



ABSTRACTS
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TWO DECADES OF NITROGEN REDUCTION AND WATER QUALITY IN JAMAICA BAY, NEW YORK

Jamaica Bay is an urban shallow estuary which receives most of its nitrogen load from wastewater treatment plant discharges. In 1994, the New York City Department of Environmental Protection (NYCDEP) began implementing a nitrogen control action plan to reduce this loading, and these efforts continue today. Long term water quality monitoring in Jamaica Bay by both the NYCDEP and the National Park Service allows us to identify spatial and temporal changes in water quality in response to changes in nitrogen loading and other potential drivers. A comparison of water quality parameters at common sampling sites between the two agencies indicates that there are no significant differences in the respective data sets allowing us to combine them and increase the statistical robustness of the analyses. Principal Component Analysis and General Additive Models were used to determine if there have been significant changes in spatial distribution and temporal trends in water quality since 1995.

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MARSHES ON THE MOVE: TESTING EFFECTS OF SEAWATER INTRUSION ON VEGETATION COMMUNITIES OF THE SALT MARSH-UPLAND ECOTONE

The Northeastern United States is a hotspot for sea level rise (SLR), which subjects coastal salt marshes to erosive loss, shifts in vegetation communities, and altered biogeochemistry due to seawater intrusion. Salt marsh plant community zonation is driven by tradeoffs in stress tolerance and interspecific interactions. As seawater inundates progressively higher marsh elevations, shifts in marsh vegetation communities landward may herald salt marsh "migration," which could allow continuity of marsh function and ecosystem service provision. To elucidate possible effects of seawater intrusion on marsh-upland edge plant communities, a space-for-time approach was replicated at two Rhode Island salt marshes. At each site, peat blocks (0.5 m x 0.5 m x 0.5 m, n=6) with intact upland-marsh edge vegetation were transplanted into the regularly-inundated mid-marsh. Procedural controls (n=3) were established at each elevation by removing and replacing peat blocks, and natural controls (n=3) consisted of undisturbed plots. During peak productivity, each plot was assessed for species composition, percent cover, and average height. Results demonstrate stunting of marsh-upland edge vegetation in response to increased inundation and initial colonization of the transplanted plots by salt marsh species. The extent of colonization differed between the sites, suggesting that site-specific factors govern vegetation responses to increased inundation. Though this experiment is ongoing and in its early stages, results suggest the potential for seawater intrusion to drive shifts in marsh-upland

edge plant community composition. These findings have implications for the ability of marshes to migrate in the face of sea level rise.

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EXTREME SHALLOW WATER, VESSEL-BASED ACOUSTIC SEAFLOOR MAPPING IN ESTUARINE ENVIRONMENTS

Information regarding benthic habitats, submerged aquatic vegetation, algal beds, sediment transport and other biological and physical characteristics and processes are perhaps most important and difficult to obtain in estuarine environments. Lidar, while extremely efficient, though costly, can be of little use in the turbid waters of many estuaries. In addition, lidar currently provides only elevation information with little to no data on the above-mentioned characteristics and processes. A series of acoustic surveys were conducted onboard a custom-built, shallow draft pontoon boat using a Phase-Measuring Sidescan Sonar in the Herring River Estuary Wellfleet, Massachusetts, a very shallow, tidally-restricted estuary, in the Summer of 2016 with repeat surveys scheduled for early fall of 2016. The instrument collects coincident, dual-frequency, backscatter imagery and swath bathymetry. The backscatter resolution is 0.01 m and 0.006 m for the low and high frequencies, respectively. The bathymetric resolution is approximately 3 cm vertically. Underwater video and grab samples were collected to ground-truth the backscatter imagery and improve our understanding of the seafloor. CTD measurements were made throughout the estuary. The average water depth was approximately 1 m. Salinity ranged from 32-33 ppt at the first tidal restriction to 0 ppt at a small box culvert upriver. The sonar regularly collected 30-40 meter swaths of backscatter imagery in <1m of water. The instrument was able to map in high salinities, fresh water and the transition zone with little to no loss in data quality. This instrument/platform combination makes vessel-based acoustic mapping in these types of systems more feasible, efficient, and desirable.

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GREENHOUSE GAS FLUXES FROM NITROGEN REMOVAL AT CENTRALIZED AND DECENTRALIZED WASTEWATER TREATMENT SYSTEMS.

Narragansett Bay in RI has historically received high anthropogenic nitrogen (N) loads, and centralized wastewater treatment plants (WWTPs) and decentralized onsite wastewater treatment systems (OWTS) are significant sources of N to the Bay. Recent policies and regulations have led to system upgrades that include N removal. While these upgraded systems lower N loads to the Bay, they may increase the fluxes of three greenhouse gases (GHGs): nitrous oxide (N₂O), methane (CH₄), and carbon dioxide (CO₂). We compared GHG fluxes from the N removal tanks at the largest centralized WWTP in RI to those from three types of advanced OWTS designed to remove N (Orenco Advantex AX20, Bio-Microbics MicroFAST, and SeptiTech D Series) located in Jamestown, RI. Gas fluxes were measured using a closed chamber and a cavity ring down spectroscopy real time analyzer twice during the

summer/fall of 2016. Preliminary results show that emissions of N₂O and CO₂ are at least an order of magnitude larger at the WWTP than all OWTS technology types. However, CH₄ emissions from all OWTS and the WWTP are on the same order of magnitude. In addition, the Orenco Advantex AX20 systems often had CH₄ emissions higher than the upper detection limit of the analyzer. In the WWTP CO₂ was responsible for 93% of GHG emissions, whereas CH₄ was responsible for the majority of emissions (62-92%) in all OWTS technology types. Both approaches to N removal generate appreciable GHG emissions. A better understanding of the mechanisms responsible for emissions may facilitate future management practices that minimize emissions while maintaining high N removal rates.

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BACTERIA BONANZA: USING WATER QUALITY INDICATORS TO REDUCE THE IMPACT OF SEWAGE POLLUTION ON ESTUARIES

Eutrophication is a significant threat to the health of estuaries. Nutrient loading results from sewage pollution, fertilizers and manure, and leaking septic tanks. Estuarine and human health are negatively impacted by the presence of sewage. Aging infrastructure coupled with poorly maintained septic tanks allows sewage to enter estuaries untreated. Testing of bathing beaches and shellfish beds occurs regularly to protect human health, but monitoring of waterways for environmental implications is conducted less frequently. This type of monitoring is necessary to identify sewage leaks before major damage to estuarine health is incurred. *Escherichia coli* (*E. coli*) is used as an indicator of sewage. However, *E. coli* concentrations can vary due to multiple factors including ultraviolet radiation, temperature, and source duration. This variability complicates the interpretation of indicator bacteria data and requires a nuanced approach to study design. We studied the temporal and spatial variability of *E. coli* in a Long Island Sound tributary over eight years to determine the ideal sampling frequency to accurately identify pollution sources while efficiently managing sampling effort and resources. We found that different sampling frequencies impacted our ability to detect pollution and day of the week was an important factor. Bacteria levels at sites along the river were not impacted by upstream sites, indicating that a greater density of sampling locations may be required to ensure that sewage pollution between sites isn't overlooked. This information can help guide the formation of water quality monitoring plans, efficiently identify sewage pollution sources, and improve the health of the estuaries.

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HISTORIC EELGRASS TRENDS IN TWO MASSACHUSETTS EMBAYMENTS

With funding from MassBays, the Division of Marine Fisheries Habitat Project is assessing historic eelgrass trends in two Massachusetts embayments: Duxbury, Kingston, and Plymouth Bays (DKP) and Salem Sound. The project utilizes photo-interpretation methods to delineate eelgrass beds in historic aerial photos from 1951 to present, implementing two patchiness categories to better describe meadow density. Side scan mapping surveys are completed throughout the embayments to further assess and groundtruth the meadows at a higher resolution. A data mining exercise follows, collecting relevant datasets on water quality, weather, physical disturbance and various biotic variables that may cause or contribute to the eelgrass trends observed in the mapping exercises. The DKP analysis completed this spring concludes that approximately 70% of eelgrass in DKP disappeared in the 60+ year study period. All areas of DKP are affected and losses are occurring at a variety of water depths. The loss is likely caused primarily by degrading environmental conditions due to water quality impairments from runoff and wastewater, the effects of which are exacerbated by a documented temperature increase. Once stressed, the eelgrass is more vulnerable to weather and hydrodynamic related impacts.

Local losses due to geomorphological changes and direct impacts as a result of human activities in DKP are also relevant. The acoustic survey of Salem Sound was completed in August 2016 and preliminary results suggest that eelgrass loss in this embayment has not been as extensive as in DKP. While some discrete areas have seen complete loss since 1951, others appear to have rebounded recently.

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DEVELOPMENT OF AN IN SITU POREWATER SAMPLER COUPLED TO AN UNDERWATER MASS SPECTROMETER FOR HIGH-RESOLUTION BIOGENIC GAS MEASUREMENTS IN PERMEABLE SEDIMENTS
Permeable sands, which cover the majority of continental shelves worldwide, have traditionally been thought to be biologically inactive due to their low carbon content. Recent research, however, has revealed that these sediments are in fact highly metabolically active. Unlike in muddy, diffusively-dominated sediments, reaction rates in permeable sands depend on advection, making them notoriously difficult to sample using conventional techniques such as sediment coring. Consequently, there is a severe lack of data on reaction rates within permeable sand environments which has limited quantification and modelling of key biogeochemical processes on continental shelves. Our lack of understanding of porewater sediment processes is fundamentally a methods issue. To advance our ability to sample in permeable sands, we are developing a robust porewater sampling system that will operate in situ and minimize sampling artifacts. The instrument, which is in an early stage, currently consists of an inlet prototype, a novel valve system to control porewater sampling, and a benchtop mass spectrometer (MS) system. Recent experiments were conducted in a flowing seawater flume to investigate flow artifacts caused by the current inlet design. Based on these results, a new inlet prototype has been conceived and both designs will be further evaluated. Another set of experiments aimed at establishing the operational limits of our system is underway. These tests will guide selection of environments suitable for deployments of our sampler with an underwater version of the benchtop MS. An overview of the technological developments to date, as well as preliminary results from these experiments will be presented.

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EVALUATION OF BAY BACTERIA AFTER PHASE I AND II OF THE NARRAGANSETT BAY COMMISSIONS CSO ABATEMENT PROJECT

Since the Narragansett Bay Commission (NBC) completed the first two phases of a three phase Combined Sewer Overflow (CSO) Abatement Project, bacterial pollution in the upper reaches of Narragansett Bay has decreased considerably. The first two phases of the CSO Abatement Project were completed in 2008 and 2014, respectively, and have resulted in the capture of over 7 billion gallons of combined sewer flow, the majority of which received full advanced secondary treatment at the Field's Point wastewater treatment facility. This presentation will focus on the analysis of NBC river and bay fecal coliform data collected since 2004 to evaluate levels of bacterial pollution prior to and after the completion of Phases I and II. As a result of Phase I and II, fecal coliform has been reduced by 45% in the upper reaches of the Bay; thousands of pounds of pollutants have been collected and redirected to the Field's Point facility for full treatment instead of flowing untreated from CSOs; and state shellfish closure regulations have been modified to allow increased rainfall totals prior to initiating a closure. The third phase of the CSO Abatement Project is currently in design and will consist of another large scale project to address the remaining CSOs in the Bucklin Point district. Monitoring and analysis are

essential components of such large, expensive, and complicated infrastructure projects and provide crucial information to stakeholders, ratepayers, engineers and regulatory officials to determine what benefits are being realized in the receiving waters and to help guide future decisions regarding projects meant to improve water quality.

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CHANGES IN THE JUVENILE BENTHIC FISH COMMUNITY OF A LONG ISLAND SOUND EMBAYMENT

Long Island Sound embayments serve as nursery grounds and refuges for many species. In order to maintain healthy adult populations of these species, the maintenance of good water quality for reproduction and juvenile habitat is critical. Despite its importance to both people and the environment, coastal water quality is threatened, particularly by bacterial contamination and nutrient pollution. Here, we present a study of juvenile benthic fish in a Connecticut embayment spanning 25 years and explore changes in the fish community and abiotic conditions over time. We sampled 20 stations in Norwalk Harbor, Connecticut, conducting trawls of a subset of stations each week from 1987 to 2016. We observed a decrease in catch per trawl and an increase in trawls without any fish over time. During this same time period, water temperature increased and mean dissolved oxygen decreased. Shifts in community composition were also observed, with some once dominant fish species being replaced by others that had never been observed prior to the past several years. Juvenile fish can serve as indicators of estuarine health, and exploring this community will improve our understanding of the ecological status of Long Island Sound embayments.

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WATER QUALITY IN SOUTHWESTERN CONNECTICUT'S RIVERS AND EMBAYMENTS AND IMPLICATIONS FOR THE HEALTH OF LONG ISLAND SOUND

Long Island Sound is a diverse and highly productive estuary that serves as a nursery, refuge, and breeding habitat for thousands of species. It is an ecologically rich environment and is also among the region's most valuable natural resources. However, the Sound is also surrounded by densely populated communities and millions of people live within its watershed. The impacts of these people on the Sound are numerous, from habitat loss to point and nonpoint source pollution. Poor water quality (and specifically eutrophication) poses one of the greatest threats to the ecological status and ecosystem service provision potential of Long Island Sound. Water quality in the Sound is impacted by the water quality of its tributaries and embayments which serve as a conduit for human-derived pollutants throughout the watershed. Here, we present a study of 10 rivers and 6 embayments in southwestern Connecticut. We studied indicator bacteria (for sewage pollution) and dissolved oxygen in each river and embayment between May and October 2016. We found that many rivers are not meeting the state criteria for bacteria and may be delivering sewage pollution to the Sound. Multiple harbors showed evidence of prolonged periods of hypoxia in addition to high bacteria loading. Sewage pollution is a large contributor of nutrients to the Sound and can exacerbate eutrophication impacts. Dissolved oxygen levels in the embayments provide further evidence that the ability of these harbors to serve as habitat for critical species may be compromised. In order to improve the health of Long Island Sound, it is critical to explore these pollution inputs and impacts within its watershed.

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SPARTINA PATENS: NEW FORMS IN NEW PLACES IN RHODE ISLAND

In New England, *Spartina patens* is known as the grass that forms cow-licks in the saltmarsh. Frequently, this grass is inundated at full tide, rarely upright, and may bear 1 to 4 branches in the inflorescence. Until recently, this salt marsh form was the only phenotype of *Spartina patens* known in Rhode Island. Here we report several new phenotypes of *Spartina patens* that are upright and grow in the white sand on the upper strand in Saunderstown, in the dunes at Napatree Point, and at Scarborough, from the north end of the beach to Black Point. Within these dry environments, colonies vary from 1.5 ft. to 5 ft. in height, and the number of branches on the inflorescence range from 4 to 10. The phenotypic plasticity of *Spartina patens* is well known. Reportedly, these several phenotypes are associated with different levels of polyploidy. Our studies of chromosome numbers and chromosome behavior aim to clarify some of the several questions within the genus *Spartina*.

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ASSESSING IMPACTS OF OYSTER AQUACULTURE IN RHODE ISLAND COASTAL LAGOONS USING SUBAQUEOUS SOILS AND BENTHIC MACROINFAUNA

Coastal lagoons are unique estuaries at the interface of marine and terrestrial ecosystems that are currently experiencing the expansion of oyster (*Crassostrea virginica*) aquaculture in southern New England. Although it is well established that native shellfish can provide improve water quality, few studies have examined the environmental impacts of continuous shellfish aquaculture on the benthic environment. We assessed the effects of oyster aquaculture on three coastal lagoons in southern New England using benthic infauna and subaqueous soils as indicators of environmental impact. Sampling locations were stratified based on the number of years the location was utilized for aquaculture (4-20 years). Samples were collected from the upper 20 cm of the soil surface in aquaculture areas and in adjacent, non-aquaculture locations, as a control. Samples were taken for soil analysis (incubation pH, particle size, bulk density), and benthic infauna, which were sorted, identified to species level, and classified by functional feeding group. Aquaculture sites had higher numbers of benthic infauna individuals and larger populations of deposit feeders, compared to areas not previously used for aquaculture. Time in aquaculture had no clear effect on most functional feeding groups, except for deposit feeders which were most abundant after eight years of aquaculture use. Preliminary soil analysis revealed no apparent differences in soil pH, particle size distribution, or bulk density between aquaculture and control sites. Our results suggest that continuous aquaculture does not affect physical soil properties, and may have a positive impact on the lagoon environment by increasing the size of benthic infauna communities.

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AN UNDERWATER VIEW OF CONSERVATION MOORINGS: ARE THEY REALLY EELGRASS FRIENDLY?

“Conservation moorings”, also sometimes called “eelgrass-friendly” moorings are boat and float moorings designed to minimize impacts to the seafloor using a helix anchor and a floating, flexible rode. Regulators and resource managers have been recommending “helix anchors and flexible rodes” on boat and float moorings for many years with little knowledge of how the systems function in the field. Both Eco-moorings and Hazelett brand moorings have been installed in several harbors in Massachusetts over the past six years, including 275 eco-moorings installed as partial mitigation for two acres of permitted eelgrass loss at Boston Logan Airport’s Runway Safety Area Expansion. To better understand how the moorings are functioning in the field, *MarineFisheries* is monitoring eco-moorings in Gloucester, Manchester, Boston, Wareham and West Falmouth harbors. By measuring the

size of the scar, quantifying eelgrass shoot density and % cover within the scar and at reference locations, and collecting photo and video images to document the condition of the mooring and the condition of the eelgrass, we are answering the questions; will eelgrass grow back into a mooring scar after the conventional mooring has been switched with a conservation mooring? How long does it take? What other observations can we make about the conservation moorings? Do they really work to minimize impacts to the sea floor? In many cases eelgrass is growing back into the former mooring scars, but problems with design, installation and maintenance of the mooring gear have been responsible for cases where the moorings are not eelgrass friendly.

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RESOLVING DISCREPANCIES IN THE CHRONOSTRATIGRAPHY OF A SALT MARSH SEDIMENT CORE FROM NORTH CINDER ISLAND IN THE TOWN OF HEMPSTEAD, LONG ISLAND, NY, USING RADIOCARBON AND POLLEN

A 122 cm sediment core was collected from the salt marsh of North Cinder Island (73.6092W, 40.6097N) in Middle Bay, Town of Hempstead, NY, on 2 July 2013, in order to investigate the age, sedimentation, and trace metal pollution of the marsh. First, to determine the chronostratigraphy of the core, pollen counts were compared to radiocarbon measurements. Sediment samples from the core were analyzed for Pine, Oak, Hickory, Birch, Grass (*S. alterniflora* and *S. patens*), and Ragweed pollen. The concentration of Ragweed was below 3% in samples below 80cm, and greater than 7% in samples above 80cm. This disturbance species suggests that layers deeper than 81cm were deposited prior to local European settlement in the early to mid 1600s AD. Paired radiocarbon measurements on sieved sediment at 42-43 cm depth match well (1-sigma confidence intervals overlap), but suggest a calendar age between 932 and 997 years BP and radiocarbon measurements at 78-79 cm and 96-97 cm depths give older ages, as expected stratigraphically. Paired radiocarbon measurements from the 60-61 cm depth, however, represent an age approximately 200 years younger, perhaps due to the reworking of marsh sediments. Root matter from the sediment at the same depths gives radiocarbon ages that range from 600-1200 years younger. Perhaps the roots penetrate down through older sediment, or recaptured sediment contains lignin or other older organic matter that is difficult to break down. These occurrences would explain the apparent contradiction between the radiocarbon dates on fine sediment and the younger pollen date at a deeper depth. We will also discuss our progress using additional chronostratigraphic methods that we hope will further resolve discrepancies.

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EFFECTS OF DROUGHT ON MARSH CO₂ EXCHANGE

Salt marshes are important carbon sinks, but large uncertainties about current rates of carbon exchange with the atmosphere and the ocean remain. These need to be constrained for a better assessment of changes in long-term drivers such as sea level and climate. At the Plum Island Ecosystems LTER, we have set up two eddy covariance sites, one in a high marsh (starting in 2013) and one in a low marsh (starting in 2015) to study net ecosystem CO₂ exchange. For the high marsh site, we observe less overall net CO₂ uptake in years with low rainfall during the growing season (2014, 2016). In 2014, a low rainfall period occurred at the beginning of the growing season, during which ET was slightly higher than in other years, likely increasing soil salinity. In 2016, the period of low rainfall has extended much longer into the growing season which seems to have an overall stronger effect on low

marsh net CO₂ uptake. We will discuss our findings in the context of salt marsh hydrology and carbon cycling in high and low marsh.

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ASSESSING ESTUARINE VULNERABILITY THROUGH MODEL AND DATA SYNTHESIS

The communities that rely on estuaries - human, floral, and faunal – are vulnerable to threats such as eutrophication, sea-level rise, storms, and geologic processes. Quantifying that vulnerability in space and time requires multiple observational and modeling techniques. This presentation will detail new observational and modeling capabilities, and demonstrate how they can be applied in parallel to assess geomorphic change, wetland stability, coastal hazards, and ecosystem response to eutrophication. Specific examples from throughout the northeast United States will be used to illustrate how these capabilities can inform other scientific disciplines, coastal managers, and the general public.

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IMPROVED SITING OF KELP AQUACULTURE USING ¹⁵N STABLE ISOTOPE ANALYSIS

Interest in wild harvest of seaweed, and farming it using aquaculture techniques, has skyrocketed in the Americas and Europe. More research is needed to determine how land use along these coastlines could influence decisions regarding optimal siting of seaweed farms or the identification of best areas for wild harvest. The objective of this study was to test if nitrogen isotopes measured in the tissue of sugar kelp (*Saccharina latissima*) grown in strategic locations could be used to improve siting of future kelp farms. The small curved embayment of Saco Bay, Maine was selected as the field site for this study because it is akin to many developed coastlines. It has a strong tourism industry, historic industrial operations, and it receives water from a major river, effluent from 6 wastewater treatment plants, water from tidal pools and salt marshes, and runoff from residential developments. Buoys were deployed along two perpendicular transects in Saco Bay and mature kelp was attached to each buoy, along with temperature, light, and salinity sensors. Tissue samples were collected from the kelp every two weeks, and following rain events greater than 1 in. Samples were excised from the meristem, mid part, and distal tissue of the kelp and analyzed for their ¹⁵N/¹⁴N ratio. These results were compared with effluent data from the area's wastewater treatment plants and discharge measurements from the Saco River in a spatial analysis tool to identify relationships between predicted dispersion of anthropogenic nitrogen and observed nitrogen isotope ratios in kelp grown on the buoys. Results from this and other parallel efforts may help to inform a management plan for wild or farmed seaweed harvest in the region.

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ASSESSING THE IMPACTS OF SALINITY AND NUTRIENT STRESS TO *RUPPIA MARITIMA* AND *ZOSTERA MARINA*

Healthy seagrass beds were once found throughout the shallow areas of Narragansett Bay, R.I. but have disappeared due to infilling, pollution and disease. In Greenwich Bay, a highly developed embayment within Narragansett Bay, *Ruppia maritima* has colonized an area on the northern shore historically dominated by *Zostera marina*. *Ruppia* is extremely salinity tolerant, and may also be more nutrient tolerant than *Zostera*. To test this hypothesis 6-week microcosm experiments were conducted in the summers of 2014 and 2015. Microcosms were renewed daily to simulate tidal flushing and the water column was dosed with a $\delta^{15}\text{N}$ tracer for the first week of the experiments. In the 2014 microcosm experiment two salinity (20, 30 ppt) and four nutrient (0, 5, 10, 30 μM inorganic N) levels were used to test the species' relative tolerance. This experiment yielded structurally significant results for *Ruppia* but no significant differences were detected for *Zostera*. In 2015 the experiment was performed again with lower salinity (5, 30 ppt) and higher nutrients (0, 30, 100, 300, 1000 μM inorganic N) in order to determine *Zostera's* tolerance to nutrient and salinity stress and confirm the 2014 *Ruppia* results. Both species had significant structural responses to the nutrient and salinity variables. Isotopic analysis run on above-ground tissue indicated that with increasing nutrient levels $\delta^{15}\text{N}$ in the seagrass shoots increased, suggesting that nutrients were well incorporated into the plants. Overall both species experienced diminished growth with nutrient increase, however the 2015 structural results show that *Zostera* was more significantly impacted than *Ruppia*.

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ESTUARINE ECOLOGICAL DISCOVERY IN THE ANTHROPOCENE: IMPROVING BASIC SCIENCE THROUGH OPPORTUNITIES IN APPLIED RESEARCH

Estuarine ecology has long embraced research questions targeting societal needs. Academic researchers frequently collaborate with state and federal agencies to provide science-based advisory services for management of our coastal waters. Several federal programs (e.g. Sea Grant) support a mission of applied research with strategic plans that promote transfer of basic science to the policy and management realm. In many cases, this support and promotion of applied research has been leveraged into discovery and basic science that has transformed our field. Despite a long tradition demonstrating the value of these connections, we continue to face a common divide between classifications of "basic" versus "applied" research. This presentation provides examples where discovery and creativity flow from addressing problems encountered by managers and policy-makers. A framework for appreciating these feedbacks and expanding the reach of our science in the Anthropocene to mutual benefit by society and science is proposed for discussion. Finally, repercussions of considering a broader discovery space for estuarine research are presented in the context of improving a culture of inclusion and diversity in the geosciences.

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THE USE OF SCIENCE IN NEW HAMPSHIRE MARINE AQUACULTURE

Over the past decade, New Hampshire's Great Bay has become home to over a dozen oyster aquaculture farms. Championed as a sustainable and profitable marine industry, scientific research is critical for ensuring the success of the industry. Nonetheless, how oyster farmers access and apply different types of scientific and non-scientific information is less clear. We interviewed seventeen oyster farmers from New Hampshire, as well as Maine and Massachusetts, to understand how different social forces shape how growers access and use scientific research within their oyster growing operations. We hypothesized that farmers' backgrounds and scientific training would influence their use of science. However, results from our interviews show that growers' connections to friends, their own experience, and their involvement in grower associations are more important in shaping how farmers access and apply science with their farms operations. Surprisingly, within our sample, anecdotal information appears to be more influential in farmer's decision-making than self-sought scientific research.

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MICROPLASTIC DISTRIBUTION IN THE HUDSON RIVER PARK, NEW YORK CITY

Densely populated urban rivers such as the Hudson Estuary may play a key role in the influx of plastics into the world's ocean. While recently the abundance and distribution of microplastic particles (<5mm in diameter) in the American Great Lakes region and marine environments worldwide has been quantified, very little data of this type exist for the Lower Hudson River. At the mouth of the Hudson River, within Hudson River Park's estuarine sanctuary (59th Street to Chambers Street), we measured the concentration of microplastics at off shore and near shore sites in both downtown and midtown locations. This survey will help to establish baseline data on the abundance and distribution of microplastics in the Hudson Estuary. Future surveys following implementation of the The Microbead-Free Waters Act in 2017 and 2018 and other floatable discharge reduction measures in New York City will allow the effectiveness of these measures to be assessed.

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TESTING FOR ECOLOGICAL CORRELATIONS BETWEEN GREENHOUSE GAS FLUXES AND THEIR POTENTIAL BIOTIC DRIVERS IN COASTAL WETLANDS

The role of coastal wetlands in ameliorating the plight of climate change is well documented. Per unit area, coastal wetlands are among the largest natural carbon sinks, taking up abundant carbon dioxide (CO₂) and emitting minimal methane (CH₄). While the role of coastal marsh vegetation in mediating CO₂ and CH₄ flux dynamics has been well-studied, less is known about effects that other biotic drivers, including marsh invertebrates, exert on greenhouse gas (GHG) fluxes. Crabs and mollusks may directly alter soil biogeochemistry and GHG fluxes by bioturbation and deposition of nutrient-rich feces, and indirectly through impacts to vegetation. The objective of this research was to survey GHG fluxes along a gradient of fiddler crab (*Uca pugnax*) and ribbed mussel (*Geukensia demissa*) densities. Surveys were performed in a Rhode Island salt marsh at randomly-chosen points in both the *Spartina alterniflora*-vegetated low marsh and the unvegetated creek bank. During the peak growing season, GHG (CO₂ and CH₄) fluxes and *S. alterniflora*, live and dead mussel, and crab burrow densities were measured. GHG fluxes differed substantially between the *S. alterniflora* marsh and creek bank, with greater CO₂ uptake and CH₄ emission in the *S. alterniflora* marsh than along the creek bank. In the *S. alterniflora* marsh, Spearman's Correlation Analysis revealed a significant positive correlation between density of dead mussels and CH₄ emission; however, none of the measured variables correlated with CH₄ fluxes on the creek bank. Though preliminary, results of this experiment underscore both the spatial variability of

coastal marsh GHG fluxes and the potential for distinct drivers to mediate fluxes across the marsh landscape.

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RESEARCH AT THE BORDERLANDS: DIVERGENT THINKING ON THE EDGE OF DISCIPLINES TO ACHIEVE EFFECTIVE INTERDISCIPLINARITY

Research that cuts across disciplines offers the promise of conceptual and practical advances by capitalizing on synergies from different perspectives and knowledge. Interdisciplinarity comes in many shapes and sizes, and is viewed as the panacea for solving the world's complex problems. Funding agencies and academic institutions are increasingly seeking more interdisciplinarity. As estuarine and coastal scientists studying the land-sea interface, we are well positioned for cutting-edge interdisciplinary research. However, this cannot be done by simply gathering individuals from different disciplines, getting them involved in a project, then sitting back and watching it unfold. In this talk I will argue that a new type of scientist is needed to facilitate interdisciplinary research, one that operates in spaces at the edge of disciplines to deconstruct disciplinary borders, broker engagement, and explore multiple pathways to solutions. While there must be commitment to professional relationships for successful interdisciplinary collaboration, this is often underestimated and inherently discouraged in the current funding and promotion landscape. I will use my own experiences as an early-career researcher who has worked within interdisciplinary teams and talk about what I see as real solutions to achieving more effective interdisciplinarity.

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ABOVEGROUND NITROGEN USE EFFICIENCY AND GROWTH DYNAMICS IN *SPARTINA ALTERNIFLORA* AND *DISTICHLIS SPICATA*

Long-term N fertilization studies suggest shifting dominance from *Spartina alterniflora* to *Distichlis spicata*, although the underlying mechanism is unclear. A limitation on our ability to predict changes is a poor understanding of resource use under ambient conditions. The present project compares growth rates and N use dynamics between two emerging salt marsh dominants, *S. alterniflora* and *D. spicata*. We hypothesize that under ambient Narragansett Bay nutrient conditions, *S. alterniflora* is a more efficient user of nitrogen than *D. spicata*. *S. alterniflora* and *D. spicata* cores were collected from the field and raised in a greenhouse. Heights of all stems were measured weekly to determine growth rates. To understand N movement, a pulse of ^{15}N was added and three cores were sacrificed each subsequent week. Live aboveground biomass was separated into stems and leaves, with leaves categorized based on their position from the top of the stem. Samples were analyzed by isotope ratio mass spectrometry to trace N accumulation in different pools over time. One week after the ^{15}N pulse, most of the aboveground ^{15}N was bound in the stems and the youngest leaves. Efficient nutrient transfer in photosynthetic material likely provides a stronger competitive advantage for taller plants, which are able to better compete for light. Growth rates of *S. alterniflora* proved to be more variable over time than that of *D. spicata*. A better understanding of N dynamics under ambient conditions will improve our ability to predict response to environmental perturbations.

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QUANTIFYING THE POTENTIAL FOR NITROGEN REMOVAL THROUGH THE HARVEST OF AQUACULTURE OYSTERS FROM SOUTHEASTERN MASSACHUSETTS EMBAYMENTS

Increasingly, water quality management plans are incorporating oyster aquaculture and oyster reef restoration as a means of reducing nitrogen (N) from estuarine ecosystems. One method of permanent N removal from embayments is through grow out of oyster seed and subsequent harvest of the adult oysters. Previous studies have looked at N content of oyster tissue and shell; however, data are quite variable as several factors appear to affect oyster nutrient assimilation capacities, e.g. oyster size, deployment method, time of harvest, and water quality conditions. This study focused on oysters raised in southeastern MA embayments. Aquaculture oysters were collected from multiple embayments with varying water quality. Embayments were selected based on the presence of on-going multi-year water quality monitoring programs. Water quality samples were analyzed for temperature, salinity, total nitrogen, chlorophyll-a, pheophytin-a, orthophosphate, dissolved oxygen, and transparency (secchi depth). Oysters, spanning a range of sizes and deployment methods, (e.g. floating cages, bottom cages, artificial reefs), were processed to determine N content of the tissue and shell. Water quality data and N assimilation capacities were analyzed to quantify the potential for N removal through oyster harvest. Results are used to examine differences in nutrient assimilation capacities that could affect water quality management plans involving oyster aquaculture as a means of reducing N levels in estuaries. An overarching goal is to develop a comprehensive dataset that encompasses the variability in eastern oyster N assimilation capacities over a wide geographic range.

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THE NORTHEAST OCEAN DATA PORTAL: MAPS, DATA, TOOLS, AND INFORMATION FOR REGIONAL OCEAN PLANNING

The Northeast Ocean Data Portal (www.northeastoceandata.org) is an online resource which provides public access to maps and spatial data required for ocean planning in the Northeast U.S. The data portal lends necessary transparency to the northeast ocean planning process by serving as a centralized repository for data included in the region's ocean plan, which was available for public review during the summer of 2016. Data on human uses of the ocean, marine life, and the marine environment are shared through a variety of user-friendly formats, including interactive maps, thematic resource pages, and ArcGIS Storymaps. Using these interactive mapping tools, users can explore interactions between ocean uses, extract and download datasets of interest, and access external data sources. Tools and functionality have been developed to serve users with diverse needs and technical expertise, including government agencies, NGOs, and ocean stakeholders. In addition to supporting regional planning efforts, this centralized source of authoritative ocean data can be used by marine scientists and conservation professionals as a resource for research, and as a tool for education, communication and outreach.

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HIGH AND DRY: STRANDINGS IN CAPE COD BAY

For centuries, animals have been stranding on Cape Cod Bay beaches unable to maneuver back out to

sea. The overriding question is simply, why? Theories abound but four factors - geography, circulation, bathymetry, and shoreline topography may work in concert to produce the extraordinary events that make Cape Cod among the top three places in the world for marine strandings. Our collective attitudes toward these animals has evolved over the centuries from considering them a gift from the Great Spirit, to a financial windfall, to a financial liability, to compassion, pity and awe. Our response has also evolved from harvesting these animals to serve our purposes to devising methods to save them, rehabilitate them, and return them to their natural environment. While the mysteries of “why” continue, the reality is that they will almost certainly continue.

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VALUING AN INTERVENTION: MARSH MIGRATION AND ECOSYSTEM SERVICES

There is growing interest in valuing ecosystem services provided by marsh systems. Ecosystem service values represent a flow of benefits to society from the existence or functioning of the marsh. Therefore, when “putting a value on” the marsh, or estimating the value of its natural capital, the dynamics of the marsh through time matter to its current value. For carbon sequestration and nutrient processing services, this means understanding the varying flow of these services as the marsh migrates inland due to sea-level rise. This work will combine an existing marsh migration tool, SLAMM, field observations on a transitioning marsh, and a dynamic economic valuation framework to evaluate interventions that encourage upland marsh migration as compared to the “do-nothing” scenario. There are a number of existing marsh ecosystem service valuation tools, but most use a static snapshot of a marsh or, in some cases, a simple linear extrapolation of dynamics through time, to evaluate interventions. Our work fills a need to verify and take into account the time-paths of marsh dynamics and resulting flows of services in order to more accurately value the ecosystem services of marsh systems.

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TRACING EELGRASS(*ZOSTERA MARINA*) FOODWEBS – SIMULTANEOUS ANALYSIS OF ¹⁵N, ¹³C AND ³⁴S OF LOW BIOMASS SAMPLES

Conventional stable isotope analysis of solid samples usually requires high sample amounts to achieve exact analytical results. We developed a high sensitivity elemental analyser coupled to a conventional isotope ratio mass spectrometer, with which carbon, nitrogen and sulfur stable isotopes can be measured simultaneously in samples with low carbon content. This method was applied to examine food webs of eelgrass in the Baltic Sea, Germany and Pleasant Bay, Cape Cod. Where previous C and N studies could not determine differences between the signatures of primary producers our method enabled the distinction of these two carbon sources. The low amount of sample material required (0.25 mg for plant and 0.05 mg for animal tissue), allowed analysis of individuals like copepods and amphipods as well as seagrass epiphytes without raising our sampling effort. Comparing stable isotope compositions of species between study sites we found that, on all trophic levels, temporal variation was more pronounced than spatial variation. Temporal variation of primary producer signatures followed similar patterns at all sites. Mixing models showed that, while trophic levels of consumers changed, diet remained the same. Trophically flexible species such as these may promote population stability by incorporating carbon and nutrients from several sources.

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RECEIVING WATERS MONITORING FOLLOWING WWTF UPGRADES TO REDUCE NITROGEN LOADING
In recent years, many of the wastewater treatment facilities (WWTFs) in the Narragansett Bay watershed have undergone extensive multi-million-dollar upgrades in order to meet more stringent total nitrogen effluent permit limits. The impetus for these mandated nitrogen reductions was a major fish kill in Greenwich Bay in August 2003, caused by anoxic conditions resulting from excessive organic material growth and exacerbated by circulation and weather conditions. Since this mandate, the Rhode Island Department of Environmental Management has noted a 65% reduction in nitrogen loading from local WWTFs, though the ecosystem response is still largely unknown. The Narragansett Bay Commission (NBC) operates the two largest WWTFs in the watershed, discharging a combined daily average (2015) of 56 million gallons of advanced secondary treatment effluent into the upper reaches of Narragansett Bay. In order to better understand the impact of its effluent on the receiving waters, the NBC maintains a comprehensive water quality monitoring program, including monitoring nutrient concentrations in rivers and the upper Bay since 2007. This nine year (and growing) dataset includes data collected prior to and following WWTF nitrogen reductions; NBC's nutrient reduction facilities came online in 2014. The NBC uses these data to observe whether nutrient loading reductions have led to changes in water quality in the upper Bay, including reduced nitrogen concentrations, changes to phytoplankton, or improvement of dissolved oxygen levels. Continued monitoring is leading to better understanding of the relative effects of nutrient reductions and hydrodynamics in the Bay, as well as the importance of precipitation trends on Bay water quality.

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BELOWGROUND NITROGEN UPTAKE AND ALLOCATION BY *SPARTINA ALTERNIFLORA* AND *DISTICHLIS SPICATA*

Anthropogenic nitrogen inputs coupled with rising sea level complicate predictions of marsh stability. As marsh stability is a function of its vegetation, it is important to understand the mechanisms that drive community dynamics. Many studies have examined aboveground dynamics and nutrient cycling, but few have studied the belowground uptake and allocation of nitrogen. Literature suggests that *D. spicata* may dominate the marsh platform in nutrient-rich conditions, though the mechanism driving the vegetation shift is unclear. Our study examines belowground nutrient uptake and allocation underlying these patterns. To determine whether *D. spicata* is a more efficient scavenger of nutrients than *S. alterniflora*, we performed a ¹⁵N pulse-chase experiment by adding tracer to mesocosms of these species in monoculture pots. After the initial pulse, a subset of pots were sacrificed weekly and partitioned into detailed depth intervals for ¹⁵N analysis of several belowground pools. Comparisons between *D. spicata* and *S. alterniflora* uptake and allocation can explain mechanisms of competitive advantage and predictions of *D. spicata* dominance. Additionally, we used denitrification enzyme assays and greenhouse gas slurries to quantify denitrification rates and potentials. Initial results suggest that the vegetation types support similar N-relevant microbial communities. This implies that even if platform vegetation shifts as predicted, changes in nitrogen cycling and ecosystem functioning would be minimal. Our study of belowground nitrogen cycling lends new insight into how uptake could change as environmental changes shift vegetation communities on the marsh platform.

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COLOR RADIOMETRY REMOTE SENSING OF COASTAL SYSTEMS

Remote sensing offers one of the most spatially and temporally comprehensive tools for observing the

coastal ocean. However, current satellite radiometers were primarily designed for observing the global ocean, presenting challenges when trying to adapt for coastal waters. I will review considerations for utilizing current satellite capabilities in coastal systems as well as looking toward anticipated near-future capability. I'll provide examples of current applications of coastal remote sensing and outline needs to help support continued development of remote sensing products that are valuable to a wide range of user groups.

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OBSERVATIONS OF ACOUSTIC BACKSCATTER AND CURRENT VELOCITY ABOVE AN EELGRASS CANOPY OVER MULTIPLE TIDAL CYCLES

Acoustic mapping of eelgrass beds has the potential to document, in three dimensions, the structure of an eelgrass canopy. However, the acoustically-measured height of a submerged canopy can vary by more than 50% due to plant pronation in response to hydrodynamic forcing. In May of 2016, a multi-beam echosounder, high-resolution current profiler and high-definition video camera were deployed on a custom-built stationary frame above an eelgrass canopy in New Castle, NH. The objectives of the study were (1) to observe how the varying posture of the eelgrass canopy due to currents affects the acoustic backscatter signature and (2) to verify, in the field, a laboratory-tested model by Luhar and Nepf (2011) for deflected canopy height under varying hydrodynamic forcing. Acoustic, current velocity, and video data were collected continuously over several tidal cycles, and plant morphological characteristics (blade length, thickness, width) were sampled periodically during the deployment. Preliminary results indicate that the acoustic signature of a fully-pronated canopy differs significantly from an upright canopy, and that changes in the acoustically-measured canopy heights are correlated to changes in horizontal current velocity. Continuing work will also try to examine the changes in acoustic backscatter intensity from the canopy with changing light levels and time of day. These data offer an interesting snapshot of the daily and weekly variability of parameters that may affect the acoustic signature of an eelgrass canopy.

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THE BLOCK ISLAND BEACH PROFILE PROJECT: USING (SUPER) CITIZEN SCIENTISTS TO MONITOR BEACHES AT HARD TO ACCESS FIELD SITES

Beginning in 2013, eight beach profiles on Block Island, Rhode Island have been measured monthly by local residents using the modified Emery Method. Profile BI-MB (Mansion Beach), initiated by Dave Vanko, was measured biannually (May and August) 2007-2013. BI-MB represents the only profile that captures recent storm events, including Tropical Storm Irene (2011) and Superstorm Sandy (2012). Profiles are measured by trained volunteers and the data are sent to the author for plotting and interpretation. The accessibility of the Emery method makes this an ideal technique for non-geologists to learn, however, this project has benefitted immensely from the scientific training and background of the (super) citizen scientists involved. These profiles are in conjunction with analysis of bluff erosion and historic shoreline change mapping. While too early to draw significant conclusions, several key inferences can be reached. 1. Profiles on the eastern shoreline are the most dynamic, although erosion and deposition has largely been limited to the berm. 2. BI-MB showed little erosion during TS Irene but showed significant ($25 \text{ m}^3/\text{m}$) erosion of the foredune and berm. 3. The profiles on the west side of the island show little change (erosion or accretion), and point to the importance of storms to modify this shoreline, although the exact conditions needed to alter the profile here are still being examined. 4. The western profiles north of the inlet to New Harbor (BI-WB and BI-WP) have showed little to no appreciable change in volume over the last three years. This area is highly sediment starved due to the lack of bypassing at the New Harbor Inlet, and has the highest rates of shoreline change (1952-2014) on the island.

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COMPARING AND DETERMINING THE CAUSES OF RIBBED MUSSEL NITROGEN ISOTOPE SIGNATURES IN THREE NEW ENGLAND SUB-WATERSHEDS

Geukensia demissa, the ribbed mussel, is a useful indicator of sources of nitrogen input into coastal watersheds as it possesses a slow tissue turnover rate and is a common salt marsh species. During the summer of 2016, we sampled ribbed mussels from three New England sub-watersheds: Ocean Heights and Farm Neck sub-watersheds, Massachusetts, and Greenwich Cove sub-watershed, Rhode Island, for their nitrogen and carbon isotope signatures. Isotope signatures of the mussels were consistent with historical isotope data from these three sites. The results suggest the nitrogen isotopic signatures from the two sub-watersheds in Massachusetts are indicative of a mix of synthetic fertilizer and wastewater. Despite upgrades to the major waste water treatment facility in the Greenwich Cove sub-watershed, the mussels still contain a nitrogen isotope signature indicative of wastewater. We plan to investigate the isotope signatures of ribbed mussel food sources in the respective watersheds, and the total nitrogen loads of the watersheds to more conclusively explain the isotopic signatures. This will provide useful information for nutrient management in coastal watersheds.

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MODELING AND ANALYZING CHLOROPHYLL A DATA FOR TEMPORAL TRENDS AND PATTERNS IN PHYTOPLANKTON IN SAVIN HILL COVE, BOSTON HARBOR

Nearshore ecological monitoring provides key insight in changes to temporal trends and patterns in phytoplankton, which is critical given climate change and human impacts like coastal development or dredging. With phytoplankton as the foundation of the food web, a characterization of temporal patterns serves as a barometer for ecosystem changes at higher trophic levels. Chlorophyll a, sampled every two weeks using discrete surface bottle replicates, serves as a robust emergent property of phytoplankton abundance, and also community structure by employing size fractionation filtration of particles greater than 8 μm . An analysis of seasonal patterns and inter-annual trends from 2008-2014 was conducted from data collected in Savin Hill Cove, Boston Harbor. A summer seasonal signal was found with an average monthly phase in July. These data had significant variability, especially in the larger size class of phytoplankton. Sampling in 2011 showed a significant spike in chlorophyll a which defined an inflection point. A mathematical decomposition of these data revealed a non-stationary total chlorophyll seasonal signal. Average total chlorophyll from 2008-2010 were characteristic of having a summer seasonality, compared to 2011-2014 where significant variability begins to degrade this seasonal pattern and the contribution of the larger size class of phytoplankton to total chlorophyll increases. The changing seasonal phytoplankton patterns could be due to biological, physical and anthropogenic forces (e.g. grazing or freshwater input), which suggest potential changes in nearshore food web structures and ecosystem health.

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IMPACTS OF BLOOM-FORMING *ULVA* AND ECADS ON SALT MARSH VEGETATION AND GREENHOUSE GASES

Macroalgae is a natural component of salt marshes, but large accumulations on the marsh surface can have adverse effects on vegetation due to competition for light and space. Interactions among coastal algal species and the salt marsh plant, *Spartina alterniflora* will intensify as macroalgal abundance increases due to climate change effects. Through physiological processes, *S. alterniflora* and macroalgae can emit or absorb greenhouse gases at various rates. The purpose of this study was to determine how algal coverage of *Ulva* spp. and *Fucus* spp. affects the survival of *S. alterniflora* and associated greenhouse gas fluxes from vegetated mesocosms. Our experiment consisted of twenty-five 20 cm cores of *S. alterniflora* placed under five treatments (n=5 each). The treatments included: (1) *S. alterniflora* cores covered with 210g/m² of *Ulva* spp., (2)-cores with 210g/m² of *Fucus* spp., (3)-cores with 105g/m² of *Ulva* spp. and 105g/m² of *Fucus* spp., (4)-cores with 210g/m² of *Ulva* spp. and 210g/m² of *Fucus* spp., and (5)-cores with no algal treatment as the control. Stem density, height, and photosynthetic capacity as well as methane (CH₄) and carbon dioxide (CO₂) gas fluxes of the *S. alterniflora* cores were measured monthly from June-September. Stem height of the control was significantly higher than algal treatments. CH₄ and CO₂ emissions showed a trend of increase within algal treatments containing *Ulva* spp. Future field studies will explore the effects of higher density algal accumulation on *S. alterniflora*.

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JAMAICA BAY MARSHES, NEW YORK – VEGETATION, SEDIMENT, AND POLLUTION HISTORY

Understanding the characteristics of salt marshes prior to human impact is essential for defining how the sediment supply, vegetation, foraminifera, and pollutants have changed through time. We present the results of examination of two salt marsh peat cores from Jamaica Bay, Yellow Bar and JoCo, which

at 1 meter depth span over 400 years. Sediments were analyzed for pollen and spores, foraminifera, plant macrofossils, and heavy metals. Both marshes show human impact with a dramatic decline in inorganic supply along with declines in tree pollen and the rise of ragweed, a marker for human disturbance. Foraminifera show a shift in Yellow Bar marsh from *Miliammina* to *Trochammina inflata*, while JoCo marsh reveals a shift from *T. inflata* to *Jadammina macrescens* towards the present. Heavy metal increases toward the present document the industrial history of the region.

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THE EFFECTS OF BOAT NOISE ON RESOURCE COMPETITION IN THE BLUE CRAB (*CALLINECTES SAPIDUS*)
Marine noise has been shown to have a wide range of negative impacts on marine fauna, ranging from behavioral disturbance, to stress related physiological changes, to masking of communication, to direct physical injury. Marine invertebrates are generally thought to “hear” only low frequency sounds (from 10 to a few hundred Hz), but may be sensitive to acoustic pressure waves or particle motion outside of this range. The available data on sublethal behavioral impact of sound exposure on invertebrates is very limited. As part of a larger experiment on the impact of sound on invertebrate physiology and behavior, we exposed subadult blue crabs (*Callinectes sapidus*) to simulated boat noise (broadband, low frequency with peak level approximately 170dB re 1 μ Pa @ 60Hz) to determine whether exposure would alter interspecific resource competition with green crabs (*Carcinus maenas*). After 24 hours post exposure, control and sound-treated *C. sapidus* competed with unexposed *C. maenas* for food, as well as for shelter in an experimental arena. Trials were videotaped for analysis with the behavioral software *Ethovision* and a variety of behaviors and interactions types were recorded for each trial. We then categorized the individual behaviors as aggressive, passive, or neutral. While we did not observe a dramatic shift in behavior, some differences in aggression were observed between treatment and control *C. sapidus*. Particularly given the short duration of our experimental exposure, our results highlight the importance of understanding the impact of low frequency, especially boat noise, sound on marine animal behavior and competition.

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CAN WE MAKE PREDATOR FORAGING LESS EFFICIENT? MANIPULATION OF FOOD REWARDS MAY ALTER TURTLE-NEST-PREDATION BEHAVIOR.

Many species have distinct life stages with greatly increased mortality, and conservation efforts often target those high-mortality life stages. For wetland turtles in anthropogenically managed landscapes, nesting and nest survival is severely impacted by foraging meso-predators, which frequently depredate 95% or more of nests. We created simulated turtle nests with quail eggs, sham nests without eggs, and a control series with only marker stakes as experimental groups to measure predator foraging response to increased and decreased food resources from nests. We found that nest depredation rates were highest among the quail egg group, with all the nests in this group being depredated within two weeks. Sham nest depredation rates were comparatively lower, with only two fifths of the nests depredated and another two fifths partially disturbed. The control group had the lowest levels of depredation among the three experimental groups, with none of the controls being fully depredated and one half being partially disturbed. These results suggest that predators are capable of distinguishing simulated nests with eggs from sham nests without, and will forage in areas with known eggs more persistently. Conservation managers might consider creating large numbers of no-reward nests to reduce predator foraging activity.

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ASSESSING IMPACTS OF OYSTER AQUACULTURE ON THE WATER QUALITY OF COASTAL SALT PONDS IN RHODE ISLAND

Coastal lagoons require good water quality to thrive. Poor water quality disrupts nutrient cycling, which negatively impacts the health of these ecosystems and can make water unsuitable for recreational use. We assessed the effects of oyster (*Crassostrea virginica*) aquaculture on water quality in three coastal ponds in southern Rhode Island. Water samples were analyzed monthly from May through October of 2016 for chlorophyll a, total suspended solids (TSS), pH, temperature, salinity, and dissolved oxygen (DO). Samples were collected from each pond inside the aquaculture areas, and control samples were collected from adjacent non-aquaculture areas. A total of two samples were collected from each aquaculture and control site. Control sites had higher values of TSS and chlorophyll a when compared to aquaculture sites, possibly because oysters have a controlling effect on these parameters over time. Dissolved oxygen levels at all sites increased from May to June and decreased from July to August, likely driven by the increase in water temperature between spring and summer months. We did not observe consistent differences in pH, temperature or salinity between aquaculture and control sites. Our results suggest that continuous oyster aquaculture has a positive effect on water quality, as indicated by lower chlorophyll a and TSS, but no apparent effect on temperature, pH, salinity, or DO.

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SEDIMENT NITROGEN STABLE ISOTOPE RATIOS AS AN INDICATOR OF HISTORIC EUTROPHICATION TRENDS IN A CALIFORNIA ESTUARY

Nutrient pollution linked to wastewater inputs and agricultural fertilizers is one of the nation's most challenging environmental problems, and has caused major changes to estuarine ecosystems, such as declines in eelgrass beds, nuisance blooms of macroalgae, and reduced habitat quality for shell and finfish. Nutrient management goals are beginning to shift from relatively arbitrary percentage reduction goals to more holistic nutrient management plans, which consider among other factors the longer-term history of nutrient inputs and how these changes have impacted estuarine ecosystems. Here we report on historic changes in nutrient enrichment from four dated wetland sediment cores collected from a moderately eutrophic central California estuary. Significant increases in sediment $\delta^{15}\text{N}$ values were found at all four coring locations. Pre-1920s $\delta^{15}\text{N}$ values ranged from 0.5‰ in the upper Slough, to 5.6‰ near the mouth of the estuary, with sites in the middle slough averaging 3-4‰. There was a rise in sediment nitrogen stable isotope ratios beginning in the 1940s that mirrored an increase in fertilizer sales in the watershed. Values in the upper slough, where the residence time is longest, and in the lower slough, where loads are highest, were found to be most enriched in ^{15}N , at 9.5‰ over baseline values. This study demonstrates that stable nitrogen isotope values in wetland sediment cores closely reflect changing nutrient inputs, and can therefore be a useful tool for examining historic trends.

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VARIATION IN RECENT MARSH ACCRETION ALONG DELAWARE AND BARNEGAT BAYS

Tidal wetlands provide valuable ecosystem services including nutrient and carbon burial. The rate of nutrient and carbon burial is related to the rate at which both mineral and organic material accumulates on the marsh surface. As part of a larger regional wetland monitoring program in marshes ranging from saline lagoonal to urban tidal freshwater, short-term marsh surface accretion has been measured along with potential influential factors that include elevation, % organic matter (OM), and total suspended solids (TSS). Spatial variation in surface accretion rates were high, as predicted, with rates that ranged from 0 ± 1 mm/yr in a salt marsh on a barrier island in Barnegat Bay, NJ to 12 ± 2 mm/yr in a tidal freshwater wetland in the upper Delaware Estuary. Tidal freshwater wetlands had higher accretion rates than saline marshes. Many factors influenced this variation including geomorphic setting, elevation, and sediment availability.

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HIGH RESOLUTION MAPPING OF SALT MARSH SURFACE ELEVATIONS

High resolution elevation mapping is essential to understanding and predicting the response of salt marshes to sea-level rise. These elevation data are required to support accurate and precise marsh response and migration models with the output informing future management strategies. Light Detection and Ranging (LiDAR) provides a reasonable elevation data set for many coastal features (e.g., beaches, dunes, tidal flats), with an elevation accuracy varying from 5-30cm. However, with the dense vegetation cover of salt marshes LiDAR is a less preferred method for acquiring high resolution elevation. Moreover, marsh vegetation zones can typically vary by only a few centimeters in elevation (or duration of tidal inundation). To better measure the elevation of the salt marsh surface and relate its position to local tidal datums, survey grade GPS equipment is used. This method of elevation collection not only provides more accurate measurements of elevation than LiDAR, but also the ability to consistently measure the marsh surface. These field-based elevation data, with accompanying water level elevation, were collected in spring of 2016 at Sandy Hook-Gateway National Recreation Area (NJ), with findings for three marsh sites provided here. We collected comprehensive elevation data from the bay side edge to the upland using 20m grid spacing. A water level logger was deployed to understand tidal dynamics in the immediate vicinity of the marsh. These intensive on-the-ground elevation data (along with water level data) will be used to tie all of these data to the North American Vertical Datum of 1988 and to calculate tidal datums specific to each salt marsh site.

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N₂O AND CH₄ FLUXES FROM OYSTER AQUACULTURE

Oyster aquaculture is a food production technique of increasing global importance. As the oyster aquaculture industry continues to expand, it is necessary to understand its local and global environmental impacts. Using a combined field and laboratory sampling approach, we quantified fluxes of nitrous oxide N₂O and methane CH₄ from sediment beneath different ages of oyster aquaculture in Ninigret Pond, Rhode Island in the summers of 2014 and 2015. We also quantified fluxes of these two greenhouse gases from oysters with and without shell biofilms. We found that oyster aquaculture did not alter sediment N₂O fluxes and instead acted as a sink for N₂O, with a mean uptake rate of $- 231.5 \pm$

53 nmol m⁻² hr⁻¹. We found that oysters released N₂O with a mean rate of 55.6 ± 16 nmol individual⁻¹ hr⁻¹. Oysters with intact biofilms release N₂O at a slightly lower rate than those with the biofilm removed. Finally, we found that oyster aquaculture stimulated CH₄ release from sediment for a 3-4 year period before CH₄ fluxes returned to pre-aquaculture levels. Oysters did not take up, or release CH₄. Our results will be discussed in terms of a greenhouse gas budget associated with oyster aquaculture in Rhode Island, and greenhouse gas release from oyster aquaculture will be compared with other food production methodologies.

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INTEGRATED MARSH MANAGEMENT ON LONG ISLAND: FROM DEMONSTRATION PROJECT TO LARGE SCALE IMPLEMENTATION

Integrated marsh management (IMM) aims to mitigate ecological, societal, and public health issues related to tidal wetlands by creating a framework for multiple objectives. These goals can range from ecological restoration, coastal flood protection and habitat enhancement in the face of sea level rise to mosquito abatement and invasive plant control. A proof-of-concept IMM project was implemented at Suffolk County's Wertheim National Wildlife Refuge over a decade ago with continued good success. Following Hurricane Sandy, Suffolk County was awarded multiple competitive grants for the restoration of major salt marshes along Long Island's South Shore Estuary in partnership with US Fish and Wildlife Service, local jurisdictions, and non-profit organizations. The new challenges faced by these projects include increased marsh waterlogging, excessive ponding of interior marsh areas, deterioration of ditch network, and losses of high marsh. Regulatory restrictions have the potential to limit restoration techniques, especially given the strict time line to complete the work. We will discuss some of the challenges and potential solutions that include runneling, partial filling of ditches, reconstructing meandering channels, and fish pools. The integrative approach to marsh restoration is expected to improve the marsh health and increase their resilience to sea level rise, mitigate flood hazards to surrounding communities, protect floodplain ecosystems, sustain biodiversity, and support biological control of salt marsh mosquitoes.

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BARN ISLAND SALT MARSH COMPLEX – EIGHT DECADES OF CHANGE

The pre-ditching or natural marsh, reconstructed from the 1934 aerial photos, consists of wide and continuous creekbank levees and interior basins. The levee supported nearly pure stands of *Spartina patens* and the basins supported Egler's panne community sequence. Using the 1934 photos examples of levee and basin wetlands were found throughout coastal Connecticut regardless of tidal range. Few natural marshes remain in the northeast but the largest area occurs at Barnstable Marsh (mesotidal) and the smallest is Mamacoke Marsh at Connecticut College (microtidal tidal river). The photos also reveal that every colonial (farm) ditch has a natural plug (ditch bank levees) at the mouth of the ditches to restore the continuous levee system. Post-ditching, creek high tides are depressed which causes the long-term contraction of the levees over five or more decades. The bayfront levees remain stable over the long-term. In 1947, *S. patens* dominates the basins and *Juncus gerardii* dominates the levees. Over the next five decades as the ditches aggrade, the basin vegetation reverts to panne communities. There is no new levee growth until recent times. The Sassafras Marsh section has reverted to the natural marsh with two wide levees and a basin. Ditch plugs are evident here. New levee growth is present at the colonial ditch below dike 1. What appear to be reverting marshes are seen at other

locations from Connecticut to New Hampshire – all have characteristic ditch plugs. Mamacoke Marsh is tracking sea level rise while Barn Island is not.

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AN APPROXIMATION TO TIDAL MARSH DRAINAGE AND POREWATER RESIDENCE THROUGH SHORT-LIVED RADIUM ISOTOPES

This study represents an approximation to marsh drainage as porewater residence times as traced by short-lived radium isotopes (^{224}Ra and ^{223}Ra). Porewater was collected from three salt marshes in the south shore of Long Island, NY, during summer and winter at 20 cm and 120 cm depths over three-station transects from the inner marsh to the marsh bank to a tidal channel. The marshes: Wertheim 1 (restored), Wertheim 2, and Seatuck are located within U. S. Fish and Wildlife Service refuges. The results suggest that for Wertheim 1, marsh drainage shows longer porewater residence times for deep (120 cm) porewater and toward the marsh interior. Marsh edge shallow samples (20 cm) had shorter residence times than at 120 cm, indicating a possible drainage effect by the tidal channel. Wertheim 2 showed longer residence times during summer at the marsh edge and mid-marsh at 20 cm, suggesting that summer marsh drainage is more characterized by deep flow (120 cm) rather than shallow (20 cm). Winter showed shorter residence times at the marsh edge at 20 cm, suggesting a possible drainage effect. Seatuck showed residence times with a decreasing pattern from marsh edge toward the marsh interior. Longer residence times were detected at shallow depth (20 cm), and more marked in winter. These observations suggest differences in drainage between restored and non-restored marshes in geographical proximity. The method to age marsh porewater used here has the potential to further study other hydrogeological dynamics and nutrient loading on marshes targeted for restoration

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EFFECTS OF OYSTER AQUACULTURE ON BENTHIC MACROINVERTEBRATES IN COASTAL PONDS OF SOUTHERN RHODE ISLAND

Oyster (*Crassostrea virginica*) aquaculture in the coastal ponds of southern New England has become increasingly popular over the past twenty years. Although oysters are native to this area, little is known about the effects of oyster aquaculture on the infaunal benthic community under aquaculture. The anthropogenic effects of continuous oyster aquaculture could change the trophic structure of these ecosystems. We studied three coastal ponds in southern Rhode Island used to grow oysters commercially. Aquaculture sampling locations were selected by age to survey the change in functional feeding group counts over time, and one control site was established in each pond. Organisms were collected from the first 20 cm of substrate using five benthic cores per site. The soil was sieved, the organisms preserved in ethanol, and stained with rose bengal. Organisms were identified to the species level using a microscope and dichotomous keys, then sorted into functional feeding groups. We found organisms belonging to seven feeding groups: deposit feeders, suspension/filter feeders, interface feeders, scavengers/collectors, grazers/scrapers, predators, and parasites. Our data show that aquaculture sites have more deposit and interface feeders than control sites, possibly due to biodeposit accumulation under aquaculture racks, which may attract deposit feeders and alter the trophic structure of the infaunal community. In one pond, we found that the newest aquaculture site

(established in 2010) had the highest number of organisms. Our results indicate that continuous aquaculture may lead to changes in the size and structure of infaunal communities.

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EFFECTS OF NUTRIENT ENRICHMENT ON ESTUARINE BENTHIC COMMUNITIES IN SOUTHEASTERN MASSACHUSETTS ESTUARIES

The effects of nitrogen enrichment on the benthic communities in 42 southeastern Massachusetts estuaries were examined over a five year period. We quantified the spatial distribution of benthic species and their relation to summer nutrient related water quality and determined the role of temporal changes in dissolved oxygen in structuring benthic communities. Physical and chemical characteristics were sampled biweekly from summer to early fall over multiple years and used to calculate concentrations of total nitrogen, chlorophyll-a, and dissolved oxygen. Benthic grabs were collected in 611 sites during the late fall from 2004-2008 to detect variations in benthic communities within environments displaying a wide range of nutrient enrichment. In 2007 and 2008 additional grabs were collected in early spring at selected sites to bracket the critical summer period of potential low oxygen in order to capture changes in species diversity associated with hypoxic events. Our results indicated that nitrogen enrichment and dissolved oxygen levels were closely linked to habitat quality and that a threshold exists above which benthic communities show declining diversity and shifts to stress tolerant opportunistic species.

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CHARACTERIZING THE ORGANIC MATTER IN SURFACE SEDIMENTS FROM THE SAN JUAN BAY ESTUARY

The San Juan Bay Estuary (SJBE) is located on the north coast of Puerto Rico and includes the San Juan Bay, San José Lagoon, La Torrecilla Lagoon and Piñones Lagoon, as well as the Martín Peña and the Suárez Canals. The SJBE watershed has the highest density of inhabitants and major industrial activities in Puerto Rico. As a result, the SJBE is impacted by wastewater from combined-sewer overflows, faulty sewer lines, and storm water runoff; these factors combined with trash accumulation and infilling of the Martín Peña canal, contribute to decreased tidal exchange and reduced flushing in the estuary. To quantify the impact of the obstruction of the Martín Peña canal on anthropogenic nutrient distribution in the SJBE, over 200 sediment grab samples were collected throughout the estuary in 2015. The samples were analyzed for carbonate content, organic matter, grain size, bulk density, percent phosphorus, percent nitrogen (%N), and stable isotopes ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$). The %N values were highest in the surface sediments from the western portion of the Martín Peña canal, where %N was >0.86%. In contrast, %N from the adjacent San José lagoon averaged <0.2%. Grain size distributions across the SJBE were consistent with low flushing in the inner portions of the SJBE. Our preliminary results quantify how the obstruction of the Martín Peña canal has resulted in an enhanced depositional environment. This has been associated with bottom water hypoxia, fish kills, and excessive trash accumulation, which have serious implications for human and ecological health along the SJBE. To ameliorate these problems, the Martín Peña canal is slated to be dredged in 2018. This study provides baseline sediment quality data with which to compare future ecosystem changes.

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LIVING SHORELINES IN NEW ENGLAND: MONITORING MARSH STABILIZATION, RESTORATION BENEFITS, AND NITROGEN REMOVAL

Salt marshes provide a unique intertidal habitat between land and sea, making them one of the most diverse and productive ecosystems on Earth. Their ecosystem services are often undervalued, and are being degraded by multiple stressors such as human development and climate change. To protect eroding shorelines a new approach called a “living shoreline” has been developed. This technique is a natural approach to shoreline stabilization, which uses biodegradable materials such as coconut fiber coir logs and oyster shell bags that cup the marsh edge in order to reduce wave energy, enhance the robustness of existing marsh, and facilitate the growth of new marsh. Though this approach has been successful throughout the Mid-Atlantic and southern parts of the United States, few efforts have been made to assess the feasibility of living shorelines in New England. Between June and August 2016, the largest living shoreline restoration project in New England was installed at Felix Neck Wildlife Sanctuary on Martha’s Vineyard, MA. We have constructed three living shoreline experimental areas, spanning a total of 80 m. We are currently sampling a range of metrics to better understand changes in water quality, soil, and flora and fauna growth in living shoreline areas and adjacent eroded marsh edges. We are also measuring denitrification potential to investigate whether living shorelines enhance biogeochemical productivity and therefore facilitate nitrogen removal. This restoration work will provide novel information about the feasibility and success of living shorelines in New England. It will also help better identify the benefits of living shorelines in regards to shoreline stabilization, habitat quality, and nitrogen mitigation.

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MONITORING FOR AMERICAN SHAD (*ALOSA SAPIDISSIMA*) IN SMALL MASSACHUSETTS COASTAL RIVERS

An exploratory study was initiated by the Massachusetts Division of Marine Fisheries to monitor the presence and abundance of American shad in two coastal river systems in Massachusetts. The South River and Indianhead River historically supported viable recreational fisheries for shad, however no recent data on catch or harvest of shad exist for either of these systems. Monitoring and sampling were conducted in each river from the head of tide to the first obstruction, using a combination of visual and stream electroshocking surveys to detect the presence of spawning adult shad. Eleven sampling trips were made to the South River along with 12 sampling trips to the Indianhead River between April and June, 2016. A total of 93 shad were observed in the South River, of which 66 were captured (including 11 recaptures), and 322 shad were observed (108 captured, 5 recaptured) in the Indianhead River, respectively. Biological information, including age and genetic samples were collected from individual shad. Aging of shad samples will provide information on age structure, mortality and survivorship of these two populations. Indices of abundance (catch-per-unit-effort and density estimates) for each river system were calculated to examine trends over the course of the spawning run. Additional analyses of gear efficiency including capture efficiency and capture

probability were conducted to assist the goals of developing standardized sampling protocols and long-term indices of population demographics.

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LESSONS FROM THE PAST: WHAT THE US EXPLORING EXPEDITION (1838-1842) TELLS US ABOUT HOW
OR HOW NOT TO DO SCIENCE!!

The US Exploring Expedition, or the Wilkes Expedition, circumnavigated the globe in the period of 1838 to 1842. Ostensibly, one of the main purposes was to show the other nations of the world that indeed the US had equality with the other nations of the world, but a second purpose was to defend the US whalers and fur sealers, particularly in the southern hemisphere. Although some of the positive outcomes of this expedition will be mentioned, the main purpose is to list and describe some of the huge mistakes that occurred before, during and after the return of the expedition. Some of those that will be described will include: selection and actions of the leadership; the antagonistic relationships between the naval officers and the “scientifics”; care and treatment of the collections; and publication of the outcomes.

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MAKING NATURE GREAT AGAIN

It's been a difficult transition into the Anthropocene for Nature. The Human nation has overexploited ecosystem goods and services, many to extinction, failed to address illegal alien invasions, fueled their economy with indiscriminate annexing of Nature's land, and fostered unsustainable trade practices that promote overconsumption and leave only their spillage and spoilage to sustain Nature. Human intrusions have intractably altered Nature's prime infrastructure that once produced those valued goods and services in abundance, while half-baked and superficial attempts by the Human nation at restoration have proven ineffective if not counter-productive. In short, the collective Human nation footprint has outgrown Nature's ability to withstand the obdurate, relentless trampling. And, despite multiple treaties to restore or repurpose compartmentalized domains of Nature – air, water, fish, forests – they inevitably have disappointed because of obtuse and unilateral human translations of the laws of Nature into the laws of humanity. Nowhere is this more evident than in Nature's estuaries. Now, Nature's capital has been intractably drained, and its structure modified into novel dysfunction, which is paradoxically divergent from the desired outcomes and demands of the Human nation that caused the problem. It is clearly a time for a regime change and time to divulge Nature's 10-step plan for Making Nature Great Again.

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SUBAQUEOUS SOIL SURVEY AND TRACE METAL ANALYSIS OF THE BARNEGAT BAY, NEW JERSEY

Subaqueous soil is a new frontier in soil science, and Barnegat Bay is one of the first estuaries on the east coast to be the subject for a study such as this. This research seeks to assist in the assessment of the benthic environment at certain locations for dredge management, submerged aquatic vegetation restoration, shellfish habitat, carbon storage capacity, and other applications by focusing on data such as soil taxonomy and profiling, depth, slope, and other physical and chemical characteristics in cooperation with the United States Department of Agriculture - Natural Resource Conservation Service. In his subaqueous soil survey of the Barnegat Bay locations from the Point Pleasant Canal down to Forked River were studied and mapped. Trace metal analysis was conducted in every horizon of every core taken, totaling forty cores with up to seven horizons in each core. These soils were examined for trace metal levels of arsenic, lead, zinc, and copper specifically, but were also monitored for other contaminants. Moderately high levels were found in multiple locations throughout the Barnegat Bay. The subaqueous soils of the Barnegat Bay estuary have been deemed to be somewhat healthy in regards to trace metal concentrations, in contrast to the bay's reputation as a impaired body of water.

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SUMMER GREENHOUSE GAS FLUXES ALONG A 100-FOLD NITROGEN GRADIENT IN NARRAGANSETT BAY

Anthropogenic nitrogen inputs can counteract beneficial salt marsh processes through stimulated emissions of potent greenhouse gases, carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄). Short-term nitrogen inputs are known to potentially increase N₂O emissions, but more research is needed to quantify how chronic and large- scale nitrogen inputs affect greenhouse gas fluxes. It is important to quantify all greenhouse gas emissions from marsh systems in order to estimate net climate forcing. We aim to examine impacts of long term nitrogen inputs on emissions of greenhouse gases along a nitrogen gradient in Narragansett Bay at three salt marshes which have historically received 100-fold differences in levels of anthropogenic nitrogen inputs (low, medium, high). Measurements will be taken biweekly-monthly throughout the year for two years, at various temporal stages, within the dominant low marsh species, *Spartina alterniflora*, to capture representative greenhouse gas fluxes. Preliminary results show average CO₂ uptake at the sites ranges from -2 to -7 $\mu\text{mol m}^{-2} \text{s}^{-1}$, average N₂O fluxes range from 0.002 to 0.6 $\mu\text{mol m}^{-2} \text{h}^{-1}$, and average CH₄ fluxes range from 6 to 40 $\mu\text{mol m}^{-2} \text{h}^{-1}$. Understanding how chronic nitrogen inputs affect greenhouse gas emissions along a nitrogen gradient can help inform management decisions and help to provide incentives to protect these valuable ecosystems.

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CASE STUDY FOR POTENTIAL SOFT INFRASTRUCTURE SOLUTIONS VERSUS TRADITIONAL INFRASTRUCTURE SOLUTIONS IN COCKEAST POND, WESTPORT, MASSACHUSETTS, USA

Cockeast Pond located in Westport, MA is a salt pond that exchanges tidal waters with the lower West Branch of the Westport River and Buzzards Bay. Cockeast is a valuable resource to the community, providing spawning habitat for herring, shellfish and migratory birds, it is also used for sailing and its aesthetic value. In 2008, the Westport River Watershed Alliance collaborated with the Coastal Systems Program (CSP) at SMAST to complete a quantitative water and habitat quality assessment. Research efforts determined that Cockeast Pond is eutrophic due to nitrogen loading from septic system effluent, agriculture, and fertilizers in the watershed. In 2010, efforts were made to remediate Cockeast by repositioning the inlet culvert to increase tidal flushing. This resulted in a salinity rise from 0.1 to 10ppt, but was insufficient to effectively lower N levels to those supportive of a healthy habitat. In 2015, CSP launched a more detailed assessment focusing on water quality, benthic regeneration, tidal flux, stream input, benthic infauna, and macrophyte coverage. In Spring 2016 a graduate case study was conducted to assimilate all previous and current data for development of a N box model and set of potential management scenarios that included soft and permanent infrastructure solutions aimed at lowering N to less than 0.50 mg N/L. Soft infrastructure solutions focused on reducing watershed N sources (septic, fertilizers, agriculture by BMPs) and through oyster aquaculture. Permanent infrastructure solutions included culvert reconstruction and enhanced wastewater treatment. This type of detailed assessment is essential for maximizing the effectiveness of water quality management while minimizing the cost to the community.

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PLOT LEVEL RESULTS TO ECOSYSTEM LEVEL RESPONSES: EXTRAPOLATE WITH CAUTION

Plot-level studies are a critical tool in experimental ecology, with results frequently extrapolated to landscape and ecosystem levels. Such predictions of ecosystem structure and function have provided important insights in basic ecosystems science, as well as the basis for stewardship decisions. Such extrapolations, from m² to km², however, should be applied with caution. The TIDE ecosystem-level experiment tested impacts of estuarine eutrophication on tidal salt marshes in Plum Island Sound, MA. With 10 years of artificial N enrichment (“moderately polluted” by EPA) we report plant responses at species and community levels in contrast with predictions that could have been made from plot-level literature. Contrary to plot-level studies, we found nominal to mild increases in aboveground biomass of both low and high marsh *Spartina alterniflora* (*Sa-t* & *Sa-s*) but lower *Sa-t* culm densities, so no change in ecosystem above ground production. Belowground responses by *Sa-t* and the microbial community, however, drove significant low marsh erosion and loss, with negative impacts on some higher trophic level species. Previous work also highlights the potential for *Sa* to expand into the high marsh and for *Distichlis spicata* to increase, both at the expense of *S. patens*, as nutrients shift competitive dynamics. We found no change in high marsh vegetation attributable to N enrichment. Differences between our findings and projections from the literature likely result from our simulation of actual eutrophication with NO₃ delivered tidally vs. solid forms of ammonia N delivered directly to the marsh surface.

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LESSONS FROM THE PAST TO PREPARE FOR THE FUTURE: THE VALUE OF ESTUARINE HISTORICAL ECOLOGY IN A CHANGING WORLD

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Given the accelerating pace of environmental change in estuaries, many scientists assert that past conditions are irrelevant, because we cannot turn back the clock. Instead, they argue, we should embrace novel ecosystems where they provide ecosystem functions or are impervious to restoration. Yet, it is only by reconstructing historical ecological changes that we can understand why coastal ecosystems look the way they do: which processes and functions have been altered by human actions, where irreversible state shifts have occurred, and how to best restore coastal ecosystems to be self-sustaining and provide high quality habitat for biota. This presentation will provide a brief overview of the methods of historical ecology, illustrated with examples drawn from the authors' work in California, Mexico, New England, and the Mid-Atlantic. Promising new techniques in historical ecological analyses will be described, and management implications emphasized.

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CAN WE MEASURE NITRATE IN REAL TIME IN MAINE ESTUARIES?: DETERMINING THE ACCURACY OF IN SITU MEASUREMENTS OF NITRATE.

The production of food for bivalve aquaculture in estuaries is dependent on light, grazing, and nutrients. Recently, technological advances have allowed researchers to measure nutrients continuously. The Submersible Ultraviolet Nitrate Analyzer (SUNA V2) is an example of one of these advances. It is a chemical-free optical sensor that measures in situ nitrate levels, using the physical properties of nitrate to be absorbed at wavelengths of 217-240 nm. To test the accuracy of the SUNA, water samples were collected adjacent to deployed SUNA's in the Damariscotta River estuary, then analyzed through a Teledyne T200 Nitrogen Oxide Analyzer. Results are showing that the SUNA V2 measures consistently 2 μM difference than the samples analyzed in the lab. The higher levels of nitrate could be a due to the levels of color dissolved organic matter (CDOM), that may absorb at the same wavelength as nitrate. Future work concentrating on the absorbance of CDOM in these systems could improve SUNA accuracy in estuaries.

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VULNERABILITY ASSESSMENT AND SHORELINE STABILIZATION ALTERNATIVES STUDY, SPRING HOUSE POND NEW SHOREHAM, RHODE ISLAND

Spring House Pond is located in the southeastern portion of Block Island and lies at the edge of a coastal bluff. As stewards of the parcel that contains the southern portion of the pond, the Block Island Land Trust is concerned with the vulnerability of the pond to coastal erosion. While maintaining the scenic qualities, historical significance, and habitat values associated with the pond are laudable goals, the safety of the public (by reducing the risk of catastrophic bluff failure) is of paramount importance. To address these concerns, ESS Group, Inc. (ESS) investigated historic and potential future shoreline changes and evaluated possible short- and long-term solutions to address the on-going coastal erosion and improve resiliency. In order to evaluate the practicality and effectiveness of potential alternatives, ESS undertook a number of field and desktop investigations, including a bathymetric survey, characterization of the existing bluff stratigraphy, as well as terrestrial and wetland communities present, groundwater seepage sampling, and a determination of erosion rates and susceptibility. The findings of these investigations, along with an evaluation of both short- and long-term alternatives will

be presented. Long-term alternatives included: 1) actions necessary to limit pond losses as the result of catastrophic bluff failure, 2) a planned lowering of water levels with various outlet controls; and 3) construction of a stable earthen embankment to control seepage, add additional stability to the bluff, and provide additional sacrificial land mass in the event of a future bluff failure.

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ASSESSING THE ROLE OF MACROPHYTES IN ESTUARINE SILICON CYCLING

In many coastal ecosystems, primary production can be dominated by macrophytes (i.e., submerged aquatic plants and macroalgae). Macrophytes are known to play a key role in the cycling of oxygen, nitrogen, and phosphorus; however, macrophytes may also alter the cycling of another important element, silicon (Si). Determining the role of macrophytes in Si biogeochemistry has important implications for our understanding of estuarine ecology including phytoplankton composition and food web dynamics. In this study, we quantified the biogenic Si (BSi) content of 27 macrophyte species from three temperate marine ecosystems (Waquoit Bay, MA, Narragansett Bay, RI, and Long Island Sound, CT) and from one tropical ecosystem (Graham's Harbor, BS). Based on the preliminary findings, it appears that certain macrophytes in Waquoit Bay are accumulating Si. BSi concentrations were highest in *Cladophora* sp., *Gracilaria* sp., and the roots of *Zostera marina* with mean BSi concentrations of 1.4, 2.7, and 2.3% dry weight, respectively. These concentrations are indicative of active Si accumulation, suggesting that macrophytes are taking up Si for physiological and ecological purposes. In contrast, the nodes and rhizome of *Z. marina* and *Ulva* sp. had relatively low BSi concentrations (0.30, 0.20, and 0.20% dry weight, respectively). Furthermore, using microscopic techniques we determined the presence of Si stones or phytoliths in *Cladophora* sp. and *Gracilaria* sp. Such formations are similar to the structures found in terrestrial land plants. If this preliminary research holds true then it appears that certain macrophytes may play a key role in marine Si cycling that, until now, has been overlooked.

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CHARACTERISTICS OF PLASTIC PARTICLE DEBRIS ON TWO HAWAI'IAN BEACHES

Sediment samples were collected from two Hawai'ian beaches (Kamilo Beach on the Big Island and Kahuku Beach on O'ahu). A total of over 48,000 tiny plastic particles were handpicked from the samples and then sorted by size and color. Nurdles made up 6.8% of the plastic particles. In all size categories ranging from 0.5 mm to 8 mm the most common plastic fragment color was white/clear (71.8%) followed by blue, green and black (7.3 - 8.5% each), red (2.6%), yellow (1.2%), and orange, brown and purple (0.2 - 0.6% each). Plastic type based on Raman Spectrometer analysis of a small representative subsample indicated that most of the fragments were polyethylene and a small number were polypropylene.