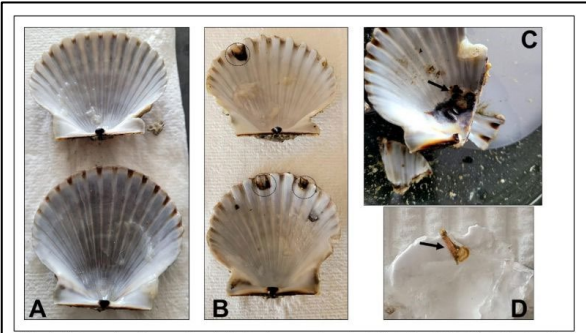


## Small Research Grants Program

### Summary of Final or Progress Reports Received from Funded Research (2008 - 2021)

#### MARINE FLORA AND FAUNA RESEARCH

<b>Project Title:</b> Molecular Taxonomy of Shell-boring Polychaete Worms from Commercially Important Shellfish on Nantucket	
<b>Researchers:</b> Andrew A. Davinack (David)	
<b>Affiliation:</b> Clarkson University Department of Biology	
<b>Grant Year:</b> 2020	
<p><b>Final Report Abstract:</b> Shell-boring polychaete worms can severely impact shellfish aquaculture by reducing growth rates and compromising tissue quality of their molluscan hosts. In this study we report the first known instance of shell-infestation of commercially important scallops on Nantucket Island by polydora worms. Genetic and morphological analyses found that the etiological agent of infection was <i>Polydora neocaeca</i>, a species that is believed to be non-native to the region. Additional analyses indicate a relatively high level of genetic connectivity between worms from Nantucket Island and the mainland United States, forming a distinct haplotype which is genetically isolated from populations from South Africa and Japan. While transportation of infected seed could have introduced the worm to Nantucket, limited sampling and the paucity of sequence data available makes it impossible to definitely determine its origins. We recommend a long-term biomonitoring strategy over the next few years to assess any changes in infestation rates during the hatchery's growing season.</p>	
 <p>Fig. 4. Photographs of bay scallop shells showing overview of uninfested host (A), infested hosts with mud blisters (dashed circles) (B), ruptured mudblister with semi-exposed worm (C) and an intact worm (arrows) exposed within its burrow (D).</p>	

<b>Project Title:</b> An Ecological Survey of Hither Creek to Determine the Suitability as a Shellfish Habitat	
<b>Researchers:</b> Valerie Hall and Chloe Coggins Carey	
<b>Affiliation:</b> Maria Mitchell Association	
<b>Grant Year:</b> 2019	
<p><b>Final Report Abstract:</b> 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 (<i>Argopecten irradians</i>) 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</p>	

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 a few 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. Five adult quahogs were found along the docks of Madaket Marine. We conclude that Hither Creek is not 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.



**Project Title:** Analysis of Tunicate Fouling on Eelgrass Habitat at Jackson Point, Nantucket

**Researcher:** Mary R. Carman

**Affiliation:** Woods Hole Oceanographic Institution Biology Department

**Grant Year:** 2017

**Final Report Abstract:** Eelgrass is a valuable coastal habitat and an ecosystem for a plethora of species that have been in decline due to a number of stressors. Invasive species of tunicates have recently spread to eelgrass in New England, causing additional pressure on an already stressed ecosystem. We wanted to determine if tunicates have spread to eelgrass on Nantucket and therefore surveyed Jackson Point as a representative meadow. The eelgrass meadow at Jackson Point appeared healthy, both in density and canopy height, and not overgrown by epiphytic tunicates. The presence of tunicates, both non-native and native species, on a proximal anthropogenic substrate (town landing dock) confirms that tunicates are in the area. The abundant tunicate (*Botryllus schlosseri*, *Botrylloides violaceus*, *Molgula manhattensis*) coverage on the dock indicated that all available space was occupied during the tunicate reproductive period (summer) and that tunicate propagules had not inhabited the eelgrass. Eelgrass plants immediately adjacent to both sides of the infested dock were not inhabited by tunicates. The site merits on-going monitoring.



**Project Title:** Factors Influencing Crab Species Abundance in New England Seagrass Beds

**Researcher:** Matthew F. Souza

**Affiliation:** University of Massachusetts, Boston Biology Department

**Collaborator:** Jarrett Byrnes

**Grant Year:** 2017

**Final Report Abstract:** Crabs function as important predators and scavengers within the ecologically important seagrass habitat. Some crab species also have commercial and recreational importance. Seagrass beds are permanent habitat and nurseries for important fishery species. Changing crab population dynamics have the potential to affect the balance and health of seagrass bed environments of Nantucket. Here I set out to document the current abundance of crab within a Nantucket seagrass bed. How crab species diversity in Nantucket seagrass is affected by seagrass density and the seagrass proximity to a marsh is evaluated. Crab species have the potential to impact other crab species placement within the seagrass, therefore the



relationships between crab species found were evaluated. Four strands of baited crab pots were placed three times for twenty four hour soaks for ten weeks. Crab number and species were recorded. A seine net was used to capture species and sizes not captured by the baited pots. The study found five crab species *Libinia dubia*, *Carcinus maenas*, *Callinectes sapidus*, *Ovalipes ocellatus*. *C. maenas*, an invasive species, was found to be a significant percentage of the total crab population. The study found no evidence that marsh proximity or seagrass density affects crab diversity with all five species found at all locations. Increased crab population was found proximate to the marsh entrance. Effects of seagrass density were less distinct and varied by species. An avoidance relationship was found between *C. sapidus*, *C. maenas* and *L. dubia*. The most distinct negative relationship was between *C. sapidus* and *C. maenas* and *L. dubia*. Observation of pots containing *C. sapidus* showed evidence of inter and intra species predation. These findings suggest changes in seagrass density located near marshes and shifts in species, such as an increase in *C. Sapidus*, would have a significant impact on total crab population and dynamics.

<b>Project Title:</b> Biodiversity of the Tunicate Fauna at Nantucket and Muskeget Islands	
<b>Researcher:</b> Mary R. Carman	
<b>Affiliation:</b> Woods Hole Oceanographic Institution Biology Department	
<b>Collaborator:</b> Annette Govindarajan	
<b>Grant Year:</b> 2016	
<p><b>Final Report Abstract:</b> Tunicates (Ascidacea) are common benthic marine invertebrates that occur in New England and elsewhere from the intertidal zone to the deep sea. In the near shore, they are often the dominant fouling organism on anthropogenic and natural surfaces and are known to cause problems for shellfish aqua-culturists. The tunicate fauna of Nantucket has not been previously documented. Our goal was to survey Nantucket and the nearby island of Muskeget for tunicates and to determine the biodiversity of the population for future comparisons. In July 2016, we surveyed Muskeget and found no tunicates. We also surveyed Nantucket in July 2016, and found 7 species of tunicates attached to anthropogenic substrates including boat hulls, floating dock sides, and ropes hanging off docks, and attached to natural substrates including bivalves, sponges, and eelgrass. When present, tunicate abundance or percent coverage ranged up to 50-75%. Of the 7 species observed on Nantucket, 5 are considered non-native species and 2 are considered native species. The Nantucket faunal composition, abundance, and substrates utilized are similar to other tunicate populations in New England.</p>	



<b>Project Title:</b> Distribution and Genetic Diversity of the Invasive Clinging Jellyfish <i>Gonionemus vertens</i> on Nantucket and Muskeget Islands	
<b>Researcher:</b> Annette Govindarajan	
<b>Affiliation:</b> Woods Hole Oceanographic Institution Biology Department	
<b>Collaborator:</b> Mary R. Carman	
<b>Grant Year:</b> 2016	
<p><b>Final Report Abstract:</b> The goals of this project were to document the distribution of the invasive clinging jellyfish <i>Gonionemus</i> in Nantucket and Muskeget Islands and to analyze its regional population genetic diversity. <i>Gonionemus</i> is native to the north Pacific coasts and was first documented locally in Woods Hole and Muskeget Island in the early 20<sup>th</sup> century. This form of <i>Gonionemus</i> was not associated with painful stings, despite frequent handling by scientists and collectors. An invasion of a more toxic form of <i>Gonionemus</i> appears to have occurred in the late 1980s in the Cape Cod region. Several individuals have reported <i>Gonionemus</i> stings in parts of Waquoit Bay (Cape Cod) and Martha's Vineyard, but none to date have been recorded from Nantucket. Jellyfish surveys were coordinated with Mary Carman (WHOI) who conducted a parallel NBI study on the distribution and abundance of invasive tunicates in</p>	



eelgrass meadows on Nantucket and Muskeget Islands. Despite extensive searching, no *Gonionemus* were found on either Nantucket or Muskeget. However, a broader genetic analysis of regional *Gonionemus* populations indicated the presence of multiple lineages, one of which is shared with well-known toxic populations in the Sea of Japan. The unique lineages indicated that native *Gonionemus* diversity also likely exists in the area. While no *Gonionemus* were found on Nantucket or Muskeget, it is possible that *Gonionemus* may arrive in the near future. The life cycle of *Gonionemus* includes minute asexual stages which could easily hitchhike on ship hulls and other vectors. Monitoring eelgrass habitats will facilitate early detection, so that mitigation measures can be most effectively applied.



#### Associated Publications:

- 1- Govindarajan AF, Carman MR, Khaidarov MR, Semenchenco A, Wares JP. (2017) Mitochondrial diversity in *Gonionemus* (Trachylina:Hydrozoa) and its implications for understanding the origins of clinging jellyfish in the Northwest Atlantic Ocean. *PeerJ* 5:e3205 <https://doi.org/10.7717/peerj.3205>

**Project Title:** Investigating Mooring Impacts on *Zostera marina* Meadows and Associated Epifauna in Nantucket, MA

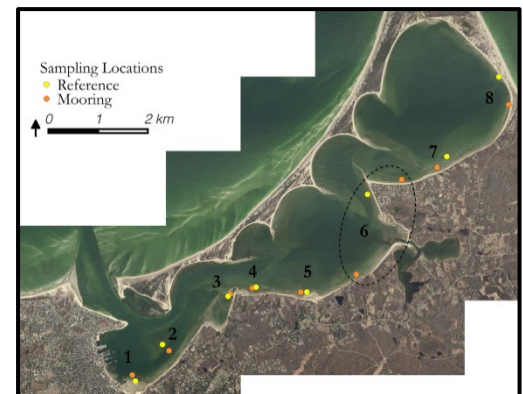
**Researcher:** Andrew McCandless

**Affiliation:** Portland State University Earth, Environment, and Society Program

**Collaborator:** Andrew McKenna-Foster

**Grant Year:** 2015

**Final Report Abstract:** While anchoring and mooring are known to damage seagrass beds, the effects are spatially variable, and the effects on associated epifaunal communities are not well known. Seagrass epifaunal diversity and abundance are a metric of seagrass community health tied to the services the meadows provide as habitat and settlement substrate. Due to the variability between geographic locations in both the impact of anchoring and mooring, and the diversity of the epifaunal communities within seagrass meadows, effective management may hinge on an intimate understanding of these variables for particular seagrass systems. Seagrass in areas near moorings was found to be shorter and have lower percent cover than paired nearby areas further from moorings. While no per stem differences in epifaunal diversity or abundance were found, overall abundance differences were large driven by the difference in seagrass cover. The median area of seagrass meadow denuded by mooring chains was found to be 21m<sup>2</sup>. These findings suggest that usage associated with moorings or the scarring from the moorings is contributing to a decrease in primary production 8m or more from moorings in Nantucket Harbor, Massachusetts.



## ESTUARY RESEARCH

**Project Title:** How do Cross-ecosystem Interactions Affect Nantucket Salt Marsh Food Web Structure, Creek Bank Erosion and Ecosystem Functioning?

**Researcher:** Marc Hensel

**Affiliations:** University of Massachusetts Boston Department of Biology

**Collaborator:** Jennifer Karberg

**Grant Year:** 2016, 2015

**Final Report Abstract:** New England salt marshes are some of the most productive and important coastal ecosystems but they are currently under threat from human activities in adjacent terrestrial and marine habitats (e.g.

eutrophication from terrestrial runoff and the removal of top predators). Recent experiments indicate that predators are likely key interactors along salt marsh creek banks but the identity and relative importance of common cross ecosystem predators are unknown and likely vary from marsh to marsh. Surveys in 2014 indicate that salt marshes of Nantucket host a diverse suite of predators including marine (e.g. green crabs, blue crabs, American eels, mummichogs) and terrestrial species, (e.g. shorebird predators such as Great Egrets, gulls, American Oystercatchers, Greater Yellowlegs, Willets, and Whimbrels). I used a combination of surveys, tethering experiments, and a manipulative field experiment to answer the following questions: (1) What are the most common predators of creek bank invertebrates in Nantucket salt marshes? and (2) What is the relative importance of shorebird and marine predators on the community structure and ecosystem functioning of Nantucket marshes? Preliminary results indicate that marine predators such as green crabs and blue crabs are likely keystone predators of marsh crabs, whereas bird predation is periodic. Marine predators have the largest effect on the marsh community, decreasing crab, mussel, and juvenile snail abundances. These same predators, likely green crabs and blue crabs and eels, also increase *Spartina* primary production. Determining the frequency and importance of cross ecosystem predators on creek bank processes will help understand how Nantucket salt marshes function and provision ecosystem services like erosion protection and nursery habitat availability.



## FRESHWATER WETLANDS RESEARCH

**Project Title:** Monitoring of Physical Habitat, Water Physical-Chemical Characteristics, and Biodiversity of Temporary Freshwater Pools (Vernal Pools) of Nantucket Island, Massachusetts

**Researchers:** Catherine Colliton and Alan D. Christian

**Affiliations:** University of Massachusetts Boston School for the Environment

**Grant Year:** 2019

**Final Report Abstract:** Temporary freshwater pools, such as vernal pools, are lentic waterbodies with a recurrent dry phase which creates interesting and complex physical, chemical, and biological characteristics (Podrabsky et al. 1997, Schneider and Frost 1996, Wilbur 1997, Williams et al. 2010). 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 invertebrate, amphibian, and reptile species and assemblages who depend on vernal pools for survival (Carpenter et al. 1992, National Science and Technology Council 2008). The island of Nantucket is unique in that nearly half of it is conservation land and it is home to 27 certified vernal pools (MassGIS). 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. Our proposed research is to use a standard protocol to temporally 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 in an effort to determine baseline conditions that can be used for future monitoring and management.




## ARTHROPOD AND INVERTEBRATE RESEARCH

<b>Project Title:</b> Prevalence of Ticks and Tick-borne Disease Agents at Sentinel Sites on Nantucket and Tuckernuck, Massachusetts
<b>Researcher:</b> Allison A. Snow
<b>Affiliations:</b> University of Massachusetts at Amherst Biology Department
<b>Grant Years:</b> 2020, 2021, 2022
<b>Collaborators:</b> Patrick Pearson, Guang Xu, David M. Allen, Roberto Santamaria & Stephen Rich
<b>Final Report Abstract:</b> At the scale of local communities, few studies have documented tick densities and infection levels with the goal of tracking changes over time. To provide a baseline for the town of Nantucket, Massachusetts, we recorded tick densities and infection prevalence at study sites on Nantucket and Tuckernuck islands. Densities were recorded by drag-sampling along ~0.5-1.5 km of trail per site in 2020-2022. Nymphal blacklegged ticks ( <i>Ixodes scapularis</i> Say) were most abundant at five shadier sites and least common in grasslands and scrub oak thickets ( <i>Quercus ilicifolia</i> ). Lone star ticks ( <i>Amblyomma americanum</i> L.) were common on Tuckernuck and rare on Nantucket, and both tick species were more numerous in 2021 compared to 2020 and 2022. We did not encounter American dog ticks ( <i>Dermacentor variabilis</i> Say) at any of our study sites. We tested for several pathogens in <i>Ixodes</i> nymphs using ~300-400 nymphs/site/year to allow comparisons among five sites over two years. At two Nantucket sites, 4-10% of nymphs were identified as <i>Ixodes dentatus</i> Marx, some of which were infected. Infection levels for <i>I. scapularis</i> were generally similar among the four Nantucket sites within years, averaging 10% vs. 19% (2020-2021) for <i>Borrelia burgdorferi</i> , 11% vs. 15% (2020-2021) for <i>Babesia microti</i> , and 17% (both years) for <i>Anaplasma phagocytophilum</i> . Infection prevalence for these pathogens was greater on Tuckernuck in 2021, as were coinfections with two or more pathogens. Despite year-to-year variation in tick densities and nymphal infection levels, our site-specific, quantitative approach provides an assessment of current conditions and a baseline for future monitoring.

Figure 2. Density of *Ixodes* nymphs at 9 sites on Nantucket and one site on Tuckernuck Island in 2020-2022. Average of 4 sampling days per site per year.

Site	2020	2021	2022
Shady Pond	~160	~200	~140
Unknown Field Site	~110	~170	~90
Newwood Farm	~80	~70	~70
Jaws Trail	~70	~90	~70
Pine Woods L.L.	~30	~40	~50
Pine Woods W.T.	~20	~30	~30
Barrett Farm Rd	~10	~40	~10
South Pasture	~10	~10	~10
Little Cove	~10	~10	~10
Tuckernuck Island	~60	~140	~40

<b>Project Title:</b> Galls and Leaf Mines of Nantucket and More Neglected Herbivorous Insects	
<b>Researcher:</b> Charley Eiseman and Julia Blyth	
<b>Affiliation:</b> Freelance naturalists	
<b>Collaborators:</b> Noah Charney, Sydne Record	
<b>Grant Years:</b> 2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011	
<p><b>Progress Report Summary:</b> A focus on the evidence left by certain herbivorous insects, such as galls and leaf mines, can reveal otherwise overlooked biodiversity. In many cases these persistent signs on plants are sufficient to identify the species that caused them. We surveyed Nantucket and Tuckernuck for galls and leaf mines, collecting those that we could not identify to attempt to rear them. We found well over 260 species not previously reported from the islands, not including dozens of reared parasitoid wasps that remain to be identified. In the process we documented new host associations and found species that are new to science. Future surveys should target galls and leaf mines that remain unidentified, as well as free-living herbivorous larvae of other poorly known insect groups, with the goal of rearing the larvae to adults.</p>	
	
<b>Associated Publications:</b>	

- 1- Charles S. Eiseman and Owen Lonsdale (2018): New state and host records for Agromyzidae (Diptera) in the United States, with description of thirty new species. *Zootaxa* 4479 (1): 1-156; <https://doi.org/10.11646/zootaxa.4479.1.1>
- 2- Charles S. Eiseman (2018): New Rearing Records for Muscoid Leafminers (Diptera: Anthomyiidae, Scathophagidae) in the United States. *Proceedings of the Entomological Society of Washington*, 120(1):25-50; <https://doi.org/10.4289/0013-8797.120.1.25>.
- 3- Charles S. Eiseman and David R. Smith (2017): Nearctic species of *Metallus* Forbes (Hymenoptera: Tenthredinidae): biology and distribution. *Proceedings of the Entomological Society of Washington*, 119(4): 551-564; <http://www.bioone.org/doi/10.4289/0013-8797.119.4.551>.
- 4- Charles S. Eiseman, Donald R. Davis, Julia A. Blyth, David L. Wagner, Michael W. Palmer & Tracy S. Feldman (2017): A new species of *Marmara* (Lepidoptera: Gracillariidae: Marmarinae), with an annotated list of known hostplants for the genus. *Zootaxa* 4437 (2): 198-222; <https://doi.org/10.11646/zootaxa.4437.2.2>.
- 5- Peter N. Buhl & Charles S. Eiseman (2016): Three new reared species of *Platygaster* (Hymenoptera, Platygastridae) from the United States; *International Journal of Environmental Studies*; doi: 10.1080/00207233.2016.1201322.
- 6- Charles S. Eiseman & Emily A. Hartop (2015): A New Species of *Megaselia* Rondani (Diptera: Phoridae) Reared from a *Macrodiplosis* Kieffer (Diptera: Cecidomyiidae) Gall on Black Oak. *Proceedings of the Entomological Society of Washington*, 117(4), 463-466; doi: 10.4289/0013-8797.117.4.463.
- 7- Charles S. Eiseman & Andrew S. Jensen (2015): Insects Feeding On Sea Lavender (Plumbaginaceae: *Limonium carolinianum* [Walt.] Britt) Along the New England Coast. *Entomological News* Apr 2015: Vol. 124, Issue 5, pg(s) 364-369; doi: 10.3157/021.124.0510.
- 8- Charles S. Eiseman (2015): Notes on Leaf-Mining Chrysomelidae (Coleoptera) in New England. *The Coleopterists Bulletin* Sep 2015: Vol. 69, Issue 3, pg(s) 453-458; doi: 10.1649/0010-065X-69.3.453.
- 9- Charles S. Eiseman (2015): On the Distinctive Feeding Pattern of *Sterictiphora* Billberg (Hymenoptera: Argidae) Sawfly Larvae. *Proceedings of the Entomological Society of Washington* Jan 2015: Vol. 117, Issue 1, pg(s) 65-67; doi: 10.4289/0013-8797.117.1.65
- 10- Charles S. Eiseman (2016): Notes on the Larval Hosts and Habits of Some North American Eriocraniidae and Acanthopteroctetidae. *Journal of the Lepidopterists' Society* Mar 2016: Vol. 70, Issue 1, pg(s) 79-81; doi: 10.18473/lepi.70i1.a11.
- 11- Charles S. Eiseman, Julia A. Blyth, & David R. Smith (2015): Notes on Four Anemone-Feeding Insects in the Eastern United States (Diptera: Agromyzidae; Hymenoptera: Tenthredinidae; Lepidoptera: Noctuidae). *Proceedings of the Entomological Society of Washington* Jul 2015: Vol. 117, Issue 3, pg(s) 281-289; doi: 10.4289/0013-8797.117.3.281.
- 12- Henry A. Hespenheide & Charles S. Eiseman (2016). A New Species of *Brachys* Dejean, 1833 (Coleoptera: Buprestidae) from the Eastern United States Using an Unusual Host. *The Coleopterists Bulletin* Jun 2016: Vol. 70, Issue 2, pg(s) 335-340; doi: 10.1649/0010-065X-70.2.335.
- 13- Charles S. Eiseman & Julia A. Blyth (2022). Nantucket's Neglected Herbivores I: Coleoptera. *Proceedings of the Entomological Society of Washington*, 124(2): 202-224; doi.org/10.4289/0013-8797.124.2.202.
- 14- Charles S. Eiseman & Julia A. Blyth (2022). Nantucket's Neglected Herbivores II: Diptera. *Proceedings of the Entomological Society of Washington*, 124(3): 564-605; doi.org/10.4289/0013-8797.124.3.564.

<b>Project Title:</b> A Preliminary Inventory of the Leafhoppers (Cicadellidae) of Nantucket Island
<b>Researcher:</b> Nicholas Block
<b>Affiliation:</b> Stonehill College Biology Department, Easton, MA
<b>Collaborators:</b> Rebecca Johnson, Mackenzie Lachkey and Nicholas Perry
<b>Grant Year:</b> 2018
<b>Final Report Abstract:</b> Leafhoppers have not been surveyed on Nantucket Island since a list published by Johnson in 1930, which comprises 54 species. Given that leafhopper diversity in New England totals several hundred species, we expected that the true diversity on Nantucket greatly exceeds the 1930 list. We inventoried leafhoppers on Nantucket



for four days in mid-July 2018 to expand on Johnson's checklist. We collected 1,212 leafhoppers from 20 sites across the island. Sorting and identification of specimens is in the early stages, but over half of the taxa identified thus far are new additions to the list of leafhoppers on Nantucket. We anticipate that further identifications will continue to add new species at a similar rate, likely yielding dozens of new additions to the island's known biodiversity.

**Project Title:** A Search for Female Specimens of an Undescribed Spider Species in the Genus *Tiso*

**Researcher:** John R. Dobyns

**Affiliation:** University of Wisconsin Oshkosh

**Grant Year:** 2018

**Final Report Abstract:** Hand and sweep net collecting and curation spiders from Ram Pasture and Squam Swamp occurred from July 29<sup>th</sup> to August 9<sup>th</sup>, 2019 to attempt to add female (and additional male) specimens of a yet-to-be described spider believed to be in the genus *Tiso* (Linyphiidae). The genus, first described by Simon (Simon, 1884) currently has 7 described members (van Helsdingen, 2015). Intermittent sampling by prior arachnologists (Draney and McKenna-Foster pers. comm.), and by the author, yielded 5 males of this undescribed species on Nantucket Island (from Ram Pasture and Squam Swamp) from 2015-2017. Spiders of this genus are small (1.6 mm to 2.2 mm in length), males have slightly raised eye regions, and rather small eyes relative to other members of the Linyphiidae. Abdomen coloration is usually black to brownish-grey with yellow tinged legs. The genus is most commonly collected in Scandinavian countries, with two species, *Tiso aestivus* and *Tiso vagans*, being found in North America. Sampling of the above natural areas on Nantucket generated 0 new specimens that could be used for the description of the species this past season. All bi-catch spiders that were collected were identified, with voucher specimens of new "island list" species deposited in the Maria Mitchell collection, and other specimens housed at the UMASS Boston Field Station in their teaching collection.

**Project Title:** Empirical Testing of Theoretical Predictions on the Cape Cod Islands and Mainland

**Researchers:** Patrick Pearson and Stephen Rich


**Affiliation:** University of Massachusetts Amherst Laboratory of Medical Zoology


**Grant Year:** 2018


**Final Report Abstract:** 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. Furthermore, tick infection prevalence with common pathogens was assessed to help inform local public health risk. 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. All ticks were subsequently tested for *B. burgdorferi*, *Babesia microti*, and *Anaplasma phagocytophilum* infection. *I. scapularis* was found at all locations except for Muskeget Island. 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. Relatively high prevalence of *B. microti* and *A. phagocytophilum*, when compared to *B. burgdorferi*, and a positive association between *B. burgdorferi* and *B. microti* were detected on the island sites. Therefore, coinfections and other tick-borne infections besides *B. burgdorferi* should be considered in people who are bitten by ticks in these areas.





<b>Project Title:</b> Results of a Survey of Macroscopic Beach Dependent Invertebrates and Attempted Comparison Between Beaches Experiencing Different Levels of Motorized Recreation	
<b>Researcher:</b> Tim Simmons	
<b>Affiliation:</b> Simmons Stewardship and Conservation Ecology	
<b>Grant Year:</b> 2018	
<b>Final Report Abstract:</b> Sandy beaches with reduced or complete prohibitions on vehicle use were identified for sampling in consultation with Nantucket Conservation Foundation (NCF) and Nantucket Islands Land Bank (NILB) staff. Very few species and families were documented. Detectable recreational impacts were overwhelmed by the effects of relatively recent repeat storm events that drastically altered beach morphology and ecology.	

<b>Project Title:</b> The Macroinvertebrate Freshwater Stream Fauna of Nantucket	
<b>Researcher:</b> Greg Whitmore	
<b>Affiliation:</b> Southern New Hampshire University	
<b>Grant Year:</b> 2018	
<b>Progress Report Abstract:</b> Aquatic macroinvertebrate sampling in Nantucket streams has produced a limited fauna typical of intermittent and perennial streams. Several species may be stream-specific, and as such as are particularly susceptible to disturbance. Stream chemistry measurements fall within expected ranges for developed areas. Dissolved oxygen levels may be a limiting factor in most of the streams.	

<b>Project Title:</b> Evaluation of the Prey Base and Feeding Relationships of the American Burying Beetle ( <i>Nicrophorus americanus</i> ) on Nantucket Island	
<b>Researcher:</b> Brandon M. Quinby	
<b>Affiliation:</b> Perdue University Department of Forestry and Natural Resources	
<b>Collaborators:</b> Elizabeth A. Flaherty, J. Curtis Creighton	
<b>Grant Year:</b> 2017, 2018	
<b>Final Report Abstract:</b> The American burying beetle, <i>Nicrophorus americanus</i> , (ABB), once widely distributed across the eastern two-thirds of North America, has recently experienced a dramatic decline in abundance and geographic range. In 1989, the ABB was listed as a federally endangered species. 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, Rhode 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. Despite over 30 years of research, we know little about the preferred carrion base necessary to support a healthy ABB population. In this study, we investigated feeding relationships of local burying beetles using stable isotope analysis ( $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ )	

N) conducted on 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  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in adult burying beetles reflect their larval diet, indicating the carrion their parents used as a reproductive resource. We found a significant difference in  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values among wild-caught burying beetle species. Additionally,  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values differed significantly among wild-caught burying beetle species and potential carrion. This allows us to identify the small vertebrate species and the size of individual carrion used by *N. americanus* for reproduction.

**Project Title:** *Lasius cf. niger*, a New Invasive Ant Species of Nantucket Archipelago?

**Researcher:** Robert D. Stevenson

**Affiliation:** University of Massachusetts Boston Department of Biology

**Collaborators:** Tim Lynam, Luiz Rodrigues, Emily Clark and Charles Defarias

**Grant Year:** 2014

**Final Report Abstract:** Ant surveys on Tuckernuck and Muskeget islands in 2013 revealed 5 new species including the invasive species *Lasius cf. niger*. *Lasius cf. niger* has been found before in New England but only sporadically. Our 2013 surveys found it to be the 4<sup>th</sup> most common ant by number on Tuckernuck and the second most common ant on Muskeget (Stevenson et al 2014). This ant species was not previously reported in Ellison's (2012) synthesis of ant records for Nantucket Island. Given its relative abundance in our 2013 samples, especially in dune areas, we predicted that *Lasius cf. niger* would be found on Nantucket dune habitats. In the seven dune habitats we sampled around Nantucket Island, we found *Lasius cf. niger* to be the most common ant at each site. It was absent at 2 upland sites where we sampled. Genetic tests are needed to determine if the morphotype *Lasius cf. niger* is truly *Lasius niger*.



**Project Title:** A Survey of the Ants of Tuckernuck and Muskeget Islands

**Researcher:** Robert D. Stevenson

**Affiliation:** University of Massachusetts Boston Department of Biology

**Collaborators:** Tim Lynam, Luiz Rodrigues, and Michele Chow

**Grant Year:** 2013

**Final Report Abstract:** Ellison (2012) found unexpectedly high ant diversity on Nantucket Island - about 50% of the species and 70% of the genera found in all of New England. The closely affiliated islands of Tuckernuck and Muskeget, while much smaller in size, might also be expected to have relatively high species diversity for their areas. Using the equilibrium island biogeography area equation,  $S=cA^z$ , we predicted 16 to 33 species for Tuckernuck Island and 11 to 29 species for Muskeget Island. We tested these predictions by sampling ants with pitfall traps, baits, hand collections and litter samples along ten transects on Tuckernuck and five transects on Muskeget. A total of 42 people-days of fieldwork were spread across four field trips in June, July, August and September of 2013. Among 3,935 specimens collected on Tuckernuck, we found 38 species. The most common species were *Myrmica americana*, *Aphaenogaster rudis*, *Crematogaster lineolata*, *Lasius cf. niger*, and *Solenopsis cf. texana*. Five species, including *Lasius cf. niger*, *Camponotus pennsylvanicus*, *Camponotus nearctica*, *Formica argentea*, and *Myrmica rubra*, were not reported in Ellison's synthesis of Nantucket's ants. Among 16,621 specimens collected



on Muskeget, we identified seven species all of which were also found on Tuckernuck. Muskeget's ant fauna is dominated by *Crematogaster lineolata*, which comprised 98% of the specimens, followed by *Lasius cf. niger* with 1.7% of the specimens. Our predictions of species diversity were underestimates for Tuckernuck (38 observed and 33 maximum predicted) and overestimates for Muskeget (11 minimum predicted and 7 observed). Using published equations of ant island biodiversity to predict diversity on Nantucket, Tuckernuck and Muskeget yielded results that were not consistent among the islands. Together our findings suggest area alone is not a good predictor of ant diversity on Tuckernuck and Muskeget. The higher than predicted diversity of ants for Tuckernuck may be the result of high habitat diversity for its area and lower human disturbance rates when compared to Nantucket and Muskeget. The lower than predicted diversity of Muskeget may be the result of reduced number of habitats and its higher disturbance rates when compared to Nantucket and Tuckernuck. An unexpected finding was the high densities of the invasive ant *Lasius cf. niger* on both islands. Only one individual of this species, captured in 2011 in southeastern Massachusetts, had been documented previously on the East Coast. Another invasive species, *Myrmica rubra*, was documented for the first time on Tuckernuck, but has not yet been seen on Nantucket.

**Project Title:** Dragonfly and Damselfly Populations on Nantucket Island

**Researcher:** Julia Blyth

**Affiliation:** Maria Mitchell Association

**Collaborator:** Eric LoPresti

**Grant Year:** 2012

**Final Report Abstract:** The first comprehensive survey of Odonates (dragonflies and damselflies) on Nantucket Island occurred in 1917. Four species were added to this list by 1930. In 2012, we surveyed several ponds bi-weekly for adults and larval skins to update the species list and provide records of relative abundance. We found six species of dragonflies that have colonized the island since 1930 and added two species to the island list that are migratory or irruptive. The damselflies are more complicated because of difficult or questionable identification, but there are certainly five species new to the Nantucket list and two species that have likely been extirpated since 1930.



**Project Title:** Moth Mania- A Citizen Scientist Survey of the Moths of Nantucket

**Researcher:** Jennifer Forman Orth

**Affiliation:** Massachusetts Department of Agricultural Resources


**Collaborator:** David Small


**Grant Year:** 2012


**Final Report Abstract:** The goal of this project was to record and raise public awareness about the diversity of moth fauna on Nantucket through a three-day summer "Moth Blitz." Public events were held where stations set up to attract moths were staffed by photographers with "mothing" experience and the public was encouraged to explore the various creatures that showed up and to learn more about the world of nighttime insect fauna. Photographers documented all moth species observed at the stations and found 125 different species across 19 different families, including 24 that do not appear to have been recorded on island in the past. Through this project, we contributed numerous Nantucket and Massachusetts records to online databases and greatly expanded the online public records of Nantucket moth fauna.



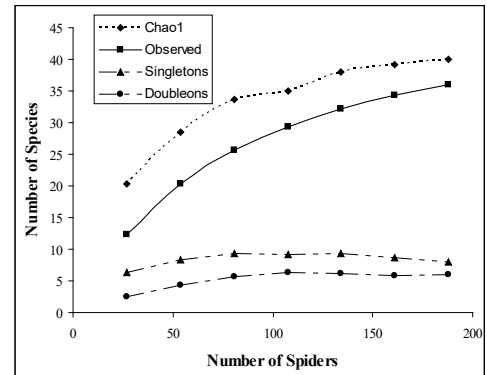


<b>Project Title:</b> A Checklist of Harvestmen for Nantucket, Tuckernuck and Muskeget Islands (Arachnida: Opiliones)	
<b>Researchers:</b> Andrew Mckenna-Foster and Justine Psaradis	
<b>Affiliation:</b> Maria Mitchell Association	
<b>Grant Year:</b> 2010	
<p><b>Final Report Abstract:</b> From 2006 through 2008, we collected surface invertebrate specimens using pitfall traps from a variety of habitats on Nantucket Island and Tuckernuck Island, Massachusetts. In this project, we sorted 413 harvestmen from these samples, identified all specimens to species, and compared species distributions within four general habitat types. We identified all four species that appear on a historic species list from the late 1920's and we added the non-native species <i>Phalangium opilio</i>. We found that <i>H. maculosus</i> prefers open heathland habitat over dense heathland and tupelo forest. Other species showed no significant preference for a specific habitat. We continue to sort specimens.</p>	

<b>Project Title:</b> Earthworm Survey on Nantucket, Tuckernuck, and Muskeget Islands, Massachusetts	
<b>Researchers:</b> Andrew Mckenna-Foster and Julianna Arntzen	
<b>Affiliation:</b> Maria Mitchell Association	
<b>Grant Year:</b> 2009, 2008	
<p><b>Final Report Abstract:</b> We collected earthworms on Nantucket, Tuckernuck, and Muskeget Islands, MA using a modified liquid mustard extraction method. We found earthworms on all three islands and added 54 specimens to the collection. We identified a new island record (<i>Lumbricus rubellus</i>) and the species list now contains six species. <i>Dendrodrilus rubidus</i> and <i>Dendrobaena octaedra</i> are the most common species numerically. Some areas of Nantucket appear to have no earthworms, but we predict they will be eventually colonized by litter dwelling species.</p>	

<b>Project Title:</b> An Investigation into the Headless Millipedes on Tuckernuck Island, Massachusetts	
<b>Researchers:</b> Andrew Mckenna-Foster, Cheryl Beaton and Lawrence Millman	
<b>Affiliation:</b> Maria Mitchell Association	
<b>Grant Year:</b> 2009	
<p><b>Final Report Abstract:</b> The American millipede <i>N. americanus/annularis</i> complex is common on Tuckernuck Island, Massachusetts. Each summer numerous headless millipede bodies are found partly alive on the trails and roads of Tuckernuck; the cause of these decapitations remains unknown. We traveled to the island three times between June and October 2009 to measure headless millipedes and attempt to catch a decapitation on digital video. We did not see any evidence of millipede predation. In 97 minutes of video but we did record birds foraging on the roads for 6.7% of the video time. We present measurement data for injured and headless millipedes found during 2009 and note the occurrence of parasitic Myriophora flies harassing millipedes. Our data do not explain how or why millipedes are found headless on the island but present several possibilities for future work as well as important baseline observations to aid future investigators.</p>	

<b>Project Title:</b> A Proposal to Test the Rapid Assessment Protocol for Spiders and Millipedes in Nantucket Sandplain Grassland and Coastal Heathland	
<b>Researchers:</b> Andrew Mckenna-Foster and Michael Draney	
<b>Affiliations:</b> Maria Mitchell Association and University of Wisconsin-Green Bay Department of Natural and Applied Sciences	
<b>Grant Year:</b> 2009	
<p><b>Final Report Abstract:</b> We tested a Rapid Assessment Protocol for Spiders and Millipedes (RAPSM) in sandplain grassland and coastal heathland on Nantucket Island, Massachusetts. The objective of this protocol is to efficiently capture most of the available species within a defined area and provide species diversity datasets that are comparable between habitats. The RAPSM requires a combination of two person-hours of litter sorting and one person-hour of hand collecting (sweep-netting) in individual 100 m<sup>2</sup> circular plots. We collected 538 spiders representing 36 species (188 were identifiable) from seven plots. The average number of spiders collected (adult and juvenile) per plot was 77 and the average number of species per plot was 12. On average, there are 0.77 spiders per square meter of sandplain grassland and coastal heathland within our study area. Litter sorting produced the most complete collection as indicated by accumulation curves. The RAPSM species list contains 71 percent of the species in a season adjusted species list for the study area and they are 58 percent similar. Our data suggest there is high beta diversity in the sandplain grassland and coastal heathland habitat. Millipedes will be sent to the Chicago Field Museum for identification.</p>	



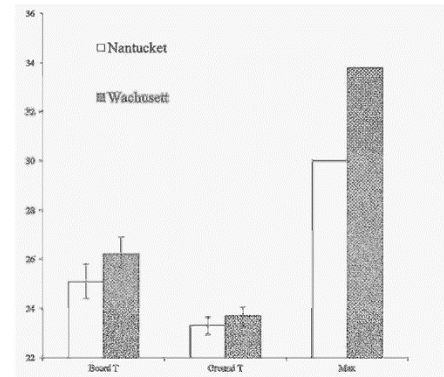
<b>Project Title:</b> Permanently Marking <i>Sphodros rufipes</i> Pursewebs for Long Term Monitoring on Tuckernuck Island	
<b>Researchers:</b> Andrew Mckenna-Foster, Cheryl Beaton and Molly Hukari	
<b>Affiliation:</b> Maria Mitchell Association	
<b>Grant Year:</b> 2009, 2008	
<p><b>Final Report Abstract:</b> Tuckernuck Island, Massachusetts is home to one of the densest colonies of the purseweb spider <i>Sphodros rufipes</i>, on the east coast. During the 2009 summer, we counted and marked pursewebs in 27 square meter quadrats on Tuckernuck. Quadrat locations were carefully recorded so that they can be revisited over the next decade to monitor individual <i>S. rufipes</i> spiders within the larger colony. The goal is to record how long a spider stays in one place, how web densities change spatially, and determine average individual longevity. Our quadrats indicate that the colony is much denser than previously thought with <math>2.9 \pm 0.8</math> webs per square meter (with standard error). We also set up a 10 m x 10 m survey plot where we counted and marked every web to record clustering of webs within a large area. This plot produced a density measurement of 0.47 webs per square meter.</p>	



## AMPHIBIAN AND REPTILE RESEARCH

<b>Project Title:</b> Snake Survey: Nantucket	
<b>Researcher:</b> Scott Smyers	
<b>Affiliation:</b> Oxbow Associates, Inc., Acton, MA	
<b>Grant Years:</b> 2015, 2014	

**Progress Report Summary:** The 2015 snake study had two objectives: replace cover boards at Squam Farm and Linda Loring Nature Foundation (>20 new boards) and collect temperature data when snakes were encountered using standardized methods (HDE Non-Contact Infrared IR Temperature Gun Digital Thermometer). Temperature is a very important variable to measure in any reptile research and the use of an infra-red thermometer removes important variability. My initial comparative analysis of temperature data from beneath cover boards where snakes were found indicated that garter snakes from populations on Nantucket were found during cooler temperatures compared to those from an inland population (Wachusett Mountain). However, after one full season (2015) of using the IR thermometers at both study areas, I found that there was no significant difference ( $P>0.05$ , see attached). During the summer months it is important to understand that the overall temperature is cooler on Nantucket compared to Wachusett. Therefore, the on -the-ground temperature experienced by an individual snake is likely cooler on Nantucket compared to Wachusett, but the snake can compensate for this difference through exhibiting more risky basking behavior or spending more time under warmer cover objects. This supports the hypothesis that garter snakes preferred body temperature is approximately 30 C throughout the species' range (Rosen, 1991).



Temperature (C) under boards vs. nearby ground temp.

**Project Title:** Fine Scale Population Genetic Structure of the Spotted Turtle

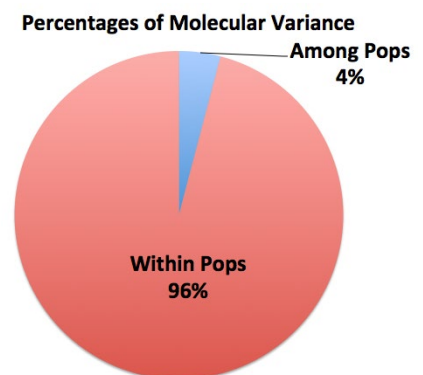
**Researcher:** Barbara Brennessel

**Affiliation:** Wheaton College

**Collaborators:** Lindsay Petrenchik and Danielle O'Dell

**Grant Year:** 2013

**Final Report Abstract:** We examined allelic diversity, genetic variability and population structure of three populations of spotted turtles in Massachusetts using six highly polymorphic microsatellite markers. Two of the populations were from the mainland (Canton and Halifax) and one was from Nantucket (Sanford Farm). Pairwise  $F_{st}$  and population assignment tests showed that overall, spotted turtles from all three locations belong to the same population. The two mainland populations are highly genetically similar and the Sanford Farm population is somewhat less genetically similar to the mainland groups. Assessment of allelic patterns indicates that the Sanford Farm population has the least allelic diversity, as it showed the fewest number of private alleles and the fewest number of different alleles at each locus. We also examined the relationship between two known spotted turtle populations on Nantucket. The two populations, at Sanford Farm and Medouie Creek, are virtually indistinguishable at two of the three loci that were tested.



**Project Title:** Snake Survey: Nantucket and Tuckernuck

**Researcher:** Scott Smyers

**Affiliation:** Oxbow Associates, Inc., Acton, MA

**Collaborator:** Andrew-Mckenna-Foster

**Grant Years:** 2012, 2011, 2010, 2009, 2008, 2007



**Progress Report Summary:** Through a cooperative effort between the Nantucket Biodiversity Initiative, especially Maria Mitchell Association and Tuckernuck Land Trust, we have been collecting population data on the snakes of Nantucket and Tuckernuck from 2007-2012. The purpose has been to determine species distribution and population demography by monitoring our study sites for 10 years. The results of the snake study have demonstrated that the island snakes are indeed different in several aspects compared to mainland snakes, but the ecological and evolutionary mechanisms that have selected for these differences remain undetermined. The smaller body size of female garter snakes from islands may be due to earlier sexual maturation compared to mainland populations.



**Associated Publications:** Scott D. Smyers, Andrew Mckenna-Foster and Jonathan D. Shuster (2014): Quantification of Color Pattern Variation in the Common Gartersnake (*Thamnophis sirtalis*) from Two Coastal Islands and Mainland, Massachusetts, USA. Herpetological Review, 2014, 45(1), 8–12.

**Project Title:** Amphibian Monitoring Project: Measuring Amphibian Breeding Effort Using Recording Devices in Remote Locations; Station # 1: Nantucket, Massachusetts

**Researcher:** Scott Smyers

**Affiliation:** Oxbow Associates, Inc., Acton, MA

**Grant Year:** 2009

**Final Report Abstract:** In 2008-2009 I installed digital recording equipment (Song Meter, Wildlife Acoustics, Inc.) to monitor calling frogs at three locations within New England to begin year 1 of a long-term study. The objective is to determine how reproductive effort of different species of frogs varies across New England within one season and how those same frogs vary from season to season. Study locations were selected based on occurrence of a fishless pond where amphibians had been previously observed breeding and calling. The three study sites include one pond on Nantucket Island (low elevation, low latitude), near the summit of Wachusett Mountain (mid elevation, mid latitude) in central Massachusetts, and Hermit Lake (high elevation, high altitude) on Mount Washington, NH. Recording devices were set to record for 30 minutes every evening beginning at approximately 2100 h. Temperature loggers (iButton) were also installed at each study site to record water surface temperature (~12 cm from the surface) and another taped to the underside of the recording devices (Song Meter by Wildlife Acoustics, Inc.). As expected, the species calling at each location are not as interesting as the phenology of breeding. Specifically, spring peepers call until the end of July at the high elevation, high latitude site at Hermit Lake. There were several lone males calling into the first few days of August, but after that it seems the peepers were done calling. The Nantucket and Wachusett peepers were finished calling at the end of May. However, because the recording did not begin until early June, therefore, this deduction is based on the presumption that these species were done calling by that time because they were mostly absent from the recordings starting in early June.



## MAMMAL RESEARCH

**Project Title:** Roosting Habits and Behavior of Northern Long-eared Bats on Nantucket

**Researcher:** Zara Dowling

**Affiliation:** University of Massachusetts Amherst Environmental Conservation Department

**Collaborators:** Luanne Johnson, Elizabeth Baldwin and Danielle O'Dell

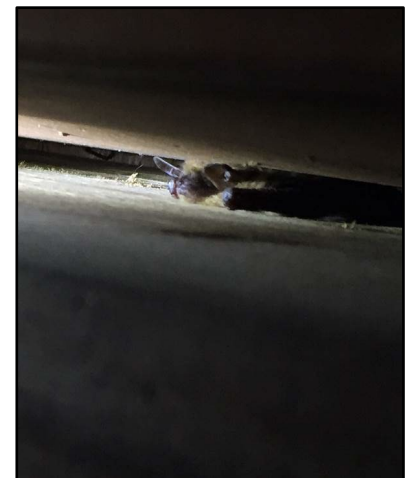
**Grant Year:** 2017

**Final Report Abstract:** The federally threatened northern long-eared bat (*Myotis septentrionalis*) appears to be persisting on Nantucket and in other coastal areas, despite dramatic population declines across the inland Northeast,

associated with the spread of White Nose Syndrome. We expanded on mist-netting, radio-tracking, and acoustic survey efforts from 2016 to better characterize northern long-eared bat behavior and habitat use on the island. We also partnered with graduate students from UNH and UAlbany to collect swab and tissue samples for WNS and genetic testing. We captured a total of 36 bats, all northern long-eareds, and tagged 13 individuals. In July, we tracked 6 bats to a total of 9 roosts located within 3 km of their capture location. Bats were found roosting in mature pitch pine trees and snags, as well as under shingles or trim boards on houses sided with cedar shingles. Mist-netting led to the capture of both lactating female bats and healthy juveniles; emergence counts revealed maternity colonies of at least 7-18 individuals. In October, we tracked 3 bats to a total of 6 roosts, which were used for multiple nights in succession. One bat roosted in a pitch pine, but the other locations were structural roosts on houses and barns, and in one case, in a crawl space.



<b>Project Title:</b> A Bat Acoustic Survey and Exploratory Study of Northern Long-eared Bats on Nantucket	
<b>Researcher:</b> Zara Dowling	
<b>Affiliation:</b> University of Massachusetts Amherst Environmental Conservation Department	
<b>Collaborators:</b> Luanne Johnson, Elizabeth Baldwin and Danielle O'Dell	
<b>Grant Year:</b> 2015, 2016	
<p><b>Final Report Abstract:</b> In 2015, I conducted a preliminary acoustic study of bats on Nantucket, in order to inventory species present on the island, and to document the persistence of any northern long-eared bats. Bats were surveyed using passive acoustic monitoring at five sites on the eastern part of Nantucket. Silver-haired and hoary bats were recorded beginning in late July and late August respectively, and continuing into October and early November, suggesting use during the fall migration season. Eastern red bats were recorded from May through early November, and appear to be summer residents. The northern long-eared bat, a federally threatened species, was also documented, using both acoustic and physical evidence. Presence of other <i>Myotis</i> spp. was suggested by auto-classification software, but could not be confirmed via manual identification. Big brown bats and tricolored bats were also present on at least one site on Nantucket. I worked with the Nantucket Conservation Foundation in 2016 to conduct a small-scale mist-netting and radio-tracking study, in an effort to confirm the presence of northern long-eared bat colonies on the island. We successfully captured lactating females and healthy juvenile northern long-eared bats in July, and tracked one female to a maternity colony comprising at least 11 individuals. In October, we captured an adult male northern long-eared bat, which we tracked to a fall roost and potential hibernation site. We tagged three of the four additional individuals found at this site, and deployed data loggers to record temperature and humidity. Nantucket appears to be supporting at least one healthy colony of northern long-eared bats, which could be due in part to bats remaining on-island throughout the winter.</p>	



<b>Project Title:</b> A Survey for River Otters on Nantucket	
<b>Researchers:</b> Elizabeth Baldwin and Luanne Johnson	
<b>Affiliation:</b> BiodiversityWorks, Martha's Vineyard, MA	
<b>Collaborators:</b> Danielle O'Dell and Karen Beattie	
<b>Grant Year:</b> 2014	

**Final Report Abstract:** Though river otters are common throughout Massachusetts, they were not documented on Nantucket until 2008 when tracks were photographed by biologist Edie Ray and verified by the state furbearer biologist. To follow up on these verified tracks staff from Nantucket Conservation Foundation and BiodiversityWorks conducted a systematic survey of suitable river otter habitat on Nantucket with the goal of documenting whether river otters had colonized the island. A total of 26 sites were surveyed for otter activity on April 2nd, 2014. We spent ~16 biologist hours surveying these sites and did not locate any otter sign (latrines, scat, tracks, and trails). However, there was ample fresh and brackish ponds, with cover habitat for dens, to support an otter population should they become established.



**Project Title:** Migrating Bats at Tuckernuck Island, Nantucket, Massachusetts

**Researcher:** Richard R. Veit

**Affiliation:** College of Staten Island CUNY Biology Department

**Grant Year:** 2011

**Final Report Abstract:** I used mist nets to sample bats on 12 nights, 12 August to 24 September 2011 in order to address how many migratory bats cross Nantucket Sound during the fall. There are no resident bats on Tuckernuck (pers. obs.), so any bats caught there have presumably just flown across the Sound. I opened mist nets on 12 nights 12 August to 24 September, and caught a total of 3 Red Bats (*Lasiurus borealis*), all on two nights in August. This was a smaller number of bats than anticipated, but I don't think I was missing bats that were present. I saw many fewer bats in 2011 than I did in 2012, using just casual observations.



## BIRD RESEARCH

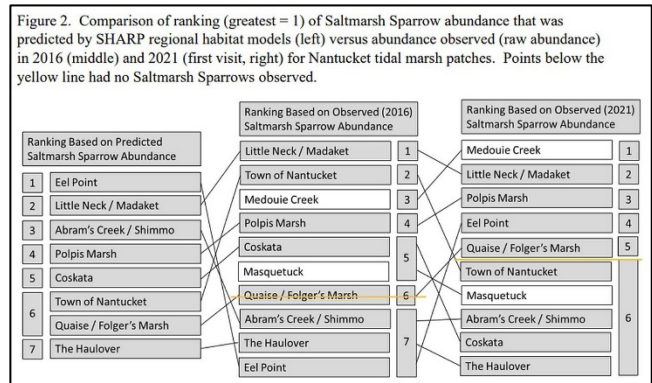
**Project Title:** Tidal Marsh Bird Abundance and Demographics Resurvey: 2021

**Researcher:** Kate Ruskin

**Affiliation:** University of Maine

**Grant Year:** 2021

**Final Report Abstract:** Tidal marshes are a globally rare and valuable ecosystem that is threatened by global change, specifically sea-level rise. Bird taxa endemic to tidal marshes are at risk for population decline, and perceived threats to tidal marsh species have been borne out; in 15 years, the specialist tidal marsh bird community has declined across the northeastern U.S. With support from the Nantucket Biodiversity initiative, I resurveyed tidal marsh birds on Nantucket Island in the 2021 breeding season using a regional monitoring protocol produced by the Saltmarsh Habitat and Avian Research Program (SHARP). I used a point count survey conducted at 17 points across Nantucket Island and applied two new monitoring tools, a rapid demographic monitoring protocol developed by SHARP and an environmental DNA (eDNA) pilot survey. Across two visits to Nantucket Island, I conducted one full round of point counts, rapid demographic survey requiring two visits at two sites, and sampled eDNA from four sites. Through the





point counts, I observed a diverse array of species utilizing tidal marsh habitat across Nantucket that was comparable to the initial 2016 point count survey. The rapid demographic survey yielded confirmed Saltmarsh Sparrow breeding at both sites, Medouie Creek and Eel Point, as evidenced by presence of active nests and fledglings, respectively. Comparisons of raw detection data from Nantucket to those collected elsewhere in Massachusetts suggest that the local Saltmarsh Sparrow population appears to be comparable to the regional population despite the small area of tidal marshes on Nantucket. Particularly notable was Medouie Creek, a restoration site that hosted high abundance of Saltmarsh Sparrows relative to other points on Nantucket, despite a tidal restriction that at a regional scale has been linked the more rapidly declining Saltmarsh Sparrow populations. We recommend resurveys of the Nantucket points in future years to determine whether the Saltmarsh Sparrow population of Nantucket is stable, or merely declining less than populations elsewhere in the region. More generally, this project successfully bridged the gap between larger regional monitoring efforts for tidal marshes and Nantucket Island.

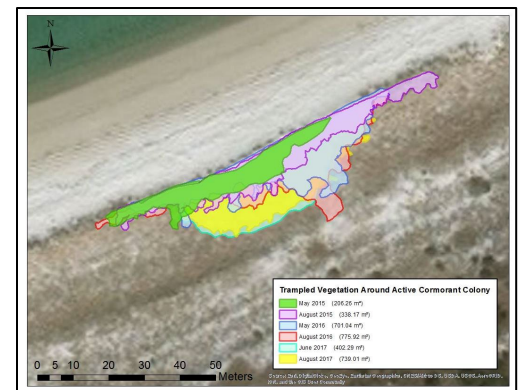
**Project Title:** Co-nesting and Landscape Ecology of Double-crested Cormorants on Nantucket Island, Massachusetts

**Researcher:** Neil Foley

**Affiliation:** Central Michigan University Department of Biology

**Grant Year:** 2017

**Final Report Abstract:** Double-crested Cormorants (*Phalacrocorax auritus*) began nesting on Nantucket Island, Massachusetts within the last 15 years, providing an opportunity to study how a small colony (<200 pairs) of cormorants interacts with other nesting birds, humans, and habitat. Interspecific competition and antagonistic interactions can impact behavior and nesting success of neighboring birds, especially when human disturbance is present. Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls (*Larus marinus*) have been documented foraging and kleptoparasitizing in cormorant colonies during periods of human disturbance when cormorant adults flush entirely from the colony. Active cormorant colonies physically and chemically alter the habitat in and around the nesting area through vegetation trampling, plant removal, and deposition of nutrients. The breeding cormorant population on Coatue has tripled in the last four years (2013 N=42 nests, 2017 N=135 nests) and the footprint cormorants create when re-establishing their colony location has increased in size to accommodate the new residents (May 2015 Area= 206.26m<sup>2</sup>, August 2017 Area= 739.01 m<sup>2</sup>), making this the largest recorded nesting colony of Double-crested Cormorant on the Nantucket archipelago. My four remote cameras monitoring the colony captured 293 camera days between April 19<sup>th</sup> and August 15<sup>th</sup>, 2017. Most gulls observed on the remote cameras occur further than 10 m from the nearest cormorant or nest. Gull predation within the colony does occur and has been documented throughout the breeding season, but no definitive trend has been observed yet. Humans were present on the North side of Coatie throughout the bird breeding season. In total, 230 boats were recorded during the 90 standardized observations, with the peak of 25 boats at one time occurring on the 4<sup>th</sup> of July at 4:13pm. General plant diversity surveys were conducted in the active and abandoned cormorant colonies in 2015 and 2016. In 2017, 110 square meter quadrats were surveyed to record plant diversity and community structure of 5 habitat plots, including the active and abandoned cormorant colonies as well as the surrounding open beach, primary dune, and interdune. A total of 24 plant species were recorded across the 5 habitat plots. Three of the species, *Atriplex patula*, *Oenothera parviflora*, and *Spartina patens*, were not recorded in previous biodiversity plot records for Coatie. A Non-Metric Multidimensional Scaling (NMDS) analysis on presence/absence of species showed distinct separation of habitat types based on the species recorded, but analysis of the plant survey results is still ongoing. Once abandoned, a cormorant colony site changes from mostly bare sand and ornithogenic nutrient-filled substrate back through stages of succession over the course of several growing seasons, showing a transition from low-lying colonizing beach plants to more competitive but slower growing perennial dune plants. Monitoring this nesting footprint both as it grows and as it is recolonized by vegetation is an interesting way to assess ground-nesting cormorant



impact on biodiversity and inform land management. Studying the spatial relationships of the birds, humans, and plants that use this property will facilitate informed management practices.

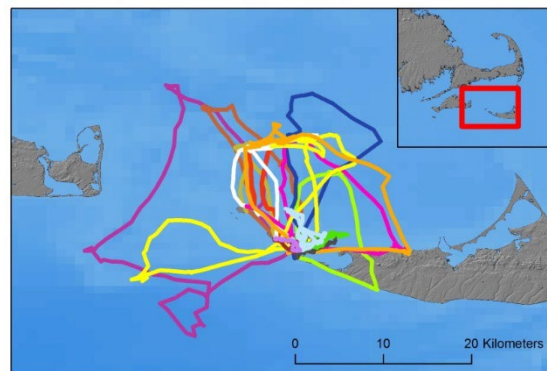
**Project Title:** Diet and Foraging of Herring and Great Black-backed Gulls on Tuckernuck and Muskeget Islands, Massachusetts in 2016

**Researcher:** Richard R. Veit

**Affiliation:** College of Staten Island CUNY Biology Department

**Grant Year:** 2016

**Final Report Abstract:** We studied diet and foraging behavior of Herring and Great-blacked Gulls at Tuckernuck and Muskeget Islands during May-July 2016. We had anticipated that the inshore fishery for Long-finned Squid (*Loligo peali*), which extends to within 3 NM of the beach at Tuckernuck, was to be curtailed or restricted to waters much farther offshore in 2016, and if this had occurred, would have yielded a convenient comparison with our work in 2015. The fishery was not curtailed in 2016, so multiple trawlers worked within 3 NM of the beach throughout the period of our 2016 study, and we were unable to make the anticipated comparison. Of 89 Great Black-backed Gull chicks whose diet we sampled in June, 11 had food in their crops, and of these 11 samples, 6 contained squid. The 5 others contained lady crabs and unidentified fish fragments. Of 12 adult Herring Gulls sampled in late May, 4 contained fresh sand lance. Our GPS tracking of Herring Gulls revealed that birds traveled 3-5 NM offshore, to areas populated with squid trawlers. Nevertheless, the diet samples we obtained contained primarily sand lance.



**Project Title:** Estimating Tidal Marsh Bird Abundance on Nantucket

**Researcher:** Kate Ruskin

**Affiliation:** Department of Ecology and Evolutionary Biology, University of Connecticut

**Grant Year:** 2016

**Final Report Abstract:** Tidal marshes are a globally rare and valuable ecosystem that is threatened by global change, specifically sea-level rise. Bird taxa endemic to tidal marshes are at risk for population decline, and perceived threats to tidal marsh species have been borne out; in 15 years, the specialist tidal marsh bird community has declined across the northeastern U.S. With support from the Nantucket Biodiversity Initiative, I implemented a regional monitoring protocol for tidal marsh birds on Nantucket Island in the 2016 breeding season (May to July). I used a point count survey conducted at 17 points across Nantucket Island to inventory all bird species that used tidal marsh habitat or its immediate edge. Across 3 survey visits, I observed a diverse array of species utilizing tidal marsh habitat across Nantucket. Though I was prohibited from formally modeling Saltmarsh Sparrow abundance due to small sample sizes, comparisons of raw detection data from Nantucket to those collected elsewhere in Massachusetts suggest that the local Saltmarsh Sparrow population appears to be comparable to the regional population despite the small area of tidal marshes on Nantucket. Particularly notable was Medouie Creek, a restoration site that hosted high abundance of Saltmarsh Sparrows relative to other points on Nantucket, despite a tidal restriction that at a regional scale has been linked the more rapidly declining Saltmarsh Sparrow populations. We recommend resurveys of the Nantucket points in future years to determine whether the Saltmarsh Sparrow population of Nantucket is stable, or merely declining less than



populations elsewhere in the region. More generally, this project successfully bridged the gap between larger regional monitoring efforts for tidal marshes and Nantucket Island.

## FLORA RESEARCH

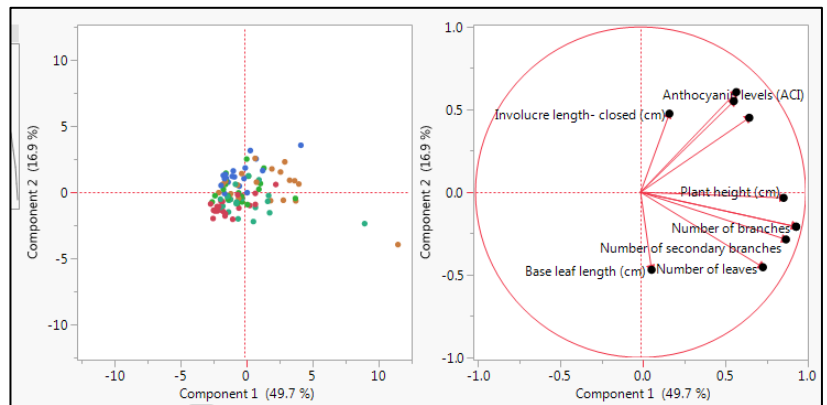
**Project Title:** Analysis of Morphological and Genotypic Variation Among Populations of *Lactuca hirsuta* var. *sanguinea* (Asteraceae) on Nantucket Island

**Researchers:** Paige L. Murin, Steven M. Ballou, Jr. and Jennifer R. Mandel

**Affiliation:** University of Memphis Department of Biological Sciences

**Grant Year:** 2018

**Final Report Abstract:** *Lactuca hirsuta* var. *sanguinea* Muhl. ex Nutt., commonly known as wild, hairy lettuce, is Watch Listed within the state of Massachusetts with the only recently confirmed populations found growing on Nantucket Island. During the summer of 2018, five populations were located on Nantucket and morphological measurements were collected along with seeds and leaf tissue from a little over 100 individuals. These data were then used to construct a principle components analysis (PCA) of the morphological variation among individuals, and plastid (chloroplast) primers were used to distinguish genetic variation among individuals. In terms of morphological variation, all populations were similar except the population on the Nantucket Memorial Airport property, which was substantially larger in many of the measurements taken including leaf size and number of flowering heads. Despite these morphological differences, we found that all individuals on the island harbored the same plastid haplotype essentially demonstrating no genetic variation in terms of the plastid genome. Given these findings, the population of *L. hirsuta* var. *sanguinea* on the airport property may be a candidate for protection given its unique morphology.



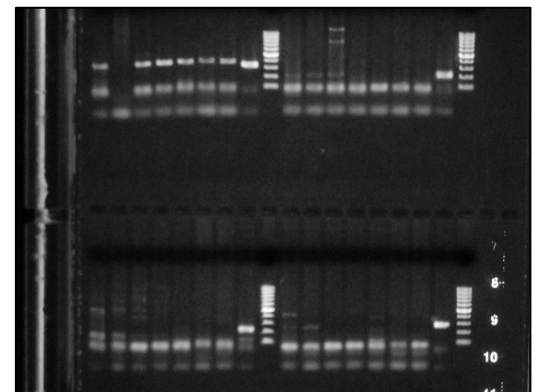
**Project Title:** Distribution and Genetic Diversity of *Nabalus serpentarius* and its Common Congener, *N. trifoliolatus* (Asteraceae)

**Researchers:** Steven M. Ballou, Jr. and Jennifer R. Mandel

**Affiliation:** University of Memphis Department of Biological Sciences

**Grant Year:** 2017

**Progress Report Summary:** *Nabalus serpentarius* is native to the Eastern portion of the United States and in Massachusetts it is listed as endangered. On the island of Nantucket, there are known populations of *N. serpentarius* and a strong conservation effort making the island a great location to conduct a population genetic study to better understand the species and build a conservation plan. To better understand the genetic diversity within *N. serpentarius* populations, a common (non-endangered) related species, *Nabalus trifoliolatus*, was also studied. To conduct this study, leaf tissue samples were collected from individuals from four populations of *Nabalus serpentarius* and individuals from five populations of *Nabalus trifoliolatus*. DNA was extracted from these samples and PCR was performed on a test set of samples from each species using primers for ten 10 microsatellite loci developed for a species in the same tribe, *Taraxacum kok-saghyz* (Russian dandelion). Four of the primers (TK3, TK 97, TK 105, and TK 111)





successfully produced an amplicon of similar size to the dandelion sample. The six primers that failed were attempted again using a modified recipe and a different thermocycler program. This resulted in the successful amplification of the TK25 primer. Future steps include testing at least seven more dandelion loci, plastid loci from other related species, and developing *Nabalus* specific primers. Data from these markers will be used to understand levels of population genetic diversity and structure within and among the island's *Nabalus* populations with special emphasis on developing a conservation genetic management plan for the endangered *N. serpentarius*.

**Project Title:** A Cooperative Update of the Vascular Flora of Nantucket

**Researcher:** Bryan Connolly

**Affiliation:** Framingham State University Department of Biology

**Collaborators:** Andrew Mckenna-Foster, Kelly Omand and Sarah Bois

**Grant Year:** 2015

**Progress Report Summary:** Andrew Mckenna-Foster (Director of Natural Science at Maria Mitchell Association) worked on modifying the existing database that was originally created for *The Vascular and Non-Vascular Flora of Nantucket, Tuckernuck, and Muskeget Islands* (Sorrie & Dunwiddie, 1996). The current Nantucket Flora Database is built on a Microsoft Access file created in a very early version of Microsoft Access (version 2.0). The original database had few one-to-many relationships and virtually all the data were in one table called 'Names'. It was designed to hold basic taxonomic and sighting information. Updating the database entailed three tasks: (1) making it easier to update many fields at once by separating out some data from the 'Names' table to create a database structure that includes one-to-many relationships;



(2) building a more user friendly data entry form that reduces input errors and allows relatively quick data checking and updating; (3) adding fields to better track species details (synonomies, collections, sightings, ranking, etc.) and record updating (modified dates, record updated check boxes, etc.). The next step in the process will include creating a report with a style similar to the 1996 publication. This report will be used to quality check additions to the Flora as well as nomenclature changes.

**Project Title:** Assessing the Risk of Queen Anne's Lace (*Daucus carota*) on Native Pollination Strategies on Nantucket Island

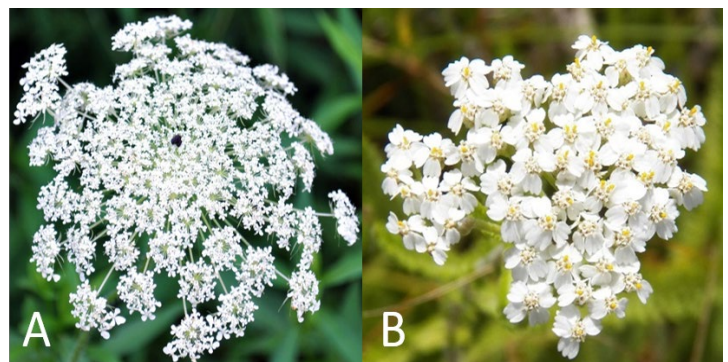
**Researcher:** Adam Ramsey

**Affiliation:** University of Memphis Department of Biological Sciences

**Collaborator:** Jennifer Mandel

**Grant Year:** 2016, 2015

**Final Report Abstract:** *Daucus carota* (Queen Anne's Lace) is a non-native plant species that was introduced to North America from Europe, and its presence on Nantucket Island, Massachusetts has been documented since at least the nineteenth century. Research in other plant systems has investigated whether the presence of a non-native can affect native pollination, and the results have been mixed. A native may be negatively affected, may not be affected or may be positively affected by the presence of the non-native. In 2015 A population survey was performed on *D. carota*, and a pollinator observation study was performed on *D. carota* and a native species,



*Sericocarpus asteroides* (Toothed White-top Aster). Pollinators were observed for three hours per day and five days each for the two species individually and both species cohabitating together. In 2016, additional populations were added to the *D. carota* population survey, and a removal treatment was performed on sites where both species cohabitate. On day one, the sites were observed as described, however, *D. carota* umbels were then removed from the site, and on the following day, pollinators were observed on *S. asteroides*. In addition, *S. asteroides* populations from a range of distances from *D. carota* were assayed for the presence and degree of heterospecific pollen. We had four hypotheses: 1) *D. carota* would be present across Nantucket Island; 2) The presence of *D. carota* would increase pollinator visitation rates and diversity indices on *S. asteroides*; 3) The removal of *D. carota* would restore pollinator visitation rates and diversity indices to those found on sites with only *S. asteroides*; 4) Higher levels of heterospecific pollination would be found in *S. asteroides* populations located close to *D. carota*. We found *D. carota* to be abundant across the island. While both plant species are generalist-pollinated, *D. carota* attracted 15 insect families and *S. asteroides* attracted only 8, with the majority being flies and bees. Each removal treatment received at least 50 % fewer pollinator visits after *D. carota* was removed, and the analysis on heterospecific pollination is currently on-going.

**Associated Publication:** Adam J. Ramsey, Steven M. Ballou, Jr., & Jennifer R. Mandel (2019). Altered Pollination Ecology of a Native Plant Species in the Presence of an Attractive Non-Native Plant Species. *Rhodora*, Vol. 121, No. 987, pp. 159–173; doi: 10.3119/18-11.

**Project Title:** Using Ground-Penetrating Radar to Map Buried Trunks of Prostrate-Growing Eastern Red Cedar Trees on Coskata/Coatue Wildlife Refuge

**Researcher:** C. Roberta Lombardi

**Affiliation:** University of Massachusetts Amherst Biology Department Herbarium

**Collaborators:** William Clement (University of Massachusetts Amherst Department of Geosciences), Pamela Polloni (Marine Biological Lab/Woods Hole Oceanographic Institution Library Herbarium)

**Grant Year:** 2014

**Final Report Abstract:** We used Ground Penetrating Radar (GPR) transects, which is not disruptive to trees and substrate, to test whether it could be used to provide evidence of underground stems and roots of low-growing Eastern Red Cedars on the Coatue/Coskata Wildlife Refuge, Nantucket. This coastal Maritime Juniper Woodland/Shrubland, is classified as a critically imperiled natural community. These trees described as dwarf cedars, are better described as large, prostrate-growing trees buried by sand with exposed, upright-growing branches in this dynamic, coastal habitat. GPR signals using 200 MHz antennas were collected to create profile images showing diffractions in the sand substrate. Interpretations of several profile images showed diffractions that are likely from trunks, branches or roots. Above ground tree dimensions were measured with one tree 16 m long x 6 m wide and only 1.75 m tall. Exposed roots were observed growing north-northwest, toward shore, and above ground portions growing south-southeast, away from prevailing winds. Core samples of some branches were taken to determine ages of branches, and whether it was stem or root material, which differs morphologically. Ring counts from core samples taken on exposed trunks of the larger trees indicate ages of 55+ years, with severe stress signals in the rings.



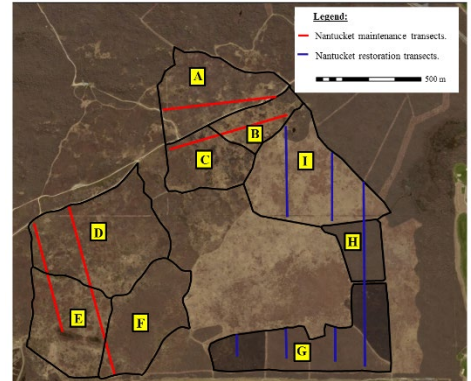
**Project Title:** Disturbance-based Management in a Changing World: Plant Species Diversity in Massachusetts Sandplain Grasslands and Heathlands over the Past Two Decades

**Researcher:** Kirsten Martin

**Affiliation:** University of Central Florida

**Grant Year:** 2012

**Final Report Abstract:** Massachusetts sandplain heathlands are habitats of conservation concern, harboring many rare plant species and providing habitat for animals that depend on open lands. These heathlands are threatened by human development, shrub encroachment in the absence of disturbance, and potentially increasing soil nutrient levels. Sandplain heathlands are managed with prescribed fire, in order to maintain their open structure and maintain species diversity. In order to assess how past management was correlated with species change, I used a data set that spanned twenty years from three different heathlands in Massachusetts. I looked for correlations between management and species change. Correlations between species change and prescribed burning were very site, or microsite, specific, indicating that variables such as vegetation type and edaphic characteristics need to be taken into account before management is applied. Prescribed fire was also associated with an increase in ruderal species in one of the sites studied, indicating that there may be undesirable effects of prescribed fire in this system. Species diversity was negatively associated with shrub encroachment, reinforcing the importance of preventing shrubs from encroaching into these heathlands. I also found evidence that burning has not been a successful technique in preventing shrub encroachment in these sites. Lastly, the nitrophilic species *Carex pensylvanica* increased in all three sites, indicating that future studies should investigate the possibility that sandplain heathlands are currently experiencing nitrogen deposition beyond their critical loads.



**Project Title:** Coatue Wyer's Point Biodiversity Plot Botanical Survey

**Researcher:** Pamela Polloni

**Affiliation:** Marine Biological Lab/Woods Hole Oceanographic Institution Library Herbarium

**Collaborator:** C. Roberta Lombardi (University of Massachusetts Amherst Biology Department Herbarium)

**Grant Year:** 2012

**Final Report Abstract:** Coatue, the barrier spit sheltering Nantucket Harbor, is a remote natural area formed approximately 6000 years before present. It hosts several plant communities considered rare in Massachusetts: Maritime Juniper Woodland/Shrubland (S1) is "critically imperiled" and Maritime Dune (S2) is "imperiled" in the State. Also present, the vegetated Maritime Beach Strand (S3) is "vulnerable" and increasingly rare in Massachusetts. This 6-day, 3-visit, 2012 study of the Wyer's Point Biodiversity Plot (Plot) was conducted to document existing conditions and to characterize the flora. We examined vegetative cover at 17 observation points in May, and in a series of 23 study plots on two transects in September. Our provisional list for the Plot includes 76 species including MESA-listed Special Concern, *Polygonum glaucum*. In addition we traveled the full extent of the peninsula and sampled for genetic analysis a colony of the state Endangered prickly pear cactus (*Opuntia humifusa*) at First Point. This subpopulation occurs on a narrow sand spit (Maritime Dune) bordered by tidal flat.



**Project Title:** The Role of Arbuscular Mycorrhizal Fungi in Sandplain Grassland Management on Nantucket Island, Massachusetts

**Researcher:** Gretchen Addington

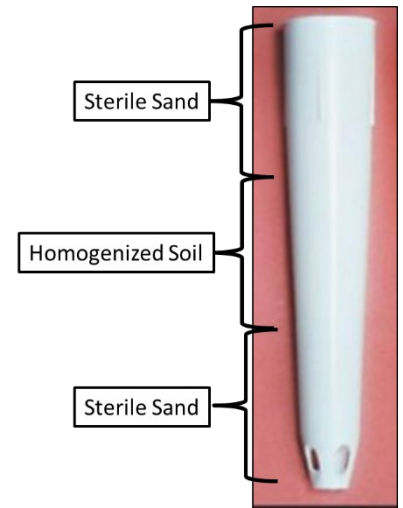
**Affiliation:** Clemson University

**Collaborators:** Christina Wells and Jennifer Karberg


**Grant Year:** 2012




**Final Report Abstract:** Approximately 90% of terrestrial plants associate with arbuscular mycorrhizal (AM) fungi. AM fungi are responsible for a significant amount of nutrient uptake in host plants. Certain plant communities, such as grasslands and shrublands, may associate with specific groups of arbuscular mycorrhizal fungus. A diverse AM community is a driver of a diverse plant community and understanding of the AM fungal community may prove useful in management of the sandplain grasslands of Nantucket Island, Massachusetts. The goal of the current research on Nantucket was two-fold: to document the density and biodiversity of mycorrhizal communities across the rare sandplain grassland on Nantucket, and to examine the potential mycorrhizal colonization in these same communities. The AM fungal community was measured in two ways: density of spores in the soils, and the colonization potential of the soils. Analysis of spore density differed by high and low cover classes of both shrubs and grasses. However, AM colonization potential, determined through AM fungal root colonization of corn (*Zea mays* L.), is not correlated with percent cover of any particular vegetation community type. These mixed results indicate that further study of the specific mycorrhizal communities associated with vegetation cover type might provide more complete understanding of the community assemblage of the sandplain grasslands of Nantucket Island.




## INVASIVES RESEARCH

<b>Project Title:</b> Population Genetics of Spotted Knapweed, an Invasive Plant Species on Nantucket Island	
<b>Researcher:</b> Tomáš Závada	
<b>Affiliation:</b> University of Massachusetts Boston Department of Biology	
<b>Grant Year:</b> 2012	
<p><b>Final Report Abstract:</b> <i>Centaurea maculosa</i> (Spotted Knapweed) and <i>Centaurea jacea</i> (Brown Knapweed) are members of the Composite family (Asteraceae) and natives of Eurasia. <i>C. maculosa</i> is a major invasive species in North America, dominating large stretches of grassland. Both species were introduced on Nantucket island, and aim of this study is to describe genetic structure and diversity of these weeds. Analyses based on chloroplast DNA sequence data suggest just one introduction of these species on Nantucket island. The only outlier appears to be a specimen H5, and based on its morphology it was suggested that we found a specimen of <i>Centaurea nigrescens</i> on Nantucket island that has not been described there before. The further analysis of nuclear DNA with microsatellite markers might elucidate a potential gene flow and hybridization between these two species as all hybrid-like plant specimen clustered together with <i>C. jacea</i> cpDNA sequences, suggesting environmental plasticity of brown knapweed and not a genetic diversity.</p>	
	
<p><b>Associated Publications:</b></p> <ol style="list-style-type: none"> <li>1- Tomáš Závada (2016): Phylogeny and Population Genetics in Genera Cichorium and Centaurea (Asteraceae) – Case Studies in Domestication and Biological Invasion. Ph.D. Thesis, May 2016. UMass Boston Department of Biology/Molecular, Cellular, and Organismal Biology. Available for download June 15, 2017: <a href="http://scholarworks.umb.edu/doctoral_dissertations/276/">http://scholarworks.umb.edu/doctoral_dissertations/276/</a>.</li> <li>2- Tomáš Závada, Kelly A. Omand, Rony J. Malik, Dina Tsirelson &amp; Rick V. Kesseli (2021). Testing for Hybridization Between <i>Centaurea stoebe</i> and <i>Centaurea jacea</i> (Asteraceae) in the Isolated Island Setting of Nantucket, Massachusetts, U.S.A. <i>Rhodora</i> 123(993): 1-10. 2021; doi.org/10.3119/20–19.</li> </ol>	

<b>Project Title:</b> Adaptations in Competitive Traits in Invasive Nonnative Plant Species: A Test of the ERCA Hypothesis Using New England Islands	
<b>Researcher:</b> Joshua Atwood	
<b>Affiliation:</b> University of Rhode Island	
<b>Grant Year:</b> 2010, 2009	
<b>Final Report Abstract:</b> The Evolution of Reduced Competitive Ability (ERCA) hypothesis posits that nonnative plant populations invading habitats with low competitive pressure (few competing species or individuals per unit area) will rapidly evolve decreased vegetative growth in favor of other traits such as reproductive effort and herbivore tolerance. The ERCA hypothesis addresses recent calls for an expanded consideration of habitat characteristics that might drive post-establishment evolution. We provide the first test of the ERCA hypothesis by growing nonnative plant populations from high and low competitive environments in a two-year common garden. We germinated nonnative seeds collected from high and low competitive environments, represented respectively by mainland and nearshore island habitats along the New England coastline, including several populations from Nantucket. We utilized three nonnative plant species commonly found in New England: <i>Lythrum salicaria</i> (purple loosestrife), <i>Solanum dulcamara</i> (bittersweet nightshade) and <i>Vincetoxicum nigrum</i> (black swallow wort). We asked whether mainland and island populations would differ in growth, reproduction, and/or herbivore tolerance when grown under identical conditions for two growing seasons. We predicted that island populations would produce less biomass and more fruit mass per unit biomass than mainland populations in each of our three growth scenarios. We further asked whether mainland and island populations would differ in their response to simulated herbivory and predicted that leaf damage would have a lesser effect on biomass production in island populations than in mainland populations (Agrawal et al. 2005; Rogers and Siemann 2005). Our collective results provide a description of rapid evolution for specific traits related to survival and fecundity in nonnative plants.	

## BACTERIA RESEARCH

<b>Project Title:</b> Genomic Characterization of Filamentous Cyanobacteria on Nantucket Beaches	
<b>Researcher:</b> Pia Moisander	
<b>Affiliation:</b> University of Massachusetts Dartmouth Department of Biology	
<b>Grant Year:</b> 2014	
<b>Final Report Abstract:</b> A benthic, epiphytic cyanobacterium has been recently reported as invasive in temperate coastal beaches of the Nantucket Island, Massachusetts, USA, during late summer. Microscopic and molecular analyses were applied to identify the cyanobacterium and describe its phylogenetic position, and to characterize the microbial communities associated with it. The morphological observations in parallel with 16S rRNA and <i>nifH</i> results suggest that the cyanobacterium is closely related to <i>Hydrocoleum</i> sp. (Oscillatoriales, Phormidiaceae), with the closest previously described relative <i>Hydrocoleum lyngbyaceum</i> , and appears to represent a unique strain. The genus is a ubiquitous benthic cyanobacterium in tropical and subtropical waters and coral reefs, where it is at times considered a nuisance, while these observations in North Atlantic temperate waters may represent an expansion of its habitat range. Amplicon sequencing targeting the <i>nifH</i> gene confirmed that the cyanobacterium is capable of fixing N <sub>2</sub> , and also hosts a relatively diverse community of <i>nifH</i> -gene containing bacteria typifying microbial mat diazotroph communities growing in association with it. <i>Hydrocoleum</i> was recently reported to be a potential producer of homoanatoxin-a, a neurotoxin, but genes for these toxins were not detected in the communities	

investigated in this study. Increasing sea surface temperatures in the North Atlantic Ocean may have contributed to this potential expansion of *Hydrocoleum* sp. habitat range.

**Project Title:** Diversity of Toxin Producing Cyanobacteria on Nantucket Island

**Researcher:** Pia Moisander

**Affiliation:** University of Massachusetts Dartmouth Department of Biology

**Grant Year:** 2011

**Final Report Abstract:** The main goal of this project was to investigate diversity of potentially toxic cyanobacteria on Nantucket Island. Previous studies have reported a range of cyanobacteria in blooms from the island, and some of these have been confirmed to be toxic (*Microcystis aeruginosa*). The goal of this study was to obtain information for other potential toxic species among the bloom formers, investigate the distribution of these species, and obtain phylogenetic information for these taxa. The study employed microscopic observations combined with toxin analyses and molecular investigations, with a specific focus on potential influence of elevated salinity on toxic blooms in the ponds on the island, some of which experience periodic flushing by ocean water. These results will be used as background information for future potential studies on cyanobacterial ecology on the island.

