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ABSTRACTS

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LOOKING TO THE PAST TO PROTECT THE FUTURE: FARMERS IN THE MARSH AND "SMARTeams"

Building on the work of Sebold (1998) and others, we have used historic documents to identify a system of alterations used by salt marsh farmers. Beginning in Maine, we have since reliably found these signatures south to the mid-Atlantic. We review the incentives farmers had for altering salt marshes, as well as some of the techniques used to achieve those ends. Today these features appear on a spectrum from readily visible to exceptionally subtle. For this presentation we focus on the more visible "late period" (1800s) embankments and show examples of such signatures from both aerial imagery and in the field. Further, we review current marsh expression and its relationship to these alterations. SMARTeams (Salt Marsh Adaptation and Resiliency Teams) is an effort to increase the capacity for restoration efforts using these historical insights and innovative restoration techniques. Motivation for this approach stems from increased sea levels, the 18.6 yr lunar cycle and declines of the at-risk saltmarsh sparrow.

Balint, S.J. (1), M. Potter (2), S. Davis (2), A. Oczkowski (3), R.W. Fulweiler (4,5), C. Oviatt (2); *(1) ORISE Fellow, U.S. EPA Atlantic Coastal Environmental Sciences Division, Narragansett, RI; (2) Graduate School of Oceanography, University of Rhode Island, Narragansett, RI; (3) U.S. EPA Atlantic Coastal Environmental Sciences Division, Narragansett, RI; (4) Department of Earth & Environment, Boston University, Boston MA; (5) Department of Biology, Boston University, Boston MA*

TEMPERATURE-INDUCED CHANGES IN ESTUARINE NUTRIENT CYCLING OBSERVED THROUGH STABLE ISOTOPES IN MESOCOSMS

The impacts of increasing water temperature on nutrient dynamics remains an uncertain consequence of climate change in temperate estuaries, particularly regarding nitrogen (N) fixation. Here, the effects of water temperature on N cycling are investigated using stable isotope composition ($\delta^{15}N$ and $\delta^{13}C$) of particulate organic matter collected in mesocosms with -3°C, ambient, and +3°C temperature treatments. Significant differences between warm and cold treatments were observed for both N ($p=0.016$) and carbon (C, $p=0.020$), suggesting that the warmer tanks were experiencing greater rates of N fixation and greater productivity. However, particulate N and C concentration within the water column remained consistent across temperature treatments, indicating that these changes in N sources and productivity were not impacting biomass accumulation. This work builds on a growing body of evidence pointing to the substantial effects climate change will have on estuarine nutrient dynamics.

Bartolucci, N.N., Fulweiler, R.W.; *Department of Earth and Environment, Boston University*

THE IMPACTS OF THIN LAYER PLACEMENT OF SEDIMENT (TLP) ON GREENHOUSE GAS DYNAMICS IN A TEMPERATE SALT MARSH

Sea level rise (SLR) is the primary driver of salt marsh loss in New England. One proposed strategy to increase marsh resilience in the face of SLR is thin layer placement of sediment (TLP). However, we know little about how TLP impacts marsh biogeochemistry such as greenhouse gas (GHG) dynamics. We addressed this knowledge gap by measuring summer GHG fluxes in experimental TLP plots (7 cm and 14 cm of added sediment), control, and reference plots in Coggeshall Marsh, RI. While not significantly different, TLP plots emitted more CH4 (7 cm: 35.7 µmol m-2 hr-1 ± 12.7, 14 cm: 19.8 µmol m-2 hr-1 ± 3.5) compared to control (5.8± 0.7) and reference plots (1.6±0.7). TLP plots took up more CO2 (7 cm: -6.8 ± 0.9, 14 cm: -6.4 ± 0.6) than

reference plots (-2.7 ± 0.8) and comparable amounts to control plots (-7.2 ± 0.7). N2O fluxes were negligible for all treatments. Overall, this study demonstrates the potential for TLP to alter salt marsh GHG dynamics and highlights the need for holistic monitoring of salt marsh restoration approaches

Buchsbaum, R., Perry, D.; *Mass Audubon, Lincoln, MA*

NEERS SYMPOSIUM: MAKING OUR ESTUARIES RESILIENT. HOW ARE WE RESPONDING TO CLIMATE CHANGE IN NEW ENGLAND ESTUARIES?

Estuarine habitats like salt marshes and eelgrass beds have been essential to life in New England since people first inhabited the region. These habitats are highly vulnerable to climate change impacts, particularly increased frequencies of inundation and greater erosion. In salt marshes these stressors transform high marsh vegetation to low marsh and to open water, resulting in challenges for obligate salt marsh fauna. Warmer temperatures threaten to push eelgrass beyond its optimum level of thermal tolerance. This symposium will examine some of the innovative methods being practiced In New England to increase the resiliency of our estuaries to sea level rise. These include sediment deposition, runnelling to drain excess surface water off marshes, remediating tidal restrictions and mosquito ditches, and planting eelgrass. As we build a more inclusive restoration community, we will hear from indigenous voices and learn tools to incorporate indigenous perspectives into restoration.

Hopping R. (1), **D. Burdick** (2), G. Moore (2), G. Wilson (3); *(1) Trustees, N. Andover, MA; (2) Jackson Estuarine Laboratory, School of Marine Science and Ocean Engineering, University of New Hampshire, Durham, NH; (3) Bear Creek Wildlife Sanctuary, Saugus, MA.*

PREPARING A CLIMATE CHANGE-RESILIENT MARSH AT OLD TOWN HILL THROUGH HYDROLOGIC RESTORATION OF ABANDONED AGRICULTURAL INFRASTRUCTURE

Salt marshes at Old Town Hill were farmed for centuries, using ditching, embankments and tide gates to exclude saltwater and drain stormwater. Abandonment, likely in the late 19th century, was followed by re-ditching of relict ditches for mosquito control and less-intensive haying operations. Impairments from legacy structures were investigated in 2017 and a multi-year plan developed and implemented in 2020 to address over-draining and over-saturation in Trustee-owned portions of the marsh. The primary technique, ditch remediation, uses salt marsh hay to heal peat in ditches and restore beneficial hydrology. Monitoring of mosquitos, marsh-nesting birds, water levels, vegetation and sediment accretion was conducted and initial results show progress toward goals. While early trends still need confirmation, presence of mosquito larvae decreased, use by saltmarsh sparrows continued, the marsh surface is accreting, and high marsh vegetation has increased. Operations in 2021 and 2022 will be reported in future presentations.

Burman, E (1), Mulvaney, K (2), Merrill, N (2), Bradley, S (3), and Wigand, C (2); *(1) Oak Ridge Institute for Science Education (ORISE) Fellow at U.S. Environmental Protection Agency, Center for Environmental Management and Modeling, Atlantic Environmental Sciences Division; (2) U.S. Environmental Protection Agency, Center for Environmental Management and Modeling, Atlantic Environmental Sciences Division; (3) University of Rhode Island, Environmental Data Center*

HAZARDOUS AND CONTAMINATED SITES WITHIN SALT MARSH MIGRATION CORRIDORS IN RHODE ISLAND, USA

As salt marshes attempt to migrate upland due to sea level rise, they will encounter land development. Hazardous and contaminated sites (HCSs) -- facilities and infrastructure that store, use, or release harmful substances -- are concerning obstacles to salt marsh migration (SMM) as they can release contaminants. To identify HCSs that migrating marsh may encounter in Rhode Island (RI), USA, we inventoried sites from government sources, assigned contaminant hazard rankings to most sites, and overlayed sites with projected SMM corridors. We found many HCSs across state SMM corridors, especially in urban areas. Common HCSs in and around RI salt marshes include stormwater outfalls, underground storage tanks, facilities that use hazardous materials, and facilities that release pollutants into waterways. These sites pose varying hazards to human and aquatic life if breached. This

coastal HCSs inventory can inform both management practices of coastal salt marshes and decisions about which HCSs to prioritize for remediation.

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AN ANALYSIS OF WASHOVER FAN DEPOSITS RESULTING FROM PERIGEAN SPRING TIDES IN WELLFLEET, MASSACHUSETTS

Over the past year and a half, a washover fan has developed at Duck Harbor in Wellfleet, MA. This washover fan is unique in that its formation was not associated with a storm event and that overwash continues periodically for several days, associated primarily with spring tides and particularly perigean spring tides. The system is inundated with salt water during each event, resulting in significant habitat changes within the floodplain of the Herring River. Here, we present our sedimentological and geomorphological observations tracking the washover fan as it progresses using time-lapse photography, grain-size analysis, elevation transects, and water level and velocity measurements. This dramatic change from a back-barrier wetland to a periodically-inundated tidal inlet has substantial implications for other low-lying, low-energy coastal areas, which are increasingly at risk from sea-level rise and similar inundation events during extreme high tides.

Cheng, H. (1) K. Lotterhos (1), M. McMahan (2), S. Scyphers (1), J. Grabowski (1); *(1) Marine Science Center, Northeastern University (MA); (2) Manomet (ME)*

UNDERSTANDING THE SOCIAL-ECOLOGICAL IMPACTS OF RANGE-EXPANDING SPECIES ON THE AMERICAN LOBSTER FISHERY

The American lobster (Homarus americanus) fishery is being impacted by the effects of climate change in part due to novel, range-expanding species such as black sea bass and blue crabs. Given the significance of this fishery to New England, efforts to enhance its resilience are critical. An initial step is to examine the lobster industry's observations and perspectives. In this study, we conducted a mail and Qualtrics survey of commercial lobster fishers and assessed their 1) observations and perceptions of black sea bass and crab range expansion and prevalence, and 2) concerns about and potential future impacts from these species on the lobster fishery. Fishers stated that water temperature is driving range-expansion and indicated having caught more black sea bass in recent years. Concerns about range expanding species included how they will affect lobster growth and catch rates. Assessing the local ecological knowledge of fishers will help resource managers mitigate the potential impacts of climate change on commercial fisheries.

Chidsey, T.J. (1, 2) Al-Haj, A.N. (1) Fulweiler, R.W. (1, 2); *(1)Boston University Department of Earth and Environment, (2) Boston University Department of Biology*

QUANTIFYING SANDY BEACH GREENHOUSE GAS FLUXES WITH AND WITHOUT EELGRASS WRACK

Few studies have made *in situ* measurements of gas fluxes from seagrass wrack, yet beach wrack is considered a hotspot for decomposition. We measured nitrous oxide (N_2O), methane (CH_4), and carbon dioxide (CO_2) fluxes on a sandy beach near *Zostera marina* meadows on three occasions in summer 2021. We used benthic chambers to measure fluxes in three chamber substrate scenarios: bare beach, wrack and beach, or wrack alone. We observed no significant N_2O fluxes during any incubations. CO_2 fluxes ranged from 0 to 11,939.52 μmol m^{-2} h^{-1} and did not differ across scenarios. CH_4 fluxes ranged from -1.68 to 3.92 μmol m^{-2} h^{-1}, did not differ across scenarios, but were significantly ($p = 0.007$) different on two sampling dates. We analyze possible drivers of these flux patterns using generalized linear models of environmental parameters, presenting implications for greenhouse gas flux management in coastal areas.

Colarusso, P.D. (1), E. Shumchenia (2), Z. Libohova (3); *(1) US EPA; (2) Northeast Regional Ocean Council; (3) US Dept. of Agriculture*

A REGIONAL ASSESSMENT OF BLUE CARBON RESOURCES FROM MAINE TO NEW YORK

Blue carbon is the accreted carbon associated primarily with the sediments in salt marshes, mangroves and seagrass meadows. A workgroup of 30 scientists collaborated on compiling data on salt marsh and eelgrass distribution and the carbon sequestered in these systems. Carbon heat maps depicting areas of high carbon accumulation were created and will be presented.

Crawford, H.; *The Nature Conservancy, Department of Environmental Science and Policy, Northeastern University, Boston, MA.*

A LITERATURE REVIEW FOR SALT MARSH INSURANCE PILOT PROJECT

Salt marsh covers 1.7Mha of land in the continental US and are gaining more attention than ever for climate change adaptation. Salt marshes sequester more carbon/acre compared to other habitats and bolster coastal resiliency. Salt marshes face both acute and chronic threats, including damage from storms, sea level rise, and oil spills. After these events, rapid response is crucial to restore functional, resilient marshes. Funding these repairs is often prohibitively expensive and complex. Salt marsh insurance represents an innovative financial solution to enable salt marsh restoration after damaging events occur. The first phase of this salt marsh insurance feasibility assessment provides a comprehensive overview of hazards and threats to salt marshes, the types of actions needed for salt marsh repair and restoration, and restoration cost estimates. Salt marsh insurance can increase the resilience of coastal communities and salt marsh habitats by ensuring that funding is directed to salt marsh restoration when damages occur.

Davenport, T.M., J.H. Grabowski, A.R. Hughes; *Department of Marine and Environmental Sciences, Northeastern University Marine Science Center, Nahant, MA*

EDGE EFFECTS INFLUENCE THE COMPOSITION AND DENSITY OF REEF RESIDENTS ON SUBTIDAL RESTORED OYSTER REEFS

Within estuarine and coastal ecosystems, ecological processes can vary within habitats, which has important implications for the design and implementation of restoration efforts aimed at enhancing ecosystem functions and services. We examined how habitat (presence; edge vs. interior) influences communities of resident fish and mobile invertebrates on restored oyster (*Crassostrea virginica*) reefs in Rhode Island, USA. Reef presence altered community composition and augmented total abundance and biomass relative to sedimentary habitat. Community composition and biomass also differed between reef edges and interiors via species-specific patterns. Patterns were weakly linked to oyster density, suggesting that other factors that vary between edge and interior (e.g., predator access or species interactions) are likely more important for community structure on oyster reefs. Fine-scale information and mechanistic studies on resident species' use of oyster reefs may allow decision-makers to optimize the amount of edge vs. interior habitat.

DiTomaso, A.M., T. Maney, M. Fregeau; *Department of Biology, Salem State University, Salem, MA*

INSHORE AND OFFSHORE PLANKTON POPULATIONS AND THEIR IMPACTS ON MUSSEL FARM HEALTH

Salem State University's Northeastern Massachusetts Aquaculture Center (NEMAC) mussel farm conducts biweekly monitoring for local plankton populations. Throughout the year of 2020, samples of zooplankton and phytoplankton were collected from both the offshore mussel farm site (7.5 NM off Rockport MA) and inshore (Sandy Bay, Rockport) sites for comparison. Through this sampling and surveying of the seasonal plankton blooms at these sites, we are able to measure the seasonal availability of plankton for the mussels to consume, as

well as the likelihood of contamination from sources of Paralytic and Amnesic Shellfish Poisoning (PSP and ASP).

Donnelly, B.R., J.L. Bowen; *Department of Marine and Environmental Science, Northeastern University, Boston, MA*

MULTIPLE STRESSOR INFLUENCE ON MICROBIAL COMMUNITY STRUCTURE AND NITROGEN CYCLING IN TIDAL, FRESHWATER WETLANDS

Increases in both salinity and temperature can have direct impacts on microbial communities that underly crucial biogeochemical ecosystem services such as carbon storage and nutrient cycling. We elucidated the influence of increased temperature, increased salinity, and both stressors in tandem on nitrogen cycling and microbial community structure and function in sediments from a tidal, freshwater wetland. Increased salinity initially inhibited denitrification and promoted nitrous oxide production. Increased temperature stimulated denitrification, but over time all three treatments showed no significant difference in denitrification rates suggesting potential underlying microbial community changes. The multiple stressors stimulated rates of dissimilatory nitrate reduction to ammonium throughout the entire experiment, likely due to the introduction of sulfide. Salinity proved to be the driving factor in altering nitrate-reducing pathways leading to tidal, freshwater wetlands potentially becoming a source of N_2O instead of a sink.

Fiorilla, J.E. (1), D.S. Johnson (2); *(1) Marine Biological Laboratory, Woods Hole, MA; (2) Virginia Institute of Marine Science, Gloucester Point, VA.*

INVESTIGATING FACTORS THAT INFLUENCE POPULATION DYNAMICS OF THE COFFEE-BEAN SNAIL

We looked at the response of the coffee-bean snail, *Melampus bidentatus*, to long-term nutrient enrichment in the salt marshes of northeast Massachusetts. We found that densities moderately increased with the addition of nitrogen to the system. While there was some evidence of legacy effects after enrichment was stopped in 2016, a dramatic decline in snail density and biomass was observed between 2017 and 2018. This decrease was noted in both treatment and reference marshes. We suggest this mortality resulted from Winter Storm Grayson. As of 2021, the data indicates that the salt marsh coffee-bean snail population has since recovered to historical densities.

Geoghegan, P. (1), J. Obrien (1), C. W. Walker (2), M. Heagy (3), S. A. Bottger (4); *(1) Normandeau Associates, Inc.; (2) University of New Hampshire; (3) University of Guam; (4) West Chester University*

LONG-TERM TRENDS IN THE OCCURRENCE OF HEMIC NEOPLASIA IN A POPULATION OF SOFTSHELL CLAMS (*MYA ARENARIA*) FROM A NEW HAMPSHIRE ESTUARY.

Annual trends of hemic neoplasia in Softshell Clams in the Hampton-Seabrook estuary were quantified using logistic regression from 3,975 individuals collected from 2002-2018. There was a negative trend in the incidence of stage 1 neoplasia (0-25% neoplastic cells), positive trends in the incidences of stages 2 and 3 (26-50% and 51-75% neoplastic cells), and no trends in incidence of stage 4 (76-100% neoplastic cells). The significant changes in neoplasia development suggest that the incidence of the disease is increasing. The lack of a significant trend in the terminal stage 4 neoplasia may be due to the short duration of this stage prior to death. The mean length of Softshell Clams with stage 4 neoplasia was 66.7 mm (range= 53.2-78.1 mm), which indicates that terminal neoplasia only occurs in reproductive adults. The presence of advanced stages of the disease in sexually mature individuals can reduce the reproductive potential of the population.

E. Gorrill (1), D. Burdick (1), C. Peter (2), K. Cressman (3), S. Shull (4), C. Feurt (5), B. Russell (6); *(1) The University of New Hampshire, Durham, NH; (2) Great Bay National Estuarine Research Reserve, Greenland, NH; (3) Grand Bay National Estuarine Research Reserve, Moss Point, MS; (4) Padilla Bay National Estuarine Research Reserve, Mount Vernon, WA; (5) Wells National Estuarine Research Reserve, Wells, ME; (6) Clemson University, Clemson, SC.*

AN EVALUATION OF SALT MARSH BIOMONITORING METHODS USED ACROSS A NATIONAL COLLABORATIVE STUDY

Salt marshes are critical to estuary health and protection of coastal communities. For salt marshes to continue carrying out ecosystem services, they must be able to maintain integrity against sea-level rise (SLR). Monitoring data were collected at National Estuarine Research Reserves (NERRs) across the United States to examine how salt marsh systems are changing with SLR. While the NERRs all followed the same protocol as a baseline for monitoring at their reserves, the methodologies at each reserve evolved, resulting in several variations in methods. Meetings with each NERR clarified these differences in the methods used and the unique attributes of each Reserve. The reconciliation of metadata highlighted the similarities and differences in monitoring across the NERRs, and raised the questions: How can the collaborative data best be analyzed together despite the differences in methods? Going forward, what methods should be adopted by each NERR to improve consistency and our ability to analyze data at regional and national scales?

Gravelle,N.L., S.E. Appelbaum, C.C. Chabot; *Department of Biological Sciences Plymouth State University Plymouth, NH*

SEX ON THE BEACH AND IN THE MUD: AMERICAN HORSESHOE CRAB BREEDING IN BEACH AND ALTERNATIVE HABITATS

The American horseshoe crab, *Limulus polyphemus*, is a keystone species and recent decreases in suitable breeding habitats and declines in some populations has increased interest in their population biology and breeding behavior. Although beaches are thought to be the primary breeding habitat, most of the eastern coastline is not beach, and horseshoe crabs have been observed spawning in alternative habitats. However, this behavior has been assumed to be non-adaptive and rare. To better understand the relative importance of these habitats for horseshoe crab breeding, we assessed breeding behavior and egg density at both beach and alternative sites in Great Bay, NH. The results demonstrate two surprising findings: similar densities of both breeding horseshoe crabs and egg densities were found in both beach and alternative habitats. Thus, alternative habitats are crucial for horseshoe crab spawning activity and these results will help to inform conservation efforts for this species and the many other species that depend on them.

Hayes, J.S. (1), Y. Chen (2), H. Chang (2), P. Woodruff (2), C. Roble (1); *(1) Hudson River Park, New York, NY; (2) Stony Brook University, Stony Brook, NY*

CORROBORATING LONG-TERM DATASETS TO ELUCIDATE SHIFTS IN LOCAL FISH POPULATIONS WITHIN THE LOWER HUDSON RIVER ESTUARY, NYC

For over 30 years, The River Project, now part of Hudson River Park (the Park), has conducted ongoing fish abundance and diversity surveys between Piers 25 and 40 in the Park's Estuarine Sanctuary. This survey is one of the longest-running fish population monitoring efforts in NYC and the data collected on over 12,000 fish of 44 species could prove instrumental in demonstrating influences of climate impacts and anthropogenic activities on local fish populations.

Preliminary analysis identifies an overall decline in species richness and evenness as the community composition shifts to be dominated by a few, highly prevalent species such as oyster toadfish (*Opsanus tau*) and blackfish (*Tautoga onitis*). The Park will continue this survey and develop analytical tools to monitor the dynamics of fish community and populations in an ever-changing urban estuary.

Jakuba, R.W. (1), A.F. **Besterman** (1,3), J.E. Costa (2), L. Deegan (3), W. Ferguson (4), D. Brennan (5), N. Ganju (6); *(1) Buzzards Bay Coalition; (2) Buzzards Bay National Estuary Program; (3) Woodwell Climate Research Center; (4) Save The Bay; (5) Bristol County Mosquito Control Project; (6) U.S. Geological Survey*

EARLY RESPONSES TO RUNNELS IN TWO BUZZARDS BAY MARSHES

Across southern New England marshes have lost significant area and loss is increasing in some places. One marsh restoration technique gaining attention involves restoring tidal hydrology on marshes by creating small, shallow channels ("runnels") that drain areas of expanding shallow water. If left untreated, these shallow water areas could expand outward, killing vegetation and converting interior marsh platform into open water. We tested runnels using a Before-After-Control-Impact study design. The study includes 10 runnel-sites and 10 reference-sites, distributed across two marshes in Buzzards Bay. The runnel and reference sites capture a range of characteristics likely to impact the efficacy of runnels (marsh elevation, water depth in dieback areas, percent bare ground and condition of peat soil). We are monitoring vegetation, hydrology, soil characteristics, and structural properties. After only one year there were indicators at both sites that runnels were restoring tidal hydrology and revegetation was beginning in denuded areas.

James, M.M., J. O'Donnell; *Department of Marine Sciences, University of Connecticut, CT*

OBSERVATIONS OF THE CIRCULATION IN A SALT MARSH CREEK

Local salt marshes provide a natural defense against flooding and storm damage along the shoreline. By studying the complex flow regime within a marsh system, we can better understand the ways they buffer storm damage. In this study, we evaluated the interactions and connections of marsh grasses and channels 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 experienced shear as adjacent marsh grasses flooded. Under certain conditions, the flow in the channel followed the law of the wall for bottom friction. Analyzes of marsh flow dynamics under fair weather conditions will potentially lead to more accurate flood predictions during storms.

Kahn, B.C.M. (1,2), Zarnoch, C.B. (1,2), Gosnell, J.S. (1,2); *(1) Department of Biology, The Graduate Center, City University of New York, 365 Fifth Avenue, New York, NY; (2) Department of Natural Sciences, Baruch College, City University of New York, 17 Lexington Ave, New York, NY.*

SALT MARSH NUTRIENT AND GAS FLUXES ARE UNAFFECTED BY ACIDIFICATION IN A SEDIMENT CORE STUDY

Nitrogen (N) loading contributes to coastal habitat degradation through hypoxia and harmful algal blooms. In eutrophic estuaries, respiration and decomposition of algal blooms can lower seawater pH in a process known as coastal acidification. It is unclear how acidification affects important biogeochemical process such as denitrification in salt marshes. We measured nutrient and gas fluxes in response to manipulated pH in sediment cores collected from two contrasting marshes (restored vs degrading) in Jamaica Bay, NY. We hypothesized that acidification would result in CO2 fertilization of autotrophic nitrifiers which would enhance coupled nitrification-denitrification. However, we found no effect of acidification on any measured variables. There were differences in nutrient and gas fluxes between study sites likely related to sediment conditions. These results suggest that denitrification in eutrophic salt marshes may be unaffected by acidification and the marshes will continue to provide the ecosystem service of nitrogen removal.

Karberg, J.M.; *Nantucket Conservation Foundation, Science and Stewardship Department*

NATURE-BASED COASTAL RESILIENCE PILOT PROJECT: OYSTER CASTLE REEFS IMPROVING SALT MARSH HEALTH AND RESPONSE TO SEA LEVEL RISE

Faced with coastal salt marsh dieback as well as poorer harbor water quality, the Nantucket Conservation Foundation undertook the laborious process to design and permit an intertidal oyster reef to provide salt marsh protection from storm and wave impacts while improving localized water quality. This solution had not previously been permitted in Massachusetts. Working through the MA In Lieu Fee Program and building partnerships with local shellfish associations, USACE, MA CZM, MA DEP and MA DFW, we obtained permitting within a year and a half with full reef installation completed over 3 days in November 2021. We designed extensive pre- and post-installation monitoring to capture reef impacts to intertidal water movement, storm surge impacts, salt marsh erosion, salt marsh health and harbor water quality as well as monitoring the physical reef successful. This project demonstrates how to develop and implement innovative nature-based coastal resilience solutions and provides a model for other salt marsh protection projects.

Kendzia, T.A.; *Department of Environmental Policy and Management, American Public University, Charlestown, WV.*

COASTAL RESILIENCY OF PHRAGMITES AUSTRALIS: REVIEWING THE BENEFITS OF AN INVASIVE REED

This research reviews specific components of coastal salt marsh resiliency to identify attributes of Phragmites australis that impact the adaptive capacity of the marsh. The review focuses on resilience issues in mid-Atlantic and New England coastal marshes related to the chronic stress of sea level rise. Many marshes are considered at risk of being lost due to environmental and anthropogenic factors. The research reviews and synthesizes published literature on the topics of salt marsh accretionary and erosional mechanics, salt marsh evolution modeling, and the attributes of the reed as related to the provision of ecosystem engineering services. The expansion of Phragmites into the salt marsh presents a strong suite of functional traits that influences local geomorphology, providing enhanced resistance to steady environmental pressures that threaten the stability of marshes. I propose a more holistic management that will consider the presence of Phragmites as an active mechanism of marsh adaptation.

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MANAGING COASTAL MARSHES IN THE FACE OF SEA LEVEL RISE: THIN LAYER PLACEMENT AND SOIL PORE WATER CHEMISTRY

Salt marshes worldwide face widespread loss as sea levels rise and landward marsh migration is constrained by human development. Thin layer placement (TLP) is a management strategy in which sediment is added to the marsh surface to increase elevation and prevent wetland loss, but can hinder plant growth if acid sulfate soils develop. To evaluate the feasibility of TLP and prevent the development of acid sulfate soils for salt marshes bordering Long Island Sound, we used a soil core experiment consisting of low-cost soil amendments (mulch, crushed shells, pelletized lime, and recycled concrete). Preliminary analysis of weekly pore water samples show that crushed shells were most effective at increasing soil pH, while recycled concrete provided an immediate pH

increase, which declined as the experiment progressed. These experimental results can inform managers to improve large sale restoration projects.

MacNeil, C., Fregeau, M., Maney, T.; *Salem State University, Salem MA*

MONITORING CLIMATE CHANGE IN COASTAL AND OFFSHORE GULF OF MAINE

At Salem State University, the Northeastern Massachusetts Aquaculture Center (NEMAC) established an offshore mussel farm 7.5 NM off Rockport Massachusetts. Every other week, a YSI EXO SONDE is deployed to collect samples at both inshore (Sandy Bay, Rockport) and in deeper offshore waters at the farm site. The goal of this oceanographic study is to monitor climate change effects of pH, chlorophyll, temperature, and salinity within the Gulf of Maine. Changes could affect the plankton community, harmful algal blooms, and mussel growth. The data are presented in 5-meter depth intervals, leading to interesting results within our study.

MacNeil, C., Fregeau, M., Maney, T.; *Salem State University, Salem MA*

MICROBIAL DATA COLLECTED FROM IN SHORE AND DEEP WATERS

At Salem State University, the Northeastern Massachusetts Aquaculture Center (NEMAC) established an offshore mussel farm 7.5 NM off Rockport Massachusetts. Every other week, a YSI EXO SONDE is deployed to collect samples at both inshore (Sandy Bay, Rockport) and in deeper offshore waters at the farm site. The goal of this oceanographic study is to monitor climate change effects of pH, chlorophyll, temperature, and salinity within the Gulf of Maine. Changes could affect the plankton community, harmful algal blooms, and mussel growth. The data are presented in 5-meter depth intervals, leading to interesting results within our study.

Mazur, C.I. (1), Fulweiler, R.W. (1,2); *(1) Boston University, Department of Earth & Environment; (2) Boston University, Department of Biology*

ESTUARINE SEDIMENTS EXHIBIT VARIABLE FLUXES OF NITROUS OXIDE AND METHANE IN RESPONSE TO COASTAL ACIDIFICATION

Increased nutrient loading is the primary driver of low pH (i.e. acidification) in estuaries. Research from terrestrial studies suggest microbial processes responsible for the production and consumption of nitrous oxide and methane are sensitive to changes in pH, however, measurements of these fluxes in marine systems remain largely unconstrained. To fill this knowledge gap we conducted continuous flow through incubations on sediments collected from two sites in Waquoit Bay (MA) representing high and low nutrient impact. We exposed sediments to moderate (pH 7.3) and extreme (pH 6.3) acidification events. Our findings show acidification alters fluxes differently depending on the level of impact. In the high impacted site nitrous oxide flux increased and methane flux decreased under acidic conditions. In the low impacted site acidification decreased nitrous oxide flux but had no clear effect on methane. We will discuss the possible drivers of these fluxes and the implications for coastal greenhouse gas budgets under acidification.

McGarrigle, S. and H. Hunt; *Department of Biology, University of New Brunswick, Saint John, New Brunswick, Canada*

MULTIVARIATE INFAUNAL INVERTEBRATE COMMUNITY RESPONSE TO ALTERED SEDIMENT CARBONATE CHEMISTRY IN THE BAY OF FUNDY

In the coastal environments, eutrophication and ocean acidification both decrease pH and impact the abiotic conditions experienced by marine life. Infaunal invertebrates are exposed to more extreme pH conditions than epifauna, as porewater pH is typically lower than the overlying water. Here, we investigated the impacts of altering sediment carbonate chemistry, through the addition of transplanted green algae and/or crushed shell hash,

on the infaunal community in a factorial field experiment conducted on an intertidal mudflat in 2020. There was a significant interaction between algae and shell treatments in month 1. The community composition was more similar between samples when a high amount of shell hash was added to the treatment plots, no matter the algae treatment. Due to the complexity of the processes driving sediment pH and carbonate chemistry in the coastal ocean, further experiments focusing on drivers and effects of sediment acidification are required to deepen our understanding of the impacts on infaunal marine species.

Moore, G.E. (1) D.M. Burdick (2), A.R. Payne (3), E. Dutton (1), D. Jean (4); *(1) Department of Biological Sciences, University of New Hampshire; (2) School of Marine Science and Ocean Engineering, University of New Hampshire; (3) Drexel University; (4) Department of Molecular, Cellular and Biomedical Sciences, University of New Hampshire.*

ACCRETING EVIDENCE: HOW A NATURAL SEDIMENT EVENT AND A THIN LAYER PLACEMENT (TLP) STUDY LED TO SIMILAR CONCLUSIONS IN TWO NEW ENGLAND SALT MARSHES

Significant regulatory hurdles in New England discourage scalable application of thin layer placement that could help salt marshes keep pace with sea level rise, despite evidence of the utility of this technique elsewhere. A large-scale natural event in 2018 provided an opportunity to explore the effects of sediment placement in the Great Marsh (MA), while an ongoing field manipulation looked at the same metrics in Great Bay (NH). Despite different scales, both studies found 1) sediment did not significantly migrate after placement; 2) pore water did not differ for pH, redox, salinity or sulfides; 3) vegetation composition and percent cover reflected reference conditions within two growing seasons for additions through 7cm depths; 4) invertebrates were not affected for additions ≤14cm; and 5) belowground biomass rapidly exploited new sediment regardless of thickness. Our evidence suggests that whether natural or manually placed, ≤7cm sediment doesn't significantly impact vegetation or invertebrates and appears to build marsh capital.

Nelson, G, K. McCartin, A. Dries, N. Cormier; *SUNY Suffolk County Community College*

COMPARING NEKTON COMMUNITIES IN SOUTH SHORE SALT MARSHES WITH DIFFERING STAGES OF RESTORATION

An Integrated Marsh Management approach is being used to restore four salt marshes (Suffolk County, NY) to improve coastal resiliency. Surveying nekton communities throughout all stages of restoration is an essential component of salt marsh monitoring. During summer 2021, we used minnow traps to conduct nekton surveys at four sites representative of different levels of post-restoration. Fish and invertebrate abundance and species richness were measured for each site, month, and microhabitat. Preliminary results show a temporal change in nekton communities across all sites, with increased species richness as summer progressed. Killifish abundance and species richness were higher for nearly all traps deployed in ditches compared to micro-pools. Abundance of sheepshead minnows was highest at sites with little to no restoration. Our results suggest that the relationship between the level of salt marsh restoration and nekton community composition is complicated and may be dependent on other factors.

Novak, AB; *Boston University*

RESTORING RESILIENT EELGRASS POPULATIONS IN A EUTROPHIC AND THERMALLY STRESSED SYSTEM

Nantucket Island supports over 2,000 acres of eelgrass that serve as essential habitat to a number of different species including the last commercially viable "wild" bay scallop fishery in the U.S. The abundance of eelgrass has, however, diminished from historic levels by 30% in some areas. In 2018 and 2020, we assessed the overall health of eelgrass meadows located at multiple sites in Nantucket by collecting information on various eelgrass plant parameters. Our results show that eelgrass meadows are exposed to high levels of nutrients, light-limited, and thermally stressed during the peak growing season, suggesting that cultural eutrophication as well as warming

waters are contributing to eelgrass losses. To facilitate recovery of eelgrass, our team implemented a ½ acre eelgrass restoration in Nantucket Harbor using innovative techniques and community volunteers. Eelgrass is surviving and expanding at the site, suggesting that restorations could be used to offset losses and build a population resilient to multiple stressors.

Pappal AL, (1) **Kahl, K.** (2); *(1) Massachusetts Office of Coastal Zone Management, Boston, MA; (2) University of Massachusetts Amherst, Gloucester Marine Station, Gloucester, MA*

DEFINING PRIORITY RESEARCH FOR RESILIENT SALT MARSHES

Given the complexity of marsh systems and the serious threat of climate change, a collaborative, transdisciplinary approach is needed to address data gaps, improve understanding of drivers of change, and inform effective management strategies. In recognition of this need the Salt Marsh Working Group (SMWG), a network of state, federal, nonprofit, and university researchers, and coastal resource managers in the New England Region was formed in 2018. The SMWG meets regularly to advance salt marsh resiliency through sharing of ideas, research, and supporting collaborative action. In the last year the SMWG identified priority salt marsh research and data needs through a consensus-based approach. Next steps to take action from the resulting document outlining these priorities, and the process to socialize and attain them will be discussed.

Pau, N (1), Burdick, D. (2), Wilson, G (3), and S. Adamowicz (1); *(1) US Fish and Wildlife Service; (2) University of New Hampshire; (3) Northeast Wetland Restoration*

APPLYING INNOVATIVE RESTORATION TECHNIQUES IN THE GREAT MARSH

From 2015-2020, marsh practioners in the Great Marsh piloted several innovative techniques to address signs of marsh degradation. Through these studies, we have learned how past salt marsh haying infrastructures and Open Marsh Water Management features can exacerbate impacts of climate-related flooding, and how restoration techniques such as runnels and ditch remediation can reverse trajectories of marsh conversion or subsidence. We will present results from these pilot studies, and how they are currently being used in concert to restore marsh-level tidal hydrology for a resilient marsh that is able to keep up with sea level rise and provide habitat for salt marsh sparrows.

Pellegrino, P.E.; *Coastal Resource Analysts, Waterford, CT 06385*

THE LIVING SEASHORE

The Living Seashore is a series of interactive, multimedia electronic books that combine live video footage of shallow water invertebrates along with physical descriptions of habitats and organisms. Each volume deals with a specific invertebrate community and all are free. They are literally living reference collections. The interactive format allows the reader to control the flow of information. These guides allow the viewing of living invertebrates with their natural colors rather than just looking at lifeless, contorted, colorless preserved specimens. These guides will allow the reader to gain the true essence of these animals and to appreciate their natural beauty.

Pelletier, M.C. (1), D. Cobb (1), K. Rocha (1), K.T. Ho (1), M.G. Cantwell (1), M. Perron (2), M.A. Charpentier (3), H.W. Buffum (3), S.S. Hale (4), R.M. Burgess (1); *(1) US EPA, Office of Research and Development, Center for Environmental Measurement and Modeling, Atlantic Coastal Environmental Science Division, Narragansett, RI, USA; (2) US EPA, Office of Chemical Safety and Pollution Prevention, Office of Pesticide Programs, Health Effects Division, Arlington, VA, USA; (3) General Dynamics Information Technology, Narragansett, RI, USA; (4) US Environmental Protection Agency, retired*

SEVEN DECADES OF BENTHIC COMMUNITY CHANGE IN AN URBANIZED ESTUARY: A HISTORICAL ECOLOGY APPROACH

Narragansett Bay is representative of urbanized estuaries in the northeastern US. Human development led to environmental degradation, which in turn promoted implementation of management controls starting in the 1970s. This study was designed to examine the response of benthic macroinvertebrates communities to large decadal changes in stressors and to management actions in the watershed between the 1950s through the 2010s. In Greenwich Bay and the Providence River, patterns of benthic response reflected the decline and then improvement in sewage treatment at the Fields Point wastewater treatment plant. In Mount Hope Bay, benthic impairment was related to changes in bay fish populations due to thermal discharge from the Brayton Point power plant. The benthos of the Upper West Passage reflected climatic changes that caused regime shifts in the plankton and fish communities. Future work will examine the effects of further environmental improvements in the face of continued climatic changes and population growth.

Perry, D.C. (1,2), W. Ferguson(3), C. Thornber(2); *(1) Mass Audubon, Lincoln, MA; (2) Department of Natural Resources Science, University of Rhode Island, Kingston, RI; (3) Advocacy & Restoration, Save The Bay, Providence, RI*

SALT MARSH CLIMATE ADAPTATION: USING RUNNELS TO ADAPT TO ACCELERATING SEA LEVEL RISE

Hydrological alteration (ex. Runnels) is a type of climate adaptation technique that can be used to combat the effects of sea level rise within salt marshes. Runnels (shallow channels) are used to enhance drainage in marshes undergoing flooding stress. In this Rhode Island study, we investigated the impacts of runnels, 3–5 years post-implementation, on vegetation composition and greenhouse gas fluxes. We studied two runnel treatments (Low Elevation Runnel and High Elevation Runnel) and found that in the Low Elevation Runnel areas *Spartina alterniflora* stem density significantly increased in the third growing season after runnels were installed, and the high marsh plant, *Spartina patens*, persisted in the High Elevation Runnel areas. There was a significant impact on carbon dioxide uptake rates, with an increase in CO_2 uptake over time seen in the Low Elevation Runnel. These findings highlight the potential use of runnels to combat sea level rise impacts and provide insights for future adaptation efforts.

Peter DL,; *Woodwell Climate Research Center*

MEANINGFUL RESEARCH FOR MEANINGFUL IMPACT: ARCTIC RESEARCHERS AND INDIGENOUS COMMUNITIES WORKING TOGETHER TO COMBAT GLOBAL CLIMATE CHANGE

People in the Arctic are feeling the effects of climate change at 3x the rate as the rest of the world. Food insecurity, unclean drinking water, inaccessibility, thawing permafrost, thermoerosion, and loss of culture are just a few examples of the climate injustices inflicted upon Indigenous people in Alaska. Indigenous knowledge and western science have the power to implement change, if the science is done and communicated correctly, and in a way everyone will understand. Ms. Peter has created a Guiding Principles document to build a bridge between western researchers and Indigenous people, with 11 principles to hold the hand of western researchers and scientists as they conduct their research in the Arctic.

Carr, J.A. (1), **H. Plaisted** (2), J. Nagel (1), S. Rasmussen (2), H. Neckles (1); *(1)U.S. Geological Survey, Eastern Ecological Science Center at the Patuxent Research Refuge; (2)U.S. National Park Service*

NORTHEAST COASTAL AND BARRIER NETWORK PREDICTING EELGRASS VULNERABILITY TO ENVIRONMENTAL CONDITIONS UNDER CHANGING TEMPERATURE REGIMES IN PLEASANT BAY, CAPE COD, MA.

Increased water temperature due to climate change is predicted to exacerbate stresses to eelgrass beds throughout the northeastern US. We developed a model to predict how eelgrass distribution and abundance within Pleasant Bay, MA will likely change with expected temperature increases under climate change scenarios. Long-term eelgrass, water quality monitoring, and satellite temperature data were leveraged to generate spatial distributions

of environmental drivers. This driver data was then used by a mechanistic model calibrated with long term field monitoring data to predict spatial eelgrass distribution under three temperature regimes. Distribution and abundance are predicted to decline under all regimes. Predicted loss occurs along the shallow and deep edges of the meadows; eelgrass becomes limited to a narrow depth range where both light and temperature conditions remain favorable. These results inform managers of the prospects for eelgrass and will aid in the development of conservation strategies to sustain eelgrass populations.

Rozsa, R; *Plant community ecologist, Ashford, CT*

MAMACOKE MARSH A REVERTED SALT MARSH

In 1961, Dr. William Niering described Mamacoke Marsh (MM) as a natural, unditched marsh. Spring 2021, Sue Adamowicz and Geoff Wilson were touring MM when they located a series of colonial reclamation embankments designed to drain the central basin and divert freshwater from the upland into the estuary. Rhizome analysis of the central basin revealed the conversion of the wet basin vegetation dominated by *Spartina alterniflora* stunted (Sas) to *Distichlis spicata* perhaps as early as the late 1600's. In 1934, three megapools dominated the marshscape. Only the central basin megapool was present in 1951 and its area had been reduced by ~50%. The marsh is mapped in 1957 and the megapool is replaced by Sas. The marsh sits high in the tidal frame and was tracking sea level rise in 2015. The return of the marsh to the pre-reclamation condition is a testament to the resiliency of tidal marshes.

Rudman, A. (1), Mulvaney, K. (2), Merrill, N. (2), Canfield, K.(2); *(1) ORISE Fellow, U.S. Environmental Protection Agency, Atlantic Coastal Environmental Sciences Division, Narragansett, RI; (2) U.S. Environmental Protection Agency, Atlantic Coastal Environmental Sciences Division, Narragansett, RI*

NITROGEN-REDUCING INNOVATIVE/ALTERNATIVE (I/A) SEPTIC SYSTEMS: SOCIAL FACTORS INFLUENCING THEIR ADOPTION AND STRATEGIES TO DIFFUSE THEM

As persistent nitrogen loading from septic systems threatens coastal water quality in southern New England, decision makers are considering the adoption of alternative nitrogen-remediating technologies. Efforts evaluating these technologies have examined their technical and economic efficiency, overlooking social and cognitive factors critical to their implementation. This research describes socio-cognitive factors influencing homeowners' willingness to adopt one such technology, Innovative/Alternative (I/A) septic systems, identified through focus groups with adopters and prospective adopters in Massachusetts. Informed by the literature on technology adoption, we create a mental model of I/A system adoption to help decision makers develop more targeted and effective messaging and interventions around adoption. We use these findings, and insights from behavior change and technology diffusion literature, to propose behavior change strategies to encourage the adoption of I/A systems if they are to be used to improve water quality.

Schwartz, M. (1), Oczkowski A. (1), Hanson A. (1), Balint S. (2); *(1) U.S. EPA Atlantic Coastal Environmental Sciences Division, Narragansett, RI (2) ORISE Fellow, U.S. EPA Atlantic Coastal Environmental Sciences Division, Narragansett, RI*

CHARACTERIZING WICKFORD HARBOR, RI BEFORE AND DURING NONPOINT SOURCE NUTRIENT REDUCTIONS

Wickford Harbor is a cove in central Narragansett Bay which consists of several shallow embayments and whose water quality is heavily influenced by non-point source pollution. Non-point sources of pollution can be hard to identify making them difficult to manage and monitor. In 2017 the town installed a sewer line to decrease non-point source contributions, but due to the expense of sewer tie in, many homes in this historical area remain on substandard septic systems. In this study we observe water quality in Wickford Harbor over time, with the goal of characterizing the Harbor before and during efforts to reduce septic inputs. Baseline measurements show average fecal coliform counts of 65.35 CFU/100ml, with a maximum of 588.00 CFU/100ml, indicating the presence of septic effluent. Other indicators such as dissolved inorganic nitrogen concentrations averaged 18.15 μM, and

chlorophyll averaged 9.19 μ/L. By characterizing the Harbor now, we can draw conclusions about the reduction of non-point source pollution in the future.

Sharkey, CS, M Fregeau, T Maney; *Salem State Univ., Salem MA*

A STUDY OF OFFSHORE PLANKTON POPULATIONS COMPARING SURFACE AND DEEP-WATER ASSEMBLAGEA

pilot mussel farm was established 7.5 nautical miles off the coast of Massachusetts in 2016. Mussels are filter feeding shellfish requiring a constant supply of plankton to survive and grow. Mussels were suspended below 50 feet to avoid conflict with shipping activity, at 50 feet will light be sufficient to support plankton growth. A sampling protocol was established to monitor local plankton populations. Phytoplankton and zooplankton samples were collected from the farm site at the surface and at 50 ft (15m) depth where the mussels are grown. The goal of the study was to identify and quantify the diversity of plankton populations between surface waters and deeper areas. Using a Sedgewick rafter counting slide, water samples were collected over time and analyzed according to the types and densities of phytoplankton/zooplanktons present at the farm site. The study showed that abundant and diverse plankton populations are present offshore to sustain mussel growth throughout the year at depths of greater than 50 feet.

Sheremet, V.A. (1)M. Tyrrell (2) and R. Dunn (3); *(1) Department of Physical Oceanography, Woods Hole Oceanographic Institution, MA; (2) Waquoit Bay National Estuarine Research Reserve, MA; (3) North Inlet - Winyah Bay National Estuarine Research Reserve, SC.*

WATER LEVEL MONITORING SYSTEM IN ESTUARIES AND MARSHES FROM MAINE TO FLORIDA: CHARACTERIZING LOCAL NON-SINUSOIDAL TIDAL FLOODING AND DRAINING RECORDS.

At Waquoit Bay NERR, we have been employing a simple and inexpensive system of water level monitoring utilizing a custom built FloatArm water level based on a stock HOBO Pendant G accelerometer logger made by Onset Computers. The principle of operation is based on converting the raw signal of the arm tilt into the elevation of the float relative to a fixed pivot by multiplication by the arm length. Expanding the system, we installed about hundred instruments at seven National Estuarine Research Reserves spanning the coast from Maine to Florida. The monitoring results allow us to characterize different types of flooding and draining behavior at various features in the tidal marshes, which permits analysis of the spatial patterns and timing of inundation in the marsh. The system is efficient for understanding sea level change effects on vegetation and accretion, restoration planning, removal or remediation of tidal restrictions – improperly sized or placed culverts; planning other hydrological manipulations.

Spencer, L.T.; *Department of Biology, Plymouth State University, Plymouth, NH*

BY THE TIME I GET TO BOSTON, I WILL HAVE DROWNED OFF CAPE COD: FERDINAND HASSLER AND THE EARLY WORK OF THE US COAST SURVEY

In the late seventeen hundreds, early 1800s getting between any of the major cities along the coastal US was almost impossible. By land, there were major rivers to cross, swamps to slog through and dark forest with either indigenous folk or wolves to contend with. The situation by ship was not much different only the obstacles were shoals, currents, winds, tides, and leaky ships. This changed in 1807 when Congress authorized the expenditure of $50,000 to begin the survey the US coast with the Swiss import, Ferdinand Hassler as superintendent (five years later in 1812). His efforts to chart the coastal US had the major outcomes of shortening sailing times and safer routes and a discussion of his work will be the brunt of the presentation.

Sullivan, H.L. (1,3), A.F. Besterman (1,2), R.W. Jakuba (2), L.A. Deegan (1), J.L. Bowen (3); *(1) Woodwell Climate Research Center; (2) Buzzard's Bay Coalition; (3) Northeastern University*

THE IMPACT OF RUNNELS AS A HYDROLOGIC ADAPTATION STRATEGY ON TEMPERATURE DRIVERS OF SALT MARSH CARBON DECOMPOSITION

Salt marshes are significant blue carbon ecosystems that are experiencing vegetation dieback and drowning due to interactions of sea level rise and anthropogenic disturbance. Vegetation loss and standing water increase sediment temperatures, which could increase decomposition rates and reduce salt marsh carbon stores. Runelling, a proposed mitigation strategy, is designed to connect standing water on the marsh to nearby open water, thereby restoring marsh hydrologic patterns and decreasing the area of standing water that can lead to vegetation dieback. However, the impacts of this adaptation strategy on carbon decomposition are unknown. We measured rates decomposition in impounded and hydrologically restored marshes and found that in year one, runnel installation altered edaphic characteristics, but did not impact decomposition rates. These are beneficial outcomes for the continued use of runnels as a hydrological mitigation strategy.

Tagliaferri, T.N., Welk, R.J., Finkelstein, K.M.; *U.S. Geological Survey, New York Water Science Center*

DISSOLVED OXYGEN MONITORING IN GREAT SOUTH BAY, LONG ISLAND, NY, IN SUPPORT OF COASTAL RESOURCE MANAGEMENT

The U.S. Geological Survey worked collaboratively with The Nature Conservancy to assess the spatial and temporal variability of dissolved oxygen (DO) concentrations in Great South Bay, Long Island, New York, during the summers of 2015-2017. The Nature Conservancy suspected that low DO concentrations may limit the survival of juvenile hard clams found in Great South Bay. To understand the dynamics of DO in the Great South Bay, DO data were collected continuously (every 6-min) at fixed points along transects across the study area and an Autonomous Underwater Vehicle (AUV) was used to gather high resolution spatial data. Data collected were compared to New York State Department of Environmental Conservation (DEC) marine DO standards to identify acute (if the DO concentration drops below 3.0 mg/L at any time) and chronic (if the daily average drops below 4.8 mg/L for a specified number of days based on developed formulas) exceedances of the standard in Great South Bay.

Thibodeau, P.S. (1)Puggioni, G. (2), Strock, J. (2), Borkman, D.G. (3), and Rynearson, T.A. (1); *(1) University of Rhode Island, Graduate School of Oceanography, Narragansett, RI; (2) University of Rhode Island, Department of Computer Science and Statistics, Kingston, RI; (3) Rhode Island Department of Environmental Management, Office of Water Resources – Shellfish, Providence, RI*

ELUCIDATING LONG-TERM TRENDS FROM A 60-YEAR PLANKTON TIME SERIES IN NARRAGANSETT BAY, RI

The Long-Term Plankton Time Series in Narragansett Bay, RI represents one of the longest-running time series in the world and provides an exceptional opportunity to explore long-term trends in phytoplankton and nutrient dynamics. Dynamic linear models were used to analyze the 60-year dataset of environmental variables (1959-2019) and revealed a long-term decline in chlorophyll a (chl-a), ammonium, and phosphate. Bloom intensity (i.e., maximum annual chl-a concentration) also decreased significantly over time. Long-term declines of chl-a were best explained by decreases in ammonium, silicate, and nitrate/nitrite. Despite this observed decrease in chl-a, the phenology, or the seasonal timing, of phytoplankton biomass and nutrient pulses did not change over time and was characterized by large variability. These results reveal that strong variability in phenology may aid in buffering this estuarine system from ongoing environmental changes, which has important implications for stabilizing food web interactions in the region.

Bonnie Turek, Brian Yellen, Qian Yu, Wenxiu Teng, Jonathan Woodruff; *University of Massachusetts Amherst, Department of Geosciences, 611 N Pleasant Street, Amherst, MA*

SPATIAL VARIABILITY OF SOIL ORGANIC CARBON IN NORTHEAST TIDAL MARSHES: *APPLICATION OF A LIDAR AND REMOTE SENSING-BASED MODEL*

Tidal marshes serve as important sinks and sources for nutrients, sediments, and "blue carbon." Blue carbon ecosystems such as tidal marshes accrete large amounts of carbon with limited area and protect coastlines from increasing impacts of climate change. Much attention has been dedicated to the quantification of sedimentation rates in tidal marshes, however estimation of carbon storage in marsh peat is less understood. Driven by tidal inundation, surface topography, and sediment supply, soil organic carbon (SOC) in marshes varies spatially with several parameters, including marsh platform elevation, proximity to the marsh edge and tidal creek network, and vegetation percent cover and structure. We applied lidar and optical remote sensing techniques to extract topographic, suspended sediment supply, water inundation, and vegetation parameters to map SOC at the meter scale in four northeast tidal marshes.

Brian Yellen
Yellen, B (1), K Kahl (2), A Pappal (3), J Woodruff (1); *(1) Department of Geosciences, University of Massachusetts Amherst, Amherst, MA; (2) Department of Ecological Conservation, University of Massachusetts Amherst, Amherst, MA; (3) Massachusetts Office of Coastal Zone Management, Boston, MA*

OUTSTANDING QUESTIONS REGARDING SEDIMENT SUPPLY TO NOREAST US TIDAL MARSHES

In 2020, the Salt Marsh Working Group identified sediment supply as one of five subtopics of critical importance to sustained marsh resilience in the Northeast US. This talk presents critical knowledge gaps identified by the sediment supply subcommittee which centered on spatial and temporal variability, magnitude of influence, and the efficacy of sediment-based restoration.

Outcomes from the sediment supply subgroup highlight how New England's unique geologic setting with low fluvial sediment supplies and a glacially conditioned coast make the region's back barrier marshes uniquely reliant on marine sediment supplies. It also highlights how sediment supply priority research needs dovetailed with other subgroups' priorities. Recurring overlaps between committee subtopics helped to drive consensus and pare down priority needs.

Young, A.M.
Salem State University

EFFECT OF PREDATOR EXCLUSION ON SOFTSHELL CLAM RECRUITMENT

Many suitable mudflats remain devoid of softshell clams (*Mya arenaria*), due either to pre-settlement planktonic larvae mortality (estimated at >99.9%) or post-settlement predation. Predator exclusion / clam recruitment boxes covered with screening were set on a mudflat in Salem Harbor, Salem, MA from April to November. Clam larvae were able to settle through the screening into the boxes but predators such as European green crabs (*Carcinus maenas*) were excluded. At the end of the study, the boxes contained between 147 and 417 juvenile softshell clams. A bimodal frequency distribution of sizes likely illustrates an early summer (June) set followed by a second late-summer set. Small green crabs (9 – 46 mm CW) found in all boxes must have grown from stage 1 crabs (~ 1 mm) that were able to crawl through the screening. No clams were found in samples taken outside of the boxes. The conclusion is that the absence of a clam population on the mudflat is due to post-settlement predation and not pre-settlement mortality.