

Science Communication, Wednesday, 9:00 AM, Breakout A, (Avalon 20-22)

The Skippack Creek is the most impaired tributary in the Perkiomen Watershed. To combat the degradation of this creek, local municipalities and concerned residents have banded together with the Perkiomen Watershed Conservancy to create a watershed-wide restoration plan. Over the past four years, dozens of projects have been implemented and thousands of volunteer hours have been logged in order to bring this plan to fruition. This presentation highlights the engagement of these volunteers and the work their efforts have produced.

The Floating Classroom STEM Education Program

Beltz, Ryan, Executive Director, Perkiomen Watershed Conservancy, 1 Skippack Pike, Schwenksville, PA, 19473, Rbeltz@perkiomenwatershed.org

Science Communication, Wednesday, 9:00 AM, Breakout A, (Avalon 20-22)

The Floating Classroom STEM Education Program is the best thing to environmental education since the #2 pencil! Imagine environmental education, kayaking, and a floating science lab rolled into one incredible program geared towards developing real-world field skills in our young learners. Students participate in courses in watershed science, aquatic communities, ornithology, geology, and botany. Moreover, students will discover real-world applications for their newly acquired knowledge through hands-on explorations on Green Lane Reservoir... and all from the cockpit of a kayak.

About the Floating Classroom: “Dragonfly I” is a state-of-the-art science lab constructed on a reimagined 24' pontoon boat. The "classroom" is equipped with microscopes, iPads, Wifi, water quality testing supplies and other equipment that will aid students in their investigations. The boat itself is equipped with a 10 horse electric motor which derives its power from 4 specially-configured solar panels. Dragonfly I is a self-sustaining, green machine.

This presentation will highlight the Floating Classroom Program, the students who benefit from it, and the construction of our sun-powered research boat.

Comparison of Microplastic Pollution in Different Urban Creeks

Bhatia, Vijay, Program Scientist, Philadelphia Water Department, 1500 E Hunting Park Ave, Philadelphia, PA, 19124, vijay.bhatia@phila.gov; Adam Eyring, Philadelphia Water Department; Fadila Sore, Constitution High School

Water Quality II, Wednesday, 10:30 AM, Breakout A, (Avalon 20-22)

Microplastics as globally distributed pollutants continue to receive attention worldwide and this field has raised more questions than the answers we have. Though freshwater bodies are recognized as origins and transport pathways of plastics to the oceans, there is a lack of comparison of microplastics in different water bodies. In the present study, the distribution of microplastics was studied across Wissahickon, Pennypack, Poquessing, and Cobbs Creeks in Philadelphia. Significant differences in microplastic contamination were revealed not only across different creeks but also across different sampling points within each creek. The results for Wissahickon showed increasing abundance of micro pellets of varying size that appear not to be biofouled in the winter months. Though these micro pellets are seen across all the creeks, there appear to be some slight differences in the plastic type. The proportion of fibers was highest in Cobbs Creek, followed by the Poquessing, the Pennypack and the Wissahickon. The fibers were mostly present as polyesters or as cellulose (both natural and semisynthetic). Beads from Pennypack were polystyrene in composition while those from Poquessing Creek were inorganic in composition. A large percentage of films in the Poquessing Creek corresponded to cellulose nitrate while those in other creeks matched compositions similar to zein or polyamide. Microplastic contamination corresponding to resin has been observed in Cobbs Creek and the Poquessing Creek but not in the Wissahickon and Pennypack. Among other variations, we have observed the presence of additives or plasticizers, Tygon polymer, and silicone oil compositions in Cobbs Creek, but not in the other creeks. The results suggest that both the abundance and composition of microplastic pollution varies across different water bodies. To understand the source, it is necessary to measure microplastic pollution across different bodies.

Delaware Estuary Shell Recycling Program-Background, Status, & Expansion

Bouboulis, Sarah, Habitat Project Manager, Partnership for the Delaware Estuary, Suite 202, 110 S. Poplar St., Wilmington, DE, 19801, sbouboulis@delawareestuary.org; Danielle A. Kreeger, Partnership for the Delaware Estuary

Restoration & Conservation III, Wednesday, 1:00 PM, Main Ballroom, (Avalon 23)

The eastern oyster, *Crassostea virginica*, has a long history as a commercially and ecologically important species in Delaware Bay. The eastern oyster is a popular seafood item, and post consumption oyster shells are typically discarded. The removal of oyster shell, combined with other constraints on oyster population recruitment and growth, contributes to a negative "shell budget" in Delaware Bay. Dwindling available shell directly affects oyster stocks. Oyster recruitment depends on shell availability, and the planting of recycled shell is widely regarded as a very cost-effective oyster restoration tactic. In shallow saltwater areas that are amenable to oyster colonization, recycled & bagged shell is quickly colonized, leading to formation of resilient reef structures that filter water and provide wave attenuation, among other benefits.

Since 2016, the Delaware Estuary Shell Recycling Program (DESRP) has been alleviating this negative "shell budget" by recycling shell from area restaurants. Shell has been collected weekly from several restaurants in the Wilmington/Newark, DE area. Recycled shell is deposited at a shell management area in Wilmington where it is cured for 6-12 months. Once cured, the shell is bagged for restoration projects. The first 6 years the program has recycled and returned to the water nearly 8000 bushels (200 tons) of shell. In 2022, with help from the Philadelphia Water Department, the DESRP expanded into Philadelphia. The establishment of shell recycling operations in Philadelphia will greatly increase the availability of shell in the region by nearly doubling shell volumes recycled and the amount of added shell management space will aid in long term planning of shell resources.

Effect of Oyster Farms on the Distribution of Horseshoe Crab Eggs and Other Rufa Red Knot Foraging Resources

Bouchard, Elizabeth, Graduate Student, Rutgers Haskin Shellfish Research Laboratory, 6959 Miller Ave, Port Norris, NJ, 08349, ehb52@hsrl.rutgers.edu; Daphne Munroe, Rutgers Haskin Shellfish Research Laboratory; Brooke Maslo, Rutgers University; David Bushek, Rutgers Haskin Shellfish Research Laboratory

Living Resources I - Shellfish, Monday, 2pm, Breakout B, (Avalon 24-26)

Delaware Bay hosts the world's largest spawning population of horseshoe crabs (*Limulus polyphemus*, HSC) and is the primary migratory stopover site for the federally threatened rufa red knot (*Calidris canutus rufa*). Red knots time their spring circumpolar migration to capitalize on the abundant HSC eggs in Delaware Bay. The resurgent eastern oyster (*Crassostrea virginica*) aquaculture industry in this region may alter this trophic interaction by influencing access to foraging resources (i.e. farm avoidance, change in prey distribution). Research shows that foraging behavior is not impacted by the presence of farms, although the probability of shorebird presence is reduced by 2-7% while farms are tended. Oyster farms do not impact HSC access to spawning beaches; however, it is unknown how they may impact the distribution of eggs or other red knot prey. In Spring 2021, benthic sediment surveys were conducted in four paired farm-control plots (90 m x 180 m) across a 3.5-km stretch of tidal flats in Delaware Bay. Sediment cores determined the relative abundance of surficial eggs and other potential prey across each plot.

Preliminary analysis (AIC model selection with generalized linear mixed effects models) indicated that HSC eggs and potential alternative prey resources vary across the intertidal zone. Horseshoe crab eggs were the most abundant prey, but they were concentrated on the beach. Bivalves, gastropods, and polychaete worms were often more abundant on the tidal flats than the beach. Red knots foraging on tidal flats may be consuming these other prey types that were more abundant than HSC eggs on the flats. Potential prey abundances were similar in farm and control plots, regardless of intertidal zone and prey type. These findings suggest that oyster farms do not affect the distribution and abundance of rufa red knot prey resources.

Reducing Microplastics in the Delaware River Estuary

Bransky, Jake, Aquatic Biologist, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Jacob.Bransky@drbc.gov; Fanghui Chen, Delaware River Basin Commission

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Plastic is perhaps the most prevalent type of debris found in our oceans, rivers, and large lakes. Plastic debris comes in all shapes and sizes, but those that are less than five millimeters in length are called microplastics. These tiny particles easily pass-through water filtration systems and end up in receiving waters. Over time, larger plastics degrade into microplastics, but microplastics also include man-made products like microbeads. Little is known about microplastics and their impacts on human health and aquatic life and few microplastics studies have been conducted in the Delaware River Basin. DRBC monitored for microplastics and modeled loadings of microplastics in the upper Delaware River Estuary—from Trenton, N.J. to Wilmington, DE. Samples were collected from four sites in the mainstem Delaware River Estuary and ten tributary sites. Samples were analyzed for microplastic concentration, color, size, shape, and composition. Microplastics were found in all samples collected. Data collected during microplastic monitoring efforts was to model microplastic dynamics in the estuary and to target high plastic-loading tributaries for cleanup efforts. Understanding the inputs of microplastics is a vital first step towards understanding the prevalence and potential problems posed by this contaminant.

Delaware River Conservation Blueprint: Accelerating Strategic Conservation Gains in the Delaware River Watershed

Brooks, Kelsey, Senior Manager, Delaware River Programs, National Wildlife Federation, 20 Ridgely Avenue, Annapolis, MD, 21401, brooksk@nwf.org; Christina Ryder, US Fish and Wildlife Service; Lin Perez, The Academy of Natural Sciences of Drexel University

Big Picture Environmental Planning, Monday, 11:30am, Breakout B, (Avalon 24-26)

The Delaware Basin Conservation Act directs the U.S. Fish and Wildlife Service (USFWS) to establish the Delaware River Basin Restoration Program (DRBRP). The legislation envisions 3 major program components: a partnership, a grant program, and a watershed wide conservation strategy. Since 2018, in collaboration with the National Fish and Wildlife Foundation, the DRBRP's Delaware Watershed Conservation Fund (DWCF) has funded 159 projects, awarding $40.4 million in federal funds enabling partners to leverage $59.7 million in matching funds, totaling an impressive conservation impact of $100.1 million across the watershed. This process and the program are overseen by the Delaware River Basin Conservation Collaborative, a steering committee of stakeholders representing different sectors and geographies throughout the watershed. The final component of the program, the watershed wide conservation strategy, will be met through the Delaware River Conservation Blueprint. The Conservation Blueprint is intended to both help Delaware Watershed Conservation Fund applicants craft priority aligned, competitive proposals as well as inform funding decisions, ensuring that funded projects are contributing to shared conservation and restoration goals for the watershed. Through a collaborative effort between USFWS, the National Wildlife Federation (NWF), and the Academy of Natural Sciences of Drexel University a beta version of the tool will be completed in February 2023. During this session we will provide an overview of the Conservation Blueprint and its development; the priorities for the 2023 DWCF solicitation; and the timeline for tool development, including opportunities to provide input on the Blueprint before its launch with the 2024 DWCF grant cycle.

South Wetlands Park: A Case Study on Freshwater Tidal Ecological Restoration and Environmental Justice in the Urban Corridor of the Delaware Estuary

Buckner, Jessie, Ecologist III/Project Manager, Resource Environmental Solutions, 230 S. Broad St., 17th Floor, Philadelphia, PA 19102, jbuckner@res.us

Urban Ecology & Restoration, Monday, 2:00pm, Breakout A, (Avalon 20-22)

The South Wetlands Park site provides a novel model of freshwater tidal restoration in an urban environment that also seeks to be a publicly accessible park. The project brings together scientific research into realistic restoration strategies used in an urban setting, environmental justice, and confronting regulatory hurdles that aren't prepared to quantify a site with so many variables. As climate changes, and sea-level rises, we focus more intently on the intersection of humans and the rest of the ecological world. For many years, urban settings and wetlands shared the same perception by outsiders, places devoid of ecological value. However, in the last 40 years, wetlands have grown to be recognized as sources of incredible ecosystem services and values that can't be recreated in upland habitats. Similarly, more research is being performed in urban ecology to understand the specific biomes that have been created by the needs of humans. Regulations have been put in place to protect and preserve our natural resources, yet these regulations have often been created to reflect the conditions and ideals of less developed habitats and neglect the place that humans occupy in the current ecosystem. This presentation reviews South Wetlands Park from the ecological lens of site selection, research design, findings, and their place in design AND the social lens of climate change, urban ecology, and environmental justice and how all of these things work together in our current zeitgeist to foster a healthy and sustainable environment for humans and nature.

Documenting Oyster Habitat in Tidal Creeks and Tributaries along Delaware Bay, NJ

Burt, Iris, Laboratory Technician, Rutgers University, 6959 Miller Avenue, Port Norris, NJ, 08349, iburt@hsrl.rutgers.edu; David Bushek, Rutgers University; Conor Davis, New Jersey Department of Environmental Protection; Kurt Cheng, The Partnership for the Delaware Estuary; Zack Greenberg, The Pew Charitable Trusts

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

In addition to the large commercial oyster dredge fishery and aquaculture farming in Delaware Bay there is an active seasonal, artisanal hand-tonging oyster fishery that operates in the mouths of several tributaries and tidal creeks. Hand tonging has occurred for over a century and provides vital support for watermen that earn a living harvesting various species as seasons change. The extent of these three resources is well documented, however, the extent of the oyster resource across the wider geographic area was largely unmapped. Understanding this wider distribution was of interest to resource managers and restoration practitioners for multiple reasons. As part of a joint project between Rutgers University, NJDEP, PDE and Pew to advance sustainable shellfish resource planning in New Jersey, oyster presence and suitable habitat for oysters was documented in tidal creeks and tributaries of Delaware Bay in New Jersey. Benthic surveys were conducted in 2020-2022 within 14 tidal creeks and tributaries from Mad Horse Creek to Dias Creek, spanning a salinity gradient of about 10-25 psu. A Humminbirdä Helixâ G2 sonar unit was used to collect side scan sonar imagery and bottom hardness data to aid in the identification of oyster beds or hard/shell substrates. Once areas of interest were identified, they were ground-truthed with a small oyster dredge or oyster tongs. The Humminbird ä sonar unit along with the Auto Chart pro software was easy to use in conducting this survey and results identified oyster resources in 11 of the 14 tributaries.

The Aquatic Research and Restoration Center (ARRC): A Collaborative Approach to Addressing the Conservation, Restoration, and Enhancement of Key Aquatic Natural Resources in Urban Regions of the Delaware River Basin

Butler, Lance, Senior Scientist, Philadelphia Water Department, 1101 Market Street, 4th Foor, Philadelphia, PA, 19107, Lance.Butler@phila.gov; William Whalon, Philadelphia Water Department; Danielle Kreeger, PhD, Partnership for the Delaware Estuary; Leah Morgan, Partnership for the Delaware Estuary; Kurt Cheng, Partnership for the Delaware Estuary; Roger Thomas, Academy of Natural Sciences at Drexel Unviersity; Charlotte Scaff, Drexel University

Urban Ecology & Restoration, Monday, 2:00pm, Breakout A, (Avalon 20-22)

Like other major estuaries in the mid-Atlantic region, the Delaware Estuary is dominated by a substantial freshwater input with extensive riverine and tidal wetlands that provide critical habitat to commercial and recreational fisheries and shellfish assemblages. Within the urban portions of the basin, these provisioning and supporting ecosystem services have been greatly reduced, altered, or in some instances, removed entirely. The proliferation of built structures, lack of habitat heterogeneity, and invasive species introduction are pervasive along urbanized shorelines of the Delaware River. Despite this, however, habitat enrichment in urban regions represents an important enhancement of ecosystem services and is critical to the health and survival of resident and migratory species, providing natal grounds for spawning areas for foraging, and refugia from predation. In 2018, the Aquatic Research and Restoration Center (ARRC), a multi-agency collaboration among organizations based in the Delaware Estuary, was established with the guiding principles of improving the health and integrity of aquatic ecosystems along the urban centers of the Delaware River. In the last five years, the ARRC's achievements have been far-reaching: principles and practices of freshwater mussel propagation have advanced, shoreline stabilization techniques have expanded, and essential natural resources within urban ecosystems have been further explored. This partnership has also led to the establishment of the first shell recycling facility in Pennsylvania, which aims to reduce waste to neighboring landfills while providing the Delaware Estuary with essential oyster shell for reef habitat replenishment. From these successes, the ARRC has expanded its goals over the next five years to include the establishment of a production-scale freshwater mussel hatchery, expansion of its culturing facilities, and continued nearshore habitat enhancement projects in the Philadelphia region.

Latest Projections of US Mid-Atlantic Sea-Level Rise and an Update from the Coastal Effects Chapter of the Fifth US National Climate Assessment

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DRBC Climate Forum Technical Session I-Building Foundational Science for Regional Impacts, Tuesday, 10:30am, Main Ballroom, (Avalon 23)

Coastal flooding is one of the most significant natural hazards facing the Delaware Estuary and the wider US Mid-Atlantic region today. It can degrade ecosystems, erode beaches, damage infrastructure, and put human safety at risk. Rates of sea-level rise (SLR) have been increasing across the coasts of the contiguous US, and projections are expected to continue that acceleration, with sea level rise over the next 30 years to be equivalent to the past 100 years. This results in an exponential increase in flood frequency of minor/high-tide flood events as well as increases in major flooding. In addition to the increase in global mean SLR, the US Mid-Atlantic is well-known for regional factors that enhance the region's rate of relative SLR (i.e., hotspot of SLR) and is routinely impacted by both tropical and extratropical coastal storms. In this talk, we will look at past observations, impacts, and the drivers of SLR and coastal flooding in the Mid-Atlantic. We'll also review the projections of SLR, flood frequency days, and extreme water levels for the region as presented in the US Interagency Task Force SLR Technical Report, released in early 2022. Lastly, I will provide an update on the Fifth National Climate Assessment (NCA5) Coastal Effects chapter, slated for a final public release in Fall 2023.

What matters and what doesn't with regard to low dissolved oxygen events in the Delaware Estuary?

Chen, Fanghui, Water Resource Engineer - Operations, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Fanghui.Chen@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

While the eutrophication model represents an important tool for informing management decisions, it can also enhance our understanding of dissolved oxygen (DO) processes in the Delaware Estuary. Analyses of DO components and algal limitation factors are discussed to provide insights for a better understanding of the processes that affect DO, particularly within the urban estuary. Diagnostic analysis of DO components indicates that in the urban estuary, reaeration and photosynthesis are the major processes controlling dissolved oxygen production, while the major processes affecting DO consumption are nitrification, followed by SOD, CBOD oxidation, and respiration. The analysis suggests that the DO gain from net algal production is much smaller than the DO loss caused by nitrification in the tidal river, and that the reaeration impacts can offset both sinks and sources. Evaluation of phytoplankton limitation factors indicates that light is the primary factor restraining algal growth due to light absorption by color and light scattering by particles, and that nutrients (nitrogen, phosphorus and silica) infrequently limit algal growth.

The design condition for the analysis of attainability study simulates the impact of wastewater facilities discharging their permitted flows at their current treatment levels under critical environmental conditions, resulting in a conservatively low DO condition used for design purposes. The design condition provides a baseline model simulation against which to compare a range of future scenario simulations. A series of 2D model sensitivity test scenarios were designed to evaluate which pollutant sources to the Estuary have the potential to substantially improve DO in the most compromised section of the urban estuary. The analysis identified those factors that most impact DO, namely summer (May–Oct) ammonia loads from wastewater discharges. Equally importantly, the analysis identified those factors that do not impact the magnitude of DO sags, such as wastewater and tributary carbon loads.

Advances in Juvenile Freshwater Mussel Grow Out Techniques

Cheng, Kurt, Shellfish Programs Manager, Partnership for the Delaware Estuary, 110 South Poplar Street, Suite 202, Wilmington, DE, 19801, kcheng@delawareestuary.org Matthew J. Gentry, Partnership for the Delaware Estuary, Danielle A. Kreeger, Partnership for the Delaware Estuary, Lance H. Butler, Philadelphia Water Department, Roger L. Thomas, The Academy of Natural Sciences of Drexel University

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Freshwater mussels (Unionida) are infaunal bivalves that inhabit multiple, diverse freshwater environments. Over 70% of the nearly three hundred species in North America have a conservation concern and populations have been in decline nationally, and locally in the Delaware River Basin, during the last century. There has been an increasing interest in freshwater mussels, not only associated with conservation, but also concerning their ecosystem engineering abilities, such as water filtration, habitat creation, and nutrient cycling. Freshwater mussels serve a unique role in freshwater habitats as dominant filter-feeders and comprise a bulk of benthic biomass.

Efforts have been focused on key topics such as propagation, growth trials, and reintroductions across the nation. Locally, researchers have conducted growth trials using juvenile mussels, including Alewife Floater (*Utterbackiana implicata*) and Eastern Pondmussel (*Sagittunio nasutus*) to improve growing practices associated with restoration activities. Improvements have been made to facilitate floating gear retrieval and maintenance. Substrate types such as sand and crushed granite were evaluated for their ability to support mussel growth and survivorship. Granite was found to be equal to and, at times, outperform traditional sand with regard to effects on growth and mortality of both species.

Growth and survivorship were tracked over 677 days and both species demonstrated plateaus in growth. Trends in mortality were consistent, with *U. implicata* demonstrating a higher mortality compared to *S. nasutus*. Growth was not consistent among sites. Limited data currently exist, or is not widely distributed, with regard to baseline growth rates or natural mortality for freshwater mussels. This is especially true for juvenile and sub-adult life stages. Thus, results observed from restoration and conservation activities are often difficult to interpret. As practitioners continue to gather data on growth and survivorship for local species, restoration efforts will be refined to achieve future restoration and conservation goals.

Using Wildlife Camera Traps as a Tool for Wildlife Habitat Monitoring

Clauson, Kayla, Environmental Scientist, Delaware DNREC, Watershed Assessment and Management Section, 285 Beiser Blvd, Dover, DE, 19904, kayla.clauson@delaware.gov

Monitoring & Assessment, Monday, 11:30am, Main Ballroom, (Avalon 23)

Field scientists are often faced with tradeoffs when selecting monitoring techniques for habitat-based projects. Time constraints, organizational capacity, weather, and tidal conditions limit monitoring abilities, which often leads to gaps in knowledge surrounding wildlife habitat utilization, particularly detecting highly mobile and secretive species (e.g., birds). Wildlife camera traps (WC) are an effective tool for enhancing habitat monitoring because they provide passive, discreet, and continuous monitoring year-round. Integrating WC in a restoration project allows wildlife habitat utilization to be monitored, which can be used as a proxy for the success of restoration sites, while also providing supplemental insight to vegetation growth, storm incidences, and tidal information.

Wildlife camera traps were therefore integrated into monitoring a beneficial reuse of dredge material project in southern Delaware, in which the goal is to recreate a tidal saltmarsh. This monitoring effort will capture wildlife habitat utilization before, during, and after construction at the restoration project site, and a nearby reference tidal marsh. This presentation will showcase preliminary data from WC for the beneficial reuse of dredge material project and further share how WC can be incorporated to produce worthwhile data that will enhance current monitoring efforts for restoration projects.

Living Shoreline and Tidal Marsh Enhancement at Angola by the Bay

Collins, Bob, Manager of Programs and Facilities, Delaware Center for the Inland Bays, 39375 Inlet Road, Delaware Center for the Inland Bays, Rehoboth Beach, DE, 19971, jamesfarm@inlandbays.org; Doug Janiec, Sovereign Consulting, Inc.

Restoration & Conservation I, Monday, 4pm, Main Ballroom, (Avalon 23)

The community of Angola by the Bay (ABTB) is located on Burton Prong, a branch of Herring Creek on Rehoboth Bay. The community property includes approximately 2,225 linear feet of shoreline and a small marina along the creek. The community has become increasingly concerned about erosion that has occurred over the past several years both upstream and downstream of the marina. The ABTB Property Owners Association is working with the CIB and Sovereign Consulting, Inc. to stabilize the community shoreline, restore wetland and buffer vegetation, and develop the project as a living shoreline demonstration site.

The purpose of the project is to improve water quality in Herring Creek through shoreline stabilization and enhancement of vegetated wetland buffers along the ABTB community waterfront. Living shoreline structures, using an innovative toe log tactic are being installed to provide protection, resilience, and ecological uplift to the shoreline, enhance and restore disappearing high- and low marsh buffers, and demonstrate a green infrastructure tactic to retrofit existing riprap revetments.

Specifically, this project will:

• Stabilize 130 linear feet of eroding shoreline within the cove with a living shoreline

• Provide a nature-based retrofit in eroding gap areas of a 692-ft section of existing hard-armored shoreline

• Re-establish and/or enhance/protect ~4,000 square feet (0.1 acre) of tidal wetlands.

Investigating Use of Enhanced Saltmarsh Habitats by Seaside and Saltmarsh Sparrows in Southern New Jersey

Collins, Samantha, Research Scientist, The Wetlands Institute, 1075 Stone Harbor Blvd, Stone Harbor, NJ, 08247, scollins@wetlandsinstitute.org; Christopher Dolan, The Wetlands Institute; Lisa Ferguson, The Wetlands Institute

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Suitable habitat for avian species in coastal New Jersey has been limited by habitat loss associated with dense development, and is being further constrained by sea level rise, marsh subsidence, increased storm intensity and flood frequency. As high marsh habitat becomes increasingly limited, identifying important nesting areas and understanding the factors that influence population dynamics of saltmarsh breeding birds is essential to protect or enhance habitat for these sensitive species. During the 2022 nesting season, we investigated habitat use, nest site selection, and reproductive success of Saltmarsh Sparrow (*Ammospiza caudacuta*) and Seaside Sparrow (*Ammospiza maritima*) in coastal wetlands within the Seven Mile Island Innovation Laboratory study area. We conducted active and passive monitoring of sparrows within restored and natural marsh areas throughout the study area to better understand differences between sites. Highest nesting activity and detections for sparrows was documented within an area impacted by historic placement of dredged materials. Throughout the study area, we documented 75% hatch success for all nests monitored (n=8) with flooding identified as the cause of failure for two nests. Creating additional high marsh areas with abundant *Spartina alterniflora* or *Distichlis spicata* cover may provide essential nesting habitat for sparrows to support declining populations. Results from this study will help provide recommendations for continued maintenance and monitoring at priority or enhancement sites, as well as considerations (i.e. lessons learned) for future project development related to beneficial use of dredged materials.

Biodiversity and Ecosystem Services in the Cooper River Watershed - Invertebrate Diversity in Suburban Gardens

Curley, Jenna, Student, Haddonfield Memorial HS, 401 Kings Highway East, Haddonfield, NJ, 08033, jennacurley127@gmail.com; Caroline Potts, Haddonfield Memorial HS; Ron Smith, Haddonfield Memorial HS

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Step outside your home into the garden and wild places and wild species can be found. Hundreds, if not thousands, of species can be documented right in our own backyards. It is here where we have the opportunity to manage and protect the biodiversity in our neighborhoods and throughout the watershed. In Haddonfield, NJ, a western Camden County municipality in the Cooper River Watershed, we examined and documented the invertebrate diversity in 1 meter square plots and compared gardens with high chemical input (fertilizers and pesticides) with those maintained as “wild” gardens. Our results not only demonstrate that biodiversity can be increased in the natural gardens of our backyards, but that a range of essential ecosystem services provided by these species will be protected if chemical input is reduced or eliminated.

A GIS-Based Tool for Planning and Management of Shellfish Aquaculture and Restoration in New Jersey: A Rutgers University Project in Partnership with the New Jersey Department of Environmental Protection Supported by the National Sea Grant Program and Pew

De Luca, Michael, Director, Aquaculture Innovation Center, Rutgers University, 3920 Bayshore Drive, Cape May, NJ, 08204, deluca@marine.rutgers.edu; Lucas Marxen, Office of Research Analytics, Rutgers University; Jeanne Herb, Bloustein School of Planning and Public Policy, Rutgers University, David Bushek, Haskin Shellfish Research Laboratory, Rutgers University, Russ Babb, Bureau of Shellfisheries, New Jersey Department of Environmental Protection, Jeff Normant, Bureau of Shellfisheries, New Jersey Department of Environmental Protection, Megan Kelly, Bureau of Shellfisheries, New Jersey Department of Environmental Protection, **Michelle Stuart**, Office of Research Analytics, Rutgers University, Zack Greenberg, Pew Charitable Trusts

Living Resources I - Shellfish, Monday, 2pm, Breakout B, (Avalon 24-26)

With support from the National Sea Grant Program and the Pew Charitable Trust, a team of Rutgers University researchers, in partnership with the New Jersey Department of Environmental Protection is using geospatial tools to weigh and analyze data about conditions affecting shellfish production to develop an interactive tool that can identify areas that are suitable for shellfish aquaculture and restoration in New Jersey. Such a tool can be used as a resource to inform planning and policy regarding the diversity of uses of the State's coastal resources, and to identify potential conflicts with other uses of coastal waters. Surveys were conducted to identify areas for potential shellfish and submerged aquatic vegetation (SAV) restoration, and to map areas of shellfish and submerged aquatic vegetation where data are lacking to inform development of the GIS tool.

The project will not result in a comprehensive spatial plan for shellfish aquaculture in New Jersey; rather, it will result in a data-informed tool that can be used by state and federal agencies and the stakeholder community for aquaculture, shellfish and coastal management policy, planning and applications for shellfish aquaculture and restoration operations.

Data that are incorporated into the interactive tool include:

• Hydrological characteristics;

• Areas not suitable for aquaculture development;

• Areas with physical limitations such as man-made obstructions;

• Climate and environmental data including information regarding current and projected climate or environmental conditions that could affect shellfish production;

• Current shellfish leased grounds ; and

• Social information regarding other coastal resource uses.

Mechanisms of Salt Intrusion in the Upper Delaware Estuary

Duzinski, Phil, Philadelphia Water Department, 1101 Market St, Philadelphia, PA, 19107, phil.duzinski@phila.gov; Robert Chant, Rutgers University

Physical and Chemical Processes, Wednesday, 1:00 PM, Breakout A, (Avalon 20-22)

Philadelphia and nearby communities rely upon the freshwater section of the tidal Delaware River as a source for drinking water. The Philadelphia region is also home to the largest freshwater port and the second largest center for petroleum products in the United States. Therefore, the study of transport mechanisms in this portion of the Delaware Estuary is crucial to the Philadelphia Water Department (PWD) for the protection of drinking water intakes from both environmental contamination events and changing water quality conditions as well as to inform future planning considerations for the operability of PWD's largest drinking water intake. Additionally, the oligohaline range of the estuary, which contains the upstream extent of salt intrusion, is sensitive to extremes in river discharge in the main tributaries and can advance to below the City of Philadelphia during these low flow events.

A Regional Ocean Modeling System (ROMS) numerical model of the upper Delaware Estuary was used to analyze the potential mechanisms of dispersion in the tidal Delaware River. While the model domain is largely within the tidal-fresh upper estuary, the domain below Philadelphia becomes oligohaline during low-flow events, and there is evidence that this intrusion is facilitated by a combination of steady vertical shear dispersion and tidally oscillatory salt flux (TOSF), with the latter becoming increasingly important approaching the upstream intrusion extent. Frontogenesis is also important in the intrusion process in the vicinity of specific bathymetric features.

The presentation will highlight several locations in the oligohaline reach of the Delaware Estuary that have rapid changes in cross-sectional area, which appear to drive frontogenesis and increase the horizontal salinity gradient, the exchange flow, and the upstream salt flux. Moreover, the tidal advection of these fronts produces strong lateral gradients that drive secondary flows and produce stronger TOSF away from the regions of frontogenesis.

Impact of Strategic, Unconfined, Dredged Material Placement on Turbidity Within a Shallow Back Bay System: Observations from Seven Mile Island Innovation Laboratory, NJ

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Restoration and Conservation II, Wednesday, 10:30 AM, Main Ballroom, (Avalon 23)

Near-marsh, shallow-water strategic placement of sediment dredged from navigation channels is a promising method for increasing marsh accretion rates and providing erosion protection to marsh edges. A significant challenge for unconfined sediment placement in near-marsh, shallow water areas is the concern related to the degree of and persistence of turbidity, both during and following placement. The objective of this study was to document turbidity during and following unconfined sediment placement near and on a marsh. Observations were collected during and following a strategic placement activity within the Seven Mile Island Innovation Laboratory (SMIIL), a living laboratory launched by the US Army Corps of Engineers, in conjunction with the State of New Jersey and The Wetlands Institute (TWI) to evaluate beneficial use of dredged material management practices in coastal New Jersey. In 2020, a field effort utilizing roving turbidity surveys conducted during and following placement was combined with a two-month deployment of a near-bed sensor to characterize turbidity associated with unconfined placement near and on the southern end of Gull Island, a low marsh island within the SMIIL system. Roving turbidity surveys found the resulting turbidity plume was localized, only extending about 20 m offshore and 100 m along shore, and that during calm conditions (wind speeds <5 m/s), plume direction and intensity were driven by tidal circulation. Monitoring showed that near-bed turbidities during active placement were greater than typical background conditions but were often less than those observed during high wind or storm events. During post placement surveying the week following the completion of dredging, turbidity in the region was observed to be similar to levels documented in an earlier study of the region, prior to any placement.

Evaluating change in marsh condition pre and post-restoration in two National Wildlife Refuges along the Delaware Bay

Faller, Kelly, Estuary Science Specialist, Partnership for the Delaware Estuary, 110 S Poplar St, Suite 202, Wilmington, DE, 19801, kfaller@delawareestuary.org; LeeAnn Haaf, Partnership for the Delaware Estuary; Danielle Kreeger, Partnership for the Delaware Estuary; Heidi Hanlon, U.S. Fish and Wildlife Service

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Tidal marshes provide a suite of ecosystem services, yet many marshes along the Delaware Bayshore are degraded and susceptible to loss. In this study, we review the effects of intervention activities carried out to reduce marsh losses and enhance resilience at two National Wildlife Refuges in southern New Jersey: Cape May (Reeds Beach), which was runnelled, and Supawna Meadows, which underwent breakwater repair. Prior to intervention in 2015 and again in 2022, we performed broad-scale (watershed-wide) and site-specific surveys to ascertain marsh conditions. Vegetation density and substrate firmness were analyzed to show changes in plant community health and peat-building capacity, both across watersheds and within intervention areas. We also compared elevation, grouped by elevation zones, to understand changes along a topographical gradient within intervention areas. Finally, we determined how vegetation productivity varied over the 7-year time period to surmise whether changes in field-based metrics were related to intervention tactics or followed broader patterns of change. Broadly, Reeds Beach's substrate was significantly less firm ($n = 34$, $p<0.05$) in 2022 while aboveground vegetation was not significantly different. Within the intervention area, 3 out of the 4 elevation zones showed significantly higher elevations in 2022 ($n= 12$, $p<0.05$). Runnelling at Reeds Beach has likely increased tidal flushing, perhaps lending to elevation building through sedimentation, although plant production does not yet show signs of significant change. Supawna's aboveground vegetation was significantly denser ($n = 5$, $p<0.05$), and substrates were firmer in 2022. This is likely a result of the pervasive, highly productive, and resilient non-native species *Phragmites australis* at Supawna. This study shows the utility of using broad and site-specific surveys to determine how intervention efforts may affect marsh conditions over time, which in turn helps inform future tactic designs to ameliorate marsh loss.

Superbugs Upstream of the Delaware River: Assessing the Antibiotic-Resistant Bacteria in the Blue Marsh Watershed

Felker, Jill, Lecturer Biochemistry, Biology, and Forensic Science, Biochemistry and Molecular Biology Laboratory Manager, Penn State Berks, 1801 Broadcasting Rd, Reading, PA, 19610, jmg240@psu.edu; Tami Mysliwiec, Penn State Berks; Erin Horack, Penn State Berks; Safitaj Sindhar, Penn State Berks; Melissa Buchter, Penn State Berks

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Emerging contaminants and nonpoint source pollutants act as selective pressures and force microbial communities to adapt to chemicals in waterways. Changes in a watershed's chemical characteristics can negatively impact human health if microbial communities develop antibiotic-resistant characteristics, toxic algae blooms, or increased concentrations of pathogenic microorganisms. Pathogenic bacteria and algae blooms can close recreational areas and disrupt water supplies. Microorganisms may develop chemical-resistant genetic characteristics in chemical-rich environments. Bacteria can become antibiotic resistant in chemical-rich ecosystems in a phenomenon known as chemical cross-resistance. The impact of anthropogenic activities on microbial populations' antibiotic resistance expression was this study's focus. This study evaluated the physical, biochemical, and microbiological characteristics of the Blue Marsh Watershed in Berks County, Pennsylvania. Three distinct chemical sample sites were identified based on the anthropogenic activities associated with the watershed. Areas supporting recreational, agricultural, and industrial activities were evaluated, and water and sediment samples were collected monthly for five years. *Escherichia coli* (*E.coli*) and *Enterococcus spp* (Enterococci) were isolated, and approximately 10% of the colonies were evaluated for antibiotic susceptibility using Kirby Bauer disk diffusion techniques. E.coli and Enterococci are common indicators for detecting pathogenic microorganisms in recreational waters. More than 50% of the isolates tested had resistance to two or more antibiotics, classifying them as superbugs. Tetracycline and ampicillin resistance was commonly found at each sample site. PCR analysis confirmed our gene expression findings, and tetracycline-resistant genes, tet(A) and tet(R) and ampicillin resistance, ctx, and blaP were found in genomic DNA samples. Both tet(A) and tet(R) resistance genes are common in microbial communities exposed to emerging contaminants. Additional studies are needed to assess these findings' impact on human health in the Blue Marsh Watershed.

Salt Marsh Migration into Forests and Farms: Effects to Soil Biogeochemistry Along the Salinity Gradient

Fettrow, Sean, PhD Candidate, University of Delaware, 37 east montgomery ave, apt 12, Ardmore, PA, 19003, sfettrow@udel.edu; Virginia Jeppi, University of Delaware; Angelia Seyfferth, University of Delaware

DRBC Climate Forum Technical Session I-Building Foundational Science for Regional Impacts, Tuesday, 10:30am, Main Ballroom, (Avalon 23)

Sea level rise has caused salinization of soils due to a landward expansion of the intertidal zone in the low-lying Delmarva Peninsula, allowing salt marshes to migrate upland into forests and agricultural (ag) fields. Transition zones along the marsh-forest and marsh-ag salinity gradients are visible above ground as ghost forests and crop die-off. While it is clear that marsh migration affects the aboveground vegetation, it remains unclear how marsh migration affects belowground soil biogeochemistry. We hypothesized that as salt marshes migrate upland, soil C concentration increases due to increased inundation and slower C mineralization. We further hypothesized that each transition zone will have a unique biogeochemical fingerprint, characteristic of the extent of salinization. To investigate this, we took soil cores at up to five transition zones along the marsh-forest and marsh-ag transects during the summer and fall of 2021 at six different sites (i.e., 3 ag, 3 forest) along the Delmarva Peninsula. Our results suggest significant ($p<0.05$) changes to soil C concentration as marshes move into forests and ag fields, with a range between 4-50 times more concentrated soil C in the marsh soils than upland soils. In addition, unique biogeochemistry was apparent in the transition zones. At all six Delmarva sites, salinity, K and Slope Ratio (indicator of Marine DOC source) increased significantly towards the marsh while redox, Mg and Si decreased significantly towards the marsh. The trends of these biogeochemical variables provide a belowground chemical fingerprint that indicates how impacted a transition zone may be by sea level rise, which has important implications for understanding how coastal ecosystems will respond to future global change scenarios.

Starting from Scratch: Building Delaware's Submerged Aquatic Vegetation Program

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Monitoring & Assessment, Monday, 11:30am, Main Ballroom, (Avalon 23)

Delaware lacks comprehensive temporal and spatial records of submerged aquatic vegetation (SAV) communities. There have been previous efforts to document saline and freshwater species, but these studies were limited to Delaware's Inland Bays and the Nanticoke River. Furthermore, past SAV restoration efforts in Delaware fell short of their goals due to the absence of baseline environmental and species data. This inspired Delaware's Department of Natural Resources and Environmental Control (DNREC) to establish the SAV Workgroup, which aims to document existing SAV across the freshwater-estuarine continuum, develop regular monitoring protocols, support restoration efforts, and foster collaboration with outside partners.

Using a unique approach, the SAV Workgroup synthesized community science, previous studies, and anecdotal evidence to develop a database and survey plan. Then, ArcGIS applications were created to collect spatial and environmental data during SAV field surveys. This presentation will cover the process of developing a long-term monitoring plan, preliminary survey results, lessons learned, and next steps.

Continuous Water Quality Monitoring in the Inland Bays

Garmoe, Zachary, Environmental Science Coordinator, Delaware Center for the Inland Bays, 39375 Inlet Road, Rehoboth Beach, DE, 19971, Zgarmoe@inlandbays.org; Andrew McGowan, Delaware Center for the Inland Bays; Scott Andres, Delaware Geological Survey

Water Quality I, Tuesday, 10:30 AM, Breakout A, (Avalon 20-22)

Accurate and meaningful water quality data are critical for understanding the condition of estuarine water resources and for making informed management decisions. In the Inland Bays watershed, a number of programs maintain monitoring sites, however data for these are taken using daytime grab samples and therefore miss daily fluctuations in parameters such as dissolved oxygen, salinity, or temperature. Continuous monitoring offers one solution to this problem; water quality sondes can be programmed to record parameters at frequent intervals and operate continuously over several weeks, thereby increasing the chances of capturing the true ranges for a given area over time. The Delaware Center for the Inland Bays, with funding and support provided through project WiCCED, has installed 6 of these sondes throughout the watershed.

Initial results from four of the six stations with enough data to analyze, have shown widespread hypoxia throughout summer months in the upper tributaries of the Inland Bays. At all four stations, more than 75% of summer mornings recorded dissolved oxygen concentrations of 4 mg/L or less. Two of these four stations recorded 75% of summer mornings with dissolved oxygen concentrations of 2 mg/L or less.

These results are particularly relevant for section 305(b) of the Federal Clean Water Act, which requires that states compile a list of impaired waters that do not meet established water quality standards for their designated uses. In 2021 data collected through this program resulted in the relisting of one segment, with additional future relistings also anticipated. Goals for future sampling seasons include telemetry and an increase to ten total monitoring stations.

Overcoming Propagation and Juvenile Care Bottlenecks for Two Native Freshwater Mussel Species in a Novel Hatchery Setting

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Living Resources I - Shellfish, Monday, 2pm, Breakout B, (Avalon 24-26)

Freshwater mussels are one of the most imperiled group of organisms in North America and can provide valuable ecosystem functions associated with habitat creation and nutrient dynamics. An essential component of freshwater mussel restoration is hatchery propagation and culturing; however, much less is known about freshwater mussel propagation compared to marine species. Continued development and standardization of methods is necessary for successful freshwater mussel propagation. Since 2017, Partnership for the Delaware Estuary and the Philadelphia Water Department have operated a small-scale mussel hatchery in Philadelphia, Pennsylvania. At this facility, trials and experiments have been completed to assess host fish suitability and to contrast juvenile mussel growth and survival resulting from different feeding strategies, culture water sources, and substrate types. Rapid growth in the hatchery allows juvenile mussels to be relocated to rearing ponds earlier in the growing season, typically translating to higher survival and quicker growth to sizes suitable for use in restoration sites. In 2022, propagation trials using Brook Trout (*Salvelinus fontinalis*) as a host fish resulted in the facility's first successful production of juvenile Eastern Elliptio (*Elliptio complanata*), a primary target species for freshwater mussel restoration in the Delaware River Basin. Implementation of improved recirculating aquaculture systems and protocols within the hatchery increased survival and growth rates of juvenile Eastern Pondmussel (*Sagittunio nasutus*) when compared to substrate-free downwelling systems. The use of filtered source water from a healthy reservoir, and the application of a new uniform substrate for rearing systems significantly improved on culturing efficiencies and survivorship in 2022. These improvements to hatchery systems and operations have contributed to major advances in propagation and culturing of two native mussel species, and will serve as a measure for future propagation studies at this facility.

Physiological Plasticity and Response to Food Availability of Two Native Freshwater Mussel Species

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Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Aquatic organisms in temperate regions experience periodic shifts in environmental conditions. For suspension feeding organisms like freshwater mussels, some of the most consequential shifts in environmental conditions relate to seston composition (i.e., particulate profile of the water column). On natural time scales mussels can adjust their physiological processing to respond to changes in concentration of particulate matter (PM), particulate organic matter (POM) and the proportion of POM to PM (PPOM). However, freshwater mussels may be exposed to changes on accelerated, non-natural time scales through transplantation or reintroduction efforts. Following hatchery propagation, mussels are held in grow-out ponds before being released to their final restoration or reintroduction site. Seston profiles of grow-out ponds and target restoration sites may differ dramatically, exposing mussels to a shift in environmental conditions and food quality and quantity much more quickly than they would experience in a seasonal shift, potentially introducing transplantation stress. To assess the physiological plasticity of freshwater mussels, two native species, *Utterbackiana implicata* (N = 60) and *Sagittunio nasutu*s (N = 60), were reciprocally transplanted between a stream (PM = 3.71 mg/l, POM = 2.16 mg/l, PPOM = 0.59) and pond (PM = 11.95 mg/l, POM = 3.99 mg/l, PPOM = 0.35) with significant differences in seston profile. Mussels of both species in the stream site grew significantly faster than those in the pond site. The seston profile of both sites, as well as transplantation condition, correlate to the physiological metrics of growth, condition index, and absorption efficiency for the mussels. Filtration rate and size selection data will be processed in early 2023. The results from this study will inform best practices for transferring freshwater mussels between sites that differ in seston profile, and provide further data for accurate assessment of water quality uplift services provided by freshwater mussels.

GIS-Based Framework for Measuring Disaster Resilience using Community and Infrastructure Capitals

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DRBC Climate Change Forum Technical Session II-Building Community-level Climate Resilience, Tuesday, 4:15 PM, Main Ballroom, (Avalon 23)

Two main approaches are currently being pursued to evaluate resilience. The first approach is the "community resilience" developed by social scientists, planners, etc. and attempts to capture community resilience, using numerous pre-disaster attributes to describe the functioning of a community. The approach subsumes that pre-disaster attributes can predict the community resilience to a disaster. An example is the number of people with college degrees within a community, because it has been observed that the higher the number the more resilient the community is. The second approach adopted for infrastructure resilience, mostly by engineers, focuses on robustness, redundancy, resourcefulness, and rapidity. This approach is appropriate for systems that are operated by highly skilled personnel, and where the actions are of engineering type and are limited. For example, replace a girder in a bridge, repair a downed wire, or drain a flooded road. Our goal herein is to use elements of each approach to develop an area- or place-based resilience index that we label ARez (A for Area) that captures the role/impact of infrastructure and community. ARez combines five sectors: Energy, public health, natural ecosystem, socio-economic, and transportation. ARez also captures the impact of the stress (i.e., magnitude of a hurricane) on the resilience of a region and allows one to compute resilience over various time scales. ARez is also GIS-based and easy to use allowing one to polygon an area across-political boundaries and obtain its ARez value, implicitly encouraging communities to work together on common threats.

Effects of storm conditions of increased temperature and decreased salinity on the North American non-reef building coral *Astrangia poculata*

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Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Astrangia poculata is a non-reef building stony coral found in shallow waters of the western North Atlantic Ocean including the Delaware Bay. It is part of benthic communities, growing on boulders, ledges, pebbles, docks, and empty mollusk shells. In addition to ocean temperature changes, climate change is causing more frequent severe storms. Near shores where *A. poculata* is found, substantial, rapid decreases in salinity due to heavy rains or increases in salinity due to storm surge can occur. We are investigating the effects of increased temperature and decreased salinity on *A. poculata*. Specimens from Florida and Massachusetts were acclimated to 35 ppt and 19oC and then exposed to increasing temperature alone, decreasing salinity alone, and combined increased temperature and decreased salinity drop. We measured changes in daily rate of zooxanthellae release and photosynthetic efficiency as measures of coral health in corals exposed to increased temperature and decreased salinity over a 16 day period. We found an increase in zooxanthellae released into the water column and a decrease in photosynthetic efficiency (Fv/Fm) in corals exposed temperature increase alone (28oC) and temperature increase (28oC) combined with decrease in salinity (10 ppt). Salinity decrease (10 ppt) alone had little effect. We are currently investigating the effects of more rapid changes in temperature and salinity that can occur in storms on *A. poculata*.

Long-term impacts of impervious surface cover change and roadway deicing agent application on chloride concentrations in exurban and suburban watersheds within the Delaware Watershed

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Physical and Chemical Processes, Wednesday, 1:00 PM, Breakout A, (Avalon 20-22)

Roadway deicing agents, including rock salt and brine containing NaCl, have had a profound impact on the water quality and aquatic health of rivers and streams in urbanized areas with temperate climates. Yet, few studies evaluate impacts to watersheds characterized by relatively low impervious surface cover (ISC; < 15 %). Here, we use long-term (1997-2019), monthly streamwater quality data combined with daily streamflow for six exurban and suburban watersheds in southeastern Pennsylvania to examine the relations among chloride (Cl-) concentrations and ISC. Both flow-normalized Cl- concentrations and ISC increased over time in each of the six watersheds, consistent with changes in watershed management (e.g., ISC, road salt application, etc.). The watersheds that experienced the greatest changes in ISC (e.g., agriculture replaced by residential and commercial development) experienced the greatest changes in flow-normalized Cl- concentrations. A comprehensive mass-balance model (2011–2018) for the six study watersheds indicated Cl- inputs exceeded outputs; excess Cl- inputs accumulated in groundwater. Road salt applied to state roads, non-state roads, and other impervious surfaces (e.g., private contractors and residential inputs) accounted for the majority of Cl- inputs. Furthermore, increasing Cl- concentrations during baseflow conditions in all six streams confirm impacts to shallow groundwater. Although flow-normalized Cl- concentrations are below the U.S. Environmental Protection Agency's chronic threshold value for impacts to aquatic organisms, year-round exceedances may result before the end of this century based on current trends. Though reduced Cl- concentrations in streams may be achieved by decreasing the Cl- inputs, changes in baseflow concentrations are likely to be gradual because of the accumulated Cl- in groundwater.

Climate Change Impacts to the New York City Water Supply

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DRBC Climate Forum Technical Session I-Building Foundational Science for Regional Impacts, Tuesday, 10:30am, Main Ballroom, (Avalon 23)

New York City's (NYC) Water Supply System is intensively and intricately managed. This is especially true of its Delaware Water Supply which includes the Pepacton, Cannonsville, and Neversink (PCN) Reservoirs. In 1954, the United States Supreme Court issued a decree mandating releases from the PCN reservoirs to ensure a minimum flow to the Delaware River. The State of New York as well as the states of Delaware, New Jersey, and Pennsylvania were parties to this decree and ever since have had to collaborate with NYC on how to best achieve these minimum flow objectives.

Of great concern to lower Delaware River communities is the location of the Delaware River salt front. The salt front is the location of the 7-day average 250 mg/l isochlor, or where saltwater from the Delaware River estuary meets the fresh water coming down from the river. Drinking water supplies from the Delaware River could be threatened if the salt front advanced far enough upriver to enter municipal intakes. A source of contention between the decree parties has been trying to determine how much fresh water is required to repel the salt front, especially during times of drought. Sea level rise brought on by climate change will only increase the potential for the Salt Front to advance upriver and make it more difficult for NYC to manage its reservoirs, maintain a minimum flow, and provide drinking water. In addition to the challenges associated with the Salt Front there are opportunities to increase freshwater inflows from US Army Corps of Engineers reservoirs (such as the F.E. Walter Reservoir in Pennsylvania) to help manage the Salt Front.

Sperm Limitation in the Delaware Bay Blue Crab Population

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Living Resources II, Wednesday, 9:00 AM, Main Ballroom, (Avalon 23)

The blue crab *Callinectes sapidus* is both ecologically and economically important in the United States, playing a critical role within food webs, structuring benthic populations and supporting fisheries located along the western Atlantic coast. *C. sapidus* contribute greatly to Delaware's economy, acting as the largest and most important fishery in the state. However, the selective size- and sex-specific harvesting that occurs in this fishery can reduce the operational sex ratio and alter male mating behaviors, thus leading to sperm limitation in the species. Bay-wide operational sex ratios (reproductively competent males:reproductively receptive females) were determined using historical trawl data (1978-2021) from the Delaware Department of Natural Resources and Environmental Control (DNREC). Female blue crabs were collected monthly from various stations throughout the Delaware Bay by DNREC during trawl surveys and by a commercial fisherman from August 2020 to July 2022. Crabs were then characterized by a series of morphological and reproductive parameters, in addition to sperm plug presence (hardened seminal fluid) and were subsequently processed for spermathecal contents. Sperm storage quantities were determined using phase-contrast microscopic examination. Total sperm quantity per female varied between 1.33x106 and 4.41x108 cells, with maximum sperm quantities an order of magnitude lower than the benchmark sperm count calculated to evaluate sperm limitation in the Chesapeake Bay blue crab population (3x109 cells). Crabs that mated late in the season (e.g. females with early-stage ovaries in November) appear to store an order of magnitude less sperm than those that mated earlier in the season. Additionally, the quantity of sperm measured in crabs collected late in the season does not appear to be sufficient enough for fertilizing more than a single brood. The data suggests potential sperm limitation in the Delaware Bay blue crab population.

Identifying Potential Atlantic Sturgeon Habitat Post Dredging in the Delaware River: Side Scan Sonar and Bottom Sampling Analyses

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Monitoring & Assessment, Monday, 11:30am, Main Ballroom, (Avalon 23)

Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) have been listed as federally endangered since 2012. As of 2007, fewer than 300 adults were found to return to the Delaware River to spawn, contributing ≈14% of the total estimated populations in US East Coast river systems. Atlantic sturgeon come into the Delaware River in late spring to spawn, favoring regions of larger-grained sediments in fast-flowing reaches of the river. Blasting and dredging by the United States Army Corps of Engineers during the Delaware River Main Channel Deepening project created new accumulations of gravels and larger-sized rocks, which could serve as sources for sturgeon spawning habitat. This study examines the impacts of the Main Channel Deepening project and documents post-dredging bottom morphology and sediment types. An approximately 18 km stretch of the river between the Bellevue and Tinicum Ranges using data collected through side scan sonar was examined. The sonar surveys were completed using a dual-frequency 600 and 1600 kHz Edgetech 4125P towfish deployed 3-4 meters below the water surface. Vessel speed was maintained between 4-6 knots generating an along-track resolution of approximately 30 centimeters. A series of bottom sediment grab samples were collected and will be analyzed for particle size distribution to ground-truth the side-scan sonar imagery. Preliminary results document newly exposed bedrock and regions of large boulders, cobbles, pebbles, gravels, and sand dunes. Sturgeon counts derived from side scan sonar analyses conducted during the spawning season will be used to provide constraints on whether or not Atlantic sturgeon are preferentially locating within gravel- to bedrock dominated areas for spawning and sand dune regions for staging. The results from this study will improve our understanding of how the Delaware River has responded to deepening and if bottom environments have been altered in a positive (or negative) way in terms of sturgeon habitat.

A Nature-Based Shoreline System New To The Barnegat Bay and State of New Jersey: A Case Study Of The Natural Resource Education Foundation of New Jersey - Lighthouse Center Living Shoreline Project.

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Restoration & Conservation I, Monday, 4pm, Main Ballroom, (Avalon 23)

Over recent decades, the Natural Resource Education Foundation (NREF) of New Jersey - Lighthouse Center (LHC), located on the Barnegat Bay near Waretown, New Jersey, has experienced horizontal shoreline loss at rates ranging between 4 and 6 feet per year. The loss of the shoreline has increased the vulnerability of other habitats on the property (e.g., marshes, flats, riparian zones) and many of the LHC facility structures. The LHC marshes are being impacted by localized changes in hydrology, low platform marsh elevations, sea level rise, severe storm events, and chronic wave energy. The long-term plan is to improve or "rejuvenate" all its aquatic terrestrial habitats, related resources, and LHC facilities. The first crucial element of this effort is to manage wave energy impacting the shoreline and marshes. To date, a hybrid living shoreline design for the entire ~1,600-foot shoreline has been developed and the northern 400 feet (Phase 1) of the hybrid living shoreline has been permitted and implemented. The combination of hybrid tactics being employed (e.g., WADs™, anchored shell bag toes, and clustered vegetation plantings) for this project are new to the Barnegat Bay and State of New Jersey. This presentation is a case study of the Phase 1 effort and will include preliminary monitoring results from the first post-implementation year.

Anchoring Of Materials In Coastal Restoration. Do We All Understand The Science Behind Anchoring, Or Is It More A "Monkey See Monkey Do" Thing?

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Restoration & Conservation III, Wednesday, 1:00 PM, Main Ballroom, (Avalon 23)

Proper anchoring of material is a critical component to nearly every coastal restoration project. For certain materials (e.g., coir fiber logs) anchoring techniques have become fairly standardized, and the anchoring details are essentially identical between designs of various projects. Again, using coir fiber logs for an example, the standard detail for anchoring coir fiber logs was originally prepared for upland or stream bank application, not tidal systems. So, are the standard details being used appropriate? This idea can be applied to other materials as well.

It is safe to assume that anchoring requirements are site-specific. This infers that site-specific checks or calculations may be needed to make sure that materials are being properly anchored. Also, anchoring is based upon the characteristics of the material being anchored, the material be used to anchor the base material, the bindings used (if any), the substrate, and the surrounding conditions. All component noted must be compatible in terms of strength, life, availability, and efficiency.

The question asked is do designers perform the proper calculation and consider site-specific variations associated with anchoring, or is it more a "monkey see monkey do" thing?

This presentation identifies what to consider when developing anchoring specification for materials in a restoration design. Included in the presentation is how to determine holding capacity of anchors (e.g., stakes), a safe way to estimate how many stake sets are needed, and how to conservatively compensate for wave energy. Certain installation tips will also be provided.

A Hybrid Living Shoreline At The Rutgers University (Rutgers) New Jersey Aquaculture Innovation Center (AIC) - A New Jersey Agricultural Experiment Station (NJAES) – An Opportunity, An Idea, A Nature-Based Success

Janiec, Douglas, Natural Resources Program Manager, Sovereign Consulting Inc., 50 W Welsh Pool Rd, Suite 6, Exton, PA, 19341, djaniec@sovcon.com; Jenny Paterno Shinn, Rutgers University, Haskin Shellfish Research Laboratory; David Bushek, PhD, Rutgers University, Haskin Shellfish Research Laboratory; Thomas Leisse, PE, CME, Pennoni

Restoration & Conservation I, Monday, 4pm, Main Ballroom, (Avalon 23)

The Rutgers University (Rutgers) Aquaculture Innovation Center (AIC) is a New Jersey Agricultural Experiment Station (NJAES) located on the western side of the Cape May Canal, approximately 0.8-mile from the Cape May Ferry Terminal. Adjacent to the AIC facility is an intertidal drainage swale that was being impacted by the AIC seawater effluent and wake energy from vessels using the canal. The effluent consisted of unfiltered sea water via a pipe located perpendicular to and near the canal plus filtered sea water that was circulated throughout the facility to support marine organisms and discharged at the upper end of the swale. Examples of the diversity of wake-causing vessels using the adjacent portion of the canal include jet skis, small to large recreational vessels, larger commercial tour guide vessels, and U.S. Coast Guard and local law enforcement vessels. Cumulatively, these sources of erosive energy were severely impacting the shoreline surrounding the drainage feature. Rutgers elected to address the erosion by constructing a hybrid living shoreline, allowing for the discharge to enter the canal in a stable controlled manner, while protecting the shoreline from wake energy. A uniquely configured array of oyster castles with an oyster shell bag toe was installed in October of 2021 and a dense planting of vegetation was completed in May of 2022. The AIC living shoreline project is an excellent example of the application of cost-effective nature-based solutions which solve multiple coastal stability issues while enhancing the local ecosystem. During and subsequent to its installation, the project has provided outreach to Rutgers students and staff and a technical workshop. This presentation will be a case study of the project and will include the preliminary findings of the first year of monitoring.

Indigenous, European, and American Place Names of Streams and Waterways in Delaware

Kauffman, Gerald, Director, University of Delaware, DGS Annex Academy St., Newark, DE, 19711, jerryk@udel.edu; Elizabeth Shields, University of Delaware; Andrew Homsey, University of Delaware

Hot Topics, Wednesday, 2:30 PM, Main Ballroom, (Avalon 23)

Recognizing the rich Indigenous history and lasting presence of the Native people, the University of Delaware Water Resources Center has dedicated a project aimed at highlighting original place names and their meanings. Indigenous names have always existed for many water-relevant locations, far outdating their anglicized replacements common today. In many places, Swedish and Dutch names established by some of the earliest settlers in Delaware are also relevant to the state's history, and have been lost in similar fashion. Utilizing 1966 U.S. Geological Survey Bulletin 1245, the UDWRC mapped original place names of streams and waterways in Delaware (Lenapehoking). The evolution of place names in Delaware mirrors history from the Lenape to the Swedes and Dutch to the English then the Americans. The Lenape lived here for millennia since the melting of the glaciers and the rising of the seas at least 12,000 years ago and met the Europeans in Lenapewihittuck. Many of the original place names are derived from Lenape, Nanticoke, and Algonkian origin reflecting the indigenous people who lived here for millennia. The Europeans arrived at the turn of the 17th Century and met the indigenous people in the tribal homeland of the Lenni-Lenape in Lenape Haki-nk to the north and along the bay, the Nanticoke in Nentego to the south, and the Susquehannock to the west. When the Swedes and Dutch sailed here in the early 17th Century, these western Europeans left multiple variants due to differences in spelling and translation among all the influential languages in the area. When King Charles II regained the monarchy after the interregnum of Oliver Cromwell in 1660, the Duke of York granted land charters to William Penn after 1682 and many place names were anglicized and Swapecksiska and Hvitlers Creek became White Clay Creek and the Swedes distilled potato and barley mill snaps (Brannvin) along the Wawaset or Suspecough now the Brandywine River.

Reconnaissance Study of Potentially Eligible National Wild & Scenic Rivers in Delaware

Kauffman, Gerald, Director, University of Delaware, DGS Annex Academy St., Newark, DE, 19711, jerryk@udel.edu; Elizabeth Shields, University of Delaware; Andrew Homsey, University of Delaware

Big Picture Environmental Planning, Monday, 11:30am, Breakout B, (Avalon 24-26)

The University of Delaware Water Resources Center worked with the Coalition for the Delaware River Watershed and National Park Service to evaluate the potential eligibility and suitability of designating streams on the Nationwide Rivers Inventory to the National Wild & Scenic River system in Delaware. During the 1970s and 1980s, the NPS mapped the NRI that listed 41 river segments in Delaware as potentially eligible for wild and scenic river designation. Since 2000, the White Clay Creek has been the sole wild and scenic river wild and scenic river in Delaware and after 20 years of successful management the thought is more rivers could be added to the system. UDWRC research students assisted with the reconnaissance study that began in summer 2021 with delivery of a December 2021 draft report. The 1968 Wild and Scenic Rivers Act indicates to be eligible for designation, a river must be free-flowing and possess outstandingly remarkable values (ORV) that are river-dependent natural, cultural, or recreational resources and unique, rare, or exemplary at a regional or national scale. The eligibility analysis examines the river's hydrology, including man-made alterations, and an inventory of its natural, cultural, and recreational resources. The final step in the river assessment process for wild and scenic designation is determination of suitability which rivers should be recommended for addition to the National System and an agency's recommendation to Congress. The UDWRC recommended that the National Park Service conduct reconnaissance studies of the Brandywine River and Red Clay Creek for potential wild and scenic river eligibility in Delaware.

Species, Subspecies, and Pollution Resistance Analysis of the killifish Fundulus heteroclitus in Delaware Bay Tributaries

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Living Resources II, Wednesday, 9:00 AM, Main Ballroom, (Avalon 23)

Fundulus heteroclitus is a small estuarine fish native to the North American Atlantic coast and rarely, freshwater streams. Some F. heteroclitus populations exposed to Environmental Protection Agency (EPA) superfund sites have been found to have evolved pollution resistance through de-activation of aryl hydrocarbon receptor(s) genes (AHRs) that initiate hydrocarbon pollution metabolism. F. heteroclitus inhabits the freshwater Darby Creek downstream of two landfills designated an EPA superfund site in the John Heinz National Wildlife Refuge (JHNWR) near Philadelphia, PA as well as the freshwater Muckinipattis Creek where they cohabitate with their freshwater relative *F. diaphanus* in Norwood, PA. These sites are less than three miles upstream from where Darby Creek enters the Delaware River.

Using single nucleotide polymorphism (SNP) analysis of mitochondrial DNA (mtDNA) we established that F. heteroclitus from both creeks follow the pattern previously reported for *F. heteroclitus* in the northernmost Delaware and Chesapeake Bays---we found that F. heteroclitus in the creeks carry the mtDNA of the northern subspecies Fundulus heteroclitus macrolepidotus whereas individuals from Ocean City, NJ carries the mtDNA of the southern subspecies Fundulus heteroclitus. The Darby and Muckinipattis Creek populations are the most inland populations whose subspecies status has been studied. Microsatellite analysis revealed no evidence of hybridization between *F. heteroclitus macrolepidotus* and *F. diaphanus* in either creek although clonal hybrids between these two species are reported in Nova Scotia.

To study possible pollution resistance in the Darby Creek population, we analyzed SNPs in Exon 10 of AHR1a in *F. heteroclitus macrolepidotus* collected downstream of the EPA superfund site. SNPs discovered in exon 10 of AHR1a were significantly divergent from exon 10 sequences of individuals from the relatively unpolluted Muckinipattis Creek and Ocean City, NJ. populations. These polymorphisms may play a role in pollution resistance in *F. heteroclitus macrolepidotus* in the JHNWR Darby Creek.

Climate Change Impact on Biodiversity in the Delaware Estuary - Community Science, Curriculum Development and Education Initiatives

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Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Across the planet scientists and citizens are racing to save species threatened by the impacts of climate change. Here in the Delaware Estuary ecosystems are affected by regional changes that are threatening species from the bayshores to the urban rivers to the forests of the Pine Barrens. Scientific efforts to document the impacts of climate change and the state of biodiversity must be paired with education initiatives in our schools and communities if we are to secure the support needed to save species and strengthen ecosystem integrity.

The students of Haddonfield Memorial High School, in western Camden County in the Lower Delaware River Watershed, have explored the diversity of species whose survival is connected to climate change in our region. From songbirds in the urban forested parks to horseshoe crabs on the beaches of the Delaware Bay to amphibian communities in the wetlands of the Pine Barrens, community composition, population size and/or habitat state have been assessed over the past 20 years as part of the environmental program. Though not all projects have occurred within the watershed boundary of the Delaware River and Bay, the ecology of these case studies are tied to the health of the entire region. These community science initiatives have contributed to conservation projects and research, provided experiences and data that have enhanced educational initiatives and have increased the opportunity to connect the regional effects of climate change with the state of biodiversity in our community.

A living shoreline feasibility model to support successful restoration projects

Klinkam, Jessica, Restoration Science Intern, Partnership for the Delaware Estuary, 2811 Brown St, Philadelphia, PA, 19130, jklinkam@delawareestuary.org; Sarah Bouboulis, Partnership for the Delaware Estuary; Josh Moody, Ph.D., Partnership for the Delaware Estuary; Ella Rothermel, Partnership for the Delaware Estuary

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Living shorelines are one of a myriad of shoreline protection tactics intended to reduce erosion while maintaining and maximizing ecological connectivity and function. Potential living shoreline sites are often dynamic environments with unique characteristics. A successful living shoreline design must consider a variety of parameters to understand the individual considerations involved in building and maintaining a shoreline at a particular location. The Living Shoreline Feasibility Model integrates four categories of metrics (physical, biological, site access, & community resources) to evaluate site-specific conditions and provide overall feasibility at one or multiple sites. Site-specific data can be collected using a variety of methods including desktop analyses, field collection, and/or personal communications that are then input into the model using drop-down menus. Data sheets and resources are provided with the model to assist the user in sourcing the required information. Each of the four metric categories is then given a score that can be evaluated relative to the other categories per site, or to the same categories among sites. Individual metric scores per site are then combined to evaluate the Design Complexity, Implementation Complexity, and ultimately Overall Feasibility of individual sites. The output of the LSFM helps users to identify specific advantages and challenges of working at sites, and supports team building for successful installations.

Incidence and restoration prioritization of rare and common species of freshwater mussels in the tidal Delaware River, USA

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Living Resources I - Shellfish, Monday, 2:00 PM, Breakout B, (Avalon 24-26)

Freshwater mussel assemblages have been in steep decline as measured by decreasing biodiversity, range and abundance. Most restoration attention has centered on rare species, despite the implications of losing whole mussel assemblages for critical ecosystem processes. There is emerging interest in restoring both common and rare species for their supporting and provisioning ecosystem services, such as the positive contributions of mussel beds to water and habitat quality. In addition to traditional restoration, mussels could be added or enhanced in created or heavily altered aquatic systems, such as stormwater ponds, living shorelines, and reengineered canals. However, inclusion of common species in mussel recovery plans has elicited concern based on the premise that augmenting common species could undermine rare species recovery due to competition or other ecological factors.

To inform restoration, quantitative mussel surveys were performed between 2010-2015 by excavating quadrats (n=264) along transects at 9 sites in the tidal freshwater zone of the Delaware Estuary. Mussel percent occurrence, numerical density, and biomass were dominated by *Elliptio complanata* and *Utterbackiana implicata*, and subordinate species included *Atlanticoncha ochracea*, *Sagittunio nasutus*, and *Lampsilis cariosa*. The two dominants were found by themselves in > 38% of the quadrats, whereas *A. ochracea*, *S. nasutus* and *L. cariosa* were found by themselves in 3.8%, 0%, and 0% of quadrats, respectively. The greatest occurrence of subordinates was in quadrats with >10 mussels. No evidence of negative species interactions was detected, and the occurrence of rarer species may depend on the abundance of foundation species. Although this finding may not be universally applicable, it suggests that (re)establishing a mussel bed using common species is a necessary first step for mussel recovery in eutrophic, impacted systems that currently have very few or no mussels, such as the urban corridor of the Delaware River. Once foundation species are established, rarer species can be augmented to mimic natural assemblages at reference sites.

Algal Processes in the Urban Delaware River: A synthesis of available data

Kulis, Paula, CDM Smith, 75 State Street Suite 701, Boston, MA, 02109, kulisps@cdmsmith.com; Kinman Leung, Philadelphia Water Department; Kathrine Lavallee, Woods Hole Group; Eileen Althouse, CDM Smith; Zachary Eichenwald, CDM Smith; Damian Brady, University of Maine; Sen Bai, Tetra Tech

Water Quality II, Wednesday, 10:30 AM, Breakout A, (Avalon 20-22)

Freshwater and marine algae are living organisms sensitive to nutrients, light, temperature, and predation, making algal processes notoriously difficult to represent in water quality models. Slightly imperfect representation of any single factor can drastically impact a modeler's ability to simulate observed algal growth. The Philadelphia Water Department (PWD) has developed and continues to refine a 3-dimensional hydrodynamic and water quality model of the upper Delaware Estuary from Trenton, NJ to Delaware City, DE. Full eutrophication modeling includes nitrogen and phosphorus species, algal processes, and dissolved oxygen (DO).

Working with coastal science experts and academic researchers, PWD has collected data throughout the upper Delaware Estuary to characterize water quality processes and support model refinement. PWD has maintained fluorometry sondes for estimating concentrations of photosynthetic pigments such as chlorophyll-a at two locations, one in the urban river near the mouth of the Schuylkill River, and one farther downstream. These two sondes have been operational since 2017 and have provided important insights regarding long-term, seasonal trends for algal processes in the river. Similarly, long-term fluorometry data collected by USGS at Trenton, Penn's Landing and Pennypack Woods also provide insights into long-term algal trends. Many years reflect an early spring bloom, followed by a later summer bloom. These long-term datasets also provide insights on the effects of temperature, turbidity, and nutrients on algal growth. Data collected on algal community taxonomic composition also further inform the nature of observed blooms. These data are also consistent with observed data from grab samples collected in PWD and Delaware River Basin Commission boat run monitoring programs.

The impacts of algal blooms on water quality in the Delaware River are also evaluated. Historical long-term data in the river demonstrate that while day-to-day algal densities (chl-a as measured by fluorometry) do not substantially impact daily average DO, algal blooms seem to coincide with elevated DO. Seasonally depressed DO conditions also tend to occur during periods when algal densities are relatively low.

Continued Data-informed Model Refinements for Philadelphia Water Department's Tidal Delaware Estuary Water Quality Model

Kulis, Paula, CDM Smith, 75 State Street Suite 701, Boston, MA, 02109, kulisps@cdmsmith.com; Kinman Leung, Philadelphia Water Department; Eileen Althouse, CDM Smith; Zachary Eichenwald, CDM Smith; Sen Bai, Tetra Tech; Damian Brady, University of Maine

Water Quality I, Tuesday, 10:30 AM, Breakout A, (Avalon 20-22)

The Philadelphia Water Department (PWD) has developed and continues to refine a 3-dimensional hydrodynamic and water quality model of the upper Delaware Estuary from Trenton, NJ to Delaware City, DE. The model includes inflows from 43 tributaries, more than 300 municipal and industrial discharges, and direct river runoff from the local watershed not represented by tributaries. Full eutrophication modeling includes nitrogen and phosphorus species, algal processes, and dissolved oxygen (DO).

The PWD modeling team's recent refinements to the water quality model continue to improve model representation of water quality processes in the tidal fresh river, including nitrification, light attenuation, sediment fluxes, and algal processes. An analysis of a comprehensive nitrification rate dataset assesses the variability of nitrification rates observed in the river and helps inform uncertainties associated with modeled nitrification rates. A comparison of light attenuation data collected by the Delaware River Basin Commission boat run field program with historical data and also with light attenuation data collected on behalf of PWD informs a more robust representation of modeled light attenuation in the river, and also helps to quantify the variability of light attenuation in the river. A comprehensive sediment flux dataset informs modeled sediment flux for key water quality model constituents on a seasonal basis. Algal community taxonomic composition data, along with historical grab sample chlorophyll data and several fluorometry sondes at various locations along the urban river inform both algal group dynamics and the nature and timing of algal blooms within the urban tidal fresh estuary. This presentation discusses data analyses that have refined the modeling team's conceptual model of the Tidal Delaware as a system, and the resulting improvements that are reflected in model performance. These refinements support efforts to quantify impacts of current and potential management practices on the DO in the river.

DELCORA's Water Quality Improvement Projects: Wastewater Tunnel & Multiport Diffuser Outfall

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Water Quality I, Tuesday, 10:30 AM, Breakout A, (Avalon 20-22)

The Delaware County Regional Water Quality Control Authority (DELCORA) serves approximately half a million people in Delaware and Chester Counties in Pennsylvania, collecting and treating wastewater and stormwater at its Western Regional Treatment Plant (WRTP) in Chester, Pennsylvania, before discharging its treated effluent into the Delaware River. DELCORA proposes to construct an 8.5 mile tunnel from its easternmost pump station in Darby Township, Pennsylvania to its wastewater treatment plant in Chester to redirect flows within DELCORA's service area that are not currently being treated by DELCORA. The proposed tunnel has been designed to be constructed using a tunnel boring machine (TBM) and would be concrete-lined, with an inside diameter of 14 feet, allowing it to hold 50 million gallons of water for gradual withdrawal and treatment. DELCORA has recently submitted to EPA an updated Long-Term Control Plan (LTCP) to address its combined sewer outfalls and drastically reduce the frequency and volume of combined sewer overflows along the Chester Creek, Ridley Creek and Delaware River by connecting to the wastewater tunnel. The storage and conveyance tunnel would collect and thereby reduce the volume of untreated combined sewage that currently enters the Delaware River watershed during wet weather events, reducing occurrences from an average of 35 times a year to 6 times per year. The proposed 95% reduction in CSO discharge is combined with the water quality benefits of WRTP's planned multiport diffuser outfall extension into the Delaware River. These two projects could ultimately result in the largest water quality improvements since DELCORA's formation 50 years ago. This presentation will discuss the tunnel design, how the CSO system could be connected to the wastewater tunnel, the anticipated water quality benefits of the DELCORA's planned infrastructure and challenges constraining the implementation.

Long Term Water Quality Monitoring in the Tidal Delaware River

Lavallee, Katherine, Coastal Scientist, Woods Hole Group, 107 Waterhouse Road, Bourne, MA, 02532, klavallee@whgrp.com; Kinman Leung, Philadelphia Water Department; David Walsh, Woods Hole Group; Elana Ames, Woods Hole Group

Water Quality I, Tuesday, 10:30 AM, Breakout A, (Avalon 20-22)

The Philadelphia Water Department (PWD) conducts a water quality measurement program in the tidal Delaware River to meet the data collection needs of the water quality compliance group. Since 2016, long-term timeseries of water quality parameters at multiple sites has been collected. A series of surface buoys equipped with multi-parameter sondes have been deployed at three stations: one in the urban corridor of the river, approximately 1 mile upstream of the confluence with the Schuylkill River, off Marcus Hook, and approximately one mile upstream of Pea Patch Island. The sondes measure 12-minute timeseries of parameters at depth, temperature, conductivity, salinity, turbidity, dissolved oxygen, and chlorophyll-a at approximately 3 feet below the water surface. An extensive field maintenance and data quality management protocol has been established to produce near continuous timeseries of these parameters from early spring to late fall from 2016 to present. These datasets allow for the analysis of seasonal trends, annual changes, and provide additional longitudinal data to concurrent continuous monitoring stations. PWD can implement these data to inform numerical modeling, and water resource decision-making.

Use of a Radio Telemetry Receiver Grid to Study Movements and Habitat Use of Female Diamondback Terrapins (*Malaclemys terrapin*) in a Southern New Jersey Salt Marsh

Lyons, Amanda, Research and Conservation Coordinator, The Wetlands Institute, 1075 Stone Harbor Blvd, Stone Harbor, NJ, 08247, alyons@wetlandsinstitute.org; Brian Williamson, The Wetlands Institute; Lisa Ferguson, The Wetlands Institute

Living Resources II, Wednesday, 9:00 AM, Main Ballroom (Avalon 23)

Movements and habitat use of Northern Diamondback Terrapins (*Malaclemys terrapin terrapin*) can be difficult to examine due to limitations of standard telemetry technology in a salt marsh environment. In 2021, we tested a new approach to track terrapin locations using Cellular Tracking Technologies' Powertag radio transmitters to better understand terrapin movements and habitat use in a tidal salt marsh in southern New Jersey. We captured and attached radio transmitters to 60 nesting terrapins. We detected radio signals using a grid of 33 stationary receiver nodes spaced 100 meters apart throughout the study site. We triangulated terrapin locations based on the relationship between strength of the radio signal received by each node and distance. We then used these triangulated locations to generate Kernel Density Estimates (KDEs) of terrapin activity areas using the AdehabitatHR package in R with likelihood cross validation and least-squares cross validation to derive smoothing factors. Preliminary results suggest female terrapins spend more time in salt pannes during the nesting period than previously understood, and seasonally inhabit tidal creeks close to nesting areas between subsequent nesting attempts, sometimes remaining near the nesting area for several weeks. Results of this work will improve our understanding of terrapin habitat use and movements, and help inform conservation efforts focused on the species locally and range wide.

Development of a Fecal Coliform Bacteria Model in the Tidal Fresh Delaware River – Lessons learned

McCullough, Ramona, Water Quality Modeler, Sci-Tek Consultants Inc., 1880 JFK Blvd, Suite 600, Philadelphia, PA, 19103, rmccullough@scitekanswers.com; Kinman Leung, Philadelphia Water Department; Philip Duzinski, Philadelphia Water Department

Water Quality I, Tuesday, 10:30 AM, Breakout A, (Avalon 20-22)

Philadelphia Water Department (PWD) has developed a 3D fecal coliform bacteria (FCB) model of the fresh tidal Delaware River to support the City's Green City Clean Waters Combined Sewer Overflow (CSO) Long Term Control Plan. The model was developed using US EPA's Environmental Fluid Dynamic Code (EFDC) and includes a comprehensive list of anthropogenic and natural FCB loadings, such as municipal and industrial wastewater treatment plants and overflows from CSOs.

Observed data for bacteria were only sparsely available as grab samples, representing a snapshot of local conditions at a specific time, unlike other water quality parameters for which data were readily available as continuous time series. In this presentation we discuss the challenges in building and calibrating a numerical bacteria model limited by the availability of observed fecal coliform data within the system.

Methods were developed to create realistic continuous FCB model loadings for two model years by analyzing long-term FCB grab sample datasets. We present a range of post-processing tools that were developed to compare continuous model results to reference grab sample observations within the river in order to facilitate model development and calibration. Grid resolution, bathymetry and salinity sensitivity analyses were conducted to enhance our capability to interpret results due to uncertainties in the model.

Community Science Model for High Frequency Headwater Stream Monitoring in Southeastern Pennsylvania

McGrath, Lauren, Director of Watershed Protection Program, Willistown Conservation Trust, 925 Providence Road, Newtown Square, PA, 19073, lbm@wctrust.org; David Bressler, Stroud Water Research Center; Aurora Dizel, Darby Creek Valley Association

Science Communication, Wednesday, 9:00 AM, Breakout A, (Avalon 20-22)

Community based scientific monitoring is an increasingly important tool that can be used to understand the rapid onset of changes in freshwater ecosystems as a result of climate change and human activity. Willistown Conservation Trust (WCT), Darby Creek Valley Association and Stroud Water Research Center partnered to design a high frequency community monitoring project where residents of the Darby Creek watershed, a small tributary to the Delaware River in southeastern Pennsylvania, USA, were trained (via in-person events, easy-access written protocols, and video tutorials) on data collection including conductivity, pH, chloride, water temperature, detailed photos and water samples, analyzed by WCT for total suspended solids. Monitoring visits are conducted every four weeks to capture possible rapid fluctuation of conditions in small order streams. Training not only covered the scientific data and sample collection procedures, but connected residents to the stream as a resource and aimed to increase scientific literacy within the community. Monthly email updates provide continued education and discussion topics, as well as new opportunities for advocacy, engagement, and additional monitoring efforts.

New Jersey Living Shorelines Engineering Guidelines Updates

Miller, Jon, Research Associate Professor, Stevens Institute of Technology, Davidson Lab, Castle Point on Hudson, Hoboken, NJ, 07030, jmiller@stevens.edu; Laura Kerr, Stevens Institute of Technology; Amy Bredes, Stevens Institute of Technology

Restoration & Conservation III, Wednesday, 1:00 PM, Main Ballroom, (Avalon 23)

In 2015, the New Jersey Department of Environmental Protection (NJDEP) released a set of engineering guidelines for living shorelines projects. The intent of the document was to provide guidance to engineers and regulators on the engineering components of living shorelines projects, which at the time were relatively uncommon in New Jersey. In the seven years since their release, the guidelines have been used to design dozens of projects throughout the state and have served as inspiration for the development of similar guidance documents throughout the northeast. At the same time, much progress has been made in the field of living shorelines design. In 2019, the NJDEP funded Stevens to update the living shorelines engineering guidelines to bring them more in line with the current state of practice. Updates to the guidelines fall into two categories. The first is an update to the original guidelines which were focused on natural shorelines. The second is the development of a new set of guidelines for developed coasts. Some of the updates to the existing guidelines include modernizing the design framework to align with recently released international guidance, adding a scoping level analysis, incorporating adaptive management and beneficial reuse, and aligning the guidance with state resilience initiatives. The newly created guidance for developed shorelines identifies nine core design principles based on an analysis of existing developed shoreline guidance documents and case studies. This presentation will provide an overview of updates to the existing living shorelines engineering guidelines and the new guidance for developed shorelines.

Implementation of a regional "Mussels for Clean Water Initiative" for the upper mid-Atlantic region

Morgan, Leah, Shellfish Specialist, Partnership for the Delaware Estuary, Suite 202, 110 S. Poplar St., Wilmington, DE, 19801, lmorgan@delawareestuary.org; Danielle Kreeger, Partnership for the Delaware Estuary; Kurt Cheng, Partnership for the Delaware Estuary; Matthew Gentry, Partnership for the Delaware Estuary

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Freshwater mussels are one of the most imperiled animal groups in North America, and interest in these bivalves has understandably been focused on conserving biodiversity rather than the ecological consequences of declines in abundance. And yet, freshwater mussels can furnish valuable ecosystem services such as water quality improvement by removing and transforming seston and associated pollutants (e.g., nitrogen). Historic population loss coupled with modern constraints on natural recruitment therefore undermines management efforts to sustain water quality in freshwater ecosystems. The Mussels for Clean Water Initiative (MuCWI) aims to facilitate mussel restoration in streams, rivers and lakes in the upper mid-Atlantic region. Since natural populations are so depleted, the initial focus is to develop a reliable source of mussels for restoration, research, monitoring and outreach projects in the Delaware and Susquehanna River Basins. A production-scale hatchery is being designed for a site in southwest Philadelphia, PA. This central facility will initially focus on propagating up to 500,000 juveniles per year of the more common, "foundational" species that dominate natural mussel beds. Hatchery-produced mussels will be raised to larger sizes at regional rearing centers in different states and watersheds. Pilot projects have shown that hatchery mussels can survive and grow in various stream, river, reservoir, living shoreline and stormwater pond sites, confirming that mussel recovery projects can be viable in many areas. Programs such as MuCWI expand the toolkit of nature-based tactics that can help sustain water quality, especially because they can be implemented in freshwater areas closer to sources of impairment.

A paradigm shift: Rethinking Phragmites management in the context of ecosystem resilience with insights from a meta-analysis of ecosystem services in North American tidal wetlands

Mozdzer, Thomas, Associate Professor of Biology, Bryn Mawr College, 101 N Merion Ave, Bryn Mawr, PA, 19010, tmozdzer@brynmawr.edu; Logan Wallace Shepard, Bryn Mawr College; Frances Romero, Bryn Mawr College; Grace Cott, University College Dublin; Erik Kiviat, Hudsonia; Judith Weiss, Rutgers University Newark

Hot Topics, Wednesday, 2:30 PM, Main Ballroom, (Avalon 23)

Phragmites australis is one of the most common and prolific invasive species in coastal wetlands throughout North America, and is especially prolific in the mid-Atlantic area. Despite decades of study, the consequences of *Phragmites australis* invasion on ecosystem services are poorly understood. To evaluate the degree to which *Phragmites australis* invasion alters ecosystem services in North American tidal wetlands, we performed a meta-analysis of published studies identified using Web of Science. Our study synthesizes the findings of 69 peer-reviewed publications that contained over 900 paired data points allowing us to evaluate ecosystem services provided by *Phragmites australis* and native plant communities. Our meta-analysis found no overall effect of *Phragmites australis* invasion on ecosystem services. Subsequent analysis on each of the 22 individual ecosystem services revealed that *Phragmites australis* dominated marshes provided many beneficial effects including greater effect sizes on coastal blue carbon, soil formation, carbon assimilation, primary productivity, and sea level rise resilience. Our analysis suggests the pressing need to reconsider the role that *Phragmites australis* plays in coastal wetlands, especially with respect to maintaining ecosystem resilience in an era of accelerating global change.

Impact of Sea Level Rise on Cultural Resources in the Delaware Bay region

Nikitina, Daria, Professor of Geology, West Chester University of Pennsylvania, 750 S. Church Street, 228 Merion Science Center, West Chester, PA, 19383, dnikitina@wcupa.edu; Heather Wholey, West Chester University of Pennsylvania; Yong Hoon Kim, West Chester University of Pennsylvania; Michael Powers, University of Delaware; Joanna Maurer, West Chester University of Pennsylvania

DRBC Climate Change Forum Technical Session II-Building Community-level Climate Resilience, Tuesday, 4:15 PM, Main Ballroom, (Avalon 23)

The Delaware Bay coastal zone includes 1580 cultural resource sites, 699 of them could be damaged or lost by the year 2100. Future projections of sea-level rise (SLR) and storm surges identified cultural resources at high risk for inundation by the years 2030, 2050, 2080, 2100. The projections are aimed for high-end estimates preparing for long-term planning and 'worse-case' scenarios. Sites located along the riverbanks are facing the highest threats from SLR. Coastal sites will be more frequently impacted by storms as surge levels increase with SLR. Storm-surge simulations predicted non-linear increase in surge levels, reaching greater heights along the New Jersey side of the Bay compared to the Delaware side. Coastal sites without a protective dune system, or a dune less than 2 m in elevation should be considered at immediate risk from coastal flooding. Shoreline erosion, and more frequent storms combined with SLR will increase vulnerability of coastal sites in the future. All endangered sites cannot be protected, therefore results of the study should be of particular interest to historic preservation planners, cultural resources managers, and scholars to prioritize resources, develop most effective preservation strategies, plans for reconnaissance, survey, or data retrieval from threatened sites and landscapes.

Microplastics in Stormwater

Parameswarappa Jayalakshmamma, Meghana, Student, New Jersey Institute of Technology, 323 Dr Martin Luther King Jr Blvd, Coltan hall, Room 431, Newark, NJ, 07102, meghana.pj1@gmail.com; Dr. Michel Boufadel, New Jersey Institute of Technology

Water Quality II, Wednesday, 10:30 AM, Breakout A, (Avalon 20-22)

Microplastics (MPs) are ubiquitous in nature and are difficult to remove once released into the environment. Although there are very few studies relating to microplastics in stormwater, the investigations show stormwater is a significant pathway for microplastics, collected as tire wear, road wear, plastic litter, etc. from highways/roadways, and discharge into adjacent waterbodies (de Jesus Piñon-Colin et al., 2020; Grbić et al., 2020; Järlskog et al., 2020). Additionally, urban stormwater runoff includes pollutants like heavy metals, total suspended solids, polycyclic aromatic hydrocarbons (PAHs), street organic waste and nutrients (Aryal et al., 2010; Makepeace et al., 1995). It is estimated that up to 2.41 million tons of plastic waste was transported via river to the ocean and is expected to increase in the coming decades (Jambeck et al., 2015; Lebreton et al., 2017) and the adsorption of pollutants to these microplastics (Fu et al., 2021) may lead to fatal in freshwater organisms. To add on, the MPs accumulates in the sediments along the runoff way and remain forever without any treatment, which may eventually enter groundwater and contaminate; this calls for finding immediate solutions to the microplastics and treat them as water quality pollutants. In our study, we have investigated samples from stormwater runoff and sediments in Newark, New Jersey to observe the abundance of microplastics via urban stormwater and their impact on freshwater systems.

Delaware Inland Bays' Diamondback Terrapin Survey

Pérez-Pérez, Nivette, Manager of Community Science, Delaware Center for the Inland Bays, 39375 Inlet Rd, Rehoboth Beach, DE, 19971, nperezperez@inlandbays.org

Living Resources II, Wednesday, 9:00 AM, Main Ballroom (Avalon 23)

Diamondback terrapins (*Malaclemys terrapin*) are the only turtles in North America that are uniquely adapted to live exclusively in brackish waters. The terrapin is also an iconic species of the mid-Atlantic region and generates a lot of attention during the nesting season as residents of the area and tourists come into close contact with breeding females. Despite their importance, little is known about their population status across much of their range. In addition to this uncertainty, terrapins face numerous serious threats, including habitat loss across their entire range, nest predation, road mortality, drowning from crab pot fishing, commercial harvest, and collisions with boats.

These threats combined with a range-wide decrease in abundance from historical levels, has resulted in the terrapin being listed as a "Species of Greatest Conservation Need Tier 2". This Delaware listing is not based on long term population studies, but of perceived population numbers and the common sightings that occur within salt marshes throughout the spring and summer. Within the Inland Bays watershed, relatively few studies have targeted terrapins, because of this, population dynamics, sizes, and spatial distribution of terrapins are unknown within this system.

The combination of their importance to salt marsh ecosystems, historical declines in populations, numerous serious threats to existing populations, and the uncertainty of their current status within the Delaware Inland Bays spurred the Center for the Inland Bays to develop a long-term population survey of terrapins within the Inland Bays that engages members of the public in meaningful science.

Since 2020, volunteers have conducted both water-based and land-based terrapin head counts, along predetermined transects and at stationary locations throughout the Inland Bays. After three years of data collection early patterns of distribution are emerging. Future work will test possible correlations between terrapin density and site composition.

Climate's Rising Tide and Our National Parks

Reber, Renee, Mid-Atlantic Coastal & Climate Resilience Program Analyst, National Parks Conservation Association, 777 6th Street, NW, Suite 700, Washington, DC, 20001, rreber@npca.org

DRBC Climate Change Forum Technical Session II-Building Community-level Climate Resilience, Tuesday, 4:15 PM, Main Ballroom, (Avalon 23)

The impacts of climate change are here and present new and intensified challenges to both built and natural landscapes. Increased temperatures, rising sea level, and extreme weather events are just a few of the direct impacts natural resource managers and policy makers must confront. America's national parks, established to preserve natural and cultural resources for current and future generations, are warming at a rate twice as fast as the rest of the country. Climate change impacts to parks affect everything from wildlife and water quality to infrastructure and the visitor experience. The National Parks Conservation Association will examine climate change impacts to national parks within the Delaware River watershed, such as Delaware Water Gap National Recreation Area and First State National Historical Park and explore the impacts of sea level rise affecting coastal parks throughout the Mid-Atlantic region. This presentation will also discuss actions underway to prepare our national parks for climate change, as well as existing resource gaps and needs to be resilient in the face of the climate crisis.

Monitoring a Tidal Wetland Beneficial Use Project in Delaware for Baseline Conditions and Project Design

Rogerson, Alison, Environmental Scientist, DNREC Division of Watershed Stewardship, 285 Beiser Blvd. Suite 102, Dover, DE, 19904, alison.rogerson@delaware.gov

Restoration and Conservation II, Wednesday, 10:30 AM, Main Ballroom, (Avalon 23)

Coastal states nationwide and the Mid-Atlantic are experiencing an increase in demand for beneficial use projects stemming from pressure to manage dredge material ecologically coupled with coastal wetland erosion and sea level rise. In Delaware, there is only one example of thin layer application in a tidal wetland for habitat restoration. No examples of thick layer application to replace former wetlands has occurred. DNREC seeks to demonstrate how to use dredge material to recreate a functioning, sustainable low marsh habitat. This presentation will explore the biological and physical indicators being sampled and monitored before and after a 15-acre tidal wetland recreation using dredge materials with a high marsh restoration component, comparing a reference and treatment site in Millsboro, Delaware. Three years of baseline monitoring have been collected so far, allowing early readings and comparisons to reference conditions. Also, discuss how critical it is to thoroughly assess site-specific conditions for beneficial use project design and execution.

Urban Ecological Restoration Planning on the Christina and Brandywine Rivers; Wilmington, DE

Rothermel, Ella, Data Management Coordinator, Partnership for the Delaware Estuary, 110 South Poplar Street, Suite 202, Wilmington, DE, 19801, erothermel@delawareestuary.org; **Matthew Sarver**, Sarver Ecological

Urban Ecology & Restoration, Monday, 2:00pm, Breakout A, (Avalon 20-22)

The Christina-Brandywine River Remediation Restoration and Resilience (CBR4) project aims to restore both ecological function and human connection to a central tributary of the Delaware River in Wilmington, DE. Goals include a return to swimmable, fishable, and drinkable waters through remediation of contaminated sediments, ecological restoration, conservation of riparian habitat, and improved public access. Although urban environments are generalized as lacking biodiversity and ecological value, assessments of focal project areas have revealed a wealth of existing habitats and species. Project planning must therefore incorporate both uplift and preservation opportunities while also considering human recreation and economic needs.

Necessary remediation frequently requires habitat disturbance or destruction, and therefore ecological restoration subsequent to remediation activities is critical to mitigate impact to biodiversity. We describe restoration concepts developed for opportunity areas identified within the urban river corridor that will create a network of habitat patches at spatial scales relevant for supporting urban riparian biodiversity. These restorations are designed to be implemented before, concurrent with, and after remediation activities, helping to offset habitat loss and species displacement throughout the remediation timeline.

Delaware River Watershed Seabin Aquatic Litter Collection and Monitoring Project– a private-public partnership between EPA, Partnership for the Delaware Estuary, and Seabin Project Ltd.

Sanders, Hannah, Life Scientist, US EPA, Region 3, 1600 JFK Blvd, Philadelphia, PA, 19103, sanders.hannah@epa.gov; Kelly Somers, US EPA, Region 3; Mahi Paquette, Seabin Project; Solomon Wadani, Seabin Project; Angela Padeletti, Partnership for the Delaware Estuary

Urban Ecology & Restoration, Monday, 2:00pm, Breakout A, (Avalon 20-22)

The U.S. Environmental Protection Agency (EPA), Partnership for the Delaware Estuary (PDE), and an Australian clean tech start-up company, Seabin Project, have partnered on a project to monitor and remove aquatic trash from the Delaware River Watershed.

The project consists of a six-month field pilot study during which Seabin Project's self-titled trash-capture devices, Seabins™, were deployed at three separate locations on the Delaware and Schuylkill Rivers in Philadelphia, PA and Camden, NJ from May through October, 2022. Seabins™ devices work by filtering surface water to capture floating debris, including microplastics and microfibers down to one (1) millimeters in size.

EPA and Seabin™ staff piloted the Seabin Pollution Index Protocol to meet the needs of the study. Data generated includes the weight of debris captured (daily), including organics as well as floating trash; and the number of pieces of trash collected, categorized into twenty-eight (28) categories, including five (5) microplastic categories. Following the six-month data collection period, data will be analyzed against physical and geographic watershed variabilities, such as weather events and outfall locations. The data analysis period is anticipated to wrap up in May 2023. (At the time of issuance, data analysis is still ongoing.)

Trash is pervasive in the watershed, but data on types and quantities of trash is limited. This study seeks to generate data on trash in the watershed in order to push forward work in this area, specifically, to understand the abundance and diversity of trash types in the nearshore environment. Results of this pilot study are intended to inform future trash removal, source reduction, and monitoring efforts in the Delaware River Watershed and beyond. This presentation will share highlights, lessons learned, and initial results from this pilot project and partnership.

Water Resource System Analyses - Planning for Climate Change and Sea Level Rise Impacts

Shallcross, Amy, Manager of Water Resource Operations, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, amy.shallcross@drbc.gov

DRBC Climate Forum Technical Session I-Building Foundational Science for Regional Impacts, Tuesday, 10:30am, Main Ballroom, (Avalon 23)

The drought management program for the Delaware River Basin utilizes low flow augmentation from multiple sources to manage salinity in the Delaware River Estuary to support wildlife, drinking water sources, and other water users. The plan, based on extensive analyses and modeling performed in the late 1970s and early 1980s, was developed to be protective of the basin's water resources through a repeat of the drought of record. Since then, studies have shown that climate change may alter the patterns and amounts of precipitation in the basin, which will affect water availability. Sea level rise will likely result in changes to the hydrodynamics of the estuary and transport of salinity upstream into the estuary, potentially impacting the suitability of estuarine water for different purposes. Studies are underway to develop information for a comprehensive basin plan to improve its resiliency to drought conditions. The presentation will focus on the process and intermediate results from the development of GCM meteorological data, hydrologic analyses, 3D-dimensional and screening level salinity models, and water supply/operations modeling.

Intertidal Oyster Reef Development for Restoration in the Delaware Bay

Shinn, Jenny, Field Researcher lll, Rutgers University, 6959 Miller Avenue, Port Norris, NJ, 08349, jenny.shinn@rutgers.edu; David Bushek, Rutgers University

Living Resources I - Shellfish, Monday, 2pm, Breakout B, (Avalon 24-26)

The Gandy's Beach Nature Conservancy Preserve includes undeveloped shoreline adjacent to Nantuxent Creek and along the Delaware Bay in New Jersey. Beginning in 2014, a collaborative project constructed living shorelines (LS) using coir fiber logs, shell bags, and Oyster Castles® to augment the beach and creek shorelines in an effort to slow the rate of erosion and create habitat. Recruitment, survival, and shell height of oysters living on the artificial structures were monitored seasonally for seven years. A multi-generational population of oysters colonized the structures and demonstrated persistence through time with densities similar to wild, subtidal oyster beds in the area. Additionally, ribbed mussels were observed; sometimes at coverage densities of 95%; and likely supplied additional structural support to the reefs while diversifying the habitat and increasing filtration capacity as well as sediment capture. Oyster recruitment and survival varied annually. Although winter temperatures and ice cover on the structures weren't monitored throughout this project, it was hypothesized that interannual oyster survival was impacted by winter conditions. This project provided a unique opportunity to document intertidal oyster reef development in the Mid-Atlantic region via a long-term monitoring program administered by the USFWS in response to shoreline erosion caused by Hurricane Sandy.

Non-Tidal Wetland Health in the Brandywine Watershed, Delaware

Smith, Kenny, Environmental Scientist, DNREC-Delaware Department of Natural Resources and Environmental Control, 286 Besier Blvd, Suite 102, Dover, DE, 19904, Kenneth.e.smith@delaware.gov

Monitoring & Assessment, Monday, 11:30am, Main Ballroom, (Avalon 23)

The Delaware Department of Natural Resources and Environmental Control's (DNREC) Wetland Monitoring and Assessment Program (WMAP) documented wetland acreage trends and determined the ambient condition of tidal and non-tidal wetlands in the Brandywine watershed in 2019. As we assessed this watershed we focused on capturing the health of seep wetlands. The goals of this project were to: summarize acreage gains, losses, and changes across the Brandywine watershed based on the most current state wetland maps; assess the condition of tidal and non-tidal wetlands throughout the watershed; identify prevalent wetland stressors; assess the value that non-tidal wetlands provide to the local landscape; and make watershed-specific management recommendations to different audiences.

Impact of Climate Change on the Salinization of Coastal Wetlands

Solomon, Sam, New Jersey Institute of Technology, 27 Corbin Ave., Apt. 4, Jersey City, NJ, 07306, ss327@njit.edu; Michel Boufadel, New Jersey Institute of Technology; Gregg Sakowicz, Rutgers University Marine Field Station; Andrea Habeck, Rutgers University Marine Field Station; Michael De Luca, Rutgers University Marine Field Station; Thomas Herrington, Monmouth Univ

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Climate change is adversely impacting freshwater and brackish coastal ecosystems through two processes: Sea level rise (SLR) and salinization. SLR causes seawater intrusion through the formation of a saltwater edge into aquifers. Salinization could also occur on the top of the soil due to evaporation and could increase the salt concentration (ion content) in porewater by many folds. Eventually, the ion content would decrease during and following subsequent rain events. The increase in salinity reduces the absorption of carbon in the wetland. We have set up a transect of three wells spaced by 5 m in the wetland in Little Egg Harbor New Jersey. We are currently obtaining continuous (at 1-hour intervals) measurements of water table level and pore water salinity and temperature at each location to evaluate the change in salinity over time. The measurement depth is around 1.2 m. We plan to also take soil cores to measure the soil porosity and permeability, and to measure the moisture content and the resulting salinity. The measurements will be used to calibrate our groundwater-atmosphere evaporation model.

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary

Suk, Namsoo, Director, Science & Water Quality Management, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Namsoo.Suk@drbc.gov; Thomas Amidon, Delaware River Basin Commission; Sarah Beganskas, Delaware River Basin Commission; Jake Bransky, Delaware River Basin Commission; Fanghui Chen, Delaware River Basin Commission; John Yagecic, Delaware River Basin Commission; Li Zheng, Delaware River Basin Commission

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

The Delaware River Basin Commission (DRBC), formed through a Compact in 1961 amongst the federal government and the States of NY, NJ, PA and DE, has worked with its state and federal partners to improve water quality, and the aquatic life that depends on it, within the Delaware Estuary for more than 60 years. The Commission reached an important milestone in September 2022 with the publication of a draft "Analysis of Attainability," the purpose of which was to analyze how improved dissolved oxygen levels to support enhanced aquatic life uses may be attained within the portion of the estuary from Philadelphia/Camden to Wilmington that currently experiences occasional episodes of low dissolved oxygen during critical summer periods. The Analysis of Attainability provides a specific road map of ammonia allocations that will significantly improve dissolved oxygen such that fish maintenance and propagation is supported throughout the Estuary. The study represents the culmination of five years of intensive study involving scientific and technical expertise across multiple disciplines.

Monitoring, modeling and analytical components will each be presented in the poster.

How did DRBC address low dissolved oxygen in the Delaware Estuary - then and now?

Suk, Namsoo, Director, Science and Water Quality Management, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, namsoo.suk@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

The study area for this project encompasses the entire Delaware Estuary, which includes the tidal Delaware River (DRBC Zones 2-5) from its head of tide at Trenton, NJ to the mouth of the Delaware Bay (Zone 6). Special focus was given to the most urban portion of the estuary from Philadelphia/Camden to Wilmington (Zones 3, 4, and upper 5), which is not currently designated for fish propagation use. Seasonal and spatial variations of dissolved oxygen (DO) levels in the Delaware Estuary show that a DO trough (or “sag”) develops in the Philadelphia/Camden area of the tidal river during dry and hot periods in the summer. Adequate levels of DO are required to support healthy aquatic life communities and DO is among the most critical environmental parameters directly affecting fish communities. DO is affected by many processes in the water column, but the decomposition of organic carbon and nitrification of ammonia nitrogen are two major causes of DO depletion in the Delaware Estuary.

In 1967, the Commission developed a "road map" for DO improvement that included: 1) criteria to support fish migration and maintenance throughout the estuary and propagation outside the 38-mile urban corridor where propagation was not deemed attainable; and 2) carbon allocations for point source discharges, which were established by regulation in 1968, to achieve the criteria. In 2022, DRBC published a draft "Analysis of Attainability," which constitutes a road map for additional DO improvements to support fish maintenance and propagation throughout the estuary based on ammonia allocations for point source discharges. This second phase of DO restoration initiated by DRBC determines the highest attainable DO condition that can be achieved in the estuary and identifies the specific and feasible wastewater reductions that will achieve it.

DRBC Q&A Panel: Enhancing support for aquatic life uses in the Delaware Estuary

Panelists: Steve Tambini, Executive Director; **Namsoo Suk**, Director, Science and Water Quality Management; **John Yagecic**, Manager, Water Quality Assessment; **Li Zheng**, Water Resource Modeler; **Fanghui Chen**, Senior Water Resource Engineer; **Sarah Beganskas**, Water Resource Specialist; **Thomas Amidon**, Manager, Water Resource Modeling; Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Namsoo.Suk@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

The Delaware River Basin Commission (DRBC), formed through a Compact in 1961 amongst the federal government and the States of NY, NJ, PA and DE, has worked with its state and federal partners to improve water quality, and the aquatic life that depends on it, within the Delaware Estuary for more than 60 years. The Commission reached an important milestone in September 2022 with the publication of a draft "Analysis of Attainability," the purpose of which was to analyze how improved dissolved oxygen

levels to support enhanced aquatic life uses may be attained within the portion of the estuary from Philadelphia/Camden to Wilmington that currently experiences occasional episodes of low dissolved oxygen during critical summer periods. The Analysis of Attainability provides a specific road map of ammonia allocations that will significantly improve dissolved oxygen such that fish maintenance and propagation is supported throughout the Estuary. The project represents the culmination of five years of intensive studies involving scientific and technical expertise across multiple disciplines.

Speakers in this special session addressed the following questions: 1) Why are we here? 2) How did DRBC address low dissolved oxygen in the Delaware Estuary - then and now? 3) Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know? 4) What is this estuary-wide eutrophication model and why do we need it? 5) What matters and what doesn't with regard to low dissolved oxygen events in the Delaware Estuary? 6) What combination of wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary? 7) What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses? A Q&A Panel including all the speakers will conclude this special session.

Evaluating anthropogenic influences on salt marsh carbon cycling at the Seven Mile Island Innovation Laboratory (SMIIL)

Supino, John, Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA, 02467, supinoj@bc.edu; Kristen Fogaren, Boston College; Kelsey Fall, Engineering Research and Development Center, US Army Corps of Engineers; Dave Perkey, Engineering Research and Development Center, US Army Corps of Engineers; Lenore Tedesco, The Wetlands Institute; Hilary Palevsky, Boston College

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Tidal salt marshes provide a variety of ecosystem services and play an outsized role in sequestering carbon, but are currently under threat from sea level rise (SLR). The Seven Mile Island Innovation Laboratory (SMIIL) in Cape May County, New Jersey is a testbed collaboration between the U.S. Army Corps of Engineers, the State of New Jersey, and The Wetlands Institute to improve dredging, habitat creation, and marsh restoration techniques in the Mid-Atlantic region, where SLR risk is among the highest in the United States. Key to designing effective marsh restoration projects is minimizing short-term ecosystem impacts of dredging and sediment placement. During past beneficial use sediment placement at SMIIL, monitoring of turbidity in open water channels adjacent to the placement site has shown a rapid return to baseline with sediment settling out of the water column within six hours, but potential ecosystem impacts were not monitored directly. Here, we present on the spatial and temporal extent to which sediment placement affects adjacent open water channel ecosystem productivity and biogeochemistry during planned placement of 7,000 cubic yards of dredged material onto Sturgeon Island in October 2022. Five In-Situ AquaTroll 600 sondes measuring salinity, temperature, depth, dissolved oxygen, pH, and turbidity were deployed in waters surrounding the placement site in August 2022, and provided continuous monitoring (10 minute resolution) before, during, and after sediment placement. We will present results and initial analysis of the results of this monitoring, including assessment of the magnitude and timing of ecosystem impacts and return to baseline and comparison with the time it takes sediment to settle out of the water column. These results will provide information that can be used for planning and monitoring future beneficial use sediment placement projects and understanding the impacts of climate mitigation strategies and anthropogenic disturbance.

Introduction: Why are we here?

Tambini, Steve, Executive Director, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, steve.tambini@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

This session tells the ongoing story of restoring dissolved oxygen (DO), and the aquatic life that depend on it, in the Delaware Estuary, the tidal Delaware River and Delaware Bay. When the DRBC was created in 1961, for periods of up to six months each year, little or no DO was present in portions of the Delaware Estuary, preventing maintenance, migration and propagation of fish. In 1967, DRBC established a road map to improve DO, consisting of both water quality standards for the Estuary and point source allocations to achieve the DO criteria. In doing so, it effectively created two tiers of standards, both of which were aspirational. DO concentrations sufficient to support fish propagation were not deemed attainable within the 38-mile reach extending from Northeast Philadelphia to Wilmington, encompassing DRBC water quality Zones 3 and 4 and upper Zone 5. The standards DRBC established thus included maintenance of resident fish and passage of migratory fish throughout the Estuary but excluded propagation within this densely urbanized reach.

Improvements in Estuary water quality and fish populations in the decades since have been remarkable. Following DRBC's regulatory actions in 1967 (standards) and 1968 (allocations), DO levels in the Delaware River Estuary steadily improved, to the point where the designated uses and the oxygen levels (numeric DO criteria) established to support those uses have been achieved. The Commissioners unanimously approved Resolution No. 2017-4, which established a set of studies comprising an analysis of attainability to be performed, together with a schedule for their completion, and the following goals: protect the improved conditions, continue the path of water quality improvements, and update water quality standards (designated uses and water quality criteria) as quickly as possible and practicable consistent with the results of the analysis of attainability.

Beneficially Using Dredged Sediments to Enhance Marshes, Build Resiliency and Restore Habitats in New Jersey's Back Bays

Tedesco, Lenore, Executive Director, The Wetlands Institute, 1075 Stone Harbor Blvd, Stone Harbor, NJ, 08247, ltedesco@wetlandsinstitute.org; Monica Chasten, US Army Corp of Engineers; Kelsey Fall, US Army Corp of Engineers - ERDC; David Perkey, US Army Corp of Engineers; Lisa Ferguson, The Wetlands Institute; Christina Davis, New Jersey Fish and Wildlife; Samantha Collins, The Wetlands Institute

Restoration and Conservation II, Wednesday, 10:30 AM, Main Ballroom, (Avalon 23)

In 2019, the USACE Philadelphia District partnered with the State of New Jersey, The Wetlands Institute, and the USACE Engineer Research and Development Center to launch the Seven Mile Island Innovation Laboratory (SMIIL) in Cape May County, New Jersey. The initiative is advancing dredging and marsh restoration techniques through innovative research, knowledge sharing and practical application. Engineering with Nature principles and practices are central to the development of innovative solutions for sediment management needs within the region.

SMIIL is the location of several marsh restoration, wetland enhancement, and habitat creation projects that are beneficially using dredged sediments from the NJ Intracoastal Waterway. At Gull and Sturgeon Islands, 2020/2021 unconfined sediment placement provided uplift to a drowning tidal marsh, provided edge protection, and is creating nesting habitat. More than 65,000 cy of fine sand and mud was placed at thicknesses of more than one foot in places to raise unvegetated interior pools and low marsh up to ecological benchmark elevations targeting high marsh and recovery back into *Spartina alterniflora* growth ranges. Subtidal placements built a marsh-edge protection berm to intercept waves and defend against marsh edge collapse.

Results from monitoring of marsh platform elevation evolution, vegetation response, tidal flushing, geochemistry and avian site usage will be presented and project partners at the USACE, NJDEP, and The Wetlands Institute will share lessons from recent placements on Gull Island and throughout SMIIL.

Seven Mile Island Innovation Laboratory: Projects, Goals and Outcomes of Beneficial Use Projects in New Jersey's Back Bays

Tedesco, Lenore, Executive Director, The Wetlands Institute, 1075 Stone Harbor Blvd, Stone Harbor, NJ, 08247, ltedesco@wetlandsinstitute.org; Monica Chasten, US Army Corps of Engineers; Ginger Kopkash, New Jersey Department of Environmental Protection; Lisa Ferguson, The Wetlands Institute; Christina Davis, New Jersey Fish and Wildlife; Samantha Collins, The Wetlands Institute

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

In spring 2019, the USACE Philadelphia District partnered with the State of New Jersey, The Wetlands Institute, and the USACE Engineer Research and Development Center to launch the Seven Mile Island Innovation Laboratory (SMIIL) in Cape May County, New Jersey. SMIIL focuses on maintaining safe navigational channels while retaining dredged sediment in the system to benefit natural ecosystems and coastal communities. The goal of SMIIL is to advance and improve dredging and marsh restoration techniques in coastal New Jersey through innovative research, collaboration, knowledge sharing and practical application.

Coastal marshes and ecosystems and their associated wildlife face numerous challenges. Sea level rise (SLR) is drowning marsh islands as evidenced by frequent inundation, conversion of marsh to unvegetated flats and open water areas. Marsh edge erosion contributes to marsh loss and breaches to interior marsh pools. Historic dredged material placement represents the only remaining high marsh in SMIIL and these sites are home to more than 1/3 of colonial nesting wading birds in the state of New Jersey. Sites are experiencing habitat degradation with elevation loss impacting nesting success. Similarly, beach nesting colonial birds are declining due to habitat loss, nest loss from sea level rise, and competition for space on recreational beaches.

SMIIL is the location of several marsh restoration, wetland enhancement, and habitat creation projects that are beneficially using dredged sediments from the NJ Intracoastal Waterway. To date, seven beneficial use projects have been constructed and extensively monitored by project partners at the USACE, NJDEP, and The Wetlands Institute. This poster will share project locations, ecological goals and outcomes of the suite of projects within SMIIL.

Head Above Water: The Work to Establish Stormwater Utilities with New Jersey Municipalities

Thompson, James, Campaigns Director, New Jersey League of Conservation Voters, 1 N Jonston Ave, Hamilton, NJ, 08609, james.thompson@njlcv.org

Big Picture Environmental Planning, Monday, 11:30am, Breakout B, (Avalon 24-26)

Major storm systems like Sandy and Ida easily overwhelmed New Jersey's aging stormwater infrastructure, leading to wide-scale issues with flooding and overall water quality impairment. Changing patterns of precipitation and stormwater runoff have also contributed to the prevalence of harmful algal blooms (HABs), which negatively affect New Jersey's economy and water quality. With the introduction of New Jersey's Clean Stormwater and Flood Reduction Act in 2019, the New Jersey League of Conservation Voters Education Fund sought to work with municipalities to implement stormwater utilities. A stormwater utility (SWU) acts as a dedicated funding source to address local stormwater management issues, employing an equitable fee structure, with properties most responsible for contributing to flooding contributing the most. Simultaneously, it incentivizes properties to convert their impervious cover to rain gardens, pervious cover, or other stormwater Best Management Practices. Investing in a water utility and ultimately green infrastructure is the most effective and equitable way to address New Jersey's ongoing stormwater problem that will only get worse with time, and the Flood Defense NJ works closely with municipalities to address stormwater management in the Garden State. Through a program of technical assistance, community outreach and education, grassroots engagement, and presentations to local decision makers, Flood Defense NJ has made significant progress toward enacting the first stormwater utility in New Jersey.

Down By the Bay: A Human Story

Wholey, Heather, West Chester University, Department of Geography and Planning, West Chester, PA, 19383, jm918532@wcupa.edu; Joanna Maurer, West Chester University, Department of Anthropology and Sociolgy; Daria Nikitina, West Chester University, Department of Earth and Space Sciences

DRBC Climate Change Forum Technical Session II-Building Community-level Climate Resilience, Tuesday, 4:15 PM, Main Ballroom, (Avalon 23)

Scientists are often challenged to communicate climate change impacts in ways that create authentic dialogues with non-scientific partners. One of the effective principles to communicate with local communities and to engage public into decision making is to 'tell a human story' (IPCC Handbook, 2018). Cultural resources along the Delaware Bay hold the stories of thousands of years of connections between the communities, cultures and resources of the Bay and its coastal marshes. Sea level rise and the effects from hurricanes jeopardize some of the natural and cultural resources that local communities rely upon economically and to build, renew, or reinforce a sense of identity. "Science-telling" is a cross-disciplinary approach that uses a narrative communication style, social media, apps, and other visual platforms to translate technical studies, explain science, and incorporate local knowledge. "Science-telling" increases comprehension, interest, and engagement with diverse audiences. We use Esri's ArcGIS Online software and web applications to develop engaging narratives that draw linkages between cultural and socio-economic resources along the Delaware Bay and illustrates the impact of sea level rise on these resources. Digital maps, models, and narratives are developed on ArcGIS Online to 1) make technical information accessible and relevant to public audiences and stakeholders; 2) raise awareness to local issues impacting physical and cultural landscapes; and 3) engage non-technical audiences with empirical data and processes in a powerful way, ultimately allowing users to interact and develop their own conclusions about significance, priorities and preservation needs. The outcomes demonstrate the effectiveness of a science-telling approach for integrating scientific modeling, preservation concerns, and public outreach and brings awareness to an issue of global concern.

Elevated Specific Conductivity and Chloride Concentration in the Headwaters of 3 Southeastern Pennsylvania Streams Linked to Impervious Surface Cover

Willig, Anna, Willistown Conservation Trust, 925 Providence Rd, Newtown Square, PA, 19073, aew@wctrust.org; Lauren McGrath, Willistown Conservation Trust

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Relationships between impervious surface cover, specific conductivity, and salt concentration are well-known, though the dynamics of these relationships vary spatially. This study examines relationships between impervious surfaces and specific conductivity and chloride concentration through high-frequency monitoring of headwater streams in sub-basins of the Delaware River Watershed in Southeastern Pennsylvania. Ten sample sites in the headwaters of the Darby, Crum, and Ridley Creeks in Willistown, PA were sampled every four weeks from January 2018 through December 2021 to elucidate water chemistry dynamics. Specific conductivity was measured in-stream and chloride concentration was analyzed in-lab. Impervious surface cover of each watershed was estimated through mapping with GIS and related to specific conductivity and chloride to better understand relationships between land use and water chemistry. Specific conductivity ranged from 226 µS/cm to 1186 µS/cm during the study period, with maximum values for all sites occurring during winter months. Chloride concentration ranged from 27 ppm to 247 ppm with maximum values again occurring during winter months, indicating that chloride concentration and specific conductivity are driven by winter road salt applications. Specific conductivity remained elevated above natural background levels in all seasons, suggesting persistence of salts in groundwater and soils. Data analysis reveals that specific conductivity is strongly related to chloride concentration ($p < 0.001$). Moreover, both specific conductivity and chloride concentration vary significantly between sites ($p < 0.001$). Variation between sites is best explained by differences in impervious surface cover: specific conductivity and chloride concentration are related to impervious surface cover in the surrounding catchment ($p < 0.001$). These analyses highlight the importance of limiting the expansion of impervious surfaces and protecting open spaces to prevent impairments to headwater streams.

Using Macroinvertebrate Indexes to Characterize the Impacts of Hydrologic Restoration in an Urban Philadelphia Watershed

Xiang, Galen, Master of Science in Applied Geosciences Candidate, University of Pennsylvania, 4620 Cedar Ave, Apt 3, Philadelphia, PA, 19143, galen28@sas.upenn.edu

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

Urban watersheds face a variety of stressors that impair their function from ecological and hydrologic perspectives. Such impaired watersheds may suffer from poor water quality, lack of suitable habitat, and extensive damage to riparian areas resulting from erosion. The Philadelphia Water Department has implemented a robust system of water quality protection and conservation through widespread usage of green stormwater infrastructure and projects designed to lessen urban runoff, sewage, and restore native freshwater regimes. While such projects have proven effective in curbing combined sewer overflow and stormwater runoff, there is a lack of research to determine if these measures also confer benefits to ecosystem health and function. Macroinvertebrate indexes have emerged as a widespread and cost-effective method in determining biological condition and health of streams and rivers. This study aims to conduct detailed macroinvertebrate assessments at documented sites of hydrologic restoration: the Indian Creek daylighted stream in Cobbs Creek Watershed and the Abington Friends Elementary School within the Tookany/Tacony Frankford watersheds. Sampling will occur upstream, downstream and within the restored reaches. From identifying macroinvertebrates to family, multiple biotic indexes can be generated, and their scores will be compared against measures of habitat quality and water parameters. In doing so, stream health can be characterized at these locations, and potential effects that hydrologic restoration confers to ecological integrity canA be assessed.

Social and Economic Factors Affecting the Attainment of Aquatic Life Uses in the Delaware River Estuary

Yagecic, John, Manager, Water Quality Assessment, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, John.Yagecic@drbc.gov; Sara Sayed, Delaware River Basin Commission

Poster Session, Monday, 5:30pm & Tuesday, 6:00pm; Poster Hall, (Avalon 14-17)

On September 30, 2022, the Delaware River Basin Commission (DRBC) issued a draft Analysis of Attainability documenting that the addition of technically feasible advanced treatment to reduce effluent ammonia nitrogen levels by nine major wastewater treatment plants discharging to the Estuary will significantly improve the level of dissolved oxygen that can be achieved, and that water quality supporting the aquatic life use of "fish propagation" is attainable throughout the Estuary. As part of the overall evaluation, DRBC evaluated the social and economic factors affecting the attainment of uses as required in Resolution No. 2017-4. DRBC computed metrics developed by the EPA and by the utility industry (AWWA) to assess the affordability of new proposed effluent levels for ammonia nitrogen. This poster will provide a detailed review of the metrics and overall assessment of the social and economic factors affecting the attainment of uses.

Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know?

Yagecic, John, Manager, Water Quality Assessment, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, John.Yagecic@drbc.gov; Elaine Panuccio (lead author), Delaware River Basin Commission

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

Extensive monitoring was conducted during the 2018 and 2019 period to support development of a model of eutrophication processes throughout the Delaware Estuary, which was central to the DRBC's determination of highest attainable dissolved oxygen condition and evaluation of aquatic life uses pursuant to Resolution 2017-4. Data were primarily needed for characterization of loadings from tributaries and point sources to the estuary, and secondarily for ground truthing kinetic rates and transect gradients. Accordingly, synoptic field sampling and analysis was performed at 27 tributaries, and samples of treated effluent from 32 wastewater plants were collected and analyzed at various frequencies. These data were used to prepare concentration boundaries for the eutrophication model, allowing for a more complete characterization of loads. In addition, laboratory experiments were performed to estimate primary productivity at various times and locations in the estuary, and dissolved oxygen transect profiles across the channel and top to bottom were obtained to verify gradients. Estimating boundary loads to a system as large and complex as the Delaware Estuary presents a significant challenge, which the DRBC addressed through an iterative screening process to focus sampling and analytical efforts on the most significant sources.

The model characterized all loads in one way or another, but the extensive monitoring allowed the vast majority of loads to be characterized based on actual measurements. Loading estimates based on these data indicate that wastewater treatment facilities account for more than 90 percent of ammonia inputs to the Delaware Estuary.

Environmentally-driven Oyster Microbiome Dynamics in the Delaware Bay

Yeh, Heidi, PhD Candidate, Rutgers University, Haskin Shellfish Research Laboratory, 6959 Miller Ave, Port Norris, NJ, 08349, heidi.yeh@marine.rutgers.edu; David Bushek, Rutgers University, Haskin Shellfish Research Laboratory

Living Resources I - Shellfish, Monday, 2pm, Breakout B, (Avalon 24-26)

Oysters living in the Delaware Bay can be found along salinity and nutrient gradients that may be correlated with microbiome dynamics. This community of bacteria is consequential for the humans who consume oysters, and likely plays a role in the health of the oyster itself. To study temporal and spatial patterns in the oyster microbiome, we applied next-generation sequencing techniques to characterize the bacterial communities present in oysters and the ambient water. From April to October 2021, bi-monthly samples of oyster mantle tissue and surface water were collected from three subtidal oyster beds in the Delaware Bay. The 16S rRNA operon was sequenced using the Oxford Nanopore Technologies MinION to yield strain-level resolution of the bacterial community.

Oysters maintain a microbiome that is distinct and more diverse than the surrounding water, although they are constantly exposed to seawater bacteria through filter-feeding. Seasonally-driven trends in the microbiota of both water and oyster samples were evident in the dataset. Geospatial differences were not statistically significant, reflecting the thorough mixing of water masses in this tidal estuary. Although pathogens of human concern such as vibrios often receive much attention in oyster microbiome studies, these species were relatively rare within the dataset. Strain-specific microbiome studies like this will greatly expand our understanding of the environmental drivers of oyster microbiome dynamics, as well as its consequences for both oyster and human health.

What is this estuary-wide eutrophication model and why do we need it?

Zheng, Li, Senior Water Resource Modeler, Delaware River Basin Commission, PO Box 7360, 25 Cosey Road, West Trenton, NJ, 08628, Li.Zheng@drbc.gov

Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary (DRBC), Monday, 2:00pm, Main Ballroom, (Avalon 23)

In support of the evaluation of highest attainable dissolved oxygen (DO) conditions, DRBC developed a three-dimensional dynamic model of eutrophication (nutrient and algal) processes that impact DO such as photosynthesis, respiration, decomposition, and nitrification. Modeling DO in the Delaware Estuary requires an understanding of complex interactions among many processes including: tidal dynamics and water circulation; temperature, salinity, and algal dynamics; nutrient cycling and transformation; and solute exchange across the air/water and sediment/water interfaces. To adequately capture these dynamics, the DRBC linked a hydrodynamic model of the system developed using Environmental Fluid Dynamics Code (EFDC) with a water quality model developed using Water Quality Analysis Simulation Program (WASP8). The result is a spatially explicit, time-variable model of the entire estuary from the head of tide at Trenton to the mouth of the bay.

DRBC led and executed this project through a collaborative process informed by an Expert Panel comprised of nationally recognized water resource scientists. Three significant enhancements were made during this study to improve model accuracy and reliability: 1) WASP and EFDC model integration, 2) reaeration simulation, and 3) light extinction formulation. The Delaware Estuary water quality model was calibrated for the 2018-2019 period to an intensive dataset obtained specifically for this purpose, encompassing a range of hydrologic and temperature conditions. The model was successfully corroborated against a 2012 hindcast based on available boundary data and forcing functions without changing calibration coefficients, a historical period that resulted in the lowest DO encountered in more than 12 years.

The DRBC modeling team and the Model Expert Panel conclude that the Delaware Estuary water quality model is scientifically defensible over a wide range of environmental conditions and suitable for its intended use – to determine the improvement in dissolved oxygen condition that would result from specific reductions to point and nonpoint source loadings.

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