

PLUM ENVISION REPORT APPENDIX

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APPENDIX A: A Local Law in Relation to Plum Island Zoning and Schedule A

(Complete the certification in the paragraph that applies to the filing of this local law and strike out that which is not applicable.)

1. (Final adoption by local legislative body only.)

I hereby certify that the local law annexed hereto, designated as local law No. 6 of 20 13, of the ~~(County)(City)(Town)(Village)~~ of SOUTHOLD was duly passed by the TOWN BOARD on August 29, 20 13, in accordance with the applicable provisions of law.

2. (Passage by local legislative body with approval, no disapproval or re-passage after disapproval by the Elective Chief Executive Officer*.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20 _____ of the (County)(City)(Town)(Village) of _____ was duly passed by the _____ on _____ 20 _____, and was (approved)(not approved)(re-passed after disapproval) by the _____ and was deemed duly adopted on _____ 20 _____, in accordance with the applicable provisions of law.

3. (Final adoption by referendum.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20 _____ of the (County)(City)(Town)(Village) of _____ was duly passed by the _____ on _____ 20 _____, and was (approved)(not approved)(repassed after disapproval) by the _____ on _____ 20 _____. Such local law was submitted to the people by reason of a (mandatory)(permissive) referendum, and received the affirmative vote of a majority of the qualified electors voting thereon at the (general)(special)(annual) election held on _____ 20 _____, in accordance with the applicable provisions of law.

4. (Subject to permissive referendum and final adoption because no valid petition was filed requesting referendum.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20 _____ of the (County)(City)(Town)(Village) _____ of was duly passed by the _____ on _____ 20 _____, and was (approved)(not approved) (repassed after disapproval) by the _____ on _____ 20 _____. Such local law was subject to permissive referendum and no valid petition requesting such referendum was filed as of _____ 20 _____, in accordance with the applicable provisions of law.

* Elective Chief Executive Officer means or Includes the chief executive officer of a county elected on a county-wide basis or, If there be none, the chairperson of the county legislative body, the mayor of a city or village, or the supervisor of a town where such officer is vested with the power to approve or veto local laws or ordinances.

5. (City local law concerning Charter revision proposed by petition.)

APPENDIX A: A Local Law in Relation to Plum Island Zoning and Schedule A

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20 _____ of the City of _____ having been submitted to referendum pursuant to the provisions of section (36)(37) of the Municipal Home Rule Law, and having received the affirmative vote of a majority of the qualified electors of such city voting thereon at the (special)(general) election held on _____ 20 _____, became operative.

6. (County local law concerning adoption of Charter.)

I hereby certify that the local law annexed hereto, designated as local law No _____ of 20 _____ of the County of _____ State of New York, having been submitted to the electors at the General Election of November _____ 20 _____, pursuant to subdivisions 5 and 7 of section 33 of the Municipal Home Rule Law, and having received the affirmative vote of a majority of the qualified electors of the cities of said county as a unit and a majority of the qualified electors of the towns of said county considered as a unit voting at said general election, became operative.

(If any other authorized form of final adoption has been followed, please provide an appropriate certification.)

I further certify that I have compared the preceding local law with the original on file in this office and that the same is a correct transcript there from and of the whole of such original local law, and was finally adopted in the manner indicated in paragraph 1, above.

Elizabeth A. Neville

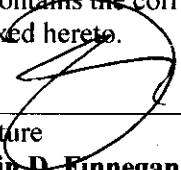
Clerk of the County legislative body, City, Town or Village Clerk or officer designated by local legislative body
Elizabeth A. Neville, Town Clerk
Date: August 30, 2013

(Seal)

(Certification to be executed by County Attorney, Corporation Counsel, Town Attorney, Village Attorney or other authorized attorney of locality.)

STATE OF NEW YORK
COUNTY OF SUFFOLK

I, the undersigned, hereby certify that the foregoing local law contains the correct text and that all proper proceedings have been had or taken for the enactment of the local law annexed hereto.



Signature
Martin D. Finnegan, Town Attorney
Jennifer Andaloro, Esq., Assistant Town Attorney
Title
~~County~~
~~City~~
Town of SOUTHOLD
~~Village~~
Date: August 30, 2013



RESOLUTION 2013-631

ADOPTED

DOC ID: 9035

THIS IS TO CERTIFY THAT THE FOLLOWING RESOLUTION NO. 2013-631 WAS ADOPTED AT THE REGULAR MEETING OF THE SOUTHOLD TOWN BOARD ON AUGUST 27, 2013:

WHEREAS, there has been presented to the Town Board of the Town of Southold, Suffolk County, New York, on the 2nd day of July, 2013, a Local Law entitled **"A Local Law in relation to Plum Island Zoning"** and

WHEREAS the Town Board of the Town of Southold held a public hearing on the aforesaid Local Law at which time all interested persons were given an opportunity to be heard, now there for be it

RESOLVED that the Town Board of the Town of Southold hereby ENACTS the proposed Local Law entitled **"A Local Law in relation to Plum Island Zoning"** which reads as follows:

LOCAL LAW NO. 6 of 2013

A Local Law entitled **"A Local Law in relation to Plum Island Zoning"**.

BE IT ENACTED by the Town Board of the Town of Southold as follows:

I. Purpose.

The purpose of this local law is to create and establish zoning districts on Plum Island. The Plum Island Research District is intended to encourage the use of the island for research and educational opportunities and provide quality employment opportunities, and to preserve Plum Island's regionally significant natural historic and scenic resources. The purpose of the Plum Island Conservation District is intended to preserve the integrity of the regionally significant natural historic and scenic resources of Plum Island.

II. Chapter 280 of the Code of the Town of Southold is hereby amended as follows:

§280-4. Definitions.

IMPERVIOUS SURFACE – Impervious surfaces include all areas where the ground is covered by a surface that interrupts or prevents rain from falling directly to the ground and percolating into the groundwater, including but not limited to: roads, driveways, parking lots, other pavement, buildings, and concrete pads.

§280-5. District designations.

PIR Plum Island Research District

PIC Plum Island Conservation District

Article XXXI
Plum Island Research District (PIR)

§280-182. Purpose.

The purpose of the Plum Island Research District is to encourage the use of land for research and educational opportunities, provide quality employment opportunities and to preserve Plum Island's regionally significant natural, historic, scenic and cultural resources.

§280-183. Use regulations.

In the PIR District, no building or premises shall be used and no building or part of a building shall be erected or altered which is arranged, intended or designed to be used, in whole or in part, for any purpose except the following:

- A. Permitted uses. The following uses are permitted uses and are subject to site plan approval by the Planning Board:
- (1) Research laboratories with multiple buildings allowed in a campus-style development, subject to the following conditions:
 - (a) The use shall not involve the handling, storage or discharge of explosives.
 - (b) No offensive noises, gases, fumes, smoke, odors, dust, effluent or vibrations shall emanate from such use and no waste products shall be discharged therefrom of a character to create a nuisance or to be injurious to health or to negatively impact surface or groundwater.
 - (c) All sewage will be treated by a sewage treatment plant or similar sewage treatment.
 - (2) Educational facilities, with multiple buildings allowed in a campus-style development. All sewage will be treated by a sewage treatment plant or similar sewage treatment.
 - (3) Museums housed in a designated historic landmark. All sewage will be treated by a sewage treatment plant or similar.
- B. Uses permitted by special exception of the Board of Appeals. The following uses are permitted as a special exception by the Board of Appeals as hereinafter provided and subject to site plan approval by the Planning Board:
- (1) Solar energy generation in excess of that needed to provide power to permitted uses
- C. Accessory uses. The following uses are permitted as accessory uses:
- (1) Any customary structures or uses which are customarily incidental to the principal use, except those prohibited by this chapter;
 - (2) Sleeping quarters, apartments or dormitories providing accommodations solely for personnel associated with permitted or special exception uses set forth in §280-183(A) and §280-183(B);
 - (3) Cafeteria for personnel associated with permitted or special exception uses set forth in §280-183(A) and §280-183(B);
 - (4) Infrastructure necessary to the operation of the permitted or special exception uses set forth in §280-183(A) and §280-183(B), limited to roads, sewer system, water storage and water pipelines and utility lines;
 - (5) The existing harbor and ferry facility for transportation by boat to and from the Island.
- D. Additional Standards: All uses in this District shall be subject to the following:

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Vegetation shall not be disturbed. Where noxious or invasive plants are overtaking native flora or where vegetation must be disturbed in conjunction with a permitted use, an application may be made to the Planning Board for an approval to remove vegetation.

The application shall include:

1. a plan indicating the types of vegetation present, the vegetation to be removed and a revegetation plan (if any), using plant species listed in the Southold Town Planning Board's Native/Natural Buffer Plantings list of recommended native plants;
2. an application fee of \$100;
3. The Planning Board shall render a written determination within 30 days of receipt of a complete application stating the reason therefor and advising the applicant of the right to appeal; and
4. The Town Board shall hear appeals or shall designate a person or body to hear appeals regarding a denial under this Section. Any person whose application to remove vegetation is denied, may appeal within 30 days of a denial.

§280-184. Bulk, area and parking regulations.

No building or premises shall be used and no building or part thereof shall be erected or altered in the Plum Island Research District unless the same conforms to the Bulk Schedule and Parking and Loading Schedules incorporated into this chapter by reference, with the same force and effect as if such regulations were set forth herein in full.

PIR Bulk Schedule: (to be placed in new Appendix)

Minimum Lot Size: 125 acres

Uses: Multiple uses and buildings are allowed on a single parcel, the number of which are limited only by lot coverage

Lot Coverage: 20% of buildable land, except that solar energy installations may exceed this limit up to a total of 50% lot coverage.

Building Height (ft.): 35

Number of Stories: 2

Setback from property line (ft.): 30

Landscape area: 30%

§280-185. Setbacks.

New structures and impervious surfaces shall be set back at least 300' from the shoreline, bluff or dune crest, or wetlands edge, whichever is more protective.

Article XXXII

Plum Island Conservation District (PIC)

§280-186. Purpose.

The purpose of the Plum Island Conservation District is to preserve the integrity of the regionally significant natural, scenic and historic resources of Plum Island for the benefit of the residents of the Town of Southold.

§280-187. Use regulations.

In the Plum Island Conservation District, no building or premises shall be used and no building or part of a building shall be erected or altered which is arranged, intended or designed to be used, in whole or in part, for any purpose except the following:

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- A. Permitted uses. The following uses are permitted uses and are subject to site plan approval by the Planning Board:
- (1) Nature preserve
 - (2) Public park
 - (3) Educational facility related to the study of natural resources conservation. All sewage will be treated by a sewage treatment plant or similar sewage treatment.
 - (4) Museums, housed in existing designated historic landmark. All sewage will be treated by a sewage treatment plant or similar sewage treatment.
- B. Uses permitted by special exception of the Board of Appeals. The following uses are permitted as a special exception by the Board of Appeals as hereinafter provided and subject to site plan approval by the Planning Board:
- (1) Solar energy generation in excess of that needed to provide power to permitted uses.
- C. Accessory uses. The following uses are permitted as accessory uses:
- (1) Any customary structures or uses which are customarily incidental to the principal use, except those prohibited by this chapter;
 - (2) Sleeping quarters, apartments or dormitories providing accommodations solely for personnel associated with the permitted or special exception uses set forth in §280-187(A) and §280-187(B).
- D. Additional Standards: All uses in this District shall be subject to the following:
Vegetation shall not be disturbed. Where noxious or invasive plants are overtaking native flora or where vegetation must be disturbed in conjunction with a permitted use, an application may be made to the Planning Board for an approval to remove vegetation. The application shall include:
1. a plan indicating the types of vegetation present, the vegetation to be removed and a revegetation plan (if any), using plant species listed in the Southold Town Planning Board's Native/Natural Buffer Plantings list of recommended native plants;
 2. an application fee of \$100;
 3. The Planning Board shall render a written determination within 30 days of receipt of a complete application stating the reason therefor and advising the applicant of the right to appeal; and
 4. The Town Board shall hear appeals or shall designate a person or body to hear appeals regarding a denial under this Section. Any person whose application to remove vegetation is denied, may appeal within 30 days of a denial.

§280-188. Bulk, area and parking regulations.

No building or premises shall be used and no building or part thereof shall be erected or altered in the Plum Island Conservation District unless the same conforms to the Bulk Schedule and Parking and Loading Schedules incorporated into this chapter by reference, with the same force and effect as if such regulations were set forth herein in full. *Editor's Note: The Bulk Schedule is included at the end of this chapter, and the Parking and Loading Schedules are in §§ 280-78 and 280-79.*

Plum Island Conservation District Bulk Schedule: (to be placed in a new Appendix)

Minimum Lot Size: 350 acres

Uses: Multiple uses and buildings are allowed on a single parcel, the number of which are limited only by lot coverage

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Lot Coverage: 2% of buildable land, except that solar energy installations may exceed this limit up to a total of 20% lot coverage.

Impervious surface: 5% of buildable land, except that solar energy installations may exceed this limit up to a total of 20% impervious surface.

Building height (ft.): 35
Number of stories: 2
Setback from property line (ft.): 30

§280-189. Setbacks.

New structures and impervious surfaces shall be set back at least 300' from the shoreline and wetlands.

III. Zoning Map Amendment.

Based upon the Town Board's consideration of the recommendation of the Town's Planning Board, the SEQRA review, the Plum Island Planning Study and the public comments taken at the public hearing or otherwise, the Town Board of the Town of Southold hereby amends the Official Zoning Map of the Town of Southold as adopted by §280-6 of the Town Code to create the Plum Island Research District (PIR) and the Plum Island Conservation District (PIC), as depicted on the attached map.

IV. SEVERABILITY

If any clause, sentence, paragraph, section, or part of this Local Law shall be adjudged by any court of competent jurisdiction to be invalid, the judgment shall not affect the validity of this law as a whole or any part thereof other than the part so decided to be unconstitutional or invalid.

V. EFFECTIVE DATE

This Local Law shall take effect immediately upon filing with the Secretary of State as provided by law.



**Elizabeth A. Neville
Southold Town Clerk**

RESULT: ADOPTED [UNANIMOUS]
MOVER: James Dinizio Jr, Councilman
SECONDER: William P. Ruland, Councilman
AYES: Dinizio Jr, Ruland, Doherty, Talbot, Evans, Russell

SOUTHOLD CODE

280 Attachment 7

Town of Southold

Bulk Schedules

Plum Island Research (PIR) and Plum Island Conservation (PIC) Districts
 [Added 8-27-2013 by L.L. No. 6-2013]

Plum Island Research District (PIR)	
Minimum lot size	125 acres
Uses	Multiple uses and buildings are allowed on a single parcel, the number of which are limited only by lot coverage
Lot coverage	20% of buildable land, except that solar energy installations may exceed this limit up to a total of 50% lot coverage
Building height (feet)	35
Number of stories	2
Setback from property line (feet)	30
Landscape area	30%

Plum Island Conservation District (PIC)	
Minimum lot size	350 acres
Uses	Multiple uses and buildings are allowed on a single parcel, the number of which are limited only by lot coverage
Lot coverage	2% of buildable land, except that solar energy installations may exceed this limit up to a total of 20% lot coverage
Impervious surface	5% of buildable land, except that solar energy installations may exceed this limit up to a total of 20% impervious surface
Building height (feet)	35
Number of stories	2
Setback from property line (feet)	30

PLANNING BOARD MEMBERS

DONALD J. WILCENSKI
Chair

WILLIAM J. CREMERS
PIERCE RAFFERTY
JAMES H. RICH III
MARTIN H. SIDOR



MAILING

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**PLANNING BOARD OFFICE
TOWN OF SOUTHDOLD**

MEMORANDUM

To: Elizabeth A. Neville, Town Clerk

From: Donald J. Wilcenski, Chairman *DW*

Date: April 29, 2013

Re: Resolution Number 2013-"276" A Local Law in Relation to
Amendments to the Marine II District and Plum Island Zoning".

Thank you for the opportunity to provide comments on the proposed amendments to the Town Code referenced above. The Planning Board has prepared a planning study in support of the proposed zoning for Plum Island, attached.

In addition to the island, the federal government also owns and is proposing to sell its parcel in Orient Point that contains the ferry dock and related buildings serving the Plum Island facility. This parcel is already zoned Marine II. It is prudent for the Town Board to consider the potential uses for this parcel should it become privately owned, and in particular its potential future use as a ferry dock. The Planning Board supports the proposed amendments to the Marine II zoning district for the following reasons:

A ferry service has the potential to be an intense land use with the impacts spreading far from the ferry landing site in the form of traffic and its associated noise and pollution. Experience in Southold Town has made it clear that there are minimum land area needs for a ferry service to ensure it is able to operate safely and with the least impact to surrounding communities.

APPENDIX B: Plum Island Planning Study

Ferries capable of carrying vehicles must have adequate space to stage the vehicles arriving to board the boats. A staging area that cannot accommodate the vehicles arriving at the site will result in traffic backing up into the public streets, increasing the possibility of accidents. In addition, there must be sufficient area to park cars for passengers boarding on foot, and especially for passenger-only ferries.

Mass transit in Southold is limited at this time, thus passengers wishing to walk on to a ferry would likely be arriving in a personal automobile. Insufficient parking leads to unsafe conditions for the public through overcrowded parking lots or haphazard parking along the public streets.

The parking and staging area requirements are directly correlated to the number and size and type (passenger or vehicle) of ferries landing at the site. The parking calculation for passenger-only ferries is based on the capacity of the passenger ferry and the assumption that the majority of passengers will drive a car to the ferry and need to park at the site for the duration of their trip. If the ferry can accommodate 300 passengers, for example, presumably all 300 passengers could, in the worst case scenario, drive a car to the site. It is more likely, however, that there will be a combination of situations ranging from one person per car to four or more. To account for this variation, it is reasonable to assume that a calculation based on one car per two people would likely provide enough parking for a full schedule of passenger ferries.

For the auto ferry's parking calculation, we assumed that about 10% of the passengers would arrive by car, but would walk on and park their car instead of driving on. Again, we divided that number by two to account for the variation in numbers of people per car, assuming that allowing for two people per car would average out.

The new minimum lot size ensures that there will be enough land area to safely accommodate the necessary parking and staging areas.

cc: Scott Russell, Town Supervisor
Members of the Town Board
Town Attorney

Plum Island Planning Study

Southold Planning Board

April 23, 2013

Plum Island consists of an 816¹ acre island about 1.5 miles from the tip of Orient Point. There are two other parcels associated with Plum Island and located in Orient Point, a 9.5 acre waterfront parcel containing the ferry terminal for Plum Island, as well as another parcel (approximately 10 acres) near the tip of Orient Point (an in-holding in Suffolk County's Orient Point County containing the electric power transfer station).

Plum Island has been entirely under the control of the federal government since 1901, with federal ownership on the island beginning as early as 1826. It was used by the government for military purposes, first as an army base, and then as a military research facility. Later the island became an animal disease research facility, which has operated on the island since 1954 and is currently controlled by the US Department of Homeland Security. The island has never been officially assigned a zoning district by the Town, largely because land being used by the federal government for a public purpose is exempt from zoning laws. Now that the island is scheduled for sale into private ownership by an act of Congress, it is prudent for the Town to assign a zoning designation.

Plum Island infrastructure & resources

Currently the island contains 554,109 square feet of building space in 47 buildings, including the Plum Island Animal Disease Center (PIADC) and associated buildings, historic Fort Terrence buildings in various states of repair, the Plum Island Lighthouse, and various other buildings, some currently in use, and some vacant. There is an electrical system connected by underground cable to the main power grid on Long Island, as well as an emergency generator designed to keep the lab in operation should electricity from the mainland fail. The water system is supplied by freshwater wells on the island, and includes a 200,000 gallon water tower and water distribution system, with a sustainable capacity of about 150,000 to 200,000 gallons per day (gpd)².

¹ The area of Plum Island is reported differently in different sources. We chose to use the size calculated by the Town of Southold's GIS system, with line-work based on the Suffolk County Tax Map. The true size of the island can only be determined by a survey.

² BMT Entech, Inc. 2002. CERCLA program report for Plum Island Animal Disease Center. Contract No. 1-0006. Prepared for U.S. Department of Agriculture.

also a wastewater treatment plant with a capacity of 80,000 gpd (although it is currently permitted at 60,000 gpd)³.

Though used intensively at times in the past, a majority of the island has been left to grow over time as the activity has been concentrated on the small area in the immediate vicinity of active lab buildings and support infrastructure. This has allowed natural habitats to re-grow undisturbed, and the island is host to diverse populations of flora and fauna, including one of the highest concentrations of rare plants in New York State. Plum Gut, the adjacent waterway between Orient Point and Plum Island, is designated by the State as a Coastal Significant and Wildlife Habitat. It is also identified by Audubon as an Important Bird Area for the 13 species of birds observed there, including thirteen New York State Species of Greatest Conservation Concern that use the island as a breeding ground. In addition, the island is located in the Atlantic Flyway, providing essential resting and feeding habitat for migratory birds.

The flora is also diverse, and includes at least 25 different natural communities, including those considered significant from a statewide perspective: maritime dunes, maritime beach, maritime bluff, and marine rocky intertidal. The marine environment at the edge of and surrounding Plum Island is home to the state's largest seal haul-out site, and productive eel-grass meadows have been shown to be a highly productive area for marine fish species.⁴

Rationale for creating new zoning districts for Plum Island

The existing zoning districts, as well as the other islands in Southold which are currently in use, were examined for their applicability to Plum Island. Upon review of the issues related to the future potential uses of the island should it become privately owned, it is clear that none of the current Southold Town zoning districts are suitable. Plum Island is unique in size, location, uses, and new zoning designations must be crafted to adequately address the situation. The rationale for creating new zoning designations to regulate future uses for Plum Island is based on a study of the limited infrastructure, both on the island and in the eastern portion of Southold Town, the community character of the Town, including along the main route to the island through East Marion and Orient, the economic value of the current use of the island, the value of the natural resources supported by the island, and the historic resources.

A study of the other islands' characteristics and zoning demonstrated that Plum Island is unique among them for many reasons. Plum Island, at 816 acres is the only island of its size in the Town. The three other islands of considerable size are Fishers Island at 2,644 acres, Robeson Island at 455 acres and Great Gull Island at 17 acres. The other seven islands range in size from one tenth of an acre to three acres.

³ Details about the infrastructure of Plum Island are from the Draft Environmental Impact Statement dated 2012, for the Public Sale of Plum Island, New York.

⁴ Schlesinger, M.D., A.L. Feldman, and S.M. Young. 2012. Biodiversity and ecological potential of Plum Island, New York. New York Natural Heritage Program, Albany, New York.

APPENDIX B: Plum Island Planning Study

Plum Island is unique in its recent past and current uses, both on the mainland and among other islands in Southold. Although other Southold islands are/were owned by the federal government and used for various purposes (military and aids to navigation), Plum Island is the only island with a major research facility (PIADC). After some history as a military fort, Gull Island has been owned since 1949 by the American Museum of Natural History for the purpose of a bird sanctuary. Robins Island was and is privately owned, and is protected by a perpetual conservation easement held by The Nature Conservancy, which limits future development to only a few structures. It is zoned R-400 Residential Low-Density District (one acre minimum lot size), Southold's most restrictive zoning district, and the conservation easement restricts the uses even further. Both Great Gull and Robins Island have issues similar to Plum Island with regard to potential development, however both are protected from development making it unnecessary for the Town to take any further steps to mitigate the potential impacts of any future development.

Fishers Island's recent past and current use is very different from that of Plum Island in that it has been developed primarily with residences with a small commercial center. More important than its land use is the island's geographic location as a reason for it being unsuitable as a comparison for zoning of Plum Island. Because of its proximity to Connecticut, Fishers Island residents have direct nearby access to necessary services in New London, CT, while Plum Island's nearest access to services is through Orient, NY. It is the difference between the access points that make the case for Plum Island's uniqueness as compared to Fishers Island. New London is a small city through which a major interstate highway runs. The city can provide basic services that the residents need, including doctors, a hospital, and retail stores. Orient, in contrast, is a small hamlet served by a two-lane road. The nearest grocery store, hospital, and other services are over eight miles away in Greenport, and these are limited in size to those typically found in a small village. Once on the mainland, the nearest interstate is over 31 miles away (a 45 minute drive).

Plum Island is also unique with regard to the mainland of Southold Town by the fact that it is a small island located at the end of the peninsula, with its main access through the most sparsely developed part of the Town. There is no other land in Southold Town with a comparable situation.

For all the reasons stated above, Plum Island was found to be a unique situation not contemplated in current zoning districts. All the existing zoning districts allow one or more uses that are contrary to the goals for Plum Island to continue to provide high quality employment opportunities, while minimizing the impact to the Town's most rural hamlets, and preserving natural and historic resources on the island.

APPENDIX B: Plum Island Planning Study

Rationale for the proposed zoning

Transportation and access

When considering zoning for Plum Island, we must take into account the community character and quality of life along the transportation route to and from the island and through the neighboring hamlets. The nearest hospital, grocery store and other services to Plum Island landing in Orient Point are located in Greenport and farther west, requiring a trip of at least 10 miles along a two-lane road through the hamlets of Orient and East Marion. They are the rural hamlets in Southold Town. Both are primarily residential hamlets with low density. For example, Orient Hamlet includes a total of 765 residential units at an overall density of 0.2 units per acre.

Both hamlets are already adversely affected by intense pulses of traffic caused by the Cross Sound Ferry operation. Any additional traffic would degrade the community character and quality of life by adding noise, decreasing air quality from added vehicle emissions, and decreasing the safety of the main road.

The transportation route is also a New York State designated Bike Route, and a New York State designated Scenic Corridor. Adding traffic to this corridor would decrease the safety for bicyclists and erode the scenic qualities.

All the current zoning districts in Southold Town Code, should any be applied to Plum Island, have the potential to create adverse traffic impacts by nature of their minimum lot size requirements and lack of detail and sensitivity to the unique situation of Plum Island. The proposed zoning districts are designed specifically for Plum Island's unique situation as to traffic and transportation and the nearby communities that would be most affected by the proposed zoning.

Plum Island as a source of high-quality employment

Plum Island has long been a source of high-paying technical jobs for Southold Town residents. Currently the lab employs 60 people who live in Southold Town. Retaining a research and educational facility that will provide a similar number of jobs is of great importance to the community. The Plum Island Research District is designed to encourage this type of development by stating that type of use is allowed, and also by limiting the ability for the island to be subdivided. This subdivision limitation (accomplished by the large minimum lot size), will ensure that the research facility remains large enough to contain and maintain its own infrastructure, as containing enough land for future expansion, and to retain flexibility in future design.

Preservation of natural and cultural resources

Water

While Plum Island's aquifer could support some level of future additional development, it is in the best interest of the overall Town to limit the use of this precious resource. Having a n

APPENDIX B: Plum Island Planning Study

source of potable water could be critical to the Town's future infrastructure and ability to clean water for its citizens, especially in Orient which is served by their own sole source. Orient's sole source aquifer is already suffering from some pollution and salt water intrusion. Therefore it is good planning to preserve Plum Island's aquifer as a future source of potable water for the Town.

The Plum Island Conservation District will accomplish the goal of protecting Plum Island aquifer by limiting the amount of development that will occur over the majority of the island and also limiting the type of development to that which would use very little water, and contribute little or no pollution to the groundwater. It has been well documented that intensive development can contribute significant amounts of pollution to the groundwater in the form of excess nitrogen and other pollutants through stormwater runoff, septic systems, and the application of fertilizers, and pesticides.

Habitat & Wildlife

Plum Island contains flora and fauna unique to the state in their quality and should be preserved with as little disturbance as possible (see above for more details). The proposed Plum Island Conservation District will accomplish this goal by limiting the amount of human disturbance on the island. The new zoning will provide additional protection to wetlands and surface waters, both of which contain important sensitive wildlife habitats, by ensuring that all structures and impervious surfaces be set back at least three hundred feet from surface waters and wetlands.

Historic Resources

Plum Island contains unique historic resources, including the Plum Island Lighthouse and Terry. In addition to any federal historical designations, the proposed zoning districts will preserve and protect those historic resources by allowing uses of the island that are complementary to historic preservation including educational facilities and museums.

Public Safety and Emergency Response.

Serving the public safety and emergency response needs of an island are challenges for some Towns such as Southold. The rural Fire Districts have limited revenue and personnel. In the case of Plum Island, the nearest Fire District is Orient. Presumably this Fire District would be upon to serve the emergency and fire needs of any development on Plum Island. Southold Police would be the nearest law enforcement agency. The proposed Plum Island Research District and Conservation District are designed to limit the potential strain on local first responder and public safety resources by limiting the amount of development on the island, concentrating the majority of potential development in one area. Currently the PIADC has its own fire equipment, and some future similar use that fits in with the proposed zoning could presumably do the same.

APPENDIX B: Plum Island Planning Study

Navigation

The Plum Gut and other waters adjacent to Plum Island are important navigation channels. The Cross Sound Ferry travels through Plum Gut, as well as other boat traffic on its way to Cross Sound, Fishers Island, and Block Island. The proposed zoning districts address this by limiting uses to those that would not interfere with navigation.

Commercial & Recreational Fishing

Commercial and recreational fishing are important to Southold's economy. The waters surrounding Plum Island are productive fisheries. The proposed zoning districts protect these nearby fisheries by limiting future uses of the island to those that will not interfere with them.

Conclusion

The federal government, and more particularly the U.S. General Services Administration, has begun the process to sell Plum Island. While zoning was not necessary while the island was under federal ownership (local zoning does not apply to the federal government), the Town of Southold has found it prudent to zone the island in the event the island is sold into private hands. Plum Island has many resources important to the Town, is unique in many ways, and warrants zoning designation to best regulate its future uses. The new zoning designations accomplish multiple goals for the island of protecting its exceptional natural resources, while also providing for future economic opportunities. They also provide the necessary balance with the nearby mainland connection at Orient Point, ensuring that the rural character of the hamlets of East Marion and Orient is maintained.

APPENDIX B: Plum Island Planning Study

TIMOTHY H. BISHOP
1ST DISTRICT, NEW YORK

308 CA
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COMMITTEE ON EDUCATION
AND THE WORKFORCE

Congress of the United States

House of Representatives

Washington, DC 20515-3201

COMMITTEE ON TRANSPORTATION
AND INFRASTRUCTURE

3
w

Hon. Scott Russell
Supervisor
Town of Southold
53095 Main Rd
P.O. Box 1179
Southold, NY 11971

May 1, 2013

Supervisor Russell:

On May 7th, the Town will hold a public hearing on the implementation of zoning dist Plum Island. I write today in strong support of the efforts the Town is undertaking. Pre the future of Plum Island, which is located in my district, is one of my top priorities in Co

The proposed zoning designations before you on May 7th represent a reasoned approach economic development and environmental preservation. The proposed Plum Island R District will ensure the viability of this land for future economic development needs sh current facility close. Plum Island represents tremendous potential and opportunity fo scientific research and discovery.

Even more importantly, the Plum Island Conservation District will create and protect on more pristine and beautiful preserves in the tri-state area. Plum Island is home to more th rare, protected, and noteworthy vascular plants, and more than one-hundred bird including the federally endangered roseate terns and federally threatened piping plovr proposed conservation district would protect this valuable flora and fauna in pe Regardless of the future of the research facility, protection of these valuable natural resc an important step forward.

I strongly favor the continued use of Plum Island as a federal research facility. As I cor work in Washington to prevent its closure, it is important that I have a strong partner in tl of Southold. The proposed zoning designations before you on May 7th are the fruits of partnership that will ensure the future of Plum Island is one of which we can all be proud

Sincerely,



Tim Bishop
Member of Congress

APPENDIX B: Plum Island Planning Study



To: Southold Town Supervisor and Board

May 5, 2013

Ladies and Gentlemen,

On behalf of the Board and the Membership of the Orient Association, I wish to express support for the Proposed Zoning of Plum Island. As we have indicated at numerous community governmental meetings over the past year, the future use of Plum Island will have a very dramatic impact on the quality of life for the residents and organizations located in Orient. It will also have a significant impact on all of the people and businesses in the Town of Southold, the East End and even the Long Island.

The federal facility on Plum Island has been a complex neighbor. It plays an important role in the safety of our country's agricultural interests, but poses challenges relating to safety and environmental responsibility. The ecological importance of Plum Island deserves special attention and very careful planning. Given the proposed sale by the General Services Administration (GSA), it is imperative that the Town establish the zoning standards that will apply once the property is no longer under federal control.

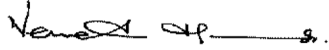
The Orient Association was particularly concerned to hear about some of the alternative plans the GSA outlined in its draft Environmental Impact Statement. The possible creation of large numbers of residential units or extensive commercial use on the Island would have a seriously negative effect on the community and place extensive burdens on the Town infrastructure. It would also jeopardize an area that is now effectively a wonderful nature preserve, as well as an important historical site. We believe that zoning to preserve the current level and type of usage would be in the best interests of the residents and commercial interests of Orient and the Town as a whole.

The Town's proposed zoning plan is an excellent step in that direction. We support the zone structure as planned. We also recognize the potential benefits of allowing some alternative research and uses. However, the placement and type of that usage needs to be carefully planned to avoid harming important plants and animals, and to support the use of the majority of the Island as a nature preserve and educational resource. We understand that the Supervisor, Board and State Planning Department are in the process of developing a comprehensive plan for alternative uses throughout the Town. We also support this effort.

APPENDIX B: Plum Island Planning Study

On behalf of the Association, I wish to thank the Supervisor, Board and Staff for the ok thoughtfulness and extensive efforts that have gone into this zoning proposal. We look forward working with the Town to make this plan a reality.

Yours Sincerely,

A handwritten signature in black ink, appearing to read "Venetia Hands", followed by a horizontal line and a period.

Venetia Hands

President

RE: PH



North Fork Environme
 12700 Main Road
 PO Box 799
 Mattituck, NY 11952

Phone: 631.298.8880
 Fax: 631.298.4649
 Web: www.NFEC1.o

3 May 2013

REC

Attn: Scott Russell, Supervisor
 Southold Town Board
 P.O. Box 1179
 53095 Route 25
 Southold, NY 11971

MAY

Southold

RE: Proposed Zoning Plan, Plum Island

Dear Supervisor Russell and Southold Town Board Members,

The North Fork Environmental Council (NFEC) wishes to thank the Supervisor and Board for its foresight and its work in developing a zoning plan for Plum Island in ad any potential federal sale of the island. Such diligence will go a long ways towards e that any transfer of ownership of the island will be both on the terms of Southold Tow the best interests of the Town, its residents and the island's wildlife and other natura resources.

Therefore, the NFEC wishes to voice its support of the general zoning plan for Plum

By identifying a Plum Island Research District and a Plum Island Conservation Distr zoning plan at its minimum supports the "status quo." This is important as it defines protects the island's assets now and into the future, but it also acknowledges and pr quality of life so valued by the residents of Southold Town, especially those from Gre Orient Point. By removing the spectre of vast residential and commercial expansion island, the zoning plan also greatly reduces the possibility of any associated expans traffic on local North Fork roads.

But we must be aware that passage of this zoning plan is simply a first, important st looks to be a long road ahead. And as we look ahead, the NFEC wants to work with and other parties to ensure that if the federal sale of the island proceeds, that future both the Research and Conservation Districts protect the island's unique ecosystem not adversely impact the way of life on the North Fork, especially traffic along Route between Greenport and Orient Point.

APPENDIX B: Plum Island Planning Study

page 2

In considering the Town's proposed zoning, the NFEC supports the changes suggested by the Preserve Plum Island Coalition. They include:

- 1) to move the majority of the coastline around the proposed Research District into the Conservation District so that as much of the natural shoreline as possible will be protected
- 2) move approximately 35 acres of untouched upland growth to the west of the main road along the western shoreline bluffs, to the Conservation District
- 3) move approximately 2 acres of wetlands and ponds to the southeast of the main road to the Conservation District
- 4) to remove the language which allows up to 20% of the Conservation District to be used for solar arrays as such coverage would be detrimental to plant and animal life, placed in an area where little or no clearance of vegetation is required

We believe that these relatively small changes will better serve to protect the unique ecosystems and nature of Plum Island and thus protect the native plant and native and visiting species of birds and animals with no impact on the use and value of the Research District.

The NFEC looks forward to working with the Town and all interested parties in making sure that the future of Plum Island serves the best interests of the Town and its residents as it protects one of the last remaining unprotected coastal conservation areas on East End Island.

Sincerely,



William Toedter
president NFEC on behalf of the NFEC Board of Directors

cc: Bob DeLuca, Group for the East End
Randy Parsons, The Nature Conservancy, Long Island Chapter
Charles Rothenberger, Connecticut Fund for the Environment
Leah Schmalz, Save the Sound
John Turner, Preserve Plum Island Coalition
Diana van Buren, North Fork Audubon Society

APPENDIX B: Plum Island Planning Study

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54375 Stat
(cor. Main Rd.
South

Telephone:

Fax: 631

PLANNING BOARD OFFICE TOWN OF SOUTHOLD

MEMORANDUM

To: Martin Finnegan, Town Attorney

From: Mark Terry, Principal Planner

Date: May 6, 2013

Re: SEQRA Review of the *Plum Island Planning Study* (2013) prepared by the Town of Southold Planning Department

The proposed action of the preparation of the *Plum Island Planning Study* (2013) has been subject to Chapter 130 Environmental Quality Review of the Southold Town Code and the New York State Department of Environmental Conservation regulation 6NYCCRR Part 617 State Environmental Quality Review and it is my determination that pursuant to Part 617.5C (21) provided by the Department of Environmental Conservation, the proposed action, as proposed is a Type II action and therefore not subject to SEQRA review.

(21) conducting concurrent environmental, engineering, economic, feasibility and other preliminary planning and budgetary processes necessary to the formulation of a proposed action, provided those activities do not commit the agency to commence, engage in or carry out such action.

Please contact me with any questions.

Cc: Heather Lanza, Director of Planning

APPENDIX B: Plum Island Planning Study



Audubon NEW YORK

Re: PH 5

3

200 Trillium Lane
Albany, New York 122
Tel: 518-869-9731
Fax: 518-869-0737
audubonny@audubon.org
<http://ny.audubon.org>

Supervisor Scott Russell
Members of the Town Board
Town Hall
53095 Main Rd
P.O. Box 1179
Southold, NY 11971

R

Commandine Sidamon-Erisoff
Founding Chairman

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John Wilkerson

Erin M. Crouty
Executive Director

May 7, 2013

MA)

South

RE: A Local Law in relation to the Marine (II) District and Plum Island Zoning

Dear Supervisor Russell and Members of the Southold Town Board,

On behalf of Audubon New York and Audubon Connecticut, the state programs National Audubon Society (Audubon), we thank you for the opportunity to provide the following comments in support of the Town of Southold's proposed "A Local Law in relation to the Marine (II) District and Plum Island Zoning." We commend the Town for advancing this strong proposal to protect the important ecological features of this incredible resource.

The mission of Audubon is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity. To guide our conservation efforts, Audubon has identified Important Bird Areas (IBAs) throughout the state and nation that provide critical habitat for birds based on a set of standardized site criteria. In addition to identifying IBAs, Audubon is also engaged in large scale ecosystem restoration campaigns, and has been a leading force working to secure desperately needed federal funds to improve the water quality and protect the important habitats of Long Island Sound.

With its mixture of rocky shoreline, sand beaches, wetlands, and various upland shrub, grassland, and forest habitats, Plum Island stands out as a critically important habitat and a key migratory bird stopover site on Long Island Sound. In 1997 Plum Island was recognized as part of the Orient Point to Plum Island IBA because it supports large concentrations of birds, including at-risk species like the federally threatened Piping Plover and endangered Roseate Tern. Since that time we have worked heavily to ensure the future protection of this amazing resource, and remain concerned over efforts by the Federal Government to sell the Island without restrictions to protect the ecological features that make it significant for birds and other wildlife. In 2005, to further the protection of this IBA, Audubon New York convened a group of partners to identify the greatest threats and conservation needs for this area. The result of that effort was a Conservation Action Plan for the IBA, which was finalized in 2009. The plan emphasizes the need to protect the critical natural resources of Plum Island and one of the priority strategies identified in the plan is to increase our understanding of bird usage on Plum Island. Over the last 5 years, Audubon has participated in bird surveys to better document birds' usage of the island. Through these surveys, over 190 bird species have been documented breeding or foraging on Plum Island and adjacent coastal waters, including birds-of-prey, shorebirds, wading birds, waterfowl, and songbird species. However, we know that these limited surveys are only providing us with a snapshot of the ecological value of Plum Island and it is likely more species depend on it than we are aware.

APPENDIX B: Plum Island Planning Study

Notable species found on Plum Island include; breeding Piping Plovers (a federally threatened species), nesting Osprey, an active Bank Swallow colony, several dozen Roseate Terns (a federally endangered species), and several hundred Common Terns (a NYS threatened species), which feed in nearby surrounding waters. The waters surrounding Plum Island are rich in nutrients and are vital feeding and courting grounds for birds such as terns and waterfowl. Plum Island also provides important stopover habitat for many fall and spring migrant raptor, songbird and shorebird species. Finally, Common Goldeneye is known to breed on nearby Fisher's Island, may also breed on Plum Island; if so this would be only second location in the State where this sea duck breeds. All this highlights the biologic importance of Plum Island and its unique contribution to the ecology of the Long Island Sound Estuary. Efforts must be made to ensure these unique natural assets are protected in perpetuity, and we appreciate the Town's attention to this.

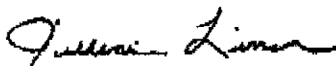
Conserving this area long term not only makes good environmental sense, but represents good fiscal policy as well. Bird watching is the fastest growing outdoor recreation in New York and across the nation, with an estimated 3.8 million bird and wildlife watchers in New York contributing \$4.2 billion to the state economy as estimated by the US Fish and Wildlife Service. Ensuring the future protection of this critical area, that supports such a great diversity of bird species, will help communities surround Plum Island continue to capitalize on this ecotourism revenue and provide alternative options to maintain the island as a tourist destination.

With this in mind, Audubon strongly supports the proposed zoning changes by the Town that delineate a conservation district, including the Piping Plover nesting area and important wetland habitat. In order to enhance this proposed conservation district, which does not cover all the areas on the island that are important to birds, we ask that the Town consider a few additional items when planning for the future of Plum Island.

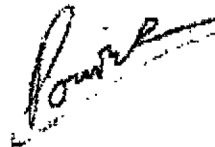
We urge that any future development in the Research District be required to maintain the same form as the existing development. In addition, we ask that wetlands within the Research District be conserved (e.g., the cattail marsh) and that the areas surrounding the sewage treatment pond continue to be maintained in a way that provides bird habitat. To bolster the protections afforded in the Conservation District, we recommend that future land uses be restricted to only those which maintain or enhance bird habitat in the Conservation District. Industrial uses, such as siting photovoltaic cells, would undermine the habitat value of the Conservation District and should be avoided. In addition, it's important to note that although the historic Piping Plover nesting areas are contained within the conservation district, there are additional stretches of shoreline that have the potential to provide habitat to beach nesting birds; these areas should be protected.

We once again commend the Town for advancing this zoning proposal that will help ensure the most important habitat areas on Plum Island are protected from future land use changes. We would be pleased to meet with the Town to discuss any of these recommendations further, and please don't hesitate to contact Jillian Liner at 607-254-2437 or jliner@audubon.org.

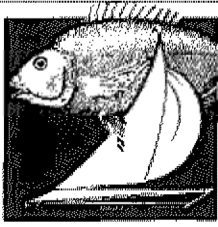
Sincerely,



Jillian Liner
Audubon NY Director of Bird Conservation



Patrick M. Comins
Audubon CT Director of Bird Conservation



LONG ISLAND SOUND STUDY

A Partnership to Restore and Protect the Sound

CITIZENS ADVISORY CO

OF THE LONG ISLAND
Website: <http://www.liss.org>

**CITIZENS ADVISORY
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OF THE
LONG ISLAND SOUND
STUDY**

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Communications
Nutrients

CAC ADDRESS

Long Island Sound Study
Citizens Advisory Committee
c/o EPA LIS Office
Stamford Government Center
888 Washington Blvd, Suite 6-5
Stamford, CT 06904
Office: 203 977-1541
Fax: 203 977-1546

The CAC meets quarterly on the second Thursday of March, June, September, and December at alternating locations in New York and Connecticut. Meetings are open to the public.

Supervisor Scott Russell
Members of the Town Board
Town Hall
53095 Main Rd
P.O. Box 1179
Southold, NY 11971

Dear Supervisor Russell and Members of the Southold Town Board

On behalf of the Citizens Advisory Committee ("CAC") of the Long Island Sound Study ("LISS"), we provide these comments in support of Southold zoning of Plum Island, New York. The CAC represents a broad environmental and business organizations from New York and Connecticut long advocated for the restoration of Long Island Sound. We provide advice to the LISS Management Committee on LISS decision making to diverse stakeholders in the region. Our membership and meetings include interested parties in the region that use, or have concerns about, the Sound. The CAC is the only body in the Long Island Sound Study that can take positions on issues and topics. CAC positions are adopted by a majority of the Citizens Advisory Committee members and are reflective of these positions, but do not necessarily reflect the opinion of the Long Island Sound Study. Attached is a list of our CAC membership.

Our interest in Plum Island is in assuring the conservation of undeveloped portions of the island as well as the safe re-use of the developed portions of the island. In the past, we have provided comments to the General Services Administration during its scoping and Draft Environmental Impact Statement published in 2009, urging it require a mixed conservation/re-use sale. We assert that the *Consolidated Security, Disaster Assistance, and Continuing Appropriations Act of 2009* requiring the sale of Plum Island provides GSA with the flexibility to conduct such a sale. However, thus far it appears that GSA is not moving forward with this approach, leaving the task of protecting the natural areas and wildlife on the island to the Town of Southold. It is for this reason that we submit these comments in our enthusiastic support of the Town of Southold's new zoning proposal.

APPENDIX B: Plum Island Planning Study

As you know, Plum Island boasts large populations of loons, scoters, buffleheads, piping plover, common, least and roseate terns and dozens of other species, along with wild orchids and rare plants. There are numerous federal programs and LISS related policies whose goal is to protect critical areas like this one. The CAC has a strong interest in ensuring those programs and policies are implemented. The Town's proposed zoning will help protect Plum Island space for future public use and enjoyment, and essential plant and wildlife habitat, consistent with the goals of Long Island Sound CCMP.

Plum Island and The Long Island Sound Stewardship Initiative

The Long Island Sound Stewardship Initiative was created by a Resolution of the Policy Committee dated September 28, 2006 (attached). One month later it was codified by Congress (see the *Long Island Sound Stewardship Act of 2006*). It formally adopted the initiative to achieve the permanent protection, restoration, and conservation of various critical Long Island Sound areas, and to increase public access to appropriate recreation and education. Through this action thirty-three inaugural Stewardship Areas around the Sound were formally endorsed.

Plum Island, together with Little Gull and Great Gull, form the *Plum-Gull Islands complex* which was identified for protection as an inaugural stewardship site by the Long Island Sound Stewardship Initiative. This trifecta was found by scientists to possess "exemplary" ecological value and is considered a crown jewel filled with unspoiled habitat types and federally listed endangered species. (See attached Stewardship Site Atlas).

The LISS endorsement was formally signed by all the members of its Policy Committee including the Region I and II Regional EPA Administrators and the Environmental Commissioners of New York and Connecticut, and represents a strong and unequivocal governmental interest in ensuring the conservation of the undeveloped portions of Plum Island. We are pleased that the Town of Southold's proposed zoning for the island recognizes the need to protect this ecologically valuable site.

Plum Island and The Comprehensive Conservation and Management Plan

In addition to the Long Island Sound Stewardship Initiative, the CCMP—the Long Island Sound Management Plan adopted by federal and state governments to restore its waters and land—itself highlights the need to protect areas like Plum Island.¹

The *Management and Conservation of Living Resources and Their Habitats* section of the CCMP "Managing Habitats" states "The destruction of coastal habitats has had a major impact on the diversity and abundance of plants and animals in the Sound." And that "Long Island Sound is an area that has undergone rapid industrialization and rapid diminution of areas remaining in the original condition. It is desirable to identify areas of land and water of outstanding or exemplary scientific value."

¹ See http://longislandsoundstudy.net/wp-content/uploads/2011/10/management_plan.pdf, pp.104-107; pp.126; and pp.132-133.

APPENDIX B: Plum Island Planning Study

educational, or biological value to reflect the regional differentiation and variety of ecosystem address all the significant natural habitats found in Long Island Sound. These sites would be c form a *Long Island Sound Reserve System*. Many of these sites are already in public owner for conservation purposes. Therefore, acquisition priorities should emphasize sites not current conservation purposes.” This section resulted in the creation of the above described Stewards Initiative, of which Plum Island is included. It is clear, that given the current potential for tho significant habitats to change from federal to private hands, that the island is considered a pric conservation. This is bolstered from the action item list in this same section of the CCMP unc Needs to Be Done”: “...Conservation of natural resources and open space is vital to the protee Sound.”

There are two other sections of the CCMP that align with Southold’s vision to zone pe Plum Island as conservation areas. First, the *Conserve and Enhance Natural Resources Open Spaces* section outlines “Preserv[ing] open space and natural areas” as a key obj Second, the *Land Use and Development* provision states that “preserving environment sensitive habitats, such as forests, and maintaining open space minimizes runoff pollu provides wildlife habitat.” It further outlines that “existing federal, state, and local op or other land acquisition programs should support Long Island Sound water quality an objectives.”

Plum Island and the U.S. Fish and Wildlife Service

The Town’s move to preserve Plum Island also meshes with the United States Fish and Service (“USFWS”) assessment. It identified a host of important habitat functions and designations recognizing the ecological value of Plum Island and its adjacent waters. Specifically, the USFWS recognized the ecological importance of the site that is part of Orient Point – Islands Complex of regionally significant fish and wildlife habitat (USF 1991)² and a part of the USFWS Coastal Barrier Resource system, unit numbers NY-2 25.

The value of the ecologically interconnected chain of islands in this area of Long Islan has been recognized as providing unique opportunities for collaborative natural resour management. As the USFWS presented to the GSA: the Long Island National Wildli Complex was founded in order to “conserve, manage, and where appropriate, restore v plant species and their habitat for the benefit of present and future Americans.”³ In th letter, the USFWS noted their ongoing efforts to encourage Least and Roseate Tern ne recently acquired Gardiner’s Point Island, referring to the island’s proximate location Plum and Gardiners Island and underscoring the tremendous wildlife and habitat pote three islands.⁴ While the CAC believes the best way to conserve the island is for it to federal hands and to be incorporated into the USFWS Refuge system, we applaud Sou effort to ensure that even if the federal government moves forward with a public sale, will be protected.

² The USFWS highlighted that this Habitat Complex “underscores its high value for nesting colonies o plover and least tern . . . and colonial wading bird rookeries of black-crowned night heron . . . and grea USFWS Letter to GSA dated June 16, 2010.

³ USFWS Letter to GSA dated June 16, 2010

⁴ USFWS Letter to GSA dated June 16, 2010, pp.4-5

Plum Island and SoundVision

In 2011, the CAC recognized that there had been significant progress in the implementation of the 1994 CCMP but noted that the region's heritage—which is centered on appreciating views of the coast, enjoying our beaches, sailing and kayaking, clamming and fishing—was threatened. In an effort to protect the watershed landscape, not only for the birds, fish and animals that depend on special habitats, but also to re-build the economically vibrant Long Island Sound shoreline industries and neighborhoods the CAC, advised by the best Long Island Sound scientists and experts, developed a practical and attainable Action Plan to heal and restore the Sound.

The SoundVision Plan identifies four priority areas, one of which is “Creating Safe Places for All Sound Creatures.” A key Action Step for this priority area is to “Improve management and acquisition of key coastal and island wildlife refuges” by “Protect[ing] Long Island Sound from unfettered development and encourage[ing] the US Fish and Wildlife Service to add Long Island Sound to its network of preserved habitats.”⁵ Again, Southold's effort to create “Plum Island Conservation District” demonstrates the town's commitment to do what it can to help Long Island Sound escape from rampant development.

Plum Island and LISS Action Agenda

In addition to the CAC's SoundVision Action Plan, the LISS Management Committee released its 2011-2013 Action Agenda for Long Island Sound. Similar to SoundVision, it continues to “Restore and maintain Long Island Sound in a healthy, productive and resilient condition that it can provide the services humans want and need.” One of the top priorities is to “Restore 820 acres of coastal habitat” by 2013.⁶ Plum Island is one such coastal habitat, as identified in the Stewardship Initiative.

According to this Agenda

Healthy coastal habitats provide critical feeding, breeding, and migratory stopovers for the diverse abundance of plants and animals that use LIS. In 1996, the LIS established the Habitat Restoration Initiative, and in 1998 established a goal of identifying and protecting 12 priority LIS habitat types around the Sound. The Initiative uses public-private partnerships to accomplish the restoration objectives and leverage limited state and federal funds. In addition, the LISS established the Stewardship Initiative in 2006 to conserve natural areas, increase access to the Sound, protect important habitats for multiple uses. The Stewardship Initiative identified places with significant scientific or recreational value throughout the Sound and developed a strategy to protect and enhance these special places. In 2006, the LISS adopted thirty-three inaugural Stewardship Areas that represent lands of outstanding or exemplary scientific,

⁵ See <http://www.lisoundvision.org/pdf/Sound-Vision-Final.pdf> pp.14-16.

⁶ See http://longislandsoundstudy.net/wp-content/uploads/2011/09/Final-LISS-Action-Agenda_2011_2013.pdf pp.8-10.

The Long Island Sound Study is a cooperative Federal/state Management Conference researching and addressing environmental problems of the Sound identified in the Comprehensive Conservation and Management Plan (CCMP). A Citizen's Advisory Committee provides advice on public education activities to the Management Committee in the CCMP.

APPENDIX B: Plum Island Planning Study

recreational, educational, or biological value for protection, management. They provide opportunities around the Sound to enhance the public's awareness and connection with our special estuary.

By providing zoning requirements that protect habitats and provide for limited public enjoyment of the island and potentially learning opportunities, Southold is once again part to ensure the goals and policies established for Long Island Sound are met.

In addition to offering our support on your zoning plan for the island, we extend a res well. One of our partner Long Island Sound Study committees, The Stewardship Wor has provided GSA with information on the rare wildlife and habitats found on Plum Is They offer their wide variety of resources and expertise to the Town Board should yo additional factual information moving forward. They can be reached by email at David.Kozak@ct.gov (David Kozak, CT DEEP) and Basso.Georgia@epamail.epa.gov (Basso, U.S. Environmental Protection Agency and U.S. Fish and Wildlife Service).

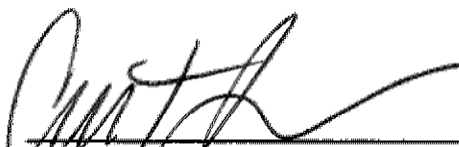
We are supportive of Southold's plan, and encourage it to make a couple of minor mo and explain one apparent discrepancy, all of which are identified and described in mo the Preserve Plum Island Coalition. First we recommend that the 35 acres surroundi Island lighthouse that also runs along the shoreline in each direction, along the edge o facility, along the edge of the main laboratory facility, and to the paved road be includ Plum Island Conservation District ("PIC"), not the Plum Island Research ("PIR") Dist Second, we do not believe solar energy installations should be permitted within the PI they are incorporated into/on-top of existing structures. Lastly, we note that the combi of the PIR and PIC districts fall short of the island's actual size, is there a particular re the acreages differ?

We sincerely appreciate the Town's willingness to protect and preserve this rare jewel applaud your effort to do what the federal government has not yet done: Save Plum Is

Yours truly,



Nancy Seligson
New York CAC Co-Chair
Nancy18b@aol.com
914 834 4953



Curt Johnson
Connecticut CAC Co-Chair
cjohnson@cfenv.org
203 787 0646/ext. 111

**RESOLUTION
OF THE
LONG ISLAND SOUND STUDY
POLICY COMMITTEE
CONCERNING
LONG ISLAND SOUND STEWARDSHIP**

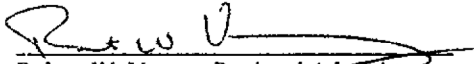
Whereas, Long Island Sound is recognized as a National treasure of great cultural, environmental, ecological, and economic importance; and

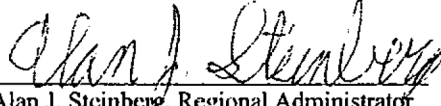
Whereas, as a highly urbanized estuary, the Long Island Sound ecosystem is under stress from both sustained human uses as well as emerging global and regional environmental conditions; and


Whereas, the *Comprehensive Conservation and Management Plan* for Long Island Sound calls for creation of a system to identify areas of land and water of outstanding or exemplary scientific, educational, or biological value for protection, management or acquisition; and

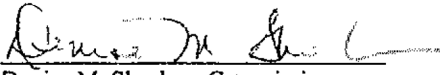
Whereas, at the direction of the Policy Committee under the Long Island Sound 2003 Agreement, the Long Island Sound Study Management Committee has worked to identify key areas in the Long Island Sound watershed that reflect regional differentiation, a variety of ecosystems and significant natural habitats found in the Sound, and public access to this magnificent body of water;

NOW THEREFORE BE IT RESOLVED THAT, the Long Island Sound Study Policy Committee, assembled in Rye, New York on September 28, 2006, hereby endorses the work of the Management Committee in recommending thirty-three inaugural Stewardship areas, and hereby adopts them as part of the Long Island Sound Stewardship Initiative.


Robert W. Varney, Regional Administrator
US Environmental Protection Agency
New England Region


Alan J. Steinberg, Regional Administrator
US Environmental Protection Agency
Region II


Gina McCarthy, Commissioner
Connecticut Department of
Environmental Protection


Denise M. Sheehan, Commissioner
New York State Department of
Environmental Conservation

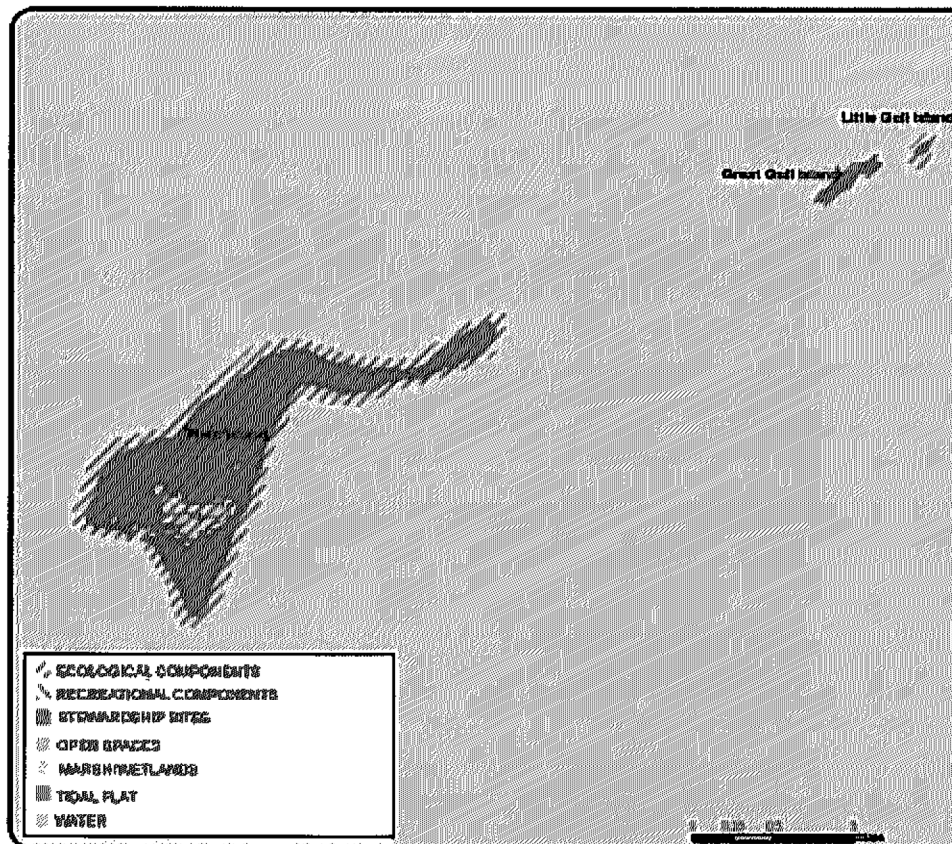
Stewardship of Plum Island

Plum Island and the adjacent Great Gull and Little Gull Islands have been recognized as a Stewardship Area of ecological value by the Long Island Sound Study (LISS) as a Stewardship Area of ecological value.

LISS is a bi-state partnership of federal and state agencies, user groups, concerned citizens, and individuals dedicated to restoring and protecting the Sound. LISS's Stewardship Initiative was created to protect the diverse plants and animals that make their home in or near the Sound. The Stewardship Initiative also seeks to ensure that the Sound's citizens will continue to enjoy the natural seascapes that make the area an enjoyable place to live. In 2006, the Stewardship Initiative work group identified 33 inaugural areas around the Sound with significant biological, scientific, or recreational value.

Read more at www.longislandsoundstudy.net/stewardship.

Plum & Gull Islands Southold, New York



Stewardship Sites: Plum Island, Little Gull Island, and Great Gull Island

Ecological significance:

- Exemplary colonial waterbird habitat, including sites that are of national—if not international—
- Small rocky islets dominated by grassy and herbaceous vegetation
- Colonized by over 6,000 pairs of common terns and approximately 1,200 pairs of roseate terns, the second largest breeding population of this endangered species in North America
- Identified by the USFWS as a Significant Coastal Habitat



Long Island Sound Study Citizens Advisory Committee

Nancy Seligson

Town of Mamaroneck, Citizen's Advisory Committee New York Co-chair

Curt Johnson (Leah Schmalz)

CT Fund for the Environment/Save the Sound, Citizen's Advisory Committee Connecticut Co

Martin Garrell

Aldephi University, Citizen's Advisory Committee Secretary

Paul DeOrsay

Friends of the Bay

Allen Berrien (Walter Raleigh)

Milford Harbor Marina

Sandy Breslin (Tom Baptist)

Audubon Center at Bent of the River

Sean Mahar

Audubon New York

Abbie Coderre

Saybrook Point Inn & Spa

Chantal Collier (Nathan Frohling)

Director, LIS Program

Tanya Court

The Business Council of Fairfield County

Carol DiPaolo

Coalition to Save Hempstead Harbor

Kay Eisenman

Westchester County Dept. of Planning

William Evanzia

J. B. E. Associates

Daniel Fucci

Nassau County Public Works Dept

Fred Grimsey

Save the River/Save the Hills

Rachel Gruzen (Elizabeth DeCelles)

Great Ecology and Environments

Jennifer Herring (Jamie Alonzo)

The Maritime Aquarium/Norwalk

Jim Hutchinson

New York Sportfishing Federation



Long Island Sound Study Citizens Advisory Committee

Sarah Kruse
PSEG Power Connecticut LLC

Cesare Manfredi (Warren Ross)
Federated Conserv. of Westchester County

John McDonald (Bud Raleigh)
Darien Advisory Comm./Coastal Waters

Donald McKay
Coalition/Protection of LI Groundwater

David Miller
Ecology and Environment, Inc

Jim Moriarty
Town of Oyster Bay

Maureen Dolan Murphy (Adrienne Esposito)
Citizens Campaign for the Environment

Daniel Natchez
Daniel S. Natchez & Assoc.

Joel Rinebold
Joel Rinebold LLC

Dianne Selditch
SoundWaters, Inc.

Daniel Snyder
Shoreline Shellfish, LLC

Eric Swenson
Hempstead Harbor Protection Committee

Tim Visel
The Sound School

Howard Weiss
Project Oceanology

Grant Westerson
CT Marine Trades Association

Jennifer Wilson-Pines
Manhasset Bay Protection Comm.

Paul Winters
Regional Plan Association

Joel Ziev
Town of North Hempstead

APPENDIX B: Plum Island Planning Study



Steven Bellone
SUFFOLK COUNTY EXECUTIVE
Department of
Economic Development and Planning

Joanne Minieri
Deputy County Executive and Commissioner

**Division of Planning
and Environment**

May 15, 2013

RE

Town of Southold
P.O. Box 1179
Southold, N.Y. 11935
Attn: Elizabeth Neville, Town Clerk

MAY

Southo

Applicant: Town of Southold
Zoning Action: Local Law, "Marine (II) District and Plum I
Zoning"
Resolution No.: 2013-276

Dear Ms. Neville:

Staff made an error in the review of the above referenced application. This referred application has placed on the Agenda for the June 5, 2013 Suffolk County Planning Commission Meeting. Please advised that the local determination decision letter, that was sent to the Town of Southold on April 2013, has been rescinded. Additional correspondence will be forthcoming.

Very truly yours,


Sarah Lansdale
Director of Planning


Andrew P. Freleng
Chief Planner

APF:cd

Oysterponds Rod and Gun Club, Inc.

Louise Evans

Dear Honorable Supervisor Russell and Town Board Members,

June 1

The Oysterponds Rod and Gun Club is one of the oldest associations of its kind, founded when local wildlife was threatened with extinction due to over-harvesting. Our birth parallels the great conservation movements of the time, leading to the formation of the New York Conservation Department, the forerunner of our modern New York State Department of Environmental Conservation (NYSDEC). We lease and patrol lands in Orient adjacent to NYSDEC Tidal wetlands, in one of the last places on Long Island where conservation and preservation of our land and water resources continues to provide a broad range of exceptional high quality environmental experiences for the public and our members.

Our long history of supporting conservation activities in the Orient area includes: providing support for the purchase of Orient Point by Suffolk County, maintaining wildlife sanctuaries patrolled by our deputized wardens, replacing invasive species with wildlife plantings, providing an emergency feed for wildlife in harsh winters and constructing numerous nest boxes and platforms. The Club has an annual fishing contest, open to all, in which the waters surrounding Plum Island play a prominent role.

Our club would like to go on record as cautiously supporting the proposed zoning of Plum Island. We are, however, concerned that any zoning of the island provide universal fishing access along the entire shoreline of the island and would caution the Town Board that limiting the proposed preserve areas to "passive recreation", if that means "no hunting", may not be in the best interest of preservation and conservation. Plum Island's current ecological status is a direct consequence of an animal extermination policy of the USDA, which has been in effect for over half a century. We are concerned that the island, which will undoubtedly repopulate and overpopulate with deer, may become over-browsed, killing vegetation and reducing song bird nest sites. When overpopulated with deer, it may require expenditures of public monies for government snare shooters to control them. The killing of birds by Plum Island employees stopped some time ago, creating one of the first havens for Canada Geese, which now plague the mainland. Given the history of goose and deer problems in Southold Town, we would suggest that any determination concerning restricting legal wildlife harvest under "passive recreation" controls be carefully vetted by the wildlife and habitat professionals of the New York State Department of Environmental Conservation before enactment and after we know whether DHS/USDA/DOI may create an overarching wildlife control program in the Final Environmental Impact Statement, covenanted to the island's sale.

The Oysterponds rod and Gun Club would like to thank the Town Board for this opportunity and input on the proposed zoning of Plum Island.

Sincerely,



Robert W. Sorenson, Jr., Pres.
Orient, NY

CC: Town Clerk, Elizabeth Neville; Town Planner, Heather Lanza

REC

JUN

Southold

ARTICLE XIII
Marine II (MII) District
[Added 1-10-1989 by L.L. No. 1-1989]

§ 280-54. Purpose.

The purpose of the Marine II (MII) District is to provide a waterfront location for a wide range of water-dependent and water-related uses, which are those uses which require or benefit from direct access to or location in marine or tidal waters and which, in general, are located on major waterways, open bayfronts or the Long Island Sound.

§ 280-55. Use regulations.

In the MII District, no building or premises shall be used and no building or part of a building shall be erected or altered which is arranged, intended or designed to be used, in whole or in part, for any uses except the following (one use per 80,000 square feet of land above mean high water, unless otherwise specified):

- A. Permitted uses. The following uses are permitted uses and, except for those uses permitted under Subsection A(1) hereof, are subject to site plan approval by the Planning Board: **[Amended 5-9-1989 by L.L. No. 6-1989]**
- (1) One one-family detached dwelling per single and separate lot of record in existence as of the date of adoption of this article.
 - (2) Marinas for the docking, mooring and accommodation of recreational or commercial boats, including the sale of fuel and oil primarily for the use of boats accommodated in such marina.
 - (3) Boat docks, slips, piers or wharves for charter boats carrying passengers on excursions, pleasure or fishing trips or for vessels engaged in fishery or shellfishery.
 - (4) Beach clubs, yacht clubs or boat clubs, including uses accessory to them, such as swimming pools, tennis courts and racquetball facilities.
 - (5) Boatyards for building, storing, repairing, renting, selling or servicing boats, which may include the following as an accessory use: office for the sale of marine equipment or products, dockside facilities for dispensing of fuel and, where pumpout stations are provided, rest room and laundry facilities to serve overnight patrons.

APPENDIX C: Marine II District Description

§ 280-55

§ 280-55

- (6) Mariculture or aquaculture operations or research and development.
 - (7) Boat and marine engine repair and sales and display, yacht brokers or marine insurance brokers.
 - (8) Buildings, structures and uses owned or operated by the Town of Southold, school districts, park districts and fire districts.
 - (9) Retail sale or rental of fishing, diving or bathing supplies and equipment if accessory to a marina or boatyard or ship's loft or chandlery.
- B. Uses permitted by special exception by the Board of Appeals. The following uses are permitted as a special exception by the Board of Appeals, as hereinafter provided, subject to site plan approval by the Planning Board:
- (1) Restaurants, excluding outdoor counter service, drive-ins or curbside establishments. Such prohibition shall not prevent service at tables on a covered or uncovered terrace or porch incidental to a restaurant.
 - (2) Ferry terminals.
 - (3) Transient hotels or motels, subject to the following conditions:
 - (a) The minimum area for such use shall be not less than three acres.
 - (b) The number of guest rooms permitted in the hotel or motel shall be determined by the proportion of the site utilized for such use and the availability of public water and sewer. The maximum number of guest units shall be one unit per 4,000 square feet of land with public water and sewer.
 - (4) Fish processing plants.
 - (5) Fish markets, which may include a combination of wholesale and retail sale of finfish and shellfish.
 - (6) Museums with a nautical theme or art galleries.
 - (7) Bed-and-breakfast uses as set forth in and regulated by § 280-13B(14). **[Added 9-9-2008 by L.L. No. 10-2008]**

§ 280-55

§ 280-56

C. Accessory uses. The following uses are permitted as accessory uses and, except for residential accessory uses and signs, which are governed by Article XIX, are subject to site plan review: **[Amended 5-9-1989 by L.L. No. 6-1989]**

(1) Accessory uses as set forth in and regulated by § 280-13C(1) through (7) of the Agricultural-Conservation District, and subject to the conditions of § 280-15 thereof.¹

§ 280-56. Bulk, area and parking regulations.

No building shall be used and no building or part thereof shall be erected or altered in the MII District unless the same conforms to the Bulk Schedule and Parking and Loading Schedules incorporated into this chapter by reference, with the same force and effect if such regulations were set forth herein in full.²

1. Editor's Note: Former Subsection C(2), which regulated signs and immediately followed this subsection, was repealed 11-29-1994 by L.L. No. 25-1994. For current sign provisions, see Art. XIX, Signs.

2. Editor's Note: The Bulk Schedule is included at the end of this chapter, and the Parking and Loading Schedules are in §§ 280-78 and 280-79.

Local Law Filing

(Use this form to file a local law with the Secretary of State.)

Text of law should be given as amended. Do not include matter being eliminated and do not use italics or underlining to indicate new matter.

- County
- City
- Town of SOUTHOLD
- Village

Local Law No. 17 of the year 2019 .

A Local Law entitled, A Local Law in relation to an Amendment to Chapter 280, Zoning, in connection with the Marine III (MIII) District

Be it enacted the Town Board of the:

- County
- City
- Town of SOUTHOLD
- Village

I Purpose.

The federal government, which currently owns Plum Island, has announced its intention to close the research facility on Plum Island and eventually sell the island. Previously, when the Federal Government made the aforementioned announcement, the Town Board of the Town of Southold took steps to amend the Town’s Zoning Map in preparation for the Plum Island being privately owned. The purpose of the Marine III (MIII) District is to provide a waterfront location in the portion of the Town located on Long Island for ferry service to and from Plum Island.

II. Article XXXV Marine III Zone District (MIII)

§ 280-205 Use regulations.

In the MIII District, no building or premises shall be used and no building or part of a building shall be erected or altered which is arranged, intended or designed to be used, in whole or in part, for any uses except the following (one use per 320,000 square feet of land above mean high water, unless otherwise specified):

- A. Permitted uses. The following uses are permitted uses and are subject to site plan approval by the Planning Board:

(If additional space is needed, attach pages the same size as this sheet, and number each.)

APPENDIX D: Marine III Zoning

(1) Ferry terminals for ferry service to and from Plum Island only.

B. Accessory uses. The following uses are permitted as accessory uses and/or structures:

- (1) Ticket offices, waiting areas, snack bar
- (2) Off-street parking or loading areas.
- (3) Offices for executive and administrative uses.
- (4) Storage sheds and tool sheds.
- (5) On-site storage and repair facilities directly related to the operation of the primary permitted use
- (6) Museum
- (7) Any other customary structures or uses which are customarily incidental to the principal use, except those prohibited by this chapter.

§ 280-206 Bulk, area and parking regulations.

No building shall be used and no building or part thereof shall be erected or altered in the MIII District unless the same conforms to the Bulk Schedule and Parking and Loading Schedules incorporated into this chapter by reference, with the same force and effect if such regulations were set forth herein in full.

III. SEVERABILITY

If any clause, sentence, paragraph, section, or part of this Local Law shall be adjudged by any court of competent jurisdiction to be invalid, the judgment shall not affect the validity of this law as a whole or any part thereof other than the part so decided to be unconstitutional or invalid.

IV. EFFECTIVE DATE

This Local Law shall take effect immediately upon filing with the Secretary of State as provided by law.

APPENDIX D: Marine III Zoning

(Complete the certification in the paragraph that applies to the filing of this local law and strike out that which is not applicable.)

1. (Final adoption by local legislative body only.)

I hereby certify that the local law annexed hereto, designated as local law No. 17 of 20 19, of the ~~(County)(City)(Town)(Village)~~ of SOUTHOLD was duly passed by the TOWN BOARD on December 3, 20 19, in accordance with the applicable provisions of law.

2. (Passage by local legislative body with approval, no disapproval or re-passage after disapproval by the Elective Chief Executive Officer*.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20____ of the (County)(City)(Town)(Village) of _____ was duly passed by the _____ on _____ 20____, and was (approved)(not approved)(re-passed after disapproval) by the _____ and was deemed duly adopted on _____ 20____, in accordance with the applicable provisions of law.

3. (Final adoption by referendum.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20____ of the (County)(City)(Town)(Village) of _____ was duly passed by the _____ on _____ 20____, and was (approved)(not approved)(repassed after disapproval) by the _____ on _____ 20____. Such local law was submitted to the people by reason of a (mandatory)(permissive) referendum, and received the affirmative vote of a majority of the qualified electors voting thereon at the (general)(special)(annual) election held on _____ 20____, in accordance with the applicable provisions of law.

4. (Subject to permissive referendum and final adoption because no valid petition was filed requesting referendum.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20____ of the (County)(City)(Town)(Village) _____ of _____ was duly passed by the _____ on _____ 20____, and was (approved)(not approved) (repassed after disapproval) by the _____ on _____ 20____. Such local law was subject to permissive referendum and no valid petition requesting such referendum was filed as of _____ 20____, in accordance with the applicable provisions of law.

* Elective Chief Executive Officer means or Includes the chief executive officer of a county elected on a county- wide basis or, If there be none, the chairperson of the county legislative body, the mayor of a city or village, or the supervisor of a town where such officer is vested with the power to approve or veto local laws or ordinances.

APPENDIX D: Marine III Zoning

5. (City local law concerning Charter revision proposed by petition.)

I hereby certify that the local law annexed hereto, designated as local law No. _____ of 20 _____ of the City of _____ having been submitted to referendum pursuant to the provisions of section (36)(37) of the Municipal Home Rule Law, and having received the affirmative vote of a majority of the qualified electors of such city voting thereon at the (special)(general) election held on _____ 20 _____, became operative.

6. (County local law concerning adoption of Charter.)

I hereby certify that the local law annexed hereto, designated as local law No _____ of 20 _____ of the County of _____ State of New York, having been submitted to the electors at the General Election of November _____ 20 _____, pursuant to subdivisions 5 and 7 of section 33 of the Municipal Home Rule Law, and having received the affirmative vote of a majority of the qualified electors of the cities of said county as a unit and a majority of the qualified electors of the towns of said county considered as a unit voting at said general election, became operative.

(If any other authorized form of final adoption has been followed, please provide an appropriate certification.)

I further certify that I have compared the preceding local law with the original on file in this office and that the same is a correct transcript there from and of the whole of such original local law, and was finally adopted in the manner indicated in paragraph 1 , above.

(Seal)

Clerk of the County legislative body, City, Town or
Village Clerk or officer designated by local legislative body
Elizabeth A. Neville, Town Clerk
Date: December 6, 2019

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Regional Director, Region 1

SUNY @ Stony Brook, 50 Circle Road, Stony Brook, New York 11790

P: (631) 444-0345 | F: (631) 444-0349

www.dec.ny.gov

PLUM ISLAND ROLE SUMMARY

The New York State Department of Environmental Conservation's overall responsibility is the protection and enhancement of the environment in New York State. This protection includes but is not limited to preventing, mitigating or remedying pollution by administering in accordance with regulations, the remediation of contaminated land and waterways, and monitoring and enforcement proportionate to the threat posed.

The Plum Island Animal Disease Center (PIADC) has a long history of conducting research on animal diseases on Plum Island. This work has potentially impacted the land and waters of the island through the generation of solid waste, regulated medical waste and other biohazardous materials, hazardous waste, petroleum spills, pesticide use, wastewater discharges, and air emissions.

The Department has taken the necessary actions to regulate the use of materials and activities on the island and has required critical measures to ensure the best available techniques (or technology) to remediate past disposal sites, regulate the treatment, movement and disposal of all waste streams necessary to promote, and maintain the conservation and enhancement of the island. These measures include issuance of solid waste, air and wastewater permits, oil storage licenses, oversight of pesticide use, clean-up of petroleum spills and hazardous waste, and removal of waste from many of the past disposal sites, including requiring groundwater testing and monitoring of impacted areas. To further support this effort, the Department has required the PIADC to assemble environmental data, survey waste disposal sites and report to the Department specific information for addressing any pollution concerns. The Department has reviewed the data, collaborated, advised and communicated with PIADC representatives at all levels on all matters necessary to ensure and secure the proper closure of the facility. Staff from several Department Divisions in both the Regional Offices and Albany headquarters provide oversight and maintain communication with PIADC representatives on a day-to-day basis to ensure that work that is conducted to close the facility reflects their statutory and regulatory obligations. To date the following actions have been completed or ongoing:

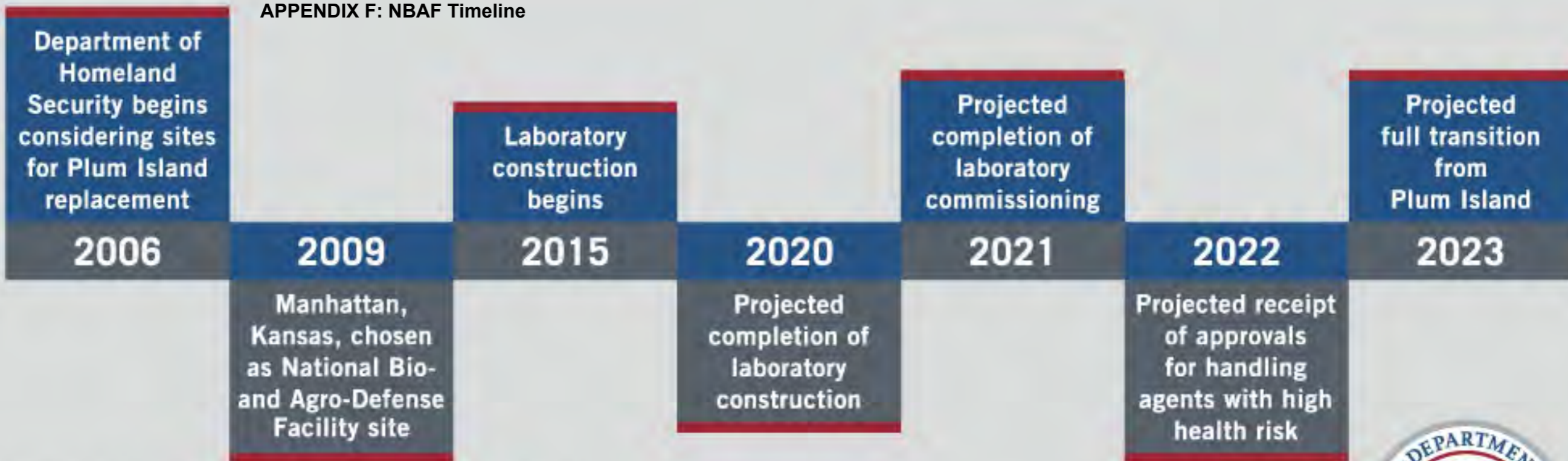
1. Closure of all hazardous waste disposal sites completed in 2005.
2. Ongoing Department oversight of the remediation of two petroleum spills.
3. Pesticide use of certain antimicrobial agents necessary for PIADC research has been authorized and monitored.
4. Decommissioning of the wastewater thermal decontamination system in building 102 is underway and a new state-of-the-art system has been installed in building 111.
5. Closure of 3 of the incinerators burning regulated medical waste and permitting of two pathological crematories has been completed.
6. Validation and frequent challenge testing of autoclaves used to treat biohazardous waste is conducted in accordance with permits issued for all treatment devices.
7. Removal of all waste currently generated on the island.
8. Remediation and ongoing monitoring of past waste disposal sites.
9. Completion by PIADC of data gaps, conceptual site modeling, reviewed and evaluated by the Department.
10. Planning for decontamination of all buildings where infectious agents were used for research.



Department of
Environmental
Conservation



APPENDIX F: NBAF Timeline



Sources: Department of Homeland Security, Kansas State University



APPENDIX G: Federal laws effective in 2009 and 2012 exempting Plum Island from the normal process for transferring surplus property

Federal laws effective in 2009 and 2012, exempting Plum Island from the normal process for transferring surplus property:

<https://www.congress.gov/110/plaws/publ329/PLAW-110publ329.pdf> [Please see SEC. 540]

<https://www.congress.gov/112/plaws/publ74/PLAW-112publ74.pdf> [Please see SEC. 538]

APPENDIX H: Envision Plum Island – Agenda and Questions for Stakeholders

Envision Plum Island

Agenda

Friday, Nov. 16, 2018

Cornell Cooperative Extension Center
423 Griffing Avenue, Riverhead, NY
Ground Floor meeting room

- 9:15 – 9:30 Coffee, find your table
- 9:30 – 10:00 ***Welcome, Participant Introductions and Vision, Instructions for the Day***
What do you see? - a visual kick-off by Thomas Halaczinsky & Petrina Engelke
Louise Harrison & Chris Cryder , Save the Sound
Marian Lindberg, The Nature Conservancy
Richard Engel, Senior Real Estate and Land Use Advisor, Marstel-Day
- 10:00 – 11:15 ***Alternative Pathways for Reuse of Plum Island***
Richard Engel, Senior Real Estate and Land Use Advisor, Marstel-Day, followed by Q&A
- 11:15 – 11:35 ***Plum Island's Biodiversity***, Matt Schlesinger, NY Natural Heritage Program
Plum Island's History, Chris Zeeman, Coast Defense Study Group
- 11:35 - 12:30 ***Potential scenarios: re-use and conservation; costs and potential revenue sources*** –
Table breakout discussions followed by plenary reports
- 12:30 – 1:15 ***Lunch and Remarks***
Scott Russell, Supervisor, Town of Southold
Staff of U.S. Senators and Representatives
- 1:15-1:30 Break
- 1:30 – 2:30 ***Participant discussion integrating the day's presentations: major questions and next steps*** (what major questions must be answered and steps taken to advance a feasible plan with broad support?)

Sponsors

Save the Sound

The Nature Conservancy

Videography by Archipelago New York Productions LLC

Lunch and morning coffee menu by Wine Country Deli, sponsored by Group for the East End
Compostable table service by North Fork Audubon Society and North Fork Environmental Council

Hosts

Legislator Al Krupski and Gwynn Schroeder
Cornell Cooperative Extension of Suffolk County



Save the Sound®



ENVISION PLUM ISLAND'S CONSERVATION DISTRICT Workshop Agenda

Sign-in, pick up lunch	Sheila Meehan, Save the Sound <i>Volunteer, Timekeeper</i>
Film: <i>What Do You See?</i>	<i>by</i> Thomas Halaczinsky and Petrina Engelke
Please introduce yourselves to your table mates	All
Welcome, why we're here	Louise Harrison, Save the Sound
Quick agenda overview; ground rules	Chris Cryder, Save the Sound
Plum I zoning; map products to use; assumptions	Marian Lindberg, The Nature Conservancy
Plum Island's ecological communities and species	Steve Young, NY Natural Heritage Program
Table instructions	Chris Cryder
Tables deliberate	All
Tables report out	Scribes/Facilitators
Conclusion	Chris Cryder
Hand in questionnaires!	<i>to</i> Sheila Meehan

If you need more time, please deliver them to Envision Plum Island table in lobby —or— scan and email them to lharrison@savethesound.org.

*Thank you to the **Long Island Nature Organization** for co-sponsoring this workshop and making it possible for us to assemble here today. We owe a debt of gratitude to the scientists at the **New York Natural Heritage Program** for their Plum Island studies and biodiversity inventories. It is a privilege to work with these organizations and today's workshop participants.*

Thank you for helping to Envision Plum Island's Conservation District!



Save the Sound®



ENVISION PLUM ISLAND

Save the Sound and The Nature Conservancy request your input for the Envision Plum Island project:

1. What areas of the Plum Island Conservation District should be protected from general use by the public for visitation or passive recreation to protect ecological communities or particular species?

- Name the ecological communities and/or species and mark on map (see reverse).

- By what means would you suggest uses be restricted?

Fencing yes no If yes, where and where not? _____

Patrols yes no If yes, where? _____

Signage yes no If yes, where and where not? _____

Natural buffers yes no If yes, where? _____

Other _____ Where? _____

2. Are you in favor of some overnight access, such as camping, natural history retreats, or educational programs? yes no

If not, why not? _____

If so, what area(s) could accommodate such uses? Describe use and be specific about location

3. What concerns, if any, do you have about management of Fort Terry's historical resources as they may relate to conservation of Plum Island's ecological resources?

- Describe: _____

- What potential solutions are there to those concerns? _____

4. Some natural areas on Plum Island are in need of restoration because of invasive species infestation or other adverse impacts. In order of urgency, which areas should be addressed first?

1. _____

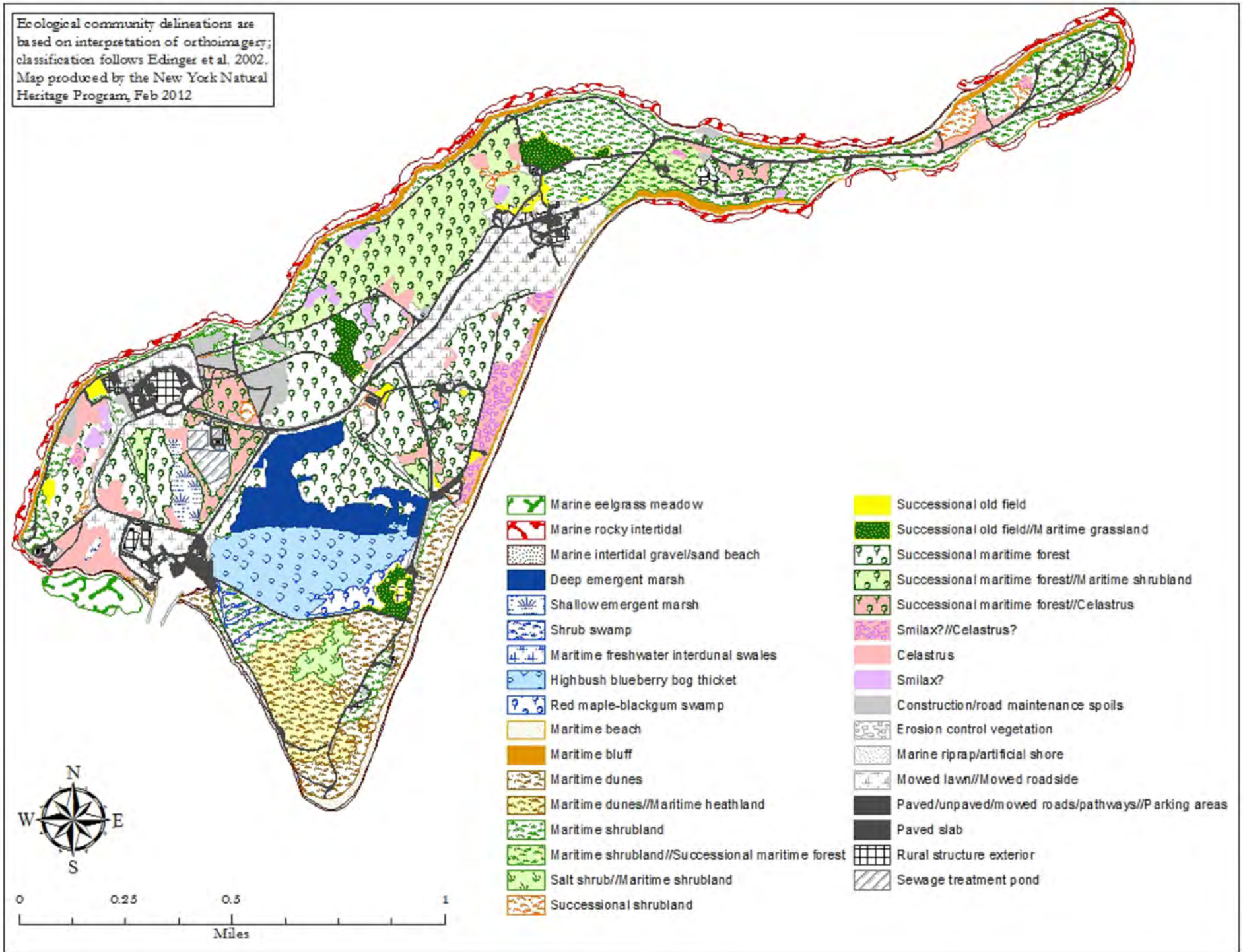
2. _____

3. _____

5. What questions need to be answered to guide further study of future conservation measures?

If you would like to stay involved and updated, please provide your name and email address (print clearly!):

APPENDIX I: Envision Plum Island – Agenda and Questions for Stakeholders



A Look Back to Envision Plum Island: What Do You See?

Thursday, September 26, 2019 9 a.m. to 3 p.m.

300 Broadhollow Road, Melville, NY

Hosted by The Long Island Association

- 9:00 – 9:30 Coffee, find your table
- 9:30 – 10:00 ***Introduction*** - Louise Harrison, *Save the Sound*
Welcome - Matthew Cohen, VP Government Affairs & Communications, Long Island Association
Participant Introductions - All
Instructions for the Day - Louise Harrison & Chris Cryder, *Save the Sound*
Marian Lindberg, *The Nature Conservancy*
Rich Engel, *Marstel-Day*
- 10:00 – 10:20 ***Town of Southold’s Perspective on Plum Island and its Zoning***
Scott Russell, Supervisor, Town of Southold
Mark Terry, Assistant Town Planning Director, Town of Southold
- 10:20 – 10:40 ***Contamination/Remediation Update***
Carrie Gallagher, Regional Director, NY State Department of Environmental Conservation
Marian Lindberg, *The Nature Conservancy*
- 10:40 – 10:50 ***Envision Plum Island’s Conservation District, LI Natural History Conference - Outcomes***
Louise Harrison, *Save the Sound*
- 10:50 – 11:20 ***Panel Discussion: Plum Island Progress***
[legislation, new appraisal, academic/research institution interest, closure of PIADC, & more]
Moderator: Leah Schmalz, *Save the Sound*
Greg Jacob & Marian Lindberg, *The Nature Conservancy*
Louise Harrison & Chris Cryder, *Save the Sound*
- 11:20 – 11:45 ***Question & Answer Session***
- 11:45 – 12:30 LUNCH
- 12:30 – 12:35 ***What Do You See? Video*** by Thomas Halaczinsky and Petrina Engelke
- 12:35 – 1:05 ***Alternative Pathways for Reuse of Plum Island and its Historical and Cultural Resources***
Introduction – Marion Lindberg
Richard Engel, Senior Real Estate and Land Use Advisor, *Marstel-Day*
- 1:05 – 1:15 ***Native American use of and ties to Plum Island***
Sandi Brewster-walker, Acting Exec. Director & Government Affairs Officer, *Montaukett Indians*
- 1:15 – 1:40 ***Panel Discussion: 1700 through Fort Terry Era and Today***
[cultural history, lighthouse update, Fort Terry and its potential reuses, & more]
Moderator: Marian Lindberg, *The Nature Conservancy*
Ruth Ann Bramson – Co-Author, *“A World Unto Itself: The Remarkable History of Plum Island, NY”*
Ted Webb – Chair, *Southold Historic Preservation Commission*
Chris Zeeman – Board member, *Coast Defense Study Group*
Fred Stelle – *Stelle Lomont Rouhani Architects*
- 1:40 – 2:45 ***What Do YOU See?***
All, at your tables – Prioritize reuse options of Plum Island’s Conservation and Research Districts
- 2:45 – 3:00 ***Next Steps***

Appendix J: A Look Back to Envision Plum Island – Agenda and Questions for Stakeholders

A LOOK BACK TO ENVISION PLUM ISLAND

September 26, 2019

Long Island Association

Melville, New York

A Look Back to Envision Plum Island: What Do You See?

Questions for the afternoon breakout session

In light of the information you have heard today, please offer your perspective on the following strategic questions:

- 1) What do you see as future reuses of Plum Island that could recognize and celebrate its cultural heritage and historical resources?
- 2) Based on your answer above, how could multiple and simultaneous reuses be accommodated?
- 3) What concerns if any, do you have about conservation of Plum Island's ecological resources as they may relate to management of Fort Terry's historical resources?
 - a. Describe:
 - b. What potential solutions do you propose?
- 4) Based on what you heard today, in your opinion what entity or entities should acquire the Conservation District?
- 5) What are the best means for undertaking future stewardship of the Plum Island lighthouse?
- 6) What further questions need to be answered to Envision Plum Island?



**New York State Office of Parks,
Recreation and Historic Preservation**

Historic Preservation Field Services • Peebles Island, PO Box 189, Waterford, New York 12188-0189
518-237-8643
www.nysparks.com

David Paterson
Governor

Carol Ash
Commissioner

May 6, 2010

Mr. Phil Youngberg, Environmental Manager
c/o Mr. John Dugan
General Services Administration (GSA)
10 Causeway Street, Room 925
Boston, MA 02222

Re: GSA
Sale of Plum Island
Orient Point, Suffolk County
10PR02105

Dear Mr. Youngberg:

Thank you for requesting the comments of the State Historic Preservation Office (SHPO) regarding the proposed sale of Plum Island. We are reviewing the project in accordance with Section 106 of the National Historic Preservation Act of 1966. These comments are those of the SHPO and relate only to Historic/Cultural resources. They do not include potential environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the National Environmental Policy Act and/or the State Environmental Quality Review Act (New York Environmental Conservation Law Article 8).

We offer the following comments:

1. The Light Station on Plum Island is listed in the New York State Register of Historic Places. Using both the Historic Structure Report for the Plum Island Light Station and the Historic Preservation Plan for Plum Island, New York, prepared by FPM/GAI in 2003, we understand there are a number of other structures which are eligible for listing in the registers:
 - a. Plum Island Lighthouse Complex
 - b. Batteries Floyd and Eldridge, Battery Construction No. 217
 - c. Shelter Searchlights 13 and 14
2. Based on our review of previously submitted material, it does not appear that the potential for significant archaeological deposits to be present on Plum Island has been addressed. Please contact Douglas Mackey at extension 3291 if you have any questions regarding this issue.

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3. Therefore, SHPO recommends that any action to remove Plum Island from Federal ownership should include covenant or other language mandating consultation with the SHPO regarding possible effects to historic and cultural resources as well as to archaeological deposits for any future ground disturbing activities.

We understand there is a public meeting scheduled in the near future as a member of the SHPO staff should be present. Please contact me at 518-237-8643 (ext 3287) or by email at elizabeth.martin@oprhp.state.ny.us should you have any questions. Refer to the project (PR) number above when corresponding about the project.

Sincerely,



Elizabeth Martin
Historic Sites Restoration Coordinator

Via email only



GSA New England Region

June 22, 2010

Ms. Elizabeth Martin
Historic Sites Restoration Coordinator
New York Office of Parks, Recreation, and Historic Preservation
P.O. Box 189
Waterford, NY 12188

Re: Sale of Plum Island, NY
Suffolk County
SHPO Project No.: 10PR02105

Dear Ms. Martin,

Thank you for your letter dated May 6, 2010 regarding the proposed sale of Plum Island, NY. Your office identified three sets of structures eligible for listing on the National Register of Historic Places (collectively, the "Eligible Structures"), they include:

- 1) Plum Island Lighthouse Complex;
- 2) Batteries Floyd and Eldridge, Battery Construction No. 217;
- 3) Shelter Searchlights 13 and 14.

Furthermore, your office recommended that, "...any action to remove Plum Island from federal ownership should include covenant or other language mandating consultation with SHPO regarding possible effects to historic and cultural resources as well as to archaeological deposits for any future ground disturbing activities." The General Services Administration (GSA) accepts this recommendation and pursuant to GSA's obligations under Section 106 of the National Historic Preservation Act of 1966, so amended, and in particular 36 CFR Part 800, GSA has determined that this disposal action will have no adverse effect on the Eligible Structures. The attached covenants, which mandate consultation with your office regarding possible effects on historic and cultural resources, will be included in the deed transferring title out of federal ownership. In regards to the Plum Island Lighthouse and associated structures, the Department of Homeland Security is currently preparing a nomination package and will forward this to your office upon completion.

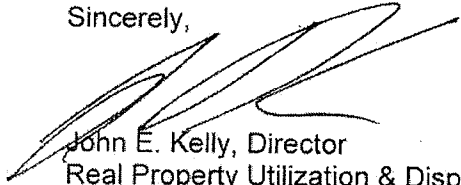
On the topic of significant archaeological deposits, GSA will be preparing a predictive model during the Environmental Impact Statement to identify areas where potentially significant archaeological deposits may be present. If any areas are identified that may encompass significant archaeological deposits, GSA will consult with you to develop a covenant to be included in the deed that will protect the potential archaeological resource.

Finally, on March 30, 2010, GSA sent early coordination letters to fourteen Native American tribes prior to initiating the NEPA scoping process. We received one response, an email from the Delaware Nation of Oklahoma requesting that they be a consulting party. We have attached that email for your review and request your assistance in determining how to best facilitate that consultation under Section 106.

U.S. General Services Administration
Thomas P. O'Neill, Jr. Federal Building
10 Causeway Street
Boston, MA 02222
www.gsa.gov

If you have any questions, or would like to discuss this matter further, please feel free to contact me at 617.565.8094 or john.kelly@gsa.gov.

Sincerely,



John E. Kelly, Director
Real Property Utilization & Disposal
Public Buildings Service

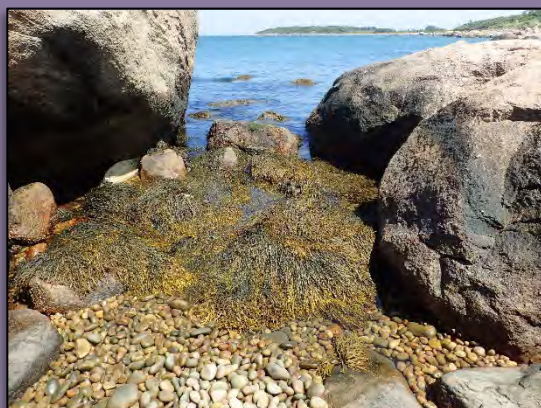
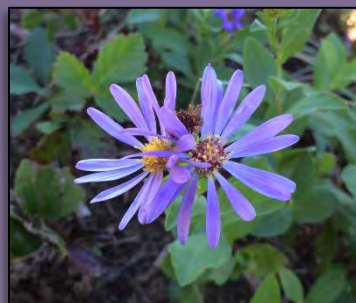
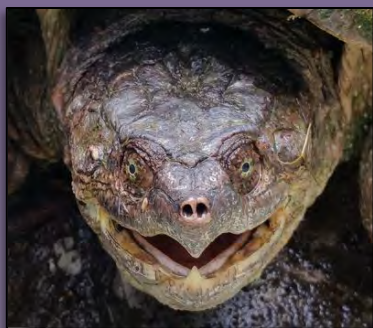
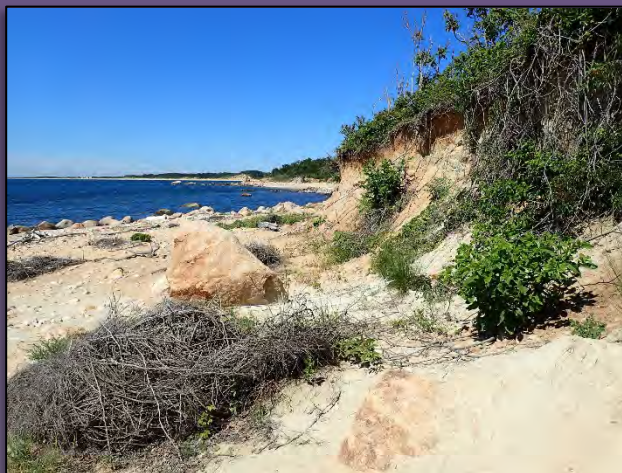
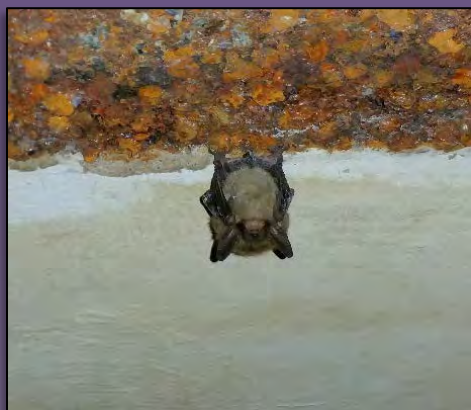
PROPOSED HISTORIC PRESERVATION COVENANT FOR PLUM ISLAND DEED

1. Grantee shall maintain and preserve the Property in accordance with the recommended approaches in *The Secretary of the Interior's Standards for Treatment of Historic Properties, 1995, Standards for Preservation* (Technical Preservation Services for Historic Buildings, National Park Service) in order to preserve and enhance the distinctive materials, features and spaces that make the Property eligible for inclusion in the National Register of Historic Places.
2. When rehabilitation is the appropriate treatment, Grantee shall rehabilitate the Property in accordance with the recommended approaches in *The Secretary of the Interior's Standards for Treatment of Historic Properties, 1995, Standards for Rehabilitation* (Technical Preservation Services for Historic Buildings, National Park Service). Rehabilitation is appropriate when repair and replacement of deteriorated features is necessary or when alteration or additions to the property are planned.
3. Distinctive materials, features, finishes, construction techniques and examples of craftsmanship that characterize the Property shall be preserved.
4. Plans of proposed rehabilitation, construction, alteration or replacement of distinctive materials, features, finishes or spaces which would affect the appearance or structural integrity of the Property shall be reviewed and approved by the State Historic Preservation Officer ("SHPO") for consistency with in *The Secretary of the Interior's Standards for Treatment of Historic Properties, 1995*.
5. Archaeological resources shall be protected and preserved in place. All projects involving ground-disturbing activity shall be reviewed by the SHPO. If such resources must be disturbed, mitigation measures must be undertaken with the express prior written permission of the SHPO.
6. The SHPO shall be permitted at all times to inspect the Property in order to ascertain if the above conditions are being observed.
7. In the event that the Property, or any associated historic artifact associated with the Property ceases to be maintained in compliance with the covenants, conditions and restrictions set forth in this section, in addition to any remedy now or hereafter provided by law, the SHPO may, following reasonable notice to Grantee, institute suit to enjoin said violation or to require restoration of the Property.
8. The covenants, conditions and restrictions contained herein shall be inserted by the Grantee verbatim or by express reference in any deed or other legal instrument by which it divests itself of either the fee simple title or any other lesser estate in the Property.
9. The Grantee agrees that the SHPO may, at its discretion, without prior notice to the Grantee, convey and assign all or part of its rights and responsibilities contained herein to a third party.
10. The failure of the SHPO to exercise any right or remedy granted under this instrument shall not have the effect of waiving or limiting the exercise of any other right or remedy or the use of such right or remedy at any other time.

Appendix L: Covenant communication, June 22, 2010. Letter from John E. Kelly to Elizabeth Martin

11. The covenants, conditions and restrictions set forth in this Historic Preservation Covenant shall constitute a binding servitude upon the Property and shall be deemed to run with the land.
12. The above covenants shall be binding in perpetuity; however, the SHPO may, for good cause, modify, suspend, or cancel any or all of the covenants upon written application of the Grantee.

Plum Island Biodiversity Inventory





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 iMapInvasives, 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 (*Symphotrichum 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*).



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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



Plum Island Biodiversity Inventory

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 Talled 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



Plum Island Biodiversity Inventory

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

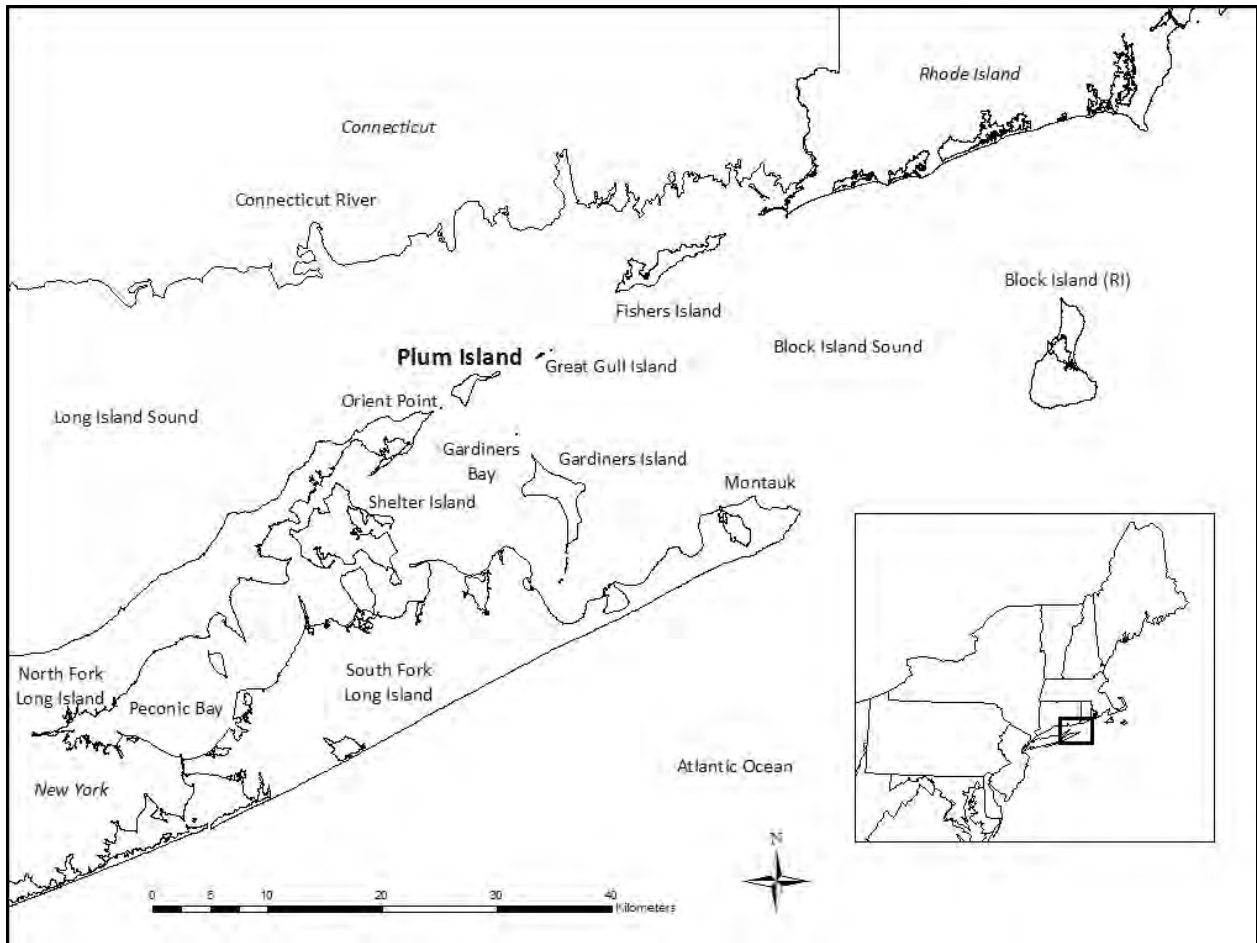


Figure 1. Plum Island with surrounding islands and points in mainland New York, Connecticut, and Rhode Island. Islands are within New York State unless otherwise noted. Inset: area of detail within the Northeast United States.

Plum Island Biodiversity Inventory

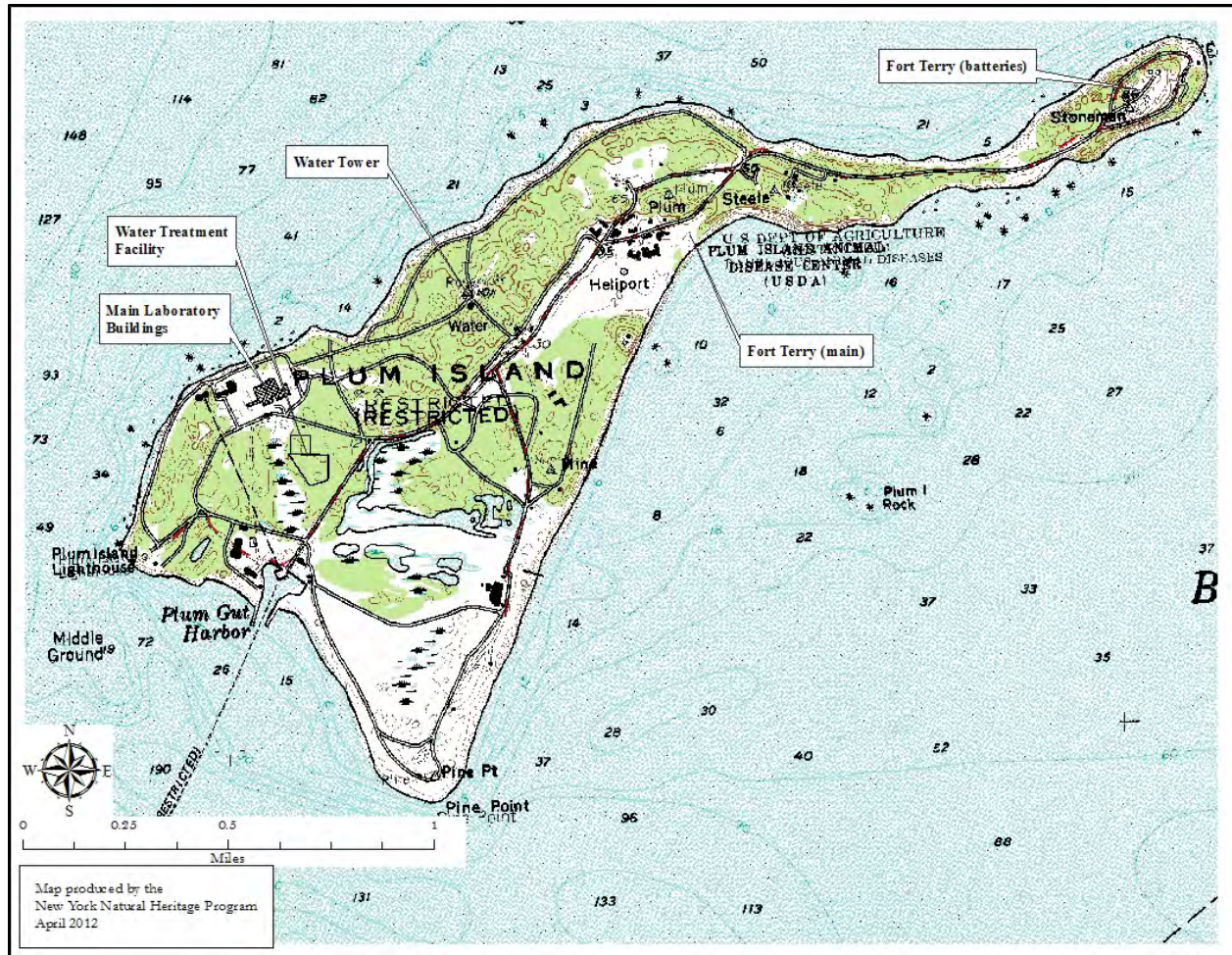


Figure 2. Plum Island, New York, with major features and human infrastructure.

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 groundtruthing 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



Plum Island Biodiversity Inventory

(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.

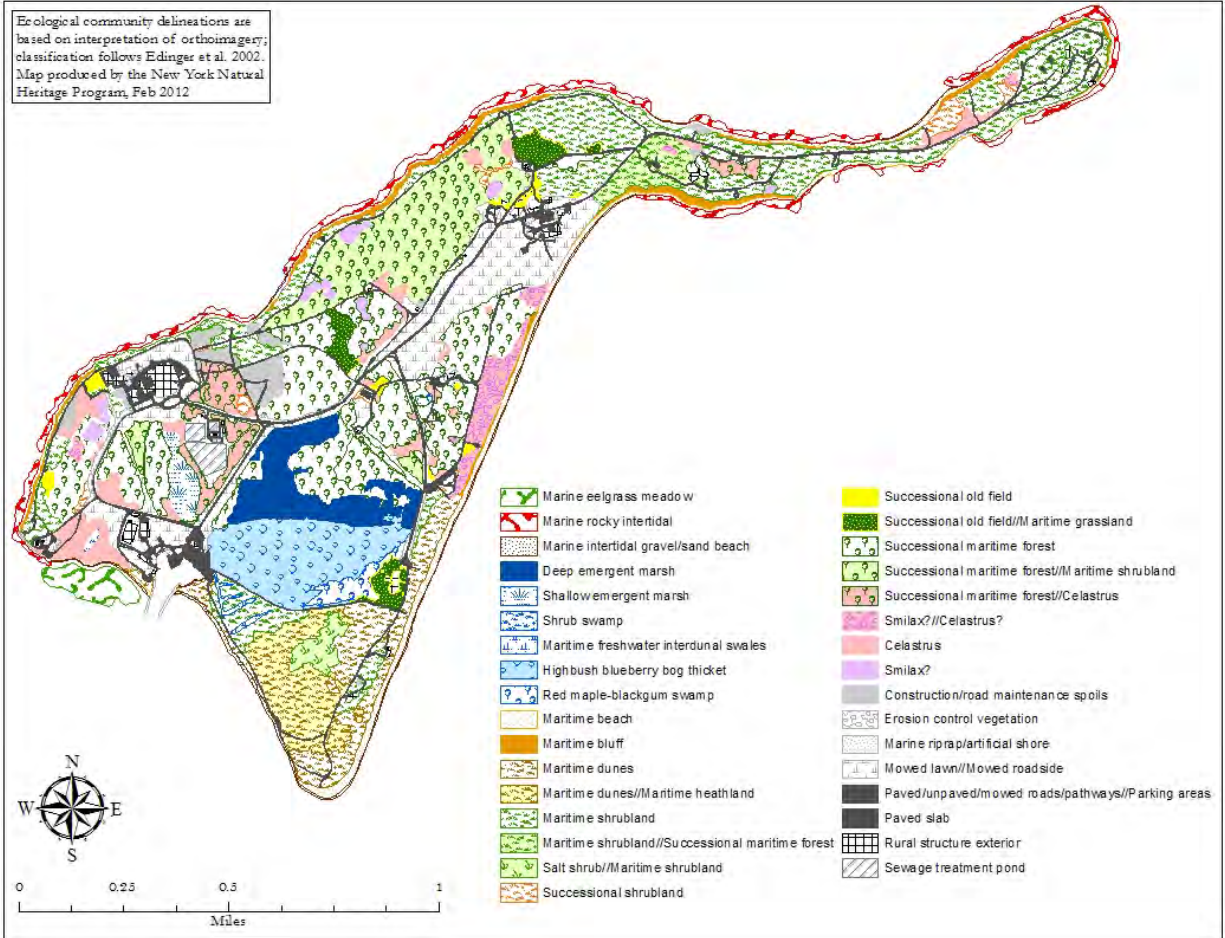


Figure 3. Natural community map of Plum Island, based on interpretation of orthoimagery, from Schlesinger *et al.* (2012).

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 macroalgae (“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.

Plum Island Biodiversity Inventory

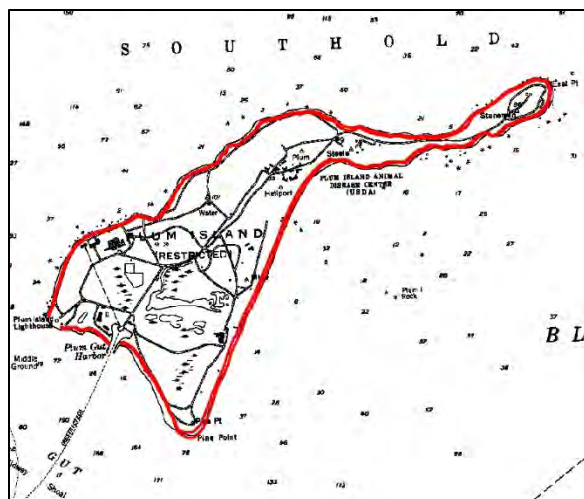


Figure 5. Maritime beach (rocky and sandy) at Plum Island.

“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: cocklebur (*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 carolinensis*). The vine layer (<0.5 m) has <1% cover consisting of hedge false bindweed (*Calyptegia 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 (*Calyptegia sepium*) and round-leaved greenbrier (*Smilax rotundifolia*) (<1% cover each).



Plum Island Biodiversity Inventory

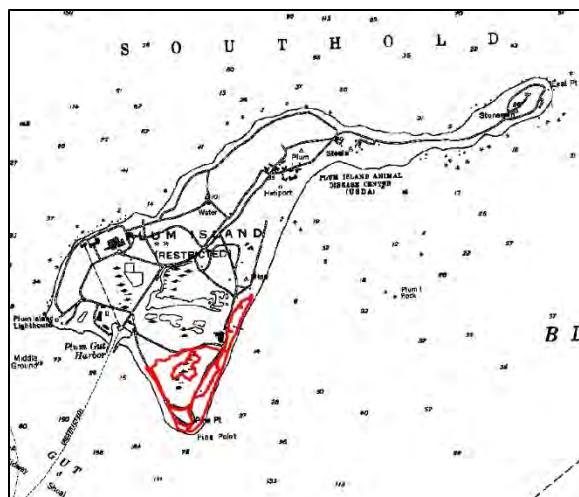


Figure 7. Maritime dunes on Plum Island.

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 japonicus*), 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 cocklebur (*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.

Plum Island Biodiversity Inventory

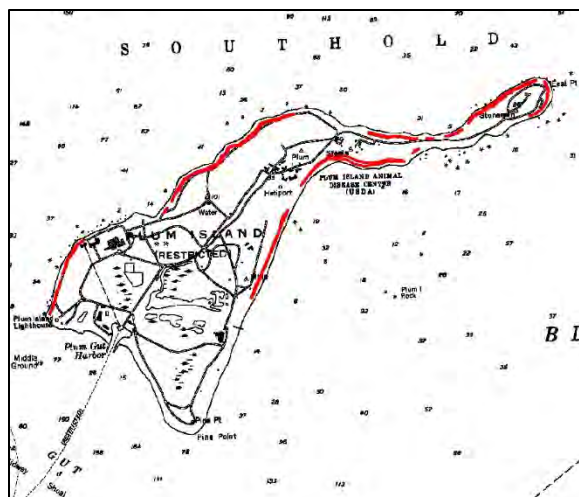


Figure 9. Maritime bluffs on Plum Island.

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*), cocklebur (*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.

Plum Island Biodiversity Inventory

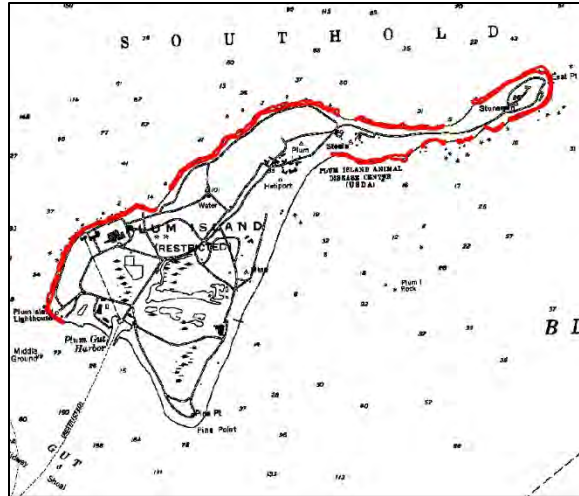


Figure 11. Marine rocky intertidal community at Plum Island.

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 horsehoe 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.

Plum Island Biodiversity Inventory

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.

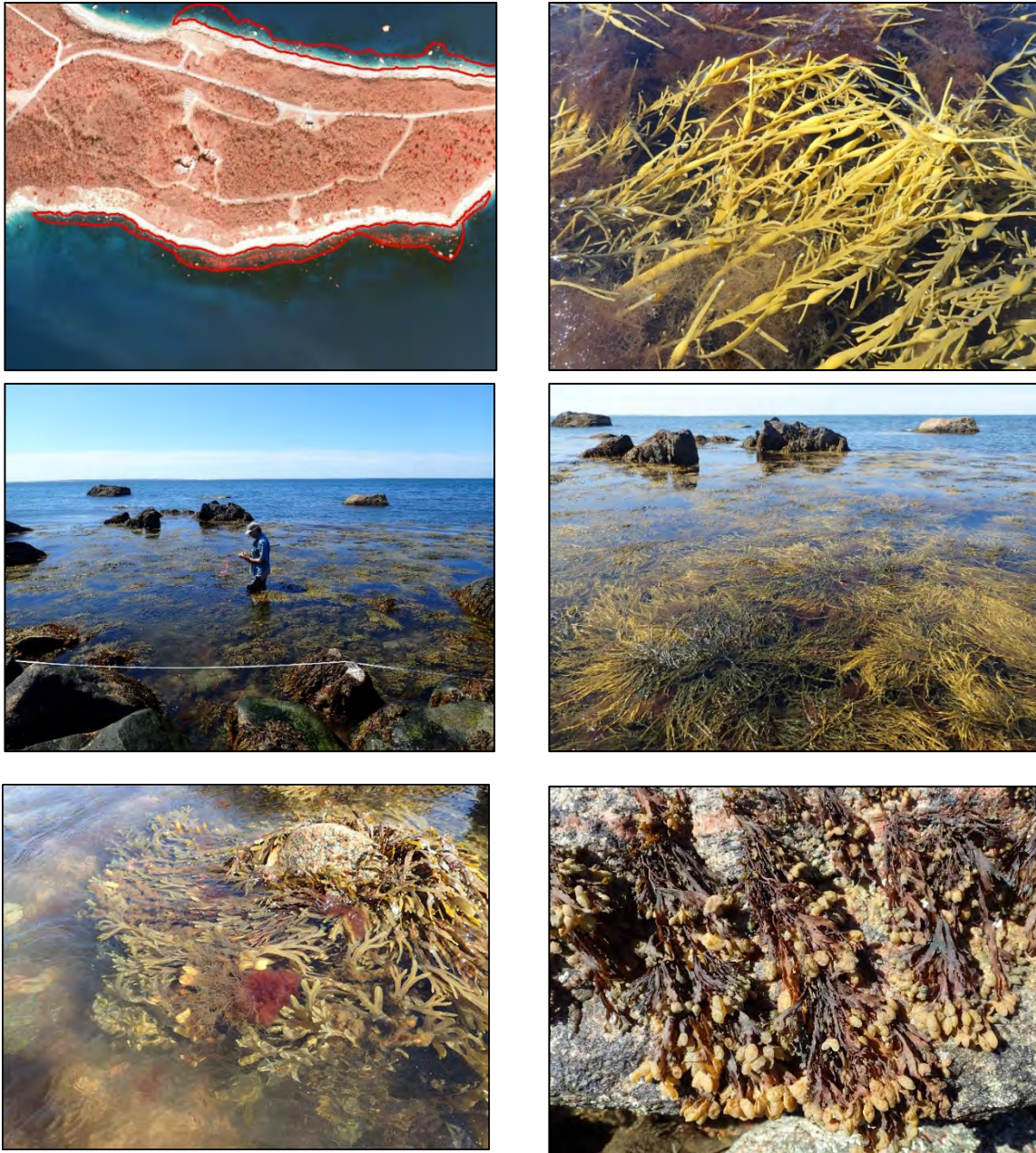


Figure 12. Marine rocky intertidal at Plum Island. Top left: Marine rocky intertidal polygon (Long Island 2010 6-inch Color Infrared). Top right: knotted wrack (*Ascophyllum nodosum*). Bottom left: rockweed (*Fucus vesiculosus*). Bottom right: rockweed (*Fucus spiralis*).

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.

Plum Island Biodiversity Inventory

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.

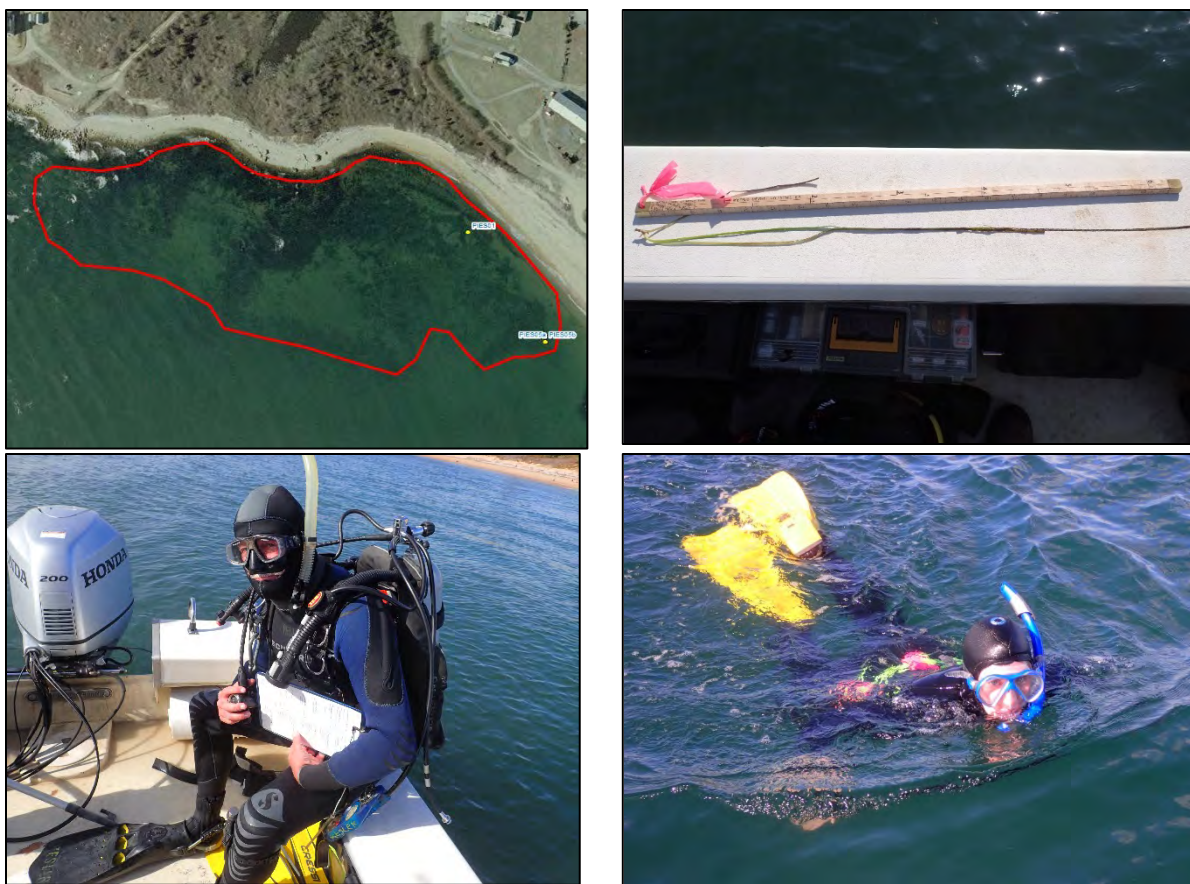


Figure 15 (clockwise from top left). Marine Eelgrass Meadow (Long Island 2004 1-foot Natural Color); Eelgrass (*Zostera marina*) specimen over 1 m long; Marine eelgrass meadow snorkel survey (Erin White); Marine eelgrass meadow SCUBA survey (Steve Resler).

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 [*Myotis 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).

Plum Island Biodiversity Inventory

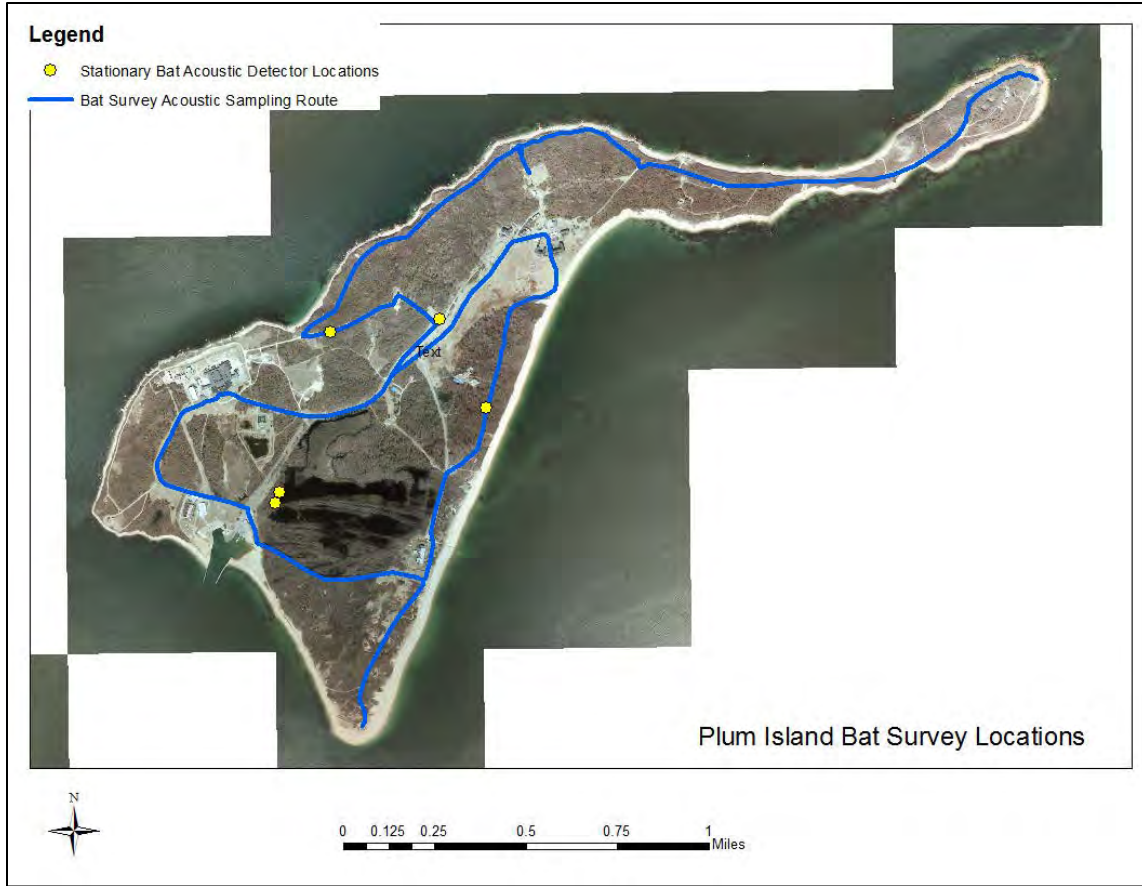


Figure 17. Bat survey route and stationary detector locations on Plum Island.



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	<i>Myotis lucifugus</i>	X			
Big brown bat	<i>Eptesicus fuscus</i>	X	X	X	X
Hoary bat	<i>Lasiurus cinereus</i>		X		X
Eastern red bat	<i>Lasiurus borealis</i>			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 (*Peromyscus 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. fuscus*) 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.



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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.

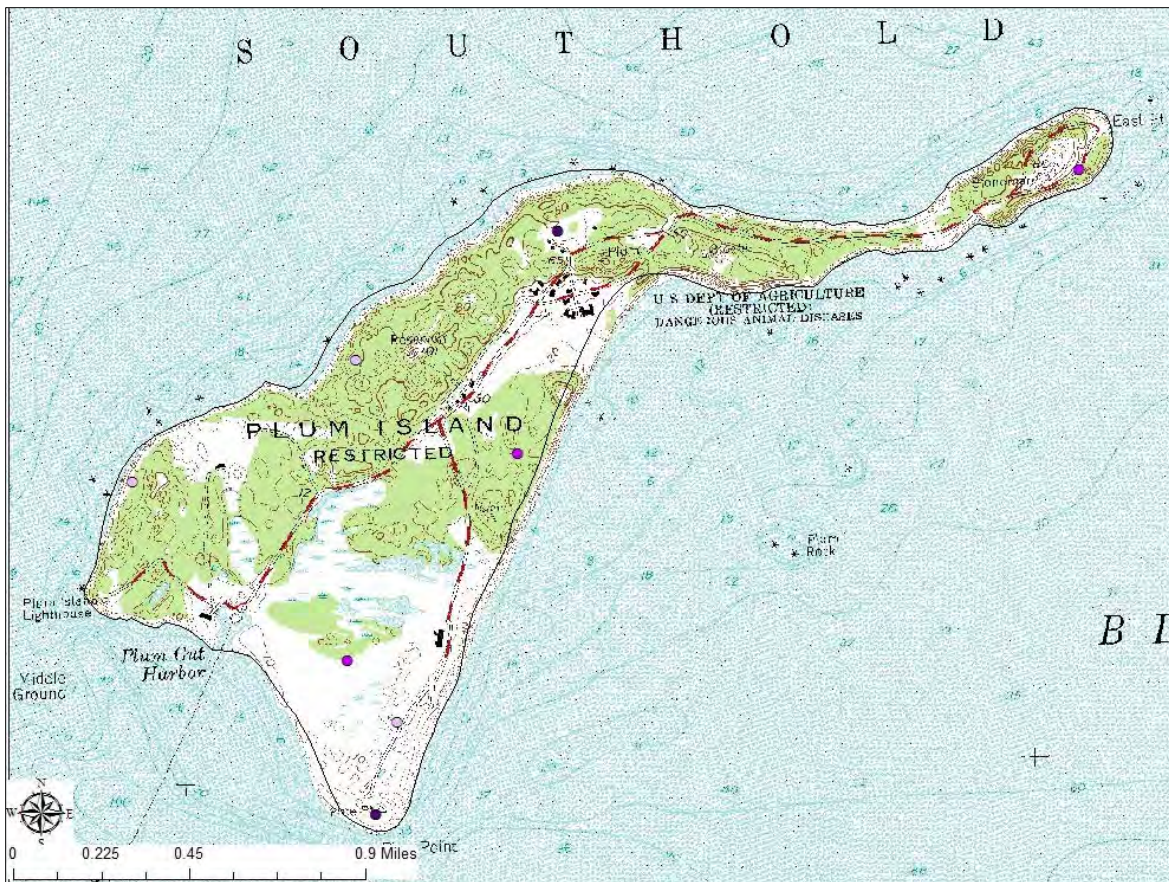


Figure 19. Map of Plum Island showing main sites of small mammal trapping effort. Sites surveyed in August are lavender, sites surveyed in September are purple, and sites surveyed both months are dark purple.



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.



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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 $\mu\text{mho}/\text{cm}^3$, 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

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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 Tennesen.

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

* Rare species; † Larva



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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 ubiquitous 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*).

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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 unique 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.



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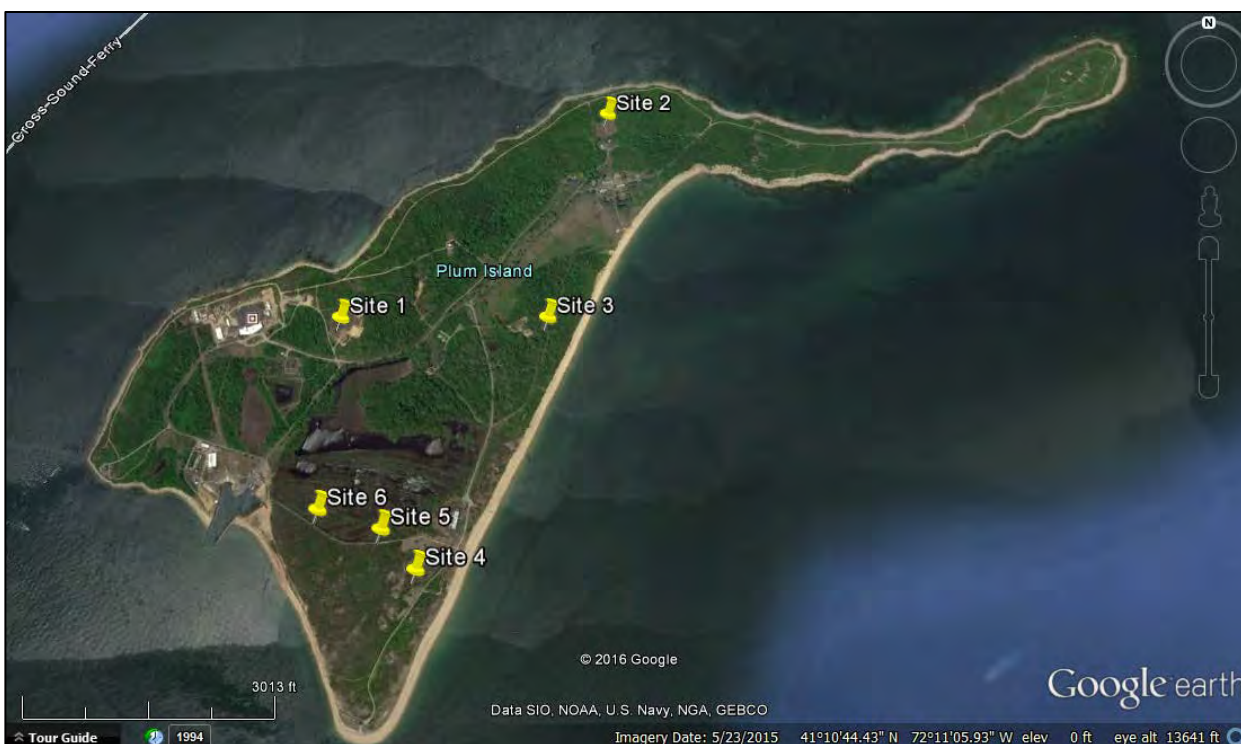


Figure 32. 2015 nocturnal collection sites for Plum Island Lepidoptera.

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	<i>Cisthene packardii</i>	G5	SU
Erebidae	<i>Virbia aurantiaca</i>	G5	SU
Noctuidae	<i>Abagrotis nefascia</i>	G4T3	S1S3
Noctuidae	<i>Apamea inordinata</i>	GU	S1
Noctuidae	<i>Apamea lintneri</i>	G4	SU
Noctuidae	<i>Eucoptocnemis fimbriaris</i>	G4	S1
Noctuidae	<i>Lepipolys perscripta</i>	G4	S1
Noctuidae	<i>Papaipema duovata</i>	G4	SH
Noctuidae	<i>Schinia spinosae</i>	G4	SU
Noctuidae	<i>Sympistis riparia</i>	G4	SU
Sphingidae	<i>Sphinx gordius</i>	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.

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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 (*Symphotrichum 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
<i>Asclepias verticillata</i>	Whorled Milkweed	Good	50 plants
<i>Carex bormathodes</i>	Marsh Straw Sedge	Failed to Find	Rare
<i>Carex merritt-feraldii</i>	Fernald's Sedge	Failed to Find	Rare
<i>Chamaecyparis thyoides</i>	Atlantic White Cedar	Failed to Find	Extirpated
<i>Crocantemum dumosum</i>	Bushy Rockrose	Failed to Find	Unknown
<i>Cyperus erythrorhizos</i>	Red-rooted Flatsedge	Poor	A few plants
<i>Cyperus lupulinus</i> ssp. <i>lupulinus</i>	Great Plains Flatsedge	Failed to Find	Rare
<i>Cyperus polystachyos</i>	Coast Flatsedge	Poor	A few plants
<i>Cyperus retrorsus</i>	Retrorse Flatsedge	Failed to Find	Rare
<i>Dichanthelium scoparium</i>	Velvet Panic Grass	Failed to Find	Rare
<i>Eleocharis fallax</i>	Creeping Spikerush	Failed to Find	Unknown
<i>Eleocharis uniglumis</i>	Saltmarsh Spikerush	Fair	100s of stems
<i>Erechtites hieracifolius</i> var. <i>megalocarpus</i>	Large Fruited Fireweed	Failed to Find	Rare
<i>Liatris borealis</i> ssp. <i>novae-angliae</i>	Northern Blazing Star	Failed to Find	Unknown
<i>Ligusticum scoticum</i>	Scotch Lovage	Failed to Find	Unknown
<i>Myriophyllum pinnatum</i>	Green parrot's-feather	Failed to Find	Rare
<i>Oenothera oakesiana</i>	Oakes Evening Primrose	Poor	3 plants

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Scientific name	Common name	2015 occurrence rank	Size
<i>Polygala cruciata</i>	Crossleaf Milkwort	Failed to Find	Rare
<i>Polygonum glaucum</i>	Seabeach Knotweed	Fair	39 plants
<i>Ptilimnium capillaceum</i>	Mock Bishop-weed	Failed to Find	Rare
<i>Silene caroliniana</i> ssp. <i>pennsylvanica</i>	Wild Pink	Fair	42 plants
<i>Spiranthes vernalis</i>	Spring Ladies-tresses	Good	141 plants
<i>Symphotrichum subulatum</i>	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
<i>Asclepias verticillata</i>	R	2015; mowed fields	July & August
<i>Carex bormathodes</i>	T	2002; a wetland	June & July
<i>Carex merritt-fernaldii</i>	T	2003; dry sands	June & July
<i>Chamaecyparis thyoides</i>	T	Before 1915; wetland edge	All year
<i>Crocanthemum dumosum</i>	E	1914; dry thicket	May to October
<i>Cyperus erythrorhizos</i>	R	2002; marshes, pond shores	August to October
<i>Cyperus lupulinus</i> ssp. <i>lupulinus</i>	T	2002; dry sands	August to October
<i>Cyperus polystachyos</i>	E	2015; backdune ditch	August to October
<i>Cyperus retrorsus</i>	E	2003; dune/swale area	August to October
<i>Dichanthelium scoparium</i>	E	2007; wet sands bordering marsh	July to November
<i>Eleocharis fallax</i>	E	1984; dried out pond bottom	August to October
<i>Eleocharis uniglumis</i>	T	2015; pondshore	August to October
<i>Erechtites hieracifolius</i> var. <i>megalocarpus</i>	E	2002; upper beach and strand	September & October
<i>Liatris scariosa</i> var. <i>novae-angliae</i>	T	1932; sandy field	August to November
<i>Ligusticum scoticum</i>	E	1896; north shore	May to October
<i>Myriophyllum pinnatum</i>	E	2003; ponds	July to October
<i>Oenothera oakesiana</i>	T	2015; beach and backdune	August to November
<i>Polygala cruciata</i>	R	2003; marshes	August to October
<i>Polygonum glaucum</i>	R	2015; sand beach	August to November
<i>Ptilimnium capillaceum</i>	R	2003; marshes	August to October
<i>Silene caroliniana</i> ssp. <i>pennsylvanica</i>	T	2015; sandy roadside	June to September
<i>Spiranthes vernalis</i>	E	2015; mowed fields and roadsides	August
<i>Symphotrichum subulatum</i>	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. *pennsylvanica*), 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 luciae*). 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*),

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

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



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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.

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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



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- 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.



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- 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



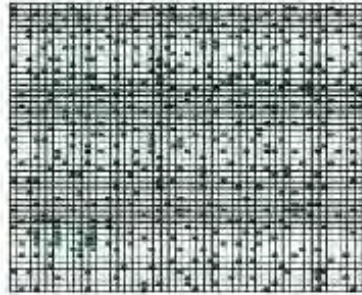
CONTINUOUS WITH BARE PATCHES



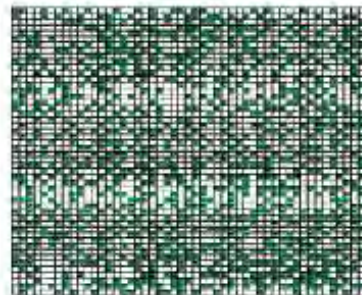
PATCHY COVER



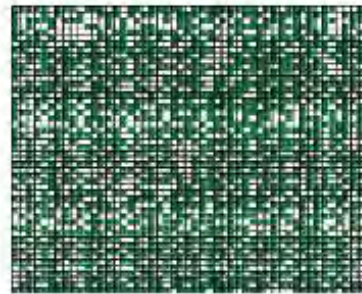
1-10%



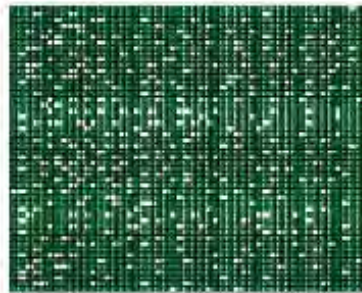
11-25%



26-50%



51-75%



>75%



Plum Island Biodiversity Inventory

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

Depth _____

Time _____

Zostera marina _____ %
Height from bottom _____ m

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

GREEN ALGAE _____ %
Codium
Ulva
Enteromorpha

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

BROWN ALGAE _____ %
Sargassum filipendula

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

RED ALGAE _____ %
Champia parvula
Polysiphonia

ROCKS >1m _____ %

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

ROCKS >10 cm _____ %

ROCKS <10 cm _____ %

SAND _____ %

SILT _____ %

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

SHELLS _____ %



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



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



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



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



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Blackpoll Warbler	<i>Setophaga striata</i>	Cas	-	Cas	-
Black-throated Blue Warbler ^S	<i>Setophaga caerulescens</i>	Unc/Rar	Unc/Rar	-	-
Palm Warbler	<i>Setophaga palmarum</i>	Com	-	Com	Unc/Rar
Pine Warbler	<i>Setophaga pinus</i>	Unc/Rar	-	Unc/Rar	-
Yellow-rumped Warbler	<i>Setophaga coronata</i>	Com	Unc/Rar	Abu	Com
Prairie Warbler ^S	<i>Setophaga discolor</i>	Unc/Rar	Unc/Rar	Unc/Rar	-
Black-throated Green Warbler	<i>Setophaga virens</i>	Com	-	Unc/Rar	-
Wilson's Warbler	<i>Cardellina pusilla</i>	Acc	-	Acc	-
Eastern Towhee ^C	<i>Pipilo erythrophthalmus</i>	Abu	Abu	Com	Unc/Rar
American Tree Sparrow	<i>Spizella arborea</i>	-	-	-	Com
Chipping Sparrow ^C	<i>Spizella passerina</i>	Com	Unc/Rar	Com	Unc/Rar
Clay-colored Sparrow	<i>Spizella pallida</i>	Acc	-	-	-
Field Sparrow	<i>Spizella pusilla</i>	Unc/Rar	-	Unc/Rar	Unc/Rar
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Com	-	Com	Unc/Rar
Grasshopper Sparrow ^{Hi}	<i>Ammodramus savannarum</i>	-	Acc	-	-
Fox Sparrow	<i>Passerella iliaca</i>	Com	-	-	Unc/Rar
Song Sparrow ^C	<i>Melospiza melodia</i>	Abu	Com	Com	Com
Lincoln's Sparrow	<i>Melospiza lincolni</i>	-	-	Acc	-
Swamp Sparrow	<i>Melospiza georgiana</i>	Unc/Rar	-	Com	Unc/Rar
White-throated Sparrow	<i>Zonotrichia albicollis</i>	Com	-	Abu	Com
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Com	-	Unc/Rar	-
Dark-eyed Junco	<i>Junco hyemalis</i>	Com	-	Com	Com
Scarlet Tanager ^S	<i>Piranga olivacea</i>	Cas	-	Cas	-
Northern Cardinal ^P	<i>Cardinalis cardinalis</i>	Com	Com	Com	Com
Rose-breasted Grosbeak	<i>Phenicticus ludovicianus</i>	Unc/Rar	-	-	-
Blue Grosbeak	<i>Passerina caerulea</i>	Acc	-	-	-
Indigo Bunting	<i>Passerina cyanea</i>	Com	-	Unc/Rar	-
Bobolink ^{Hi}	<i>Dolichonyx oryzivorus</i>	Acc	-	Acc	-
Red-winged Blackbird ^C	<i>Agelaius phoeniceus</i>	Abu	Com	Com	Com
Eastern Meadowlark ^{Hi}	<i>Sturnella magna</i>	Unc/Rar	-	Unc/Rar	Com
Rusty Blackbird ^{Hi}	<i>Euphagus carolinus</i>	Cas	-	Cas	-
Common Grackle ^C	<i>Quiscalus quiscula</i>	Abu	Com	Com	Abu
Brown-headed Cowbird ^C	<i>Molothrus ater</i>	Com	Com	-	Com
Orchard Oriole ^P	<i>Icterus spurius</i>	Unc/Rar	Unc/Rar	-	-
Baltimore Oriole ^C	<i>Icterus galbula</i>	Com	Unc/Rar	Unc/Rar	-
Purple Finch	<i>Haemorhous purpureus</i>	-	-	Cas	Cas
House Finch ^C	<i>Haemorhous mexicanus</i>	Com	Com	Com	Com
Red Crossbill	<i>Loxia curvirostra</i>	-	-	-	Cas
White-winged Crossbill	<i>Loxia leucoptera</i>	-	-	-	Acc
Common Redpoll	<i>Acanthis flammea</i>	-	-	-	Cas
Pine Siskin	<i>Spinus pinus</i>	-	-	Com	Abu
American Goldfinch ^C	<i>Spinus tristis</i>	Com	Com	Com	Com
House Sparrow ^C	<i>Passer domesticus</i>	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	<i>Peromyscus leucopus</i>
Meadow vole	<i>Microtus pennsylvanicus</i>
Muskrat	<i>Ondatra zibethicus</i>
Beaver	<i>Castor canadensis</i>
Norway rat	<i>Rattus norvegicus</i>
Little brown myotis ^{Hi}	<i>Myotis lucifugus</i>
Big brown bat	<i>Eptesicus fuscus</i>
Hoary bat ^S	<i>Lasiurus cinereus</i>
Eastern red bat ^S	<i>Lasiurus borealis</i>
Raccoon	<i>Procyon lotor</i>
Harbor seal	<i>Phoca vitulina</i>
Gray seal	<i>Halichoerus grypus</i>
White-tailed deer	<i>Odocoileus virginianus</i>
Northern right whale ^{Hi}	<i>Eubalaena glacialis</i>
Bottlenose dolphin	<i>Tursiops truncatus</i>
Common dolphin	<i>Delphinus delphis</i>
Harbor porpoise ^{Hi}	<i>Phocoena phocoena</i>
Birds	
Greater White-fronted Goose	<i>Anser albifrons</i>
Snow Goose	<i>Chen caerulescens</i>
Brant	<i>Branta bernicla</i>
Canada Goose ^C	<i>Branta canadensis</i>
Mute Swan ^C	<i>Cygnus olor</i>
Wood Duck ^C	<i>Aix sponsa</i>
Gadwall	<i>Anas strepera</i>

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



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

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



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

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



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Common name	Scientific name
Blackburnian Warbler	<i>Setophaga fusca</i>
Yellow Warbler ^C	<i>Setophaga petechia</i>
Chestnut-sided Warbler	<i>Setophaga pennsylvanica</i>
Blackpoll Warbler	<i>Setophaga striata</i>
Black-throated Blue Warbler ^S	<i>Setophaga caerulescens</i>
Palm Warbler	<i>Setophaga palmarum</i>
Pine Warbler	<i>Setophaga pinus</i>
Yellow-rumped Warbler	<i>Setophaga coronata</i>
Prairie Warbler ^S	<i>Setophaga discolor</i>
Black-throated Green Warbler	<i>Setophaga virens</i>
Wilson's Warbler	<i>Cardellina pusilla</i>
Eastern Towhee ^C	<i>Pipilo erythrophthalmus</i>
American Tree Sparrow	<i>Spizella arborea</i>
Chipping Sparrow ^C	<i>Spizella passerina</i>
Clay-colored Sparrow	<i>Spizella pallida</i>
Field Sparrow	<i>Spizella pusilla</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Grasshopper Sparrow ^{Hi}	<i>Ammodramus savannarum</i>
Fox Sparrow	<i>Passerella iliaca</i>
Song Sparrow ^C	<i>Melospiza melodia</i>
Lincoln's Sparrow	<i>Melospiza lincolni</i>
Swamp Sparrow	<i>Melospiza georgiana</i>
White-throated Sparrow	<i>Zonotrichia albicollis</i>
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
Dark-eyed Junco	<i>Junco hyemalis</i>
Scarlet Tanager ^S	<i>Piranga olivacea</i>
Northern Cardinal ^P	<i>Cardinalis cardinalis</i>
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
Blue Grosbeak	<i>Passerina caerulea</i>
Indigo Bunting	<i>Passerina cyanea</i>
Bobolink ^{Hi}	<i>Dolichonyx oryzivorus</i>
Red-winged Blackbird ^C	<i>Agelaius phoeniceus</i>
Eastern Meadowlark ^{Hi}	<i>Sturnella magna</i>
Rusty Blackbird ^{Hi}	<i>Euphagus carolinus</i>
Common Grackle ^C	<i>Quiscalus quiscula</i>

Common name	Scientific name
Brown-headed Cowbird ^C	<i>Molothrus ater</i>
Orchard Oriole ^P	<i>Icterus spurius</i>
Baltimore Oriole ^C	<i>Icterus galbula</i>
Purple Finch	<i>Haemorhous purpureus</i>
House Finch ^C	<i>Haemorhous mexicanus</i>
Red Crossbill	<i>Loxia curvirostra</i>
White-winged Crossbill	<i>Loxia leucoptera</i>
Common Redpoll	<i>Acanthis flammea</i>
Pine Siskin	<i>Spinus pinus</i>
American Goldfinch ^C	<i>Spinus tristis</i>
House Sparrow ^C	<i>Passer domesticus</i>
Reptiles	
Garter snake	<i>Thamnophis sirtalis</i>
Brown snake	<i>Storeria dekayi</i>
Snapping turtle ^S	<i>Chelydra serpentina</i>
Painted turtle	<i>Chrysemys picta</i>
Eastern box turtle ^{Hi}	<i>Terrapene carolina</i>
Fish	
Mummichog ^S	<i>Fundulus heteroclitus</i>
Mosquitofish	<i>Gambusia affinis</i>
Goldfish	<i>Carassius auratus</i>
Atlantic silverside ^S	<i>Menidia menidia</i>



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Moths

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

<i>Grammia parthenice</i>
<i>Halysidota tessellaris</i>
<i>Hypena baltimoralis</i>
<i>Hypena scabra</i>
<i>Hypercompe scribonia</i>
<i>Hypoprepia fucosa</i>
<i>Idia aemula</i>
<i>Idia americalis</i>
<i>Idia diminuendis</i>
<i>Idia forbesi</i>
<i>Idia rotundalis</i>
<i>Ledaea perditalis</i>
<i>Lophocampa caryae</i>
<i>Lymantria dispar</i>
<i>Macrochilo orziferalis</i>
<i>Metalectra discalis</i>
<i>Paltthis angulalis</i>
<i>Pangrapta decoralis</i>
<i>Panopoda rufimargo</i>
<i>Parallelia bistrifaris</i>
<i>Phalaenophana pyramusalis</i>
<i>Phalaenostola larentioides</i>
<i>Phoberia atomaris</i>
<i>Pyrrharctia isabella</i>
<i>Renia adspersigillus</i>
<i>Renia discoloralis</i>
<i>Renia flavipunctalis</i>
<i>Spilosoma congrua</i>
<i>Spilosoma latipennis</i>
<i>Virbia aurantiaca</i> ^{HT}
<i>Virbia opella</i>
<i>Zale horrida</i>
<i>Zale intenta</i>
<i>Zale lunata/ minirea</i>

<i>Zale unilineata</i>
<i>Zanclognatha cruralis</i>
<i>Zanclognatha marcidilinea</i>
Geometridae
<i>Anavitrinella pampinaria</i>
<i>Antepione thisoaria</i>
<i>Besma quercivoraria</i>
<i>Biston betularia</i>
<i>Campaea perlata</i>
<i>Chlorochlamus chloroleucaria</i>
<i>Costaconvexa centrostrigaria</i>
<i>Cyclophora packardi</i>
<i>Cyclophora pendulinaria</i>
<i>Dyspteris abortivaria</i>
<i>Ennomos magnaria</i>
<i>Epimecis hortaria</i>
<i>Epirrhoë alternata</i>
<i>Euclaena ?marginaria</i>
<i>Euclaena irritaria</i>
<i>Euclaena johnsonaria</i>
<i>Euclaena muzaria</i>
<i>Euclaena serrata</i>
<i>Eugonobapta nivosaria</i>
<i>Eulithis diversilineata</i>
<i>Eumacaria madopata</i>
<i>Eusarca confusaria</i>
<i>Entrapela clemataria</i>
<i>Gueneria similaria</i>
<i>Heliomata cycladata</i>
<i>Hethemia pistaciaria</i>
<i>Hypagyrtis unipuncta</i>
<i>Idaea dimidiata</i>
<i>Itame virginialis</i>

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



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

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

<i>Leucania extincta</i>
<i>Leucania linda</i>
<i>Leucania limita</i>
<i>Leucania ursula</i>
<i>Leuconycta diphteroides</i>
<i>Litbophane antennata</i>
<i>Marathyssa inficita</i>
<i>Morrisonia evicta</i>
<i>Mythimna oxygala</i>
<i>Mythimna unipuncta</i>
<i>Nephelodes minians</i>
<i>Noctua pronuba</i>
<i>Ochrupleura implecta</i>
<i>Orthodes cynica</i>
<i>Orthodes detracta</i>
<i>Orthodes majuscula</i>
<i>Orthosia rubescens</i>
<i>Paectes oculatrix</i>
<i>Paectes pygmaea</i>
<i>Papaipema duovata</i> ^{HT}
<i>Phlogophora periculosa</i>
<i>Phosphila misceloides</i>
<i>Phosphila turbulenta</i>
<i>Plusia contexta</i>
<i>Polygrammate hebraeicum</i>
<i>Ponometia candefacta</i>
<i>Protolampra brunneicollis</i>
<i>Protorthodes oviduca</i>
<i>Proxenus miranda</i>
<i>Schinia arcigera</i>
<i>Schinia lynx</i>
<i>Schinia nundina</i>
<i>Schinia spinosae</i> ^{HT}
<i>Sericaglaea signata</i>
<i>Spodoptera ornithogalli</i>
<i>Sunira bicolorago</i>

<i>Sympistis riparia</i> ^{HT}
<i>Trichoilita signata</i>
<i>Ulolonche culea</i>
<i>Ulolonche modesta</i>
<i>Xestia dilucida</i>
<i>Xestia dolosa</i>
<i>Xestia smithii</i>
Nolidae
<i>Baileya levitans</i>
Notodontidae
<i>Datana drexelli/major</i>
<i>Datana ministra</i>
<i>Datana perspicua</i>
<i>Gluphisia septentrionis</i>
<i>Heterocampa guttinitta</i>
<i>Heterocampa obliqua</i>
<i>Heterocampa umbrata</i>
<i>Hyperaeschra georgica</i>
<i>Nadata gibbosa</i>
<i>Peridea angulosa</i>
Saturniidae
<i>Automeris io</i>
Sphingidae
<i>Darapsa myron</i>
<i>Eumorphia acbemon</i>
<i>Eumorphia pandorus</i>
<i>Paonias excaecata</i>
<i>Sphocodina abbotti</i>
<i>Sphinx gordius</i> ^{HT}
Yponomeutidae
<i>Atteva aurea</i>



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Other invertebrates

For dragonflies and damselflies we followed the protocol for documentation from the New York Dragonfly and Damselfly 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	
<i>Limax maximus</i>	Leopard slug
Dragonflies and damselflies	
<i>Anax junius</i>	Common green darner
<i>Enallagma civile</i>	Familiar bluet
<i>Erythemis simplicicollis</i>	Eastern pondhawk
<i>Ischnura posita</i>	Fragile forktail
<i>Ischnura ramburii</i> ^S	Rambur's forktail
<i>Ischnura verticalis</i>	Eastern forktail
<i>Libellula auripennis</i> ^{HT}	Golden-winged skimmer
<i>Libellula needhami</i> ^S	Needham's skimmer
<i>Libellula pulchella</i>	Twelve-spotted skimmer
<i>Pachydiplax longipennis</i>	Blue dasher
<i>Pantala flavescens</i>	Wandering glider
<i>Pantala hymenaea</i>	Spot-winged glider
<i>Perithemis tenera</i>	Eastern amberwing
<i>Plathemis lydia</i>	Common whitetail
<i>Sympetrum</i> sp.	A meadowhawk
<i>Tramea carolina</i>	Carolina saddlebags
<i>Tramea lacerata</i>	Black saddlebags
Butterflies	
<i>Danaus plexippus</i> ^{SP}	Monarch
<i>Papilio polyxenes</i>	Black swallowtail
<i>Colias eurytheme</i>	Orange sulphur
<i>Colias philodice</i>	Clouded sulphur
<i>Pieris rapae</i>	Cabbage white

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



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



Plum Island Biodiversity Inventory

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



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



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



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



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



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



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



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



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



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



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



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



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



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



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



Plum Island Biodiversity Inventory

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

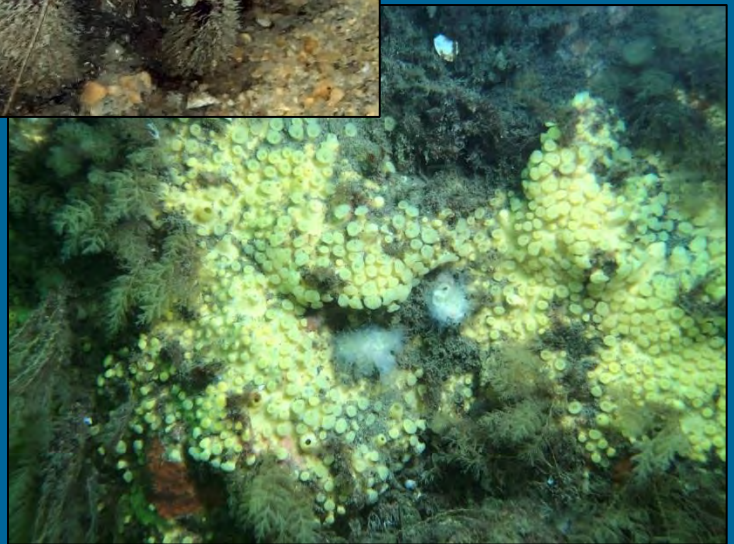
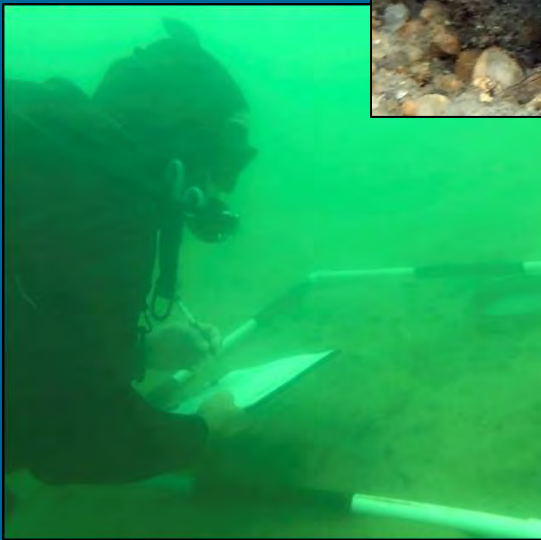
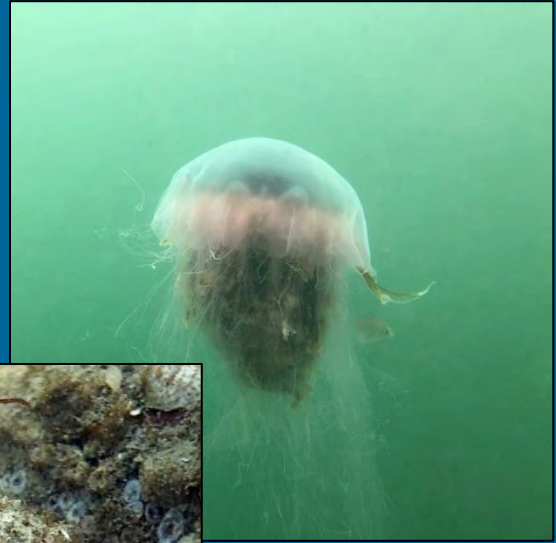
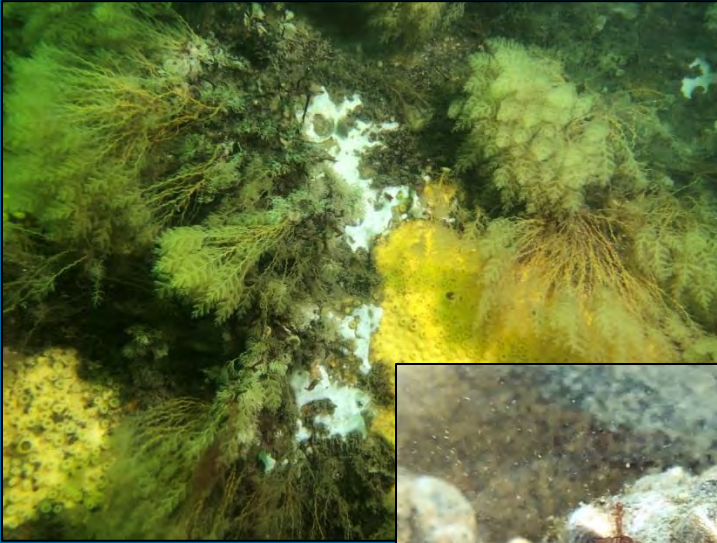
¹ Inv = Invasive

² L & S = Lamont and Stalter (2013)

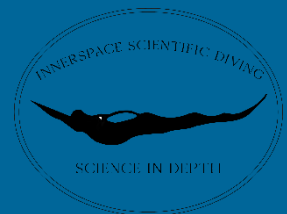
³ For S-rank definitions, see Appendix A. E = Endangered; T = Threatened, R = Rare



Initial Survey of Plum Island's Marine Habitats



New York
Natural Heritage
Program



Initial Survey of Plum Island's Marine Habitats

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InnerSpace Scientific Diving

A report to Save the Sound

April 2020

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Cover photos (left to right, top to bottom): Bryozoans and sponges; lion's mane jellyfish; flat-clawed hermit crab; diver recording information from inside quadrat; bryozoans, sponges and northern star corals. All photos herein by the authors.

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Introduction

The islands extending off Long Island's North Fork, including Plum Island, are known as areas of ecological importance. The Orient Point-Plum Island Important Bird Area (Burger and Liner 2005) is recognized because it supports a diversity and abundance of birds that feed in the marine environment. Plum Gut, the choppy waters between the island and Orient Point, is noted as a foraging area for endangered terns and a popular recreational fishing spot and is designated as Significant Coastal Fish and Wildlife Habitat (New York State Department of State 2005). However, there has been very little effort to gather detailed information on the benthic habitats underpinning the surrounding marine diversity. Our goal in this study was to describe and map subtidal natural communities and begin to document their resident organisms. We aimed to provide important data and methodological testing for a larger study in future years to map all of Plum Island's offshore habitats and more fully inventory their animals and plants.

The Plum Island Biodiversity Inventory (Schlesinger et al. 2016), conducted in 2015, included a brief survey of the eelgrass meadows on the west side of the island and preliminary surveys of the marine rocky intertidal community around its perimeter, but the subtidal marine habitat and benthic species around the island are largely unknown. The final report recommended additional survey work to expand the marine scope spatially and taxonomically. Coarse-scale seafloor data from the National Oceanographic and Atmospheric Administration and the U.S. Geological Survey, plus more recent benthic sampling efforts in eastern Long Island Sound, suggest extensive hard bottom and gravel substrates in the area to the north and west of Plum Island (Poppe and Seekins 2000; Reid et al. 2005, P. Auster personal communication), which may support diverse assemblages of macroinvertebrates and encrusting organisms. This may be one of the few places in New York where expanses of macroalgal communities, such as kelp beds, thrive. A variety of high-priority Species of Greatest Conservation Need (New York State Department of Environmental Conservation 2015) including the Harbor Porpoise, Kemp's Ridley Sea Turtle, American Lobster, Tautog (Blackfish), Lined Seahorse, White Shark, and Roseate Tern may be relying on habitats around the island for protection and food, and documenting their occurrence could inform management. This fieldwork is the first step in producing a detailed map of sediment type and understanding which benthic communities and at-risk species can be found in this important area.

Methods

The original plan for SCUBA survey and sampling was to conduct traditional and commonly used quantitative rather than qualitative transect/quadrat diver observations and sampling at set distances apart from one another (both qualitative and quantitative transect/quadrat methods are standard practice (Joiner 2001; Heine 2011)). Transects perpendicular to the shoreline with quadrats were planned around the entire circumference of the island, starting from points of approximately 3 meters deep near shore and running seaward to a depth of approximately 9 meters or a linear distance of 183 meters, whichever came first. Quadrats along physical transect lines laid along the surface of benthic substrates would be spaced anywhere from every 3–5 meters to perhaps every 10–20 meters along transects. Where and when possible, without interfering with basic survey tasks, some basic digital still and video imaging by divers would be included. We initially considered higher quality imaging but discounted the idea given the additional tasks and time involved; we determined

it was a higher priority to cover and generally characterize as much area around the island as possible during the survey.

The total number of possible transects and quadrats around the island would be limited by such factors as

- numbers of possible dives per day for two scientific divers working as a team;
- weather and sea state conditions;
- bathymetry;
- geological characteristics (rocky, sandy, vegetated);
- tidal and wind-driven currents;
- in-water visibility;
- species abundance and diversity;
- availability of a suitable topside support vessel and crew, and
- if and as necessary modified based on reconnaissance dives and assessments of conditions/circumstances.

A maximum of 5 days of field work were planned, conditions permitting. The first day of in-water field work, on September 9, 2019, involved reconnaissance dives around the island for a general characterization of the areas. This was to help estimate the numbers and lengths of transects, quadrats, type and degrees of observations and sampling that might be necessary, and the type and number of in-water tasks that could be accomplished given the above limitations.

For surface support the New York State Department of Environmental Conservation's (NYS DEC) Division of Marine Resources (DMR) provided a 8-meter Boston Whaler Challenger (R/V

Delphinus) equipped with SCUBA cylinder tie-down brackets, two 250 HP engines, navigation plotting, and depth display and recording electronics. DMR provided two surface support staff: Todd Glavin, DMR Fisheries Research Vessel Captain, and Jennifer O'Dwyer, DMR Diving Safety Officer). Emily Runnells, New York Natural Heritage Program (NYNHP) Marine Zoologist, was lead field researcher, also serving as topside dive and field data recorder in addition to providing topside diver and other topside support.



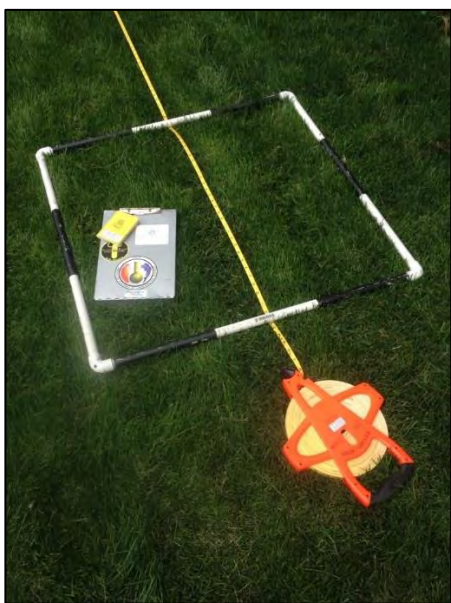
The R/V Delphinus.

The choices for the first day's reconnaissance dive sites were made in part based on general information derived from the United States Geological Survey and National Oceanographic and Atmospheric Administration generalized charts with depth and other bathymetric data (such as possible sediment types and rock, boulder or other projections from the bottom), and depth and related data from the topside support vessel's depth and Global Positioning System (GPS) instrumentation, which was plotted and recorded on the vessel's GPS/navigation instrumentation.



Emily Runnells (NYNHP) and Todd Glavin (NYS DEC).

The two divers used standard SCUBA life support equipment, thermal protection and related equipment. Basic survey and sampling equipment included a graduated meter square for observation/sampling quadrats along transect lines; a metal sieve for surficial sifting of sediments



1-m² quadrat, clipboard, and transect line.

for benthic organisms; zippered plastic storage bags, Falcon Centrifuge Tubes, and large mesh collection bags for larger biological samples and carrying loose sampling bags and tubes; clipboards and preprinted waterproof data sheets that divers could write on to record transect and quadrat numbers, general information such as sediment type and species observed, and recording other general observations; digital imaging equipment including GoPro still/video recording cameras and an iPhone in a Kraken underwater housing with video strobe; and lead-weighted 100-meter polypropylene transect lines marked every five meters along their lengths, originally planned to be used for laying out survey transect lines along which meter square observation/sampling quadrats would be established. The polypropylene transect lines were not used (see modified method below). The NYS DEC's DMR brought a Remotely Operated Vehicle (ROV) and operator, Jesse

Hornstein, on Thursday, September 12, for additional imaging. Sample and specimen trays, dissecting equipment, hand-held magnifiers, a stereomicroscope, 70% ethanol for preservative, and keys for algae, fish, crustaceans, mollusks, and other marine invertebrates were set up for use as a field lab on tables in one of the diver's hotel rooms.

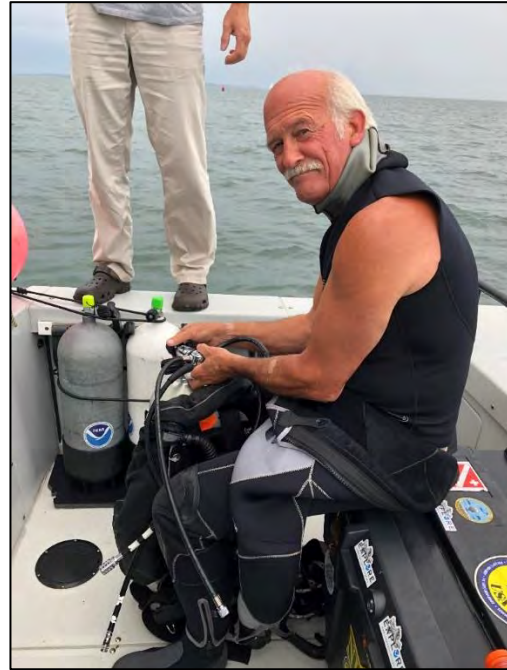


Left to right: Remotely Operated Vehicle, Steve's hotel room field lab, Dan and Emily at work in the "lab."

The original survey and sampling plan was modified based on the first day's reconnaissance dives. Surface and bottom currents – in some areas opposing, moving eastward along the bottom and westward at the surface – were too strong to drop and maintain transect lines in place, and in several areas the bathymetry, notably the presence of many large boulders projecting 2–3 meters and more off the bottom, made the use of physical transect lines rather than diver-held compass bearing transect lines impractical. For diver and vessel safety, and to maximize information gathered in the time available, the survey protocol was adjusted so that transects were the divers paths as they followed a compass bearing, the quadrat was placed in three unevenly spaced locations that represented the diversity near the transect, and divers moved towards the island along these transects.

Instead of starting dive transects from shallow nearshore areas, the start and end points of dive transects were reversed, starting at seaward rather than landward points and heading landward to shallower rather than seaward to deeper depths. The divers chose that option because they would be conducting an unknown number of multiple dives per day in relatively unknown conditions and wanted to make the best use of air supplies. Air supplies last longer at shallower depths and working from deeper to shallower depths reduces the chances of ear, sinus, or other barotrauma from repetitive diving and surfacing over short periods of time. It was also safer for the divers and the survey vessel to have the divers enter the water in deeper offshore depths, swimming the transect lines to shallower nearshore areas where hazards to the survey vessel were more prevalent, and if conditions such as navigation hazards in shallower areas warranted it, swimming back after completing the transects to deeper and safer depths for the vessel and reboarding for transport to the next transect area. This was particularly necessary off the rock and boulder-strewn shallows on the north side of the island.

The daily offshore transect starting points and general direction of transects perpendicular to Plum Island's shoreline were initially chosen by a member of the dive team and the vessel captain while consulting information provided by the survey vessel's digital navigation and depth recorder for likely bathymetric conditions and substrates. They also considered tidal stages, visual observations of winds, waves, current speeds and directions, likely subsurface navigation or other hazards, and initial reconnaissance and subsequent observations and experiences by the divers and vessel captain, and the expected type and level of subsurface and topside survey tasks and difficulties. That information was briefly summarized for the rest of the crew and transect starting locations and landward directions were agreed upon by the entire survey crew before final selection and entry in the water by the divers.



Steve preparing for a dive.

Upon entering the water and being handed survey equipment by topside crew, and while at the surface, the divers both took wrist-mounted electronic dive computer or analog compass bearings toward a point along the shore of Plum Island, descended, and placed the meter square quadrat



Quadrat with diver recording on a data sheet mounted on a writing slate.

where they landed on the substrate or on aggregations of large rocks or boulders. After making and recording their observations on the preprinted data sheets they checked compass bearings for the transect line, followed those bearings as closely as possible given relatively strong currents, and, as they swam the transect line chose areas where they dropped the quadrat using their agreed upon (through hand signals) judgments of observed characteristics best representing the area along the transect or up to approximately 6 meters of either side of the transect line represented by their compass bearings. The decision to swim and survey the area in that manner was chosen rather than the much more difficult, and in some areas impractical and much more time-consuming, tasks of setting a physical transect line along the bottom, with measured and marked distances for quadrats, in strong currents. There was not enough time for more intense survey and sampling around much of the island as originally hoped.

While swimming their compass bearing transects and stopping to drop the quadrat, divers recorded their observations on the preprinted waterproof data sheets and with some digital imaging and recordings, noting general physical characteristics and species observed, and collected some species for subsequent identification or verification of identification. The divers also noted general characteristics and species observed outside of the meter square quadrats to the edge of their visibility from the quadrats, which ranged from 1–5 meters. When finished recording information from the quadrat the divers continued sampling quadrats along the transect line compass bearings until reaching a relatively shallow depth of 3–4 meters, where they surfaced.

While the divers were submerged, the topside survey crew kept constant eyes on the exhaust bubbles of the divers as the survey vessel operated under power following the direction taken by the divers rather than staying at anchor farther offshore, and keeping an appropriately safe and usually downdrift distance from the divers. Both divers, while swimming perpendicular to sometimes very strong currents, had difficulties holding straight transect line positions in several instances. Given this initial survey was intended as a first time basic and general rather than detailed quantitative characterization of the area and its biota it was not necessary to hold more rigorously to absolutely straight transect lines and specifically spaced quadrats along them.

Basic observations were recorded on the diver data sheets, with collected specimens identified topside on the survey vessel, at the makeshift “field lab,” or preserved and retained for identification after the field survey was completed.

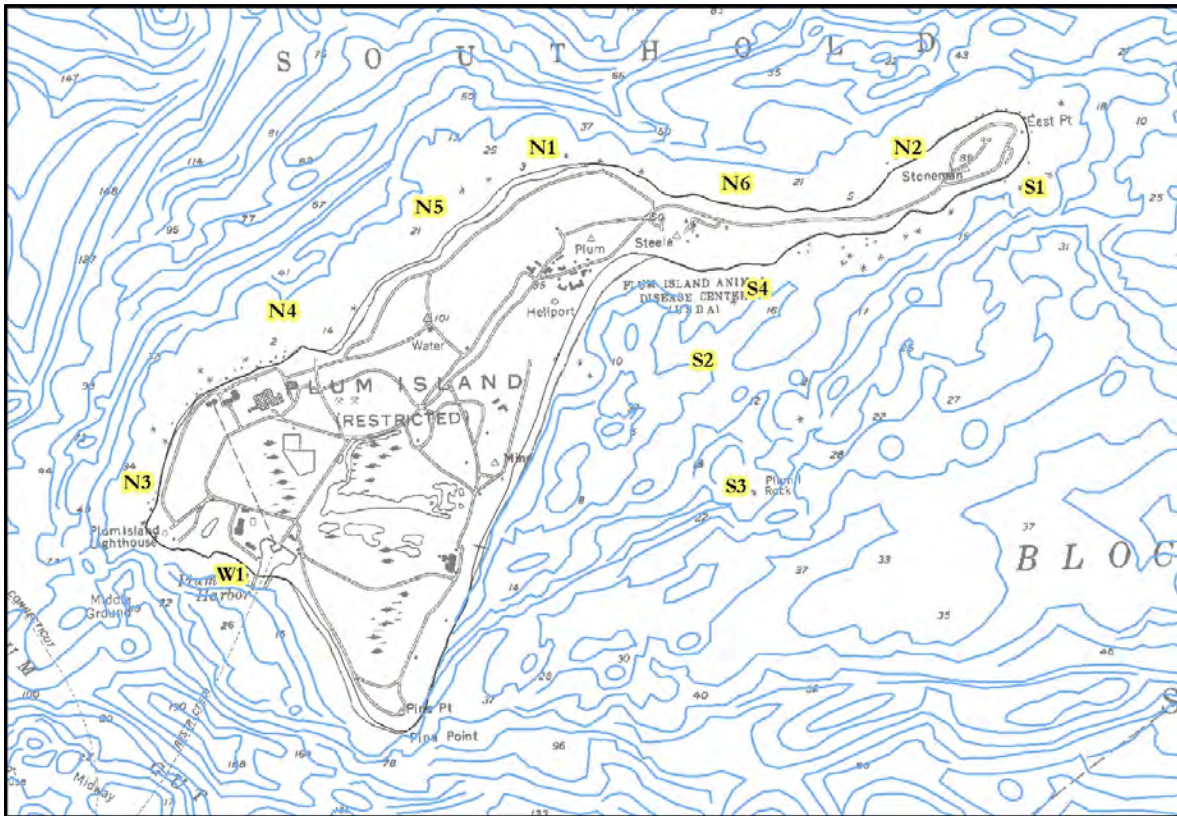
Results

The weather conditions allowed for 4 days on and in the water. We collected data in 33 quadrats along 11 transects. This field work began a few days after Hurricane Dorian passed northward off the US east coast, which left behind some ocean swells and may have influenced highly mobile species such as fish to move farther offshore, out of the area. All areas around Plum Island were influenced by strong tidally influenced currents.

Our work was intended as a pilot study to characterize the natural communities of the nearshore subtidal zone around Plum Island. To that end, we observed four generally distinct areas:

1. Relatively flat, large expanses of gently sloping coarse grained sandy areas with distinct sand ridges, primarily off the south side of the island where sandy “megaripples” were observed oriented perpendicular to the island, along with a strong current along the length of the island throughout most areas off the south side of the island’s west end, especially nearer Plum Gut’s outgoing tidal current, and the area offshore approximately half way between Plum Island’s west and east ends. The crests of the ridges were approximately 15–30 centimeters in height from the bottom of their troughs, with their crests spaced approximately 1 meter from each other. Most of the ridges in this highly dynamic area extended for a great distance offshore along Plum Island’s gently sloping, relatively shallow bathymetry. Spider crabs were highly abundant in these sandy ripple/ridge areas. Surrounded by shifting sands, there were occasional stones and shells that weren’t buried or moved

about by strong currents or wave-induced pressure gradients. Algae, including some kelp, and encrusting sponges established toeholds, were growing on any scattered and occasional stone or shell substrate available. An apparent algal growth along the crests of the ridges was intriguing and worthy of further study.



Plum Island, NY, with bathymetry and primary sampling locations.

2. Dense assemblages of boulders 2–4 meters across with smaller boulders, large stones, and crevice spaces between them. These assemblages are most prevalent over large expanses off the north shore of the island. Between these assemblages of boulders and stone there are relatively small patches of sandy sediments with little to



North shore boulders.

no silt in the top 5 centimeters of sand. In some areas where the divers experienced strong currents, off the northwest part of the island, gravel overlies the sand. In almost all areas, the divers observed considerable scouring of sediments on the updrift sides of the base of boulders and large stones. Kelp, which was found along every transect around the island, was most prevalent throughout the rocky areas off the north side of Plum Island. Because of the presence of so much hard substrate, this is also where the divers observed the most diverse and abundant assemblages of other brown and red algae, sponges, bryozoans, corals and encrusting tube worms. No hard surface in these areas lacked complete coverage by biota, and there were usually multiple layers of growth.

3. Occasional assemblages of large stones and boulders unconnected with each other scattered about in large expanses of open sandy areas (gravelly areas were primarily in and near scoured sides of boulders where smaller grained and lighter weight fine sediments are scoured and swept away by strong currents). There were assemblages of very large boulders, similar to those observed along much of the area off the north side of the island, but separated by larger open expanses of sand, off the extreme southeast side of the island. This area, subject to outgoing tides exiting The Race and large incoming waves from the south, is highly dynamic, and boulders reach upward from the sandy bottom to very near the surface of the water. As with everywhere else around the island where hard substrate is available, every centimeter is covered in biota. Layer upon layer of blue mussels (*Mytilus edulis*) completely covered the tops of boulders within 1 meter of the surface, establishing a byssal mat community underneath, which mussels facilitate.



Diver in eelgrass meadow.

4. Eelgrass meadows are well established in a relatively shallow nearer shore area off the west side of Plum Island before the bathymetry drops deep, steeply, into the very strong and fast incoming and outgoing currents (up to approximately five knots) of Plum Gut. This area was also surveyed by the NYNHP in late 2015.

Throughout all four areas, wherever boulders or rocks are present, virtually every surface is covered in kelp, bryozoans (encrusting and branching), sponges (also encrusting and branching), or northern star corals. At the physically dynamic southeasternmost end of the island, mussels attach to the tops of boulders at or near the surface, making for layered biological communities and considerable competition for space, which is typical of hard-bottom substrates and other hard, in-water

structures. Fishes also congregated around boulders and other relatively large, off-bottom, stone structures, usually on the downdrift eddy side of, in between, and under boulders where currents were weakest. The coarsest sands were observed in and adjacent to the eelgrass bed off the west side of the island and off the shallower, more gently sloping and highly dynamic south side of the island where there are fewer projecting structures above the substrate to slow currents and allow for settling of finer sediments.

Appendix A contains a list of species encountered during the surveys and discussion of basic habitat relationships.

Discussion and Next Steps

Our four days of sampling provided an enticing window into the subtidal biodiversity around Plum Island. We documented four distinct combinations of substrate and resident biota, which might form the basis for a subtidal marine natural community classification. The area around Plum Island appears to have a different salinity and temperature profile than the rest of Long Island Sound (The Nature Conservancy 2015), which may have significant influence on its biodiversity. Nearly every available hard surface was colonized by bryozoans, algae, and other organisms, demonstrating the high productivity of this marine environment. We observed high densities of bryozoans, and we expect that in other times of year there may be additional species and shifts in dominant species. The low diversity of fish may have been a result of the recent storm or the time of year; additional sampling earlier in the summer will help us better document the fish community.

This initial survey was limited and qualitative given fiscal, time, and other constraints. The oceanographic conditions around Plum Island make for challenging sampling, but our experience from our week of dives will help make a second year even more successful. In further sampling, we would propose the following:

- Sampling earlier in summer (e.g., mid- to late June);
- Additional transects intended to yield a map of substrate types;
- Accompanying draft natural community descriptions including associated fauna;
- Analysis of quadrat data and comparison to other sites;
- A possible focus on certain taxonomic groups of interest;
- Boat-based surveys of seabirds and sea turtles; and
- Higher quality imaging.

We look forward to working with Save the Sound and its donors to scope out additional surveys.

More qualitative and quantitative information is needed not only for a better understanding of the marine resources and environment housing Plum Island and its associated Great and Little Gull Islands, but for more informed and a robust management program for New York's important offshore areas. This would complement and advance some objectives of New York's 2017–2027 Ocean Action Plan (New York State Department of Environmental Conservation and Department of State 2017), especially those relating to the inclusion of information relating to important marine species and habitats tracked by the NYNHP (see page 39 of the Ocean Action Plan), and efforts to identify, designate, and manage nearshore and offshore habitats that meet criteria for designation as

Significant Coastal Fish and Wildlife Habitats pursuant to Article 42 of the Executive Law and implementing regulations in 19 NYCRR Part 602. Such a designation would advance several national objectives of the federal Coastal Zone Management Act, State coastal policies and objectives of New York's federally approved Coastal Management Program (CMP), the Long Island Sound Regional Coastal Management Program and Town of Southold Local Waterfront Revitalization Program as special area management plan elements of the State's CMP, and elements of the New York and Connecticut Long Island Sound Comprehensive Conservation and Management Plan.

In 2019, the New York State Legislature enacted and the Governor approved Title 20A, Article 11-2050 of the State's Environmental Conservation Law, establishing a Marine Mammal and Sea Turtle Protection Area in the area of and to 450 meters seaward of Plum, Great Gull, and Little Gull Islands. This new legislation recognizes the unique and significant physical and biological characteristics, qualities and values in and of the area. The purposes of the Act include providing authority to the NYS DEC to provide greater protection in the area to marine mammals, sea turtles, and associated resources.

This 2019 diver survey fell within the designated Marine Mammal and Sea Turtle Protection Area, 450 meters of the shoreline of Plum Island. While the designated protection area does not extend far offshore and is limited to relatively shallow depths, that shallow area is the most geologically varied and, given that, likely the most biologically diverse area around the island. This initial and a subsequent survey could provide the information necessary to designate the area as a Significant Coastal Fish and Wildlife Habitat in accordance with New York's Coastal Management Program.

Acknowledgments

The generosity of an anonymous donor made this work possible. We are grateful to Save the Sound for bringing this project to us, particularly Chris Cryder and Louise Harrison. Gary Mandelburg from the U.S. Department of Homeland Security at the Plum Island Animal Disease Center continues to be vital to our work in and around Plum Island. The NYS DEC was an enormous help, providing the R/V Delphinus and crew: Captain Todd Glavin, Dive Safety Officer Jenn O'Dwyer, and ROV Operator Jesse Hornstein. Thanks to Dawn McReynolds, Kim McKown, and Karen Chytalo for help securing boat and crew time and Emily's time. Debra Barnes, Chris LaPorta, and the MIPR Unit provided essential guidance, dive safety equipment, and back-up underwater video equipment. Special thanks to Bob Haase, owner of Orient by the Sea Marina, for providing a slip for the Delphinus during the surveys. Terry Keefe and family, owners of Silver Sands Motel, generously allowed us to stay in a prime location at researcher rates and didn't complain when we turned a large part of the property into a marine lab. From NYNHP, we thank DJ Evans and Fiona McKinney for administrative help and support.

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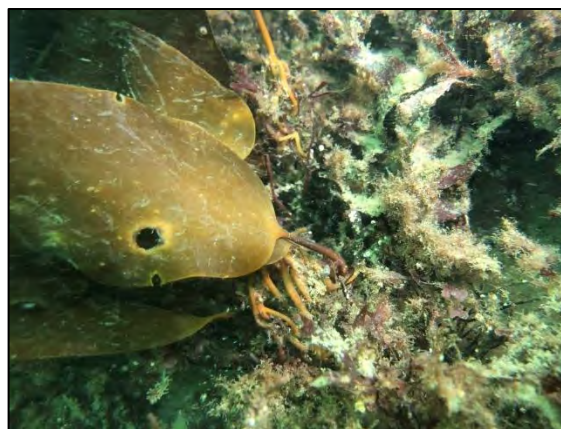
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Appendix A. Species observed and/or collected

This list is of species observed and specimens gathered in an effort to characterize the communities in the shallow subtidal (~5–7 meters) of Plum Island. Some were identified from quadrats deployed along transects, other species were gathered as part of the general habitat observation. Because the survey did not emphasize infaunal sampling it is biased towards epifaunal and emergent infaunal species. A few infaunal animals were collected as a result of haphazard sieving of sediments.

Substrate around Plum Island consists of sand with a small amount of silt-clay in it, occasional gravel deposits and rocks ranging from 1–2 centimeters in diameter to boulders of 1 meter or more across. One site on the west side of the Island supports a coarse sand and healthy eelgrass (*Zostera marina*) bed.

Where hard substrate exists, or in some cases where a large enough shell is present, nearly every surface is covered. Primary coverage is by algae but there were also sponges, encrusting bryozoans and mussels. The algae itself is a substrate for branching bryozoans and spirorbid polychaete worms. Algae was dominated in all habitats by red algae, particularly *Gracilaria*, *Gigartina*, and *Phyllophora* but sugar kelp *Saccharina latissima* was also present.



Kelp with holdfasts on boulder.

Sponges: Sponges occurred in a variety of colors and were widely distributed. All were encrusting on rock, or in the case of *Cliona* spp., boring into the rock substrate.



Diadumene sp. (anemone), common on boulders and large rocks offshore of the north side of Plum Island.

Ctenophores and cnidarians: The comb jelly *Mnemiopsis leidyi* was observed at one site but this species can often be found in large quantities and is dependent upon distribution by wind and tidal currents. *Cyanea capillata*, the lion's mane jellyfish, was observed at several sites but again this species drifts with prevailing currents. Accompanying the jellyfish at one site was a juvenile Atlantic bumper. Northern star coral (*Astrangia poculata*) was observed at a

number of sites in small colonies attached to rock. The white anemone *Diadumene leucolea* was seen at multiple sites attached to large rock substrate.

Sea cucumbers: One specimen of the synaptid sea cucumber *Leptosynapta tenuis* was collected from a sandy site. There are likely many more in the sediment but it would require benthic sampling to determine this.

Sea stars: The common Forbes sea star *Asterias forbesi* was observed at two sites. It can be expected to be a common subtidal resident in a variety of habitats.

Bryozoans: Ectoprocts or bryozoans occurred in two forms, as encrusting colonies on rock surfaces and as branching colonies generally attached to red algae. Both forms were widely distributed, with an especially large biomass of *Bugula* observed.

Polychaete annelids: Polychaete worms were observed as epifauna attached to rock or shell (mostly serpulids) and also attached to algae (mainly spirorbids). We also observed a few infaunal polychaetes, one species (*Pectinaria gouldii*) collected by sieving and the other (*Diopatra cuprea*) a dominant member of the *Zostera marina* community. Polychaetes can be expected to occur as diverse and possibly abundant members of the soft-bottom communities around Plum Island. Coarse sand environments are ideal for the “errant” species of Polychaeta.

Bivalves: Bivalves were mostly identified by collecting empty shells on the sandy substrate since our efforts did not include a great deal of subsurface sampling. The exceptions were the blue mussel

Mytilus edulis, which was collected in situ on transect S1, the only site where we surveyed high energy rocky substrate, and the jingle shell *Anomia simplex*, which is an epifaunal member of the hard substrate community. In one case a large, living Atlantic surf clam (*Spisula solidissima*) was pulled out of a



Cyanea capillata (lion's mane jellyfish), approximately 0.6 meters in diameter, off north side of Plum Island (it was common all around the island), with *Chloroscombus chrysurus* (atlantic bumper) circling tentacles (right underside of bell).



Live (left) and dead *Astrangia poculata* (northern star coral).

sand ridge on the south side of the island (S2). Bivalve shells were present at every site we examined, indicating that they are widely distributed and probably that active predation is occurring on the soft-bottom fauna. We would expect that the bivalve assemblage around Plum Island is both abundant and diverse because of the presence of well-sorted sediment and tidal currents providing a regular food supply to these suspension-feeding animals. Only at one site did we get into the high energy hard-bottom habitat (S1) where blue mussels, *Mytilus edulis*, dominated the community, but that type of community can be expected to occur at many places along the shore in the shallow subtidal and intertidal. Bay scallops (*Argopecten irradians*) should be typical inhabitants of the *Zostera* bed.



Bryozoan polyyps under stereoscope in hotel field lab.



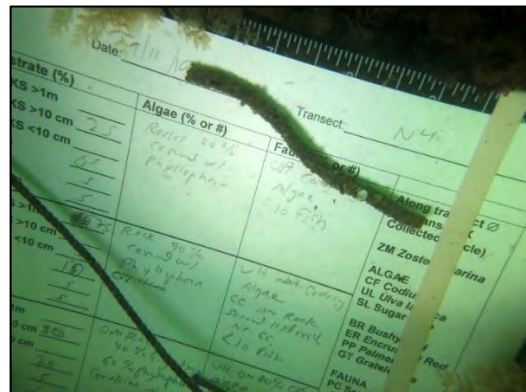
Benthic polychaetes exposed while divers sieved sediment.

were observed. The oyster drill *Urosalpinx cinerea* was predictably common in the *Mytilus edulis* bed but nowhere else. Two large predatory gastropods (the channeled whelk *Busycotypus canaliculatus* and the northern moon snail *Euspira heros* are expected to be widely distributed around the island based on evidence of dead bivalves that bore the marks of predation by these two snails; however, we observed those species only as homes for flat-clawed hermit crabs. The dog whelk *Tritia trivittata* is typical of intertidal mud flats, a rare community on Plum Island, possibly inshore of the *Zostera* meadow.

Chitons: We observed one chiton, *Chaetopleura apiculata*, on the lower surface of a rock. Chitons are probably widely distributed around the island but more typical of the high-energy subtidal, a community that we did not sample.

Barnacles: Barnacles (*Semibalanus balanoides*) are probably typical of high-energy intertidal and shallow

Gastropods: Snails are undoubtedly far more abundant and diverse than our collection would indicate. We very incompletely sampled the soft-bottom community where infaunal snails can be expected and we did not extensively collect patches of epifaunal growth on the hard substrates that can be expected to contain many more species of snails. The most common gastropod around Plum Island is the slipper shell *Crepidula fornicata*, particularly on the south side of the island where large aggregations of *Crepidula*



Benthic tube worm casing on diver data sheet.



Bryozoans, Cliona celata (sulfur/ boring sponge), encrusting bryozoans on boulder

probably an important component of those life forms in addition to being fascinating animals. We found three species in one bryozoan clump so there are likely more species, very widely distributed, around Plum Island. Because we did not adequately sample infaunal sediments or the communities of the epifaunal life forms we did not adequately characterize the gammaridean amphipods. To do that would require a very different sampling approach and a lot of lab work.

Hermit crabs: One species of hermit crab (the flat-clawed hermit crab) was seen in a number of places around the island. These scavengers are likely important members of the epibenthic community.

True crabs: Two species of true crabs were observed although the sampling strategy was not ideal. Spider crabs, *Libinia* spp., occurred widely around the island but were most common at the S2 site on the south side of the Island. One lady crab (*Ovalipes ocellatus*) was disturbed at site S4 and rapidly swam away.



Caprellid (skeleton shrimp) under stereoscope.

subtidal habitats, which we did not specifically sample. We did observe barnacles at a few sites around the island.

Caprellid and other amphipods: The caprellid amphipods or skeleton shrimp are a particular interest of one of the survey team (Dan Marelli) and though the survey was not specifically designed to characterize the caprellid community of the island we did collect branching bryozoans so that they could be examined for caprellids. Caprellids occur in association with a number of epifaunal life forms, particularly hydroids and bryozoans and they are



Live Astrangia poculata (northern star coral) among Cliona celata (sulfur/ boring sponge), surrounded by bryozoans, algae and Clathria (Microcionia) prolifera (red beard sponge), lower left and lower right.

Fish: Few species of fish were observed during the survey, but numerous individuals were often seen and fish were widely distributed around the island. The most common fish were juvenile black sea bass, *Centropristis striata*, and juvenile Atlantic bumper, *Chloroscombrus chrysurus*. Every site had juvenile black sea bass and nearly every site also had juvenile Atlantic bumper. Occasionally we observed larger juvenile black sea bass and also a few adults. Both sea bass and bumper juveniles were attracted to disturbance of the sediment, suggesting that they

feed opportunistically. One Atlantic bumper was observed shadowing a lion's mane jellyfish, a behavior that has been reported in the literature. A few tautog (*Tautoga onitis*) were observed during the survey, as well as one juvenile sea robin (*Prionotus carolinus*). The presence of fish around Plum Island is probably related to both season and ontogeny, but the presence of large numbers of juvenile black sea bass and Atlantic bumper suggests that the subtidal communities around Plum Island are nursery areas for these important species.



Pagarus pollicaris (flat-clawed hermit crab), using small shell of *Busycotypus canaliculatus* (channeled whelk) covered in live *Crepidula* (slipper shell) mollusks algae, and snails.

Seals: The gray seal (*Halichoerus grypus*), a federally protected species, was observed at a few sites during the survey. At one site a seal surprised the dive team and later grabbed the left fin of Steve Resler. Gray seals have been increasing in New York waters in recent years and have apparently pupped on nearby Great Gull Island, which also has a winter haul-out site. Harbor seals (*Phoca vitulina*) are the primary species observed hauled out near Plum Island in winter.



A gray seal in the waters around Plum Island.

Species List

Species collected only as empty shells are indicated by an asterisk (*).

Species	Locations
Rhodophyta – Red algae	
<i>Gracilaria gracilis</i>	Widely distributed
<i>Phyllophora crispa</i>	Widely distributed
<i>Gigartina</i> spp.	Widely distributed
<i>Chondrus crispus</i> Irish moss	S1, S3, N6
<i>Grateloupia turuturu</i>	N2, S1, S3
<i>Polysiphonia stricta</i>	N5, N6, S3, W1
<i>Grinellia americana</i>	S4
Ochrophyta – Brown seaweed	
<i>Saccharina latissima</i> – Sugar kelp	N2, N3, S3, S4, W1
Chlorophyta – Green algae	
<i>Ulva lactuca</i>	S1, S4
<i>Codium fragile</i>	S1
Plantae: Tracheophyta	
<i>Zostera marina</i> – Common eelgrass	W1
Porifera – Sponges	
<i>Cliona celata</i> Sulphur or boring sponge	N1, N4, S2, S3, S4
<i>Clathria (Microciona) prolifera</i> Red beard sponge	Regularly seen
<i>Halichondria panicea</i> Breadcrumb sponge	Regularly seen
Unidentified sponges	S1, S2, N5, S3
Ctenophora – Comb Jellies	
<i>Mnemiopsis leidyi</i> Ctenophore	S2
Cnidaria – Jellies, Anemones, Corals	
<i>Astrangia poculata</i> Northern star coral	N1, N3, S3
<i>Diadumene leucolea</i> White anemone	N1, S1
<i>Cyanea capillata</i> Lion's mane jellyfish	Regularly seen
Unidentified hydroids	W1
Echinodermata – Sea stars, Urchins, Sea Cucumbers	
<i>Leptosynapta tenuis</i> White synapta	
<i>Asterias forbesi</i> Forbes sea star	N2, S1
Ectoprocta – Bryozoans or Moss animals	
Unidentified encrusting bryozoa	Widely distributed
<i>Bugula</i> spp.	Widely distributed

Species	Locations
Annelida: Polychaeta – Segmented worms	
Unidentified Spirorbidae	S2, N5
Unidentified Serpulidae	N1, N4, S4
<i>Pectinaria gouldii</i> Ice cream cone worm	S2
<i>Diopatra cuprea</i> Plumed worm	W1
Mollusca – Clams, Snails, Octopus, Squid, Chitons	
<i>Anadara transversa</i> Transverse ark*	S1, S4, N1, N4
<i>Anadara ovalis</i> Blood ark*	
<i>Mytilus edulis</i> Blue mussel	S1
<i>Argopecten irradians</i> Bay scallop*	
<i>Anomia simplex</i> Jingle shell	N2, N3, S4
<i>Astarte castanea</i> Chestnut astarte	
<i>Crassinella lunulata</i> Lunate Crassinella*	N1
<i>Pitar morrhuanus</i> False quahog*	
<i>Spisula solidissima</i> Surf clam	S1
<i>Ensis directus</i> Common razor clam*	S1
<i>Periploma leanum</i> Lea's spoon shell*	Widely distributed
<i>Lacuna vincta</i> Chink shell	W1
<i>Crepidula fornicata</i> Common slipper shell	S1, S2, S4, W1
<i>Euspira heros</i> Northern moon snail*	S1
<i>Costoanachis translirata</i> Well-ribbed dove snail	N1, N3, N6
<i>Astyris lunata</i> Crescent mitrella	N3, W1
<i>Urosalpinx cinerea</i> Oyster drill	S1
<i>Tritia trivittata</i> New England dog whelk*	
<i>Busycotypus canaliculatus</i> Channeled whelk*	
<i>Chaetopleura apiculata</i> Bee chiton	N1
Crustacea	
<i>Semibalanus balanoides</i> Common acorn barnacle	S2, N5
<i>Caprella penantis</i>	N5
<i>Caprella linearis</i>	N5
<i>Deutella incerta</i>	N5
<i>Pagurus pollicaris</i> Flat-clawed hermit crab	S1, S2, S4
<i>Libinia sp.</i> Spider crab	S1, S2
<i>Ovalipes ocellatus</i> Lady crab	S4
Vertebrata	
<i>Centropristis striata</i> Black sea bass	Widely distributed
<i>Chloroscombrus chrysurus</i> Atlantic bumper	Widely distributed
<i>Prionotus carolinus</i> Sea robin	S1
<i>Tautoga onitis</i> Tautog	S1, N5
<i>Halichoerus grypus</i> Gray seal	S1