Plum Island Biodiversity Inventory









New York
Natural Heritage
Program

New York
Natural Heritage
Program

Established in 1985, the New York Natural Heritage Program (NYNHP) is a program of the State University of New York College of Environmental Science and Forestry (SUNY ESF). Our mission is to facilitate conservation of rare animals, rare plants, and significant ecosystems. We accomplish this mission by combining thorough field inventories, scientific analyses, expert interpretation, and the most comprehensive database on New York's distinctive biodiversity to deliver the highest quality information for natural resource planning, protection, and management. The Program is funded by grants and contracts from government agencies whose missions involve natural resource management, private organizations involved in land protection and stewardship, and both government and private organizations interested in advancing the conservation of biodiversity.

NY Natural Heritage is housed within NYS DEC's Division of Fish, Wildlife & Marine Resources. The program is staffed by more than 25 scientists and specialists with expertise in ecology, zoology, botany, information management, and geographic information systems.

NY Natural Heritage maintains New York's most comprehensive database on the status and location of rare species and natural communities. We presently monitor 181 natural community types, 803 rare plant species, and 474 rare animal species across New York, keeping track of more than 13,500 locations where these species and communities have been recorded. The database also includes detailed information on the relative rareness of each species and community, the quality of their occurrences, and descriptions of sites. The information is used by public agencies, the environmental conservation community, developers, and others to aid in land-use decisions. Our data are essential for prioritizing those species and communities in need of protection and for guiding land-use and land-management decisions where these species and communities exist.

In addition to tracking recorded locations, NY Natural Heritage has developed models of the areas around these locations important for conserving biodiversity, and models of the distribution of suitable habitat for rare species across New York State.

NY Natural Heritage also houses *i*MapInvasives, an online tool for invasive species reporting and data management.

NY Natural Heritage has developed two notable online resources: Conservation Guides include the biology, identification, habitat, and management of many of New York's rare species and natural community types; and NY Nature Explorer lists species and communities in a specified area of interest.

The program is an active participant in the NatureServe Network – an international network of biodiversity data centers overseen by a Washington D.C. based non-profit organization. There are currently Natural Heritage Programs or Conservation Data Centers in all 50 states and several interstate regions. There are also 10 programs in Canada, and many participating organizations across 12 Latin and South American Countries. Our collaboration with NatureServe and other states helps us put our information into a broader context. With NatureServe, we track the rarity of species and natural communities at global and state scales, allowing us to distinguish conservation priorities for species with just a few populations in the world to other species with a few populations in New York but many populations elsewhere. We can also pool our data to look across state and international lines. For example, New York data on rare species and natural communities along Lake Ontario have been combined with similar data from Canada to facilitate analyses of potential consequences of lake-level changes. New York information has also been combined with data from neighboring states to help us understand the significance of our best biodiversity sites relative to similar systems in southeastern Canada, New England, the Mid-Atlantic states, and other Great Lakes states.

Learn more at www.nynhp.org.

Plum Island Biodiversity Inventory

Matthew D. Schlesinger
Erin L. White
Stephen M. Young
Gregory J. Edinger
Kelly A. Perkins

New York Natural Heritage Program
625 Broadway, 5th Floor
Albany, New York 12233-4757
www.nynhp.org

Neil Schoppmann
Dylan Parry

State University of New York
College of Environmental Science and Forestry
Syracuse, New York

June 2016

Please cite this report as follows:

Schlesinger, M.D., E.L. White, S.M. Young, G.J. Edinger, K.A. Perkins, N. Schoppmann, and D. Parry. 2016. Biodiversity Inventory of Plum Island, New York. New York Natural Heritage Program, Albany, New York, and SUNY College of Environmental Science and Forestry, Syracuse, NY.

Cover photographs (from left to right):
Top: Little brown bat (*Myotis lucifugus*), maritime bluff, spring ladies-tresses (*Spiranthes vernalis*).
Middle: snapping turtle (*Chelydra serpentina*), late purple aster (*Symphyotrichum patens*), white-footed mouse (*Peromyscus leucopus*).
Bottom: Marine rocky intertidal, black-waved flannel moth (*Lagoa crispata*), bronzed and hairy-necked tiger beetles (*Cicindela repanda* and *C. hirticollis*).

Table of contents

Table of figures

Table of tables

Executive summary

Despite a long history of human use, Plum Island, New York remains largely undeveloped and provides habitat for many plants and animals of conservation concern. The island's disposition following the future departure of the Plum Island Animal Disease Center (PIADC) has been a subject of much political and public debate. Regardless of the island's future ownership, an understanding of the current status of biodiversity will help inform ongoing and future natural resource management efforts there. In 2014 the New York Natural Heritage Program (NYNHP) was funded by the New York State Department of Environmental Conservation (NYS DEC) to undertake a year-long inventory of Plum Island's biodiversity. The inventory was a follow-up to our 2012 report, "Biodiversity and Ecological Potential of Plum Island, New York," a compilation of available biodiversity information about Plum Island, available at www.nynhp.org/PlumIsland. The 2015 field effort was funded by the Ocean and Great Lakes Program through the New York Environmental Protection Fund. NYNHP worked with NYS DEC and other conservation partners to define the scope of the inventory, which we conducted from March through December, 2015. Permission to access the island, ferry transport, and logistical help of all kinds was provided by the U.S. Department of Homeland Security and its staff and contractors. In this report we present our findings on the current status of the island's biodiversity and make recommendations for conservation and restoration.

We conducted a four-season inventory of Plum Island, beginning in March, 2015 and ending in December, 2015. Our survey targets were chosen in conjunction with the NYS DEC and included significant natural communities (ecosystems), mammals, reptiles, amphibians, inland fish, dragonflies and damselflies, butterflies, moths, certain beetles, rare plants, and invasive plants, with some other species groups recorded opportunistically. We used a variety of survey techniques including hoop traps for turtles, echolocation surveys for bats, pitfall traps for carrion beetles, light traps for moths, and visual and netting surveys for many other taxa. We combine our survey results with others' surveys for birds and plants, as well as prior knowledge documented in our earlier report, to form the most comprehensive picture to date of Plum Island's biodiversity.

Plum Island provides habitat for 67 or 111 species and communities of conservation concern, depending on how the total is calculated (Table E1). This is a significant number for an ~840-acre island, especially since biodiversity management on the island has focused historically on just a few elements of concern, such as Piping Plover (*Charadrius melodias*). Thirteen birds of conservation concern breed on the island and other federal- and state-listed birds forage along its shores and in its surrounding waters. Surveys have documented 23 plant species of conservation concern. The island is home to one of New York's largest seal haul-out sites, hosting hundreds of seals in winter months. Certain bats occasionally use the military bunkers as hibernacula and migratory tree bats pass through in spring and fall. Rare insects including moths, tiger beetles, and dragonflies and damselflies, find habitat on Plum Island.

While our 2015 survey was extensive, some information gaps remain and a single-year survey cannot document all species and natural communities present. We recommend additional inventory for native bees, marine mammals and sea turtles, rare plants, and marine habitats. In addition, as management efforts progress, surveys to document changes over time and potential improvements from restoration efforts are necessary to demonstrate success.

Further development on Plum Island would likely result in habitat loss for many rare species. Even if the island is kept largely undeveloped, its biodiversity is currently threatened by invasive plants, which choke the forest understory and cover the shrublands, resulting in lower native plant diversity and consequently fewer native animals than the island could potentially support. As an illustration, some rare plants previously documented on Plum Island could not be located in 2015

due to the abundance of invasive species. On a small island like Plum Island, invasive plant eradication and other habitat restoration may be achievable goals, and the island could also be considered as a laboratory for introductions of species that have been extirpated from much of the region like the New England cottontail and the Threatened American burying beetle. The success of neighboring Great Gull Island may provide a template for the potential restoration of breeding colonies of gulls and terns.

Table E1. Summary of biodiversity of Plum Island, New York.

Taxon	All species	Federal E & T[1]	State E & T[1]	Element occurrences	Total of conservation concern[2]
Ecological communities	33	-	-	5	5
All birds	215	2	6	4	57
Breeding birds[3]	63	1	2	4	13
Mammals[4]	9	1	1	1	6
Reptiles	5	0	0	0	2
Amphibians	0	0	0	0	0
Inland fish	4	0	0	1	2
Odonates	16	0	0	3	3
Moths	256	0	0	11	11
Other insects[5]	-	0	0	1	2
Plants (native)	280	0	18	19	23
Plants (nonnative/invasive)	164/28	-	-	-	-
All species and communities[6]	-	2/3	21/25	45/45	67/111

[1] Endangered and Threatened.

[2] Total includes Species of Greatest Conservation Need (NYS DEC 2015), Species of Potential Conservation Need (NYS DEC 2015), Heritage-tracked species, and significant natural communities—ones that are rare in New York State or outstanding examples of more common communities (Edinger *et al.* 2014).

[3] Not including those meeting the criteria for confirmed breeding but suspected to nest off the island.

[4] Terrestrial mammals only, plus the seal haul-out site.

[5] We did not conduct a complete inventory of insects and thus cannot provide a total species count.

[6] Tallied as (number including only breeding birds)/(number including all birds).

Introduction

Plum Island, New York has a long history of human use but remains mostly undeveloped. The island's disposition following the future departure of the Plum Island Animal Disease Center (PIADC) has been a subject of much political and public debate. Regardless of the island's future ownership, an understanding of the current status of biodiversity will help inform ongoing and future natural resource management efforts there. In 2014 the New York Natural Heritage Program (NYNHP) was funded by the New York State Department of Environmental Conservation (NYS DEC) to undertake a year-long inventory of Plum Island's biodiversity. The inventory was a follow-up to our 2012 report, "Biodiversity and Ecological Potential of Plum Island, New York" (Schlesinger *et al.* 2012), a compilation of available biodiversity information about Plum Island, available at www.nynhp.org/PlumIsland. The 2015 field effort was funded by the Ocean and Great Lakes Program through the New York Environmental Protection Fund. NYNHP worked with NYS DEC and other conservation partners to define the scope of the inventory, which we conducted from March through December, 2015. Permission to access the island, ferry transport, and logistical help of all kinds was provided by the U.S. Department of Homeland Security and its staff and contractors. In this report we present our findings on the current status of the island's biodiversity and make recommendations for conservation and restoration.

Much of the following introductory material was adapted from our 2012 report (Schlesinger *et al.* 2012).

Geography and geology

Plum Island lies in a small archipelago of peninsulas and islands stretching from Long Island's North Fork to Fishers Island and then to Connecticut and Rhode Island (Figure 1). Plum Island is owned by the U.S. Department of Homeland Security and lies within the Town of Southold, Suffolk County. The island is famously shaped like a pork chop and encompasses approximately 840 acres, approximately the size of New York City's Central Park. Its total length is about three miles with the long narrow panhandle measuring about 300 feet wide at the narrowest point. Land elevations vary from sea level to approximately 100 feet on a hill where the water tower is located. The southern third of the island is characterized by low hills and depressions and a series of low beach ridges alternating with freshwater wetlands (Figure 2). The middle of the island features a central plain (where Fort Terry was developed) that divides hills to the southeast, ranging from 40 to about 75 feet, from the northwestern ridge of irregular hills that rise to 100 feet above mean sea level. The eastern third of the island is a continuation of the northwestern ridge but narrows to a low stretch of land that terminates in a group of hills that rise up to 85 feet. The shoreline is characterized by wide sandy beaches in the south and east where the topography is low to a narrow shore of rocky beach on the rest of the island at the base of low, steep bluffs and cliffs where the topography is higher.

Plum Island is surrounded by four bodies of water that influence its offshore and onshore environment and biodiversity: Long Island Sound to the west and north, Block Island Sound to the east, Plum Gut to the immediate southwest, and Gardiners Bay further southwest. Around most of the island is a narrow shelf, a little wider to the east, with depths to about 20 feet. Beyond the shelf, sea depths are from 100 to 200 feet. The strait between the island and Orient Point, called Plum Gut, is narrow and deep with depths up to 188 feet and fast-running tides but no natural hazards. The strait between the island and Great Gull Island to the northeast is wider and shallower with depths from three feet around the shoals to 25 feet toward the center. The ecology of other islands in the region, including Great and Little Gull Islands, Gardiners Island, Fishers Island, Shelter

Island, and Block Island (Rhode Island) are useful for comparison, although the biodiversity of these islands is only variously known.

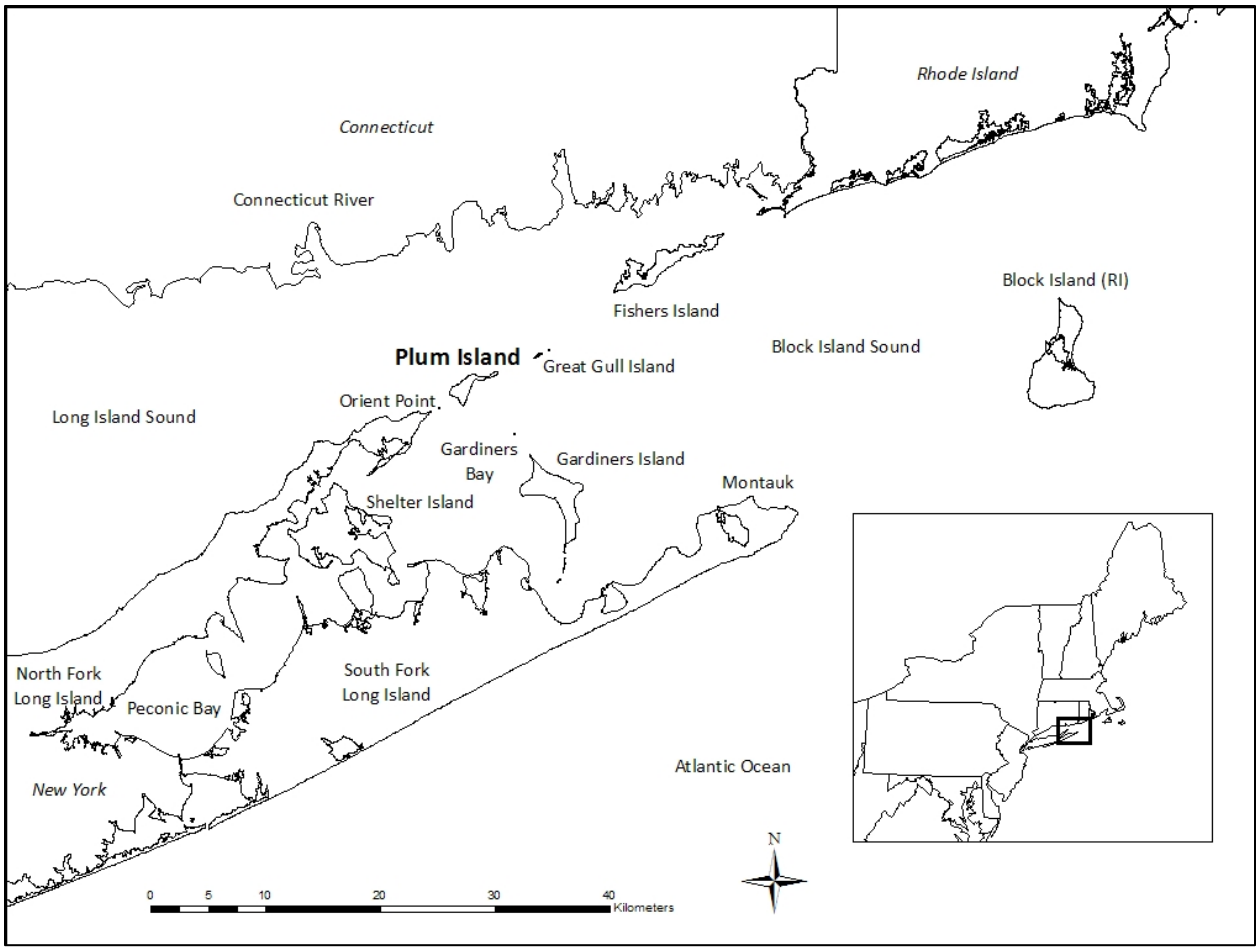


Figure 1. Plum Island with surrounding islands and points in mainland New York, Connecticut, and Rhode Island. Islands are within New York State unless otherwise noted. Inset: area of detail within the Northeast United States.

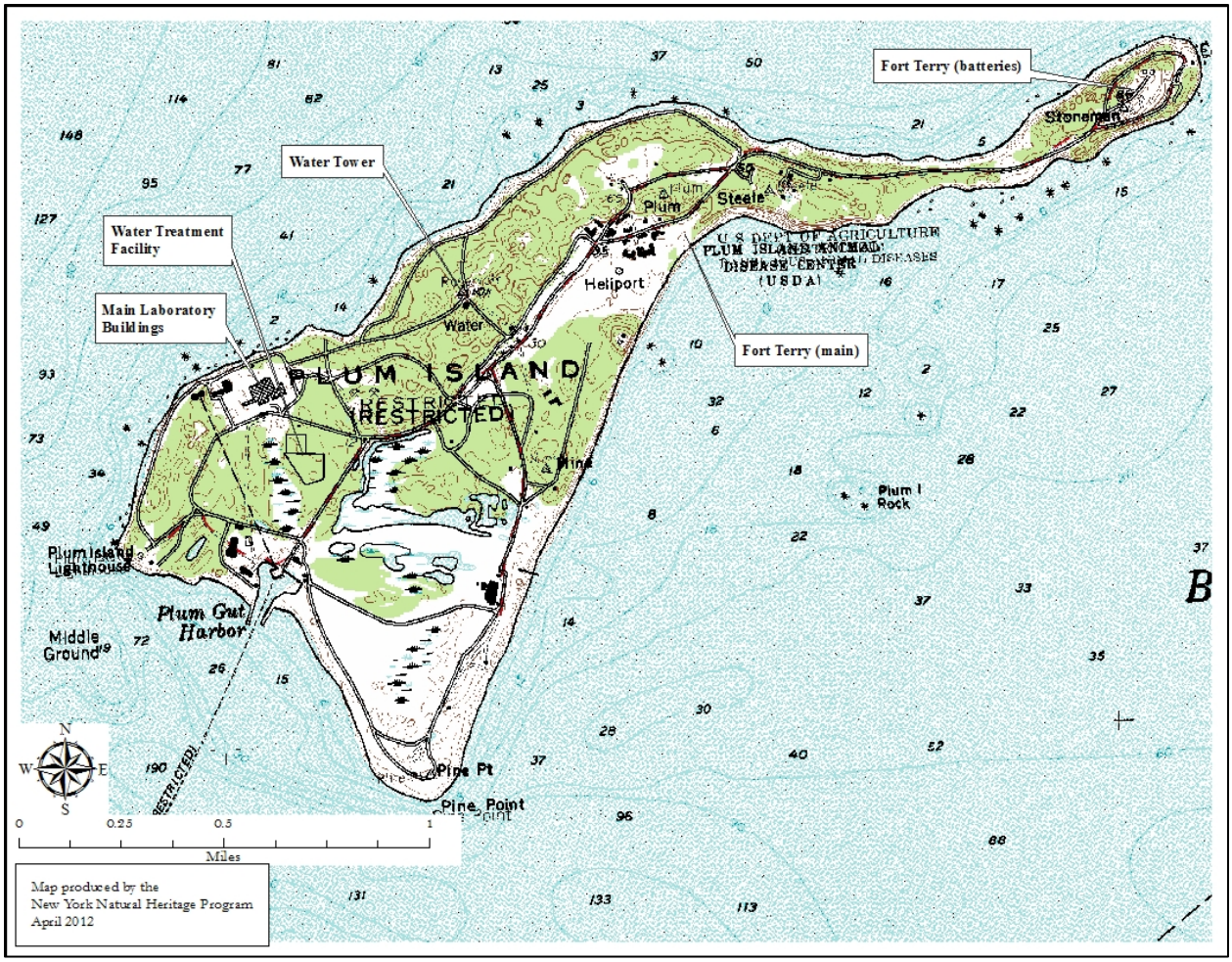


Figure 2. Plum Island, New York, with major features and human infrastructure.

The geology of Plum Island is a reflection of its glacial history, summarized here from Crandell (1962). During the Wisconsin Glacial Episode of the Pleistocene epoch the forward movement and backward melting back of the continental glaciers were instrumental in forming the island. Moraine outwash and till were laid down over existing Late Cretaceous deposits of silt, sand and gravel that had been eroded into a hilly terrain over Precambrian bedrock. As the Wisconsin ice sheet advanced, it pushed forward over the Plum Island and Long Island area carrying sand, gravel, and rocks from New York and New England. After it had reached its most southern extent, it began to melt back around 21,750 years ago. During this retreat the forward motion of the ice at times equaled the rate of melting and the glacier deposited two large moraines and outwash plains. The southern moraine was the southernmost extent of the ice sheet and is called the Ronkonkoma Terminal Moraine. As the ice sheet melted back from the Ronkonkoma moraine, its forward movement was again equaled by the rate of melting and it deposited a second moraine called the Harbor Hill Moraine that runs along the northern half of Long Island forming the North Fork, most of Plum Island, and the islands to the northeast.

The glacier first deposited thick layers of sand and gravel to form the island. Some of these layers were removed by an outwash channel beginning at the southwestern end of the island where the laboratory is located spanning to the former Fort Terry parade grounds, so this area is not as high and hilly as the rest of the island. A subsequent advance of the glacier deposited a layer of silt,

sand, gravel, and boulders (glacial till) in depths of five to 40 or more feet thick, forming the hills of the northern two-thirds of the island. This is where most of the present forests and shrublands grow. A meltwater channel eroded the till in the central part of the island to form a northeastward-trending level topography where Fort Terry is located. After the final glacial deposits had been laid down, erosion from ocean waves carried the finer sand and gravels to the southern end of the island where they formed a series of low beach ridges, allowing freshwater swales and marshes to form in between. This is where the wetland vegetation of the island can be found and where deposition has formed the wider beaches with no boulders. Elsewhere, the erosion of the upper layers of glacial till resulted in large boulders rolling down the slopes to the beach (along with some of the fort's gun emplacements in more recent history) to form the rocky beaches and rocky intertidal shore. Along the eastern shore are several exposures of gray to gray-brown sandy to solid clay that may have been deposited by the glaciers or forced upward from pre-glacial deposits.

The varied topography, along with different types of glacial till and outwash that have been eroded into new features, have resulted in 17 soil types listed for the island by the Natural Resources Conservation Service (U.S. Department of Agriculture Natural Resources Conservation Service 1995): Atsion, Berryland, Bridgehampton, Carver, Deerfield, Haven, Montauk, Montauk Variant, Plymouth, Raynham, Riverhead, Scio, Sudbury, Wallington, Walpole, Wareham, and Whitman. Descriptions of the soil types can be found at https://soilseries.sc.egov.usda.gov/osdnamequery.asp. This large diversity of soils and features in such a small area has resulted in the diverse flora and fauna found there today.

Climate

Plum Island has a maritime temperate climate and is greatly influenced by the surrounding ocean. The high heat capacity of ocean waters moderates the temperatures that are typical in central Long Island and the mainland to the west. This moderation of temperatures tends to delay the growing season in the spring and prolong it in the fall. The average high in midsummer on Long Island is in the low 80s and the average low in midwinter is in the low 20s (See http://longisland.about.com/od/neighborhoods/a/Long-Island-Ny-Climate.htm). Average monthly precipitation ranges from three to five inches in central Long Island with the lowest amount in July and the highest in March. Annual precipitation is approximately 45 inches. Plum Island is subject to a variety of storms. Spring and summer thunderstorms are a common occurrence and strong nor'easters can bring storm surges and high winds in the fall and winter. The National Oceanic and Atmospheric Administration (NOAA) website for historical hurricane tracks (See http://www.csc.noaa.gov/hurricanes) shows roughly eight hurricanes and tropical storms passing within 50 miles of the island since records began. An unnamed storm tracked right between Plum Island and Orient Point in 1944, and the most recent major storms to come close to the island were Hurricanes Irene (2011) and Sandy (2012). Even though hurricanes can be strong, the fall and winter nor'easters also have the high winds and waves that can influence the shoreline topography and vegetation.

History of human use

Plum Island has had a long and varied cultural history, which has had a dramatic impact on the animals and vegetation of such a small island. Prior to the arrival of European settlers, Native Americans probably used the island for fishing and farming (Bramson *et al.* 2014). The Pequot Indians grew corn there in the 1630s as a backup crop in case cornfields in Connecticut were burned by the English. In 1659 the island was sold by the Montauk Indians to Samuel Wyllys and for the next 238 years the island was used for farming and the grazing of sheep and cattle. By the mid-1700s there were three families living there and up to 50 people inhabited the island at times. In 1826 the

US government bought three acres of land on the southern shore for a lighthouse that was constructed in 1827. In the late 1800s it was a popular place for fishing camps of wealthy people and rustic buildings were built where they would stay. Others might stay with the resident farmers or the lighthouse keeper. Luminaries such as Grover Cleveland visited during these times (Bramson *et al.* 2014).

Most of the farmers sold their land by the end of the 1800s to Abraham S. Hewitt, former mayor of New London, Connecticut, who owned the entire island by 1890 (U.S. Department of Homeland Security 2010). His development plans for a summer resort never materialized and in 1898 the government bought the eastern half of the island to construct Fort Terry as a coastal defense for the Spanish-American War. It purchased the remainder of the island in 1901. The fort was active for the next 20 years during which roads, buildings, and gun installations were built, mainly along the eastern shore. There was even a small railroad to carry equipment and ammunition between installations. At the end of World War I in 1918, the fort changed to caretaker status and there was very little activity on the island for the next 23 years.

Beginning in 1941, the island was used as a base for World War II and activity increased over the next five years. In 1946, the fort was decommissioned and there was little or no activity until 1952, when the US Army Chemical Corps began renovating Fort Terry's Building 257 for use as a biological lab to study foot-and-mouth disease. Though Building 257 has been decommissioned, other Fort Terry structures on the island are still used to support the center's research mission. The buildings of Fort Terry have been vacated and new facilities have been constructed on the southwestern end of the island with a staff of about 400 people (U.S. Department of Homeland Security 2010). This has left much of the island in a semi-natural state except for the large mowed field and lawns of the Fort Terry parade ground and headquarters (see below), ferry dock facilities and buildings, and wastewater treatment plant . A network of narrow, paved and unpaved roads connect these historical and modern facilities. Its use as a highly secure government facility prevents the public, besides the staff and selected visitors, from using the island in any other manner or disturbing its plants or animals.

General methodology

Natural Heritage programs worldwide use standard methodologies for identifying biodiversity elements (species and natural communities) of concern, mapping occurrences of these elements, and ranking the viability of those occurrences. In Appendix A we provide some background on our methodology.

Natural communities

Our 2012 report (Schlesinger *et al.* 2012) contained the first-ever natural community map of Plum Island, based on remote imagery and others' field work (Figure 3). As a full grountruthing of that map was beyond the scope of this project, we surveyed select natural communities. We surveyed the natural communities on Plum Island using two methodologies appropriate for the environmental setting. We prioritized the island's shoreline communities over the terrestrial communities based on our earlier remote mapping that suggested that shoreline communities were the most likely to be significant from a statewide perspective (Schlesinger *et al.* 2012). For the four shoreline communities (maritime beach, maritime dunes, maritime bluff, and marine rocky intertidal) we used standard Natural Heritage Community Inventory Methods described below. For the marine eelgrass meadow boat surveys we used Natural Heritage Aquatic Community Survey Methods (Hunt 2000) modified with input from the dive team and described in the Marine eelgrass meadows section

(Page 18). We classified these communities using Ecological Communities of NYS (Edinger *et al.* 2014).

We documented one new natural community occurrences of statewide significance and updated records for four previously documented occurrences (Table 1). Highlights include a new occurrence of marine eelgrass meadow for the state.

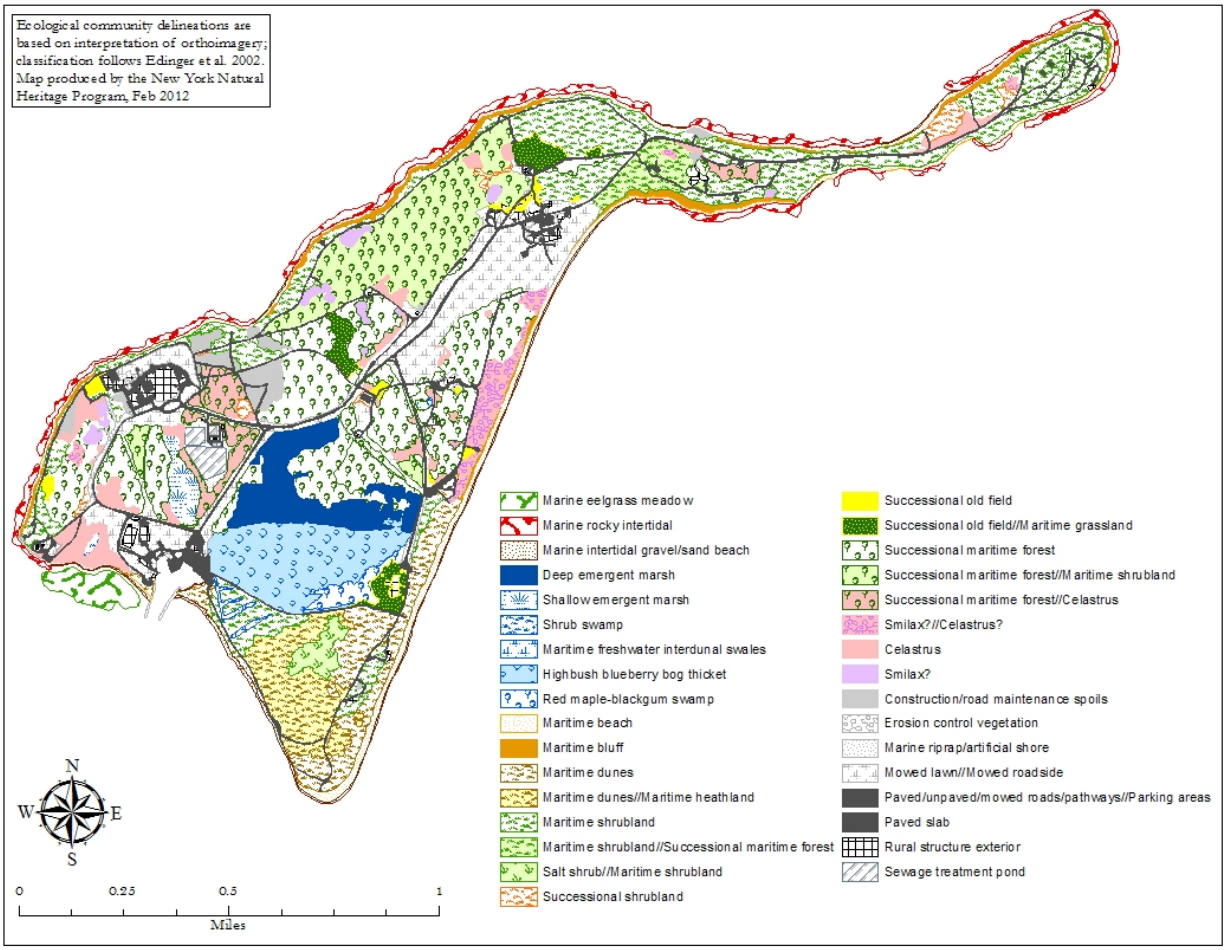


Figure 3. Natural community map of Plum Island, based on interpretation of orthoimagery, from Schlesinger *et al.* (2012).

Table 1. Significant natural community occurrences on Plum Island.

	Natural community	Global and state rank	Size (acres)	Element occurrence rank	No. of NYNHP occurrences in NY March 31, 2016	No. of estimated occurrences in NY
1	Maritime beach	G5 S3S4	45	AB	8	30-50
2	Maritime dunes	G4 S3	63	BC	10	30-50
3	Maritime bluff	GNR S2S3	44	AB	3	5-30
4	Marine rocky intertidal	G4?5 S1S2	34	AB	10	<40
5*	Marine eelgrass meadow	G5 S3	9.5	C	3	~30 max

*New occurrence documented in 2015. See Appendix A for definitions of all ranks.

Shoreline communities

For shoreline communities, we used standard inventory methodology developed by The Nature Conservancy, NatureServe, and the Natural Heritage Network, and refined by NY Natural Heritage (Edinger *et al.* 2000). This methodology involves collecting data on all or most of the following for each targeted community: plant species composition and structure in all strata, unvegetated ground and water surfaces, slope, and aspect (Edinger *et al.* 2000). Taxonomic nomenclature followed the NY Flora Atlas (Weldy *et al.* 2015) for vascular plants. For marine macro algae ("seaweeds") we used Gosner (1978) and Villalard-Bohnsack (2003).

These data allow an accurate identification of each community surveyed. We also collect and record information on occurrence size, maturity, level of disturbance, abundance of exotic species, threats, and landscape context. These data allow us to compare the quality and assess the viability of each community occurrence in relation to others throughout the range of the community, both within and outside of New York.

Specifically, for this project we collected detailed "observation points" (i.e., NY Natural Heritage Natural Community Form 1: Transect Observation Points (Edinger *et al.* 2000)). The location of each observation point was recorded with a Garmin 60cx GPS unit. The datum on the GPS unit was set to North American Datum 1983 (CONUS) and the coordinate system was set to Universal Transverse-Mercator (UTM) Zone 18N.

In addition we sampled at least one relevé plot in each of the four shoreline communities. Relevé plot data were collected following accepted Natural Heritage sampling protocols (Edinger *et al.* 2000) sampling 10-m × 10-m plots in the following communities: maritime beach, maritime dunes, maritime bluff, and marine rocky intertidal. We visually divided the vegetation into several strata: emergent trees (variable height), tree canopy (variable height), tree subcanopy (>5 m), tree sapling (2–5 m), tree seedling (<2 m), tall shrub (2–5 m), short shrub (<2 m), dwarf shrub (<0.5 m), herbaceous, non-vascular, and vines. Large trees were not expected in the targeted shoreline communities. We followed the NY Flora Atlas (Weldy *et al.* 2015) for vascular plant nomenclature. We estimated the percent cover of each species in each stratum and collected specimens of plants that were not identifiable in the field for later identification.

In addition to floristic information, we recorded the following environmental variables at each plot: slope, aspect, topographic position, hydrologic regime, soil stoniness, average soil texture, and soil drainage. We characterized unvegetated area of the plot by the type of exposed substrate (e.g., wood, rocks, soil, water, litter, etc.). We noted the plot representativeness of the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance.

Ecological community data were collected in a field notebook and entered into the NY Natural Heritage Program Field Form Database in the office after field surveys were completed. We took at least one digital photograph at all plot sampling locations. One corner of each plot was recorded with a Garmin 60Cx GPS unit.

We surveyed a total of 56 observation points on six days between July 21, 2015 and August 13, 2015 (Figure 4). Vegetation cover data were collected at 48 of these observation points of which 14 were detailed relevé plots. The 8 remaining points were reference points used to confirm a community type at that point, note a boundary between two communities, and/or document the location of an invasive plant population.

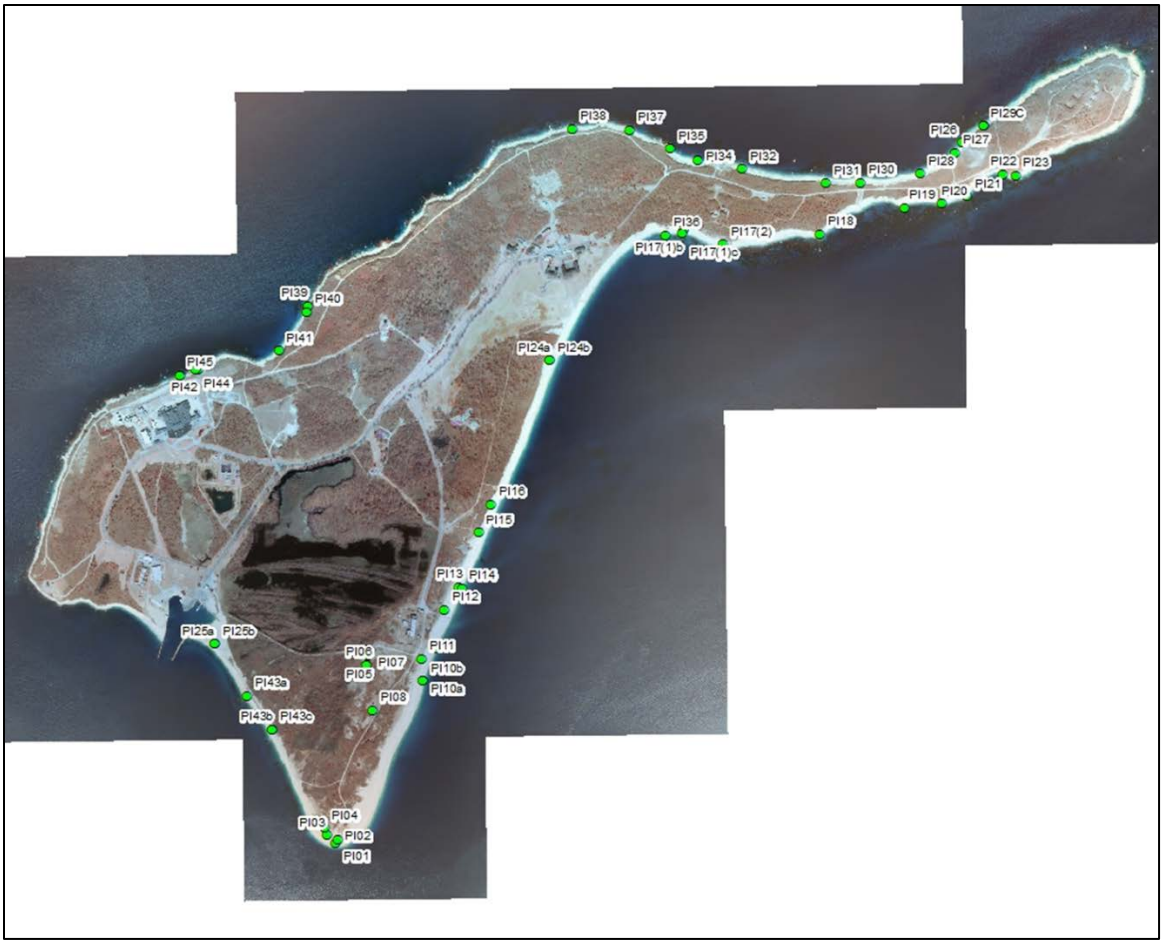


Figure 4. Shoreline ecological community observation points.

We started ecological community surveys at the south tip of Plum Island at Pine Point. We worked our way northeast and east counterclockwise around the perimeter of the island. We sequentially numbered our observation points starting at PI01 at Pine Point and finishing with PI45 on the western edge of the north shore (Figure 4). The discrepancy between 56 total points and 45 labelled points is that several points have multiple data records where several shoreline communities co-occur in close proximity (e.g., PI17(1)a, PI17(1)b, PI17(1)c, PI17(2)).

We surveyed the following shoreline communities: maritime beach, maritime dunes, maritime bluff, and marine rocky intertidal.

Maritime beach

The maritime beach community at Plum Island has two variants based on substrate type. Both variants at Plum Island are classified and mapped as one occurrence of maritime beach (sensu Edinger *et al.* 2014). The first variant is the typical sand-dominated "maritime sandy beach" with lesser amounts (~8% cover) of small (mostly 1-8 cm), smooth stones (i.e., pebbles and cobbles) mixed in with the sand. The second variant, "maritime rocky beach," consists of large rocks (i.e., large cobbles and boulders) with about 90% cover with most rocks ranging from 1 to 5 m diameter. Sand is a minor component of this variant (<7% cover). Both types are sparsely vegetated (4-12% herbaceous cover) and their distribution and descriptions for Plum Island are provided below.

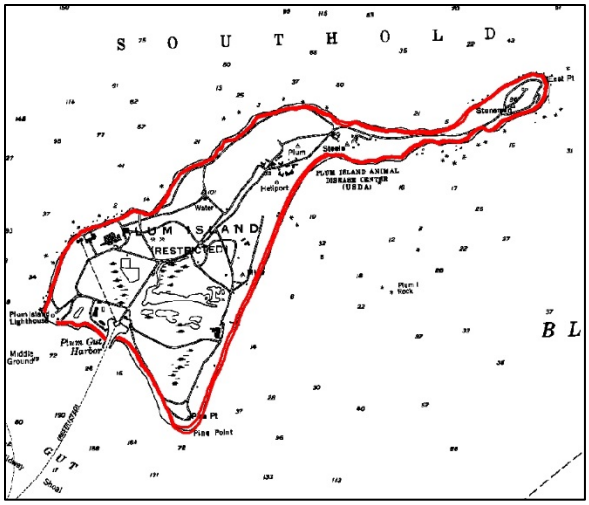


Figure 5. Maritime beach (rocky and sandy) at Plum Island.

"Maritime Sandy Beach"

We surveyed nine observation points in maritime sandy beach of which two were plots (PI02, PI03-plot, PI09b, PI10b, PI13, PI24b, PI25b, PI27, PI29B, PI30-plot). Starting at Plum Gut Harbor, the maritime sandy beach extends southeast around Pine Point, then continues northeast to Fort Terry uninterrupted for over two miles. For this stretch, the beach grades into maritime dunes and/or maritime bluff landward and marine intertidal gravel/sand beach seaward. The occurrence map likely includes portions of the latter community and it would be difficult to separate these two on air photos given their similar signature. The boundary between these two communities is the mean high water (MHW) line. Maritime sandy beach occurs around the perimeter shoreline of Plum Island in discontinuous patches, sometimes as the only beach type between the water and maritime bluff, but more often it occurs as a narrow band behind (or landward of) the maritime rocky beach (Figure 6) especially on the north shore. Maritime sandy beach is the likely beach type found in the gaps between the patches of marine rocky intertidal community (Figure 11). A summary description of the maritime sandy beach at Plum Island based on nine observation points and plots follows.

The vegetation is typically sparse (<12% cover), dominated by annuals, and most often located at the upper beach zone near the foredune (Figure 6) or at the base of a bluff. The most abundant herbs are American searocket (*Cakile edentula*) (5%), seaside goldenrod (*Solidago sempervirens*) (2%), and beach pea (*Lathyrus japonicus*) (2%). The following herbs have <1% cover each: cockleburr (*Xanthium strumarium*), common evening primrose (*Oenothera biennis*), spotted knapweed (*Centaurea stoebe*), wild radish (*Raphanus raphanistrum*), American beachgrass (*Ammophila breviligulata*), panic grass (*Dichanthelium acuminatum* ssp. *columbianum*), blue toadflax (*Nuttallanthus canadensis*), saltwort (*Salsola kali*), wild peppergrass (*Lepidium virginicum*), Greene's rush (*Juncus greenei*), Gray's flatsedge (*Cyperus grayi*), narrow-leaved goosefoot (*Chenopodium pratericola*), thin-leaved orach (*Atriplex prostrata*), beach wormwood (*Artemisia stelleriana*), sea sandwort (*Honckenya peploides*), carpet-weed (*Mollugo verticillata*), common yarrow (*Achillea millefolium*), common reed (*Phragmites australis*), common mullein (*Verbascum thapsus*), and eastern prickly-pear cactus (*Opuntia humifusa*).

The unvegetated surface has about 90.3% cover consisting of sand (73%), rocks <10 cm (6%), rocks >10 cm (2%), wrack (3%), shells (3%), wood <10 cm (3%), wood >10 cm (2%), vegetation litter (<1%), and trash (<1%). On Pine Point the width of the beach (between marine intertidal gravel/sand beach and foredune/bluff base) ranges 10-25 m (avg. 16.5 m).

Figure 6 (clockwise from top left). Maritime sandy beach; maritime beach plot (10 m × 10 m) PI03; maritime sandy beach: eastern prickly-pear (*Opuntia humifusa*); maritime rocky beach.

"Maritime Rocky Beach"

We surveyed eight observation points in maritime rocky beach and no plots were sampled (PI17(1)b, PI26, PI29A, PI32, PI34, PI37, PI38, PI39). The maritime rocky beach essentially corresponds to the extent of the marine rocky intertidal community, since both communities share the same substrate. As with the sandy beach, the boundary between these two communities is the mean high water (MHW) line with the rocky beach located landward and rocky intertidal community seaward. Starting at Fort Terry, maritime rocky beach extends east along the south shore of the island almost continuously to East Point with a few small stretches of sandy beach corresponding to the breaks in the marine rocky intertidal community map (Figure 11). The rocky beach extends west along the north shore for the length of the island with several alternating stretches of sandy beach. A summary description of the maritime rocky beach at Plum Island based on eight observation points follows.

The short shrub layer (~1 m) has 1% cover consisting of rugosa rose (*Rosa rugosa*) and false indigobush (*Amorpha fruticosa*). The dwarf shrub layer (<0.5 m) has <1% cover consisting of rugosa rose (*Rosa rugosa*) and bayberry (*Morella caroliniensis*). The vine layer (<0.5 m) has <1% cover consisting of hedge false bindweed (*Calystegia sepium*) and poison ivy (*Toxicodendron radicans*). The herbaceous layer has 4% cover. The most abundant herbs are beach pea (*Lathyrus japonicus*) (2%) and seaside goldenrod (*Solidago sempervirens*) (1%), and American searocket (*Cakile edentula*) (1%). The following herbs have <1% cover each: narrow-leaved goosefoot (*Chenopodium pratericola*), common evening primrose (*Oenothera biennis*), thin-leaved orach (*Atriplex prostrata*), sea-beach sedge (*Carex*

silicea), wild radish (*Raphanus raphanistrum*), blue toadflax (*Nuttallanthus canadensis*), carpet-weed (*Mollugo verticillata*), wild peppergrass (*Lepidium virginicum*), Gray's flatsedge (*Cyperus grayi*), American beachgrass (*Ammophila breviligulata*), horseweed (*Conyza canadensis*), sheep sorrel (*Rumex acetosella*), saltwort (*Salsola kali*), common yarrow (*Achillea millefolium*), common mullein (*Verbascum thapsus*), and wild lettuce (*Lactuca canadensis*).

The unvegetated surface has 97% cover consisting of rocks >1 m (30%), rocks <10 cm (28%), rocks >10 cm (24%), rocks >5 m (7%), sand (7%), wood <10 cm (6%), wood >10 cm (6%), wrack (3%), trash (1%), and shells (<1%).

We did not observe the typical threats to maritime beaches related to overuse by people and development seen elsewhere in New York on Plum Island (e.g., driving on the beach, fragmentation, artificial barriers, trampling, horseback riding, and littering). The primary threats to the beaches on Plum Island include invasion by exotic species and trash that washes onto the shore. We observed the following non-native species on the beaches at Plum Island: spotted knapweed (*Centaurea stoebe*), wild radish (*Raphanus raphanistrum*), narrow-leaved goosefoot (*Chenopodium pratericola*), thin-leaved orach (*Atriplex prostrata*), beach wormwood (*Artemisia stelleriana*), carpet-weed (*Mollugo verticillata*), common yarrow (*Achillea millefolium*), common reed (*Phragmites australis*), and common mullein (*Verbascum thapsus*). As long as the natural maritime processes of the ocean are maintained, these species and their native counterparts will likely be kept in check and held to relatively low percent cover. Due to limited public access we observed virtually no littering by beach goers, but we observed a significant amount of ocean derived trash especially in the wrackline.

The maritime beach at Plum Island is one of about 30-50 estimated occurrences in the state and one of eight currently documented by the NYNHP. At 45 acres, it is the sixth largest of those eight occurrences, but is tied for second place in quality with Fire Island and Lloyd Neck having a NY Natural Heritage Element Occurrence Rank (EO Rank) of "AB". Orient Point is the only currently documented occurrence of maritime beach in the state with an EO Rank of "A."

Maritime dunes

We surveyed nine observation points in maritime dunes of which five were plots (PI04-plot, PI05-plot, PI07, PI08-plot, PI12-plot, PI13, PI25a, PI25b, PI43a-plot). Maritime dunes are restricted to the southern tip of Plum Island. Starting at Plum Gut Harbor the primary dune extends southeast around Pine Point, then continues northeast to Fort Terry uninterrupted for over two miles. The relatively level backdune area fills in the "V-shaped" area created by the primary dune. The backdune grades into wetland to the north. A summary description of the maritime dunes at Plum Island based on nine observation points and plots follows.

The short shrub layer (<1 m) has <1% cover consisting of beach plum (*Prunus maritima*), multiflora rose (*Rosa multiflora*), and winged sumac (*Rhus copallinum*). The dwarf shrub layer (<0.5 m) has 4% cover. The most abundant dwarf shrub is beach heather (*Hudsonia tomentosa*) (1%). The following dwarf shrubs have <1% cover each: rugosa rose (*Rosa rugosa*), winged sumac (*Rhus copallinum*), beach plum (*Prunus maritima*), bayberry (*Morella caroliniensis*), and black huckleberry (*Gaylussacia baccata*). The vine layer (<0.5 m) has 14% cover. The most abundant vines are poison ivy (*Toxicodendron radicans*) (11%), Virginia creeper (*Parthenocissus quinquefolia*) (1%), and Asian bittersweet (*Celastrus orbiculatus*) (1%) with hedge false bindweed (*Calystegia sepium*) and round-leaved greenbrier (*Smilax rotundifolia*) (<1% cover each).

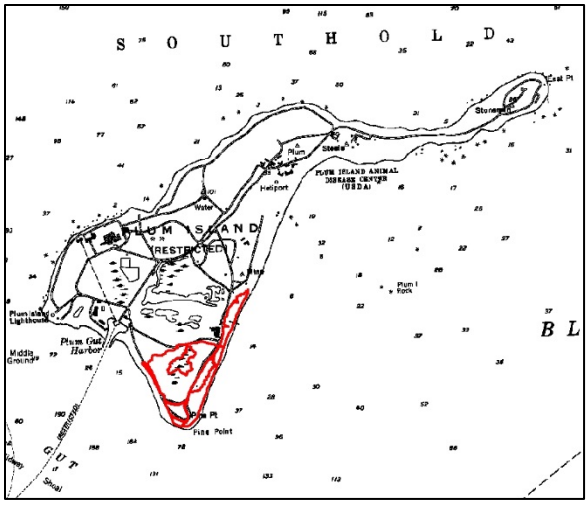


Figure 7. Maritime dunes on Plum Island.

The herbaceous layer has 52% cover. The most abundant herbs are American beachgrass (*Ammophila breviligulata*) (40%), sickle-leaved golden-aster (*Pityopsis falcata*) (5%), seaside goldenrod (*Solidago sempervirens*) (3%), and American searocket (*Cakile edentula*) (2%). The following species have <1% cover each: beach pea (*Lathyrus japonicas*), spotted knapweed (*Centaurea stoebe*), wild peppergrass (*Lepidium virginicum*), common evening primrose (*Oenothera biennis*), sea-beach sedge (*Carex silicea*), common mullein (*Verbascum thapsus*), horseweed (*Conyza canadensis*), common reed (*Phragmites australis*), sea sandwort (*Honckenya peploides*), panic grass (*Dichanthelium acuminatum* ssp. *columbianum*), seaside spurge (*Euphorbia polygonifolia*), meadow hawkweed (*Hieracium caespitosum*), carpet-weed (*Mollugo verticillata*), and cockleburr (*Xanthium strumarium*).

The unvegetated surface has 64% cover consisting of sand (32%), litter (28%), and rocks <10 cm (2%). The following components have <1% cover each: rocks >10 cm, wood <10 cm, wrack, wood >10 cm, shells, and trash.

We observed several threats to the maritime dunes on Plum Island that are common to other dunes in New York (e.g., invasive species, motor vehicle traffic, unpaved roads, beach access trails, and other development). We observed the following non-native species on the dunes at Plum Island: multiflora rose (*Rosa multiflora*), rugosa rose (*Rosa rugosa*), Asian bittersweet (*Celastrus orbiculatus*), spotted knapweed (*Centaurea stoebe*), common mullein (*Verbascum thapsus*), common reed (*Phragmites australis*), and carpet-weed (*Mollugo verticillata*). Several bisecting sand roads cross the backdune area and several beach access trails cross the top of the primary dune, especially on the east side of Pine Point. Past building development (apparently now abandoned) may have displaced former maritime dune habitat. We did not observe any new development within the dunes, but we did see old building foundations and ruins mostly in the backdune area. We did not record the locations of these structures.

Figure 8. Maritime dunes.

The maritime dune occurrence at Plum Island is one of about 30-50 estimated occurrences in the state and one of ten currently documented by the NYNHP. At 63 acres, it is one of four dunes that are under 100 acres. The other six dunes mapped by Natural Heritage are over 100 acres with the two largest at Jones Beach (905 acres) and Fire Island Democrat Point (496 acres). We are aware of another 600+ acres of maritime dunes in the Fire Island Wilderness that is not recorded in the Natural Heritage database. That site is very likely the state exemplary occurrence of maritime dunes. Despite its relatively small size, the dunes at Plum Island are in fair to good condition, within a good quality landscape, and have an Element Occurrence Rank (EO Rank) of "BC."

Maritime bluff

We surveyed seven observation points on maritime bluffs of which four were plots (PI16, PI17(1)a, PI17(2)-plot, PI24a-plot, PI29C-plot, PI31-plot, PI40). A continuous line of maritime bluffs extend southwest for about 0.5 mi. from Fort Terry toward Pine Point. The bluff faces are larger near Fort Terry reaching 25 m high (PI24a) and diminishing to 4 m (PI16) toward the southern end. Another 0.5 mi. line of bluffs extend east of Fort Terry along the south shore of Plum Island toward East Point. Here the bluffs range 15-25 m high. Toward East Point the bluffs become densely vegetated with shrubs and are only about 4 m high. Along the north shore the bluffs occur in discontinuous patches from East Point west to the lighthouse. The north shore bluffs are smaller and more vegetated than those on the south shore. A summary description of the maritime bluffs at Plum Island based on seven observation points and plots follows.

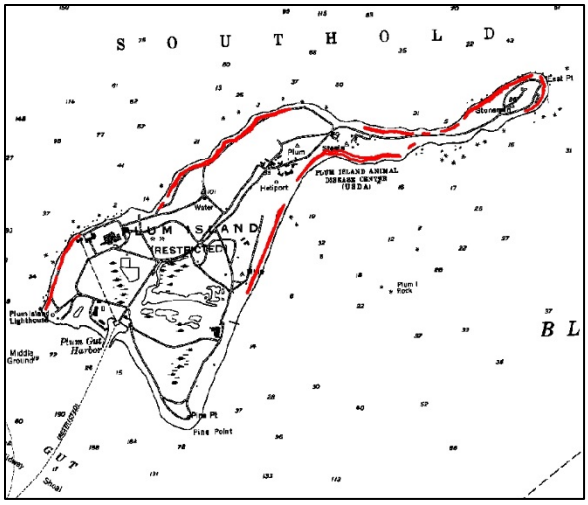


Figure 9. Maritime bluffs on Plum Island.

The tree sapling layer (4 m) has <1% cover of black cherry (*Prunus serotina*). The tall tree seedling layer (1.7 m) has <1% cover of black cherry (*Prunus serotina*) and red cedar (*Juniperus virginiana*). The short shrub layer (1 m) has 3% cover. The most abundant shrubs are bayberry (*Morella caroliniensis*) (2%), with smooth sumac (*Rhus glabra*), winged sumac (*Rhus copallinum*), multiflora rose (*Rosa multiflora*), and blackberry (*Rubus allegheniensis*) (<1% cover each). The dwarf shrub layer (<0.5 m) has 5% cover. The most abundant shrubs are dewberry (*Rubus flagellaris*) (3%), bayberry (*Morella caroliniensis*) (2%), and winged sumac (*Rhus copallinum*) (<1%). The vine layer (<0.5 m) has 16% cover. The most abundant vines are Asian bittersweet (*Celastrus orbiculatus*) (10%), Virginia creeper (*Parthenocissus quinquefolia*) (2%), Japanese honeysuckle (*Lonicera japonica*) (2%), poison ivy (*Toxicodendron radicans*) (2%), and hedge false bindweed (*Calystegia sepium*) (<1%).

The herbaceous layer has 20% cover. The most abundant herbs are common evening primrose (*Oenothera biennis*) (5%), seaside goldenrod (*Solidago sempervirens*) (4%), beach pea (*Lathyrus japonicus*) (2%), Gray's flatsedge (*Cyperus grayi*) (2%), and pokeweed (*Phytolacca americana*) (1%). The following herbs have <1% cover each: American searocket (*Cakile edentula*), wild radish (*Raphanus raphanistrum*), horseweed (*Conyza canadensis*), carpet-weed (*Mollugo verticillata*), spotted lady's-thumb (*Persicaria maculosa*), common yarrow (*Achillea millefolium*), panic grass (*Dichanthelium acuminatum* ssp. *columbianum*), sheep sorrel (*Rumex acetosella*), sowthistle (*Sonchus* sp.), orange-grass (*Hypericum gentianoides*), American beachgrass (*Ammophila breviligulata*), sea-beach sedge (*Carex silicea*), narrow-leaved goosefoot (*Chenopodium pratericola*), slender flattop goldenrod (*Euthamia tenuifolia*), Canada goldenrod (*Solidago canadensis*), black-eyed Susan (*Rudbeckia hirta*), Greene's rush (*Juncus greenei*), wild peppergrass (*Lepidium virginicum*), cockleburr (*Xanthium strumarium*), blue toadflax (*Nuttallanthus canadensis*), and common mullein (*Verbascum thapsus*).

The unvegetated surface has 70% cover consisting of sand (58%), rocks >1 m (<1%), rocks >10 cm (2%), rocks <10 cm (6%), wood <10 cm (2%), and wood >10 cm (<1%). Average bluff height: 14 m (range 4-25 m). Average bluff slope: 41 degrees (range 30-68 degrees).

We did not observe the typical threats to maritime bluffs related to overuse by people and development seen elsewhere in New York on Plum Island. The primary threat to maritime bluffs in New York is likely to be recreational overuse; specifically, climbing and sliding on the cliffs increases erosion. Additional threats include fragmentation of bluffs by development; stairways for beach access; and barriers to connectivity between the open ocean, the beach, and the bluffs. However, the primary threat to the bluffs on Plum Island is invasion by exotic species. We observed the following non-native species on the bluffs at Plum Island: Asian bittersweet (*Celastrus orbiculatus*), Japanese

honeysuckle (*Lonicera japonica*), wild radish (*Raphanus raphanistrum*), carpet-weed (*Mollugo verticillata*), spotted lady's-thumb (*Persicaria maculosa*), common yarrow (*Achillea millefolium*), sheep sorrel (*Rumex acetosella*), narrow-leaved goosefoot (*Chenopodium pratericola*), and common mullein (*Verbascum thapsus*). While the current cover of invasive species on the bluffs is relatively low, these species may become more abundant as the bluffs become more stabilized with increased vegetation cover.

The maritime bluff occurrence at Plum Island is one of 5 to 30 estimated extant occurrences statewide. At 44 acres, it is the largest of only three occurrences currently documented by the NYNHP with the other two being Montauk Peninsula (30 acres) and Shadmoor State Park (20 acres). The bluffs at Plum Island are equivalent in quality to those on Montauk Peninsula with both having a NYNHP EO Rank of "AB". Shadmoor bluffs have an EO Rank of "BC."

Figure 10. Maritime bluff community. Note bank swallow (*Riparia riparia*) nest holes near summit at left.

Marine rocky intertidal

We surveyed five observation points in the marine rocky intertidal community of which three were plots (PI19-plot, PI20, PI33, PI36-plot, PI44-plot). The marine rocky intertidal community starts east of Fort Terry and extends in discontinuous patches east to East Point and west along the north shore to lighthouse (Figure 11). The marine rocky intertidal signature is clear on color-infrared aerial photographs (Figure 12). It consists of a series of patches of marine macroalgae that occur on the tidally washed rocky shores surrounding Plum Island, extending out to the lowest tide level. Mapped patches range in width from about 5 to 50 meters. A summary description of the marine rocky intertidal community at Plum Island based on five observation points and plots follows.

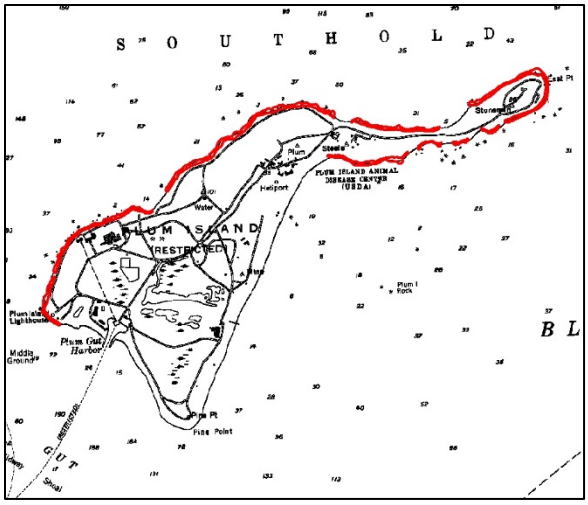


Figure 11. Marine rocky intertidal community at Plum Island.

The community was surveyed at low tide at the water line and includes subtidal underwater areas and intertidal exposed areas at low tide (Figure 12). Filamentous algae listed below are tentatively identified. The community is dominated by attached and free floating marine algae in the submerged aquatic layer and has 50% cover. The dominant marine algae includes rockweeds (*Fucus vesiculosus*, 25%, and *F. spiralis*, 7%; Figure 12) and knotted wrack (*Ascophyllum nodosum*, 11%, Figure 12) attached to rocks. Attached and suspended algae include hollow green weeds (*Enteromorpha* sp.) (1%) and brown filamentous algae (1%). The following species have <1% cover each: red filamentous algae (*Dasya pedicellata, Polysiphonia lanosa*), sea lettuce (*Ulva lactuca*), Irish moss (*Chondrus crispus*), and green filamentous algae (*Blidingia minima, Rhizoclonium* sp.). The epiphytic layer has 6% cover consisting of filamentous algae mostly attached to *Ascophyllum nodosum* and *Fucus vesiculosus* and includes red filamentous algae (*Polysiphonia lanosa*) (2%) and brown filamentous algae (*Elachista fuciola*) (1%).

The substrate has 93% cover including areas under algae cover and consists of rocks >5 m (3%), rocks >10 cm (24%), rocks >1 m (24%), rocks <10 cm (23%), and sand (8%). Water was about 0.5 - 0.75 m deep and covered about 45% of the subtidal areas and was about 0.2 m deep in small pools that covered about 12% of the intertidal areas.

Characteristic marine invertebrates include northern rock barnacle (*Balanus balanoides*), common blue mussel (*Mytilus edulis*), common periwinkle (*Littorina littorea*), rough periwinkle (*Littorina saxatilis*), and green crab (*Carcinus maenas*). We did not observe any horseshoe crabs (*Limulus polyphemus*).

We did not observe the typical threats to the marine rocky intertidal community related to overuse by people and development seen elsewhere in New York on Plum Island. The primary threat to marine rocky intertidal communities in New York is the spread of non-native marine algae, such as green fleece (*Codium fragile*). We did not find green fleece at any of our 2015 marine rocky intertidal sampling points. In addition, marine rocky intertidal community occurrences are threatened by trampling, shoreline development, pollution run-off from upland areas, and trash dumping. We did observe drain pipes that emptied into the ocean near patches marine rocky intertidal community (e.g., point PI45 on the north shore). Ocean derived pollution may threaten marine rocky intertidal communities. Over-collecting of tidal pool fauna may be a minor threat at a few sites.

The marine rocky intertidal community at Plum Island is one of an estimated 40 occurrences in the state and one of 10 currently documented by the NYNHP. At 34 acres, it is the third largest example in the state after Fishers Island (63 acres) and Napeague Bay (54 acres). The marine rocky intertidal community at Plum Island is tied with Huckleberry Island (9 acres) for highest quality example in the state with both having a NY Natural Heritage EO Rank of "AB." However, Huckleberry Island is located in western Long Island Sound off shore from a heavily developed part of Westchester County, and given that the community was last surveyed in 1991, its EO Rank of "AB" is in question. If Huckleberry Island is resurveyed and downgraded, then that would leave the marine rocky intertidal community at Plum Island as the best example in the state.

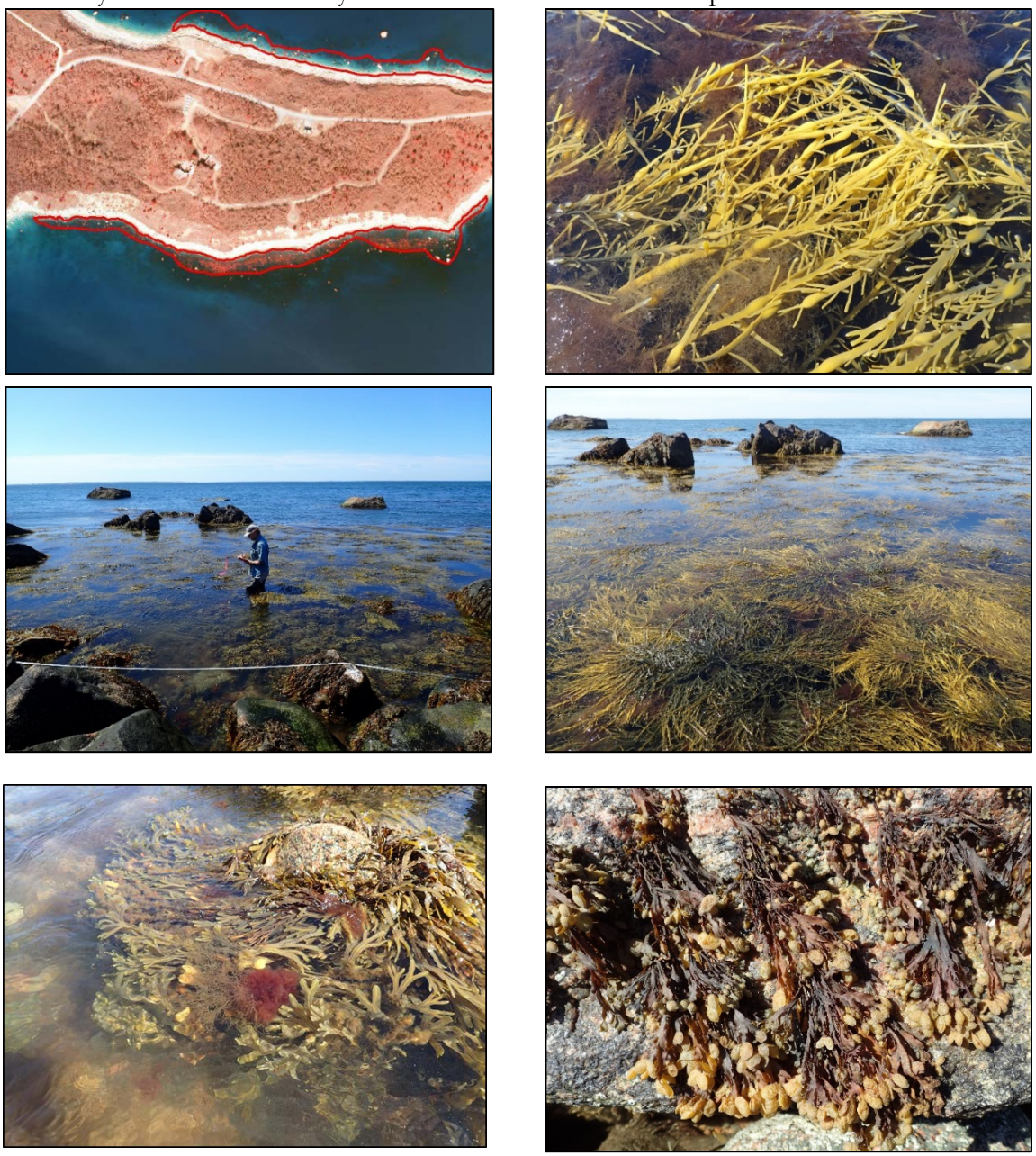


Figure 12. Marine rocky intertidal at Plum Island. Top left: Marine rocky intertidal polygon (Long Island 2010 6-inch Color Infrared). Top right: knotted wrack (*Ascophyllum nodosum*). Bottom left: rockweed (*Fucus vesiculosus*). Bottom right: rockweed (*Fucus spiralis*).

Marine eelgrass meadows

For the marine eelgrass meadow boat surveys we used NY Natural Heritage Aquatic Community Survey Methods (Hunt 2000) modified with input from the dive team. We created two Plum Island Eelgrass Survey forms; the first was completed by the on-boat data collector who recorded start and stop times, GPS coordinates, water depth, wave height, etc.; the second form was completed by the diver who recorded biotic and abiotic data present at the observation point (see examples of both forms in Appendix B). We incorporated distribution and percent cover figures from Methods for Mapping and Monitoring Eelgrass Habitat in British Columbia (Environment Canada 2002) to the forms. The forms were photocopied onto waterproof paper and completed using a #2 pencil attached to a plastic clip board.

Specimens collected by divers were placed in clear plastic collection vials and labelled. Plant specimens were pressed and dried in a plant press. Digital photographs were taken of each specimen. All fauna specimens and photos were identified in the office to closest taxonomic level possible. The following references and resources were used to identify marine organisms: Weiss (1995), Gosner (1978), and the Eelgrass Fauna Gallery (http://www.seagrassli.org/media_and_more/gallery/fauna_gallery/fauna_gallery_index.html).

We surveyed a total of six observation points on October 27, 2015 (Figure 13) and eelgrass was found at only one site. Vegetation cover and faunal data were collected at all six observation points. Three points were sampled in the same patch of marine eelgrass meadow of which one was a 1 m × 1 m plot (PIES01, PIES05a, PIES05b-plot). (Note: PIES = Plum Island Eelgrass Survey.)

Figure 13. Plum Island Marine Eelgrass (PIES) boat survey points.

The survey team included the following: a DEC boat (Figure 14); boat crew: Todd J. Glavin (DEC Boat Captain), Jennifer L. O'Dwyer (DEC Dive Safety Officer), Gregory J. Edinger (NYNHP Chief Ecologist and Data Collector); divers (Figure 15): Steven Resler (DOS Lead Diver), Erin L. White (NYNHP Zoologist and Diver).

Figure 14. DEC boat used for Plum Island Eelgrass Survey.

We looked for eelgrass at five points around the island. The first and fifth points were within the same patch that was hypothesized as an eelgrass habitat – the area between the ferry harbor and the lighthouse. We started eelgrass surveys about 130 m northwest of the western ferry harbor jetty and about 30 m offshore. We worked our way southeast then east counterclockwise around the perimeter of the island. We sequentially numbered our observation points starting at PIES01* and finishing with PIES05b near the original starting point (Figure 13). A summary description of the marine eelgrass meadow at Plum Island based on two observation points and one 1 m × 1m plot all sampled within the same patch of eelgrass follows.

The epiphytic layer on eelgrass (*Zostera marina*; Figure 15) has <1% cover of red filamentous algae (*Ceramium* sp. and *Champia parvula*). The submerged aquatic layer (0.5 m) has 47% cover. The most abundant species are eelgrass (*Zostera marina*) (38%), red alga (12%), green algae (2%), brown algae (2%), and brown filamentous algae (<1%). The unvegetated surface has 66% cover consisting of sand (65%), rocks <10 cm, silt, and shells (<1% cover each). Fauna observed included common tortoise limpet (*Testudinalia testudinalis*), common periwinkle (*Littorina littorea*), sponges (*Scypha* sp.), snails, tube worms, fishes, and eelgrass shrimp (*Hippolyte* sp).

Point PIES01 located about 130 m northwest of the western ferry harbor jetty and about 30 m offshore. Water depth 11.3-11.6 feet measured at 0932 (depth finder). Surface calm, waves 0.5 feet (visual estimate). Patchy cover (40-55%) of eelgrass (*Zostera marina*) found and surveyed. A mass of *Zostera* was collected from the anchor. *Zostera* is dominant in the wrack line on shore.

Point PIES05a-b located about 40 m west-northwest of the western ferry harbor jetty and about 45 m offshore. Water depth 9.0-9.4 feet measured at 1305 (depth finder). Waves 0.5 feet (visual estimate). Continuous *Zostera* cover under the boat (90%) with decreasing cover toward jetty (5%) with sand. *Zostera* extends to shore and stops just short of mean low water/tide line.

The greatest threats to marine eelgrass meadows in New York are decreased water quality from excess nitrogen, harmful algal blooms, increased turbidity from sedimentation, and damage from fishing/shellfishing gear and boating activities. Additional existing or expected threats include continued decline in water quality and clarity from development, hardened shorelines, polluted run-

off, and potentially from a loss of filter feeders; physical disturbances from construction of marinas and docks, navigational channel dredging (which potentially destroys eelgrass beds, increases turbidity, and alters habitat suitability), storm surges, and wind/wave action (which may be exacerbated by climate change); seagrass wasting disease; bioturbation and overgrazing; increased water temperatures from climate change; and sea level rise. Some invasive exotic species, including tunicate colonies (*Didemnum* spp.) and macroalgae (*Codium fragile*), are also threatening this community.

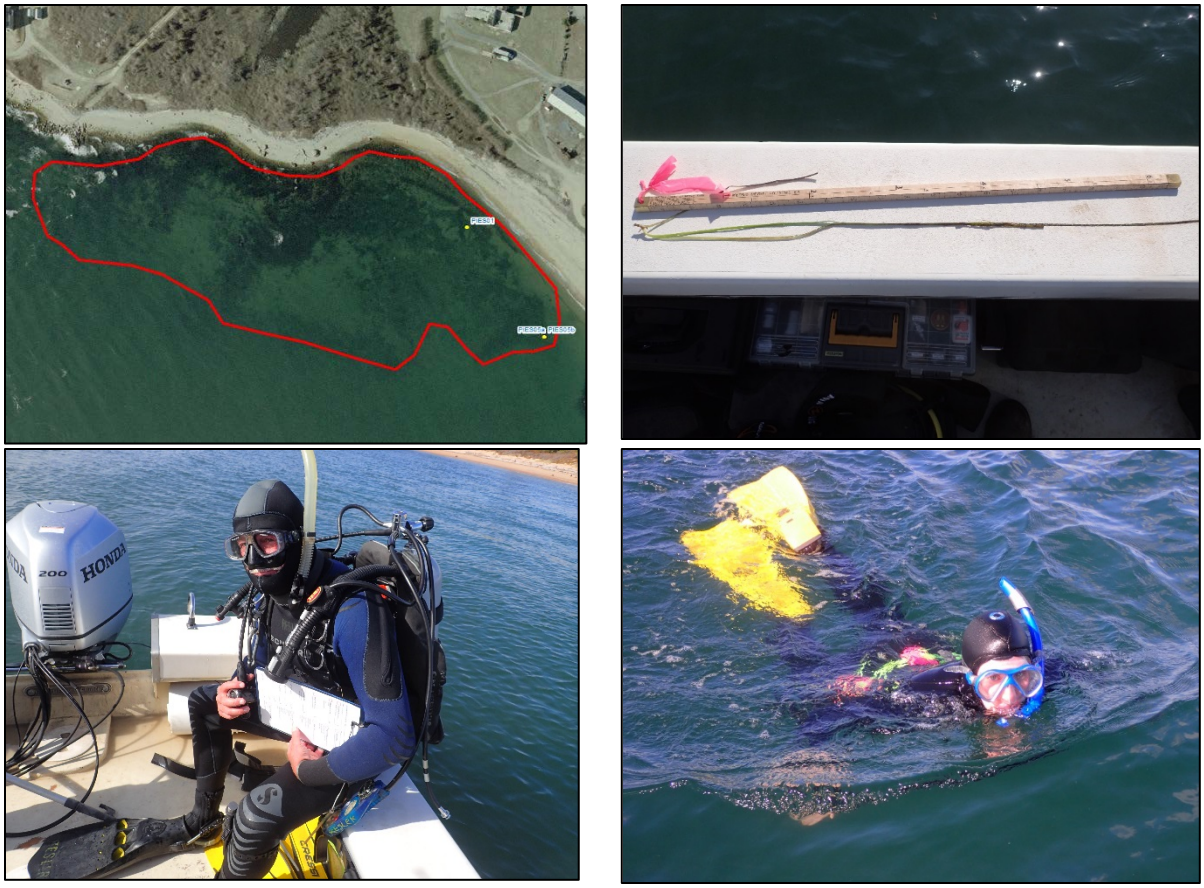


Figure 15 (clockwise from top left). Marine Eelgrass Meadow (Long Island 2004 1-foot Natural Color); Eelgrass (*Zostera marina*) specimen over 1 m long; Marine eelgrass meadow snorkel survey (Erin White); Marine eelgrass meadow SCUBA survey (Steve Resler).

The marine eelgrass meadow community at Plum Island is one of fewer than an estimated 30 occurrences in the state and one of three currently documented by the NYNHP. At 9.5 acres, it is the smallest of the three occurrences (Shelter Island – 330 acres and Napeague Harbor – 35.5 acres). Statewide the aerial extent and ecological integrity of this community is very rapidly to severely declining. While historical seagrass acreage in New York has not been documented, historical photography and records indicate that there may have been 200,000 acres in 1930; today, only 21,803 acres remain (NYS Seagrass Taskforce 2009). This is due, in part, to effects from historical seagrass wasting disease and current increased nutrient loading, decreased water quality and clarity, harmful phytoplankton blooms, habitat degradation, and fishing and boating disturbances (NYS Seagrass Taskforce 2009). Given the alarming decline of this community in the state, mapping and monitoring all patches of eelgrass like the one at Plum Island is becoming increasingly important.

Animals

We focused our animal surveys on at-risk species: those listed as Endangered or Threatened by New York State and those tracked by NYNHP. In some cases—reptiles and amphibians, dragonflies and damselflies, moths, other flying insects—surveys for single species use the same methods and sampling design as surveys to enumerate all the species in the group, so our lists of those taxa are more complete, including common species. While we recorded some birds incidentally, birds were not a focus of our efforts since Audubon New York had been surveying there for years for the Important Bird Area designation (Burger and Liner 2005). We summarized Audubon NY's surveys for this report.

Mammals

New England cottontail

The New England cottontail (*Sylvilagus transitionalis*) is a distinct species from the very common eastern cottontail (*Sylvilagus floridanus*), and is known to have occurred historically as far west as the Hudson River in New York, east to the Atlantic, and north into southern Maine. On Long Island it was known from Nassau and Suffolk Counties including on Shelter Island and at Montauk Point (Connor 1971). The two cottontail species are only reliably distinguished by skull morphology and through analysis of genetic material. They may differ in habitat. Eastern cottontails will use open areas more readily while New England cottontails avoid traveling outside dense brush.

We conducted surveys by walking rough transects and searching within dense brush, where New England cottontails typically hide, scouting for pellets and browse. We focused survey efforts on the two largest, densest patches of green brier (*Smilax rotundifolia.*) located near the north-central shore of the island. Green brier is a favorite source of food and cover for New England cottontails. We visited the green brier patches twice, once in March and again in December of 2015. We had time on the second trip to survey additional habitats including an old field and a thicket adjacent to a wetland.

No cottontails were observed on the island by Heritage biologists during the extent of this project. Cottontails or their pellets, browse, or tracks were also not found during the targeted surveys. We were informed by Plum Island staff that they had also not observed any cottontails on the island. The potential predators of cottontails on the island are likely limited to hawks and falcons and there is an abundance of forage available due to deer control efforts. Due to the limited predators and abundant forage, it seems likely that there would be a high enough number of cottontails on the island that they would be detectable if present. Therefore, it is unlikely that New England cottontails currently exist on Plum Island, but we cannot determine this for certain since it is very difficult to confirm the absence of a species, especially one that inhabits dense brush. It is unknown but possible, given the proximity of known historical records, that this species occurred on Plum Island historically.

Bats

We conducted winter surveys of historic bunkers on Plum Island to evaluate their potential to serve as bat hibernacula. We spoke with Plum Island staff to gain information on which bunkers had certain characteristics, such as dark, intact interior rooms, that may provide habitat for bats as winter hibernacula. We surveyed two bunkers at the beginning of the project in March, and then assessed other bunkers over several trips during the summer. Those deemed to have potential were visited during December. A team of between 3 and 6 individuals (consisting of 2-3 Natural Heritage biologists accompanied by 1 to 3 Plum Island staff) surveyed the bunkers during the day with headlamps or flashlights. We methodically searched each room in the bunker for hibernating bats,

including those that may roost in the open, on the bunker ceilings, and in crevices or cracks in the bunker walls (as Northern long-eared bats [*Myotis septentrionalis*] and small-footed bats [*Mytois leibii*] are known to do). Any bats observed were identified in the field by sight, assisted by binoculars, and photographed for species confirmation. Bat photos were later reviewed by state DEC biologist, Carl Herzog, to confirm identification.

Many of the bunkers on the island (Floyd, Eldridge, Kelly, Dalliba, Campbell, Greble, Bradford) are above ground, small, and degrading, missing doors, windows, and walls, leaving them likely too exposed to serve as ideal winter hibernacula, although they could use these locations as roost sites in warmer temperatures. Four bunkers (Battery Steele, Dimmick, 217, and Stoneman) appeared to have some more promising characteristics such as being partially underground or had exterior walls that were still intact.

In March, we surveyed Battery Steele (Figure 16) and Dimmick. No bats were found in Battery Dimmick. Although it is a large structure, due to the degraded state and lack of protected interior rooms, it is likely not used as a hibernaculum except maybe temporarily in the fall or early winter on milder days. The best winter habitat we found for bats on the island was at Battery Steele, which had interior rooms deep within the bunker and in some cases, doors had rusted to the ground partially open. While the doors were open enough to allow human access, they were likely still enclosed enough to provide a buffer to temperature changes to some degree within them. Some of the rooms had an outer door and a room located beyond the first room; those likely provided the best habitat having the darkest conditions with the least exposure. Four bats were found at Battery Steele on the March survey, 3 big brown (*Eptesicus fuscus*) bats and 1 little brown bat (*Myotis lucifugus*; Figure 16); all in interior rooms. A brief revisit was made in April on an evening when bats were not active during the night acoustic survey, to see if they were in the hibernacula due to the cooler temperatures. On that survey, we found a big brown bat still roosting in the hibernacula and likely the same little brown bat was found dead on the floor near where we had seen it in March.

In December, we resurveyed Battery Steele. There were no bats found. It is likely that the few bats we had found the preceding spring were just not hibernating fully yet due to the warmer temperatures. We also surveyed Battery Stoneman and Battery 217 on the same trip and neither had bats. Stoneman looked promising at first but there were no interior rooms to offer protection, so it would not likely serve as a hibernacula. Battery 217 also looked promising and did have a few interior rooms that were darker and provided some protection from winter exposure. There were also many cracks and crevices for bats to hide. It is likely that Battery 217 could serve as a hibernacula for some bats. However, since Battery Steele had the better habitat and only housed a few bats, it is not likely that any of the bunkers on the island serve as major hibernacula.

We did not detect the federally threatened northern long-eared bat (*Myotis septentrionalis*) on the winter surveys. However, there is a well-documented population of northern long-eared bats still occurring on Long Island and it is still unknown where they hibernate during the winter. Northern long-eared bats often hide in crevices in the hibernacula walls making them hard to detect. Also, they are even harder to detect now that they occur in such low numbers since populations have suffered a dramatic decline of 99% in New York State from 2007-2015 due to white-nose syndrome. Since they are so difficult to detect it would take a tremendous amount of survey effort to locate one in a bunker if they are present. It is certainly possible that they could hibernate in a bunker on Plum Island such as Battery Steele or 217, especially since we found other bats including another *Myotis* species using them.

Figure 16. Exterior of Battery Steele and little brown bat (*Myotis lucifugus*) hibernating in Battery Steele.

We used both passive and active survey methods to obtain the greatest accuracy of information on which species of bats are using Plum Island during the spring, summer, and fall. Active surveys, which consisted of driving or walking with the detector at night, enabled us to target a variety of habitats throughout the island, such as water sources that may attract bats, and also to sample pathways through the woods that bats may use as flyways during foraging.

For the passive surveys, we placed a stationary detector at a sampling location in the field and left it out for up to a month at a time. This method allowed us to greatly increase the number of nights sampled in the spring and the fall which was important since migration patterns of bats can be sporadic depending on weather and other conditions.

For the active surveys, we used a Pettersson M500 microphone connected to a Windows 8 tablet running Pettersson's BatMicRecorder software. The display screen on the tablet enabled us to view live spectrograms of the bat echolocations. The active detector was full-spectrum and therefore allowed us to view more qualities of the sound to aid in identification. We conducted acoustic driving surveys monthly from April through October, following the same prescribed route (Figure 17) except during July when night work for deer control prohibited the survey. The surveys were conducted within the first 2 hours following sunset. Bat echolocations were identified, where possible, to species by reviewing each call file manually and examining characteristics of each pulse such as minimum frequency, duration, and slope.

For passive surveys, we used an Anabat II detector with an omni-directional microphone housed in a plastic container sealed with a lid for weather protection, with a hole in the side for the microphone. The Anabat II is a zero-crossing detector that collected files of a smaller size allowing for greater storage capacity. We attached the detector horizontally approximately 4-5' high in a tree. The detector was moved between four locations on different surveys: at the edge of the wetland near the observation tower (Figure 18), at a second location on the same wetland, on a small raised bank along an access road through the forested section of the island, and along an access road near the water tower (Figure 17).

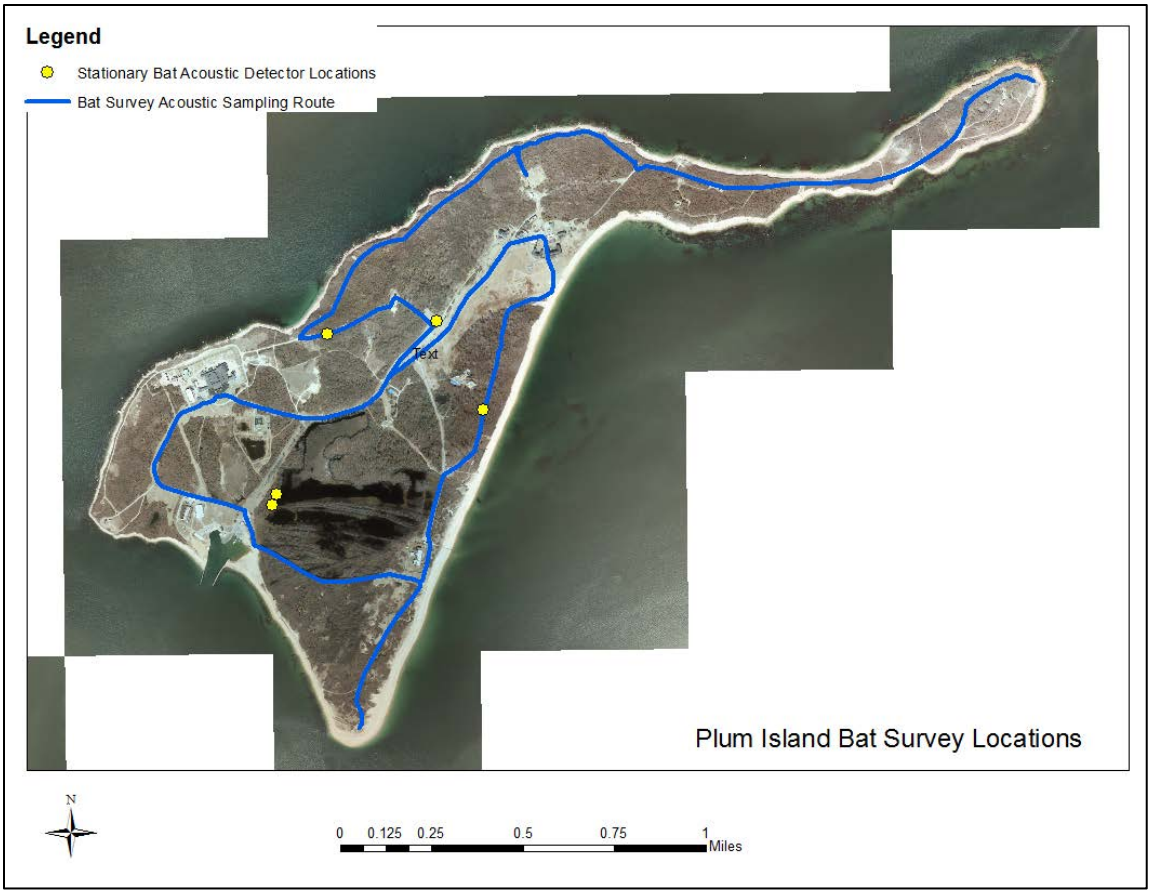


Figure 17. Bat survey route and stationary detector locations on Plum Island.

Figure 18. Bat detector location in April on the wetland near the observation platform.

Including all acoustic surveys, we collected over 1350 sound files, 63% of which were noise or low quality calls that could not be identified to species. Of these, 499 call files were of high enough quality to determine the species. Each file represents a pass of at least one bat by the detector. We identified three species of bats using the island through this method (Table 2). Eastern red bats (*Lasiurus borealis*) and big brown bats (*Eptesicus fuscus*) were present in the summer indicating their status as summer residents of Plum Island, and hoary bats (*Lasiurus cinereus*) were present only during migration in the spring and fall. Hoary bats had a particularly high activity rate in the spring. Eastern red bats were also detected during migration but only in the fall, and at a relatively high activity rate.

The species documented were all expected and common elsewhere on Long Island. One of the more interesting findings was the prevalence of hoary bats during the spring and fall and eastern red bats during the fall, which supports findings by other researchers that some tree bats may migrate along the coast.

We also did not detect the federally threatened northern long-eared bat (*Myotis septentrionalis*) on the summer surveys. Although northern long-eared bats typically occur in more forested habitat than is present on the island, they sometimes may use smaller forest patches. There is a well-documented population remaining on Long Island, so there is a chance that they could turn up on future surveys foraging or roosting on the island during the summer.

Table 2. Bat species detected at Plum Island by season.

Common name	Scientific name	Hibernating	Spring	Summer	Fall
Little brown bat	*Myotis lucifugus*	X			
Big brown bat	*Eptesicus fuscus*	X	X	X	X
Hoary bat	*Lasiurus cinereus*		X		X
Eastern red bat	*Lasiurus borealis*			X	X

Other small mammals

We conducted small mammal trapping in August and September with two goals: to inventory other small mammals of the island to determine which species are present, and to target White-footed Mice (*Peromycus leucopus*) to collect hair samples for sub-species level analysis. Meadow voles (*Microtus pennsylvanicus*) and White-footed Mice were previously documented on Plum Island. Since unique subspecies of *Peromyscus leucopus* are known to inhabit Martha's Vineyard (*P.l. fusus*) and Monomoy Island (*P.l. ammodytes*) (Bangs 1905), we wanted to see if Plum Island may harbor a unique subspecies as well. We contacted Dr. George Argyros, a professor at Emory and Henry College in Virginia, about performing DNA analysis on hair samples collected from any Plum Island mice we were able to capture.

We used 29 H.B. Sherman folding live traps baited with a mixture of peanut butter and oatmeal placed in 5 areas around the island for two nights each in August and September. We surveyed five sites in August, noted in lavender and dark purple dots in Figure 19. The five sites surveyed in September are noted in this figure as purple and dark purple dots. Habitats surveyed included a shrubby/grassy dirt roadside, roadside with dense greenbrier (*Smilax rotundifolia*), an open grassy meadow, a wooded area, and maritime dunes. Five traps were placed at each site 10 m apart during trap nights, with the exception of the meadow, which had 9 traps set since this was the only habitat where we expected Meadow Voles. During surveys, traps remained open from about 4pm until 9am the following morning. Dry nights remaining at 55° F or higher were targeted for trapping.

When a mammal was captured in a trap, we transferred it to a clear zip-lock bag (ensuring access to air for breathing) or held it in a gloved hand. We took measurements of the ear length, body length from head to tail, tail length, and hind foot length. These measurements and other body characters were used for species level identification. We then removed a hair sample from the back of the neck with tweezers and placed the sample in a vial with ethanol. To ensure we did not remove more than one hair sample per individual, we marked each individual on the stomach with a permanent marker. When possible, total handling time did not exceed three minutes before the animal was released.

In August, we captured two White-footed Mice on separate trap nights at Pine Point in maritime dune habitat. We captured a Meadow Vole in the meadow by the DO shack. In September, we captured a White-footed Mouse at Pine Point and we found a dead Meadow Vole on the east end of the island, away from trapping areas, at Battery Dimmick. We collected hair samples from all individuals and sent them for subspecies analysis, which is still pending at the time of this report. Our trapping effort did not reveal species previously unknown to Plum Island.

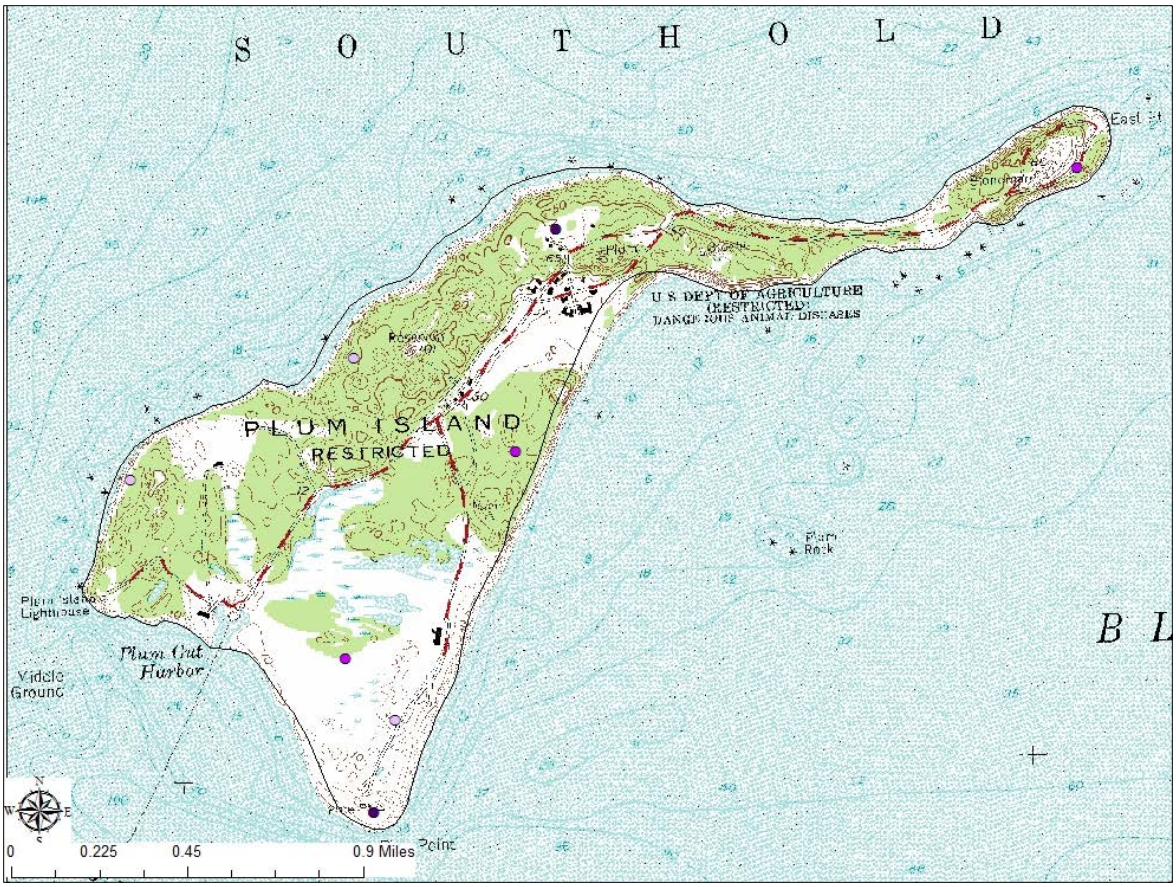


Figure 19. Map of Plum Island showing main sites of small mammal trapping effort. Sites surveyed in August are lavender, sites surveyed in September are purple, and sites surveyed both months are dark purple.

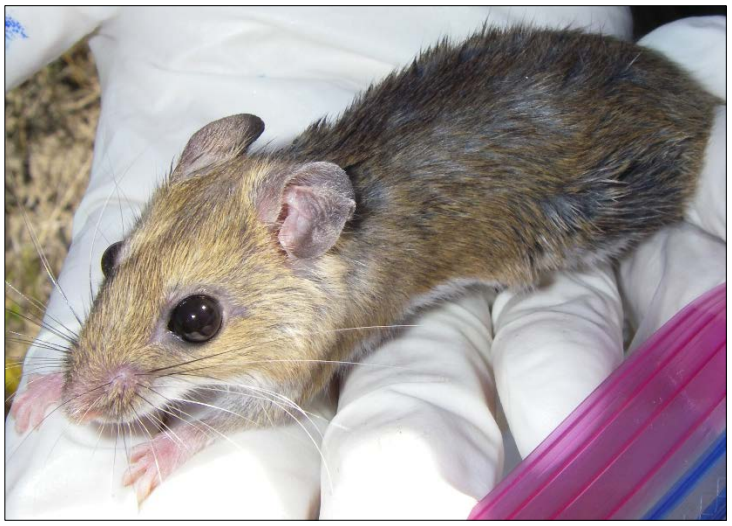


Figure 20. White-footed mouse (*Peromyscus leucopus*) captured in a small mammal trap on Plum Island.

Seals

The southeast shore of Plum Island remains one of the largest seal haul-out sites in New York State. Audubon New York has counted seals during their bird surveys regularly since 2010. The large majority of seals on Plum Island are harbor seals (*Phoca vitulina*), although gray seals (*Halichoerus grypus*) are also regularly observed in small numbers. Audubon did not attempt to divide their counts by species; unless the observer has a good view of the animal's head it is hard to tell harbor seals from gray seals. These counts should be considered minimum numbers as these surveys were not necessarily timed with low tide, when the greatest use of the haul-out site would be expected.

Table 3. Seals counted at the Plum Island haul-out site by Audubon New York during their bird surveys.

Years	Maximum number of seals observed at time of count
2010-2011	130
2011-2012	141
2012-2013	177
2013-2014	89
2014-2015	189
2015-2016*	177

* Surveys through January 2016 only.

After a dramatic increase in seal use of Long Island's waters starting a decade or so ago (Bass *et al.* 2015), the numbers at Plum Island's haul-out appear to have stabilized. Interestingly, while Plum Island's haul-out hosts harbor seals primarily, nearby Great Gull Island has mostly gray seals (Matthew Male, Great Gull Island Project, personal communication).

Birds

We compiled data from Audubon New York's regular surveys of the island to create a bird checklist by season. We did not conduct our own field surveys for birds given the extensive coverage of the island by Audubon since 2006, with regular standardized walking routes and island-wide coverage beginning in 2011. From 2006 to 2010, Audubon surveyed the island 20 times. From 2011 to 2016, Audubon surveyed 16-20 times per year. Nocturnal surveys had not been conducted previously, so Audubon's surveyor accompanied us on the nights of June 22 and October 7, 2015. We stopped at several locations along our bat route and Audubon played calls of owls, nightjars, and marsh birds. We did not detect any nocturnal bird species on those visits, although we recorded a Great Horned Owl (*Bubo virginianus*) just prior to the start of the June survey.

We wished to assign abundance codes to each species by season, focused primarily on the period from 2011 to 2015, when Audubon's surveys became more standard and regular. We used data from 2006-2010, and from 2016, in certain cases. Our "seasons" represent key life-history periods: spring migration (April-May), breeding (June-August), fall migration (September-October), and nonbreeding (November-March). Occurrence and abundance codes were adapted from the American Birding Association system (http://listing.aba.org/checklist-codes/). If a species was recorded in only 1 year from 2011-2015, only in the pre-2011 surveys, or in 2016 only, we called it "Accidental." If it was recorded in 2 or 3 years between 2011 and 2015, it was considered "Casual." If a species was recorded in 4 or 5 of the last 5 years, it was considered to be "Regular" and then was categorized by its abundance.

The primary measurement of abundance was Audubon's "day total," the number of individual birds seen over the course of a survey day. We calculated the average day total per species per year so that rare large flocks did not determine the abundance code. "Uncommon/Rare" birds were Regular species whose average day total was fewer than 3 birds. "Common" species were ones whose average day total was 3-25 birds and species with higher counts than that were called "Abundant." We based these cutoffs on the distribution of day totals by season across species, to try to balance out the number of species in each category. Codes and criteria are summarized in Table 4.

Table 4. Occurrence and abundance codes for birds of Plum Island, based on surveys by Audubon New York. Codes are adapted from American Birding Association system (http://listing.aba.org/checklist-codes/). Codes in bold are final categories used in the species list (Appendix C).

Occurrence code	Abundance code	Criteria
Regular	**Abundant**	Recorded in 4 or 5 years from 2011 to 2015; 26 or more individuals seen on an average day
	Common	Recorded in 4 or 5 years from 2011 to 2015; 3 to 25 individuals seen on an average day
	Uncommon/Rare	Recorded in 4 or 5 years from 2011 to 2015; 1 or 2 individuals seen on an average day
Casual	-	Recorded in 2 or 3 years from 2011-2015
Accidental	-	Recorded in 1 year from 2011-2015, or only in other survey years

From 2006-2016, 220 bird species were detected on Plum Island. The highest species counts were in April-May and September-October (Table 5), representing peak migration months. A total of 61 Species of Greatest Conservation Need (SGCN; NYS DEC 2015) have been documented on the island, with 17 of these being considered High-priority SGCN. In addition, three Species of Potential Conservation Need were documented.

Audubon has noted 49 species as Confirmed breeders, four more as Confirmed but likely nesting off the island, and an additional 13 as Probable breeders. Of the Confirmed and Probable Plum Island breeders, 10 are SGCN.

Table 5. Number of species detected on Plum Island by Audubon New York from 2006-2016, in five occurrence/abundance categories by season.

Code	Apr-May	Jun-Aug	Sept-Oct	Nov-Mar
Abundant	21	13	12	15
Common	54	37	46	44
Uncommon/Rare	48	48	49	34
Casual	25	19	20	24
Accidental	9	9	19	12
Total	157	126	146	129

At-risk species

We obtained detailed observation data from Audubon New York for species tracked by NYNHP: Common Eider (*Somateria mollissima*), Northern Harrier (*Circus cyaneus*), Glossy Ibis (*Plegadis falcinellus*), Least Tern (*Sternula antillarum*), Common Tern (*Sterna hirundo*), and Roseate Tern (*Sterna dougallii*; Figure 21). Common Tern observations were so frequent and dispersed around the island that we did not map them. Roseate Terns were also found all along the shoreline but the numbers were highest in the mapped area (Figure 21). Historically, the Northern Harrier had bred in the meadow near the DO Shack (north-central part of the island) but breeding now seems to take place in the dunes south of the large wetland (Figure 21). Breeding locations for the eider and harrier will be mapped in the NY Natural Heritage database as element occurrences. Along with the known Piping Plover occurrence on the beach south of Lab 257, these represent the locations of the most at-risk birds that use Plum Island.

Figure 21. Observations of at-risk birds on Plum Island by Audubon New York. The Roseate Tern polygon represents the area with the highest concentration; the species was seen frequently at other points around the island.

Reptiles and amphibians

Because of the potential for several rare species (Schlesinger *et al.* 2012), we aimed to document the herpetofauna of the island as fully as possible. We used the following methods to survey for reptiles and amphibians: nocturnal calling surveys and deployment of recording devices for frogs in March, April, and May; hoop traps for turtles in June and July; minnow traps for salamanders in June; and visual surveys for all species, including flipping potential cover objects, from April through October. On June 24 and 25 we had teams of expert herpetologists join us.

On our March visit, we deployed two Wildlife Acoustics SongMeters, recording devices intended to capture animal vocalizations that can be programmed to record at certain times and for specific lengths of time. We placed one at the large wetland and one at the former wastewater basin. From March 19 to April 1, the devices were set to record at 8000 mHz in stereo for 5 out of every 15 minutes throughout the day. From April 15 to May 26, the devices were set to record for 5 out of every 30 minutes starting at 4:30pm and ending at 5:35am. We ended up with 4,737 sound files.

Figure 22. Locations of recording devices for amphibians on Plum Island.

We reviewed call files using Wildlife Acoustics Song Scope software, which enabled us to screen call files visually for sound, which is much faster than reviewing them aurally. When sounds were detected on the spectrogram, we listened to that section of the recording to identify the sound. We did not detect animal noises of any kind in the recordings from March and from May 21-26, approximately one-third of the sound files. We did not have time to listen to all the recordings.

We conducted nocturnal calling surveys for frogs in conjunction with bat surveys in April and May. On April 14, we conducted 3-5-minute calling surveys at four wetland locations, including a repeat 5-minute visit to the former wastewater basin on April 15. We did not hear any frogs during these surveys, nor at any of our other diurnal and nocturnal surveys around the island the rest of the year.

Our visual and minnow-trap surveys in the island's wetlands did not yield any detections of amphibians. We set several minnow traps in the large wetland, the inland freshwater wetland, and in one of the channels at the south end of the wetland complex. The traps were baited with sardines and we included glow sticks, which are known attractants for salamanders. We caught only fish (and a rare dragonfly [below]) with these traps.

The lack of amphibians in the large wetland may be attributed to the wetland's chemistry (see Fish, below), particularly its high conductivity, suggesting saltwater infusions from storms.

We conducted visual surveys throughout the island for reptiles and amphibians, particularly on June 24 and 25 when five expert herpetologists from Long Island joined us. We waded in the wetlands, flipped cover objects in the forests and grasslands, and checked crevices in structures. These surveys confirmed some known species from the island but did not add additional species.

We detected three reptiles during our surveys around the island: box turtle (*Terrapene carolina*; Figure 23) and road-killed garter snake (*Thamnophis sirtalis*) and brown snake (*Storeria dekayi*; Figure 23). Road-killed brown snakes were found twice during the field season, and in October the island's fire chief told us he encountered live ones sometimes near the fire station. With the confirmation of brown snakes on the island, the list of known reptiles now includes five species (Appendix D).


Figure 23. Brown snake (*Storeria dekayi*) and eastern box turtle (*Terrapene carolina*) from Plum Island.

We deployed hoop traps (Figure 24) for aquatic turtles in the large wetland from June 22-24 and July 21-23, the small channel wetland at the south end of the large wetland June 24-25, and in the small freshwater wetland June 24-25 and July 21-23. Traps were left open overnight and baited with partially open cans of sardines. We captured two turtle species: painted turtle (*Chrysemys picta*; Figure 25) and snapping turtle (*Chelydra serpentina*; Figure 26). Both of these species are common throughout New York and the Northeast US. No rare turtles were captured.

Figure 24. Erin White checking a hoop trap for turtles.


Figure 25. Kelly Perkins holding painted turtles (*Chrysemys picta*) at the large wetland; close-up of painted turtles.

Figure 26. Snapping turtles (*Chelydra serpentina*) caught in the large wetland. Note 4-inch sardine can for scale.

Fish

On June 22 and 23, 2015, NYS DEC fisheries staff from Long Island conducted surveys of the large wetland and the wetland channels south of the main wetland using fyke nets, a 50-foot seine, and minnow traps. They caught only four species (Appendix D), with mummichog (Figure 27) being the most abundant. Two of the species, goldfish and mosquitofish, were not native, but the other two are SGCN. All four species are salt tolerant, suggesting regular infusions of salt water into the wetland. NYSDEC's water chemistry measurements in the large wetland yielded conductivity values of 117 and 254 µmho/cm^3, which is between pure freshwater and brackish water (Table 3 of http://www.vl-pc.com/index.cfm/technical-info/conductivity-guide/).

Figure 27. Mummichog (*Fundulus heteroclitus*) in a minnow trap from the large wetland on Plum Island.

Invertebrates

Dragonflies and damselflies

We performed dragonfly and damselfly (odonate) surveys on island visits during the months of June, July, and August. We conducted targeted surveys of potential adult breeding habitats on the island, which would presumably be any freshwater or brackish water habitats. We did visual searches at wetlands June-August, identifying odonates to species level when possible through the use of binoculars. When it was necessary to confirm observations, we used an aerial insect net to capture

individuals before photographing and releasing them. In a few cases, we retained a voucher specimen for later confirmation using a microscope. In addition to these targeted surveys, odonate species were noted when observed in habitats away from breeding grounds while they were foraging. Overall, we documented sixteen odonate species during our 2015 inventory (

Table 6). We confirmed three rare species. Needham's Skimmer (*Libellula needhami*, G5, S3) and Rambur's Forktail (*Ischnura ramburii*, G5, S2S3) were breeding at the large wetland near the harbor with the bird observation tower. We collected a Golden-Winged Skimmer (*Libellula auripennis*, G5, S1S2) dragonfly larva in June in a minnow trap set in the small inland freshwater wetland off the road to Lab 257, to the northeast of the large wetland. This larva was identified by odonate expert Ken Tennessen.

Table 6. Dragonfly and damselfly observations during breeding season of 2015. Rare species are noted with an asterisk. "Big Wetland" refers to the large wetland near the harbor with the bird observation tower.

Scientific name	Common name	Locations observed	Jun	Jul	Aug	Sep
Anax junius	Common Green Darner	East end field, pond near water treatment area, seal haul-out, Parade Grounds		X	X	X
Enallagma civile	Familiar Bluet	Big Wetland, east end field		X		
Erythemis simplicicollis	Eastern Pondhawk	Big Wetland	X	X		
Ischnura posita	Fragile Forktail	Big Wetland	X	X		
Ischnura ramburii	Rambur's Forktail*	Big Wetland	X	X	X	
Ischnura verticalis	Eastern Forktail	Big Wetland		X		
Libellula auripennis	Golden-winged Skimmer*	Inland freshwater wetland	X†			
Libellula needhami	Needham's Skimmer*	Big Wetland		X	X	
Libellula pulchella	Twelve-spotted Skimmer	Big Wetland, pond near water treatment area	X			X
Pachydiplax longipennis	Blue Dasher	Big Wetland, pond near water treatment area	X	X		
Pantala flavescens	Wandering Glider	Pine Point	X			
Pantala hymenaea	Spot-winged Glider	East end field		X		
Perithemis tenera	Eastern Amberwing	Big Wetland	X	X	X	
Plathemis lydia	Common Whitetail	Big Wetland, pond near water treatment area	X			
Sympetrum sp.	A Meadowhawk	Big Wetland				X
Tramea carolina	Carolina Saddlebags	Big Wetland, pond near water treatment area	X			
Tramea lacerata	Black Saddlebags	Parade Grounds, Big Wetland, east end field, pond near water treatment area	X	X		

* Rare species; † Larva

Rambur's Forktail is known from northern South America northward along the U.S. Atlantic coast (Abbott 2007). In New York, there are occurrences in Staten Island, New York City, and Long Island all the way out to Greenport, NY. Needham's Skimmer (*Libellula needhami*) is known from brackish sites in southern NY and Long Island. The large wetland where they were observed breeding is presumed to have some salt content and these species are known to be tolerant and even thrive in brackish habitats. We observed individuals of both species near the bird observation tower, as this area was accessible to us. Future inventory should include searching the entire wetland to determine the full extent of the breeding population. Golden-Winged Skimmer (*Libellula auripennis*) is known from southern NY and Long Island freshwater ponds. As a late instar nymph was collected from the small inland freshwater pond to the northeast of the big wetland, this can be treated as a confirmed breeding record. Future inventory should include searching this small wetland in July and August for adults, as well as nearby foraging areas. Captures and close observation of adult *L. needhami* and *L. auripennis* are recommended, as the two species are so similar in appearance. Another rare species known from Greenport, NY sites, Four-spotted Pennant (*Brachymesia gravida*), was not documented in 2015. Future colonization of this species on Plum Island is possible.

The two glider species (*Pantala* sp.), the two saddlebag species (*Tramea* sp.), and Common Green Darners are species known for their strong flight and migratory capabilities and were often observed foraging on the island away from aquatic breeding habitats. These individuals may therefore not be breeding on the island. The other odonate species observed are fairly ubiquitious throughout the state, common in lentic habitats and are likely breeding in the big wetland.

Figure 28. Rambur's forktail (*Ischnura ramburii*), left, and Needham's skimmer (*Libellula needhami*), which is faded after processing with acetone to preserve the specimen.

Figure 29. Large wetland on Plum Island, habitat for rare dragonflies and damselflies.

Beetles

We conducted two targeted survey efforts for beetles and incidentally collected and photographed beetles encountered during other surveys. A full inventory of the beetles of Plum Island was beyond the scope of our project but we aimed to identify as many species as we could.

On May 26 we surveyed the beach of the south shore of the island, from just east of Fort Terry to the harbor, for tiger beetles. This stretch of beach was known from a 2009 survey to support a large population of the hairy-necked tiger beetle (*Cicindela hirticollis*, G5, S1S2), an SGCN that has declined all over Long Island. We wished to update the data in our database on this population. Three of us walked the beach—at the water, in the center, and along the vegetated edge—and counted individuals of the two species present, *C. hirticollis* and *C. repanda* (which is by far the more common species elsewhere; Figure 30). We detected 800-900 *C. hirticollis* and about 170 *C. repanda*. The large population of *C. hirticollis* on this beach can be attributed to the lack of beach driving, natural sand and dune accretion, and minimal beach recreation. Beach driving and heavy recreation have apparently caused the species to become extirpated from many of Long Island's beaches (Schlesinger and Novak 2011, Mawdsley *et al.* 2013).

Figure 30. The common bronzed tiger beetle (*Cicindela repanda*), left, and the rare hairy-necked tiger beetle (*C. hirticollis*).

We surveyed intensively for the American burying beetle (*Nicrophorus americanus*), a federally listed member of the carrion beetle family (Silphidae) whose only remaining population in the eastern U.S. is on nearby Block Island. We followed the survey protocol in the federal recovery plan for the species (Raithel 1991) with some modifications. We installed pitfall trap transects in three locations on the island: at the East End, in the parade grounds near Fort Terry, and near Pine Point. Each trap consisted of a one-quart, wide-mouth mason jar in a hole with the top flush with the ground. We placed about 1 Tbsp of sardines in a small plastic container with a cheesecloth cover secured by a rubber band at the bottom of each jar. To deter predators, we used landscape cloth pins to secure a square of ½" hardware cloth on top of the jar. We used Styrofoam plates secured with landscape cloth pins and weighted with rocks as rain guards.

We installed 16 traps near Fort Terry and 12 traps at the East End on June 22, and eight traps at Pine Point on June 23. We retrieved all remaining traps on June 25. Raccoons dug up several traps at the East End and Fort Terry and significant rainfall flooded some traps. All told, we had 60-70 functioning trap-nights.

Figure 31 (clockwise from top left). Matt Schlesinger digging a hole for a pitfall trap; installing a predator guard; *Nicrophorus tomentosus*; *Necrophila americana* (yellow front) and *Nicrophorus orbicollis* (red blotches).

We caught several species of carrion beetle (Appendix D), but not the American burying beetle. The most common species we caught was *Nicrophorus orbicollis* (Figure 31). Moth traps were

also effective at catching beetles, particularly carrion beetles. See Appendix D for the full list of beetles identified from all our sampling methods.

While we did not expect to find American burying beetles, to our knowledge no surveys for the species had been conducted previously on Plum Island, which has apparently suitable habitat and is close to the remaining population on Block Island. Between the pitfall traps and season-long moth traps, we stood a good chance of detecting the species if it had been present. Since there are no historical records for the species on Plum Island, we cannot be certain it once occupied the island, although it was known from nearby Long Island and likely had a substantial prey base in the large waterbird colonies that used to occur on Plum Island. Perhaps if raccoons were eradicated from the island, large breeding bird colonies could be re-established (or return naturally) and American burying beetle could be introduced. The island appears to host a strong population of other carrion beetles, which is considered an indicator of the reintroduction potential for American burying beetle (C. Greenwood, SUNY Cobleskill, personal communication). Should restoration of this unqiue and rare decomposer be pursued, Plum Island may be a good candidate site.

Moths

Six trapping sites were selected for systematic sampling based on a preliminary visit to the island in March 2015 (Figure 32). Site selection was predicated on two criteria: (1) specific habitats likely to support rare or threatened species (selected based on knowledge of the life history requirements of rare moth communities in the northeastern United States), and (2) representative habitat that was not seriously affected by invasive plant species. We also attempted to give consideration to locations sheltered from the wind, where possible (strong winds may influence an insect's flight capabilities, and in extreme cases, damage or knock over the traps used for collection). The selected sites included two locations in early successional sandplain grasslands (Sites 1 and 2), one location in a successional hardwood forest (Site 3), and three locations within a mixture of stabilized maritime dune, heathland and wetland habitats (Sites 4, 5, and 6). On one occasion, Site 2 was relocated to an open meadow near the intersection of the road to the water tower and the main road because of deer management activities.

Sampling was conducted at roughly 14-day intervals from May 12 to October 21, 2015. If rain was forecast on any given target sampling night, the visit was rescheduled as close as possible to the original day. Each sample was conducted on a single night, using one 15W black light bucket trap, run with a photo sensor and a 12V deep cycle battery, at each site. Each trap had several dichlorvos pest strips to kill captured insects. The complete catch from each trap was collected the next morning and frozen for storage and subsequent identification.

Sample collection was conducted by Neil Schoppmann or by NYNHP staff (Matt Schlesinger, Erin White, and Kelly Perkins) with assistance from Plum Island staff (Gary Mandelburg, Kurt Klotzer, Meghan Jackson, and Katie Guarrasi). Moth identifications were conducted by Neil Schoppmann with rare or difficult species confirmed by Hugh McGuinness during a visit to the National Museum of Natural History in Washington, D.C. For the purpose of this study, only the Macrolepidoptera (a collective of taxonomic families that tend to be relatively large, easy to identify and have well documented life histories) were recorded. The bycatch of each trap (all insect specimens other than the Lepidoptera) was refrozen and returned to the NYNHP for further sorting.

Figure 32. 2015 nocturnal collection sites for Plum Island Lepidoptera.

Over the course of the 2015 sampling season, a total of 4,460 moths were collected from 63 sampling events. From these, we identified 3,814 specimens of 256 species (Appendix D). Eleven of the species collected are actively tracked by the NYNHP because they are rare and/or declining in New York State. While 11 rare species of moths is a substantial number, the island has potential for many more species with vegetation management (Schlesinger *et al.* 2012).

Table 7. Rare moth species captured on Plum Island in 2015 that are actively tracked by NYNHP. Ranks are defined in Appendix A.

Family	Scientific name	G-rank	S-rank
Erebidae	*Cisthene packardii*	G5	SU
Erebidae	*Virbia aurantiaca*	G5	SU
Noctuidae	*Abagrotis nefascia*	G4T3	S1S3
Noctuidae	*Apamea inordinata*	GU	S1
Noctuidae	*Apamea lintneri*	G4	SU
Noctuidae	*Eucoptocnemis fimbriaris*	G4	S1
Noctuidae	*Lepipolys perscripta*	G4	S1
Noctuidae	*Papaipema duovata*	G4	SH
Noctuidae	*Schinia spinosae*	G4	SU
Noctuidae	*Sympistis riparia*	G4	SU
Sphingidae	*Sphinx gordius*	G4	S1S3

The most significant find of the 2015 moth survey was *Papaipema duovata* Bird, which feeds on seaside goldenrod (*Solidago sempervirens* L.) and is typically found on the borders of salt marshes or other coastal wetlands. Prior to this find, *P. duovata* was thought to be extirpated from the state. As a caterpillar, *P. duovata* bores into the stem of its host plant, and feeds internally until pupation. It flies as an adult from September until late November (NatureServe 2016). Its cryptic behavior, in

combination with the widespread distribution of its hostplant, suggest that its sparse collection record may be partially a product of undersampling. Further collection efforts (in this case, preferably non-destructive light-trapping) would be ideal to confirm the presence of a stable population on the island.

Figure 33 (clockwise from top left). Moth trap, a salt marsh moth (*Estigmene acrea*) that hitchhiked to the island with us on the ferry, black-waved flannel moth (*Lagoa crispata*), and io moth (*Automeris io*).

Five of the rare species recorded (*Abagrotis nefascia* Smith, *Apamea inordinata* Morrison, *Sphinx gordius* Cramer, *Eucoptocnemis fimbriaris* Guenée and *Lepipolys perscripta* Guenée) have a New York State ranking of S1, meaning they are critically imperiled (NatureServe 2016). Each of these species are specialists of plants that occur in xeric habitats, including maritime dunes, grasslands, heathlands, and pine barrens. The habitat availability for xeric community specialists has declined significantly in the last century through fire suppression and anthropogenic development (Noss *et al.* 2001). Thus, all five of the above species are valuable conservation targets for future management efforts.

The remaining five tracked species (*Virbia aurantiaca* Hübner, *Cisthene packardii* Grote, *Sympistis riparia* Morrison, *Apamea lintneri* Grote and *Schinia spinosae* Guenée) are listed as SU, meaning that they cannot be properly ranked because of a lack of information concerning their distribution, population trends, or biology (NatureServe 2016). Of these five, *V. aurantiaca* and *C. packardii* are commonly recorded in the mid-Atlantic and southern states, and are known to feed on forbs and lichens, respectively. Their perceived rarity may be due, in part, to New York's location near the northern extent of their range. *Schinia spinosae*'s host plant and life history requirements are unknown. Although rarely collected in New York State, it is present in coastal areas from Massachusetts to Florida. *Apamea lintneri* and *S. riparia* are both likely to be specialists of coastal xeric habitats based on the available knowledge of their plant hosts (*A. lintneri* feeds on American

beachgrass, *Ammophila breviligulata* Fern., while *S. riparia* is suspected to feed on Beach Plum, *Prunus maritima* Marshall) (David Wagner, personal communication; Mikkola *et al.* 2009). As such, they likely face pressure from habitat loss similar to the S1 species recorded, and would benefit from the same management practices.

Other invertebrates

In addition to our targeted surveys for odonates, certain beetles, and moths, we opportunistically caught and observed other insects. We looked for all opportunities to catch and identify butterflies (Figure 34) and bumble bees in particular, but found low diversity and abundance of these taxa. Additional invertebrates we have identified are listed in Appendix D.

Figure 34. Monarch (*Danaus plexippus*) on Plum Island.

Plants

Plant surveys took place on June 3 and 4, August 12, 13 and 14, September 9 and October 6 and 7. Past field work by Dick Stalter and Eric Lamont for the *Flora of Plum Island* (Lamont and Stalter 2013) had documented twenty-two state endangered, threatened, and rare species. Seventeen of the species were found during their survey and five species were historical specimens that they did not relocate. Surveys in 2015 took place for all of the rare species by searching likely habitat on foot at the appropriate time of year. See Table 9 for a list of species with their habitats and best time to survey. All areas of the island were searched except for some of the pond areas in the southeast and some of the northwest and west boulder beaches that were too inaccessible. Naturalist MaryLaura Lamont joined NYNHP botanist Steve Young in the field on four of the eight field days and botanist Eric Lamont joined the survey on one day (Figure 35). The extra pairs of eyes and the surveyors' knowledge of the flora of the island helped discover new plant locations.

Figure 35. Eric Lamont (left) helped survey for spring ladies-tresses (*Spiranthes vernalis*; right).

Invasive species were also noted during the survey. The original survey by Stalter and Lamont listed twenty invasive plants for the island. This survey confirmed their existence and noted general abundance but no detailed mapping took place except for newly discovered species.

All plant species encountered were noted on the plant list provided by the Flora of Plum Island. New species were added and photos taken when they were discovered.

Seven of the seventeen rare species found by Lamont and Stalter were relocated and one new rare species, saltmarsh aster (*Symphyotrichum subulatum)*, was found (Table 8, Table 9, Figure 36). One of the historical rare species, saltmarsh spikerush (*Eleocharis uniglumis)*, was relocated. It was last seen on the island in 1932. Only two rare species, spring ladies-tresses and whorled milkweed, had a large number of plants over a large area which is similar to the findings of the *Flora of Plum Island* survey.

Table 8. Rare plants known currently and historically from Plum Island.

Scientific name	Common name	2015 occurrence rank	Size
Asclepias verticillata	Whorled Milkweed	Good	50 plants
Carex hormathodes	Marsh Straw Sedge	Failed to Find	Rare
Carex merritt-fernaldii	Fernald's Sedge	Failed to Find	Rare
Chamaecyparis thyoides	Atlantic White Cedar	Failed to Find	Extirpated
Crocanthemum dumosum	Bushy Rockrose	Failed to Find	Unknown
Cyperus erythrorhizos	Red-rooted Flatsedge	Poor	A few plants
Cyperus lupulinus ssp. *lupulinus*	Great Plains Flatsedge	Failed to Find	Rare
Cyperus polystachyos	Coast Flatsedge	Poor	A few plants
Cyperus retrorsus	Retrorse Flatsedge	Failed to Find	Rare
Dichanthelium scoparium	Velvet Panic Grass	Failed to Find	Rare
Eleocharis fallax	Creeping Spikerush	Failed to Find	Unknown
Eleocharis uniglumis	Saltmarsh Spikerush	Fair	100s of stems
Erechtites hieraciifolius var. *megalocarpus*	Large Fruited Fireweed	Failed to Find	Rare
Liatris borealis ssp. *novae-angliae*	Northern Blazing Star	Failed to Find	Unknown
Ligusticum scothicum	Scotch Lovage	Failed to Find	Unknown
Myriophyllum pinnatum	Green parrot's-feather	Failed to Find	Rare
Oenothera oakesiana	Oakes Evening Primrose	Poor	3 plants

Scientific name	Common name	2015 occurrence rank	Size
Polygala cruciata	Crossleaf Milkwort	Failed to Find	Rare
Polygonum glaucum	Seabeach Knotweed	Fair	39 plants
Ptilimnium capillaceum	Mock Bishop-weed	Failed to Find	Rare
Silene caroliniana ssp. *pensylvanica*	Wild Pink	Fair	42 plants
Spiranthes vernalis	Spring Ladies-tresses	Good	141 plants
Symphyotrichum subulatum	Saltmarsh Aster	Poor	A few plants

Table 9. More characteristics of Plum Island's rare plants.

Scientific name	State rank[1]	Last observed year & habitat	Best time to survey
Asclepias verticillata	R	2015; mowed fields	July & August
Carex hormathodes	T	2002; a wetland	June & July
Carex merritt-fernaldii	T	2003; dry sands	June & July
Chamaecyparis thyoides	T	Before 1915: wetland edge	All year
Crocanthemum dumosum	E	1914; dry thicket	May to October
Cyperus erythrorhizos	R	2002; marshes, pond shores	August to October
Cyperus lupulinus ssp. *lupulinus*	T	2002; dry sands	August to October
Cyperus polystachyos	E	2015; backdune ditch	August to October
Cyperus retrorsus	E	2003; dune/swale area	August to October
Dichanthelium scoparium	E	2007; wet sands bordering marsh	July to November
Eleocharis fallax	E	1984; dried out pond bottom	August to October
Eleocharis uniglumis	T	2015; pondshore	August to October
Erechtites hieraciifolius var. *megalocarpus*	E	2002; upper beach and strand	September & October
Liatris scariosa var. *novae-angliae*	T	1932; sandy field	August to November
Ligusticum scothicum	E	1896; north shore	May to October
Myriophyllum pinnatum	E	2003; ponds	July to October
Oenothera oakesiana	T	2015; beach and backdune	August to November
Polygala cruciata	R	2003; marshes	August to October
Polygonum glaucum	R	2015; sand beach	August to November
Ptilimnium capillaceum	R	2003; marshes	August to October
Silene caroliniana ssp. *pensylvanica*	T	2015; sandy roadside	June to September
Spiranthes vernalis	E	2015; mowed fields and roadsides	August
Symphyotrichum subulatum	T	2015; backdune ditch	August to November

[1] E = Endangered; T = Threatened, R = Rare.

Figure 36. Some rare plants of Plum Island (clockwise from top left): red-rooted flatsedge (*Cyperus erythrorhizos*), saltmarsh aster (*Symphyotrichum subulatum*), wild pink (*Silene caroliniana* ssp. *pensylvanica*), and seabeach knotweed (*Polygonum glaucum*).

Table 10 lists the survey results for the invasive species found including their rank and general abundance. Four new invasive species were found during the survey: pale swallow-wort (*Cynanchum rosicum)*, wineberry (*Rubus phoenocolasius*), porcelain berry (*Ampelopsis glandulosa* var. *brevipedunculata*), and memorial rose (*Rosa lucieae*). Asian bittersweet (*Celastrus orbiculatus*) was observed to be the most widespread invasive species where it covered large areas of shrubs and trees as well as the old bunkers. In the open fields and roadsides, spotted knapweed (*Centaurea stoebe* ssp. *micranthos)*,

autumn olive (*Elaeagnus umbellata)*, multiflora rose (*Rosa multiflora)*, and Japanese honeysuckle (*Lonicera japonica*) seemed to be the most widespread species. In the wetlands, Phragmites (*Phragmites australis*) was by far the most common, filling in many of the open pond areas. Purple loosestrife (*Lythrum salicaria*) is also spreading into more wetlands. At the top of dunes, rugosa rose (*Rosa rugosa*) and tree-of-heaven (*Ailanthus altissima*) were common. The stands of rugosa rose are some of the largest and densest seen on the coastal plain. These high-abundance species will take much time, effort, and money to control if they are deemed to be priorities in the future. There are five species that are ranked very high in the state but are low in abundance on the island and should be a priority to control: porcelain berry, garlic mustard (*Alliaria petiolata*), pale swallow-wort, Morrow's honeysuckle (*Lonicera morrowii*), and wineberry. Memorial rose is a new invasive for the state and not yet ranked. It was observed at only one location so it should also be a control priority.

Table 10. Invasive plants detected on Plum Island.

Scientific name	Common name	Invasive rank*	Plum Is. abundance
Acer platanoides	Norway Maple	VH	Medium
Acer pseudoplatanus	Sycamore Maple	H	Low
Ailanthus altissima	Tree-of-heaven	M	High
Albizzia julibrissin	Silk Tree	L	Low
Alliaria petiolata	Garlic Mustard	VH	Low
Ampelopsis glandulosa var. *brevipedunculata*	Porcelain Berry	VH	Low
Artemisia vulgaris var. *vulgaris*	Mugwort	H	Low
Berberis thunbergii	Japanese Barberry	VH	Medium
Celastrus orbiculatus	Asian Bittersweet	VH	High
Centaurea stoebe ssp. *micranthos*	Spotted Knapweed	H	High
Cirsium arvense	Canada Thistle	H	Low
Cirsium horridulum var. *horridulum*	Yellow Thistle	U	Low
Cirsium vulgare	Bull Thistle	U	Low
Cynanchum rossicum	Pale Swallow-Wort	VH	Low
Elaeagnus umbellata	Autumn Olive	VH	High
Lonicera japonica	Japanese Honeysuckle	VH	High
Lonicera morrowii	Morrow's Honeysuckle	VH	Low
Lythrum salicaria	Purple Loosestrife	VH	Medium
Phragmites australis	Old World Common Reed	VH	High
Pinus thunbergiana	Japanese Black Pine	M	Low
Robinia hispida var. *hispida*	Bristly Locust	L	Low
Robinia pseudoacacia	Black Locust	VH	High
Rosa lucieae	Memorial Rose	NR	Low
Rosa multiflora	Multiflora Rose	VH	High
Rosa rugosa	Rugosa Rose	M	High
Rubus phoenocolasius	Wineberry	VH	Low
Schoenoplectiella mucronata	Bog Bulrush	NR	Low
Tribulus terrestris	Puncture Vine	NR	Low

*L = Low; M = Moderate; H = High; VH = Very High; U = **Unranked; NR = Not Ranked.

Figure 37. Some invasive plants of Plum Island (clockwise from top left): Tree-of-heaven (*Ailanthus altissima*) and rugosa rose (*Rosa rugosa*) covering the dunes; Asian bittersweet (*Celastrus orbiculatus*); wineberry (*Rubus phoenocolasius*); Old World common reed (*Phragmites australis*) encroaching on a wetland with a rare plant.

Thirty-two new species were added to the Plum Island Flora list during these surveys (Table 11). Thirty new species were added to the list from the botanical survey. The prickly pear cactus was added by Greg Edinger during community surveys and *Ruppia maritima* was added by Chart Guthrie of the NYSDEC during fish surveys.

Table 11. Species detected in 2015 on Plum Island that were not listed in Lamont and Stalter (2013).

Scientific name	Common name	Plant family	Habitat
Acer platanoides	Norway Maple	Aceraceae	Roadside
Chamaecrista nictitans	Partridge Pea	Fabaceae	Shrub edges
Chenopodium pratericola	Desert Goosefoot	Chenopodiaceae	Beaches
Cynanchum rossicum	European Swallow-wort	Apocynaceae	Shrublands
Cyperus filicinus	Fern Flatsedge	Cyperaceae	Open sands
Dysphania botrys	Jerusalem Oak	Chenopodiaceae	Beaches
Eleocharis parvula	Dwarf Spike-rush	Cyperaceae	Brackish pond flats
Galium album	White Bedstraw	Rubiaceae	Fields and roadsides
Herniaria hirsuta ssp. *cinerea*	Green Carpet	Caryophyllaceae	Dunes and gravel
Impatiens capensis	Orange Jewelweed	Balsaminaceae	Marshes
Leonurus cardiaca	Motherwort	Lamiaceae	Roadsides
Lycopus uniflorus	Northern Bugleweed	Lamiaceae	Marshes
Myriophyllum humile	Low Water-milfoil	Haloragaceae	Artificial basin
Nipponanthemum nipponicum	Montauk Daisy	Asteraceae	Open sandy areas
Opuntia humifusa	Prickly-pear Cactus	Cactaceae	Beaches
Persicaria extremiorientalis	Far Eastern Smartweed	Polygonaceae	Disturbed areas
Populus tremuloides	Quaking Aspen	Salicaceae	Roadside
Potamogeton bicupulatus	Snail-seeded Pondweed	Potamogetonaceae	Ponds
Rosa lucieae	Memorial Rose	Rosaceae	Dunes
Rubus phoenocolasius	Wineberry	Rosaceae	Woodland edge
Ruppia maritima	Widgeon-grass	Ruppiaceae	Brackish ponds
Schoenoplectiella mucronata	Bog Bulrush	Cyperaceae	Artificial basin
Schoenoplectus americanus	Three-square Bulrush	Cyperaceae	Marshes
Scirpus cyperinus	Woolgrass	Cyperaceae	Artificial basin
Symphyotrichum ericoides	White Heath Aster	Asteraceae	Fields and roadsides
Symphyotrichum patens	Late Purple Aster	Asteraceae	Sandy roadsides
Symphyotrichum subulatum	Saltmarsh Aster	Asteraceae	Backdune ditch
Teucrium canadense	Canada Germander	Lamiaceae	Beach
Trifolium aureum	Golden clover	Fabaceae	Fields
Verbascum thapsus	Mullein	Scrophulariaceae	Roadsides
Vicia cracca	Cow Vetch	Fabaceae	Fields
Viola lanceolata × *primulifolia*	Hybrid Violet	Violaceae	Beach

Only seven of the seventeen known rare plant species, one of the historical species, and one new species were found during this survey. All of the rare plant species that were not found were listed as rare in the Flora of Plum Island so it is unfortunate but no surprise that they could not be found again. The species that were not found also occur in dynamic habitats like beaches, fields and wetlands that change from year to year. The last year of intensive surveys for the Lamont and Stalter flora was 2004, eleven years before the 2015 surveys and much has changed since then. Hurricane Sandy brought big changes to the salinity of the wetlands in the southeast after flattening the dunes in front of them. Invasive species, especially Asian bittersweet and Phragmites, have expanded greatly and taken over large areas of native vegetation. Natural succession has reduced the open

roadside vegetation in areas of reduced mowing where some of the rare plants occurred. On the other hand, too frequent mowing of the fields and some roadsides has also reduced some populations of rare plants. In the wetlands and ponds of the southeast corner of the island, natural succession has filled in open areas where rare plants were collected for the Lamont and Stalter flora. This was observed by Eric Lamont when he returned to the island in 2015 to assist with this survey. The creeping spikerush population, *Eleocharis fallax*, is still one of only two populations in the state but it was not found in 2015. It should be searched for a few more times and if not found should be considered extirpated.

For the plants that were found, five of them are listed in fair or poor condition with low numbers of plants but they were also listed as rare in the Flora of Plum Island. The two species that were ranked as good in this survey, whorled milkweed and spring ladies-tresses, were also the only ones seen in good numbers in the Flora of Plum Island. The ladies-tresses occurrence was the largest population in the state in 2005 and it remains so in 2015 although the numbers have gone from over 1000 to 141 plants.

One of the most interesting new plants that was found was green carpet, *Herniaria hirsuta* ssp. *cinerea*, a plant that is native to Eurasia and North Africa. It had not been seen in New York State since it was collected near a Yonkers wool mill in the Bronx in 1898, a span of 117 years. While it is common on the West Coast, it has only been collected in a handful of counties east of the Mississippi, including the Boston and Philadelphia areas, so how it got to New York is still a mystery. One plant was also found in the parking lot of the Plum Island ferry at Orient Point so it may be spreading to Long Island from Plum Island.

Figure 38. Green carpet (*Herniaria hirsuta* ssp. c*inerea*) from Plum Island.

Biodiversity summary

Full species lists for taxa surveyed in this project are in Appendix D. Here we summarize the number of species known from Plum Island for surveyed taxa, and the number of conservation concern by taxonomic group (Table 12). We also use previous knowledge documented in Schlesinger *et al.* (2012). Depending on whether the tally includes all birds, including casual visitors and accidentals, or just breeding birds, Plum Island has been documented to contain 111 or 67 species and communities of conservation concern. While it would might be helpful for context to compare this number to other locations, similar data are not available from other islands or areas of similar size, and the level of inventory effort Plum Island has now received exceeds that of most areas of similar size, making any comparisons difficult. Regardless, it is clear that 67 species and communities of conservation concern on a ~840-acre island is significant.

Table 12. Summary of known biodiversity of Plum Island, New York.

Taxon	All species	Federal E & T[1]	State E & T[1]	Element occurrences	Total of conservation concern[2]
Ecological communities	33	-	-	5	5
All birds	215	2	6	4	57
Breeding birds[3]	63	1	2	4	13
Mammals[4]	9	1	1	1	6
Reptiles	5	0	0	0	2
Amphibians	0	0	0	0	0
Inland fish	4	0	0	1	2
Odonates	16	0	0	3	3
Moths	256	0	0	11	11
Other insects[5]	-	0	0	1	2
Plants (native)	280	0	18	19	23
Plants (nonnative/invasive)	164/28	-	-	-	-
All species and communities[6]	-	2/3	21/25	45/45	67/111

[1] Endangered and Threatened.

[2] Total includes Species of Greatest Conservation Need (NYS DEC 2015), Species of Potential Conservation Need (NYS DEC 2015), Heritage-tracked species, and significant natural communities—ones that are rare in New York State or outstanding examples of more common communities (Edinger *et al.* 2014).

[3] Not including those meeting the criteria for confirmed breeding but suspected to nest off the island.

[4] Terrestrial mammals only, plus the seal haul-out site.

[5] We did not conduct a complete inventory of insects and thus cannot provide a total species count.

[6] Tallied as (number including only breeding birds)/(number including all birds).

Management and restoration

Plum Island's biodiversity is highly significant for New York State, exemplified by its high-quality shoreline communities, remaining populations of rare plants, extensive use by at-risk birds for breeding, and habitat for rare insects. However, we believe that the island has the potential to house even more extraordinary biodiversity with appropriate management. We recommend that a

full biodiversity management plan be written for the island, with review from the conservation and science communities. In the meantime, we offer these suggestions for restoring and improving the island's biodiversity. We separate them into sections for natural communities, animals, and plants, recognizing that there is considerable overlap among these sections given that many recommendations for species are habitat based.

Natural communities

We credit the resource managers at Plum Island for the beach, dune, and bluff protection efforts observed during our surveys: restricting access to dunes, bluffs, and plover nesting areas, removing trash, preventing motor vehicles on beach, restricting beach access to existing dedicated trails, restoring and replanting dunes lost to storm surges, and preventing development near the bluffs. These practices should continue into the future along with the following suggested management recommendations:

- *Maritime beach*
    - Maintain dynamic beach and dune processes, prevent recreational overuse (driving on the beach is particularly destructive) and encourage beach visitors to carry away all of their trash.
    - Monitor rare plant and animal populations, including seabeach amaranth (*Amaranthus pumilus*), beach-dune tiger beetle (*Cicindela hirticollis*), and the nesting use of beaches by species such as piping plover (*Charadrius melodus*).
    - Maintain connectivity between maritime dunes, maritime beaches, salt marshes, and the open ocean to allow seed dispersal and to enable species to freely move between habitats during nesting season.
    - Remove any shoreline armoring to increase overland sediment input; improve water quality by reducing or eliminating any wastewater and stormwater discharge and pesticide application; restore tidal regime by removing any culverts, dikes, and impoundments, plugging any ditches, and replacing any static flow restriction devices with those that are calibrated for local tidal hydrology.
- *Maritime dunes*
    - Maintain dynamic beach and dune processes, including allowing dunes to be breached and overwashed by storm events. Minimize breach closure, groundwater pollution, and road fill. Development should avoid fragmentation of such systems to allow dynamic ecological processes (overwash, erosion, and migration) to continue.
    - Prevent recreational overuse (e.g., driving and trampling) and encourage the public to stay on marked trails.
    - Undertake dune restoration using native species as needed and avoid planting potential invasives, like rugose rose (Rosa rugose).
    - Prevent the spread of invasive exotic species into the dunes through appropriate direct management and by minimizing potential dispersal corridors, such as beach access trails and roads.
    - Ensure connectivity between maritime communities and the open ocean to allow species to freely move between habitats during nesting season. Any development effort that disrupts connectivity between the open ocean and the maritime dune system should be avoided (e.g., a road running parallel to the beach between the beach and dunes). Connectivity between these habitats is important not only for nutrient flow and seed dispersal, but also for animals that move between them seasonally. Similarly, fragmentation of linear dune systems should be avoided.

- *Maritime bluffs*
    - Maintain the dominant ecological processes responsible for keeping this dynamic community in disclimax. Natural disturbances, including wave erosion and strong offshore winds, should be expected to lead to slumping, cliff retreat, and sea cave formation.
    - Prevent recreational overuse and encourage the public to stay on marked trails. In particular, continue to restrict sliding and climbing on the face of the bluffs using signage and fencing. In places where trails run directly along the top edge of maritime bluffs, those trails should be re-routed away from the edge and split rail fences could be used to direct visitors to designated overlooks. Because the face of the bluffs can be expected to migrate inland, it is important to protect adequate open space to accommodate such change.
    - Avoid planting invasive exotic species to stabilize the bluffs; if stabilization of this inherently unstable community is necessary, select native plants, perhaps American beachgrass (Ammophila breviligulata). Prevent the spread of invasive exotic species into the bluffs through appropriate direct management and by minimizing potential dispersal corridors, such as beach access trails and stairways.
    - This community is best protected as part of a large maritime system, encompassing grasslands, shrublands, bluffs, heathland, forests, barrens, and dunes. Development should avoid fragmentation of such systems to allow for nutrient flow, seed dispersal, and seasonal animal migrations within them. Connectivity to offshore communities should also be maintained as much as possible to maintain "maritime" conditions, which imply deposition of salt spray and shearing from offshore winds.
- *Marine rocky intertidal*
    - Where practical, establish and maintain a natural shoreline buffer to reduce stormwater, pollution, and nutrient run-off, while simultaneously capturing sediments before they reach the rocky shore. Buffer width should take into account the erodibility of the surrounding soils, slope steepness, and current land use. Avoid habitat alteration within the intertidal area and surrounding landscape.
    - Restore sites affected by unnatural disturbance (e.g., remove obsolete sea walls and drain pipes in order to restore the natural tidal regime). Prevent the spread of invasive exotic species into the intertidal area through appropriate direct management.
    - Development activities near this community type should strive to minimize particulate-laden run-off into this community. Water traveling on the ground or seeping through the ground also carries dissolved minerals and chemicals. Fertilizers, detergents, and other chemicals can increase the nutrient levels in tidal areas. Herbicides and pesticides often travel far from where they are applied and have lasting effects on the quality of the natural community.
- The *marine eelgrass meadow* community at Plum Island appears to be in good condition. The current condition of this community should be maintained or improved by keeping the following suggested management recommendations in mind:
    - Improve water quality by reducing pesticide/herbicide application.
    - Set guidelines and gear restrictions to minimize disturbances from shellfishing, boating, and dredging.
    - Reduce or mitigate shoreline development and armoring as much as possible. Strive to minimize or eliminate hardened shorelines and maintain low-sloped shorelines within the

tidal zone; healthy marine eelgrass meadows will slow ocean currents and reduce shoreline erosion.
  - Monitor the spread of invasive exotic species in this community, particularly tunicate colonies (*Didemnum* spp.) and macroalgae (*Codium fragile*) and, as needed, control their encroachment.
  - Include marine eelgrass meadow restoration and long-term monitoring in Harbor Management Plans, as appropriate.
  - Consider new or revised State Significany Coastal Fish and Wildlife Habitat designations to protect Plum Island's marine eelgrass meadows.

Animals

- Should restoration of the island's native biodiversity be a management goal, fullscale eradication of raccoons (*Procyon lotor*) would be a worthy effort. In our understanding, the original goal of the USDA APHIS's raccoon control efforts was eradication, but it was deemed infeasible; further conversation with animal control experts would be necessary before this were attempted. However, it seems clear that the accidental introduction of raccoons in 1995 was responsible for the disappearance of the island's substantial colonies of breeding gulls and wading birds (Schlesinger *et al.* 2012), which could be encouraged to return or re-established (as on nearby Great Gull Island). The presence of large waterbird colonies could also provide a necessary prey base for American burying beetle, should (re)introduction be of interest. Thus, the eradication of raccoons could have several cascading effects.
- We recommend minimizing disturbance to hibernating bats that are present in Battery Steele and may be present in Battery 217 during the winter months of December through March or perhaps mid-November through mid-April in colder years. Disturbance from training activities in the bunkers could impact hibernating bats by causing them to come out of bouts of torpor, which expends unnecessary energy that they need to make it through the winter.
- We documented several road-killed snakes in our single season of field work. Although the animals killed represented common species, nothing is known about their populations' ability to withstand roadkill. We can surmise that the populations of these animals on an 840-acre island are small and not easily replenished through immigration. Some signs warn drivers about crossing turtles near the wetland, but perhaps additional speed restrictions or speed bumps would help ensure that large numbers of animals are not killed by vehicles.
- The NYS DEC fisheries staff suggests no intensive management within the large wetland. It is not clear whether stocking native fishes is worth the effort, as it can be costly and the competition with the non-native species may be problematic. Removal of the non-natives would also be very costly and take several treatments and years to eradicate them. Those species found are salt tolerant and it is unclear to us if the water is inundated with sea water on a regular basis, which also may explain the presence of silversides.
- European Common Reed (*Phragmites australis* ssp. *australis*) encroachment is a potential threat to odonates at the large wetland with the bird observation tower, as it may decrease oviposition sites available for female damselflies; many odonates oviposit on native emergent plants. Maintaining some natural, wooded landscape surrounding the pond is important for maintaining water quality for invertebrate larvae. This is also essential for the maturation and roosting of adult odonates, especially when they are newly emerged from their aquatic larval stage and thus more vulnerable to predation.
- Little published information is available citing specific cases of negative impacts to rare odonates or other wetland-dwelling odonates, but any activities that degrade hydrology of habitat would

threaten populations. We recommend avoiding changes in dissolved oxygen content, pesticide application, increases in the sediment load of the water body, and chemical contamination by runoff of agricultural or other discharge. Removal of large areas of forest or shrub habitats adjacent to their breeding habitats could also threaten populations, as these adjacent habitats are important for recently emerged adults until they reach maturity.

- The most immediate threat to the insect diversity of Plum Island is the continued propagation of invasive plant species, particularly Asian Bittersweet (*Celastrus orbiculatus* Thunb.) The plant community (and by extension, much of the native insect community) has been largely extirpated from the island's eastern panhandle, and is being replaced by a monoculture of bittersweet. A similar trend appears to be taking place in several areas of successional hardwood forest around the rest of the island. Without any management intervention, the Plum Island insect community will likely face continual decline concomitant with the loss of host plant availability. Although complete eradication from the island is likely to prove infeasible, we recommend that bittersweet is managed by careful herbicide applications or mechanical removal. Herbicides should be used, if at all, with great caution given their potential to harm native species.
- The rare moths we captured were denizens of dune, wetland, and sandplain areas. These areas are compromised to varying degrees by invasive plants, and we recommend avoiding more permanent alterations of these habitat types (e.g., through development), which would degrade these populations further or eliminate them.
- The island's sandplain grasslands (represented by moth trapping Sites 1 and 2 in collection efforts) appear to be in good condition, based on the presence of specialist rare species (*Lepipolys perscripta, Abagrotis nefascia*). Both areas, particularly Site 1, appear to be maintained by semiregular disturbances from vehicle traffic and other anthropogenic activity. No management should be required to maintain the moth community recorded in this survey. However, while light disturbances are effective in maintaining an early-successional habitat, the island's sandplains should not be subjected to major disruptive events (e.g., use as a staging area for construction, major excavation projects, etc.).
- Moth trapping Sites 4, 5, and 6, which together sampled the stabilized dunes, heathlands and wetlands on the island's southern peninsula, hosted a majority of the rare species collected in this survey, of which *P. duovata* is the most significant find. This section of the island is likely best served by management practices intended to maintain a range of successional stages. Currently, the area consists mostly of stabilized dunes, and is developing towards a heathland or forested habitat. Periodic vegetation removal or controlled burns would maintain stretches of more open, exposed soil habitat required for early successional plants like toadflax (*Linaria* spp., the host of *L. perscripta*) and coastal jointweed (*Polygonella articulata* Michx., host of *E. fimbriaris*) and help to ensure long-term persistence of the rare species present (Wagner *et al.* 2011). In the event of any mechanical or fire management, it is important to leave some part of the target habitat intact, to provide refuge for species that would be adversely effected based on the timing of their lifecycles (e.g., species that are pupating underground or flying as adults at the time of management are unlikely to be affected, but species feeding as caterpillars will face elimination from the managed area).
- Less frequent mowing of the parade grounds and other grassland habitats would benefit butterflies, bees, and some specialist birds. Adoption of the mowing recommendations for plants (below) would also benefit animals.

Plants

- The two main management challenges for rare plants are figuring out proper mowing schedules and the control of invasive species. The two most common rare species, spring ladies-tresses (*Spiranthes vernalis*) and whorled milkweed (*Asclepias verticillata*), occur in and around the parade grounds, which has seen a change in mowing schedules over the years. We recommend that the parade grounds and adjacent areas where the orchids grow be mowed only once a year, in November, so the rare species have a chance to flower and set seed. The parade ground near Fort Terry structures could be mowed more often to provide shorter grass for people to use. The roadsides where wild pinks (*Silene caroliniana* ssp. *pensylvanica*) have been seen should have a wider and shorter mowed area to prevent competition from other plants. They should also be mowed only once a year in November. Changes in mowing should be evaluated year-to-year to see the effect they are having on the rare plants.
- Invasive plant species are having a detrimental effect on the native vegetation and rare species on the island. An invasive species management plan should be written to prioritize invasive species control. For example, there are four or five highly invasive plants that are just coming on to the island and a rapid response to these invasions could prevent larger problems in the future. Common invasives are also present in large number and their impact should be evaluated. For example, a large area of wetland plants has been lost to Phragmites, including almost the entire pond southeast of the lab. In addition, an invasive species research program could help to determine the direction of a control effort.

Inventory and monitoring

We were fortunate to have excellent access to most of the island in all seasons, which enabled us to conduct a thorough biodiversity inventory focused on rare species and natural communities. Our surveys, combined with bird surveys conducted by Audubon New York, can form the baseline for a long-term monitoring and adaptive management program. Should management and restoration efforts proceed on the island, future inventories can help determine the effectiveness of those efforts. Here we suggest inventory work to follow up on our study and expand its taxonomic scope.

Natural communities

- Our 2012 report included a draft wall-to-wall natural community map based on interpretation of aerial photography informed by the field work of others. A complete ground-truthed natural community map would provide a useful basis for management.
- We had just one day of surveying for eelgrass; additional survey time within the known patch and throughout the island would help ensure we have fully documented the extent of this important offshore natural community. In addition, surveys are better timed for good weather in September, when the full fauna may be witnessed.
- Additional surveys of benthic and hard bottom marine habitats surrounding Plum Island would be useful, as would a bathymetry study.

Animals

- We recommend future surveys of the bunkers on Plum Island to continue to monitor their use as bat hibernacula and to look for northern long-eared bats (*Myotis septentrionalis*). Also, follow-up surveys of the bat use of the island during summer is also recommended. We did not encounter northern long-eared bats during the summer, but there is some potential for them to be there.

Using a stationary detector to collect more data over the summer may be a good low cost method for future surveys.

- Now that more is known about the eelgrass meadows around Plum Island, surveys for use of these meadows by sea turtles is recommended. Documentation of sea turtle use of these meadows may influence suggested boating speeds in certain months.
- Surveys of marine mammals to document the extent of their use of the waters surrounding Plum Island could inform boating speeds and fishing regulations.
- Future inventory for dragonflies and damselflies should include searching the entire large wetland to determine the full extent of the breeding populations of Rambur's Forktail and Needham's Skimmer. Searching the small, freshwater wetland to the northeast for adult Golden-Winged Skimmers is recommended. Capture may be necessary for species determination as it is so similar to Needham's Skimmer. Another rare species known from Greenport, NY sites, Four-spotted Pennant (*Brachymesia gravida*), was not documented in 2015. Future colonization of this species on Plum Island is possible.
- Further collection efforts (preferably non-destructive light-trapping) for the moth *Papaipema duovata* would be ideal to confirm the presence of a stable population on the island.
- A survey of the island's native bees and wasps would inform a recent statewide emphasis on understanding the status of pollinators.

Plants

- There were some small areas of the island, especially wetland areas, that were difficult to access, because of time constraints or lack of watercraft, that still could be surveyed for rare plants.
- The dynamic habitats like beaches, fields, and roadsides could also yield new finds with repeat surveys, especially since summer 2015 was especially dry.
- Our eight days of survey could not duplicate the years of surveys that were carried out by Lamont and Stalter. We may have missed the rare species they observed in low abundance either because they are no longer there, or they are in the seed bank waiting for the next disturbance. Repeat surveys over a number of years may result in the rediscovery of these rare species.
- Surveys of the macroalgal community would expand our knowledge of Plum Island's marine environment.

Acknowledgments

A survey of this magnitude could not have been conducted without a great deal of assistance from people in many organizations. Meghan Jackson, Support Contractor and Environment, Safety, and Occupational Health Specialist for PIADC, would not wish to be first in this list but she has to be, as she was nevereendingly helpful, knowledgeable, firm with the rules, fun to tease about spiders, and enjoyable to work with. From NYSDEC we thank Kathy Moser, David Barnet, Dan Rosenblatt, Rob Marsh, Chart Guthrie, Heidi O'Riordan, Caleb Konrad, Neal Scheraga, Todd Glavin, and Jennifer O'Dwyer. From NYNHP we thank D.J. Evans, Fiona McKinney, and Tim Howard. From the U.S. Department of Homeland Security we thank Larry Barrett, Doug Ports, Gary Mandelburg, Tom Dwyer, Kurt Klotzer, Jim Palmieri, and DHS S&T ONL. DHS contractors Jason Golden, Katie Guarrasi, Sarah Acosta, and ASRC Federal PRIMUS also supported our project. Steve Resler from NYS Department of State was lead diver and helped coordinate the marine eelgrass meadow survey. Also helping plan eelgrass surveys were Aissa Feldmann, David Hunt, and Soren Dahl. Tim Green from Brookhaven National Laboratory and Jennifer Tennessen loaned recorders and

microphones. For field and logistical help we thank Fiona McKinney, Tim Green, Nate Silver, Mike Bottini, Chris Chapin, Joe Janssen, MaryLaura Lamont, Eric Lamont, Bill Anderson, John Sepenoski, and Jody Levin. Jillian Liner and John Sepenoski loaned data from their bird surveys and seal counts. Aissa Feldmann, formerly of NYNHP and now with the NYS Office of Parks, Recreation, and Historic Preservation, spearheaded the original data compilation and created the draft natural community map. For feedback on our draft report we thank Basil Seggos, Kathy Moser, Doug Stang, Steve Hurst, Jim Gilmore, David Barnet, Rob Marsh, Dawn McReynolds, Nicholas Perry, John Sepenoski, the U.S. Department of Homeland Security, and Meghan Jackson.

Literature cited

Abbott, J. 2007, 2014. Odonata central: An online resource for the distribution and identification of Odonata. The University of Texas at Austin. [Online]. Available: http://www.odonatacentral.org/index.php.

Bangs, O. 1905. Notes on the deer mice (Peromyscus) of some of the islands off the southern New England coast. Proceedings of the New England Zoological Club IV:11–15.

Bass, A. L., A. Bogomolni, G. Early, O. C. Nichols, and K. Patchett. 2015. Seals and ecosystem health: Meeting report of the Northwest Atlantic Seal Research Consortium. Woods Hole Oceanographic Institution, Woods Hole, MA.

Bramson, R. A., G. K. Fleming, and A. K. Folk. 2014. A world unto itself: The remarkable history of Plum Island, New York. Southold Historical Society, Southold, New York.

Burger, M. F., and J. M. Liner. 2005. Important bird areas of New York. Audubon New York, Albany, New York.

Crandell Jr, H. C. 1962. Geology and ground-water resources of Plum Island. USGS Water-Supply Paper 1539-X. Prepared on behalf of the Agricultural Research Service, U.S. Department of Agriculture. United States Department of the Interior Geological Survey, Washington D.C.

Edinger, G. J., D. J. Evans, A. D. Finton, D. M. Hunt, L. Lyons-Swift, and A. Olivero. 2000, May. Community field form instructions: Community Forms 1, 2, & 3. New York Natural Heritage Program.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero. 2014. Ecological communities of New York State, second edition. New York Natural Heritage Program, Albany, New York. 136 pages.

Environment Canada. 2002. Monitoring eelgrass habitat in British Columbia, Draft 4. Precision Identification Biological Consultants, Environment Canada, Vancouver, BC.

Gosner, K. L. 1978. A field guide to the Atlantic seashore. Houghton Mifflin Company, New York, NY.

Hunt, D. M. 2000. 1999 Mashomack marine and estuarine aquatic community project. New York Natural Heritage Program.

Lamont, E. E., and R. Stalter. 2013. Flora of Plum Island, Suffolk County, New York. The Journal of the Torrey Botanical Society 140:465–479.

Mawdsley, J. R., M. D. Schlesinger, T. Simmons, and O. J. Blanchard. 2013. Status of the tiger beetle Cicindela hirticollis Say (Coleoptera: Cicindelidae) in New York City and on Long Island, New York, USA. Insecta Mundi 0317:1–7.

Mikkola, K., J. D. Lafontaine, and J. D. Gill. 2009. Noctuoidea: Noctuidae (part), Xyleninae (part), Apameini (Part-Apamea group of genera). Wedge Entomological Research Foundation.

NatureServe. 2016. NatureServe Explorer: an online encyclopedia of life [web application] Version 7.1 [Online]. Available: http://www.natureserve.org/explorer. [Accessed: 01-Feb-2016].

Noss, R. F., E. T. I. LaRoe, and J. M. Scott. 2001. Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. USGS Biological Resources. 74 pages.
NYS DEC. 2015. New York State wildlife action plan. New York State Department of Environmental Conservation, Albany, NY.
NYS Seagrass Taskforce. 2009. Final report of the New York State seagrass task force. 44 pages.
Raithel, C. 1991. American burying beetle (Nicrophorus americanus) recovery plan. U.S. Fish and Wildlife Service, Concord, NH.
Schlesinger, M. D., A. L. Feldmann, and S. M. Young. 2012. Biodiversity and ecological potential of Plum Island, New York. New York Natural Heritage Program, Albany, NY.
Schlesinger, M., and P. Novak. 2011. Status and conservation of an imperiled tiger beetle fauna in New York State, USA. Journal of Insect Conservation 15:839–852.
U.S. Department of Agriculture Natural Resources Conservation Service. 1995. Soil Survey Geographic (SSURGO) data base; data use information, publication number 1527. United States Department of Agriculture Natural Resources Conservation Service, Fort Worth, Texas. 31 pages.
U.S. Department of Homeland Security. 2010. Historical timeline of Plum Island events. Plum Island Animal Disease Center.
Villalard-Bohnsack, M. 2003. Illustrated Key to the Seaweeds of New England, 2nd edition. The Rhode Island Natural History Survey, Kingston, RI.
Wagner, D. L., D. F. Schweitzer, J. B. Sullivan, and R. C. Reardon. 2011. Owlet caterpillars of eastern North America. Princeton University Press.
Weiss, H. M. 1995. Marine animals of southern New England and New York: Identification keys to common nearshore and shallow water macrofauna. State Geological and Natural History Survey of Connecticut, Dept. of Environmental Protection, Hartford, CT.
Weldy, T. W., D. A. Werier, and A. Nelson. 2015. New York flora atlas [Online]. Available: http://newyork.plantatlas.usf.edu/Default.aspx.
White, E., J. D. Corser, and M. D. Schlesinger. 2010. The New York dragonfly and damselfly survey: Distribution and status of the odonates of New York. New York Natural Heritage Program, Albany, NY.

Appendix A: Natural Heritage methodology

HERITAGE METHODOLOGY

The Natural Heritage Network specializes in compiling biodiversity information through conducting surveys for rare species and significant natural communities and delivering the resultant data to facilitate conservation. Natural Heritage Programs, NatureServe, and The Nature Conservancy have spent more than two decades developing and refining the inventory methodology used internationally by the Natural Heritage Network. The Natural Heritage Network considers each plant species, animal species, and natural community type to be an "element" of biodiversity. The documented locations of rare plants, rare animals, and significant natural communities are called "element occurrences." These terms are used throughout this report. We used our database of element occurrences as one component of the remote GIS assessment in this project.

THE COARSE FILTER/FINE FILTER APPROACH

Heritage inventory methodology works by focusing on the identification, documentation, and mapping of all occurrences of rare species and significant ecological communities. A "coarse filter/fine filter" approach is used to identify and prioritize the protection of these significant biological resources. Ecological communities represent a "coarse filter," aggregates of biodiversity at a scale larger than the species level as defined in Reschke (1990) and Edinger *et al.* (2014). Their identification and documentation can be used to describe whole assemblages of plant and animal species, both common and rare. The conservation of the best remaining examples of the natural communities ensures the protection of most of the common species that make up the biological diversity of the state. Rare animals and plants often have narrow or unusual habitat requirements. These species may "fall through" the coarse filter, and are sometimes not protected within representative communities. Identifying and documenting viable populations of each of the rare species serves as the "fine filter" for protecting the state's biological diversity. This coarse filter/fine filter approach to a natural resources inventory has proven to be an efficient means of identifying the most sensitive animals, plants, and ecological communities of an area.

Element Occurrence Quality/Viability: Individual occurrences of rare plants, rare animals, and natural communities are ranked according to their quality, or perceived viability, based on factors such as size, condition, and landscape context in which they are found. All occurrences of the elements documented in this report have been assigned a quality rank of A-F, H, or X (Table A-1). Combinations of letters, or intermediate ranks, such as AB, BC, and CD are also possible.

Table A-1. Explanation of element occurrence quality ranks used in NY Natural Heritage Biotics database reports.

Element Occurrence Rank	Definition
A	EXCELLENT*
B	GOOD*
C	MARGINAL*
D	POOR*

E	EXTANT. Existing, but not enough information to rank A-D
F	FAILED TO FIND. Not found at the previously documented site, but potential habitat was observed and /or a more thorough searching is needed.
H	HISTORICAL. No recent field information. For animals this means the particular population has not been seen, or in the case of a nest, has not been active within the last 15 years. For plants a "historical" rank means that the population has not been observed within the last 20 years.
X	EXTIRPATED. Believed to no longer exist. In many cases, habitat has been significantly altered and is believed to be no longer suitable for maintenance of the element.

*Definitions of and criteria for these quality ranks, also called viability ranks, differ by element group (plant, animal, or natural community) and even by species of plant or animal. In 2008, NatureServe introduced a new approach to "generic" ranking of occurrences based on apparent viability of the population or community (http://explorer.natureserve.org/eorankguide.htm).

Plant and animal occurrences, or populations, can be assigned any of the ranks listed above. Species occurrence ranks are based on historical evidence of presence and/or on current population data. The element occurrence rank of a species is determined by evaluating total population size, density, condition, the reproductive health of the population, ecological processes needed to maintain the population, total landscape condition, and a series of other factors. Each of these factors is compared against specifications gathered from other populations throughout its global range. A final element occurrence rank is calculated from this comparative review. Generally, an A-ranked occurrence is considered to represent one of the largest, most viable populations within a natural landscape known to support populations of the species. Significant natural communities are also assigned any of the ranks listed above, which are based on quality and are evaluated within the context of the known or hypothesized distribution of that particular community. Several ecological and spatial factors must be considered when determining the element occurrence rank of a community. These include the occurrence size, maturity, evidence and degree of unnatural disturbance, continued existence of important ecological processes, overall landscape context, and existing and potential threats. A-ranked community occurrences are among the largest and highest quality of their type. These community occurrences should be large enough to provide reasonable assurance for long-term viability of component ecological processes. They are essentially undisturbed by humans or have nearly recovered from past human disturbance, typically exhibiting little or no unnatural fragmentation. Exotic or particularly invasive native species are usually lacking in high-quality community occurrences, or, if present, are observed at very low levels.

State Conservation Rank

A rank assigned by New York Natural Heritage indicating how imperiled the species or community type is in New York State. The conservation rank is based on how rare the species or community type is in New York, and on population trends and threats.

Basic ranks are as follows:

- S1 - Critically Imperiled
- S2 - Imperiled
- S3 - Vulnerable

- S4 - Apparently Secure
- S5 - Definitely Secure
- SH - Historical in New York, not seen in last 30 years but could still be present
- SX - Extirpated, no longer present in New York
- SU - Unrankable - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- SNR - Not Ranked, state conservation status not yet assessed.
- SNA - Not Applicable, because the species is not a suitable target for conservation activities (e.g., species is a hybrid, a domesticated species, not native to New York, an accidental or infrequent visitor outside of its normal range, a transient or migrant just passing through the state, or a species with only unconfirmed or doubtful reports).

Variations of these ranks include the following:

- Range ranks, such as S1S2, indicate not enough information is available to distinguish between two single ranks.
- ? after a rank, such as S2?, indicates some uncertainty about the true rank, but is most likely the assigned rank.
- B after a rank, such as S2B, indicates the rank applies to the breeding populations in New York of a migratory animal.
- N after a rank, such as S3N, indicates the rank applies to the non-breeding populations in New York of a migratory animal.

Global Conservation Rank

A rank indicating how imperiled the species or community type is throughout the world. The conservation rank is based on how rare the species or community type is across its global range, and on population trends and threats. For species, these ranks provide an estimate of extinction risk; while for natural communities, they provide an estimate of the risk of elimination.

Basic ranks are as follows:

- G1 - Critically Imperiled (very high risk of extinction)
- G2 - Imperiled (high risk of extinction)
- G3 - Vulnerable (moderate risk of extinction)
- G4 - Apparently Secure
- G5 - Definitely Secure
- GH - Possibly Extinct, not seen anywhere in last 30 years but could still exist
- GX - Extinct, no longer present anywhere in the world
- GU - Unrankable - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- GNR - Not Ranked, global conservation status not yet assessed.

- GNA - Not Applicable, because the species is not a suitable target for conservation activities (e.g., species is a hybrid, or a domesticated species).

Variations of these ranks include the following:

- Range ranks, such as G1G2, indicate not enough information is available to distinguish between two single ranks.
- ? after a rank, such as G2?, indicates some uncertainty about the rank, but is most likely the assigned rank.
- T ranks, such as T3, indicate the rank applies to a subspecies or variety, but not to the species as a whole.

Global conservation status ranks are assigned by NatureServe, with guidance from local Natural Heritage Programs and from experts on particular taxonomic groups.

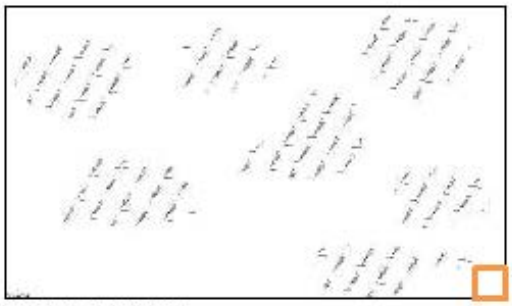
Appendix B. Data forms used in marine eelgrass survey

PLUM ISLAND EELGRASS SURVEY 2015 Date _____ Obs. Point # _____

PATCHINESS

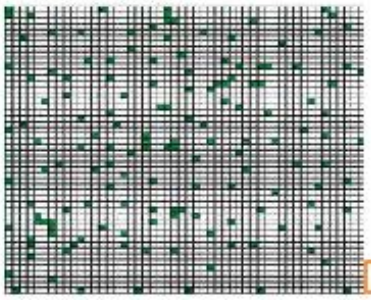
CONTINUOUS

CONTINUOUS WITH BARE PATCHES

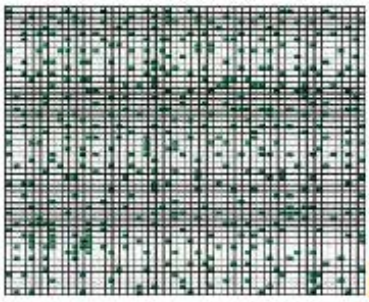


PATCHY COVER

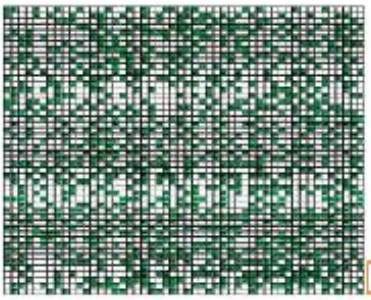
PERCENT COVER



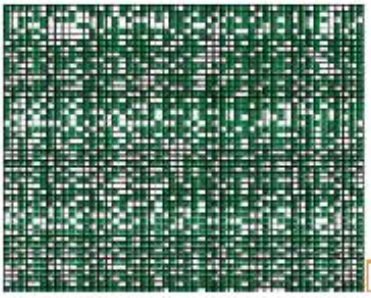
1-10%



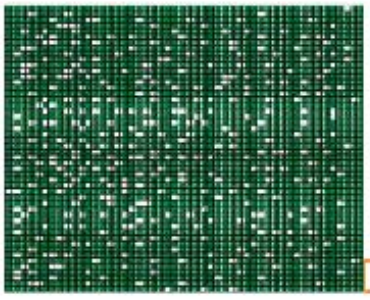
11-25%



26-50%



51-75%



>75%

PLUM ISLAND EELGRASS SURVEY 2015 **Date** _____ **Obs. Point #** _____

Depth _____ **Time** _____

☐ *Zostera marina* _____%
Height from bottom _____m

☐ GREEN ALGAE _____%
Codium
Ulva
Enteromorpha

☐ BROWN ALGAE _____%
Sargassum filipendula

☐ RED ALGAE _____%
Champia parvula
Polysiphonia

ROCKS >1m _____%

ROCKS >10 cm _____%

ROCKS <10 cm _____%

SAND _____%

SILT _____%

SHELLS _____%

☐ NEUSTON (organisms that float on the top of water (epineuston) or live right under the surface (hyponeuston)

☐ PLANKTON (organisms that live in the water column that cannot swim against a current)
Leidy's Comb Jelly
Beroe's Comb Jelly
Moon Jelly

☐ NEKTON (actively swimming aquatic organisms)
Silversides
Sheepshead Minnow
Atlantic Menhaden
Puffer
Black Seabass
Tautog

☐ BENTHIC EPIFAUNA (organisms found on the seabed)
Slippershell
Shrimp
Bay Scallop
Jingle Shell
Seahorse
Fluke – Summer Flounder
Crabs

☐ BENTHIC INFAUNA (organisms found in the seabed)
Clams
Northern Quahog

PLUM ISLAND EELGRASS SURVEY 2015 **Date** _____ **Obs. Point #** _____

Time Start_____ Time Stop_____

Boat Crew_____

Divers_____

UTM_____ / _____

POS count_____ Accuracy +/-_____meters

Lat_____N / Long_____W

Cover type found: ☐ *Zostera marina* ☐ edge of patch ☐ within patch

☐ Marine algae ☐ edge of patch ☐ within patch

☐ Unvegetated ☐ sand ☐ rock

Depth to bottom_____meters/feet Time depth taken_____

How measured ☐ depth gauge ☐ tape/rod ☐ depth finder

Wave height_____meters/feet Secchi depth_____meters/feet

Soil Sample

Depth of Sample

Texture

Color

Appendix C: Seasonal occurrence and abundance of birds of Plum Island

Appendix C. Seasonal occurrence and abundance of birds of Plum Island. Superscripts: C = confirmed breeding; P = probable breeding; Hi = High-priority Species of Greatest Conservation Need; S = Species of Greatest Conservation Need; SP = Species of Potential Conservation Need. Occurrence/abundance categories: Abundant, Common, Uncommon/rare, Casual, Accidental (see Table 4 for definitions).

Common name	Scientific name	Apr-May	Jun-Aug	Sep-Oct	Nov-Mar
Greater White-fronted Goose	*Anser albifrons*	-	-	-	Acc
Snow Goose	*Chen caerulescens*	-	-	-	Acc
Brant	*Branta bernicla*	Cas	-	Cas	Cas
Canada Goose C	*Branta canadensis*	Abu	Abu	Abu	Abu
Mute Swan C	*Cygnus olor*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Wood Duck C	*Aix sponsa*	-	Com	Com	-
Gadwall	*Anas strepera*	Com	-	-	Com
Eurasian Wigeon	*Anas penelope*	-	-	-	Cas
American Wigeon	*Anas americana*	Abu	-	-	Com
American Black Duck C,Hi	*Anas rubripes*	Com	Com	Com	Abu
Mallard C	*Anas platyrhynchos*	Unc/Rar	Com	Unc/Rar	Com
Blue-winged Teal S	*Anas discors*	-	-	Acc	-
Northern Pintail S	*Anas acuta*	-	-	-	Cas
Green-winged Teal	*Anas crecca*	Com	Com	Com	Com
Greater Scaup S	*Aythya marila*	-	-	-	Cas
King Eider	*Somateria spectabilis*	Acc	-	-	-
Common Eider P,S	*Somateria mollissima*	Abu	Com	Com	Com
Harlequin Duck S	*Histrionicus histrionicus*	-	-	-	Cas
Surf Scoter S	*Melanitta perspicillata*	Abu	Unc/Rar	Com	Abu
White-winged Scoter S	*Melanitta fusca*	Com	Unc/Rar	Com	Abu
Black Scoter S	*Melanitta americana*	Abu	Com	Com	Abu
Long-tailed Duck S	*Clangula hyemalis*	Unc/Rar	Unc/Rar	-	Com
Bufflehead	*Bucephala albeola*	-	-	-	Cas
Common Goldeneye S	*Bucephala clangula*	Com	-	-	Abu
Hooded Merganser	*Lophodytes cucullatus*	Unc/Rar	-	-	Com
Red-breasted Merganser	*Mergus serrator*	Com	Unc/Rar	Com	Abu
Red-throated Loon	*Gavia stellata*	Unc/Rar	-	Com	Com
Pacific Loon	*Gavia pacifica*	-	-	-	Acc
Common Loon S	*Gavia immer*	Com	Unc/Rar	Com	Abu
Horned Grebe S	*Podiceps auritus*	Unc/Rar	-	-	Com
Red-necked Grebe	*Podiceps grisegena*	-	-	-	Cas
Northern Gannet	*Morus bassanus*	Com	-	Unc/Rar	Abu
Double-crested Cormorant C	*Phalacrocorax auritus*	Abu	Abu	Abu	Abu
Great Cormorant	*Phalacrocorax carbo*	Unc/Rar	Unc/Rar	Com	Com
Brown Pelican	*Pelecanus occidentalis*	-	-	Acc	-
American Bittern S	*Botaurus lentiginosus*	-	-	Acc	-
Great Blue Heron	*Ardea herodias*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Great Egret P,S	*Ardea alba*	Unc/Rar	Com	Unc/Rar	Unc/Rar
Snowy Egret S	*Egretta thula*	-	Cas	Cas	-

Common name	Scientific name	Apr-May	Jun-Aug	Sep-Oct	Nov-Mar
Little Blue Heron [S]	*Egretta caerulea*	-	-	Acc	-
Green Heron	*Butorides virescens*	Cas	Cas	-	-
Black-crowned Night-Heron [C,S]	*Nycticorax nycticorax*	-	Unc/Rar	Unc/Rar	-
Glossy Ibis [P,S]	*Plegadis falcinellus*	-	Acc	-	-
Turkey Vulture [P]	*Cathartes aura*	Com	Unc/Rar	Unc/Rar	Com
Osprey [C]	*Pandion haliaetus*	Com	Com	Com	Com
Northern Harrier [C,S]	*Circus cyaneus*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Sharp-shinned Hawk	*Accipiter striatus*	Unc/Rar	-	Unc/Rar	Unc/Rar
Cooper's Hawk	*Accipiter cooperii*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Northern Goshawk [S]	*Accipiter gentilis*	-	-	-	Acc
Bald Eagle [S]	*Haliaeetus leucocephalus*	Unc/Rar	-	Unc/Rar	Unc/Rar
Red-shouldered Hawk [S]	*Buteo lineatus*	Cas	Cas	-	Cas
Broad-winged Hawk	*Buteo platypterus*	Cas	Cas	-	-
Red-tailed Hawk [C]	*Buteo jamaicensis*	Com	Com	Com	Com
Rough-legged Hawk	*Buteo lagopus*	-	-	-	Acc
Virginia Rail	*Rallus limicola*	Unc/Rar	Unc/Rar	-	Unc/Rar
Sora	*Porzana carolina*	-	Acc	-	-
Black-bellied Plover [S]	*Pluvialis squatarola*	-	Com	Com	Com
American Golden-Plover [SP]	*Pluvialis dominica*	-	-	Acc	-
Semipalmated Plover	*Charadrius semipalmatus*	-	Cas	Cas	-
Piping Plover [C,Hi]	*Charadrius melodus*	Unc/Rar	Com	Unc/Rar	-
Killdeer [C]	*Charadrius vociferus*	Com	Com	Com	Com
American Oystercatcher [C,S]	*Haematopus palliatus*	Com	Com	-	Unc/Rar
Spotted Sandpiper [C]	*Actitis macularius*	Unc/Rar	Com	Unc/Rar	-
Solitary Sandpiper	*Tringa solitaria*	Unc/Rar	Unc/Rar	Unc/Rar	-
Greater Yellowlegs [S]	*Tringa melanoleuca*	Com	Unc/Rar	Unc/Rar	Unc/Rar
Willet [S]	*Tringa semipalmata*	Com	Unc/Rar	-	-
Lesser Yellowlegs	*Tringa flavipes*	Unc/Rar	Unc/Rar	Unc/Rar	-
Whimbrel [Hi]	*Numenius phaeopus*	-	Cas	-	-
Ruddy Turnstone [S]	*Arenaria interpres*	-	Cas	Cas	Cas
Red Knot [Hi]	*Calidris canutus*	-	-	Acc	-
Sanderling [SP]	*Calidris alba*	-	Com	Com	Com
Semipalmated Sandpiper [Hi]	*Calidris pusilla*	-	Cas	Cas	-
Least Sandpiper	*Calidris minutilla*	Unc/Rar	Com	Com	-
Purple Sandpiper [S]	*Calidris maritima*	Com	-	-	Com
Dunlin	*Calidris alpina*	-	-	Cas	Cas
Short-billed Dowitcher [Hi]	*Limnodromus griseus*	-	Acc	Acc	-
Wilson's Snipe	*Gallinago delicata*	Cas	Cas	-	Cas
American Woodcock [S]	*Scolopax minor*	Cas	Cas	Cas	Cas
Bonaparte's Gull [S]	*Chroicocephalus philadelphia*	-	-	-	Cas
Laughing Gull [CO,S]	*Leucophaeus atricilla*	Com	Abu	Abu	Com
Ring-billed Gull	*Larus delawarensis*	Unc/Rar	-	Unc/Rar	Unc/Rar
Herring Gull [CO]	*Larus argentatus*	Abu	Com	Abu	Abu
Iceland Gull	*Larus glaucoides*	Cas	-	-	Cas
Lesser Black-backed Gull	*Larus fuscus*	-	-	Cas	Cas
Great Black-backed Gull [P]	*Larus marinus*	Abu	Com	Abu	Com

Common name	Scientific name	Apr-May	Jun-Aug	Sep-Oct	Nov-Mar
Least Tern [P,S]	*Sternula antillarum*	-	Cas	-	-
Caspian Tern [S]	*Hydroprogne caspia*	-	-	Acc	-
Black Tern [H]	*Chlidonias niger*	-	-	Acc	-
Roseate Tern [CO,Hi]	*Sterna dougallii*	Unc/Rar	Com	-	-
Common Tern [CO,S]	*Sterna hirundo*	Abu	Abu	Abu	-
Forster's Tern [S]	*Sterna forsteri*	-	Unc/Rar	Unc/Rar	Com
Black Skimmer [Hi]	*Rynchops niger*	-	Acc	-	-
Razorbill [S]	*Alca torda*	-	-	-	Cas
Rock Pigeon	*Columba livia*	Cas	Cas	Cas	-
Mourning Dove [P]	*Zenaida macroura*	Unc/Rar	Unc/Rar	Unc/Rar	Com
Yellow-billed Cuckoo	*Coccyzus americanus*	-	Unc/Rar	Unc/Rar	-
Black-billed Cuckoo [S]	*Coccyzus erythropthalmus*	Cas	Cas	-	-
Great Horned Owl [C]	*Bubo virginianus*	Cas	Cas	Cas	Cas
Snowy Owl	*Bubo scandiacus*	-	-	-	Cas
Eastern Whip-poor-will [Hi]	*Antrostomus vociferus*	-	Acc	-	-
Chimney Swift	*Chaetura pelagica*	Com	Unc/Rar	-	-
Ruby-throated Hummingbird	*Archilochus colubris*	Com	Unc/Rar	Unc/Rar	-
Belted Kingfisher [C]	*Megaceryle alcyon*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Red-bellied Woodpecker	*Melanerpes carolinus*	Unc/Rar	-	Com	Unc/Rar
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Unc/Rar	-	Unc/Rar	Unc/Rar
Downy Woodpecker [C]	*Picoides pubescens*	Unc/Rar	Unc/Rar	Unc/Rar	Com
Hairy Woodpecker	*Picoides villosus*	Unc/Rar	-	Unc/Rar	Unc/Rar
Northern Flicker [P]	*Colaptes auratus*	Com	Unc/Rar	Com	Com
American Kestrel [S]	*Falco sparverius*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Merlin	*Falco columbarius*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Peregrine Falcon [S]	*Falco peregrinus*	Cas	Cas	Cas	Cas
Eastern Wood-Pewee	*Contopus virens*	Com	Unc/Rar	Unc/Rar	Unc/Rar
Yellow-bellied Flycatcher	*Empidonax flaviventris*	-	Acc	-	-
Alder Flycatcher	*Empidonax alnorum*	Acc	-	-	-
Willow Flycatcher [C]	*Empidonax traillii*	Unc/Rar	Unc/Rar	Unc/Rar	-
Least Flycatcher	*Empidonax minimus*	Acc	Acc	Acc	-
Eastern Phoebe [C]	*Sayornis phoebe*	Com	Unc/Rar	Com	Unc/Rar
Say's Phoebe	*Sayornis saya*	-	-	Acc	-
Ash-throated Flycatcher	*Myiarchus cinerascens*	-	-	-	Acc
Great Crested Flycatcher [C]	*Myiarchus crinitus*	Com	Unc/Rar	Unc/Rar	-
Eastern Kingbird [C]	*Tyrannus tyrannus*	Com	Unc/Rar	Com	-
White-eyed Vireo [C]	*Vireo griseus*	Com	Com	Com	-
Yellow-throated Vireo	*Vireo flavifrons*	Cas	-	Cas	-
Blue-headed Vireo	*Vireo solitarius*	Com	Unc/Rar	Unc/Rar	-
Warbling Vireo	*Vireo gilvus*	Cas	Cas	-	-
Red-eyed Vireo	*Vireo olivaceus*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Blue Jay [P]	*Cyanocitta cristata*	Com	Unc/Rar	Com	Com
American Crow [C]	*Corvus brachyrhynchos*	Com	Com	Com	Com
Fish Crow	*Corvus ossifragus*	Cas	-	-	-
Horned Lark [Hi]	*Eremophila alpestris*	-	-	-	Acc
Northern Rough-winged Swallow [C]	*Stelgidopteryx serripennis*	Com	Com	-	-

Common name	Scientific name	Apr-May	Jun-Aug	Sep-Oct	Nov-Mar
Purple Martin [P]	*Progne subis*	-	Com	-	-
Tree Swallow [C]	*Tachycineta bicolor*	Com	Abu	Abu	Com
Bank Swallow [C]	*Riparia riparia*	Abu	Abu	-	-
Barn Swallow [C]	*Hirundo rustica*	Abu	Abu	Unc/Rar	-
Cliff Swallow	*Petrochelidon pyrrhonota*	Acc	-	-	-
Black-capped Chickadee [C]	*Poecile atricapillus*	Com	Com	Com	Com
Tufted Titmouse [C]	*Baeolophus bicolor*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Red-breasted Nuthatch	*Sitta canadensis*	Cas	Cas	Cas	Cas
White-breasted Nuthatch	*Sitta carolinensis*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
Brown Creeper	*Certhia americana*	Cas	-	Cas	Cas
House Wren [C]	*Troglodytes aedon*	Com	Com	Com	-
Winter Wren	*Troglodytes hiemalis*	-	-	Acc	-
Marsh Wren	*Cistothorus palustris*	Acc	-	-	-
Carolina Wren [C]	*Thryothorus ludovicianus*	Com	Com	Com	Com
Blue-gray Gnatcatcher	*Polioptila caerulea*	Com	Com	-	-
Golden-crowned Kinglet	*Regulus satrapa*	Com	-	Com	Com
Ruby-crowned Kinglet	*Regulus calendula*	Unc/Rar	-	Com	Unc/Rar
Northern Wheatear	*Oenanthe oenanthe*	-	-	Acc	-
Eastern Bluebird	*Sialia sialis*	Unc/Rar	-	-	Com
Veery	*Catharus fuscescens*	-	-	Acc	Acc
Hermit Thrush	*Catharus guttatus*	Unc/Rar	-	Unc/Rar	Unc/Rar
Wood Thrush [S]	*Hylocichla mustelina*	Cas	Cas	-	-
American Robin [C]	*Turdus migratorius*	Abu	Abu	Abu	Abu
Gray Catbird [C]	*Dumetella carolinensis*	Abu	Abu	Abu	Unc/Rar
Northern Mockingbird [C]	*Mimus polyglottos*	Com	Com	Com	Com
Brown Thrasher [P,Hi]	*Toxostoma rufum*	Unc/Rar	Unc/Rar	Unc/Rar	Unc/Rar
European Starling [C]	*Sturnus vulgaris*	Abu	Abu	Abu	Abu
American Pipit	*Anthus rubescens*	-	-	-	Acc
Bohemian Waxwing	*Bombycilla garrulus*	-	-	-	Acc
Cedar Waxwing [C]	*Bombycilla cedrorum*	Com	Abu	Com	Com
Snow Bunting	*Plectrophenax nivalis*	-	-	-	Com
Ovenbird	*Seiurus aurocapilla*	Cas	-	-	-
Northern Waterthrush	*Parkesia noveboracensis*	Unc/Rar	Unc/Rar	Unc/Rar	-
Blue-winged Warbler [S]	*Vermivora cyanoptera*	Cas	Cas	-	-
Black-and-white Warbler	*Mniotilta varia*	Com	Unc/Rar	Unc/Rar	-
Tennessee Warbler [SP]	*Oreothlypis peregrina*	-	-	Acc	-
Orange-crowned Warbler	*Oreothlypis celata*	-	-	-	Acc
Nashville Warbler	*Oreothlypis ruficapilla*	Cas	-	Cas	-
Common Yellowthroat [C]	*Geothlypis trichas*	Abu	Abu	Com	-
American Redstart [C]	*Setophaga ruticilla*	Abu	Com	Com	-
Cape May Warbler [Hi]	*Setophaga tigrina*	-	Acc	Acc	-
Northern Parula	*Setophaga americana*	Com	Unc/Rar	Unc/Rar	-
Magnolia Warbler	*Setophaga magnolia*	Unc/Rar	-	-	-
Blackburnian Warbler	*Setophaga fusca*	Cas	-	-	-
Yellow Warbler [C]	*Setophaga petechia*	Abu	Com	Unc/Rar	-
Chestnut-sided Warbler	*Setophaga pensylvanica*	Cas	-	Cas	-

Common name	Scientific name	Apr-May	Jun-Aug	Sep-Oct	Nov-Mar
Blackpoll Warbler	*Setophaga striata*	Cas	-	Cas	-
Black-throated Blue Warbler S	*Setophaga caerulescens*	Unc/Rar	Unc/Rar	-	-
Palm Warbler	*Setophaga palmarum*	Com	-	Com	Unc/Rar
Pine Warbler	*Setophaga pinus*	Unc/Rar	-	Unc/Rar	-
Yellow-rumped Warbler	*Setophaga coronata*	Com	Unc/Rar	Abu	Com
Prairie Warbler S	*Setophaga discolor*	Unc/Rar	Unc/Rar	Unc/Rar	-
Black-throated Green Warbler	*Setophaga virens*	Com	-	Unc/Rar	-
Wilson's Warbler	*Cardellina pusilla*	Acc	-	Acc	-
Eastern Towhee C	*Pipilo erythrophthalmus*	Abu	Abu	Com	Unc/Rar
American Tree Sparrow	*Spizella arborea*	-	-	-	Com
Chipping Sparrow C	*Spizella passerina*	Com	Unc/Rar	Com	Unc/Rar
Clay-colored Sparrow	*Spizella pallida*	Acc	-	-	-
Field Sparrow	*Spizella pusilla*	Unc/Rar	-	Unc/Rar	Unc/Rar
Savannah Sparrow	*Passerculus sandwichensis*	Com	-	Com	Unc/Rar
Grasshopper Sparrow Hi	*Ammodramus savannarum*	-	Acc	-	-
Fox Sparrow	*Passerella iliaca*	Com	-	-	Unc/Rar
Song Sparrow C	*Melospiza melodia*	Abu	Com	Com	Com
Lincoln's Sparrow	*Melospiza lincolnii*	-	-	Acc	-
Swamp Sparrow	*Melospiza georgiana*	Unc/Rar	-	Com	Unc/Rar
White-throated Sparrow	*Zonotrichia albicollis*	Com	-	Abu	Com
White-crowned Sparrow	*Zonotrichia leucophrys*	Com	-	Unc/Rar	-
Dark-eyed Junco	*Junco hyemalis*	Com	-	Com	Com
Scarlet Tanager S	*Piranga olivacea*	Cas	-	Cas	-
Northern Cardinal P	*Cardinalis cardinalis*	Com	Com	Com	Com
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Unc/Rar	-	-	-
Blue Grosbeak	*Passerina caerulea*	Acc	-	-	-
Indigo Bunting	*Passerina cyanea*	Com	-	Unc/Rar	-
Bobolink Hi	*Dolichonyx oryzivorus*	Acc	-	Acc	-
Red-winged Blackbird C	*Agelaius phoeniceus*	Abu	Com	Com	Com
Eastern Meadowlark Hi	*Sturnella magna*	Unc/Rar	-	Unc/Rar	Com
Rusty Blackbird Hi	*Euphagus carolinus*	Cas	-	Cas	-
Common Grackle C	*Quiscalus quiscula*	Abu	Com	Com	Abu
Brown-headed Cowbird C	*Molothrus ater*	Com	Com	-	Com
Orchard Oriole P	*Icterus spurius*	Unc/Rar	Unc/Rar	-	-
Baltimore Oriole C	*Icterus galbula*	Com	Unc/Rar	Unc/Rar	-
Purple Finch	*Haemorhous purpureus*	-	-	Cas	Cas
House Finch C	*Haemorhous mexicanus*	Com	Com	Com	Com
Red Crossbill	*Loxia curvirostra*	-	-	-	Cas
White-winged Crossbill	*Loxia leucoptera*	-	-	-	Acc
Common Redpoll	*Acanthis flammea*	-	-	-	Cas
Pine Siskin	*Spinus pinus*	-	-	Com	Abu
American Goldfinch C	*Spinus tristis*	Com	Com	Com	Com
House Sparrow C	*Passer domesticus*	Unc/Rar	Unc/Rar	-	Unc/Rar

Appendix D. Plum Island species lists

These lists were assembled from the inventory results reported here plus surveys, reports, and literature previously compiled in Schlesinger *et al.* (2012). Some marine species may have been observed considerably offshore of Plum Island. Moths are listed separately from other invertebrates because common names are not available for many species. Superscripts: C = confirmed breeding; P = probable breeding; Hi = High-priority Species of Greatest Conservation Need; S = Species of Greatest Conservation Need; SP = Species of Potential Conservation Need; HT = Heritage tracked, but none of the other designations.

Vertebrates

Common name	Scientific name
Mammals	
White-footed mouse	*Peromyscus leucopus*
Meadow vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethicus*
Beaver	*Castor canadensis*
Norway rat	*Rattus norvegicus*
Little brown myotis Hi	*Myotis lucifugus*
Big brown bat	*Eptesicus fuscus*
Hoary bat S	*Lasiurus cinereus*
Eastern red bat S	*Lasiurus borealis*
Raccoon	*Procyon lotor*
Harbor seal	*Phoca vitulina*
Gray seal	*Halichoerus grypus*
White-tailed deer	*Odocoileus virginianus*
Northern right whale Hi	*Eubalaena glacialis*
Bottlenose dolphin	*Tursiops truncatus*
Common dolphin	*Delphinus delphis*
Harbor porpoise Hi	*Phocoena phocoena*
Birds	
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Brant	*Branta bernicla*
Canada Goose C	*Branta canadensis*
Mute Swan C	*Cygnus olor*
Wood Duck C	*Aix sponsa*
Gadwall	*Anas strepera*

Common name	Scientific name
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
American Black Duck C,Hi	*Anas rubripes*
Mallard C	*Anas platyrhynchos*
Blue-winged Teal S	*Anas discors*
Northern Pintail S	*Anas acuta*
Green-winged Teal	*Anas crecca*
Greater Scaup S	*Aythya marila*
King Eider	*Somateria spectabilis*
Common Eider P,S	*Somateria mollissima*
Harlequin Duck S	*Histrionicus histrionicus*
Surf Scoter S	*Melanitta perspicillata*
White-winged Scoter S	*Melanitta fusca*
Black Scoter S	*Melanitta americana*
Long-tailed Duck S	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye S	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Red-breasted Merganser	*Mergus serrator*
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon S	*Gavia immer*
Horned Grebe S	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Northern Gannet	*Morus bassanus*
Double-crested Cormorant C	*Phalacrocorax auritus*
Great Cormorant	*Phalacrocorax carbo*

Common name	Scientific name
Brown Pelican	*Pelecanus occidentalis*
American Bittern S	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Great Egret P,S	*Ardea alba*
Snowy Egret S	*Egretta thula*
Little Blue Heron S	*Egretta caerulea*
Green Heron	*Butorides virescens*
Black-crowned Night-Heron C,S	*Nycticorax nycticorax*
Glossy Ibis P,S	*Plegadis falcinellus*
Turkey Vulture P	*Cathartes aura*
Osprey C	*Pandion haliaetus*
Northern Harrier C,S	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Northern Goshawk S	*Accipiter gentilis*
Bald Eagle S	*Haliaeetus leucocephalus*
Red-shouldered Hawk S	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Red-tailed Hawk C	*Buteo jamaicensis*
Rough-legged Hawk	*Buteo lagopus*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Black-bellied Plover S	*Pluvialis squatarola*
American Golden-Plover SP	*Pluvialis dominica*
Semipalmated Plover	*Charadrius semipalmatus*
Piping Plover C,Hi	*Charadrius melodus*
Killdeer C	*Charadrius vociferus*
American Oystercatcher C,S	*Haematopus palliatus*
Spotted Sandpiper C	*Actitis macularius*
Solitary Sandpiper	*Tringa solitaria*
Greater Yellowlegs S	*Tringa melanoleuca*
Willet S	*Tringa semipalmata*
Lesser Yellowlegs	*Tringa flavipes*
Whimbrel Hi	*Numenius phaeopus*
Ruddy Turnstone S	*Arenaria interpres*

Common name	Scientific name
Red Knot Hi	*Calidris canutus*
Sanderling SP	*Calidris alba*
Semipalmated Sandpiper Hi	*Calidris pusilla*
Least Sandpiper	*Calidris minutilla*
Purple Sandpiper S	*Calidris maritima*
Dunlin	*Calidris alpina*
Short-billed Dowitcher Hi	*Limnodromus griseus*
Wilson's Snipe	*Gallinago delicata*
American Woodcock S	*Scolopax minor*
Bonaparte's Gull S	*Chroicocephalus philadelphia*
Laughing Gull CO,S	*Leucophaeus atricilla*
Ring-billed Gull	*Larus delawarensis*
Herring Gull CO	*Larus argentatus*
Iceland Gull	*Larus glaucoides*
Lesser Black-backed Gull	*Larus fuscus*
Great Black-backed Gull P	*Larus marinus*
Least Tern P,S	*Sternula antillarum*
Caspian Tern S	*Hydroprogne caspia*
Black Tern H	*Chlidonias niger*
Roseate Tern CO,Hi	*Sterna dougallii*
Common Tern CO,S	*Sterna hirundo*
Forster's Tern S	*Sterna forsteri*
Black Skimmer Hi	*Rynchops niger*
Razorbill S	*Alca torda*
Rock Pigeon	*Columba livia*
Mourning Dove P	*Zenaida macroura*
Yellow-billed Cuckoo	*Coccyzus americanus*
Black-billed Cuckoo S	*Coccyzus erythropthalmus*
Great Horned Owl C	*Bubo virginianus*
Snowy Owl	*Bubo scandiacus*
Eastern Whip-poor-will Hi	*Antrostomus vociferus*
Chimney Swift	*Chaetura pelagica*
Ruby-throated Hummingbird	*Archilochus colubris*
Belted Kingfisher C	*Megaceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*

Common name	Scientific name
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Downy Woodpecker C	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker P	*Colaptes auratus*
American Kestrel S	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon S	*Falco peregrinus*
Eastern Wood-Pewee	*Contopus virens*
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Alder Flycatcher	*Empidonax alnorum*
Willow Flycatcher C	*Empidonax traillii*
Least Flycatcher	*Empidonax minimus*
Eastern Phoebe C	*Sayornis phoebe*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Great Crested Flycatcher C	*Myiarchus crinitus*
Eastern Kingbird C	*Tyrannus tyrannus*
White-eyed Vireo C	*Vireo griseus*
Yellow-throated Vireo	*Vireo flavifrons*
Blue-headed Vireo	*Vireo solitarius*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay P	*Cyanocitta cristata*
American Crow C	*Corvus brachyrhynchos*
Fish Crow	*Corvus ossifragus*
Horned Lark Hi	*Eremophila alpestris*
Northern Rough-winged Swallow C	*Stelgidopteryx serripennis*
Purple Martin P	*Progne subis*
Tree Swallow C	*Tachycineta bicolor*
Bank Swallow C	*Riparia riparia*
Barn Swallow C	*Hirundo rustica*
Cliff Swallow	*Petrochelidon pyrrhonota*
Black-capped Chickadee C	*Poecile atricapillus*
Tufted Titmouse C	*Baeolophus bicolor*
Red-breasted Nuthatch	*Sitta canadensis*

Common name	Scientific name
White-breasted Nuthatch	*Sitta carolinensis*
Brown Creeper	*Certhia americana*
House Wren C	*Troglodytes aedon*
Winter Wren	*Troglodytes hiemalis*
Marsh Wren	*Cistothorus palustris*
Carolina Wren C	*Thryothorus ludovicianus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Northern Wheatear	*Oenanthe oenanthe*
Eastern Bluebird	*Sialia sialis*
Veery	*Catharus fuscescens*
Hermit Thrush	*Catharus guttatus*
Wood Thrush S	*Hylocichla mustelina*
American Robin C	*Turdus migratorius*
Gray Catbird C	*Dumetella carolinensis*
Northern Mockingbird C	*Mimus polyglottos*
Brown Thrasher P,Hi	*Toxostoma rufum*
European Starling C	*Sturnus vulgaris*
American Pipit	*Anthus rubescens*
Bohemian Waxwing	*Bombycilla garrulus*
Cedar Waxwing C	*Bombycilla cedrorum*
Snow Bunting	*Plectrophenax nivalis*
Ovenbird	*Seiurus aurocapilla*
Northern Waterthrush	*Parkesia noveboracensis*
Blue-winged Warbler S	*Vermivora cyanoptera*
Black-and-white Warbler	*Mniotilta varia*
Tennessee Warbler SP	*Oreothlypis peregrina*
Orange-crowned Warbler	*Oreothlypis celata*
Nashville Warbler	*Oreothlypis ruficapilla*
Common Yellowthroat C	*Geothlypis trichas*
American Redstart C	*Setophaga ruticilla*
Cape May Warbler Hi	*Setophaga tigrina*
Northern Parula	*Setophaga americana*
Magnolia Warbler	*Setophaga magnolia*

Common name	Scientific name
Blackburnian Warbler	*Setophaga fusca*
Yellow Warbler C	*Setophaga petechia*
Chestnut-sided Warbler	*Setophaga pensylvanica*
Blackpoll Warbler	*Setophaga striata*
Black-throated Blue Warbler S	*Setophaga caerulescens*
Palm Warbler	*Setophaga palmarum*
Pine Warbler	*Setophaga pinus*
Yellow-rumped Warbler	*Setophaga coronata*
Prairie Warbler S	*Setophaga discolor*
Black-throated Green Warbler	*Setophaga virens*
Wilson's Warbler	*Cardellina pusilla*
Eastern Towhee C	*Pipilo erythrophthalmus*
American Tree Sparrow	*Spizella arborea*
Chipping Sparrow C	*Spizella passerina*
Clay-colored Sparrow	*Spizella pallida*
Field Sparrow	*Spizella pusilla*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow Hi	*Ammodramus savannarum*
Fox Sparrow	*Passerella iliaca*
Song Sparrow C	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Scarlet Tanager S	*Piranga olivacea*
Northern Cardinal P	*Cardinalis cardinalis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Blue Grosbeak	*Passerina caerulea*
Indigo Bunting	*Passerina cyanea*
Bobolink Hi	*Dolichonyx oryzivorus*
Red-winged Blackbird C	*Agelaius phoeniceus*
Eastern Meadowlark Hi	*Sturnella magna*
Rusty Blackbird Hi	*Euphagus carolinus*
Common Grackle C	*Quiscalus quiscula*
Brown-headed Cowbird C	*Molothrus ater*
Orchard Oriole P	*Icterus spurius*
Baltimore Oriole C	*Icterus galbula*
Purple Finch	*Haemorhous purpureus*
House Finch C	*Haemorhous mexicanus*
Red Crossbill	*Loxia curvirostra*
White-winged Crossbill	*Loxia leucoptera*
Common Redpoll	*Acanthis flammea*
Pine Siskin	*Spinus pinus*
American Goldfinch C	*Spinus tristis*
House Sparrow C	*Passer domesticus*
Reptiles	
Garter snake	*Thamnophis sirtalis*
Brown snake	*Storeria dekayi*
Snapping turtle S	*Chelydra serpentina*
Painted turtle	*Chrysemys picta*
Eastern box turtle Hi	*Terrapene carolina*
Fish	
Mummichog S	*Fundulus heteroclitus*
Mosquitofish	*Gambusia affinis*
Goldfish	*Carassius auratus*
Atlantic silverside S	*Menidia menidia*

Moths

Apatelodidae
Apatelodes torrefacta
Drepanidae
Drepana arcuata
Erebidae
Allotria elonympha
Amolita roseola
Apantesis carlotta
Apantesis nais
Apantesis phalerata
Argyrostrotis anilis
Bleptina caradrinalis
Caenurgina erechtea
Catocala ?similis
Catocala amica
Catocala andromedae
Catocala coccinata
Catocala dejecta
Catocala ilia
Catocala micronympha
Catocala paleogama
Catocala serena
Catocala sordida
Catocala ultronia
Chytolita morbidalis
Cisseps fulvicollis
Cisthene packardii HT
Crambidia pallida
Cycnia tenera
Drasteria graphica atlantica
Drasteria occulta
Euparthenos nubilis

Grammia parthenice
Halysidota tessellaris
Hypena baltimoralis
Hypena scabra
Hypercompe scribonia
Hypoprepia fucosa
Idia aemula
Idia americalis
Idia diminuendis
Idia forbesi
Idia rotundalis
Ledaea perditalis
Lophocampa caryae
Lymantria dispar
Macrochilo orciferalis
Metalectra discalis
Palthis angulalis
Pangrapta decoralis
Panopoda rufimargo
Parallelia bistriaris
Phalaenophana pyramusalis
Phalaenostola larentioides
Phoberia atomaris
Pyrrharctia isabella
Renia adspergillus
Renia discoloralis
Renia flavipunctalis
Spilosoma congrua
Spilosoma latipennis
Virbia aurantiaca HT
Virbia opella
Zale horrida
Zale intenta
Zale lunata/minerea

Zale unilineata
Zanclognatha cruralis
Zanclognatha marcidilinea
Geometridae
Anavitrinella pampinaria
Antepione thisoaria
Besma quercivoraria
Biston betularia
Campaea perlata
Chlorochlamus chloroleucaria
Costaconvexa centrostrigaria
Cyclophora packardi
Cyclophora pendulinaria
Dyspteris abortivaria
Ennomos magnaria
Epimecis hortaria
Epirrhoe alternata
Euchlaena ?marginaria
Euchlaena irraria
Euchlaena johnsonaria
Euchlaena muzaria
Euchlaena serrata
Eugonobapta nivosaria
Eulithis diversilineata
Eumacaria madopata
Eusarca confusaria
Eutrapela clemataria
Gueneria similaria
Heliomata cycladata
Hethemia pistaciaria
Hypagyrtis unipuncta
Idaea dimidiata
Itame virginalis

Lambdina fervidaria
Lobocleta ossularia
Lomographa vestaliata
Lytrosis unitaria
Macaria bisignata
Melanolophia canadaria
Melanolophia signataria
Metarranthis ?hypochraria
Metarranthis duaria
Metarranthis obfirmaria
Nematocampa resistaria
Nemoria bistriaria
Orthonama obstipata
Pasiphila rectangulata
Patalene olyzonaria
Pero anceltaria
Pero honestaria
Pero morrisonaria
Plagodis fervidaria
Pleuroprucha insulsaria
Probole amicaria
Prochoerodes lineola
Protoboarmia porcelaria
Rheumaptera prunivorata
Scopula inductata
Scopula limboundata
Speranza pustularia
Synchlora aerata
Tetracis cachexiata
Tetracis crocallata
Lasiocampidae
Malacosoma americana
Malacosoma disstria

Limacodidae
Apoda y-inversum
Euclea delphinii
Lithacodes fasciola
Parasa chloris
Prolimacodes badia
Tortricidia flexuosa
Tortricidia testacea
Megalopygidae
Lagoa crispata
Noctuidae
Abagrotis alternata
Abagrotis cupida
Abagrotis magnicupida
Abagrotis nefascia SP
Achatia indistincta
Acronicta americana
Acronicta hasta
Acronicta heasitata/tristis
Acronicta interrupta
Acronicta modica
Agnorisma badinodis
Agriopodes fallax
Agrotis ipsilon
Agrotis venerabilis
Agrotis vetusta
Amphipoea interoceanica
Amphipyra pyramidoides
Anicla illapsa
Apamea inordinata SP
Apamea lintneri HT
Apamea vulgaris
Athetis tarda
Balsa labecula

Callopistria mollissima
Cerma cerintha
Choephora fungorum
Chrysodexeis includens
Chytonix palliatricula
Condica videns
Cosmia calami
Crocigrapha normani
Dargida diffusa
Dargida rubripennis
Deltote bellicula
Elaphria alapallida
Elaphria grata
Epiglaea apiata
Eucirroedia pampina
Eucoptocnemis fimbriaris S
Eudryas grata
Eudryas unio
Euplexia benesimilis
Eupsilia ?vinulenta
Euxoa bostoniensis
Euxoa detersa
Euxoa pleuritica
Feltia geniculata
Feltia herilis
Feltia jaculifera
Fishia illocata
Helicoverpa zea
Himella fidelis
Homophoberia apicosa
Homorthodes lindseyi
Iodopepla u-album
Lacanobia grandis
Lacinipolia renigera
Lacinipolia vicina
Lepipolys perscripta SP

Leucania extincta
Leucania linda
Leucania linita
Leucania ursula
Leuconycta diphteroides
Lithophane antennata
Marathyssa inficita
Morrisonia evicta
Mythimna oxygala
Mythimna unipuncta
Nephelodes minians
Noctua pronuba
Ochrapleura implecta
Orthodes cynica
Orthodes detracta
Orthodes majuscula
Orthosia rubescens
Paectes oculatrix
Paectes pygmea
Papaipema duovata HT
Phlogophora periculosa
Phosphila miscelioides
Phosphila turbulenta
Plusia contexta
Polygrammate hebraeicum
Ponometia candefacta
Protolampra brunneicollis
Protorthodes oviduca
Proxenus miranda
Schinia arcigera
Schinia lynx
Schinia nundina
Schinia spinosae HT
Sericaglaea signata
Spodoptera ornithogalli
Sunira bicolorago

Sympistis riparia HT
Trichoilita signata
Ulolonche culea
Ulolonche modesta
Xestia dilucida
Xestia dolosa
Xestia smithii
Nolidae
Baileya levitans
Notodontidae
Datana drexelli/major
Datana ministra
Datana perspicua
Gluphisia septentrionis
Heterocampa guttivitta
Heterocampa obliqua
Heterocampa umbrata
Hyperaeschra georgica
Nadata gibbosa
Peridea angulosa
Saturniidae
Automeris io
Sphingidae
Darapsa myron
Eumorpha achemon
Eumorpha pandorus
Paonias excaecata
Sphecodina abbotti
Sphinx gordius HT
Yponomeutidae
Atteva aurea

Other invertebrates

For dragonflies and damselflies we followed the protocol for documentation from the New York Dragonfly and Damselfy Survey (White *et al.* 2010), while for butterflies we supplemented our survey results with observations from 2005 by MaryLaura Lamont as reported in Schlesinger *et al.* (2012). Apart from carrion beetles, other taxa were detected opportunistically and identified as time permitted, and this list just scratches the surface of the island's invertebrate fauna.

Scientific name	Common name
Gastropods	
Limax maximus	Leopard slug
Dragonflies and damselflies	
Anax junius	Common green darner
Enallagma civile	Familiar bluet
Erythemis simplicicollis	Eastern pondhawk
Ischnura posita	Fragile forktail
Ischnura ramburii S	Rambur's forktail
Ischnura verticalis	Eastern forktail
Libellula auripennis HT	Golden-winged skimmer
Libellula needhami S	Needham's skimmer
Libellula pulchella	Twelve-spotted skimmer
Pachydiplax longipennis	Blue dasher
Pantala flavescens	Wandering glider
Pantala hymenaea	Spot-winged glider
Perithemis tenera	Eastern amberwing
Plathemis lydia	Common whitetail
Sympetrum sp.	A meadowhawk
Tramea carolina	Carolina saddlebags
Tramea lacerata	Black saddlebags
Butterflies	
Danaus plexippus SP	Monarch
Papilio polyxenes	Black swallowtail
Colias eurytheme	Orange sulphur
Colias philodice	Clouded sulphur
Pieris rapae	Cabbage white

Scientific name	Common name
Cupido comyntas	Eastern tailed blue
Vanessa cardui	Painted lady
Vanessa atalanta	Red admiral
Epargyreus clarus	Silver-spotted skipper
Thymelicus lineola	European skipper
Poanes hobomok	Hobomok skipper
Fishflies	
Chauliodes pectinicornis	
Chauliodes rasticornis	
Caddisflies	
Cheumatopsyche sp.	
Hydropsyche betteni	
Oecetis inconspicua	
Triaenodes aba	
Triaenodes nox	
Limnephilus indivisus	
Limnephilus submonilifer	
Platycentropus radiatus	
Phryganea sayi	
Ptilostomis angustipennis	
Beetles	
Carabus nemoralis	Woodland worm and slug hunter
Cicindela hirticollis Hi	Hairy-necked tiger beetle
Cicindela punctulata	Punctured tiger beetle
Cicindela repanda	Bronzed tiger beetle

Scientific name	Common name
Copris minutis	
Cyclocephala borealis	
Diaperis maculata	
Dichelotarsus sp.	
Exomala orientalis	Oriental beetle
Harmonia axyridis	Multicolored Asian lady beetle
Harpalus affinis?	
Hydrochara soror	
Maladera castanea	Asiatic garden beetle
Necrophila americana	American carrion beetle
Nicrophorus orbicollis	
Nicrophorus sayi	
Nicrophorus tomentosus	Tomentose carrion beetle
Oiceoptoma inequale	Ridged carrion beetle
Pelidnota punctata	Grapevine beetle
Photinus sp.	Firefly
Phyllophaga sp.	May beetle
Poecilus sp.	Carabid beetle
Tetraopes tetrophthalamus	Red milkweed beetle
Tomarus gibbosus?	
Trox sp.	
Bees	
Bombus impatiens	Common eastern bumble bee
Bombus griseocollis	Brown-belted bumble bee

Plants

Species on this combined list are from the *Flora of Plum Island* (Lamont and Stalter 2013) and from surveys in 2015.

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Abutilon theophrasti	Velvet-leaf	Malvaceae	Herb	No	L & S	
Acalypha rhomboidea	Common copperleaf	Euphorbiaceae	Herb	Yes	L & S	
Acer platanoides	Norway maple	Aceraceae	Tree	Inv	New	
Acer pseudoplatanus	Sycamore maple	Aceraceae	Tree	Inv	L & S	
Acer rubrum var. *rubrum*	Red maple	Aceraceae	Tree	Yes	L & S	
Achillea millefolium var. *millefolium*	Common yarrow	Asteraceae	Herb	No	L & S	
Agalinis purpurea	Purple false foxglove	Orobanchaceae	Herb	Yes	L & S	
Ageratina altissima var. *altissima*	White snakeroot	Asteraceae	Herb	Yes	L & S	
Agrostis perennans	Autumn bent	Poaceae	Gram	Yes	L & S	
Agrostis scabra	Rough bentgrass	Poaceae	Gram	Yes	L & S	
Agrostis stolonifera	Creeping bentgrass	Poaceae	Gram	No	L & S	
Ailanthus altissima	Tree-of-heaven	Simaroubaceae	Tree	Inv	L & S	
Aira caryophyllea	Silver hairgrass	Poaceae	Gram	No	L & S	
Albizia julibrissin	Silk tree	Fabaceae	Tree	Inv	L & S	
Alisma subcordatum	Broad-leaved water-plantain	Alismataceae	Herb	Yes	L & S	
Alliaria petiolata	Garlic mustard	Brassicaceae	Herb	Inv	L & S	
Allium vineale	Wild garlic	Alliaceae	Herb	No	L & S	
Amaranthus retroflexus	Redroot pigweed	Amaranthaceae	Herb	Yes	L & S	
Ambrosia artemisiifolia	Annual ragweed	Asteraceae	Herb	Yes	L & S	
Amelanchier canadensis	Oblong-leaved serviceberry	Rosaceae	Shrub	Yes	L & S	
Ammophila breviligulata ssp. *breviligulata*	American beachgrass	Poaceae	Gram	Yes	L & S	
Amorpha fruticosa	False indigobush	Fabaceae	Shrub	No	L & S	
Ampelopsis glandulosa var. *brevipedunculata*	Porcelain berry	Vitaceae	Vine	Inv	New	
Anagallis arvensis	Scarlet pimpernel	Primulaceae	Herb	No	L & S	
Anaphalis margaritacea	Pearly everlasting	Asteraceae	Herb	Yes	L & S	
Andropogon glomeratus var. *glomeratus*	Bushy bluestem	Poaceae	Gram	Yes	L & S	
Andropogon virginicus var. *virginicus*	Broom-sedge	Poaceae	Gram	Yes	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Antennaria plantaginifolia	Plantain-leaved pussytoes	Asteraceae	Herb	Yes	L & S	
Anthoxanthum odoratum	Sweet vernal grass	Poaceae	Gram	No	L & S	
Apocynum cannabinum	Clasping-leaved dogbane	Apocynaceae	Herb	Yes	L & S	
Arabidopsis thaliana	Wall-cress	Brassicaceae	Herb	No	L & S	
Arctium minus	Lesser burdock	Asteraceae	Herb	No	L & S	
Arenaria serpyllifolia var. *serpyllifolia*	Thyme-leaved sandwort	Caryophyllaceae	Herb	No	L & S	
Arisaema triphyllum ssp. *triphyllum*	Common jack-in-the-pulpit	Araceae	Herb	Yes	L & S	
Aristida dichotoma var. *dichotoma*	Shinners three-awned grass	Poaceae	Gram	Yes	L & S	
Aristida oligantha	Prairie three-awn grass	Poaceae	Gram	No	L & S	
Aronia arbutifolia	Red chokeberry	Rosaceae	Shrub	Yes	L & S	
Artemisia vulgaris var. *vulgaris*	Mugwort	Asteraceae	Herb	Inv	L & S	
Asclepias incarnata ssp. *pulchra*	Swamp milkweed	Apocynaceae	Herb	Yes	L & S	
Asclepias syriaca	Common milkweed	Apocynaceae	Herb	Yes	L & S	
Asclepias verticillata	Whorled milkweed	Apocynaceae	Herb	Yes	L & S	S3 - R
Asparagus officinalis	Common asparagus	Asparagaceae	Herb	No	L & S	
Atriplex cristata	Crested saltbush	Chenopodiaceae	Herb	Yes	L & S	
Atriplex prostrata	Creeping saltbush	Chenopodiaceae	Herb	No	L & S	
Avenella flexuosa	Wavy hair grass	Poaceae	Gram	Yes	L & S	
Baccharis halimifolia	Eastern baccharis	Asteraceae	Shrub	Yes	L & S	
Baptisia tinctoria	Wild-indigo	Fabaceae	Shrub	Yes	L & S	
Barbarea vulgaris	Yellow rocket	Brassicaceae	Herb	No	L & S	
Berberis thunbergii	Japanese barberry	Berberidaceae	Shrub	Inv	L & S	
Betula lenta	Sweet birch	Betulaceae	Tree	Yes	L & S	
Betula populifolia	Gray birch	Betulaceae	Tree	Yes	L & S	
Bidens cernua	Nodding beggar-ticks	Asteraceae	Herb	Yes	L & S	
Bidens discoidea	Small beggar-ticks	Asteraceae	Herb	Yes	L & S	
Bidens frondosa	Devil's beggar-ticks	Asteraceae	Herb	Yes	L & S	
Botrychium dissectum	Cut-leaved grape-fern	Ophioglossaceae	F	Yes	L & S	
Brassica nigra	Black mustard	Brassicaceae	Herb	No	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Bromus inermis	Awnless brome	Poaceae	Gram	No	L & S	
Bromus japonicus	Japanese brome	Poaceae	Gram	No	L & S	
Bromus tectorum	Cheat grass	Poaceae	Gram	No	L & S	
Cakile edentula var. *edentula*	American searocket	Brassicaceae	Herb	Yes	L & S	
Calystegia sepium ssp. *sepium*	Hedge false bindweed	Convolvulaceae	Vine	No	L & S	
Capsella bursa-pastoris	Common shepherd's purse	Brassicaceae	Herb	No	L & S	
Cardamine hirsuta	Hairy bitter-cress	Brassicaceae	Herb	No	L & S	
Carex annectens	Yellow-fruited sedge	Cyperaceae	Gram	Yes	L & S	
Carex hormathodes	Marsh straw sedge	Cyperaceae	Gram	Yes	L & S	S2S3 - T
Carex longii	Long's sedge	Cyperaceae	Gram	Yes	L & S	
Carex merritt-fernaldii	Fernald's sedge	Cyperaceae	Gram	Yes	L & S	S2S3 - T
Carex pensylvanica	Pennsylvania sedge	Cyperaceae	Gram	Yes	L & S	
Carex scoparia var. *scoparia*	Broom sedge	Cyperaceae	Gram	Yes	L & S	
Carex silicea	Sea-beach sedge	Cyperaceae	Gram	Yes	L & S	
Carex swanii	Swan sedge	Cyperaceae	Gram	Yes	L & S	
Carex vulpinoidea	Fox sedge	Cyperaceae	Gram	Yes	L & S	
Carya alba	Mockernut hickory	Juglandaceae	Tree	Yes	L & S	
Carya glabra	Pignut hickory	Juglandaceae	Tree	Yes	L & S	
Celastrus orbiculatus	Oriental bittersweet	Celastraceae	Vine	Inv	L & S	
Cenchrus longispinus	Long-spine sandbur	Poaceae	Gram	Yes	L & S	
Centaurea stoebe ssp. *micranthos*	Spotted knapweed	Asteraceae	Herb	Inv	L & S	
Cephalanthus occidentalis	Common buttonbush	Rubiaceae	Shrub	Yes	L & S	
Cerastium fontanum ssp. *vulgare*	Big chickweed	Caryophyllaceae	Herb	No	L & S	
Cerastium semidecandrum	Five-stamened mouse-ear chickweed	Caryophyllaceae	Herb	No	L & S	
Chamaecrista nictitans	Partridge pea	Fabaceae	Herb	Yes	New	
Chamaecyparis thyoides	Atlantic white cedar	Cupressaceae	Tree	Yes	L & S	S2 - T
Chenopodium album	Lambs-quarters	Chenopodiaceae	Herb	No	L & S	
Chenopodium berlandieri var. *macrocalycium*	Pit-seeded goosefoot	Chenopodiaceae	Herb	Yes	L & S	
Chenopodium pratericola	Desert goosefoot	Chenopodiaceae	Herb	Yes	New	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Chimaphila maculata	Spotted wintergreen	Ericaceae	Herb	Yes	L & S	
Cichorium intybus	Chicory	Asteraceae	Herb	No	L & S	
Cirsium arvense	Canada thistle	Asteraceae	Herb	Inv	L & S	
Cirsium vulgare	Bull thistle	Asteraceae	Herb	No	L & S	
Clethra alnifolia	Coast pepperbush	Clethraceae	Shrub	Yes	L & S	
Commelina communis var. *communis*	Asiatic dayflower	Commelinaceae	Herb	No	L & S	
Comptonia peregrina	Sweet fern	Myricaceae	Herb	Yes	L & S	
Convolvulus arvensis	Field bindweed	Convolvulaceae	Vine	No	L & S	
Conyza canadensis var. *pusilla*	Canadian horseweed	Asteraceae	Herb	Yes	L & S	
Cornus florida	Flowering dogwood	Cornaceae	Tree	Yes	L & S	
Crocanthemum dumosum	Bushy rockrose	Cistaceae	Herb	Yes	L & S	S1H - E
Cycloloma atriplicifolium	Winged pigweed	Chenopodiaceae	Herb	No	L & S	
Cynanchum rossicum	Pale swallow-wort	Apocynaceae	Vine	Inv	New	
Cyperus bipartitus	Slender flatsedge	Cyperaceae	Gram	Yes	L & S	
Cyperus erythrorhizos	Redroot flatsedge	Cyperaceae	Gram	Yes	L & S	S3 - R
Cyperus esculentus var. *leptostachyus*	Yellow nut-grass	Cyperaceae	Gram	No	L & S	
Cyperus filicinus	Fern flatsedge	Cyperaceae	Gram	Yes	New	
Cyperus grayi	Gray's flatsedge	Cyperaceae	Gram	Yes	L & S	
Cyperus lupulinus ssp. *lupulinus*	Great Plains flatsedge	Cyperaceae	Gram	Yes	L & S	S1 - E
Cyperus lupulinus ssp. *macilentus*	Great Plains flatsedge	Cyperaceae	Gram	Yes	L & S	
Cyperus polystachyos	Many-spiked flatsedge	Cyperaceae	Gram	Yes	L & S	S1S2 - E
Cyperus retrorsus	Retrorse flatsedge	Cyperaceae	Gram	Yes	L & S	S1 - E
Cyperus strigosus	Straw-colored flatsedge	Cyperaceae	Gram	Yes	L & S	
Dactylis glomerata	Orchard grass	Poaceae	Gram	No	L & S	
Danthonia spicata	Poverty oatgrass	Poaceae	Gram	Yes	L & S	
Datura stramonium	Jimsonweed	Solanaceae	Herb	No	L & S	
Daucus carota	Wild carrot	Apiaceae	Herb	No	L & S	
Decodon verticillatus	Hairy swamp loosestrife	Lythraceae	Herb	Yes	L & S	
Dennstaedtia punctilobula	Eastern hay-scented fern	Dennstaedtiaceae	F	Yes	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Dianthus armeria ssp. *armeria*	Deptford pink	Caryophyllaceae	Herb	No	L & S	
Dichanthelium acuminatum ssp. *columbianum*	Panicgrass	Poaceae	Gram	Yes	L & S	
Dichanthelium clandestinum	Deer-tongue witchgrass	Poaceae	Gram	Yes	L & S	
Dichanthelium ovale ssp. *pseudopubescens*	Egg-leaved witchgrass	Poaceae	Gram	Yes	L & S	
Dichanthelium scoparium	Broom panic grass	Poaceae	Gram	Yes	L & S	S1 - E
Digitaria sanguinalis	Hairy crabgrass	Poaceae	Gram	No	L & S	
Diodia teres var. *teres*	Buttonweed	Rubiaceae	Herb	Yes	L & S	
Diphasiastrum digitatum	Fan club-moss	Lycopodiaceae	F	Yes	L & S	
Draba verna	Whitlow-grass	Brassicaceae	Herb	No	L & S	
Drosera intermedia	Spoon-leaved sundew	Droseraceae	Herb	Yes	L & S	
Dryopteris intermedia ssp. *intermedia*	Evergreen woodfern	Dryopteridaceae	F	Yes	L & S	
Dysphania ambrosioides	Mexican tea	Chenopodiaceae	Herb	No	L & S	
Dysphania botrys	Jerusalem oak	Chenopodiaceae	Herb	Yes	New	
Echinochloa crus-galli	Barnyardgrass	Poaceae	Gram	No	L & S	
Echinochloa walteri	Walter's barnyard grass	Poaceae	Gram	Yes	L & S	
Elaeagnus umbellata	Autumn olive	Elaeagnaceae	Shrub	Inv	L & S	
Eleocharis fallax	Creeping spike-rush	Cyperaceae	Gram	Yes	L & S	S1 - E
Eleocharis flavescens var. *olivacea*	Yellow spike-rush	Cyperaceae	Gram	Yes	L & S	
Eleocharis obtusa	Blunt spike-rush	Cyperaceae	Gram	Yes	L & S	
Eleocharis parvula	Dwarf spike-rush	Cyperaceae	Gram	Yes	New	
Eleocharis uniglumis var. *halophila*	Salt-marsh spike-rush	Cyperaceae	Gram	Yes	L & S	S2S3H - T
Eleusine indica	India goosegrass	Poaceae	Gram	No	L & S	
Elymus virginicus var. *virginicus*	Virginia wild rye	Poaceae	Gram	Yes	L & S	
Epilobium coloratum	Eastern willow-herb	Onagraceae	Herb	Yes	L & S	
Eragrostis curvula	Weeping lovegrass	Poaceae	Gram	No	L & S	
Eragrostis pectinacea var. *pectinacea*	Lovegrass	Poaceae	Gram	Yes	L & S	
Eragrostis spectabilis	Purple lovegrass	Poaceae	Gram	Yes	L & S	
Erechtites hieraciifolius var. *hieraciifolius*	American burnweed	Asteraceae	Herb	Yes	L & S	
Erechtites hieraciifolius var. *megalocarpus*	Large-fruited burnweed	Asteraceae	Herb	Yes	L & S	S1 - E

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Erigeron philadelphicus var. *philadelphicus*	Philadelphia fleabane	Asteraceae	Herb	Yes	L & S	
Erigeron strigosus var. *strigosus*	Prairie fleabane	Asteraceae	Herb	Yes	L & S	
Erodium cicutarium ssp. *cicutarium*	Red-stemmed stork's bill	Geraniaceae	Herb	No	L & S	
Eubotrys racemosa	Coastal fetter-bush	Ericaceae	Shrub	Yes	L & S	
Eupatorium hyssopifolium	Hyssop-leaved thoroughwort	Asteraceae	Herb	Yes	L & S	
Eupatorium perfoliatum	Common boneset	Asteraceae	Herb	Yes	L & S	
Eupatorium pilosum	Rough boneset	Asteraceae	Herb	Yes	L & S	
Euphorbia cyparissias	Cypress spurge	Euphorbiaceae	Herb	No	L & S	
Euphorbia maculata	Spotted spurge	Euphorbiaceae	Herb	Yes	L & S	
Euphorbia polygonifolia	Seaside spurge	Euphorbiaceae	Herb	Yes	L & S	
Eurybia divaricata	White wood-aster	Asteraceae	Herb	Yes	L & S	
Euthamia caroliniana	Grass-leaved goldenrod	Asteraceae	Herb	Yes	L & S	
Euthamia graminifolia	Fragrant grass-leaved goldenrod	Asteraceae	Herb	Yes	L & S	
Eutrochium dubium	Eastern Joe-Pye weed	Asteraceae	Herb	Yes	L & S	
Fallopia convolvulus	Black bindweed	Polygonaceae	Vine	No	L & S	
Fallopia scandens var. *scandens*	Climbing false buckwheat	Polygonaceae	Vine	Yes	L & S	
Festuca rubra ssp. *rubra*	Red fescue	Poaceae	Gram	No	L & S	
Festuca trachyphylla	Hard fescue	Poaceae	Gram	No	L & S	
Fimbristylis autumnalis	Slender fimbry	Cyperaceae	Gram	Yes	L & S	
Fuirena pumila	Dwarf umbrella-sedge	Cyperaceae	Gram	Yes	L & S	
Gaillardia × *grandiflora*	Firewheel	Asteraceae	Herb	No	L & S	
Galinsoga parviflora	Small-flowered quickweed	Asteraceae	Herb	No	L & S	
Galium album	White bedstraw	Rubiaceae	Herb	No	New	
Galium aparine	Cleavers	Rubiaceae	Herb	Yes	L & S	
Galium tinctorium	Stiff marsh bedstraw	Rubiaceae	Herb	Yes	L & S	
Gaylussacia baccata	Black huckleberry	Ericaceae	Shrub	Yes	L & S	
Glaucium flavum	Yellow hornpoppy	Papaveraceae	Herb	No	L & S	
Glyceria striata	Fowl manna grass	Poaceae	Gram	Yes	L & S	
Helianthus petiolaris ssp. *petiolaris*	Prairie sunflower	Asteraceae	Herb	No	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Hemerocallis fulva	Orange daylily	Xanthorrhoeaceae	Herb	No	L & S	
Herniaria hirsuta ssp. *cinerea*	Green carpet	Caryophyllaceae	Herb	No	New	
Hibiscus moscheutos ssp. *moscheutos*	Swamp rosemallow	Malvaceae	Shrub	Yes	L & S	
Hieracium scabrum	Rough hawkweed	Asteraceae	Herb	Yes	L & S	
Honckenya peploides ssp. *robusta*	Sea-chickweed	Caryophyllaceae	Shrub	Yes	L & S	
Hudsonia ericoides	Golden-heather	Cistaceae	Shrub	Yes	L & S	
Hudsonia tomentosa	Sand-heather	Cistaceae	Shrub	Yes	L & S	
Hypericum boreale	Northern St. John's-wort	Hypericaceae	Herb	Yes	L & S	
Hypericum canadense	Canadian St. John's-wort	Hypericaceae	Herb	Yes	L & S	
Hypericum gentianoides	Orange-grass St. John's-wort	Hypericaceae	Herb	Yes	L & S	
Hypericum mutilum	Dwarf St. John's-wort	Hypericaceae	Herb	Yes	L & S	
Hypericum perforatum	Common St. John's-wort	Hypericaceae	Herb	No	L & S	
Hypericum punctatum	Spotted St. John's-wort	Hypericaceae	Herb	Yes	L & S	
Hypochaeris radicata	Spotted cat's-ear	Asteraceae	Herb	No	L & S	
Ilex verticillata	Common winterberry	Aquifoliaceae	Shrub	Yes	L & S	
Impatiens capensis	Orange jewelweed	Balsaminaceae	Herb	Yes	New	
Iris versicolor	Blueflag	Iridaceae	Herb	Yes	L & S	
Juncus bufonius	Toad rush	Juncaceae	Gram	Yes	L & S	
Juncus canadensis	Canada rush	Juncaceae	Gram	Yes	L & S	
Juncus dichotomus	Forked rush	Juncaceae	Gram	Yes	L & S	
Juncus effusus var. *solutus*	Common rush	Juncaceae	Gram	Yes	L & S	
Juncus greenei	Greene's rush	Juncaceae	Gram	Yes	L & S	
Juncus secundus	Secund rush	Juncaceae	Gram	Yes	L & S	
Juncus tenuis	Path rush	Juncaceae	Gram	Yes	L & S	
Juniperus communis var. *depressa*	Dwarf juniper	Cupressaceae	Shrub	Yes	L & S	
Juniperus virginiana var. *virginiana*	Red cedar	Cupressaceae	Tree	Yes	L & S	
Krigia virginica	Virginia dwarf-dandelion	Asteraceae	Herb	Yes	L & S	
Lactuca canadensis	Canada lettuce	Asteraceae	Herb	Yes	L & S	
Lactuca serriola	Prickly lettuce	Asteraceae	Herb	No	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Lamium amplexicaule	Henbit deadnettle	Lamiaceae	Herb	No	L & S	
Lathyrus japonicus var. *maritimus*	Beach pea	Fabaceae	Herb	Yes	L & S	
Lechea maritima var. *maritima*	Beach pinweed	Cistaceae	Herb	Yes	L & S	
Leersia oryzoides	Rice cutgrass	Poaceae	Gram	Yes	L & S	
Lemna minor	Lesser duckweed	Araceae	Herb	Yes	L & S	
Leonurus cardiaca	Motherwort	Lamiaceae	Herb	No	New	
Lepidium campestre	Field pepperweed	Brassicaceae	Herb	No	L & S	
Lepidium virginicum var. *virginicum*	Wild peppergrass	Brassicaceae	Herb	Yes	L & S	
Lespedeza capitata	Round-head bush-clover	Fabaceae	Herb	Yes	L & S	
Lespedeza violacea	Wand bush-clover	Fabaceae	Herb	Yes	L & S	
Leucanthemum vulgare	Oxeye daisy	Asteraceae	Herb	No	L & S	
Liatris scariosa var. *novae-angliae*	New England blazing star	Asteraceae	Herb	Yes	L & S	S2H - T
Ligusticum scothicum ssp. *scothicum*	Scottish licorice-root	Apiaceae	Herb	Yes	L & S	S1H - E
Ligustrum vulgare	European privet	Oleaceae	Shrub	No	L & S	
Lilium superbum	Turk's-cap lily	Liliaceae	Herb	Yes	L & S	
Linaria vulgaris	Butter-and-eggs	Plantaginaceae	Herb	No	L & S	
Lindernia dubia var. *dubia*	Yellow-seeded false pimpernel	Linderniaceae	Herb	Yes	L & S	
Linum striatum	Ridged yellow flax	Linaceae	Herb	Yes	L & S	
Lobelia inflata	Indian-tobacco	Campanulaceae	Herb	Yes	L & S	
Lobelia siphilitica	Great blue lobelia	Campanulaceae	Herb	Yes	L & S	
Lobelia spicata	Pale-spiked lobelia	Campanulaceae	Herb	Yes	L & S	
Lolium multiflorum	Italian ryegrass	Poaceae	Gram	No	L & S	
Lolium perenne	Perennial ryegrass	Poaceae	Gram	No	L & S	
Lonicera japonica	Japanese honeysuckle	Caprifoliaceae	Vine	Inv	L & S	
Lonicera morrowii	Morrow's honeysuckle	Caprifoliaceae	Shrub	Inv	L & S	
Lotus corniculatus	Bird's-foot trefoil	Fabaceae	Herb	No	L & S	
Ludwigia palustris	Marsh seedbox	Onagraceae	Herb	Yes	L & S	
Lunaria annua	Annual honesty	Brassicaceae	Herb	No	L & S	
Lycopus americanus	American bugleweed	Lamiaceae	Herb	Yes	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Lycopus uniflorus	Northern bugleweed	Lamiaceae	Herb	Yes	New	
Lyonia ligustrina	Maleberry	Ericaceae	Shrub	Yes	L & S	
Lysimachia quadrifolia	Whorled loosestrife	Primulaceae	Herb	Yes	L & S	
Lysimachia terrestris	Swamp loosestrife	Primulaceae	Herb	Yes	L & S	
Lythrum salicaria	Purple loosestrife	Lythraceae	Herb	Inv	L & S	
Maianthemum racemosum ssp. *racemosum*	False Solomon's-seal	Ruscaceae	Herb	Yes	L & S	
Malus sieboldii	Toringa crabapple	Rosaceae	Tree	No	L & S	
Malva neglecta	Common mallow	Malvaceae	Herb	No	L & S	
Matricaria discoidea	Pineapple-weed chamomile	Asteraceae	Herb	No	L & S	
Medicago lupulina	Black medick	Fabaceae	Herb	No	L & S	
Medicago sativa ssp. *sativa*	Alfalfa	Fabaceae	Herb	No	L & S	
Melilotus albus	White sweetclover	Fabaceae	Herb	No	L & S	
Mentha spicata	Spearmint	Lamiaceae	Herb	No	L & S	
Mikania scandens	Climbing hempweed	Asteraceae	Vine	Yes	L & S	
Mollugo verticillata	Green carpet-weed	Molluginaceae	Herb	No	L & S	
Morella caroliniensis	Bayberry	Myricaceae	Shrub	Yes	L & S	
Morus alba	White mulberry	Moraceae	Tree	No	L & S	
Muhlenbergia schreberi	Schreber muhly	Poaceae	Gram	Yes	L & S	
Myosotis scorpioides	True forget-me-not	Boraginaceae	Herb	No	L & S	
Myriophyllum humile	Low water-milfoil	Haloragaceae	Herb	Yes	New	
Myriophyllum pinnatum	Cut-leaved water-milfoil	Haloragaceae	Herb	Yes	L & S	S1-E
Nepeta cataria	Catnip	Lamiaceae	Herb	No	L & S	
Nipponanthemum nipponicum	Montauk daisy	Asteraceae	Herb	No	New	
Nuttallanthus canadensis	Canada toadflax	Plantaginaceae	Herb	Yes	L & S	
Nymphaea odorata ssp. *odorata*	White water-lily	Nymphaeaceae	Herb	Yes	L & S	
Nyssa sylvatica	Blackgum	Nyssaceae	Tree	Yes	L & S	
Oclemena acuminata	Whorled aster	Asteraceae	Herb	Yes	L & S	
Oenothera biennis	Common evening-primrose	Onagraceae	Herb	Yes	L & S	
Oenothera oakesiana	Oakes' evening-primrose	Onagraceae	Herb	Yes	L & S	S2 - T

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Onoclea sensibilis	Sensitive fern	Onocleaceae	F	Yes	L & S	
Opuntia humifusa	Prickly-pear Cactus	Cactaceae	Herb	Yes	New	
Ornithogalum umbellatum	Common star-of-Bethlehem	Hyacinthaceae	Herb	No	L & S	
Osmunda regalis var. *spectabilis*	Royal fern	Osmundaceae	F	Yes	L & S	
Osmundastrum cinnamomea	Cinnamon fern	Osmundaceae	F	Yes	L & S	
Panicum amarum ssp. *amarum*	Smaller seabeach grass	Poaceae	Gram	Yes	L & S	
Panicum capillare ssp. *capillare*	Old witch panic-grass	Poaceae	Gram	Yes	L & S	
Panicum dichotomiflorum var. *dichotomiflorum*	Fall panicgrass	Poaceae	Gram	Yes	L & S	
Panicum virgatum	Switchgrass	Poaceae	Gram	Yes	L & S	
Parthenocissus quinquefolia	Virginia creeper	Vitaceae	Vine	Yes	L & S	
Paspalum setaceum var. *muhlenbergii*	Thin paspalum	Poaceae	Gram	Yes	L & S	
Paulownia tomentosa	Royal paulownia	Paulowniaceae	Tree	No	L & S	
Persicaria extremiorientalis	Far Eastern smartweed	Polygonaceae	Herb	Inv	New	
Persicaria hydropiperoides	Swamp smartweed	Polygonaceae	Herb	Yes	L & S	
Persicaria pensylvanica	Pennsylvania smartweed	Polygonaceae	Herb	Yes	L & S	
Persicaria punctata	Dotted smartweed	Polygonaceae	Herb	Yes	L & S	
Phleum pratense ssp. *pratense*	Meadow timothy	Poaceae	Gram	No	L & S	
Phragmites australis	Old World common reed	Poaceae	Gram	Inv	L & S	
Phytolacca americana var. *americana*	Common pokeweed	Phytolaccaceae	Herb	Yes	L & S	
Pilosella caespitosa	Meadow hawkweed	Asteraceae	Herb	No	L & S	
Pinus rigida	Pitch pine	Pinaceae	Tree	Yes	L & S	
Pinus sylvestris var. *sylvestris*	Scotch pine	Pinaceae	Tree	No	L & S	
Pinus thunbergiana	Japanese black pine	Pinaceae	Tree	Inv	L & S	
Pityopsis falcata	Sickle-leaved golden-aster	Asteraceae	Herb	Yes	L & S	
Plantago aristata	Largebracted plantain	Plantaginaceae	Herb	No	L & S	
Plantago lanceolata	Narrow-leaved plantain	Plantaginaceae	Herb	No	L & S	
Plantago major	Nipple-seeded plantain	Plantaginaceae	Herb	No	L & S	
Plantago rugelii	Black-seeded plantain	Plantaginaceae	Herb	Yes	L & S	
Platanthera lacera	Green fringed orchis	Orchidaceae	Herb	Yes	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Pluchea odorata var. *succulenta*	Saltmarsh fleabane	Asteraceae	Herb	Yes	L & S	
Poa annua	Annual bluegrass	Poaceae	Gram	No	L & S	
Poa compressa	Canada bluegrass	Poaceae	Gram	No	L & S	
Poa pratensis ssp. *pratensis*	Kentucky bluegrass	Poaceae	Gram	No	L & S	
Polygala cruciata var. *aquilonia*	Cross-leaved milkwort	Polygalaceae	Herb	Yes	L & S	S3? - R
Polygonella articulata	Coastal jointweed	Polygonaceae	Herb	Yes	L & S	
Polygonum aviculare ssp. *aviculare*	Common knotweed	Polygonaceae	Herb	No	L & S	
Polygonum aviculare ssp. *depressum*	Common knotweed	Polygonaceae	Herb	No	L & S	
Polygonum glaucum	Seabeach knotweed	Polygonaceae	Herb	Yes	L & S	S3? - R
Populus alba	White poplar	Salicaceae	Tree	No	L & S	
Populus deltoides	Eastern cottonwood	Salicaceae	Tree	Yes	L & S	
Populus tremuloides	Quaking aspen	Salicaceae	Tree	Yes	New	
Portulaca oleracea	Common purslane	Portulacaceae	Herb	No	L & S	
Potamogeton bicupulatus	Snail-seeded pondweed	Potamogetonaceae	Herb	Yes	New	
Potentilla argentea	Silvery cinquefoil	Rosaceae	Herb	No	L & S	
Potentilla canadensis	Canada cinquefoil	Rosaceae	Herb	Yes	L & S	
Potentilla norvegica ssp. *monspeliensis*	Norwegian cinquefoil	Rosaceae	Herb	No	L & S	
Potentilla recta	Sulphur cinquefoil	Rosaceae	Herb	No	L & S	
Prenanthes altissima	Tall rattlesnake-root	Asteraceae	Herb	Yes	L & S	
Proserpinaca palustris var. *palustris*	Marsh mermaidweed	Haloragaceae	Herb	Yes	L & S	
Prunella vulgaris var. *vulgaris*	Eurasian self-heal	Lamiaceae	Herb	No	L & S	
Prunus maritima	Beach plum	Rosaceae	Shrub	Yes	L & S	
Prunus serotina var. *serotina*	Wild black cherry	Rosaceae	Tree	Yes	L & S	
Pseudognaphalium obtusifolium	Fragrant cudweed	Asteraceae	Herb	Yes	L & S	
Pteridium aquilinum var. *latiusculum*	Bracken fern	Dennstaedtiaceae	F	Yes	L & S	
Ptilimnium capillaceum	Mock bishop-weed	Apiaceae	Herb	Yes	L & S	S3?H - R
Pyrus communis	Common pear	Rosaceae	Tree	No	L & S	
Quercus alba	White oak	Fagaceae	Tree	Yes	L & S	
Quercus palustris	Pin oak	Fagaceae	Tree	Yes	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Quercus prinoides	Scrub chestnut oak	Fagaceae	Tree	Yes	L & S	
Quercus velutina	Black oak	Fagaceae	Tree	Yes	L & S	
Quercus × *faxonii*	Hybrid oak	Fagaceae	Tree	Yes	L & S	
Ranunculus abortivus	Kidney-leaved crowfoot	Ranunculaceae	Herb	Yes	L & S	
Raphanus raphanistrum	Wild radish	Brassicaceae	Herb	No	L & S	
Rhododendron viscosum	Swamp azalea	Ericaceae	Shrub	Yes	L & S	
Rhus copallinum	Winged sumac	Anacardiaceae	Shrub	Yes	L & S	
Rhus glabra	Smooth sumac	Anacardiaceae	Shrub	Yes	L & S	
Rhus typhina	Staghorn sumac	Anacardiaceae	Shrub	Yes	L & S	
Rhynchospora capitellata	Brownish beak-rush	Cyperaceae	Gram	Yes	L & S	
Robinia hispida var. *hispida*	Bristly locust	Fabaceae	Shrub	Inv	L & S	
Robinia pseudoacacia	Black locust	Fabaceae	Tree	Inv	L & S	
Rosa carolina var. *carolina*	Carolina rose	Rosaceae	Shrub	Yes	L & S	
Rosa lucieae	Memorial rose	Rosaceae	Shrub	Inv	New	
Rosa multiflora	Multiflora rose	Rosaceae	Shrub	Inv	L & S	
Rosa palustris	Swamp rose	Rosaceae	Shrub	Yes	L & S	
Rosa rugosa	Rugosa rose	Rosaceae	Shrub	Inv	L & S	
Rubus allegheniensis	Allegheny blackberry	Rosaceae	Shrub	Yes	L & S	
Rubus flagellaris	Northern dewberry	Rosaceae	Vine	Yes	L & S	
Rubus hispidus	Bristly dewberry	Rosaceae	Vine	Yes	L & S	
Rubus phoenocolasius	Wineberry	Rosaceae	Shrub	Inv	New	
Rudbeckia hirta var. *pulcherrima*	Black-eyed Susan	Asteraceae	Herb	No	L & S	
Rumex acetosella ssp. *pyrenaicus*	Sheep sorrel	Polygonaceae	Herb	No	L & S	
Rumex crispus ssp. *crispus*	Curly dock	Polygonaceae	Herb	No	L & S	
Ruppia maritima	Widgeon-grass	Ruppiaceae	Herb	Yes	New	
Sagittaria latifolia	Broad-leaved arrowhead	Alismataceae	Herb	Yes	L & S	
Salix humilis var. *humilis*	Tall prairie willow	Salicaceae	Shrub	Yes	L & S	
Salix nigra	Black willow	Salicaceae	Tree	Yes	L & S	
Salsola kali ssp. *kali*	Russian thistle	Chenopodiaceae	Herb	No	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Sambucus nigra ssp. *canadensis*	Common elderberry	Adoxaceae	Shrub	Yes	L & S	
Saponaria officinalis	Bouncing-bet	Caryophyllaceae	Herb	No	L & S	
Sassafras albidum	Sassafras	Lauraceae	Tree	Yes	L & S	
Schedonorus arundinaceus	Tall fescue	Poaceae	Gram	No	L & S	
Schizachyrium littorale	Shore bluestem	Poaceae	Gram	Yes	L & S	
Schizachyrium scoparium var. *scoparium*	Little bluestem	Poaceae	Gram	Yes	L & S	
Schoenoplectiella mucronata	Bog bulrush	Cyperaceae	Gram	Inv	New	
Schoenoplectus americanus	Three-square bulrush	Cyperaceae	Gram	Yes	New	
Schoenoplectus pungens	Three-square bulrush	Cyperaceae	Gram	Yes	L & S	
Schoenoplectus tabernaemontani	Soft-stemmed bulrush	Cyperaceae	Gram	Yes	L & S	
Scirpus cyperinus	Woolgrass	Cyperaceae	Gram	Yes	New	
Scleranthus annuus ssp. *annuus*	Annual knawel	Caryophyllaceae	Herb	No	L & S	
Scutellaria galericulata	Hooded skullcap	Lamiaceae	Herb	Yes	L & S	
Scutellaria lateriflora	Mad-dog skullcap	Lamiaceae	Herb	Yes	L & S	
Sedum acre	Gold-moss	Crassulaceae	Herb	No	L & S	
Senecio vulgaris	Common groundsel	Asteraceae	Herb	No	L & S	
Setaria faberi	Giant foxtail	Poaceae	Gram	No	L & S	
Setaria parviflora	Bristly foxtail	Poaceae	Gram	Yes	L & S	
Setaria pumila ssp. *pumila*	Yellow bristlegrass	Poaceae	Gram	No	L & S	
Silene caroliniana ssp. *pensylvanica*	Pennsylvania catchfly	Caryophyllaceae	Herb	Yes	L & S	S2 - T
Silene latifolia	Bladder campion	Caryophyllaceae	Herb	No	L & S	
Silene vulgaris	Bladder campion	Caryophyllaceae	Herb	No	L & S	
Sisyrinchium atlanticum	Eastern blue-eyed grass	Iridaceae	Herb	Yes	L & S	
Sium suave	Hemlock water-parsnip	Apiaceae	Herb	Yes	L & S	
Smilax glauca	Wild sarsaparilla	Smilacaceae	Vine	Yes	L & S	
Smilax rotundifolia	Round-leaved greenbrier	Smilacaceae	Vine	Yes	L & S	
Solanum carolinense var. *carolinense*	Carolina horsenettle	Solanaceae	Herb	Yes	L & S	
Solanum dulcamara var. *dulcamara*	Climbing nightshade	Solanaceae	Herb	No	L & S	
Solanum nigrum	Black nightshade	Solanaceae	Herb	No	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Solidago altissima ssp. *altissima*	Tall goldenrod	Asteraceae	Herb	Yes	L & S	
Solidago juncea	Early goldenrod	Asteraceae	Herb	Yes	L & S	
Solidago nemoralis ssp. *nemoralis*	Gray goldenrod	Asteraceae	Herb	Yes	L & S	
Solidago odora ssp. *odora*	Sweet goldenrod	Asteraceae	Herb	Yes	L & S	
Solidago rugosa var. *rugosa*	Wrinkle-leaved goldenrod	Asteraceae	Herb	Yes	L & S	
Solidago sempervirens var. *sempervirens*	Seaside goldenrod	Asteraceae	Herb	Yes	L & S	
Sonchus asper	Spiny-leaved sowthistle	Asteraceae	Herb	No	L & S	
Sonchus oleraceus	Common sowthistle	Asteraceae	Herb	No	L & S	
Spartina patens	Saltmeadow cordgrass	Poaceae	Gram	Yes	L & S	
Spartina pectinata	Fresh water cordgrass	Poaceae	Gram	Yes	L & S	
Spiraea alba var. *latifolia*	Northern meadow-sweet	Rosaceae	Shrub	Yes	L & S	
Spiraea tomentosa var. *tomentosa*	Hardhack spiraea	Rosaceae	Shrub	Yes	L & S	
Spiranthes cernua	Nodding ladies'-tresses	Orchidaceae	Herb	Yes	L & S	
Spiranthes lacera var. *gracilis*	Southern slender ladies'-tresses	Orchidaceae	Herb	Yes	L & S	
Spiranthes vernalis	Twisted ladies'-tresses	Orchidaceae	Herb	Yes	L & S	S1 - E
Sporobolus compositus var. *compositus*	Composite dropseed	Poaceae	Gram	Yes	L & S	
Stellaria media ssp. *media*	Common chickweed	Caryophyllaceae	Herb	No	L & S	
Strophostyles helvula	Trailing fuzzybean	Fabaceae	Vine	Yes	L & S	
Symphyotrichum dumosum	Bushy aster	Asteraceae	Herb	Yes	L & S	
Symphyotrichum ericoides	White heath aster	Asteraceae	Herb	Yes	New	
Symphyotrichum lanceolatum var. *lanceolatum*	White panicle aster	Asteraceae	Herb	Yes	L & S	
Symphyotrichum novi-belgii var. *novi-belgii*	New York aster	Asteraceae	Herb	Yes	L & S	
Symphyotrichum patens	Late purple aster	Asteraceae	Herb	Yes	New	
Symphyotrichum pilosum var. *pilosum*	Hairy white old-field aster	Asteraceae	Herb	Yes	L & S	
Symphyotrichum subulatum	Saltmarsh aster	Asteraceae	Herb	Yes	New	S2 - T
Taraxacum laevigatum	Red-seeded dandelion	Asteraceae	Herb	No	L & S	
Taraxacum officinale	Common dandelion	Asteraceae	Herb	No	L & S	
Teucrium canadense	Canada germander	Lamiaceae	Herb	No	New	
Thelypteris noveboracensis	New York fern	Thelypteridaceae	F	Yes	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Thelypteris palustris var. *pubescens*	Marsh fern	Thelypteridaceae	F	Yes	L & S	
Thlaspi arvense	Field penny-cress	Brassicaceae	Herb	No	L & S	
Toxicodendron radicans ssp. *radicans*	Eastern poison ivy	Anacardiaceae	Shrub	Yes	L & S	
Tragopogon dubius	Yellow salsify	Asteraceae	Herb	No	L & S	
Triadenum virginicum	Marsh St. John's-wort	Hypericaceae	Herb	Yes	L & S	
Tribulus terrestris	Puncture-vine	Zygophyllaceae	Herb	Inv	L & S	
Trichostema dichotomum	Forked bluecurls	Lamiaceae	Herb	Yes	L & S	
Tridens flavus var. *flavus*	Tall purple-topped fluffgrass	Poaceae	Gram	Yes	L & S	
Trifolium arvense	Rabbit-foot clover	Fabaceae	Herb	No	L & S	
Trifolium aureum	Golden clover	Fabaceae	Herb	No	New	
Trifolium hybridum	Alsike clover	Fabaceae	Herb	No	L & S	
Trifolium pratense	Red clover	Fabaceae	Herb	No	L & S	
Triodanis perfoliata var. *perfoliata*	Clasping-leaved Venus' looking-glass	Campanulaceae	Herb	Yes	L & S	
Triplasis purpurea var. *purpurea*	Purple sandgrass	Poaceae	Gram	Yes	L & S	
Typha angustifolia	Narrow-leaved cattail	Typhaceae	Herb	Yes	L & S	
Ulmus americana	American elm	Ulmaceae	Tree	Yes	L & S	
Vaccinium corymbosum	Highbush blueberry	Ericaceae	Shrub	Yes	L & S	
Vaccinium macrocarpon	Large cranberry	Ericaceae	Herb	Yes	L & S	
Vaccinium pallidum	Early lowbush blueberry	Ericaceae	Shrub	Yes	L & S	
Verbascum blattaria	White moth mullein	Scrophulariaceae	Herb	No	L & S	
Verbascum thapsus	Mullein	Scrophulariaceae	Herb	No	New	
Verbena bracteata	Prostrate vervain	Verbenaceae	Herb	No	L & S	
Verbena urticifolia var. *urticifolia*	White vervain	Verbenaceae	Herb	Yes	L & S	
Veronica arvensis	Corn speedwell	Plantaginaceae	Herb	No	L & S	
Veronica officinalis	Common speedwell	Plantaginaceae	Herb	No	L & S	
Veronica serpyllifolia ssp. *serpyllifolia*	Thyme-leaved speedwell	Plantaginaceae	Herb	No	L & S	
Viburnum dentatum var. *lucidum*	Northern arrowwood	Adoxaceae	Shrub	Yes	L & S	
Vicia cracca	Cow vetch	Fabaceae	Herb	No	New	
Vicia sativa ssp. *nigra*	Narrow-leaved vetch	Fabaceae	Herb	No	L & S	

Scientific name	Common name	Family	Habit	Native[1]	Source[2]	S-rank and state listing[3]
Vinca minor	Periwinkle	Apocynaceae	Herb	No	L & S	
Viola lanceolata ssp. *lanceolata*	Lance-leaved violet	Violaceae	Herb	Yes	L & S	
Viola lanceolata × *primulifolia*	Hybrid violet	Violaceae	Herb	Yes	New	
Viola sororia	Common violet	Violaceae	Herb	Yes	L & S	
Vitis labrusca	Northern fox grape	Vitaceae	Vine	Yes	L & S	
Vulpia myuros	Rat's-tail six-weeks grass	Poaceae	Gram	No	L & S	
Vulpia octoflora var. *tenella*	Slender 8-flowered fescue	Poaceae	Gram	Yes	L & S	
Wolffia brasiliensis	Brazilian watermeal	Araceae	Herb	Yes	L & S	
Xanthium strumarium var. *canadense*	Canada cockle-bur	Asteraceae	Herb	Yes	L & S	
Yucca filamentosa	Yucca	Agavaceae	Herb	No	L & S	
Zostera marina	Sea-wrack	Zosteraceae	Herb	Yes	L & S	

[1] Inv = Invasive

[2] L & S = Lamont and Stalter (2013)

[3] For S-rank definitions, see Appendix A. E = Endangered; T = Threatened, R = Rare