2022 Long Island Sound Research Conference

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Bridgeport, CT

Photo by Syma A. Ebbin

Sea Grant Connecticut

Long Island Sound Study
A Partnership to Restore and Protect the Sound

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SCHEDULE

8:30 Coffee/registration (Event Center)

9:00 Welcome!

Opening Remarks by Dr. Sylvain De Guise, director CTSG, Dr. Rebecca Shuford, director NYSG, Mr. Mark Tedesco, director LISS/EPA

9:10 Morning Plenary: Mr. Chet Arnold, (UConn CLEAR) ***"Surround Sound: A Status Report on Land Cover in the Lower LIS" Watershed***

9:45-10:45 Parallel Sessions I

I A: Clean Waters and Healthy Watershed, Room 135, Moderator: Syma Ebbin

1. *Microplastics and Molluscs I. – A Brief Overview Of A Flawed Literature*
J. Evan Ward, Sandra E. Shumway, Kayla Mladinich, Bridget Holohan, Noreen Blaschik (University of Connecticut)

2. *Microplastics and Molluscs II - A Brief Overview Of A Flawed Literature*
Sandra E. Shumway, J. Evan Ward, Kayla Mladinich, Bridget Holohan, Noreen Blaschik (University of Connecticut)

3. *Examining the Effects of Nylon Microfibers on the Gut Microbiome of the Blue Mussel, Mytilus edulis*
Hannah I. Collins, Bridget A. Holohan, Tyler W. Griffin, J. Evan Ward (University of Connecticut)

4. *Variation of Microplastic Levels in Urban Stormwater with Rainfall Events*
Alexandra Morrison, Gaboury Benoit (Yale School of the Environment)

I B: Sound Science and Inclusive Management, Room 271, Moderator: Lane Smith

1. *Persistent Acidification in Western LIS During a Relatively Low-hypoxia Year*
Lauren Barrett, Penny Vlahos, Michael Whitney, Jamie Vaudrey (University of Connecticut)

2. *Connecticut Department of Energy and Environmental Protection Long Island Sound Ambient Water Quality Monitoring Program: Overview and Analysis of Program Data;*
Matthew Lyman, Katie O'Brien-Clayton, Christine Olsen (Connecticut Department of Energy and Environmental Protection)

3. *Alkalinity of Long Island Sound Embayments (ALISE)*
Mary McGuinness, Penny Vlahos, Mike Whitney, Robert Mason, Samantha Siedlecki (University of Connecticut)

4. *Modeling the Extreme Storm Surge and Waves and Nearshore Flooding in the Long Island Sound* **Chang Liu, Yan Jia, Yaprak Onat, James O'Donnell** (University of Connecticut)

10:45-11:00 Coffee Break

11:00-12:00 Parallel Sessions II

II A: Clean Waters and Healthy Watershed, Room 135, Moderator: Sylvain De Guise

1. *Seasonal Trends in Bacterial Abundances, Nutrients, and Phytoplankton Biomass During Hypoxia in Western Long Island Sound*
Georgie Humphries[1,2], Zabdiel Roldan Ayala[1,2], Mariapaola Ambrosone[1], Maria Tzortziou[3], Joaquim Goes[4], Dianne I. Greenfield[1,2] ([1]Advanced Science Research Center at the Graduate Center, CUNY; [2]School of Earth and Environmental Sciences, Queens College, CUNY; [3]City College Center for Discovery and Innovation, CUNY; [4]Lamont-Doherty Earth Observatory, Columbia University)
2. *An Online Tool to Assess the Health of Local Watersheds*
Chet Arnold, Rachel Lei, Dave Dickson, Cary Chadwick, Emily Wilson, (University of Connecticut) **Paul Stace**y, (Footprints in the Water LLC); **Kelly Streich**, (CT Dept. of Energy and Environmental Protection)
3. *Copepods in Long Island Sound are Shrinking*
Matthew Sasaki, Maryam Mirhakak, Erica Correia, Hans G. Dam (University of Connecticut);
4. *Investigating PFAS Composition and Concentration in the Farmington River Watershed CT*
Alison Baranovic, Adam Haynes, Anthony Provotas, Ashley Helton, Jessica Brandt, (University of Connecticut, University of California Santa Cruz)

II B: Sound Science and Inclusive Management, Room 271, Moderator: Rebecca Shuford

1. *Preference, Noncompliance, and Fishing Effort under Alternative Management: A Choice Experiment Approach in Projecting the Impact of Changing Restrictions on Fishing*
Zhenshan Chen[1,3], Jacob Kasper[1,4], Steve Swallow[1], Pengfei Liu[2], Eric Schultz[1] ([1]University of Connecticut, [2]University of Rhode Island, [3]Mississippi State University, [4]University of Missouri)
2. *Chlorophyll a Dynamics in Long Island Sound from Space using an Optimized Satellite Algorithm Developed for Sentinel-3 (OLCI)*
Jonathan Sherman, Maria Tzortziou (The City College of New York)
3. *Characterizing the Spectral Shape of Hyperspectral Remote Sensing Reflectance from Above-water Radiometric Measurements across Long Island Sound*
Ky**le Turner, Maria Tzortziou, Brice Grunert, Joaquim Goes (**The City College of New York)
4. *LIS Seafloor Habitat Mapping Initiative Update*
DeAva Lambert, Kevin O'Brien, Ivar Babb, Frank Nitsche, Tim Battista, Peter Auster, Dennis Arbige, Jim O'Donnell, Grant McCardell, Roman Zajac, Chris Conroy, Seth Ackerman, Dann Blackwood, Roger Flood, Timothy Kenna, Vicki Ferrini, Cecilia McHugh, Will Sautter (CT Department of Energy & Environmental Protection, Univ. of Connecticut, Lamont-Doherty Earth Observatory of Columbia University, NOAA National Centers for Coastal and Ocean Science, Univ. of New Haven, USGS, Stony Brook University; and Queens College)

12:00-12:45 Lunch (Event Center)

12:45-1:30 Keynote Dr. Monica Barra (University of South Carolina) ***From Accounting for, to Accountability to: Reciprocity and Restitution in Collaborative Climate Change Research***

1:30-2:00 Poster session (Event Center)

2:00-3:00 Parallel Sessions III

III A: Sustainable and Resilient Communities, Room 269, Moderator: Jim Ammerman

1. *Resilient Connecticut: Developing a Regional Resilience Plan for Fairfield and New Haven Counties;* **John Truscinski** (University of Connecticut/ Connecticut Institute for Resilience and Climate Adaptation)
2. *Atlantic Sturgeon (Acipenser oxyrinchus) Growth and Habitat Use in the Connecticut River and Long Island Sound;* **Kelli Mosca** (University of Connecticut, CT DEEP), **Tom Savoy** (CT DEEP), **Jacque Benway** (CT DEEP), and **Hannes Baumann** (University of Connecticut)
3. *Environmental Justice Mapping Tool for Connecticut;* **Yaprak Onat, Joanna Wozniak-Brown, Caterina Massidda** (University of Connecticut - Connecticut Institute for Resilience and Climate Adaptation)
4. *Observations of Circulation in a Salt Marsh Creek;* **Molly James, James O'Donnell** (University of Connecticut)

III B: Sound Science and Inclusive Management //Thriving Habitats and Abundant Wildlife, Room 271, Moderator: Lane Smith

1. *Improving the Quantification of In Situ Water Column Respiration in Western Long Island Sound*
   Annalisa Mudahy, Craig Tobias , (Department of Marine Sciences, University of Connecticut)
2. *A 20-year Retrospective Analysis of Long Island Sound Mesozooplankton Trends in the 21st Century*
   Ewaldo Leitao, Gihong Park, Lydia Norton, Josiah Grzywacz, Jessie Steadman, Luciana Santoferrara, George McManus, Hans G Dam (Dept. of Marine Sciences, University of Connecticut)
3. *Growth and Survival of Larval, Juvenile, and Adult Triploid Oysters in Long Island Waters*;
   Christopher J. Brianik[1], G. Rivara[2]., M. Patricio[2], J. Dunne[3], P. Topping[4], M. Byrnes, E. Pales Espinosa[1], R. Cerrato[1], X. Guo, B. Allam[1](1 Stony Brook University School of Marine and Atmospheric Sciences, 2 Cornell cooperative extension, 3Town of East Hampton shellfish hatchery, 4 Peconic Baykeepers, 5 Town of Islip shellfish hatchery, 6 Rutgers University Department of Marine and Coastal Sciences)
4. *Direct Comparison of Fecal and Gut Microbiota in the Blue Mussel Mytilus edulis Discourages Fecal Sampling as a Proxy for Resident Gut Community*, **Tyler W. Griffin, Julia G. Baer, J. Evan Ward** (University of Connecticut)

III C: Clean Waters and Healthy Watershed, Room 135, Moderator: Syma Ebbin

1. *Refined Integration of Remote Sensing with Biological Parameters for improved management of Long Island Sound*
   Maria Tzortziou (The City College of New York, Center for Discovery and Innovation), **Dianne Greenfield** (Queens College, CUNY Advanced Science Research Center), **Joaquim Goes** (Columbia University, Lamont Doherty Earth Observatory)
2. *Residential Lawn Fertilizer Use and Nitrogen Loading Intensity Across the Long Island Sound Watershed*
   Robert J. Johnston[1], David A. Newburn[2], Haoluan Wang[2], Tom Ndebele[1] (1 Clark University, 2 University of Maryland)

3. *An Evaluation of Microplastics Found in the Eastern Oyster (Crassostrea virginica) and the Surrounding Environment*
K**ayla M. Mladinich, Bridget Holohan, J. Evan Ward, Sandra E. Shumway** (University of Connecticut)
4. *Waste Water Treatment Plant Outfalls and Eutrophication in Black Rock Harbor and LIS*
J. C. Varekamp [1], E. Thomas[1,2], S.Wang[1], N.J. Planavsky[2], M. Altabet[3] (1. Earth & Environmental Sciences, Wesleyan University, Middletown, CT 06459 2. Earth & Planetary Sciences, Yale University, New Haven, 3. School for Marine Science and Technology, University of Massachusetts, Dartmouth)

3:00-3:15 Coffee break

3:15-4:00 Parallel Sessions IV

IV A: Sustainable and Resilient Communities, room 135, Moderator: Sylvain De Guise

1. *Regional Climate Change Vulnerability Index for Connecticut*
Yaprak Onat, (Connecticut Institute for Resilience and Climate Adaptation)
2. *Estuarine Benthos and Climate Change in Long Island Sound and Other Estuaries*
Jeffrey Levinton (Stony Brook University)
3. *Observations of Wave Damping by an Array of Reef Balls in the Inter-Tidal Zone: a Preliminary Assessment*
James O'Donnell, Amin Ilia, John Speers, Mary M. Howard Strobel (Department of Marine Sciences and the Connecticut Institute for Resilience and Climate Adaptation, University of Connecticut)

IV B: Thriving Habitats and Abundant Wildlife, room 271, Moderator: Rebecca Shuford

1. *Assessment of Habitat Provisioning by Oyster Aquaculture Gear in Long Island Sound for Wild Fish Communities*
Julie M. Rose[1], Adam Armbruster[2], Peter Auster[2], Paul Clark[1], Christian Conroy[2], Mark Dixon[1], Erick Estela[1], Yuan Liu[1,4], Lisa Milke[1], Gillian Phillips[1,4], Dylan Redman[1], Ian Robbins[1], Barry Smith[1], Alison Verkade[5], Renee Mercaldo-Allen[1] (1NOAA, NMFS, NEFSC, Milford Laboratory, 2 University of New Haven, Biology and Environmental Science Department; 3 Mystic Aquarium & University of Connecticut Department of Marine Sciences, 4 A.I.S. Inc., 5 NOAA, NMFS, GARFO)
2. *Monitoring Bivalve Disease in Long Island Sound to Support Increased Shellfish Harvesting Goals*
<u>Meghana Parikh[1]</u>, Thuy-Tien Bui[1,2] (1 NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, 2 University of California, Berkeley)
3. *Urban River Revival: Assessing Wildlife Habitat at Gablers Creek*, *Queens, NY*
Emily Hall (Seatuck Environmental Association)

4:00-4:15 Closing Remarks by Dr. Rebecca Shuford, director NYSG, Dr. Sylvain De Guise, director CTSG, Dr. Jim Ammerman, Long Island Sound Study Science Coordinator

4:15 Adjourn/Networking

Safe travels home!

POSTER PRESENTATIONS

1. Controlling Invasive Aquatic Plant European Frogbit Using Clearcast and ProcellaCOR EC - **Bin Zhu[1] and Mark Heilman[2],** [1]University of Hartford, [2]SePRO

2. An Introduction to Historical Hudson River Biological Monitoring Program – **Patricia Woodruff, Hsiao-Yun Chang, Stephanie Arsenault, Katrina Rokosz, Robyn Linner, Yong Chen,** SoMAS at Stony Brook University

3. Sources of Atmospheric Deposition in Long Island Sound (LIS) and the LIS Watershed - **Sharmin Akter and Kristina Wagstrom**, University of Connecticut

4. Tracing Colored Dissolved Organic Matter in Long Island Sound: Elucidating source and fate - **Alana Menendez[1], Maria Tzortziou[2], Kyle Turner[2], Dianne Greenfield[3], Joaquim Goes[4]**, [1]The CUNY Graduate Center, [2]CUNY The City College of New York, [3]CUNY Advanced Science Research Center, [4]Lamont-Doherty Earth Observatory at Columbia University

5. Nearshore Permeable Reactive Barriers to treat groundwater nitrate before it enters the coastal ocean **- Jing-An Lin[1], Molly Graffam[1], Ron Paulsen[2], Nils Volkenborn[1]**, [1]SoMAS at Stony Brook University, [2]The New York State Center for Clean Water Technology, Cornell Cooperative Extension of Suffolk County

6. Temporal and Spatial Trends of Long Island Sound Phytoplankton Assemblages During 2020 & 2021 - **Zabdiel Roldan Ayala[1,2], Georgia Humphries[1,2], Silvia Angles[2], Maximillian Brown[1,2], Mariapaola Ambrosone[2], Maria Tzortziou[3], Joaquim Goes[4], Dianne I. Greenfield[1,2],** [1]School of Earth and Environmental Sciences, Queens College, CUNY; [2]Advanced Science Research Center at the Graduate Center, CUNY; [3]City College Center for Discovery and Innovation, CUNY; [4]Lamont-Doherty Earth Observatory, Columbia University

7. Fishing for Space in the New Blue Economy: Conflict and Cooperation among Fishing, Aquaculture and Wind Industries in Connecticut - **Syma Ebbin, Nat Trumbull**, University of Connecticut

8. Can watershed land use legacies inform nitrogen management? - **Danielle Hare[1], Joshua Buonpane[2], Ariana Dionisio[1], Qian Lei-Parent[1], Eric M. Moore, Mary Becker, Chris Bellucci[3], David Bjerklie, Paul E Stacey[4], Emily H Wilson[1], Wilfred Wollheim[2], Ashley M Helton[1]**, [1]University of Connecticut, [2]University of New Hampshire, [3]Connecticut DEEP, [4]Footprints In The Water LLC

9. Factors Influencing Individual Efficacy and Local Confidence in Cultivating Resilient Coastal Communities - **Carolyn A. Lin,** University of Connecticut

10. Safe for Swimming Today? – Long Island Beach and Water Quality App - **Sung-Gheel Jang, Ellie Evans, Jordan Russo, Ranae Ward**, Stony Brook University

11. *Iron Additions to Marine Sediments: Effect of Mass, Grain Size and Species on Porewater Sulfide Scavenging Potential* - **Shannon Jordan**, University of Connecticut, Department of Marine Sciences

12. *Examining Temporal Trends of Downstream Migration of Alewife Through A Nature-Like Fishway* **Nicholas Ring** (Stony Brook University) **Kellie McCartin** (SUNY Suffolk County Community College)

ABSTRACTS

Plenaries:

Surround Sound: A Status Report on Land Cover in the Lower LIS Watershed - **Chet Arnold (UConn Department of Extension and Center for Land Use Education and Research)**

Long Island Sound is, in many ways, a reflection of the land surrounding it. This talk will look at land cover status and trends in the Connecticut and lower New York portions of the LIS watershed, as determined by the long-term Changing Landscape study of the University of Connecticut's Center for Land Use Education and Research (CLEAR). Particular attention will be paid to land cover information related to Long Island Sound Study ecosystem indicators. Finally, the future of land cover research related to the Sound will be discussed.

Bio: Chet Arnold is an Extension Educator Emeritus in the UConn Department of Extension. During his 34-year career at UConn he helped to create the Long Island Sound Study Public Outreach Program, the Nonpoint Education for Municipal Officials (NEMO) Program, the National NEMO Network, the Natural Resources Conservation Academy, the UConn Environment Corps, and the Center for Land Use Education and Research (CLEAR), which he directed or co-directed since its creation in 2002. Chet's research and outreach interests include land cover change, stormwater management, and STEM education, and he has been Principal or Co-Principal Investigator on over $25M of external grants. He is currently working part-time for CLEAR on several projects, all of which relate to Long Island Sound. More important, they allow him to continue to have access to, and take credit for, the expertise of his younger and smarter colleagues.

From accounting for, to accountability to: Reciprocity and restitution in collaborative climate change research - **Monica Barra (School of the Earth, Ocean & Environment and Department of Anthropology, University of South Carolina)**

In a time of global health pandemics, widespread uprisings about racial injustice, and persistent reminders about the catastrophic impacts of climate change, in what ways can climate change science align itself with the aspirations of cultivating social justice? To what extent do the environmental sciences, broadly construed, have an obligation and opportunity to mobilize science in the service of wider calls for confronting social and environmental inequalities? What shifts in research practice and individual/collective mentalities of scientists would such goals require? This talk examines these questions through the lens of Indigenous and Black thinkers and communities grappling with the acute impacts of climate change. It will draw from examples of community based and collaborative research along the US Gulf coast in Louisiana to consider how matters of reciprocity and restitution -- matters of working towards reconciliation and justice -- can begin to shift the culture of science to more squarely align with the efforts and needs of historically marginalized communities to achieve forms of racial, economic, and climate justice.

Bio: Monica Patrice Barra (she/her/hers) is a cultural anthropologist and an assistant professor of Race and Environment in the School of the Earth, Ocean & Environment and Department of Anthropology at the University of South Carolina. Her research focuses on the ways racial inequalities and geographies are forged in and through scientific knowledge and practices, racial histories, and transformations of coastal environments in the US Gulf South. These topics animate her first book project Good Sediment: Race, Science, and the Possibilities of Restoration, which is an ethnographic examination of the ways Black ecological practices and imaginaries disrupt and re-orient techno-scientific understandings of environmental restoration in the context of coastal Louisiana's coastal wetland loss crisis. Portions of her research in Louisiana have been published in the Annals of the Association of American Geographers and The Professional Geographer. Her research has been supported by several national grants, including the Wenner Gren Foundation for Anthropological Research, the National Academies of Sciences Gulf Research Program, the Louisiana Endowment for the Humanities, and the National Center for Atmospheric Research. She has collaborated with and presented her work to a variety of environmental groups and organizations, including: NOAA, The National Marine Sanctuaries Foundation, Louisiana Sea Grant, and The Water Institute of the Gulf.

<u>Clean Waters and Healthy Watershed:</u>

***An Online Tool to Assess the Health of Local Watersheds* - Chet Arnold, Rachel Lei, Dave Dickson, Cary Chadwick, Emily Wilson, University of Connecticut; Paul Stacey, Footprints in the Water LLC; Kelly Streich, CT Dept. of Energy and Environmental Protection**

Studies of watershed health based primarily on land cover characteristics have rarely focused on basins smaller than the 12-digit USGS Hydrologic Unit Code (HUC-12) level (15-42mi2). This information is useful on many fronts, but the scale of these watersheds may be too large to effectively relate to local management actions. NOAA's 2016 1-meter resolution land cover data for Connecticut enables a finer-grained look at watershed health that may be more appropriate for supporting land use decisions at the local level. The project compared land cover metrics derived from the NOAA dataset to data from CT DEEP's Macroinvertebrate Multimetric Index at the "local basin" level, comprised of 4363 basins averaging 1.1 mi2 in size. Based on regression analysis, a measure of stream biointegrity called the Combined Condition Index (CCI), was developed. CCI ranges from 0 to 1 (1 being the optimum condition) and combines land cover metrics of the entire basin with those from within the 100 foot buffer area of the stream. CCI land cover classes were merged into three grouped types: impervious, agriculture or agriculture-like, and natural. To provide a framework for local decision makers, CCI categories were developed that suggest the management focus of each basin as "Mitigation," "Recovery," or "Conservation." The CCI was then used to estimate Total Nitrogen yield, expressed as an "Enrichment Factor" (EF) for each local basin. EF is a ratio of how much nitrogen is estimated to be transported in the basin's waters compared to a theoretical baseline level of an unaltered watershed, and is expected to be a more easily understood measure of N pollution than loading data. Finally, an online decision support tool was created that includes land cover metrics, CCI, and EF for all of the local basins in the state. In addition, users can choose a basin and make changes to the land cover of the basin and/or 100-foot riparian zone, to see what these changes will do to the health of the watershed as indicated by CCI, CCI category, and EF. It is hoped that this tool will help to bring the land cover/stream biointegrity relationship into sharper, more relevant focus appropriate to support action at the local level.

***Investigating PFAS Composition and Concentration in the Farmington River Watershed CT* - Alison Baranovic, Adam Haynes, Anthony Provotas, Ashley Helton, Jessica Brandt (University of Connecticut**, University of California Santa Cruz**)**

Per- and polyfluoroalkyl substances (PFAS) are a class of chemicals that are a major concern for humans and the environment as they have been detected in water, air, food, and biota worldwide. The strong carbon-fluorine bond in PFAS allows for thermal and chemical stability that is often used in industrial and commercial applications such as textile protection, surface coating for cooking utensils, and aqueous film forming foams (AFFF). Major sources of PFAS contamination into the environment include landfills, industrial and municipal sewage treatment effluents and aqueous film-forming foams. This project investigates: (1) the spatial distribution and composition of PFAS in the Farmington River watershed (CT), (2) patterns in PFAS composition and concentrations among sample types (groundwater, water column, surface skim) and (3) temporal and spatial variation in groundwater PFAS concentrations within individual sites. 7 out of the 14 PFASs that were analyzed were not detected in any samples (PFDA, PFUnDA, PFTrDA, PFTeDA, N-EtFOSAA, N-MeFOSAA). PFHxA, PFOA, and PFOS were the most commonly detected PFASs regardless of sample type. We analyzed the data by calculating the sum of PFOA and PFOS (US Environmental Protection Agency Standard) and the sum of PFOA, PFOS, PFNA, PFHxS, and PFHpA (CT Department of Public Health Standard) per site and sample type. Site sums in groundwater (EPA: No detect – 0.078 ng/mL; CT: No detect – 0.179 ng/mL), water column (EPA: No detect – 0.068 ng/mL; CT: No detect – 0.206 ng/mL), and surface skim (EPA: No detect – 0.035 ng/mL; CT: No detect – 0.081 ng/mL) varied on their exceedances of these two thresholds.

***Examining the Effects of Nylon Microfibers on the Gut Microbiome of the Blue Mussel, Mytilus Edulis* - Hannah I. Collins, Bridget A. Holohan, Tyler W. Griffin, J. Evan Ward (University of Connecticut)**

Microplastics are a ubiquitous emerging contaminant across marine systems. Because of their small size and widespread distribution, microplastics occupy the same size fraction as the food source of many suspension feeders, such as marine bivalves, and ingestion of plastic particles could pose a threat to the health of these organisms. Ingestion of plastic particles with adsorbed compounds or microbial communities could potentially affect the gut microbiome of the host through mechanical blockages or abrasions, leaching of plasticizers or adsorbed chemicals, or direct influence on microbial communities in the gut. In many species, the microbial community of the gut aids in digestion, mediates abiotic stressors, and affects host immunity. Similar functions may be performed in bivalves. Thus, changes in the gut microbiome may have indirect effects on bivalve health. To test whether microplastics affect the gut microbiome of the blue mussel, Mytilus edulis, animals were exposed to nylon microfibers (length = 500 µm, diameter = 30 µm), Spartina spp. particles, or no particle, for 21 days. Spartina spp. particles were of comparable size and aspect ratio to nylon fibers and were used to control for the presence of indigestible particles. Mussels were fed a microalgal diet of Tetraselmis spp. (concentration in microcosm of 10,000-15,000 cells/mL) and Shellfish Diet® (concentration in microcosm of 5,000 cells/mL). All particles were aged for three days to develop a biofilm. Two experiments were conducted, one with an exposure concentration of approximately 50 particles/L/hr/mussel/day, and one using a concentration of approximately 100 particles/L/hr/mussel/day. Genomic DNA was extracted from gut tissue, nylon, Spartina spp., and stock water samples and sequenced using 16S high throughput techniques to determine community taxonomic composition. Data indicate that mussel gut microbial communities are resistant to disturbance by nylon fibers.

Seasonal Trends in Bacterial Abundances, Nutrients, and Phytoplankton Biomass During Hypoxia in Western Long Island Sound - **Georgie Humphries[1,2], Zabdiel Roldan Ayala[1,2], Mariapaola Ambrosone[1], Maria Tzortziou[3], Joaquim Goes[4], Dianne I. Greenfield[1,2] ([1]Advanced Science Research Center at the Graduate Center, CUNY, NY [2]School of Earth and Environmental Sciences, Queens College, CUNY, NY [3]City College Center for Discovery and Innovation, CUNY, NY [4]Lamont-Doherty Earth Observatory, Columbia University, NY)**
Despite substantial improvements to LIS water quality (WQ) in recent decades, high nitrogen (N) inputs have continued to lead to recurrent issues of seasonal bottom water hypoxia (<3.0 mg/L), particularly in the Western LIS (WLIS). While eutrophication and production of dissolved organic matter (DOM)/dissolved organic carbon (DOC) help fuel bottom water respiration, their linkages with N, phosphorus (P), chl a, and bacterial abundances associated with hypoxia, have been under-reported in recent years. This study sheds new insight into associations between biogeochemical and ecological linkages through a time series spanning two summer hypoxia events in WLIS (Jul 2020-Oct 2021), leveraging WQ and hypoxia monitoring conducted by the Connecticut Department of Environmental Protection (CTDEEP). Discrete water samples were collected from WLIS stations A4, B3, C2 and D3 at 2 depths (sub-chlorophyll maximum (SCM) and bottom) for analysis of DOM, N, P, chl a (SCM only), and bacteria. These data were combined with profiles of CTDEEP physical water quality spanning the hypoxia timeframe. WQ results show that bottom water dissolved oxygen (DO) began declining in early spring and continued until full hypoxia status beginning at some stations in late Jul for 2020, and early Aug for 2021, continuing throughout Aug before Sept recovery. NH4+ concentrations in bottom waters increased throughout spring, before decreasing to minimal levels at most stations once DO reached <4.0 mg/L. NO2-+NO3- measurements in bottom waters showed the opposite trend by remaining minimal until waters became hypoxic, followed by increases, revealing an inverse correlation with NH4+. Bacterial cell concentrations peaked at the early onset of hypoxia in bottom waters, ranging from ~85 x 103 – 10 x 104 cells/ml at station A4 (most hypoxic) before decreasing and remaining low for the duration of hypoxia, corresponding with the switch between dominant inorganic N form. Linkages between DOC/DOM and chl a at SCM are described, including their application to satellite and bio-optical observations to predict WLIS hypoxia.

Residential Lawn Fertilizer Use and Nitrogen Loading Intensity Across the Long Island Sound Watershed - ***Robert J. Johnston[1], David A. Newburn[2], Haoluan Wang[2], Tom Ndebele[1] (1 Clark University, 2 University of Maryland)***
This presentation reports on research funded by the Long Island Sound Study to characterize and predict lawn residential lawn fertilizer use and related practices that impact nutrient delivery to the Sound. Results are drawn from a survey of single-family homeowners within (a) the four Connecticut coastal counties and (b) municipalities of Westchester, Nassau and Suffolk Counties (New York) that overlap the watershed. The questionnaire was developed over a two-year process in coordination with stakeholders and partners of the Long Island Sound Study, with input from focus groups with watershed residents and pilot tests. The push-to-web questionnaire was implemented in 2021, with an initial mailing and follow-up reminders. Of 30,000 mailed invitations, 2,013 responses were obtained. Using survey and parcel data, a two-stage regression model was estimated to characterize effects of household and parcel characteristics on fertilizer applications during the prior twelve months. A first-stage probit model was used to estimate probability of lawn fertilizing, followed by a second-stage, zero-truncated negative binomial model to estimate the conditional number of fertilizer applications. Independent models were estimated for Connecticut and New York. Variables included household and parcel characteristics

hypothesized to influence fertilizer use. Among other conclusions, results provide robust evidence that characteristics such as parcel size (-), house size (+), and house age (-) affect fertilizer applications, along with other household characteristics. Integration of these results with parcel data allows applications to be predicted across the domain for single-family residential parcels. Further integration of an estimate of mean nitrogen deposition per application produces estimates of predicted nitrogen (N)-loading intensity due to residential fertilizer use, which are then mapped across sub-embayment watersheds. Large variations in predicted N-loading intensity across these sub-watersheds suggests the benefit of targeted interventions that focus on particular areas for residential fertilizer-reduction, rather than broadly focused programs that may cover areas where fertilizer use is already low.

***An Evaluation of Microplastics found in the Eastern Oyster (Crassostrea virginica) and the Surrounding Environment* - Kayla M. Mladinich, Bridget Holohan, J. Evan Ward, Sandra E. Shumway (University of Connecticut)**

Microplastics (MP, < 5 mm) are found in coastal waters across various environmental compartments (biota, water, marine snow, sediment). These particles can be incorporated into marine snow (heteroaggregations) and sink to the benthos quickly where they interact with benthic organisms. The eastern oyster (Crassostrea virginica) is a commercially important species that has been shown to ingest MP; however, oysters are discriminant suspension feeders that do not consume all particles to which they are exposed. This study focused on identifying the polymer compositions, shapes, and sizes of MP found in different environmental compartments on a recreational oyster bed in Norwalk, Connecticut. Oyster, water, marine snow, and sediment samples were collected and the quantity and types of MP in each were determined. Many precautions were taken to minimize and monitor MP contamination in the field and laboratory because quality control and assurance measures are essential for gathering reliable data. A project coinciding with this research sampled water and oysters on an aquaculture farm in Niantic Bay. Microplastics were isolated from samples via chemical digestion, and any suspected MP were identified using micro-Fourier transform infrared spectroscopy (μFTIR). A total of 64 microplastics were identified out of 549 suspected MP across environmental media. The highest MP count in an individual oyster was 10 MP, suggesting that there are very low concentrations of MP in oysters and the surrounding environment. There were no significant connections found between oysters and the surrounding environmental compartments. These data will aid in determining the types of MP (polymer composition, shape, size) to which oysters are exposed, and identify those they ingested. Such comparisons are important to determine if MP in the environment are problematic for the eastern oyster and if so, what MP types should be addressed in future environmental policies. The findings of both works are being compared to plastic polymers used in the farm's aquaculture gear to determine the extent the gear plays in MP pollution in oysters and our coastal areas.

***Variation of Microplastic Levels in Urban Stormwater with Rainfall Events* - Alexandra Morrison, Gaboury Benoit (Yale School of the Environment)**

Microplastics (MPs) are pervasive anthropogenic pollutants that are ubiquitously present in the environment. Sources and sinks of MPs in the environment are not yet well documented, especially in regard to urban waterways and stormwater runoff. To better understand MP fate and transport, the concentration, flux, and temporal trends of MPs in stormwater must be better quantified. Here, MP concentrations in stormwater runoff in the watershed of Beaver Pond in New Haven, CT were measured during rainfall events in order to better understand MP fate and transport in urban waterways. Time-series measurements revealed that MP concentrations ranged from 5 - 930 particles/L for the 100 – 5000 μm size fraction, with up to a 35 times increase in concentration during peak rainfall when compared to baseline measurements. Tire wear particles (TWP) were found to be a dominant particle type in urban stormwater, contributing 76% of all particles detected. MP concentrations strongly correlate with total suspended solid (TSS) concentrations, and clearly exhibit a first flush effect. MP levels vary dramatically during rainfall events, so temporal variations during storms must be considered when calculating MP budgets for urban systems. We estimate that for the city of New Haven, storm runoff releases 3 – 4 orders of magnitude greater numbers of MPs than does sewage effluent.

Copepods in Long Island Sound are Shrinking - Matthew Sasaki, Maryam Mirhakak, Erica Correia, Hans G. Dam (Dept. of Marine Sciences, University of Connecticut)

Body size is a fitness-related life history trait that also affects predator-prey interactions. Copepod body size decreases with increasing temperature and with reduced resource availability. Thus, the ongoing warming and eutrophication of Long Island Sound (LIS) are expected to alter copepod body size, in turn affecting resource availability and population growth for forage fish. Previous work in Long Island Sound detected a significant decrease in body size during the last half of the 20th century in the copepod genus Acartia, attributed to warming. We present new work comparing the seasonal trends of body size of the winter/spring biomass-dominant copepod *Temora longicornis* from collections in the period 1985-1987 and the period 2003-2016, which allows one to disentangle seasonal from long-terms trends. We show that there have been significant reductions in body size since the 1980s. We confirmed the expected negative relationship between body size and temperature, but found no effect of chlorophyll. Thus, temperature appears to be the controlling factor for both seasonal and decadal changes in body size in this species. However, we also show that the slope of temperature - body size relationship is shallower for the 2003-2016 than the 1980s period, reflecting a decrease in body size at low temperatures in recent years. That is, for a given temperature during winter and early spring, copepod body size has become smaller since the 1980s. While this may indicate that factors other than temperature or resource availability are at play, we will discuss this reduction in the temperature-body size slope in terms of selection on body size and body size plasticity. We will also highlight future efforts to achieve better mechanistic understanding of the factors controlling body size.

***Microplastics and Molluscs II – A Brief Overview of a Flawed Literature* - Sandra E. Shumway, J. Evan Ward, Kayla Mladinich, Bridget Holohan, Noreen Blaschik (Department of Marine Sciences, University of Connecticut)**
Microplastics are a contaminant of global concern and, as such, there has been a rush to action and publication. Over the past decade, this haste has resulted in a chaotic and cluttered literature that is rife with inappropriate methodologies, unrealistic experimental protocols, misinterpreted results, and overstated significance. A comprehensive critical assessment of the current literature on interactions between particle-feeding molluscs and microplastics and their purported impacts (> 600 publications) is underway. It is not surprising that microplastics have been noted globally in shellfish guts. What is surprising is the extremely low level of particles routinely recorded. The data to date clearly demonstrate low numbers of microplastics in suspension-feeding bivalves, and there are no unequivocal data demonstrating that their presence in these animals is a serious risk to human health. The hype needs to be curtailed and scientists should not imply impacts or potential impacts when there are no data to support the suppositions. Editors of scientific journals must make a stronger effort to engage qualified peer-reviewers and stop the flow of poorly done studies and superficial reviews that do nothing more than confuse the literature and reinforce prior inadequate studies.

***Refined Integration of Remote Sensing with Biological Parameters for improved management of Long Island Sound* - Maria Tzortziou, The City College of New York, Center for Discovery and Innovation; Dianne Greenfield, Queens College, CUNY Advanced Science Research Center; Joaquim Goes, Columbia University, Lamont Doherty Earth Observatory**
Remote sensing observations from space-based platforms offer environmental monitoring and water resource management communities a unique capability to observe changes in water conditions and ecological characteristics across spatial and temporal scales not feasible with conventional field-based monitoring alone. Yet, determining water composition and resolving different bloom-forming phytoplankton taxa in LIS from space has been a challenge. Here, we integrate satellite ocean color observations with long-term water-quality monitoring programs and new in-situ bio-optical measurements, including measurements of hyperspectral remote sensing reflectance, colored dissolved organic matter spectral signatures, suspended particulate matter, and phytoplankton pigments. Results were used to develop new satellite algorithms for quantitative retrievals of dissolved organic matter quality and phytoplankton dynamics in the Long Island Sound complex nearshore waters. New satellite products together with field data are used to assess seasonal and spatial transitions of organic matter and phytoplankton assemblages across this urbanized estuarine-coastal ocean continuum.

***WasteWater Treatment Plant Outfalls and Eutrophication in Black Rock Harbor and LIS* - Varekamp, J. C.[1], Thomas, E.[1,2], Wang, S.[1], Planavsky, N.J.[2], Altabet, M.[3] [1]Earth & Environmental Sciences, Wesleyan University, [2]Earth & Planetary Sciences, Yale University, [3]School for Marine Science and Technology, University of Massachusetts, Dartmouth.**

Core studies from LIS document its eutrophication history, using δ13C in foraminifera, δ15N in Corg, S, C, N and Mo in bulk sediment, with its isotope ratio, δ98Mo. We measured these in LIS cores, and sediment from Black Rock Harbor (BRH) close to a Bridgeport WWTP outfall. We used a central LIS grab sample for method development, applying various leaching techniques. The Mo concentrations from Chapman Pond (CP, East Haddam, CT) reflect sediment before entering LIS where their composition is impacted by marine processes and WWTP influences. The CP sediment is average glacial sediment, with about 0.5 to 1.0 ppm Mo, the background Mo value in LIS. The black, fine-grained sediment in BRH is heavily contaminated with metals and organics, and DO in bottom waters is regularly near zero. Benthic foraminifera in LIS belong to 5 species, with *Ammonia tepida* common in the most polluted sediment. The latter occurs in BRH with very large pores, indicating low DO. Core profiles show over time increasing N, C, S and Mo, starting around 1825 CE. The BRH sediment plots with "industrial era" samples. The raised N and C concentrations stem largely from WWTP inputs and enhanced algal growth. The Mo fixation from seawater occurs when DO drops to values where reduced sulphur is stable and Mo is incorporated into the sediment as a sulphide. The Mo values are slightly higher than CP values, but the high sediment accumulation rates in LIS prevent strong build-up of diagenetic Mo from seawater. The CP sediment δ98Mo values are -0.5 ‰, whereas the LIS grab sample has up to 1.8 ppm Mo, with δ98Mo = +1‰, the result of addition of isotopically heavy marine Mo which has δ98Mo = +2.5‰. The marine diagenetic Mo component has calculated δ98Mo of +1 to +2.5‰. The BRH samples have high C/N-wt (15-24), with δ15N of +5‰. Industrial era δ15N in core WLIS75 span from +7.7 to +9.6‰. The open-LIS δ15N values may be influenced predominantly by treated sewage from WWTP effluents with high δ15N, whereas the BRH sediment receives storm water overflow inputs with raw sewage that has lower δ15N values.

***Microplastics and Molluscs I – A Brief Overview of a Flawed Literature* - J. Evan Ward, Sandra E. Shumway, Kayla Mladinich, Bridget Holohan, Noreen Blaschik (Department of Marine Sciences, University of Connecticut)**
Microplastics are a contaminant of global concern and, as such, there has been a rush to action and publication. Over the past decade, this haste has resulted in a literature that is rife with inappropriate methodologies, unrealistic experimental protocols, misinterpreted results, and overstated significance. Many studies on suspension-feeding bivalve molluscs and other invertebrates are weak. There is a recurring presence in the published literature of misunderstanding of the feeding processes, capabilities for particle selection and rejection, and species-specific differences that all leads to misinformation, misinterpretation, and incorrect assumptions regarding potential impacts. There are major shortcomings to many laboratory studies that examined uptake and accumulation of microplastics by bivalves and their subsequent effects. In most cases, the issues can be traced to poor experimental procedures and animal husbandry, and lack of knowledge of the literature. They are compounded by a misunderstanding of the basic biology and physiology of molluscs. The shortcomings have led to a seriously flawed literature on the interactions and impacts of microplastic on these animals. Bivalves and other particle-feeding molluscs are complex living organisms with extraordinary capabilities for the control of selective capture, ingestion, and egestion of particulate material. They should be recognized and treated as such in any attempt to describe impacts of stressors, including different particle types, on their feeding and ability to accumulate materials. Any future experimental studies need to be focused carefully, based upon clear questions, use standardized analytical procedures, and demonstrate a knowledge of the animals being studied and the extant literature.

<u>Sound Science and Inclusive Management:</u>

***Persistent Acidification in Western LIS during a Relatively Low-Hypoxia Year* -Lauren Barrett, Penny Vlahos, Michael Whitney, Jamie Vaudrey (University of Connecticut)**
Eutrophication in Long Island Sound (LIS) has led to seasonal hypoxia, especially in western LIS (WLIS), as observed over 30 years of monitoring by CT-DEEP. Another effect of eutrophication in the Sound that has been given little attention prior to the past decade is acidification. While dissolved oxygen (DO) observations show that hypoxic volume and duration has decreased since the implementation of nitrogen total maximum daily loads (TMDLs), concurrent pH measurements since 2011 have shown a steadily decreasing or acidifying trend in both surface and bottom waters. In this study we expand upon CT-DEEP pH measurements by adding other inorganic carbon parameters including total alkalinity (TA), dissolved inorganic carbon (DIC), and partial pressure of carbon dioxide (pCO2). These measurements were conducted from March to October 2020. Hypoxic area was relatively low during 2020, with only 63 mi2 of hypoxia area as compared to 142 mi2 in 2021. Concurrent with hypoxic conditions

in WLIS during July and August, the saturation state of aragonite (Ωar) was < 1 for at least 6 weeks, posing a threat to organisms that generate larval shells from aragonite. DIC was elevated by 100-150 µmol kg-1 relative to March observations, and remained elevated into October. DIC showed a strong correlation with apparent oxygen utilization (p < 0.01, R2 = 0.34 in bottom waters), indicating that acidified and high-CO2 conditions were coupled with respiration. These results emphasize that eutrophication and stratification in WLIS lead to acidified conditions in addition to the well-monitored hypoxia, and should be given greater attention. Additional samples were taken during summer and fall 2021, which had slightly greater hypoxic extent and duration than 2020, and comparative results will be shown.

Growth and Survival of Larval, Juvenile and Adult Triploid Oysters in Long Island Sound Waters - **Christopher J. Brianik[1], Rivara G[2], Patricio M[2], Dunne J[3], Topping P[4], Byrnes M., Pales Espinosa E[1], Cerrato R[1], Guo X., Allam B[1]. [1]Stony Brook University School of Marine and Atmospheric Sciences, [2]Cornell Cooperative Extension, [3]Town of East Hampton shellfish hatchery, [4]Peconic Baykeepers, [5]Town of Islip shellfish hatchery, [6]Rutgers University Department of Marine and Coastal Sciences)**

Due to the significant growth benefits, triploid technology has become increasingly common in oyster aquaculture accounting for the vast majority of farm-raised oysters in many regions. Although triploids are very common in aquaculture, regions such as Long Island NY have been slower to adopt and implement the technology with anecdotal reports from baymen claiming that the triploids they have previously grown were “frail” or “ugly”. The reason for such reports is unknown and may be due to the triploids used originating from distant locations and not optimized for local stressors, diminishing the benefits of the technology. To address this, 9 oyster lines were produced and evaluated, consisting of 3 purebred local diploid lines, 3 hybrid triploid lines (local lines crossed with NEH tetraploids), and 3 hybrid diploid lines (local lines crossed with NEH diploids). Larvae and juvenile resistance to experimental exposure to Vibrio pathogens was assessed. Field grow-out experiments were also conducted in 5 separate locations to compare seed growth and survival up to market size. When exposed to Vibrio pathogens, larval and juvenile diploids outperformed triploids by 53% and 17% respectively, with no significant difference based on parental genotype. In the field, overall triploid growth was 30% greater compared to diploids. No significant difference was observed in survival when comparing ploidy alone, however significant differences were observed between locations and maternal genotypes. Differences in ploidy survival appear to be most pronounced during early developmental stages but become more dependent on genotype-location interactions as oysters mature.

Preference, Noncompliance, and Fishing Effort under Alternative Management: A Choice Experiment Approach In Projecting the Impact of Changing Restrictions on Fishing - **Zhenshan Chen[1,3], Jacob Kasper[1,4], Steve Swallow[1], Pengfei Liu[2], Eric Schultz[1] ([1]University of Connecticut, [2]University of Rhode Island, [3]Mississippi State University, [4]University of Missouri)**

Recreational fisheries managers assume that anglers do not alter their fishing behaviors. However, anglers may be expected to strategically optimize effort and may change their rate of compliance to achieve their objectives. Ignoring these changes in angler behavior reduces the accuracy of projections and undermines the ability to accomplish management goals. We employed a choice-experiment survey instrument to elicit recreational anglers’ preferences, fishing effort, and expected noncompliance under current and alternative management scenarios for an overfished stock (Long Island Sound Tautog). To identify preferences, we employed choice questions incorporating the status quo minimum size limit and two alternatives including a more restrictive minimum size limit and several slot limit options. To estimate effort and noncompliance, we included follow-up questions after each choice set. We estimated noncompliance via an innovative approach designed to elicit information on behaviors that respondents are sensitive to disclose. The survey additionally collected baseline data on fishing behavior, preferences and demographics. Almost 2000 anglers in CT and NY completed the survey in 2019. Respondents preferred slot limits over a more restrictive minimum size limit. Anglers indicated a 7.7% decrease in future fishing effort with either a wide slot limit or a more restrictive minimum size limit, compared to what they would do under status quo regulations. More than 17% of anglers would not comply with new size limits. With these results, more precise biological models can be developed to predict the potential outcomes under alternative management approaches, taking better account of changes in angler behavior.

***LIS Seafloor Habitat Mapping Initiative Update* - DeAva Lambert, Kevin O'Brien, Ivar Babb, Frank Nitsche, Tim Battista, Peter Auster, Dennis Arbige, Jim O'Donnell, Grant McCardell, Roman Zajac, Chris Conroy, Seth Ackerman, Dann Blackwood, Roger Flood, Timothy Kenna, Vicki Ferrini, Cecilia McHugh, Will Sautter (CT Department of Energy & Environmental Protection, Univ. of Connecticut, Lamont-Doherty Earth Observatory of Columbia University, NOAA National Centers for Coastal and Ocean Science, Univ. of New Haven, USGS, Stony Brook University; and Queens College)**

The Long Island Sound Seafloor Habitat Mapping Initiative was created under the Long Island Sound Research and Restoration Fund to support benthic mapping of Long Island Sound (LIS) as a priority to improve science-based management. The fund is administered by the LIS Cable Fund Steering Committee (SC), consisting of representatives from DEEP, US EPA Regions 1 & 2, New York Department of Environmental Conservation and Department of State, and the Sea Grant offices of Connecticut and New York. After outlining a benthic mapping program for LIS based on specific management needs, the SC selected a collaborative partnership combining national and local expertise and resources, which includes NOAA's Biogeography Branch and two regional academic consortiums led by the University of Connecticut and Columbia University's Lamont Doherty Earth Observatory, to implement the Mapping Initiative. The SC and collaborative partners identified three priority mapping areas in LIS for benthic mapping based on their ecological value, multiple use conflicts, compliance, resource management, and potential for further development. By mapping these geographic areas individually, the Steering Committee and collaborative partners anticipated the success of completing the entire area would be increased while allowing for evaluation and refinement of processes at each phase in order to improve project outcomes. The teams used a suite of technologies and methodologies to fully characterize the seafloor geology and habitats in waters deeper than 4m, generating data on a range of scales, from landscape features to the fine scale distribution of organisms living in and on the seafloor to develop habitat maps that integrate the physical and ecological components to depict the complex seafloor of LIS. This presentation describes products and outcomes of Phase II, the status of Phase III, and expansion to other areas of LIS.

***Modeling the Extreme Storm Surge and Waves and Nearshore Flooding in the Long Island Sound* - Chang Liu, Yan Jia, Yaprak Onat, James O'Donnell (University of Connecticut)**

Improving the coastal risk preparedness includes accurate representation of the storm surge probability. To predict floodwater elevations and significant wave heights from 10% (10-year) to 1% (100-year) annual exceedance probabilities for all Connecticut coastal towns, we modeled Long Island Sound using a coupled coastal circulation and wave model (FVCOM-SWAVE) to hindcast the 44 highest storms between 1950–2018. We fitted Poisson-GPD distributions to modeled water levels and wave heights. The results show that both water levels and their corresponding return intervals are higher along the western coast of Connecticut than on the eastern coast, whereas significant wave heights increase eastward. Using the LIS model results as boundary conditions, we used a fully nonlinear Boussinesq wave model (FUNWAVE-TVD) on the nearshore area with a high-resolution grid to determine total water elevation on the local shorelines. We applied the model to Branford, Norwalk, and New Haven, CT to represent the complex topo-bathymetric features and the structural interference in shallow water wave dynamics. The FUNWAVE-TVD model is found to model wave processes more accurately in shallow water regions than FEMA's empirical equation application and coupled circulation-phase averaged model application of NACCS and FVCOM-SWAVE. FUNWAVE-estimated total water level along the coast is generally lower than FEMA BFE, likely due to FEMA's simplistic approach neglecting fine-scale wave processes. NACCS overestimates surge water levels and underestimates the wave heights compared to the current models. In addition to evaluating historical risks, we also added a sea-level height offset of 0.5 m for 2050 estimates to examine the effect of rising sea levels on the analysis. Estimated flood extent results suggest that sea-level rise reduces the return period of storms. We suggest the planning approaches should consider the increase in the frequency of the storms in the predicted inundation zones due to sea-level rise. The collaborative modeling tools would benefit flood management by estimating flood extent under future scenarios and guiding strategic planning of flood reduction structures.

***Connecticut Department of Energy and Environmental Protection Long Island Sound Ambient Water Quality Monitoring Program: Overview and Analysis of Program Data* - Matthew Lyman, Katie O'Brien-Clayton, Christine Olsen (Connecticut Department of Energy and Environmental Protection)**

The Connecticut Department of Energy and Environmental Protection (CTDEEP) has been monitoring the water quality of Long Island Sound for over 30 years. Year-round monthly sampling includes monitoring for nutrients, chlorophyll a, biological oxygen demand, and water column profiles of temperature, salinity, pH, turbidity and dissolved oxygen. Additional biweekly summer sampling at 25-35 stations provides data on the recurrent low dissolved oxygen condition known as hypoxia. The monitoring program has been expanded over the years to include monthly phytopigment, phytoplankton and zooplankton monitoring. CTDEEP staff strive to work with other local researchers to aid them in their research efforts on Long Island Sound by providing boat time or sample collections during scheduled surveys. Staff will provide an overview and general analysis of monitoring program data and discuss additional research projects and changes in program design over the years. An extensive long-term database exists and is available by request. The CTDEEP encourages the research community to make use of the monitoring program and the resultant data base as an aid to complementary research and assessment efforts in Long Island Sound and elsewhere.

***Alkalinity of Long Island Sound Embayments (ALISE)* - <u>Mary McGuinness</u>, Penny Vlahos, Mike Whitney, Robert Mason, Samantha Siedlecki (University of Connecticut)**
Coastal systems are undergoing significant changes through both natural and anthropogenic disturbances. One of the major concerns in LIS is its ability to withstand seasonal and longer-term acidification stress. Here we build on previous work in the LIS by exploring carbonate system parameters (alkalinity (TA), dissolved inorganic carbon (DIC), pCO2) in four LIS embayments(Housatonic, Quinnipiac, Thames, Connecticut). The samples are coupled with other significant biogeochemical parameters including dissolved organic carbon (DOC) and nutrient concentrations (nitrogen, silicate, and phosphorus) during high tide, low tide, and at each freshwater end member. Over one year of ALISE project results enumerating spatial trends within and across the embayments will be presented along with regionally specific multiple linear regressions that attempt to identify predictive expressions for embayment TA.

***Improving the Quantification of In Situ Water Column Respiration in Western Long Island Sound* - Annalisa Mudahy, Craig Tobias (Department of Marine Sciences, University of Connecticut)**
Western Long Island Sound (WLIS) suffers from severe hypoxia during summer months with some regions experiencing extended periods of anoxia. Evaluating the magnitude of water column respiration is key to calibrating accurate hypoxia models for WLIS. To address this need, we developed and deployed autonomous respiration chambers (ARCs) to continuously measure water column respiration during summer hypoxia in 2020 and 2021. The ARCS were deployed for two-to-four-week intervals near the surface, pycnocline, and bottom where they captured water and measured declining oxygen concentrations over six-hour intervals. Rates were derived from the linear regression of the change in oxygen over each six-hour interval yielding four rates per day per ARC. In total, deployments generated over 3000 rates with peak values between July and August exceeding 3 mmol O2 m-3 hr-1. Rates showed clear differences between surface, pycnocline and deep, and between stations. The data also showed a baseline of respiration rates between 0.5 mmol O2 m-3 hr-1 and 1 mmol O2 m-3 hr-1 with periodic systematic excursions into higher rates. Respiration values were comparable with published rates for WLIS and demonstrated the feasibility of obtaining in situ measurements on a large temporal and spatial scale. The high frequency data provided by the ARCs can help better identify factors controlling respiration in WLIS and other estuaries.

***Chlorophyll a Dynamics in Long Island Sound from Space using an Optimized Satellite Algorithm Developed for Sentinel-3 (OLCI)* - Jonathan Sherman, Maria Tzortziou (The City College of New York)**
Long Island Sound (LIS) is amongst the most populated estuaries and valuable natural resources in North America. The Sound is strongly influenced by riverine and runoff inputs from the surrounding urbanized landscape, leading to highly variable water biogeochemistry both spatially and temporally. As a result, LIS waters are optically complex, which poses a challenge for the retrieval of ecological parameters of interest, such as chlorophyll a (Chla) concentration, from satellite observations. The standard ocean color algorithm employed by NASA to retrieve Chla concentrations was developed using a global dataset and tends to perform well on a global scale. However, in LIS it routinely overestimates Chla when compared to in situ observations. To address this issue and improve the retrievals of Chla from the LIS, we developed a regionally optimized multiple linear regression (MLR) algorithm that utilizes the full range of spectral information captured by the high-spatial (300 m) and high temporal revisit (daily) Ocean and Land Color Instrument (OLCI) on-board the Sentinel-3 satellite platform. The algorithm was developed

using concurrent hyperspectral reflectance and Chla data collected by our group from 2017-2022 across the whole LIS and its primary rivers that encompasses the spatiotemporal variability of Chla distribution in the LIS. Data was collected in collaboration with the CT-DEEP monthly water quality monitoring program as well as on-board small boats. The MLR algorithm for OLCI performs remarkably well when compared to in situ observations. Overall, the MLR provides better accuracy and less biased retrievals of Chla in comparison with the standard algorithm and other commonly utilized red-band Chla algorithms. Moreover, the MLR approach captures quite well the LIS seasonal cycle of Chla, with a main summer bloom peaking in August and a secondary, short-lived, winter bloom in February. In addition, the spatial gradient in Chla that increases from East to West throughout the year is clearly seen using the MLR approach. Application of the MLR method enables us to better understand biogeochemical dynamics and ecological processes in LIS across seasons and regions.

***Characterizing the Spectral Shape of Hyperspectral Remote Sensing Reflectance from Above-water Radiometric Measurements across Long Island Sound* - Kyle Turner, Maria Tzortziou, Brice Grunert, Joaquim Goes (The City College of New York)**

The color of natural waters is intrinsically tied to suspended and dissolved materials present within them and is the basis for monitoring aquatic ecosystems and biogeochemistry from satellite remote sensing. Characteristics of spectral remote sensing reflectance (Rrs) (i.e., shape and magnitude) vary depending on the composition and quantity of in-water constituents and are used to develop algorithms to estimate ecologically relevant parameters such as the concentration of chlorophyll or suspended particulate matter. However, the relationship between Rrs and these parameters is particularly complex in coastal waters such as the Long Island Sound (LIS) which are highly and variably influenced by processes like riverine discharge. Here, we apply a relatively new and intuitive spectral classification technique, the Apparent Visible Wavelength (AVW; Vandermeulen et al., 2020), along with a statistical clustering approach to analyze spatial and temporal variability in the spectral shape of hyperspectral Rrs and the underlying drivers of these changes using an extensive in situ data set of coincident optical and biogeochemical measurements across the western, central, and eastern basins and primary river/river plume regions of LIS from 2017-2022. Distinct differences and gradients in spectral shape are apparent regionally and seasonally, largely driven by phytoplankton dynamics and proximity to major rivers. These findings are useful to inform and improve ongoing and future satellite algorithm development for the LIS, particularly in anticipation of upcoming hyperspectral satellite sensors like NASA's PACE, GLIMR and SBG missions.

<u>Sustainable and Resilient Communities:</u>

***Observations of Circulation in a Salt Marsh Creek* - Molly James, James O'Donnell (University of Connecticut)**

The most devastating hurricanes in memory to reach the Connecticut coast were in 2012, 2011, and 1938. Local salt marshes, however, provided a natural defense against flooding and damage along the shoreline. We can better understand the mechanisms for buffering storm damage by studying the complex flow regime within a marsh system. At the Barn Island Wildlife Management Area in Stonington, CT along Little Narragansett Bay, we evaluated the interactions and connections of marsh grasses and creeks by simultaneously sampling flow through both. Marsh grasses flood only at high water and drain slowly, whereas water levels fluctuate throughout the entire tidal cycle in channels. From pressure and velocity observations, we determined that pressure gradient and bottom friction are considered the dominant momentum terms. As water level rose above the sides of the channel, near surface along creek velocities rapidly experienced shear as adjacent marsh grasses flooded and drained. Volume flux on the flood tide exceed that on the ebb, indicating water storage over the grasses in pannes. However, the duration of the ebb exceeded the flood over multiple tides, as a result of the tidal asymmetry and non-linearity in the shallow creeks of the marsh. Salinity gradients between creeks and grasses were minimal, whereas average thermal gradients were 3.5°C. Under certain conditions, the flow in the creek followed the law of the wall for bottom friction and deviated due to shear in other cases. Analyzes of marsh flow dynamics under fair weather conditions will potentially lead to more accurate flood predictions during storms and coastal resilience planning in marsh areas.

***Estuarine Benthos and Climate Change in Long Island Sound and Other Estuaries* - Jeffrey Levinton (Stony Brook University)**

Estuaries such as Long Island Sound need a broad analysis in the light of climate change. Estuarine bottoms are comprised mainly of soft sediments, with dense populations of deposit-feeders, suspension-feeders, and benthic predators. These species in the majority have planktonic larvae and strong potential for short-term environmental responses and population fluctuations. Sea-level rise and warming will combine to rearrange salinity gradients and thermal habitats for different suites of species in response to these changes. Past nutrient instability and input, endemic to many estuarine systems, combined with future rearrangements of nutrient dynamics, will only increase population instability in estuaries owing to thermal and salinity change. Acidification resulting from current eutrophication will combine with future carbon-dioxide-based ocean acidification to increase stress in diverse ways on estuarine species. Increased stress will further convert estuarine soft bottoms to domination by volatile populations, and the importance of short-term deposition of particulate organic matter on the sediment surface, selecting for shallow over deeper-burrowing species. This change in bioturbation and burrowing depth will lead to increased benthic population and bioturbation instability. Sea level rise will also strongly impinge on edge habitats, such as intertidal beaches, coastal marshes, and mangroves. The tidal adaptations of estuarine planktonic larvae will have varying outcomes in the context of regional thermal changes and rearrangement of water flow, owing to climate change. Planktotrophic larvae adapted to export and life in shelf waters may experience disequilibria with new conditions that may reduce synchronization with phytoplankton and zooplankton blooms in shelf waters and with seasonal current changes, leading to population failures owing to failed recruitment. Species with larvae adapted to retention in the estuary may suffer strong physiological stress when they are trapped in warming estuaries. Overall warming will result in extension of biogeographic ranges to higher latitudes and pinching of ranges at lower latitudes, as is occurring for coastal species. Warming will increase the vulnerability of estuaries to invasion, reducing local endemism and regionalism of estuarine biotas.

Atlantic Sturgeon (Acipenser oxyrinchus) Growth and Habitat Use in the Connecticut River and Long Island Sound
Kelli Mosca, Tom Savoy, Jacque Benway, Hannes Baumann (University of Connecticut and CT DEEP)
Atlantic sturgeon (ATS, Acipenser oxyrinchus) are a long-lived, anadromous, and endangered fish inhabiting coastal North American waters. ATS spawning populations once existed in numerous rivers, but many runs ended due to intense fishing pressure and habitat obstruction in the 19th and 20th centuries. This was thought to be true for the Connecticut River (CT River), until pre-migratory ATS juveniles appeared in 2014. Long-term archival fin spine samples collected from 1988-2021 by CT DEEP and three years of acoustically tagged ATS were used to further study ATS using the CT River and LIS, and specifically examine these empirical data for potential evidence of re-emergent spawning behavior. The majority of ATS were juveniles and sub-adults with an average ± SD age of 7.5 ± 3.1 years and a length of 101 ± 26 cm. The weighted, population-based Von Bertalanffy Growth Model estimated a K of 0.08 (95% CL, 0.01-0.17) and a L_∞ of 171.2 cm (95% CI, 129-547 cm). Acoustic data (2019-2021) revealed that most ATS utilized the lower CT River and adjacent LIS in 2019-2021, showing a positive relationship with river temperature but a negative relationship with river discharge. Average arrival of ATS in the CT River occurred in June at river temperatures of 17.5 - 24.9 ºC, while the departure generally occurred in October at river temperatures of 15.2 - 20.4 ºC. At a potential spawning habitat at Portland, CT (rkm 47), average first detections occurred on 12-23 August, which is inconsistent with the typical spring timing of ATS spawning runs in northern populations. In addition to timing, ATS sizes did not support spawning behavior, because fish of all sizes (72 – 154 cm TL) visited Portland. Hence, neither long-term age nor 3 years of telemetry data supported the notion of a re-emergent ATS spawning population in the CT River.

Observations of Wave Damping by an Array of Reef Balls in the Inter-Tidal Zone: A Preliminary Assessment **-**
James O'Donnell, Amin Ilia, John Speers, and Mary M. Howard Strobel (Department of Marine Sciences and the Connecticut Institute for Resilience and Climate Adaptation, University of Connecticut)
Arrays of "reef balls" are potential alternatives to rock breakwaters for reducing the rate of coastal erosion. They are hollow concrete structures with holes that allow seawater, and marine organisms to move into and out of the interior of the structures. Though there have been several small-scale laboratory studies of the effectiveness of these structures in damping waves, there are few observations in the ocean, and none where the structures are in the intertidal zone. We deployed an array of high-resolution current meters across the array of reef balls at Stratford Point, CT, maintained by Sacred Heart University. We measured the amplitude and direction of waves with significant wave heights up to 0.5m, periods up to 5s, and water depths between 0 and 3m. We show that the wave transmission coefficient, the ratio of the transmitted to incoming wave heights, is approximately 0.7 when the mean water level is twice the elevation of the top of the reef balls, and 0.5 when it is equal to it. When the water level is shallower than the height of the structure, the transmission coefficient tends to a minimum value of

0.3. In published parameterizations of lab experiments, the transmission coefficient is expressed as a function of the submergence ratio, the depth of fluid above the top of the structure divided by the incoming significant wave height. The trends in the field observations are consistent with the lab results, however, the lab results substantially underestimate the effectiveness of the array in reducing the wave heights. These results should provide valuable guidance in the evaluation of proposals for new reef ball installations.

***Regional Climate Change Vulnerability Index for Connecticut* - Yaprak Onat (Connecticut Institute for Resilience and Climate Adaptation)**

Regional Climate Change Vulnerability Index for Connecticut   Areas that are more vulnerable to climate change are where people, infrastructure, and ecological resources are most likely to be damaged as temperatures rise and flooding worsens. Considering that local, regional and global conditions strongly determine coastal processes and vulnerability, a good understanding of the physical, biological and social system characteristics is required. Vulnerability is a complex concept and encompasses a variety of elements, including physical exposure, sensitivity or susceptibility to harm, and lack of capacity to cope and adapt. Understanding vulnerability helps us make decisions about resource allocation, policy development, project prioritization, siting, and design. CIRCA partnered with SLR Consulting, developed a climate change vulnerability index tool, CCVI, to identify highly vulnerable areas to flood and heat stress in New Haven and Fairfield Counties of Connecticut. The CCVI combines built, social, and ecological factors to identify areas vulnerable to flooding and heat-related impacts of climate change. The project developed a methodology to identify zones that face common challenges to climate change and have shared priorities in terms of coastal resilience. The GIS-supported index-based approach is useful for interaction in multi-scale and multi-criteria and expressing an overlapped one-dimensional risk index. The index gives a relative sense of zones that are more susceptible to exposure and identifies places that need to develop adaptation measures to cope with the effects of heat and flood. These mapping tools can be used to view vulnerability at both a regional scale and at specific sites to see how factors contribute and aim to aid resilience decision-making. This presentation will inform the tool, demonstrate its use, and summarize its results in two counties.

***Environmental Justice for Connecticut: The Approach for Developing a Mapping Tool* - Yaprak Onat, Joanna Wozniak-Brown, Caterina Massidda (University of Connecticut - Connecticut Institute for Resilience and Climate Adaptation)**

Environmental Justice for Connecticut: The approach for developing a mapping tool Environmental justice is a fair division and equitable distribution of the benefits and burdens of environmental pollution sources. CIRCA, partnered with CT DEEP, is developing an Environmental Justice Screening tool for the State. This project aims to understand the unequal spatial distribution of environmental hazards to develop solutions to environmental health disparities. The tool was a recommendation made by the Equity and Environmental Justice Working Group of the Governor's Council on Climate Change (GC3). The project identifies a cumulative impact at the census level from different datasets, i.e., environmental exposure and effects and socioeconomic characteristics on sensitive populations. The common datasets will be enhanced from spatial layers that emerge from nine statewide public forums. The results of this community-academic-state partnership will ideally encourage planning, discussion, and improved decision-making to avoid or mitigate disparities. This presentation will describe the project process, how stakeholders will be involved, and the technical details of the mapping approach.

***Resilient Connecticut: Developing a Regional Resilience Plan for Fairfield and New Haven Counties* - John Truscinski (CIRCA/University of Connecticut)**

The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) initiated the Resilient Connecticut project in 2018 as a component of the U.S. Department of Housing and Urban Development (HUD) National Disaster Resilience Competition award to the State of Connecticut, which is being administered by the Connecticut Department of Housing. The three-phase project seeks to develop a regional climate adaptation framework and resilience plan for New Haven and Fairfield Counties, which builds on opportunities to focus community development around transit, and support the development of equitable, sustainable and resilient communities. Phase I resulted in the development of a Resilient Connecticut Planning Framework, following an extensive review and inventorying of municipal resilience and hazard mitigation plans. In Phase II, the planning team engaged stakeholders through a series of workshops in partnership with 4 regional Councils of Governments (COGs), completed a regional vulnerability assessment, and identified a series of Resilience Opportunity Areas (ROARs).

The 63 ROARs identified and mapped across the two Counties represent the intersection of climate induced flooding and heat risks with vulnerable populations and key regional assets. Assets include affordable housing, transportation assets, critical infrastructure, and valuable ecological systems along with other assets that impact the long-term resilience and potential of the region. Phase III, which is currently underway, focuses on the development of location specific projects building on the ROARS and includes detailed analysis, and development of implementable concept plans. Resilient Connecticut's guiding principle is to establish resilient communities through scientifically-informed planning that incorporates economic development framed around transit-oriented development (TOD), conservation strategies, and critical infrastructure improvements. The impacts of climate change to infrastructure, public health, ecology, and other systems occur at a variety of scales which overlap and cross political boundaries. This presentation will review the origins and evolution of the Resilient Connecticut project over the course of 2018-2022, and highlight lessons learned, potential outcomes for the region, and how the project can provide recommendations for a resilience roadmap for Connecticut.

Thriving Habitats and Abundant Wildlife:

***Direct Comparison of Fecal and Gut Microbiota in the Blue Mussel, Mytilus edulis, Discourages Fecal Sampling as a Proxy for Resident Gut Community* - Tyler W. Griffin, Julia G. Baer, J. Evan Ward (University of Connecticut)**

Bivalves have ecological and economic importance but information regarding their associated microbiomes is lacking. As suspension-feeders, bivalves capture and ingest a myriad of particles, and their digestive organs have a high throughput of particle-associated microbiota. To better understand the complement of transient and resident microbial communities, standard methods need to be developed. For example, fecal sampling could represent a convenient proxy for the gut microbiome and is simple, nondestructive, and allows for sampling of individuals through time. The goal of this study was to evaluate fecal sampling as a reliable proxy for gut microbiome assessment in the blue mussel (Mytilus edulis). Mussels were collected from the natural environment and placed into individual sterilized microcosms for six hours to allow for fecal egestion¬¬. Feces and gut homogenates from the same individuals were sampled and subjected to 16S rRNA gene amplicon sequencing. Fecal communities of different mussels resembled each other but did not resemble gut communities. Fecal communities were significantly more diverse, in terms of amplicon sequence variant (ASV) richness and evenness, than gut communities. Results suggested a mostly transient nature for fecal microbiota. Nonetheless, mussels retained a distinct resident microbial community in their gut after fecal egestion that was dominated by ASVs belonging to Mycoplasma. The use of fecal sampling as a nondestructive substitute for direct sampling of the gut is strongly discouraged. Experiments that aim to study solely resident bivalve gut microbiota should employ an egestion period prior to gut sampling to allow time for voidance of transient microbes.

***Urban River Revival: Assessing Wildlife Habitat at Gablers Creek, Queens, NY* - Emily Hall (Seatuck Environmental Association)**

Gabler's Creek is a small coastal stream that originates on the northern slopes of Long Island's glacial moraine in northwest Queens. Draining a narrow watershed in the community of Douglaston, it flows north through a steep wooded ravine for several thousand feet before terminating in Long Island Sound's Little Neck Bay. Much of the creek runs through a protected corridor, including the New York Department of Conservation's Udalls Cove & Ravine Natural Resource Area. Before it reaches the Sound, Gabler's Creek flows through Aurora Pond (a one-acre freshwater pond) and passes under a two-lane roadway (Sandhill Road). The dam that controls the pond's water level is not passable to most aquatic organisms and the culvert is undersized and not designed for wildlife passage; the structures combine to restrict the ability of fish and other species to move up or down the creek. Seatuck Environmental Association received a grant from the Long Island Sound Stewardship Fund in 2021 to work with NYC Parks, The Nature Conservancy, and the USFWS (Fish and Aquatic Conservation Program) to assess and improve the stream connectivity and wildlife habitat at Gablers Creek. The project 1) determined the extent to which, if any, river herring and/or river otters are already using parts of Gabler's Creek, 2) conducted detailed assessments of the barriers to wildlife movement, and 3) monitored water quality in the creek and pond to determine if there were any factors that would inhibit wildlife restoration.

***A 20-year Retrospective Analysis of Long Island Sound Mesozooplankton Trends in the 21st Century* - Ewaldo Leitao, Gihong Park, Lydia Norton, Josiah Grzywacz, Jessie Steadman, Luciana Santoferrara, George McManus, and Hans G Dam (Dept. of Marine Sciences, University of Connecticut)**

Zooplankton sentinels of water quality and climate change, and the main trophic link from primary producers to consumers such as forage fish. We analyzed mesozooplankton (200-2000 µm) data collected in the last 20 years in Long Island Sound (LIS) as part of the CT DEEP Water Quality Program. Six stations were sampled monthly from along the main axis of LIS. Total mesozooplankton biomass and abundances were relatively homogeneous across LIS, with only the station at the mouth being significantly lower than the others. Total abundance showed no trends across time, whereas total biomass showed a slight decrease with time. We then identified the main mesozooplankton taxa (*Temora longicornis*, *Acartia tonsa*, *Acartia hudsonica*), and analyzed their yearly seasonality, and change over time in abundance in each season. In winter months there was an increase in the abundance of the warm season dominant species A. tonsa, and a decrease of the cold season species *A. hudsonica* and *T. longicornis*. Temperature was significantly correlated with all three main taxa, whereas chlorophyll partially explains the abundance of the cold dominant species *A. hudsonica* and *T. longicornis*. Microzooplankton biomass was unrelated to any of these copepod species. We conclude that the concurrent increases in prevalence of warm species *A. tonsa* and decreases of cold species *A. hudsonica* and *T. longicornis* is evidence of a change in community composition.

Monitoring Bivalve Disease in Long Island Sound to Support Increased Shellfish Harvesting Goals - **Meghana Parikh[1], Thuy-Tien Bui[1,2] (1NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, 2) University of California, Berkeley)** Natural, restored, and cultivated oysters in Long Island Sound (LIS) provide major ecosystem services to the region in the form of harvested seafood, as well as water quality and habitat provisioning benefits. To more-fully realize these potential contributions, increasing shellfish production from aquaculture, recreation, and restoration has been identified as an ecosystem target in the LIS Study Comprehensive Conservation and Management Program. Expanding existing natural beds presents a desirable opportunity to increase nutrient removal services and oyster habitat coverage; however, little is known about how expansion may affect the proliferation and transmission of oyster pathogens between populations. Development of risk-based guidance for mitigating bivalve diseases is essential to the successful restoration and cultivation of oysters throughout LIS. To this effect, we analyzed over 20 years of pathology data collected for routine surveillance of predominantly aquacultured oysters in Connecticut. Disease prevalence, intensity, and weighted intensity were calculated at statewide and town-wide levels to illustrate trends of Dermo and MSX diseases over time. Body condition and shell length were compared to disease prevalence and intensity to assess the effects of infection upon oyster health. To best support location-specific oyster disease management tools, location coordinates were assigned for integration into geospatial mapping tools. Additional work quantifying disease presence and progression is needed in unmanaged populations to achieve a comprehensive understanding of how restoration will affect disease dynamics in LIS and to provide evidence-based guidance for mitigation. In a coordinated effort between federal, state, and academic partners, we plan to execute a multi-year survey of natural and restored oyster populations in NY and CT. We will identify key characteristics of the physical environment and oyster biology that contribute to disease expression and enable development of evidence-based guidance for restoration projects building healthy oyster populations to benefit the LIS ecosystem.

Assessment of Habitat Provisioning by Oyster Aquaculture Gear in Long Island Sound for Wild Fish Communities - **Julie M. Rose[1], Adam Armbruster[2], Peter Auster[3], Paul Clark[1], Christian Conroy[2], Mark Dixon[1], Erick Estela[1], Yuan Liu[1,4], Lisa Milke[1], Gillian Phillips[1,4], Dylan Redman[1], Ian Robbins[1], Barry Smith[1], Alison Verkade[5], Renee Mercaldo-Allen[1] ([1]NOAA, NMFS, NEFSC, Milford Laboratory; [2]University of New Haven, Biology and Environmental Science Department; [3]Mystic Aquarium & University of Connecticut Department of Marine Sciences; [4]A.I.S. Inc.; [5]NOAA, NMFS, GARFO)**

Oyster aquaculture gear functions as complex structure that may augment natural seafloor as habitat for economically important fish species. Using a low-cost camera mounting system for two action (Go Pro Hero 3+) cameras, underwater video census was conducted on three working oyster farms in Milford, Norwalk, and Westport, Connecticut, on single cages on low relief sand and shell seafloor in Milford, and on natural structured rock reef habitat in Milford. Fish abundance, community composition, and occurrence of habitat-related behaviors such as foraging, shelter, and reproduction were quantified. Timers were used to delay onset of video recording by 24 hours to allow recovery from deployment disturbance. Video was recorded for 8 minutes every hour for 13 hours during each deployment. Temperature, light level, current speed, and current direction were also measured. Video was collected repeatedly throughout the typical growing season, enabling assessment of seasonal variability.

Deployments were conducted from May through September in 2018 and 2019. Higher numbers of fish were associated with cages as compared to boulders (considered functionally equivalent natural habitat). Black sea bass, scup, and tautog occurred at higher abundance on cages than boulders. Species richness, and variety of life history stages were similar across the two habitats. Higher incidence of black sea bass territorial behavior, and higher incidence of four categories of scup behaviors associated with habitat provisioning were observed on cages versus boulders. Similar abundance and community composition of fish were observed across the three oyster farms in the central-western Sound. Our results suggest that oyster aquaculture bottom cages provide complex structure in soft bottom seafloor environments and provide habitat services for wild fish much like boulders on natural reefs.

Posters:

***Sources of Atmospheric Deposition in Long Island Sound (LIS) and the LIS Watershed* - Sharmin Akter and Kristina Wagstrom (University of Connecticut)**

Long Island Sound (LIS) is one of the most important natural resources and one of the largest estuaries in New England. Due to ongoing nutrient pollution -affecting watershed activities such as fishing, tourism, swimming, and boating, LIS experiences hypoxic conditions (low oxygen levels). Nitrogen is an important nutrient for ecosystems. But excessive deposition of nitrogen-containing species to aquatic systems and watersheds can lead to harmful algae growth and loss of biodiversity in LIS and its watershed. It increases the risk of acidification and hypoxia for living organisms and sometimes causes death. It is important to determine the major sources responsible for atmospheric nitrogen deposition to reduce the amount of excessive nitrogen emissions and deposition leading to eutrophication and other adverse impacts. Photochemical models are often used to simulate air pollutant concentration changes over large spatial and temporal variations considering a set of mathematical equations along with chemical and physical processes. We use an Eulerian photochemical model - Comprehensive Air Quality Model with extensions (CAMx) version 6.0 along with the Particulate Matter Source Apportionment Technology (PSAT), to track sources responsible to very small particulate matters (secondary pollutants) pollution. We model the amount of atmospheric nitrogen deposition from electricity generating units, biogenic emissions, area fugitive dust, on-road, residential wood combustion, agricultural emissions, and other non-point sources. We use emissions, meteorology, boundary conditions, and ozone column inputs developed as part of the United States Environmental Protection Agency's 2011 Modeling Platform. We evaluate total oxidized and reduced nitrogen deposition from atmospheric nitrogen containing species. This information will aid environmental regulators in developing watershed management plans to protect the health of aquatic ecosystems in the watershed by maintaining good water quality. From the results, we found that contribution from on-road emissions to total nitrogen deposition was dominant in Long Island Sound and its watershed because of the high vehicular activity in the nearby, highly populated urban areas. Agricultural ammonia and electricity generating units emissions were also substantial contributors to total nitrogen deposition in the region.

***Fishing for Space in the New Blue Economy: Conflict and Cooperation among Fishing, Aquaculture and Wind Industries in Connecticut* - Syma Ebbin, Nat Trumbull (University of Connecticut)**

Working waterfront space is limited, leading to competition for coastal space among waterfront dependent, and non-waterfront dependent industries. The ascendance of offshore wind power in the US is squeezing already scarce port resources, exacerbating competition for these spaces, and generating conflicts. The Biden administration's prioritization of wind energy generation has augmented demand for port space to serve as production, staging and marshalling areas for this offshore development. Although the development of wind power will occur offshore, Northeast US ports are anticipating port use by wind companies. This paper focuses on the competition for waterfront space among the fishing, aquaculture and wind industries in Connecticut and other New England ports. Emerging wind power in the new Blue Economy looks to reshape port usage, generating both winners and losers. This paper explores the processes by which port space is being (re)allocated and examines the generation of conflicts and cooperation among competing stakeholders

***Can Watershed Land Use Legacies Inform Nitrogen Management?* - Danielle Hare, Joshua Buonpane, Ariana Dionisio, Qian Lei-Parent, Eric M Moore, Mary Becker, Chris Bellucci, David Bjerklie, Paul E Stacey, Emily H Wilson, Wilfred Wollheim, Ashley M Helton (University of Connecticut, University of New Hampshire, Connecticut DEEP, Footprints In The Water LLC)**

Past land use activities (or land use “legacies”) can be strong indicators of contemporary water quality; yet, watershed management strategies often neglect the lag times associated with land change trajectories. Our project objectives are to 1) develop a geospatial classification scheme of vulnerability to watershed land use legacies, 2) quantify the influence of watershed land use legacies on present-day water quality, and 3) engage the public and resource managers in how watershed land use legacies can guide better watershed management decisions within the Long Island Sound watershed. In this presentation, we will describe our ongoing efforts to 1) quantify trends in satellite-derived land cover and classify historic aerial photos to identify areas with high percentages of historic agricultural land practices and deforestation, and subsequent changes in land use over the last century, and 2) synthesize existing datasets and measure water quality and stream biointegrity in select watersheds to evaluate whether incorporating land use legacies improves broad scale relationships between watershed land cover and water quality. We propose that a more complete understanding of land use legacies within the Long Island Sound watershed and how they interact with patterns of nitrogen dynamics and stream biointegrity will allow for better informed and improved management goals and expectations that align with watershed processes.

Safe for Swimming Today? – Long Island Beach and Water Quality App **- Sung-Gheel Jang, Ellie Evans, Jordan Russo, Ranae Ward (Stony Brook University)**
Water quality information on Long Island comes from myriad sources, such as academia, government, and the private sector. This data provides key insight into the status of Long Island’s precious water resources but has never been spatially integrated for the public. Thus, we set out to create the “Long Island Beach and Water Quality App”, a mobile app geographically visualizing beach and water quality data by integrating various sources of information about water quality along Long Island's coastal areas. These sources include: Water Quality Index data from the Gobler Lab at Stony Brook University’s School of Marine and Atmospheric Sciences, shellfish closures by the New York State Department of Environmental Conservation, and beach closings/openings by the Nassau, Suffolk, and New York State Departments of Health. We began by specifying information sources and user requirements. We then edited the data and created REST APIs in ArcGIS Online. Next, we developed the app using AppStudio for ArcGIS by Esri with Qt Modeling Language, creating designs and functions to leverage our data. This easily navigable app provides the latest water quality, shellfish, and beach conditions measured with varying criteria, making it useful for science-interested citizens, fishers, and swimmers alike. Future work will improve its functionality and include additional data, such as the location of harmful algal blooms, fish kills, or rip currents.

Iron Additions to Marine Sediments: Effect of Mass, Grain Size and Species on Porewater Sulfide Scavenging Potential **- Shannon Jordan (University of Connecticut, Department of Marine Sciences)**
Recent amendments in nutrient loading and associated water quality in LIS embayments have improved the prospect of successful eelgrass restoration efforts; however, the relative influence of sediment chemistry on restoration success remains poorly constrained. Previous studies have demonstrated that high porewater sulfide (HS-) concentrations infringe on eelgrass health, and many others suggest that amending sediments with iron is an efficient way of decreasing microbial HS- production and titrating this compound from sediment porewater (Hebert et al. 2007; Holmer et al., 2005a,b; Dooley et al. 2012, Chambers et al. 2001). Here, preliminary experiments aimed to better constrain the ability of iron particles to reduce porewater HS- concentrations in highly organic sediments. Siderite ($FeCO_3$), magnetite (Fe_3O_4), and 1:1 mixtures of the two were added to sulfidic sediments in masses ranging from 9.5 ▯ 0.2 to 91 ▯ 7.8% of dry sediment mass. The effect of particle size was investigated for siderite treatments. Following week long incubations, porewater pH and free sulfide measurements were compared to pre-addition values. The effects of pH were minimal across treatments, with variations <1 within even the highest addition masses. Of the iron species investigated, magnetite and magnetite-containing treatments showed the least variation, removing 99.08▯0.01% of porewater sulfide across mass additions in treatments where controls remained > 1mM sulfide (n=16). The mass dependence of each species’ HS- scavenging capacity remains unclear, as all addition masses showed comparable removal across treatments. Regardless, this experiment provides an upper limit on the mass of magnetite, siderite and combinations of both required to scavenge free HS- for a known mass of sulfidic sediment. These results also suggest that introduction of these iron species to sediments is unlikely to meaningfully disturb porewater pH, altogether providing positive insight into their suitability for use in upcoming eelgrass restoration efforts in LIS embayments (NYS, 2009).

***Factors Influencing Individual Efficacy and Local Confidence in Cultivating Resilient Coastal Communities -* Carolyn A. Lin (University of Connecticut)**

The current study examined the factors that may impact the cultivation of sustainable and resilient communities against negative climate change effects. Minority and vulnerable populations from Connecticut's coastal communities were recruited as survey participants (N=200), in consideration of environmental equity. Study participants (63.8% females and 35.7% males) were represented by 46.5% Blacks, 27.3% non-White Hispanics, 12.6% Asians/Pacific Islanders, 2.5% Native Americans, 9.6% mixed-race individuals and 1.5% "other." While 37.2% of the sample had some high school or a high school degree, another 33.2% had some college or a two-year college degree. As 52.06% of the households earned less than $50,000 annually, 37.7%, 19.6% and 17.1% were employed full time, part-time or not employed. Guided by the Extended Parallel Processing Model, the study measured the influence of cognitive and affective responses in conjunction with adaptive responses—toward coastal flooding, erosion, and storm surge—on participants' self-efficacy, collective efficacy, and confidence in local leaders in mitigating these environmental threats. Multiple regression modeling was utilized to analyze three models: self-efficacy, collective efficacy, and confidence in local leaders (i.e., municipality, government agencies, community leaders, law enforcement and news media). Findings showed that a greater level of mitigation-information seeking activity (β=.14, p=.02), confidence in local leaders (β=.44, p<.001) and willingness to participant in community-based flood-risk management planning (β=.22, p=.001) significantly predicted participants' self-reported self-efficacy (adjusted R2=.38, p=.001). Significant predictors of collective efficacy (adjusted R2=.53, p<.001) included stronger self-efficacy (β=.46, p<.001), willingness to participate (β=.19, p=.002), confidence in local leaders (β=.16, p<.014), and perceived threat severity (β=.16, p<.006). Confidence in local leaders (adjusted R2=.39, p<.001) was significantly predicted by a higher level of self-efficacy (β=.35, p<.001), collective efficacy (β=.22, p<.008), and willingness to participate (β=.15, p<.04), in addition to a weak but more positive attitude toward mitigation barriers (β=.12, p<.051). Study findings contribute to social and public policy implications.

***Nearshore Permeable Reactive Barriers to Treat Groundwater Nitrate Before it Enters the Coastal Ocean -* Jing-An Lin, Molly Graffam, Ron Paulsen, Nils Volkenborn (The New York State Center for Clean Water Technology, School of Marine and Atmospheric Sciences, Stony Brook University, Cornell Cooperative Extension of Suffolk County)**

Nitrogen input through submarine groundwater discharge is considered to significantly contribute to the eutrophication of Long Island Sound. Permeable reactive barriers (PRBs) composed of woodchips that serve a carbon source for microbially-mediated denitrification are a promising technology to intercept groundwater flow and remove nitrate before it enters coastal surface waters. This poster will highlight some of our current research activities intended to gather critical data on PRB performance to inform site-specific PRB design that maximizes NOx removal and minimizes the formation and release of secondary by-products, specifically greenhouse gases. Flow-through column experiments were conducted to assess NOx removal and greenhouse gas formation in different aged PRB woodchip media as a function of NOx concentrations and hydraulic retention times (HRTs) at summer and winter temperatures. Hardwoods (oak, and maple/cherry) outperformed softwood (pine) and N-removal rates were 7-8.5-times higher at 20 ºC than at 7 ºC. At 20 ºC, NOx concentrations declined by up to 6 mg L-1 per ft of PRB media Based on these data, the optimal thickness of a PRB to treat groundwater with a NOx concentration of 6 mg L-1 and a groundwater velocity of 2 ft day-1 was predicted to be 2.4 ft. A 10 ft deep PRB would then remove 0.7 lbs of N year-1 m-1 of shoreline. In 2020, a 100-feet wide PRB was installed at Hampton. The research PRB consists of twelve 8-ft wide,12-ft deep test cells, with triplicates of 2.5 ft and 5 ft thick trench-type PRBs, column-type PRBs, and control cells without woodchips. 2.5 ft and 5 ft trench-type PRB thicknesses were chosen to be capable of removing all incoming nitrate at summer and spring/fall temperatures, respectively. In April 2021, the average NOx concentration upstream of the PRB was 6.3 mg L-1 and 100%, 99%, 84%, and 13% of incoming NOx was removed in the 5 ft, 2.5 ft, column PRB, and control cells, respectively. We conclude that strategically placed and properly installed PRBs should be considered as an additional tool in the toolbox to reduce N-loads to coastal surface waters.

***Tracing Colored Dissolved Organic Matter in Long Island Sound: Elucidating Source and Fate -* Alana Menendez, Maria Tzortziou, Kyle Turner, Dianne Greenfield, Joaquim Goes (The CUNY Graduate Center, CUNY The City**

College of New York, CUNY The City College of New York, CUNY Advanced Science Research Center, Lamont-Doherty Earth Observatory at Columbia University)
Long Island Sound estuary is dynamic in space and time, with biogeochemical transformations occurring from anthropogenic, river, and marine sources, with tidal, seasonal, and interannual variability compounded. Colored dissolved organic matter (CDOM) is both a tracer of these processes, and an integral component that impacts carbon cycling, nutrient cycling, hypoxia, light penetration, and water color. This work represents a robust analysis of in situ LIS CDOM absorption and fluorescence from 2017 through 2021, including PARAFAC modeling, that has allowed us to characterize the diverse pools of LIS CDOM. This dataset has facilitated the development of new algorithms improving the retrievals of CDOM and dissolved organic carbon from high spatial resolution satellite sensors (Landsat-8 OLI and Sentinel-2 MSI) that afford the ability to monitor dynamic river-estuary interfaces. Together, the in situ optical analysis and satellite imagery contribute to a better understanding of LIS CDOM source and fate and help reveal some of the primary controls on LIS water quality.

Examining Temporal Trends of Downstream Migration of Alewife Through a Nature-Like Fishway -
Nicholas Ring (Stony Brook University); Kellie McCartin (SUNY Suffolk County Community College)
Alewife (Alosa pseudoharengus) populations have drastically suffered since the introduction of dams along the east coast, subsequently reducing habitat access to anadromous fish. Fishways are a structure that provides diadromous fish passage to freshwater habitat that is hydrologically obstructed by dams. Fishways also often act as a prime location to monitor and quantify these fish populations via camera monitoring. In the Peconic river, a nature-like fishway was installed in 2010 at the head of a tide dam. A camera placed inside the fishway records all activity during the alewife run. To estimate the population, each day is subsampled by randomly selecting twenty-one 10-minute clips where alewife number and are recorded. In theory, the difference between the number of alewives that migrate upstream to those moving downstream should be a proxy for in-river mortality or represent fish that choose to exit over a spillway. Subsampling periods for each day were designed to capture upstream observations therefore, it is important to investigate any temporal trends of downstream migration through the fishway to determine if subsampling is accurately capturing downstream movements. Using subsampled data, 20.4% (2020) and 15.4% (2021) of all observations were downstream. To assess our subsampling strategy, a total of five days were fully analyzed from 2020 and 2021. Full day data resulted in 10% (2020) and 17% (2021) of all Alewife seen moving downstream. Differences in downstream trends suggest the timing of upstream and downstream migration differ and that this subsampling strategy may not capture the bulk of downstream movement, resulting in higher mortality estimates or underestimate downstream use of this fishway.

T*emporal and Spatial Trends of Long Island Sound Phytoplankton Assemblages During 2020 & 2021* - **Zabdiel Roldan Ayala[1,2], Georgia Humphries[1,2], Silvia Angles[2], Maximillian Brown[1,2], Mariapaola Ambrosone[2], Maria Tzortziou[3], Joaquim Goes[4], Dianne I. Greenfield[1,2], [1]School of Earth and Environmental Sciences, Queens College, CUNY; [2]Advanced Science Research Center at the Graduate Center, CUNY; [3]City College Center for Discovery and Innovation, CUNY; [4]Lamont-Doherty Earth Observatory, Columbia University**
Long Island Sound (LIS) receives significant inputs of nitrogen (N) from the nearby New York City (NYC) metropolitan area mainly due to runoff and combined sewer overflow systems. Despite known linkages between N and harmful algal bloom (HAB) development, the extent to which LIS phytoplankton assemblages vary across spatial (area, depth) and temporal (weeks, months) scales remains less characterized. This study leveraged long-term, water quality and hypoxia monitoring conducted by the Connecticut Department of Energy and Environmental Protection (CTDEEP). Samples were acquired from five Western LIS (WLIS) stations (A4, B3, 04, D3 and C2), in addition to several Central and Eastern LIS stations, all at two depths (surface and sub-chlorophyll (Chl) maximum). We report evaluations of physical water quality (salinity, turbidity, temperature and dissolved oxygen), and nutrients (N, P) from these surveys. Phytoplankton community composition was analyzed using microscopy and molecular (sandwich hybridization assay) approaches. Microphytoplankton cell biovolume was also measured to assess the relative carbon contributions of different genera to overall biomass (chl a). Pico-sized phytoplankton were the greatest contributor to overall Chl a, particularly in WLIS, which is notable because this size class is not easily evaluated through light microscopy. In addition, phytoplankton quantification analysis showed that diatoms were more abundant during the summer 2021 compared to summer 2020. A mid-July bloom of Euglena was detected in WLIS during both years with the 2020 bloom considerably more dense (>1000cell/ml). Both chl a and phytoplankton quantification showed a sudden drop in phytoplankton abundance during May of 2021 at

station A4. In addition, results show that the HAB dinoflagellate Prorocentrum spp. was the most abundant dinoflagellate genus in WLIS during the summers of 2020 & 2021. Results will refine our understanding of the spatiotemporal transitions of phytoplankton assemblages.

***An Introduction to Historical Hudson River Biological Monitoring Program* - Patricia Woodruff, Hsiao-Yun Chang, Stephanie Arsenault, Katrina Rokosz, Robyn Linner, Yong Chen (SoMAS at Stony Brook University)**

The Hudson River Biological Monitoring Program (HRBMP) started in the 1970s to address concerns about the Indian Point nuclear power plant impacts on fishes in the Hudson River, especially striped bass. Various sampling programs were developed in the HRBMP to cover spatiotemporal distribution of different life stages of striped bass and other fishes. In addition to abundance data and biological samples, water quality data were also collected from the river-wide Water Quality Survey. The HRBMP collected more than 150 fish species, over 1 million observations of survey data, and 13 million fish specimens from 1974 to 2019. The collected data and archived biological specimens from the HRBMP were donated to the Stony Brook University School of Marine and Atmospheric Sciences. The collection is currently managed by Dr. Yong Chen's Lab. The Chen Lab is developing research programs in collaboration with stakeholders to understand the impacts of climate and environmental changes and anthropogenic activities on the dynamics of Hudson River ecosystems and key fish populations. The Chen Lab is welcoming opportunities for collaborative research with partners who share similar interests in developing a better understanding of Hudson River dynamics and improved monitoring and management.

***Controlling Invasive Aquatic Plant European Frogbit Using Clearcast and ProcellaCOR EC* - Bin Zhu[1] and Mark Heilman[2] ([1]University of Hartford, Department of Biology; [2]SePRO, Carmel, IN)**

European frogbit (*Hydrocharis morsus-ranae L*. or EFB) is an expanding invasive weed species in the northern US and has demonstrated negative impacts in its invaded systems. Integrated methods for selective control of EFB are needed and are under active investigation. The goal of this project was evaluation of the foliar efficacy of two herbicides, Clearcast (1 lb imazamox/gal) and ProcellaCOR EC (0.21 lb florpyrauxifen-benzyl/gal), on EFB growth. Two independent experiments were conducted at the University of Hartford, West Hartford, CT and the SePRO Research and Technology Campus, Whitakers, NC. Five groups were set up in each experiment: A. control group without any herbicide treatment (control), B. plants treated with Clearcast at 32 fl oz/acre (C32), C. plants treated with Clearcast at 64 fl oz/acre (C64), D. plants treated with Procellacor EC at 10 Prescription Dose Units (PDU)/acre foliar (equivalent to 32 fl oz/acre) (P10), and E. plants treated with Procellacor EC at 10 PDU/acre foliar + Clearcast 32 fl oz/acre (C32+P10). Herbicide treatments were applied to target 20 gal/acre spray solutions. Results from CT showed that plants were completely dead in C64 and C32+P10 at the end of 4-week experiment period; dry biomass in C32 and P10 were similar to the starting biomass but significantly less than the control group. Plant damage was most significant in C64, C32, and C32+P10 treatments. Similarly, results from NC revealed leaf damage in the treatments of C32, C64, and C32+P10. P10 alone showed some leaf curling one week after application, but that damage did not inhibit the plant from producing new growth. At the end of four weeks, plants in P10 ended up with more biomass whereas those in other three groups were significantly reduced. Both experiments concluded that Clearcast alone at the foliar rate of 32 fl oz per acre may control European frogbit effectively, and ProcellaCOR EC alone has low efficacy for European frogbit control.