**Nantucket Biodiversity Initiative's**
**8th Biennial Research Conference**
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**Presentation Abstracts – alphabetical by Presenter, bold signifies presenter.**

## MERCURY LEVELS IN FRESHWATER FISH: ESTIMATING CONCENTRATION WITH FISH LENGTH TO DETERMINE EXPOSURES THROUGH FISH CONSUMPTION

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Methylmercury (MeHg) is a neurotoxic pollutant that bioaccumulates and biomagnifies in aquatic food webs, impacting the health of piscivorous wildlife and human consumers of predatory fish. While fish mercury levels have been correlated with various biotic and abiotic factors, many studies only measure adults to characterize the health of locally fished populations, omitting information about how local fish bioaccumulate mercury relative to their growth. In this study, we sought to establish length: total mercury (THg) concentration relationships in juvenile and adult fish of four genera (sunfish, yellow perch, white perch, and killifish) across six freshwater pond systems of Nantucket Island to determine safe consumption sizes across species and environmental conditions. A wide length range (2-21 cm) was utilized to develop linear regression models of ln-THg vs. fish length. In most cases, different genera within the same pond indicated similar slopes, supporting that all four genera share comparable features of feeding and growth. Comparing individual species across ponds, differences in ln-THg vs. fish length were attributable to known environmental Hg-modulators including surface water MeHg levels, pH, and watershed area. Referencing human health and wildlife criteria, our results confirm that numerous Nantucket freshwater ecosystems contain elevated fish THg levels, which could impact the health of not only piscivorous wildlife in all measured ponds but also recreational fishers in at least two measured systems. Future studies should measure THg levels across juvenile and adult fish to detect potential differences in the slope of THg concentration across fish length relevant for local consumption advice.
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## HORSESHOE CRAB POPULATION TRENDS OVER A 10 YEAR STUDY ON NANTUCKET, MA.

**Libby Buck**[1]

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Horseshoe crabs (*Limulus polyphemus*) are unique aquatic creatures that have not evolved in over 350 million years. During the late spring and early summer these ancient arthropods make their annual journey from the depths of the ocean to spawn on beaches all along the New England Coast, including Nantucket, MA. Spawning coincides with the lunar cycle and coinciding astronomical high tide events. There are major concerns that horseshoe crab populations throughout New England are declining due to habitat degradation, predation, and overfishing for bait and/or biomedical research. The Atlantic States Marine Fisheries Commission have developed a horseshoe crab management plan based on the data from annual spawning surveys with the hopes of preventing further population decline.
Since 2009, Nantucket Conservation Foundation and Maria Mitchell Association have been participants in these annual surveys by collecting data for two beaches on Nantucket (Warren's Landing in Madaket Harbor and Monomoy Beach in Nantucket Harbor). This presentation will focus on the local population trends seen in this long-term data set with emphasis on the implications for horseshoe crab population recovery for the island.
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## DRONE MONITORING OF SALT MARSH STRUCTURE

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Observations of salt marsh biodiversity have been recorded photographically between 2004 and 2019 at Plum Island (Newburyport, MA), Sandy Neck (Barnstable, MA), and Eel Point (Nantucket MA). During this time, changes have been observed in plant and animal communities in all three locations, likely correlated to the rise in mean sea level. In order to achieve a wider perspective on these changes, we are studying the utility of drone photography to identify different grass species, their current locations, and to prepare for future comparisons. Preprogrammed drone flights (DJI Inspire 1Pro, with X3 camera) were taken over a 1 acre section of marsh at the Rough Meadows Wildlife Sanctuary in Rowley, MA, in August and October 2018, and August 2019. We found that images taken at 200‘ provided a reasonable balance of accuracy and efficiency. The visual images from 2018 and 2019 are being compared to each other, to historic transect data from the same location, and to infrared images taken during the 2019 flights. These procedures can be translated to other marsh and aerial surveys.
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## AN OVERVIEW OF NANTUCKET'S FIRST OYSTER RESTORATION PROJECT: PLANNING, IMPLEMENTATION, AND MONITORING

**Leah K. Cabral**[1]

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In 2018 the Natural Resources Department finished building Nantucket's first oyster restoration project in Shimmo Creek using recycled oyster and clam shells from the Town's "Shuck It for Nantucket" Shell Recycling Program. The overall project goal is to restore a native species that once was prevalent and now functionally extinct in the United States. To accomplish this, oysters are grown at the Town's Brant Point Shellfish Hatchery and stocked at the one-acre restoration site to increase oyster density and spawning stock until the site becomes self-sufficient. Some quantitative measures that are being studied including oyster and eelgrass density, species biodiversity, and water quality parameters. Since implementation there has been a declining trend in nitrogen levels, juvenile and adult oyster densities have increased, and eelgrass recruitment has been observed. Lessons learned from this pilot project will be used when planning and implementing additional oyster restoration projects in Nantucket waters.
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## AN ECOLOGICAL SURVEY OF HITHER CREEK TO DETERMINE THE SUITABILITY AS A SHELLFISH HABITAT

Valerie Hall[1] and **Chloe Coggins Carey[2]**

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Hither Creek is a degraded estuary, categorized by the Massachusetts Estuary Project as an impaired ecosystem. In 2008 a shellfish survey was conducted by Epsilon Associates Inc. along the docks of Madaket Marine. They observed high biodiversity of shellfish including hundreds of bay scallop spat attached to macroalgae, contrary to the expectations of an impaired ecosystem. The purpose of our study was to recreate and expand upon the 2008 study. Spat bags were set out every two weeks from mid-May to mid-June near the mouth of the creek, F street dock, and the boatyard. Adult scallops were collected in Madaket Harbor and the gonads were examined histologically to assess spawning condition. Adult and juvenile shellfish were sampled using an Ekman grab and clam rakes along the docks of the boatyard. We found scallop spat by the F street dock on July 25, our last day of retrieving. However, water temperatures were too cold to make a correlation between adults spawning in Madaket Harbor and the minimal spat found in Hither Creek. Other shellfish found in the spat bags were soft-shell clams and ribbed mussels. 5 adult quahogs were found along the docks of Madaket Marine. We conclude that Hither Creek may not be conducive to bay-scallop survival to adulthood, while it could be suitable for ribbed mussels and quahogs. We also question the results and conclusions of the 2008 Epsilon Associates Inc. study.
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## REVISITING THE PALEONTOLOGY OF NANTUCKET

**Jessica D. Cundiff[1]**, Scott Smyers[2], Andrew McKenna-Foster[3], Joe Martinez[1] and Scott Egan[4]

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The paleontology of Nantucket was the subject of much interest in the mid-late 1800s and early 1900s. Noted geologists and paleontologists, such as Joseph Cushman, Nathaniel Southgate Shaler and Samuel Scudder, published on the fossils found on the island. Since the early 1930s there have been only a handful of publications on the paleontology of the island as research interests have shifted to the far away and more exotic fossils. Although localities from the Pleistocene age (120,000 years ago) are still accessible, only a small amount of the fossil material is present in the local natural history collections. Since 2011, our research group has been working to collect material from the Pleistocene deposits at Sankaty Head on Nantucket. Storm erosion has made it difficult to locate previous collecting localities and at times to access the fossiliferous layers. Work at Sankaty Head has produced three possible Terebratulid brachiopod taxa that had not previously been documented in the paleontological literature. The fossil assemblage mostly consists of mollusks (bivalves and gastropods) with an abundance of barnacles from the genus *Balanus*. These taxa may help us to understand the paleobiogeography of the island and give a better understanding of the paleoecology of this Pleistocene age fauna. There is more work to be done, but it is our hope that this work will result in an updated account of the paleontology of Nantucket.
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## NANTUCKET'S NEGLECTED HERBIVOROUS INSECTS, YEAR NINE

**Charles S. Eiseman**[1] and Julia A. Blyth[1,2]

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Little-known herbivorous insects such as gall inducers and leafminers were largely ignored in past assessments of Nantucket's biodiversity. To address this knowledge gap, we conducted intensive three- to seven-day surveys for galls and leaf mines throughout the island every year from 2011 to 2019. The timing of our surveys varied from year to year so that we covered every month from May to September. Beginning in 2016, we expanded them to include other neglected insects such as leaf-tying micro-moths and free-living sawfly larvae. Each type of larva or characteristic plant damage was photographed, and when possible samples were collected in an attempt to rear adults. Collected and reared specimens have been sent to specialists around the world for examination. Each visit to Nantucket has yielded many new species for the island and a few new to science, several of which have now been formally described. We have also documented new host records for some species and discovered the immature stages of a few species previously known only from adults. Well over 200 species of gallmakers and leafminers have now been found on Nantucket, most of them during our study, and we are continuing to add new species in these and other groups.
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## NORTHERN LONG-EARED BAT HABITAT USE ON NANTUCKET, MA

**Danielle O'Dell**[1]

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Once one of the most common bats species in the northeastern US, Northern long-eared bat (*Myotis septentrionalis*) populations have been devastated by White-nose Syndrome and are currently considered high risk for extinction. Some hope remains for the species in coastal areas including Long Island, Martha's Vineyard and Nantucket. Bats on Long Island and Martha's Vineyard seem to be thriving despite exposure to the fungus that causes the disease, *Pseudogymnoascus destructans* (*Pd*). To date, Nantucket bats remain healthy and nearly fungus-free, with no indication of progression to White-nose Syndrome. All but two swabs from over 100 captured bats, as well as environmental swabs collected in roost sites, have returned negative for the presence of *Pd*. Extensive, Island-wide acoustic surveys have documented presence of Northern long-eared bats in most vegetation communities across the island with the highest levels of activity occurring in hardwood and pitch pine forests. Annual summer mist-netting surveys continue to capture lactating females as well as juvenile bats, confirming continued breeding status. Fall surveys and radio telemetry efforts have focused on the search for hibernation sites for this species which include human structures with cinder block basements or crawl spaces. Continued collaboration with researchers from University at Albany and BiodiversityWorks on Martha's Vineyard will focus on understanding the behaviorally-mediated avoidance of disease and the persistence of Northern long-eared bats on Nantucket and other coastal areas.
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## EVALUATION OF THE VERTEBRATE CARRION RESOURCES USED BY THE AMERICAN BURYING BEETLE (*NICROPHORUS AMERICANUS*).

**Brandon M. Quinby**[1], Elizabeth A. Flaherty[1], and J. Curtis Creighton[2]

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The last recorded naturally occurring ABB on Nantucket Island, Massachusetts was in 1926. Beginning in 1994, lab-reared offspring of wild-caught individuals from Block Island were used to reintroduce the ABB onto Nantucket. Despite an initially successful reintroduction, the population shows little evidence of recruitment and likely requires human assistance for long-term success. A key requirement of the ABB's life cycle is the availability of small vertebrate carcasses used for breeding. In this study, we investigated feeding relationships of local burying beetles using stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$) of small elytral clips collected from live-captured specimens. Because burying beetles build body tissues using nutrients from their larval host carcass, the stable isotope ratios of $\delta^{13}C$ and $\delta^{15}N$ in adult burying beetles reflect their larval diet, indicating the carrion their parents used as a reproductive resource. Using stable isotopes, we quantified the carrion used by ABBs for reproduction. Our results indicate that ABBs rely on both natural and provisioned carrion. In 2017, 65% of captured Nantucket ABBs were raised on natural

carrion and 35% on provisioned quail. In 2018, 83% of captured Nantucket ABBs were raised on natural carrion and 17% on provisioned quail. In both 2017 and 2018, 84% of captured Block Island ABBs were raised on natural carrion and 16% on provisioned quail. These results suggest that ABBs are not specializing on one carrion resource but are using what is available. They also suggest that long term provisioning of quail may be necessary for a successful reintroduction to Nantucket.
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## MARITIME HABITAT DIVERSITY ON THE SANDY NECK BARRIER BEACH SYSTEM, BARNSTABLE, MA

**Donald G. Schall**[1], Pamela T. Polloni[2], and Nina Z. Coleman[3]

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Maritime habitats on the Sandy Neck Barrier Beach System in Barnstable, MA are diverse and species rich. Plant communities in the interdunal swales are particularly diverse and complex. Succession in the interdunal swales and other maritime habitats is directly influenced by several environmental factors including salt spray deposition, coastal erosion and salt water flooding during storm events, and fluctuations in the water table. One such plant community is the "Swamp Hollow" discussed by Svenson in articles that appeared in *Rhodora* (The Journal of the New England Botanical Club) nearly 50 years ago. The forested wetland in the Swamp Hollow and surrounding woodland community is the focus of our presentation. The red maple swamp in the Swamp Hollow and surrounding woodlands were revisited during BCCCI botanical surveys performed in 2016-2019 to inventory the Sandy Neck flora. Surveys were supported by a Mehrhoff Research Grant awarded to BCCCI by the New England Botanical Club.
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## BREEDING SEASON AND LARVAL DEVELOPMENT VARIABILITY OF POND-BREEDING FROGS ACROSS NEW ENGLAND

**Scott Smyers**[1]

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Beginning in 2007, I have led a collaborative research project studying common amphibians using digital audio recordings at three high elevation ponds in the White Mountains, NH and two locations in Massachusetts: Wachusett Mountain, Princeton and Squam Farm, Nantucket. Spring Peeper (*Pseudacris crucifer*) is the only species that occurs at each study pond across the range of

this study. Spring Peepers begin calling (breeding) as early as March 20 (Nantucket), mid-April at Wachusett Mountain, and mid-May to early June in the White Mountains. The beginning and the end of calling fluctuates from 10-14 days, but the peak of intensity remains very similar from year to year at each pond. On Nantucket most calling is complete by the end of May, while calls extend into July in the White Mountains. Spring peepers undergo metamorphosis in late June in MA and August or September in the White Mountains. Another species that occurs on Nantucket is Green Frog (*Lithobates clamitans*), which begins calling on Nantucket in late April with a peak in May-June. This species begins calling in mid-late May in other parts of MA and continues through June and into July. I will show how species-specific call intensity (reproductive effort) and phenology vary from pond to pond and from year to year within the same pond. I propose a collaborative study using simple methods (digital recordings, catch, measure, photograph, release) to determine how environmental variables affect breeding and larval development of the Spring Peepers and Green Frogs of Nantucket.
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## ECOLOGICAL QUESTIONS ABOUT GENETICALLY ENGINEERING WHITE-FOOTED MICE TO COMBAT LYME DISEASE ON NANTUCKET

**Allison A. Snow[1]**

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The risk of acquiring tick-borne Lyme disease is affected by complex interactions among small mammals, ground-foraging birds, deer, and the blacklegged ticks (*Ixodes scapularis*) that feed on these species. To block the transmission cycle, Kevin Esvelt (MIT) and Sam Telford (Tufts University) have proposed releasing thousands of genetically engineered (GE), white-footed mice (*Peromyscus leucopus*) that are resistant to *Borrelia burgdorferi*, the bacterium that causes Lyme disease, on Nantucket. I examined their proposal from an ecological perspective to begin to evaluate its likelihood of success and explore possible environmental risks. If it is feasible to replace local mice with lab-reared GE mice that are resistant to *B. burgdorferi* (a major challenge), the project's impact on the Lyme transmission cycle will depend on the proportion of blacklegged ticks that feed on other *Borrelia*-infected reservoir hosts, such as masked and short-tailed shrews, meadow voles, rats, catbirds, robins, towhees, and other species. To date, little is known about the relative contributions of other species *vs*. white-footed mice as Lyme reservoirs on Nantucket. Also, baseline data are needed quantify current spatial and temporal variation in the density and infection levels of blacklegged ticks. I will present a framework for identifying possible ecological risks of releasing GE white-footed mice on Nantucket and elsewhere. Input from ecologists with local expertise will be very helpful for these assessments. Meanwhile, to substantially reduce public health risks from both Lyme and other tick-borne diseases on Nantucket and neighboring Tuckernuck Island, complementary efforts to severely limit deer populations may be needed.
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## THE MACROINVERTEBRATE STREAM FAUNA OF NANTUCKET

**Greg Whitmore**

To date there has been no comprehensive published treatment of the macroinvertebrate stream fauna of Nantucket. Freshwater streams are limited on Nantucket, and most appear to be intermittent. Year-long sampling has shown that a limited freshwater stream fauna is present and is indicative of small intermittent and perennial streams found elsewhere in New England.
Six sites were chosen based on the presence of measurable flow and salinity levels <0.5ppt. Sites were sampled and stream chemistry measurements were taken on a monthly basis. All sites were sampled using an aquatic D-frame dipnet, and at two sites high spring flows were sampled by kicknet.
Taxonomic groups collected include Plecoptera, Ephemeroptera, Trichoptera, Odonata, Megaloptera, Diptera, Hemiptera, Coleoptera, Isopoda, Amphipoda, Gastropoda and Clitellata. Specimens are being identified to the lowest possible taxonomic level. Overall, diversity and abundance are as expected. Abundance is low for most species, and some species may be restricted to individual streams. These species could be considered relict populations. The presence of sensitive species such as *Leuctra sp*. in Squam Brook may be a relict population from a time before humans altered the natural habitats on Nantucket. Due to limited species distribution, significant disturbance to a stream ecosystem could essentially result in the loss of species from Nantucket. Due to the island's isolation, new individuals colonizing Nantucket streams from the mainland or MV is possible, but unlikely.
Stream chemistry measurements fall within expected ranges for developed areas. Dissolved oxygen levels may be a seasonal limiting factor in most of the streams.
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**Poster Abstracts– alphabetical by Presenter, bold signifies presenter.**

## THE PRESENCE OF MICROPLASTICS IN GRAY SEALS (*HALICHOERUS GRYPUS*) AT A NANTUCKET SOUND HAUL-OUT

**Jack Barkowski**[1], Juanita Urban-Rich[1], Stephanie Wood[1], Julianne Darnell[1]

[1]University of Massachusetts, Boston

Microplastics are small (less than 5 mm) pieces of plastic that enter the ocean either through direct input or degradation over time from larger plastics. Microplastic ingestion occurs in a

variety of marine wildlife including birds, fish, whales, and seals. Despite this, not much is known about how microplastics cycle through the marine environment. The purpose of this study is to look for evidence of microplastics in the fecal matter of gray seals in the North Atlantic. The samples were collected from Great Point (Nantucket National Wildlife Refuge) on Nantucket, MA. The samples were labeled and frozen at -80° C until processing. Methodology for preliminary analysis conducted in Spring/Fall 2019 is as follows: samples are filtered through screens of 4 mm, 2mm, 500 µm, 250 µm, 125 µm, and 63 µm. After removing the remaining biological waste with $H_2O_2$, the samples were analyzed under a microscope with polarized light. The analysis of a few samples shows the presence of microfibers in the diet of these seals. In the fall of 2019, the main focus will be to determine the types of microplastic found. This will be done through Fourier Transform Infrared (FTIR) Spectrometer analysis. It is unlikely that the seals are directly consuming the plastic but that they ingest them through their prey. An analysis of prey hard parts will be conducted simultaneously. Prey data will inform future research on the potential of microplastics exposure via secondary consumption by seals.
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## THE SANDPLAIN GRASSLAND NETWORK: A REGIONAL PARTNERSHIP AMONG RESEARCHERS AND MANAGERS TO ADVANCE THE UNDERSTANDING AND EFFECTIVENESS OF THE MANAGEMENT OF SANDPLAIN GRASSLANDS

**Karen Beattie**[1], Sarah Bois[2], Russ Hopping[3], Jennifer Karberg[1], Karen Lombard[4], Chris Neill[5], Polly Weigand[6], Robert Wernerehl[7], Michael Whittemore[8].

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Sandplain grasslands are a globally rare plant community found along the Atlantic coast from northern New Jersey to southern Maine. The Sandplain Grassland Network is a multi-partner, region-wide working group that has been collaborating on the issue of conservation and management for this ecosystem since 2016. The partnership has gathered literature to create a database of current knowledge and conducted interviews of managers and researchers to capture experience and case histories. This information has been compiled into a "guidebook" website presenting the state of research and regional management experience, synthesizing results, and suggesting ways to best manage, research and monitor sandplain grasslands going forward. Next steps include bringing stakeholders together to identify common research and management goals and opportunities, identifying resources that could potentially be shared and then used across multiple owners and parcels, and creating a regional management plan and timetable for coordinating management and restoration efforts. The Sandplain Grassland Network website URL is http://sandplaingrassland.net/
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## PRELIMINARY PLANNING FOR WETLAND RESTORATION AT WINDSWEPT CRANBERRY BOG, NANTUCKET ISLAND, MA.

**Karen C. Beattie**[1], Jennifer M. Karberg[1], Danielle I. O'Dell[1], Kelly A. Omand[1] and Elizabeth C. Buck[1]

[1]Department of Science and Stewardship, Nantucket Conservation Foundation, Nantucket, MA

The Nantucket Conservation Foundation (NCF) recently retired cranberry cultivation on its Windswept Bog property in order to pursue a watershed level wetland restoration project. The decision to abandon cranberry cultivation was based on concerns about water quality and nutrient loading within the Polpis and Nantucket Harbor watersheds and the economic and climate-change related challenges facing the cranberry industry across the northeast. NCF's Department of Science & Stewardship is working with the Massachusetts Division of Ecological Restoration Cranberry Bog Program and the USDA Natural Resources Conservation Service to design a wetland restoration project. Preliminary goals include maintaining public access to the property, restoring natural wetland functions including nutrient removal and waterflow buffering prior to discharge into Polpis Harbor, as well as managing water flow in a manner that maintains Stump Pond (a unique but human-made wetland created to serve as a reservoir for cranberry cultivation). Pre-restoration research is currently underway, including trapping and radio-tracking spotted turtles (*Clemmys guttata*) to understand habitat use, botanical surveys to develop a property species list and identify rarities and water quality monitoring at key inflow and outflow locations. Pre-restoration next steps include conducting soil surveys to determine historical wetland status, undertaking a preliminary engineering study, developing interpretive education and community outreach programs, identifying and implementing additional research and monitoring of other key physical and ecological attributes, conducting pre-treatment vegetation surveys to document current conditions and future trends, applying for restoration work funding, permitting and contracting.
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## PHENOLOGICAL RESPONSE TO EARLIER SPRING: OPPORTUNITIES AND CHALLENGES IN A CHANGING CLIMATE

Sarah T. Bois[1]

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Anticipated consequences of climate change already seen in temperate regions include early spring warmup. These earlier warm temperatures may be advantageous for some species potentially extending their growing seasons. Warm weather can accelerate leaf flush in perennial woody species, potentially exposing vulnerable young tissues to damaging frosts. Earlier warming temperatures may also limit the winter chill accumulation necessary for many temperate woody shrubs. Using a combination of field observations and warming experiments, we study the phenological response of spring warming on eight different species of common, native shrubs characteristic of Nantucket shrublands. In addition, we investigate the phenological

cycles of *Malacosoma americanum* (Eastern Tent Caterpillar) in the field. Thus far, responses to warming temperatures have been species-specific. Some species were able to take advantage of the earlier spring temperatures; either leafing out or producing flowers soon after the on-set of warmer temperatures. The species with lower chilling requirements might profit from warming winters, potentially extending their growing seasons and reproductive potential, barring any effect of late spring frosts. Species more reliant on winter chilling requirements cannot similarly respond to earlier warming, potentially limiting any advantage to longer growing season. Lack of sufficient winter chilling not only led to a considerable delay in budburst for some species, but also caused substantial changes in the chronological order of species' budburst. Differential climate sensitivities have implications for the assemblages of shrub communities with predicted warmer temperatures.
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## ISLAND-WIDE COLLABORATION FOR INVASIVE PLANT MANAGEMENT TO SUPPORT LOCAL ECOSYSTEMS

**Elizabeth C. Buck**[1], Kelly A. Omand[1,2], Sarah T. Bois[2,3]

[1]Nantucket Conservation Foundation;
[2]Nantucket IPSC Co-Chair;
[3]Linda Loring Nature Foundation

The Nantucket Invasive Plant Species Committee (IPSC), is a standing committee of the Nantucket Biodiversity Initiative. We facilitate cooperation among island conservation organizations and town entities to document and manage Nantucket's invasive non-native plant species. Committee members include both conservation professionals and local citizens interested in non-native invasive plant species identification, management, research, and education. Outreach to the public has included invasive plant identification and management workshops, one-on-one mentoring with local students and class projects, and information booths at events such as the local Island Fair and Spring Fest. The IPSC also coordinates volunteer weed digs and pulls to protect key natural areas and inhibit the spread of invasive plants. We have increasingly focused on educating the public about incorporating native plants in landscaping while managing invasives to enhance biodiversity and ecosystem function. To that end the IPSC created a "Native Plants for Nantucket" pamphlet detailing native species and uses. We have also provided technical expertise in the form of an invasive plant list for the wetlands regulations to the Town of Nantucket Conservation Commission. Recently we have worked with the Nantucket DPW to adjust mowing regimes along bike paths to reduce spotted knapweed, and with Waste Options Management (the Nantucket landfill operator) to provide an invasive plant disposal dumpster to facilitate high-temperature composting of weeds. Here we present a summary of recent IPSC efforts promoting islanders' awareness and participation in maintaining native plant communities while managing invasive plant species to support biodiversity.
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## CANCELLED: MONITORING OF PHYSICAL HABITAT, WATER PHYSICAL-CHEMICAL CHARACTERISTICS, AND BIODIVERSITY OF TEMPORARY FRESHWATER POOLS (VERNAL POOLS) OF NANTUCKET ISLAND,

## MASSACHUSETTS

**Catherine E. Colliton**[1] and Alan D. Christian[1]

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Temporary freshwater pools, such as vernal pools, are defined as lentic waterbodies with a recurrent dry phase and represent interesting and complex physical chemical characteristics and biological assemblages such as invertebrates, amphibians, and reptiles. Vernal pools are no different from other ecosystems as they are susceptible to global change, however, with extreme temperatures, unusual weather patterns, and land use changes, these seasonal habitats may become increasingly more difficult to come by for endangered, rare, and native species who depend on them for survival. Located south of Cape Cod, Massachusetts, the island of Nantucket is unique in that nearly half of it is conservation land, and it is home to 27 certified vernal pools. According to the Nantucket Land Council, very few of the island's small ponds have been studied since being certified despite interest in monitoring them. My proposed MS Environmental Science research under the direction of Dr. Alan Christian of the University of Massachusetts Boston is to use a standard protocol to monitor a subset (n=11) of the 27 certified vernal pools for physical habitat, water column physical-chemical, and taxonomic biodiversity variables including inventorying the rare, native, and invasive organisms occupying the vernal pools in an effort to determine baseline data that can be used for future monitoring and management.
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## DIET OF GRAY SEALS (HALICHOERUS GRYPUS) IN NANTUCKET SOUND AS DETERMINED BY OTOLITHS FOUND IN SCAT

**Julianne Darnell**[1], John Barkowski[1], Stephanie Wood[1], Juanita Urban-Rich[1]

University of Massachusetts Boston[1]

In recent decades gray seals have recovered and recolonized historic sites in the northeast U.S.. Along with this recovery, questions have been raised about their diet and and role in the local ecosystems. Gray seals consume a variety of prey including crustaceans, cephalopods, and fish. The purpose of this study is to identify and enumerate prey from gray seal scat collected at Great Point, Nantucket.
Scat was collected between November 2017 and July 2019. The scat was frozen at -80° C until processing. The following methods are used to obtain the hard parts from the scat: The scat is dissolved in water, filtered through sieves (4 mm, 2 mm, 250 mm, 125 mm, and 63 mm), and then the remaining material is stirred in an H2O2 bath to remove any residual scat. The remaining hard parts (otoliths) are then analysed and identified to species and be used to describe

prey composition. The results will be compared to prior studies of gray seal scat analysis from sites in Nantucket Sound (Ampela 2009, Ampela and Ferland 2006). Additionally, these samples are simultaneously being analysed for the presence of microplastics. Given seals are most likely exposed to microplastics via secondary consumption, understanding their diet will inform that research.
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## CANCELLED: INVESTIGATING JUVENILE RIVER HERRING PRODUCTIVITY IN NANTUCKET PONDS: INSIGHTS FOR POND MANAGEMENT

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On Nantucket Island, anadromous river herring (alewife *Alosa pseudoharengus* and blueback herring *A. aestivalis)* use ponds for adult spawning and juvenile feeding and growth; however, little is known about their production in these systems. Townspeople are interested in restoring and sustaining river herring populations on the island, yet it is unknown how management of connectivity between ponds and the ocean impacts habitat quality and productivity. Here, we investigate the relative abundance, growth, and spatial distribution of juvenile river herring in two ponds. Hummock Pond access is manually opened twice a year (spring and fall) for nutrient management, whereas Long Pond has a permanent ditch connecting it to the ocean. Juvenile herring were sampled at night using a purse seine in June, August, and October 2019. Within ponds, sampling locations were selected along a salinity gradient. All river herring were enumerated and a subset (30 per seine haul) were euthanized, measured, and preserved for laboratory analysis. Per haul juvenile densities ranged from 0.01–3.41 herring/$m^3$ in Hummock and 0.11–0.96 herring/$m^3$ in Long. The mean fish length across months in Hummock and Long was 50.1mm and 44.9mm respectively. Otolith daily increments will be used to back-calculate hatch dates, generate age frequencies, and estimate cohort-specific growth rates. We will assess the efficacy of the current passage system in Hummock Pond by comparing river herring density before and after the passage has been opened. This information may be used to guide decisions about pond management to maximize juvenile river herring production.
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## VEGETATION OF RETIRED CRANBERRY BOGS OF SOUTHEASTERN MASSACHUSETTS

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During the last century, markets have pushed MA cranberry farmers to retire bogs from agricultural production. Currently, 20-55% of active MA cranberry bogs are at high to moderate risk of retirement. Vegetation succession in retired bogs created on former wetlands is uncertain since modification by ditching and sand deposition may prevent their return to wetlands. Active restoration has been proposed to re-create wetland hydrology and promote wetland obligate species. We measured vegetation composition in retired, unmanaged cranberry bogs along a chronosequence of 28 sites ranging from active to retired for 90 years. We identified plant species and quantified plant cover within 9 $m^2$ quadrats at ten randomly selected locations in each former bog. Average number of wetland plants peaked in mid-aged sites (22.3 species in bogs retired 20-35 years). Newly retired bogs had high cover of cranberries (*Vaccinium macrocarpon*) and poison ivy (*Toxicodendron radicans*), while sweet-pepperbush (*Clethra alnifolia*) and pitch pine (*Pinus rigida)* dominated older (>50 years) sites. Although species richness and proportion of wetland obligate species both increased in the first two decades of bog retirement, richness later declined as trees and shrubs increased. We surveyed one bog in Falmouth actively restored by the MA Division of Ecological Restoration and found greater species richness compared with retired bogs of the same age, suggesting that active restoration alters species composition toward a greater proportion and cover of wetland obligate plants and away from the high proportion of generalist upland species found in older, unmanaged, retired bogs.
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## EMPIRICAL TESTING OF THEORETICAL PREDICTIONS ON THE CAPE COD ISLANDS AND MAINLAND

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In this study, we sought to empirically test the predictions of two theoretical models concerning *Borrelia burgdorferi*, the dilution effect and multiple niche polymorphism (MNP) hypotheses, using the Cape Cod mainland and islands as our study sites. It is expected that on species-poor islands that are dominated by white-footed mice (*Peromyscus leucopus*), the *B. burgdorferi* tick infection prevalence should be higher (dilution effect hypothesis) and the *B. burgdorferi* outer surface protein C (*ospC*) diversity should be lower (MNP hypothesis) compared to the species-rich mainland sites. Therefore, we sought to collect *Ixodes scapularis* ticks on three island sites (Nantucket, Tuckernuck, and Muskeget islands) and two mainland sites on Cape Cod and test for pathogen prevalence and *ospC* allele diversity. We found no support for the dilution effect hypothesis since *B. burgdorferi* infection prevalence was significantly higher on the mainland sites compared to the island sites. We found some support for the MNP hypothesis since *ospC* diversity was lower on island sites compared to the mainland sites. However, since our predictions using each model hinge on the assumption that *P. leucopus* is dominating the

species-poor island sites, repeated multi-season tick collections with small mammal trapping to determine host species composition is needed before either hypothesis can be comprehensively supported or refuted.

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