Fishers Island Biodiversity

Rare Species and Natural Communities of the Henry L. Ferguson Museum Land Trust

New York
Natural Heritage
Program

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Cover photos (left to right, top to bottom): Spotted Turtle, Hairy-necked Tiger Beetle, Dwarf Umbrella Sedge, Seaside Dragonlet, Manyflower Marsh-pennywort, Northern Apple Sphinx, students carrying coverboards, Ashley Ballou with hands full after checking a turtle trap, Yellow ladies' tresses, Chocomount Cove.

All photos by the authors unless otherwise noted.

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Executive Summary

The Henry L. Ferguson Museum contracted with the New York Natural Heritage Program (NYNHP) in early 2020 to conduct a two-year inventory of rare plants and animals and map the natural communities of its Land Trust parcels on Fishers Island. The survey took place between May 2021 and October 2022. In this report, we present the results of our inventory and provide management and restoration recommendations.

We conducted surveys for rare plants, significant natural communities, and a variety of animal groups including small mammals, birds, turtles, snakes, salamanders, frogs, marine fish, marine invertebrates, and several groups of insects. We also mapped the ecological communities of all Land Trust parcels. Below are our key findings and recommendations.

Ecology Highlights

- We classified 64 ecological communities, including variants and novel types, on Ferguson Museum Land Trust parcels (45 natural communities and 19 cultural communities – *sensu* Edinger 2014). In total, we mapped 506 polygons covering a little more than 400 acres.
- Three upland forest types account for almost 40% of the mapped acreage as follows: successional maritime forest (65.5 acres), coastal oak-hickory forest (56.4 acres), and successional southern hardwoods (33.5 acres). Red maple-blackgum forests (incl. swamps, fringe, and upland slope types) totaled just more than 50 acres. Semi-natural grasslands cover more than 30 acres, most of which (28 acres) are dominated by switch grass (*Panicum virgatum*) in the Matty Matthiessen Wildlife Sanctuary (Parcel 20 and Parcel 35b).
- There are nine natural community occurrences of statewide significance on Fishers Island. Three occurrences are adjacent to Land Trust parcels in saltwater (two marine eelgrass meadows and one coastal salt pond); three are mostly off Land Trust property, but have small sections of larger shoreline occurrences on Land Trust parcels (marine rocky intertidal, maritime beach, and maritime bluff); one shrub swamp is mostly on Land Trust land, but a small part of it extends off the parcel; and two are fully contained within Land Trust parcel boundaries (shrub swamp and coastal oak-hickory forest).
- Of the nine significant community occurrences on Fishers Island, five are newly documented occurrences as a result of this study; and one is a previously documented occurrence (marine rocky intertidal community) that was updated with data collected during our 2021 ecology surveys.

Botany Highlights

- With 65 rare plant taxa having been recorded (including historical studies and the current inventory), Fishers Island has the greatest concentration of rare plants of any single site in New York State. Thirty-five of these rare species are currently regarded as extant by the NYNHP, having been observed since 1984. Of these 35 extant rare plant species, 28, or 83%, have been documented on Land Trust property.

Zoology Highlights

- Spotted turtles persist on Fishers Island. Trapping revealed a population in the Brickyard wetland and a private wetland near Wilderness Point.
- Coverboard surveys for snakes and salamanders confirmed many of the expected species for the island.
- A beach specialist, the Hairy-necked Tiger Beetle, was found on two Land Trust properties. Its presence indicates relatively undisturbed beach and dune habitat.
- A saltmarsh specialist dragonfly, the Seaside Dragonlet, was confirmed on Land Trust property, and a rare damselfly, Rambur's Forktail, was found at a Land Trust pond.
- Moth surveys were incredibly fruitful. Three species were documented in New York State for the first time and five species were recorded on Long Island for the first time. Twenty-seven other rare species were recorded.

Recommendations for Management and Future Work

- Invasive species are the single largest management challenge on Land Trust properties. We make parcel-specific recommendations in a large compendium on ecological communities included as an appendix. *Phragmites australis* is a special challenge for rare species, as it is everywhere.
- Maintaining the wild character of Land Trust beaches at Chocomount Cove and adjacent to Island Pond should be a top priority for protection of native flora and fauna, including several rare species.
- Mowing fewer trails at Middle Farms grassland would result in less habitat fragmentation and possibly less human and canine disturbance of nesting birds and rare insects.
- We were fortunate to be able to conduct a thorough inventory in our two seasons, but survey work always yields new questions, and natural communities and plant and animal populations are dynamic. Thus, we recommend regular monitoring of rare species populations, and continued inventory for rare plants that may be present in the seedbank. Eastern Box Turtles and Diamondback Terrapins are present on the island but their distribution and the viability of their populations are unknown. Live-capture surveys for bats may yield rare species that are merely hinted at with acoustic surveys. Thorough pollinator surveys may turn up rare bees, flower flies, and other species. Monitoring the midsized mammal community may help determine whether Fishers Island is an important stepping stone in the chain of islands allowing Long Island to be recolonized by coyote, river otter, and beaver.

Introduction

Purpose and Need

The Henry L. Ferguson Museum contracted with the New York Natural Heritage Program (NYNHP) in early 2020 to conduct a two-year inventory of rare plants and animals and map the natural communities of its Land Trust parcels on Fishers Island. Field work was postponed until 2021 because of the COVID-19 pandemic and was completed in October 2022. This report is the culmination of our study. Herein we give background on Fishers Island, refer to previous and ongoing biodiversity work there, present the results of our inventory, and provide management and restoration recommendations (in some cases at the parcel level).

NYNHP's field efforts can be grouped broadly into Ecology (natural community mapping and assessment), Botany (rare plant surveys), and Zoology (rare animal surveys). Our ecologists, botanists, and zoologists scoped out the specific needs for field inventory based on previous survey work, literature, museum records, online databases, and their areas of expertise. Each of these disciplines has distinct methodologies and resulting data, which vary widely by the target of the survey. Rather than providing standalone Methods and Results sections as in most typical scientific styles, we combine them here as "Methods and Results" for easier reading.

Our agreed-upon scope of work was as follows: 1) To conduct surveys for rare plants, rare animals, and significant occurrences of natural communities using Heritage Methodology, and 2) to delineate a wall-to-wall ecological community map of the Land Trust parcels. Our rare plant surveys were intended to target all rare plants (www.nynhp.org/documents/5/rare-plant-status-lists-2022.pdf) known to occur on Land Trust properties as well as any other rare plants known from the region. Our animal surveys focused on rare species (www.nynhp.org/documents/1/rare_animals_2017.pdf) but more common species of local interest were also targeted. In all cases, we documented all species observed. Animal survey targets included bats, turtles, leopard frogs, dragonflies and damselflies, pollinators, moths, tiger beetles, carrion beetles, and to a lesser degree, birds (which have been well surveyed on the Island).

Significant natural communities are those ecosystems considered to be of conservation importance at the statewide level. These are either rare communities or the best examples of more common communities. In addition to searching for significant natural communities, NYNHP and the Land Trust saw value in having a full map of all the natural community types on Land Trust properties. Such "wall-to-wall" ecological community maps give land managers a more complete picture of the variety of vegetation types and seral stages present currently, which can inform desired future condition.

Study Area

Fishers Island is the largest island in the archipelago stretching from Orient Point, Long Island, to Connecticut and Rhode Island. It is part of the North Atlantic Coast ecoregion (Bailey 1995, Anderson et al. 2006), also referred to as the Atlantic Coastal Plain. Fishers Island's species and ecological communities are strongly influenced by its geographical location, geology, and history of human habitation. Previous work (e.g., Tucker and Horning 1993, Todorovic-Jones and Becker 2016) has well documented these aspects of the study area, which need not be repeated here. Our

inventory work was conducted on the 353 acres managed by the Henry L. Ferguson Museum Land Trust (abbreviated frequently as "Land Trust"; Figure 1, Figure 2).

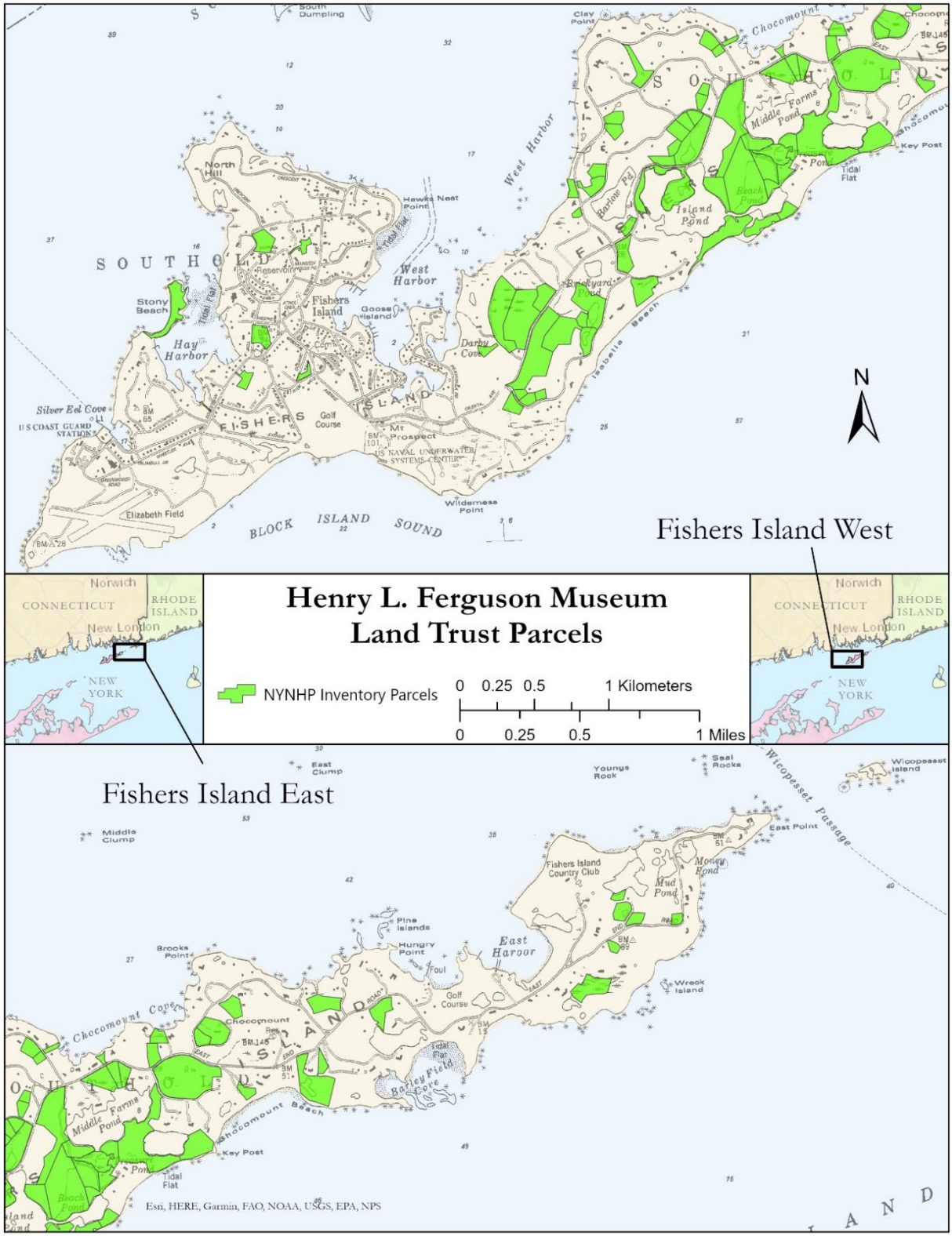

Figure 1. Henry L. Ferguson Museum Land Trust parcels, the focus of our inventory.

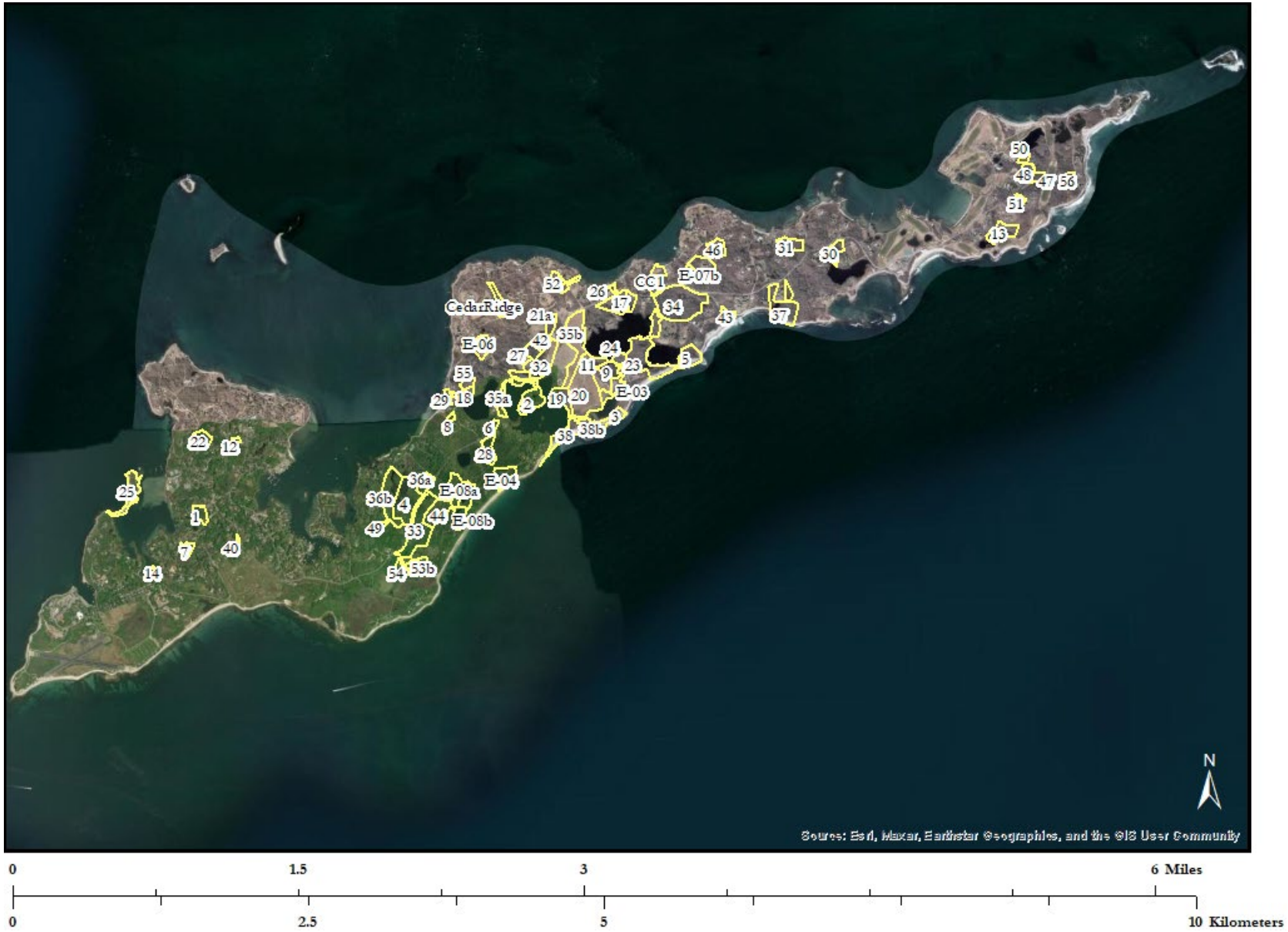

Figure 2. Parcel map with mutually agreed-upon parcel nomenclature for this project.

Geology

The bedrock geology of Fishers Island is Late Cretaceous Coastal Plain Deposits composed of silty clay, glauconitic sandy clay, sand, and gravel of the Magothy Formation (Fisher et al. 1970) (Figure 3). The surficial geology of Fishers Island is composed of three Coastal Plain Deposits as follows (Cadwell 1989):

1. The majority of Fishers Island (2,145 acres or 92%) is glacial till moraine compossed of silt to boulders;
2. There are three small areas of kame deposits (164 acres or 6%) composed of gravel and/or sand as follows:
    - south of Parcel 40 underlying the Hay Harbor Golf Course;
    - underlying the Middle Farms grassland in Parcel 20 within the Matty Matthiessen Wildlife Sanctuary;
    - east of Chocomount Beach underlying Parcel 37.
3. One area of outwash sand and gravel (64 acres or 2%) underlies the area just north of the L. F. Boker Doyle Sanctuary (Parcel 4, Parcel 36a, and Parcel 36b).

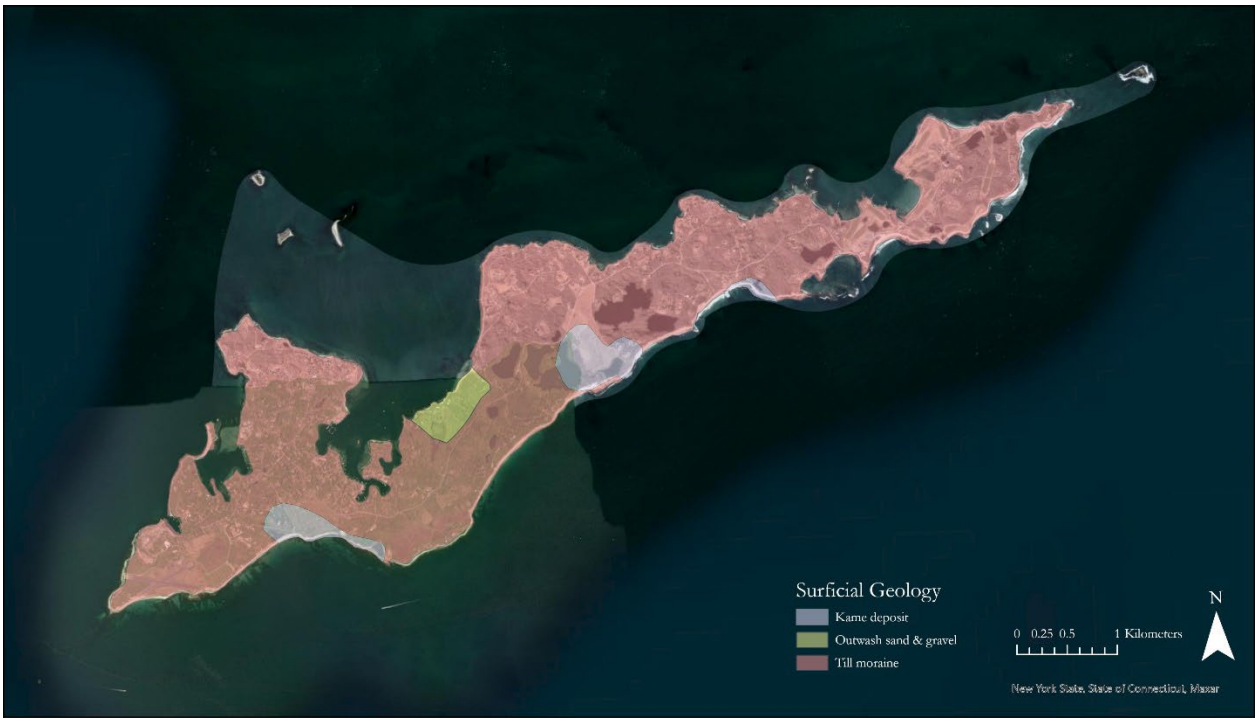

Figure 3. Surficial geology of Fishers Island.

Soils

Detailed soil maps (see example Figure 4) and descriptions by "Sectors" are included in the draft Henry L. Ferguson Museum and Land Trust Management Plan (Todorovic-Jones and Becker 2016). We direct readers to that document for that level of detail. We referred to these soil maps and soil information in the Management Plan prior to conducting our ecology surveys.

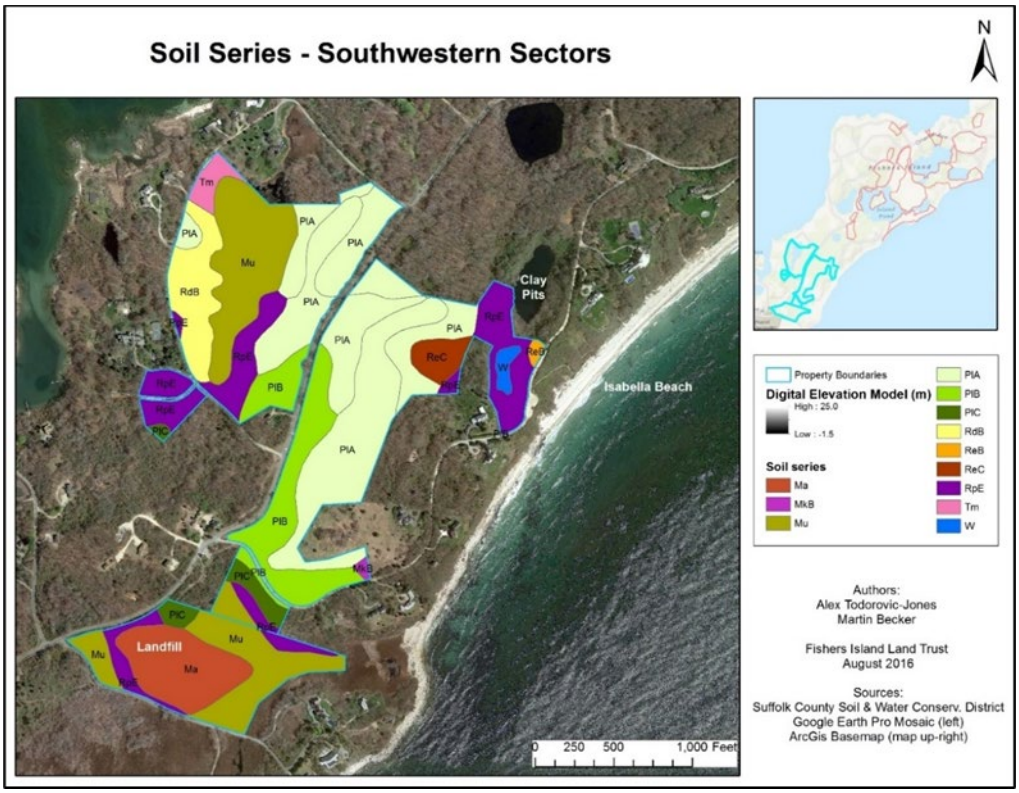

Figure 4. Soil map from draft Henry L. Ferguson Museum and Land Trust Management Plan (Todorovic-Jones and Becker 2016).

For this study, soil cores were not collected to allow more time to sample a greater number of vegetation cover observation points, and to meet our goal to survey all 77 Land Trust parcels. However, given that soil types are generally reflected by the vegetation, in this report below we briefly summarize the major soil types on Land Trust property, and provide a list of ecological communities we found associated with those soils (Table 1).

Table 1. Major soil types mapped on or near Land Trust parcels and their associated ecological communities.

Soil Code	Soil Map Unit Type	Associated Ecological Communities
B	Beaches	Maritime beach
Cp	Carver and Plymouth sands	Coastal oak-hickory forest (Millers Point)
Cu	Cut and fill land	Developed
De	Deerfield sand	Shallow emergent marsh (*Calamagrostis canadensis*)
Du	Dune land	Maritime dunes
		Maritime shrubland
Es	Escarpments	Maritime bluff
Gp	Gravel pits	Abandoned surface mining
Ha	Haven loam	Adjacent to Lant Trust parcels
Mf	Montauk fine sandy loam	Adjacent to Lant Trust parcels
Mu	Muck	Shallow emergent marsh

Soil Code	Soil Map Unit Type	Associated Ecological Communities
		Shrub swamp
		Red maple-blackgum swamp
Pl	Plymouth loamy sand	Semi-natural grasslands (*Panicum virgatum*)
		Successional old field (*Schizachyrium scoparium*)
		Successional shrubland (*Rhus copallinum*)
Rd	Riverhead sandy loam	Red maple-blackgum slope forest
		Successional maritime forest
		Coastal oak-hickory forest (Parcel 36b)
Re	Riverhead very stony sandy loam	Successional maritime forest
Rp	Riverhead and Plymouth very bouldery soils	Coastal oak-hickory forest
		Red maple-blackgum slope forest
		Coastal oak-beech forest
		Successional southern hardwoods
Tm	Tidal marsh	High salt marsh
		Low salt marsh
		Salt shrub
		Coastal salt pond
W	Water	Eutrophic pond
		Shrub swamp (*Decodon verticillatus*)

The Carver series consists of very deep, excessively drained sandy soils formed in glaciofluvial deposits of coarse and very coarse sands (U.S. Department of Agriculture Natural Resources Conservation Service 1995). The coastal oak-hickory forest on Millers Point is one of the few locations on Land Trust property underlain by Carver and Plymouth sands.

The Plymouth series consists of very deep, excessively drained sandy soils formed in glaciofluvial or deltaic deposits derived largely from siliceous rocks (U.S. Department of Agriculture Natural Resources Conservation Service 1995). The semi-natural grasslands in the Matty Matthiessen Wildlife Sanctuary (Parcel 20) are mostly on Plymouth loamy sand.

The Deerfield series consists of very deep, moderately well drained soils formed in glaciofluvial deposits. They are nearly level to strongly sloping soils on terraces, deltas, and outwash plains. Slope ranges from 0 to 15 percent (U.S. Department of Agriculture Natural Resources Conservation Service 1995). The shallow emergent marsh patches dominated by bluejoint grass (*Calamagrostis canadensis*) in the Matty Matthiessen Wildlife Sanctuary (Parcel 20) are mostly on Deerfield sand.

The Haven series consists of very deep, well drained soils formed in loamy over sandy and gravelly outwash. They are nearly level through moderately sloping soils on outwash plains, valley trains, terraces, and water-sorted moraine deposits (U.S. Department of Agriculture Natural Resources Conservation Service 1995). Haven loam soil is mapped near the following parcels: west of Parcel CC2, northeast of Parcel 46, south of Parcel 31, and east of Parcel 30. This soil type is not obviously associated with a particular natural community found on Land Trust parcels.

Montauk fine sandy loam is a very deep, gently sloping, well-drained soil on lower side slopes on uplands. Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick (U.S. Department of Agriculture Natural Resources Conservation Service 1995). Small areas of

Montauk fine sandy loam are found on the following parcels: Parcel 55 (eastern third) and Parcel E-04 (on top of the bluff).

Riverhead sandy loam is gently sloping, well-drained soil found in irregularly shaped, convex areas on broad outwash plains (U.S. Department of Agriculture Natural Resources Conservation Service 1995). Several mapped red maple-blackgum slope forests (e.g., Parcel 50) and successional maritime forests (e.g., Parcel 43) on Land Trust parcels are associated with this soil type. The best condition coastal oak-hickory forest in Parcel 36b is on Riverhead sandy loam.

Methods and Results

This study used the NYNHP system of data collection, mapping, and data synthesis. NYNHP is part of NatureServe (www.natureserve.org), a cooperative network of more than 80 Natural Heritage programs and conservation data centers throughout the Western Hemisphere. These programs specialize in compiling biodiversity information by conducting inventories of rare plants, rare animals, and ecologically significant natural communities aimed at identifying the most sensitive elements of biodiversity in a defined geographic area.

The documented locations of rare plants, rare animals, and significant natural communities are called "element occurrences." Mapped occurrences can be points, lines, or polygons, with buffers for locational uncertainty as needed. Individual occurrences are assigned ranks according to their quality, or perceived viability, based on factors such as size, condition, and landscape context in which they are found (Table 2).

Table 2. Element occurrence (EO) ranks.

Rank	Definition
A	Excellent estimated quality or viability
B	Good estimated quality or viability
C	Fair estimated quality or viability
D	Poor estimated quality or viability
E	Extant, indicating that the occurrence has simply been verified as existing
F	Failed to find, in cases when the EO has not been found despite a recent search by an experienced observer at a time and under conditions appropriate for the Element at a location where it was previously reported, but that still might be confirmed to exist at that location with additional field survey efforts
H	Historical, if there has not been a recent survey verifying its continued existence
X	Extirpated, if there is documented destruction of the habitat or environment of the EO, or persuasive evidence of its eradication based on adequate survey

NYNHP ecologists, botanists, and zoologists conducted field surveys of Land Trust parcels over 120 person-days from May 2021 to October 2022. With guest surveyors, that tally approached 150 person-days. We visited or at least viewed every Land Trust parcel.

Ecology

Floristic Quality Assessment of Observation Points

Vascular plant nomenclature for each observation point (henceforth "point") was updated prior to analyses per Werier et al. (2023). Each native species was assigned a coefficient of conservatism value ("C" value) that reflects a species' fidelity to a remnant plant assemblage in NYS (i.e., 10 = highly conservative/narrow ecological tolerance, 0 = cosmopolitan or non-native) (Swink and Wilhelm 1994). Coefficients of conservatism values for the native vascular plants of New York follow Ring (2016) and are available online via the New York Flora Atlas: https://newyork.plantatlas.usf.edu/. When tallied across all species observed, Coefficient of Conservatism values can be used to determine the floristic "quality" of a plant community (Swink and Wilhelm 1994, Taft et al. 1997, Faber-Langendoen et al. 2019). They can be weighted by the percent cover of each species or simply summed across species, and different metrics are used in different applications. Floristic quality scores are best compared by examining points sampled in the same community type; natural communities of the same type with a higher CoC score are likely to be of higher condition or better representation of that community than those with lower scores.

We calculated the following scores for each point with species cover data:

1. Total Richness: Number of unique vascular plant species recorded at the point.
2. Percent Native: Percent of species in #1 above listed as native to New York state per Werier et al. (2023).
3. Percent Invasives: Percent of species in #1 above listed as invasive in New York state by The New York State Invasive Species Council, in consultation with the Invasive Species Advisory Committee: http://www.nyis.info/?action=israt_nn_plant .
4. Total Mean C: The average Coefficient of Conservatism value for all species in #2 above.
5. Weighted Mean C: Sum of each species C-value multiplied by its cover values, then divided by the sum of cover values for all species at each point.
6. Floristic Quality: Mean C of all plants multiplied by the square-root of number of all plants at each point.
7. Weighted Floristic Quality: Cover-weighted Mean C for all species multiplied by the square-root of all species.

Floristic Quality Assessment (FQA) scores for each point sorted by parcel can be found in Appendix E and in tables grouped by community type in the following supplemental document: Classification of Natural and Semi-Natural Communities of the Henry L. Ferguson Museum Land Trust Parcels (Edinger 2023a).

Preliminary Ecological Community Maps

Using GIS (ArcMap 10) we created preliminary wall-to-wall ecological community maps for each parcel. We obtained the following GIS data layers from the NYS DEC GIS Data Selector: digital orthoimagery, soils, contours, bedrock and surficial geology, and NYNHP Element Occurrences. We screen digitized NYNHP ecological communities (Edinger et al. 2014) onto the following digital orthoimagery: NYS Map Service Color Infrared Orthoimagery from Spring 2020. The service provides a color infrared (CIR) view at approximately 12-inch resolution. The source orthoimagery is 4-band at resolutions of 12 or 6 inches. The preliminary community map was

completed on March 31, 2021 and used during field surveys to navigate to polygons with similar vegetation cover signatures on aerial photos.

Ecology Field Methodology

In this study we used standard inventory methodology developed by The Nature Conservancy, NatureServe, and the Natural Heritage Network, and refined by NYNHP (Edinger et al. 2000). General survey methodology for natural communities involves collecting data on all or most of the following for each targeted community polygons: 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 (Werier et al. 2023). These data allow an accurate identification of each community surveyed. Specifically, for this project we collected detailed observation points (i.e., NYNHP Natural Community Form 1: Transect Observation Points). The location of each observation point was recorded with a Garmin 60Cx GPS unit. The datum on the GPS unit was set to WGS 1984 and the coordinate system was set to UTM (Universal Transverse Mercator). Observation point data were collected in field notebooks and entered in the NYNHP Field Form Database (FFDB) upon return from the field. A digital photograph was taken at nearly every observation point.

We surveyed a total of 345 observation points on Ferguson Museum Land Trust parcels (Figure 5, Appendix C). Observation points were sampled as follows: 276 points in 2021 over three weeks (Aug. 30 – Sept. 3; Sept. 13 – 17; Sept. 27 – Oct. 1); 69 points in 2022 in one week (Aug. 2 – 5).

Ecology surveys spanned a range of data collection effort as follows:

- 205 observation points with detailed vegetation structure and composition data described above in ecology methods.
- 140 "reference points" to record community boundaries; note locations of large trees; note invasive plant populations, parking spots, trailheads and junctions, etc.

Field forms in pdf format for ecology observation points (Community Form 1) are included in the set of project deliverables. Digital photographs taken at each observation point are included in the set of project deliverables as well.

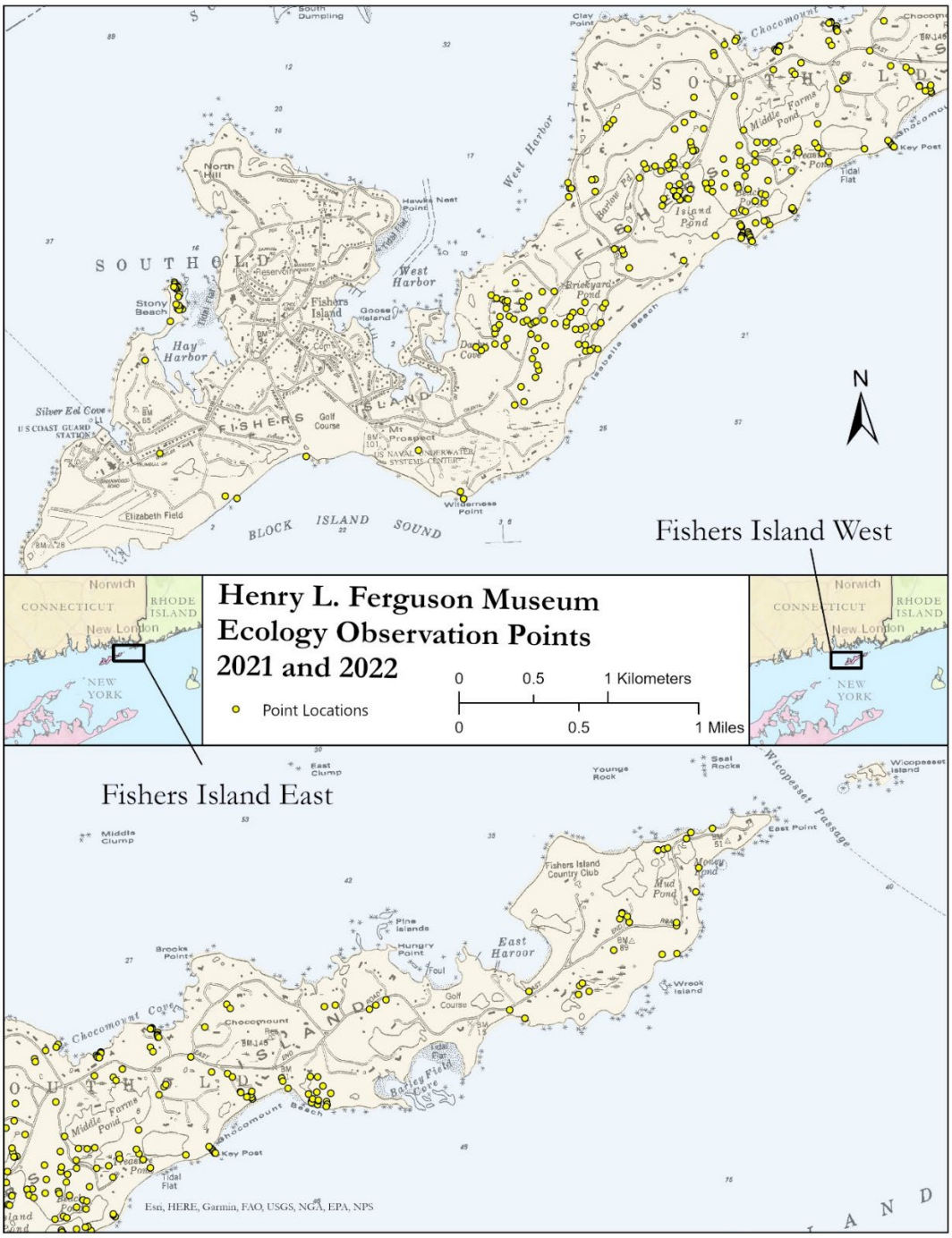

Figure 5. Ecology observation points on Henry L. Ferguson Museum Land Trust parcels.

Ecological Community Classification

After we completed the field surveys, we quality-checked and labeled each observation point record with the appropriate ecological community name from Ecological Communities of NYS (Edinger et al. 2014). In most cases we added a parenthetical tag to the name to identify variants

observed in the field (e.g., Successional old field (S*chizachyrium*), etc.). The variants were named and classified by including the name of the dominant (or co-dominant) species of that type.

We classified 64 ecological communities, including variants and novel types, on Ferguson Museum Land Trust parcels (45 natural communities and 19 cultural communities – *sensu* Edinger 2014; Table 3). Three upland forest types account for almost 40% of the mapped acreage as follows: successional maritime forest (65.5 acres), coastal oak-hickory forest (56.4 acres), and successional southern hardwoods (33.5 acres). Red maple-blackgum forests (incl. swamps, fringe, and upland slope types) totaled just more than 50 acres. Semi-natural grasslands cover more than 30 acres most of which (28 acres) are dominated by switch grass (*Panicum virgatum*) in the Matty Matthiessen Wildlife Sanctuary (Parcel 20 and Parcel 35b).

Detailed descriptions for 37 natural communities and four cultural communities that were surveyed by NYNHP Chief Ecologist Greg Edinger on Land Trust parcels in 2021 and 2022 can be found in the following supplemental document: Classification of Natural and Semi-Natural Communities of the Henry L. Ferguson Museum Land Trust Parcels (Edinger 2023a; Appendix A). This classification includes the following information for each community:

1. A table with observation points that were used to generate scores for a floristic quality assessment (FQA).
2. Summary community descriptions generated by averaging the height and percent cover of all species recorded at each observation point for each community type listed in the tables.
3. One or two representative photographs for each community taken during our ecology surveys are included if available.

Summary descriptions for 42 ecological communities that were generated by averaging the height and percent cover of all species recorded at each observation point for each community type are included in the Classification of Natural and Semi-Natural Communities of the Henry L. Ferguson Museum Land Trust (Edinger et al. 2014; Appendix A). While many communities encountered on Land Trust parcels easily classified to one of the types described in the Ecological Communities of New York State (Edinger et al. 2014), several presented classification challenges. Below we summarize the classification conventions that were developed during the course of our ecology surveys to handle the "puzzlers."

Semi-Natural Grasslands

In this study the semi-natural grasslands in the Middle Farms grassland (Parcel 20 and other Land Trust parcels) are classified as a ruderal association in the National Vegetation Classification (NatureServe 2023a) and as a cultural community in the NYS Ecological Community Classification (Edinger et al. 2014). Agricultural activities at Middle Farms ceased in the mid-1920s (see https://fergusonmuseum.org/2020/05/the-history-of-farming-on-fishers-island-2/) and eventually the upland portions of the abandoned farmland transitioned to grassland dominated by switchgrass (*Panicum virgatum*). This successional trajectory of abandoned agricultural fields on the coastal plain to switchgrass has been documented from Massachusetts to Maryland by NatureServe and classified as a Switchgrass - (Broomsedge Bluestem) Ruderal Meadow. This community is not considered of conservation concern (NatureServe 2023a) but may have significant local biodiversity value.

The origin of the tall, warm-season grasses at Middle Farms, such as switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardi*), and Indian grass (*Sorghastrum nutans*) is uncertain. While all three species are considered native to New York (Werier et al. 2023) their native status in the Middle Farms grassland on Fishers Island is uncertain and undocumented. Across the U.S., switchgrass has been planted and managed as a livestock forage plant. In the Southeast, switchgrass has been mostly used for pasture, and less frequently cut for hay (Uchytil 1993). We may never know if these native grasses were part of the Middle Farms hay fields 100 years ago, or if they spread into the field from nearby natural communities (discussed below), were brought in from afar via migratory birds, or were intentionally or unintentionally introduced to the site by humans.

Switchgrass is listed as a characteristic plant in 13 natural communities described by NYNHP (Edinger et al. 2014) Seven of those communities occur on Long Island (Edinger 2006a, 2006b) and we documented three of those on Fishers Island under this study (salt shrub, high salt marsh, and coastal salt pond). Switchgrass was found in those three natural communities on Land Trust parcels, and was also found in the following natural communities as a minor associated species: maritime rocky beach, maritime shrubland, and successional old field. All six of these communities occur around the periphery of Middle Farms grassland and may have been one of many sources of switchgrass to the field.

Middle Farms grassland does not align with the current NYNHP concept of maritime grassland, for which switchgrass is not listed as a characteristic plant (Edinger et al. 2014, New York Natural Heritage Program 2023a). Of the nine occurrences of maritime grassland tracked by NYNHP, only two mention *Panicum virgatum*, and in those it is a very minor component (<1% to 5% cover).

Regardless of its origin, the four vegetation associations that comprise the 35-acre Middle Farms grassland provide abundant and unique wildlife habitat not available elsewhere on Fishers Island, except for maybe the Ferry District managed grasslands that are being restored by the Fishers Island Conservancy. The size and location of the Middle Farms grassland in the Atlantic flyway, its lack of large herbivores, its predominately native plant composition, and its protected natural area status makes it a rare, valuable Fishers Island resource that is worthy of preserving and enhancing into the future for all to enjoy and learn about. Note that warm-season grasslands found on other Land Trust parcels dominated by little bluestem (*Schizachyrium scoparium*) in this study are classified as successional old field – a natural community.

Red Maple-Blackgum Associations

We classified and mapped three red maple-blackgum forest types, two are wetland and one is upland:

1. We found several small basin examples of the coastal plain variant of red maple-blackgum swamp described in the state classification (Edinger et al. 2014). This type often has large blackgum and red maple trees that grow close together with a lush fern-dominated ground layer. The ferns include cinnamon fern (*Osmundastrum cinnamomeum*), netted chain fern (*Lorinseria areolata*), and spinulose wood fern (*Dryopteris carthusiana*). However, the water table appeared significantly drawn down in few examples lacking the characteristic exposed, saturated, black muck expected for this type. Parcel 44 has a good example of the swamp basin type.

2. A second red maple-blackgum swamp type we recognized, is floristically similar to the one above, but occurs only as a narrow band around ponds and shrub swamps instead of isolated small basins, hence the name red maple-blackgum fringe swamp. The perimeter of Millers Point has this fringe type.
3. The upland type we called red maple-blackgum slope forest in this study, because it occurs on the upland slopes around ponds with no evidence of flooding and several oaks share the canopy. One explanation for the presence of this forest type on the slopes around ponds is that most of these areas were cleared 100 years ago up to the edge of the fringe swamp. Since red maple, blackgum, and sweet pepperbush (*Clethra alnifolia*) are classified as "Facultative Plants" (i.e., can occur in wetlands and non-wetlands); they would have the earliest opportunity to colonize the surrounding cleared upland slopes. The presumption is that these red maple-blackgum slope forests will eventually succeed to coastal oak-hickory forest in the future. Parcel 50 has a good example of the slope forest type.

Shrub Swamp Types

We classified two types of shrub swamp on Land Trust parcels: one dominated by water willow (*Decodon verticillatus*) and one dominated by sweet pepperbush (*Clethra alnifolia*). The former is shorter and usually at the center of a wetland basin while the latter forms a tall band along the wetland-upland margin. However, there are a couple basins that have a patchy mosaic of the two types.

Although this shrub swamp is very small compared to others in the state, it is likely one of the larger ones co-dominated by water willow (*Decodon verticillatus*) and sweet pepperbush (*Clethra alnifolia*). We are looking into the possibility of splitting out "water willow shrub swamp" as a new community type in NY. Until that time we will record new occurrences of this type under the broader shrub swamp concept in the NYNHP Biotics database. Data collected under this project will help further our goal of recognizing this new community. For more information, see the shrub swamp descriptions in the Significant Natural Community section in this report.

Final Map

After the plots and observation points were correctly labeled with the closest NY community name in the Field Forms Database (FFDB) we corrected the names of the corresponding polygons on the ecological community map in the GIS attribute table. We did this by systematically navigating to each observation point in GIS and confirming that each polygon classification matched the observation point classification. We split, merged, and otherwise corrected polygons as needed.

Using ArcMap 10, we revised polygon boundaries and labeled the remaining unsurveyed polygons by extrapolating information gained from the detailed field observation points, classification, aerial photography signatures, and other GIS data layers. The ecological community map is presented here in seven sections (Figure 6 through Figure 12), so most of the community color legends can be discerned within each parcel at an appropriate scale.

See the Henry L. Ferguson Museum Land Trust Parcel Ecological Community Compendium (aka "Land Trust Parcel Compendium"; Edinger 2023b; Appendix B) that includes the following for each parcel or multiple adjacent parcels:

1. Labeled ecological community map zoomed in to the parcel(s) showing ecology observation points with 2020 air photo base layer.

2. Historical mid-1920s black and white air photo of Fishers Island cropped to parcel(s) for select parcels.
3. Observation point data form for all points sampled in the parcel that includes the following: community name, vegetation structure and composition data, percent cover and type of abiotic layers, GPS coordinates, and comments.
4. Photographs taken at each observation point with captions.
5. Table with the acreage of each ecological community mapped in the parcel(s).
6. General Description of Parcel.
7. Invasive Plants in Parcel.
8. Parcel Specific Management Recommendations.
9. Parcel Specific Future Surveys for select parcels where needed.

Table 3. Ecological Communities on Land Trust parcels on Fishers Island.

Community Code		Community Name	No. of Polygons	Acres by type	System/Subsystem*
1	B	Building	5	0.38	CTERCULT
2	BCL	Brushy cleared land	1	0.17	CTERCULT
4	C/FC//ML	Cropland/field crop/Mowed lawn	1	0.07	CTERCULT
5	CO-BF	Coastal oak-beech forest	3	2.64	CTERFOR
6	CO-HF	Coastal oak-hickory forest	23	56.43	CTERFOR
7	CP	Conifer plantation	4	1.59	CTERCULT
8	CPPS	Coastal Plain pond shore	1	0.12	CPALOPEN
9	CSP	Coastal salt pond	4	2.71	CESTINTER
10	dock	dock/boat ramp	1	0.02	CTERCULT
11	ERGM	Estuarine reed grass marsh	2	0.50	CESTCULT
12	HP Pop grand	Hardwood plantation (*Populus grandidentata*)	3	1.03	CTERCULT
13	HP Tilia cord	Hardwood plantation (*Tilia cordata*)	1	0.64	CTERCULT
14	HSM	High salt marsh	7	0.35	CESTINTER
15	HSM Phragmites	High salt marsh (*Phragmites* invaded)	7	1.45	CESTINTER
16	knotweed	Japanese knotweed	1	0.09	CTERCULT
17	LSM	Low salt marsh	3	0.83	CESTINTER
18	MBF	Maritime beech forest	2	0.28	CTERFOR
19	MBLUFF	Maritime bluff	2	0.75	CTEROPEN
20	MD	Maritime dunes	5	0.51	CTEROPEN
21	MIG/SB	Marine intertidal gravel/sand beach	14	7.14	CMARINTER
22	ML	Mowed lawn	9	3.11	CTERCULT
23	MLWT	Mowed lawn with trees	15	5.96	CTERCULT
24	MOF	Maritime oak forest	1	0.43	CTERFOR
25	MR/P	Mowed roadside/pathway	29	3.53	CTERCULT
26	MRB	Maritime rocky beach	13	8.85	CTEROPEN
27	MRB vegetated	Maritime rocky beach (vegetated)	9	1.45	CTEROPEN
28	MRI	Marine rocky intertidal	12	11.26	CMARINTER
29	MRS	Marine rocky subtidal	1	0.83	CMARSUB
30	MS	Maritime shrubland	27	11.97	CTEROPEN

	Community Code	Community Name	No. of Polygons	Acres by type	System/Subsystem*
31	MSB	Maritime sand beach	3	0.90	CTEROPEN
32	MSSF	Marine subtidal sand flats	1	0.27	CMARSUB
33	pond	pond	10	5.55	CLAC
34	PP	Pine plantation	1	0.15	CTERCULT
35	PR/P	Paved road/path	14	3.14	CTERCULT
36	QP	Quarry pond	2	2.72	CLACCULT
37	RGM	Reed grass marsh	6	3.20	CPALCULT
38	RM-BG (fringe)	Red maple-blackgum (fringe)	16	20.40	CPALFOR/CTERFOR
39	RM-BG (slope)	Red maple-blackgum slope forest	13	19.28	CTERFOR
40	RM-BGS	Red maple-blackgum swamp	10	11.04	CPALFOR
41	SAL.S short	Salt shrub (short)	3	0.39	CESTINTER
42	SAL.S tall	Salt shrub (tall)	3	0.78	CESTINTER
43	SAL.S//ERGM	Salt shrub//Estuarine reed grass marsh	1	0.10	CESTINTER
44	SEM	Shallow emergent marsh	1	0.07	CPALOPEN
45	SEM Calamagrostis	Shallow emergent marsh (Calamagrostis canadensis)	8	4.39	CPALOPEN
46	SEM//SS	Shallow emergent marsh//Shrub swamp	1	2.25	CPALOPEN
47	SMF	Successional maritime forest	33	65.52	CTERFOR
48	S-NG Andropogon	Semi-natural grassland (Andropogon gerardi)	3	2.67	CTEROPEN/CULT
49	S-NG Panicum	Semi-natural grassland (Panicum virgatum)	42	28.42	CTEROPEN/CULT
50	SOF	Successional old field	7	7.36	CTEROPEN
51	SOF Schizachyrium	Successional old field (Schizachyrium)	4	5.82	CTEROPEN
52	SOF//SUCS	Successional old field//Successional shrubland	4	2.11	CTEROPEN
53	SS Cleth-Deco	Shrub swamp (Clethra-Decodon)	2	1.59	CPALOPEN
54	SS Clethra	Shrub swamp (Clethra)	7	9.21	CPALOPEN
55	SS Decodon	Shrub swamp (Decodon)	9	10.77	CPALOPEN
56	SSH	Successional southern hardwoods	33	33.45	CTERFOR
57	SSH//SUC.S	Successional southern hardwoods//Successional shrubland	4	1.72	CTERFOR
58	SSH//SUC.S vineland	Successional southern hardwoods//Successional vineland	4	5.37	CTERFOR
59	stream	stream	5	1.92	CRIV
60	SUC.S	Successional shrubland	13	1.87	CTEROPEN

	Community Code	Community Name	No. of Polygons	Acres by type	System/Subsystem*
61	SUC.S Rhus	Successional shrubland (Rhus copallinum)	6	1.12	CTEROPEN
62	SUC.S//SUC.V	Successional shrubland//Successional vineland	12	6.87	CTEROPEN
63	tennis court abandon	tennis court abandoned	1	0.17	CTERCULT
64	UR/P	Unpaved road/path	17	6.06	CTERFOR
			505 polygons	**391.73 acres**	

*System/Subsystem Codes: C=Community; TER=Terrestrial; PAL=Palustrine; LAC=Lacustrine; RIV=Riverine; OPEN=Open; FOR=Forest; CULT=Cultural; NAT=Natural

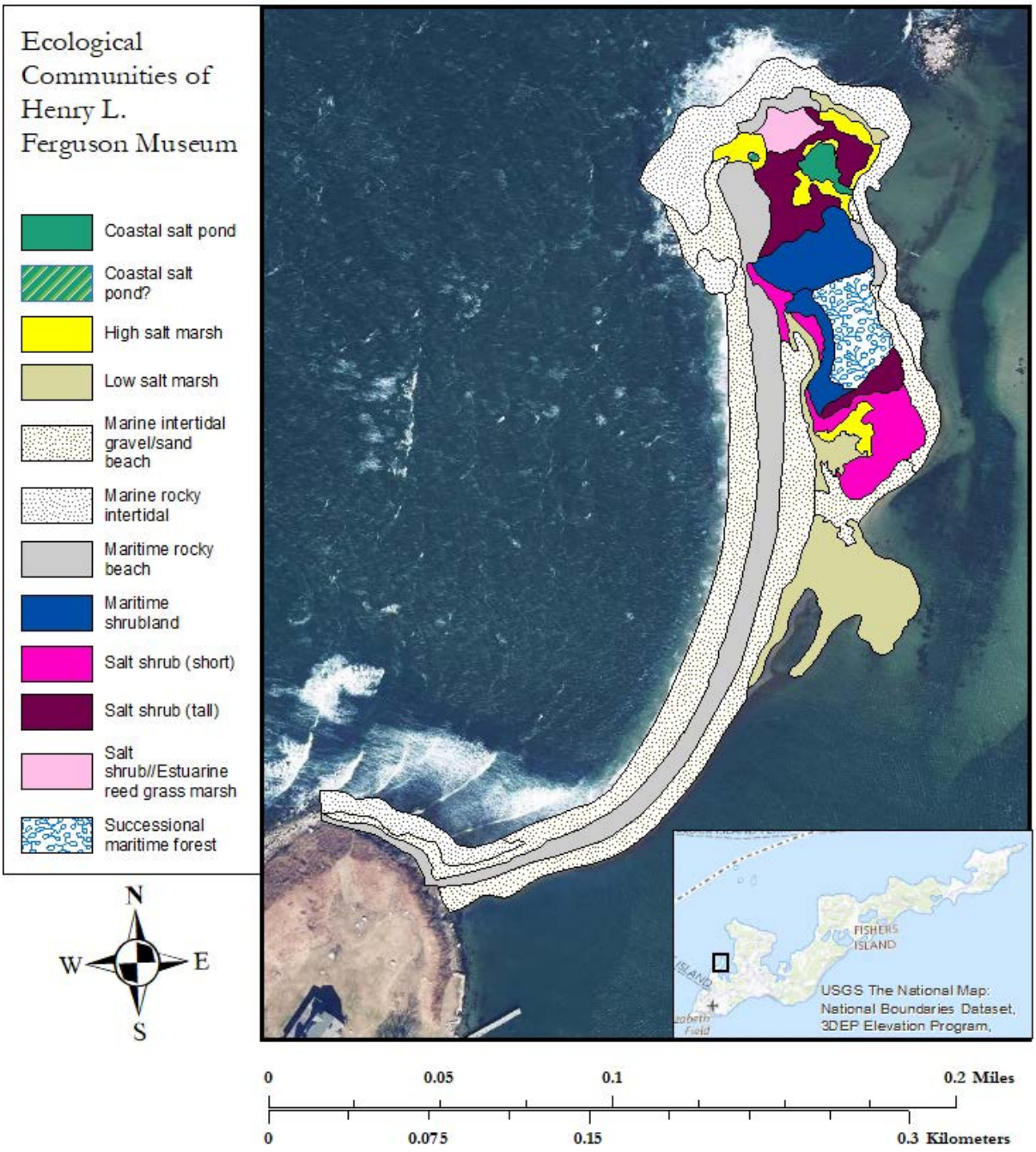

Figure 6. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (1 of 7): Stony Beach (Parcel 25).

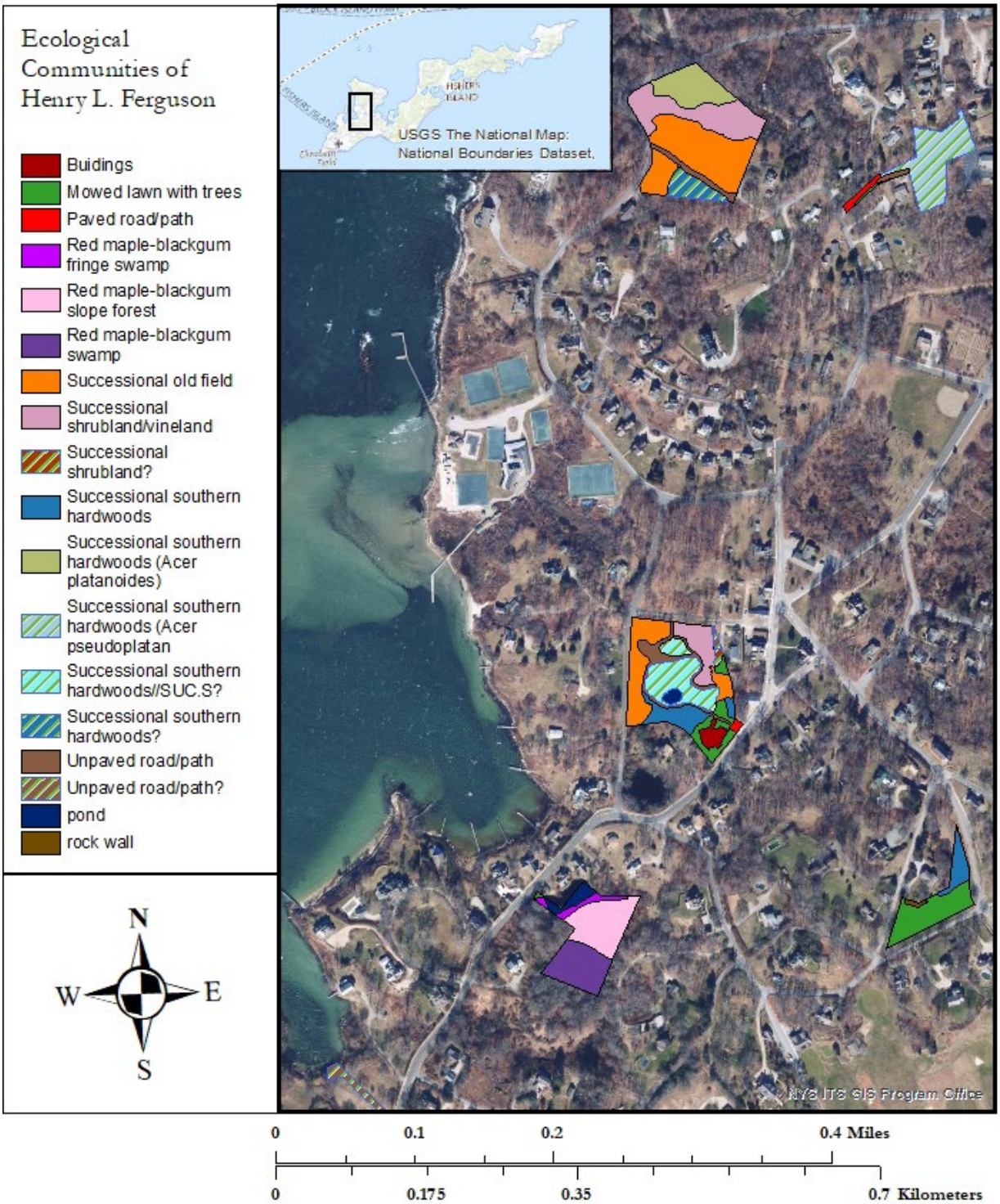

Figure 7. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (2 of 7): H. Lee Ferguson, Jr. Wildlife Sanctuary (Parcel 1 and nearby parcels).

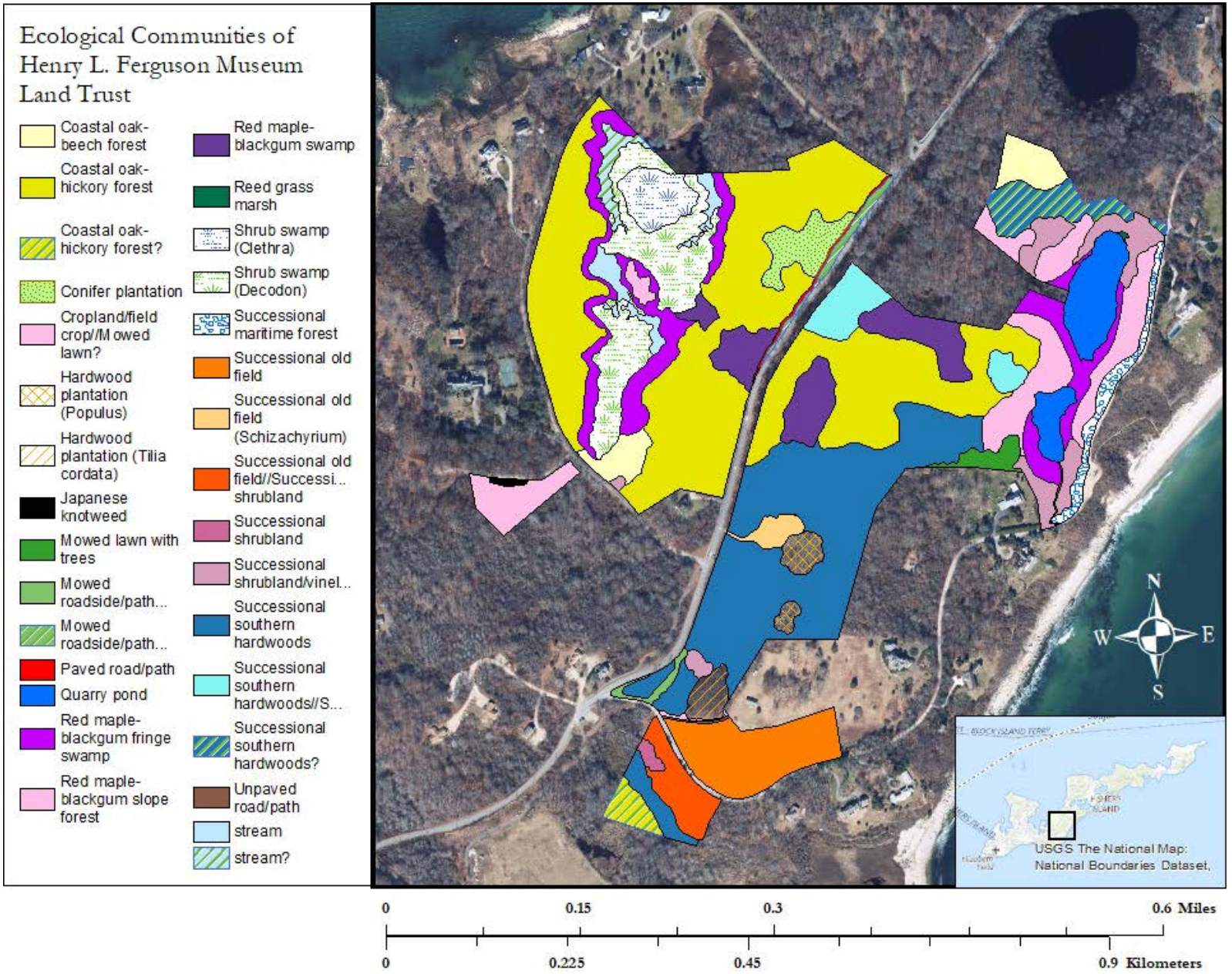

Figure 8. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (3 of 7): L. F. Boker Doyle Sanctuary (Parcels 4, 36a, and 36b); Clay Pit Trail (Parcels 33, 44, 39, and E-08a); and nearby parcels.

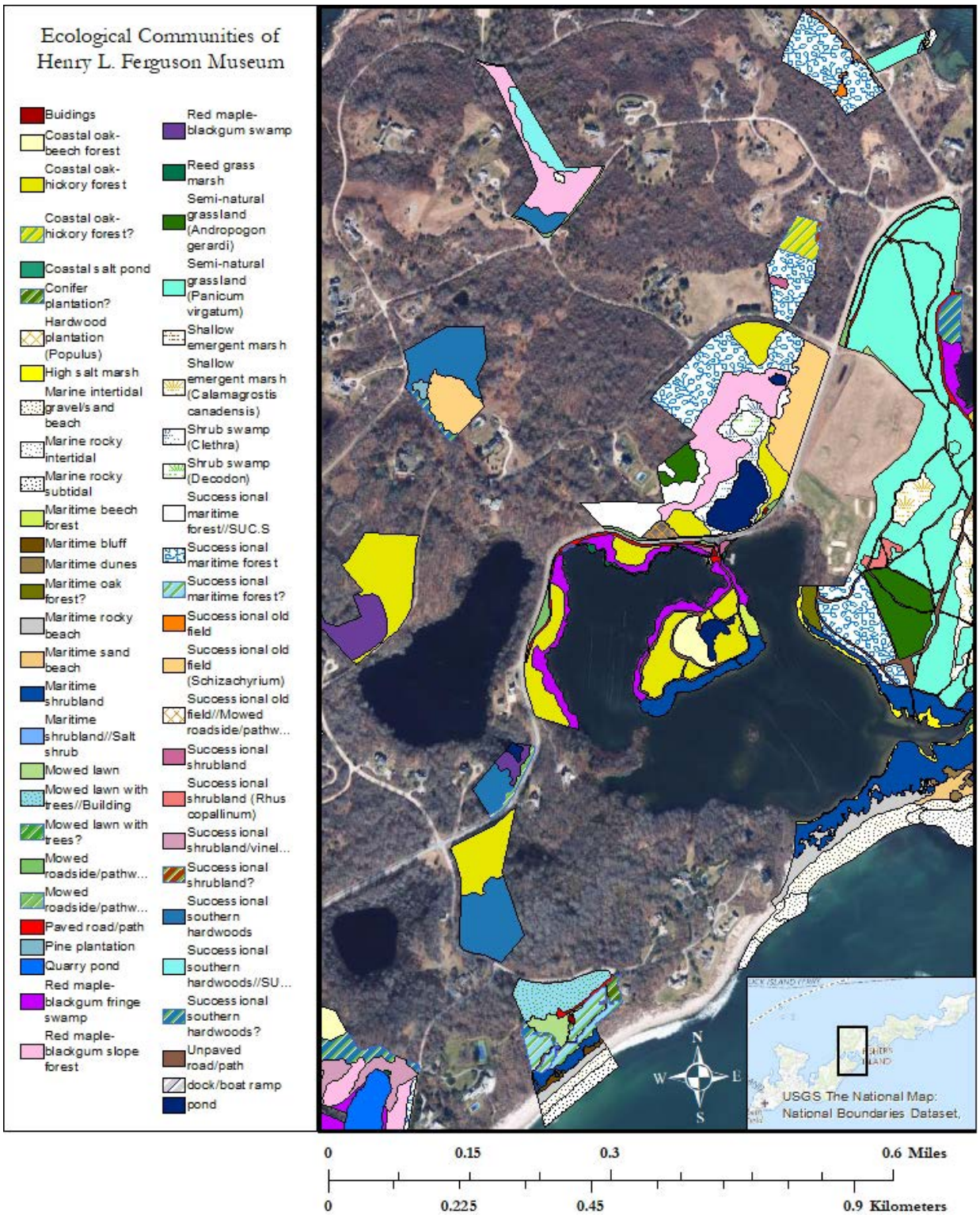

Figure 9. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (4 of 7): Betty Matthiessen Wildlife Sanctuary (Parcels 2, 35a); Matty Matthiessen Wildlife Sanctuary (Parcels 19, 20, 35b, 38); Millers Point (Parcel 11); Charles B. Ferguson Sanctuary (Parcels 23, 24, and others); Chocomount Trail (Parcel 34); and nearby parcels.

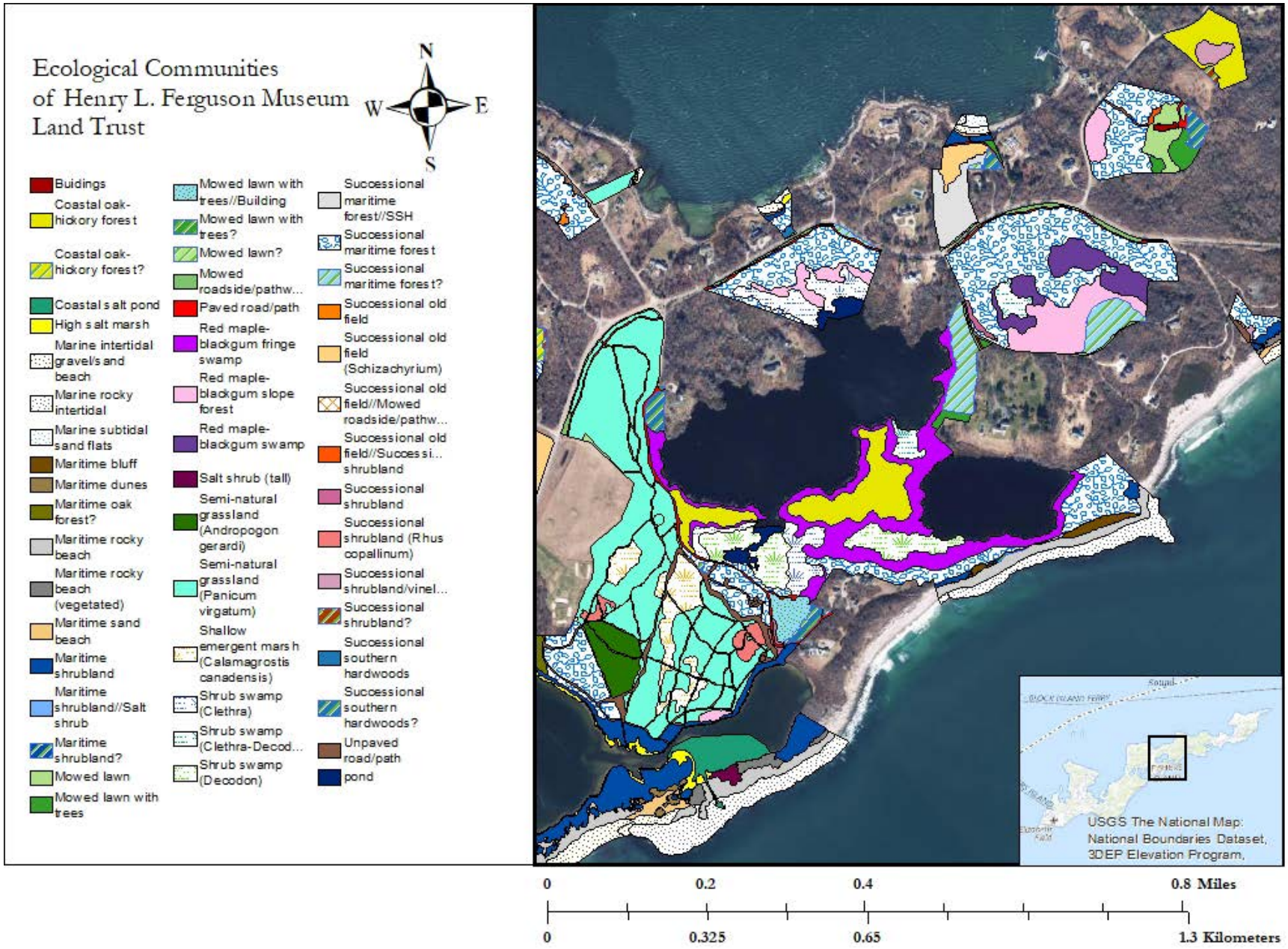

Figure 10. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (5 of 7): Middle Farms Pond area parcels.

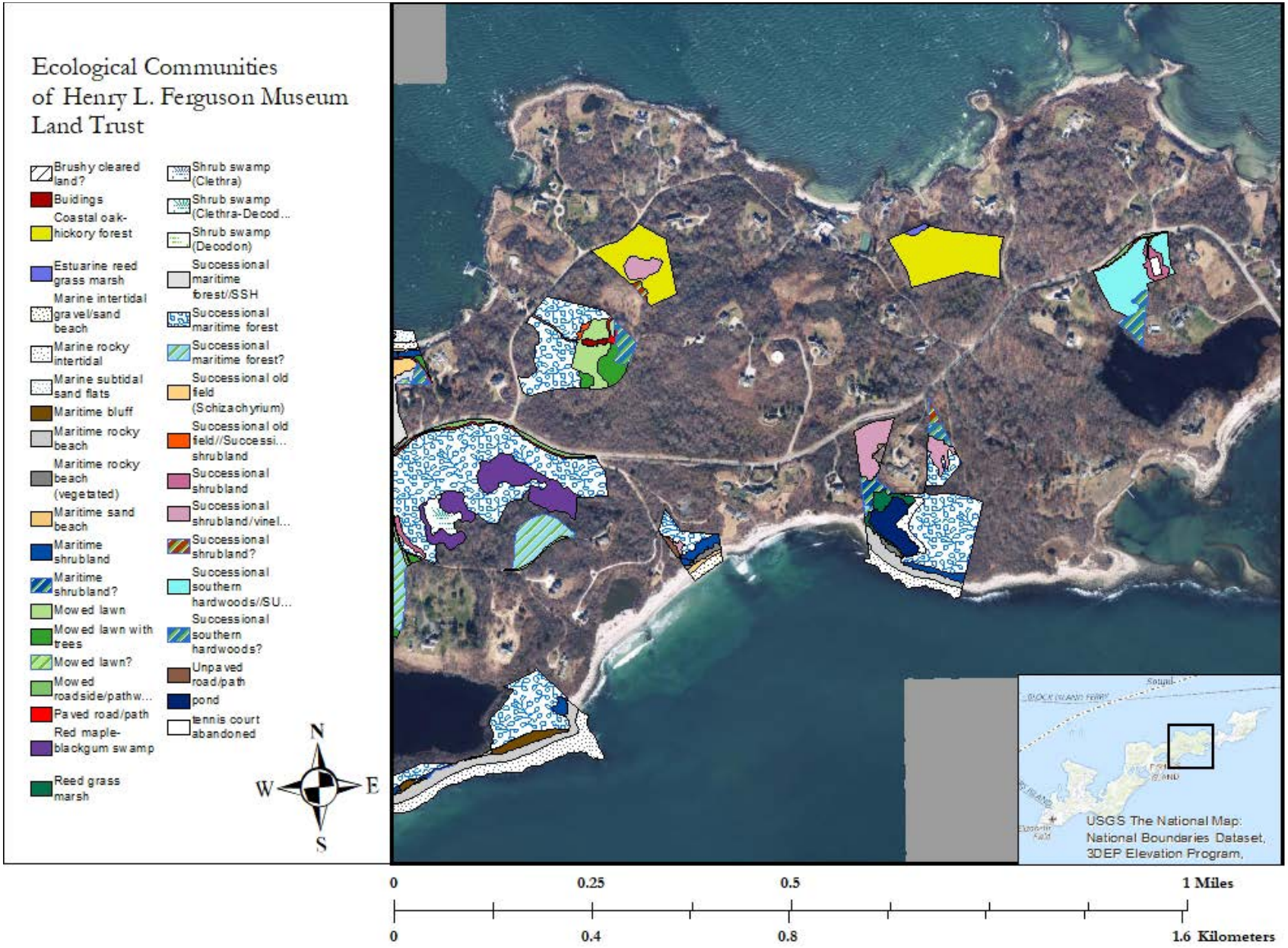

Figure 11. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (6 of 7): East of Middle Farms Pond.

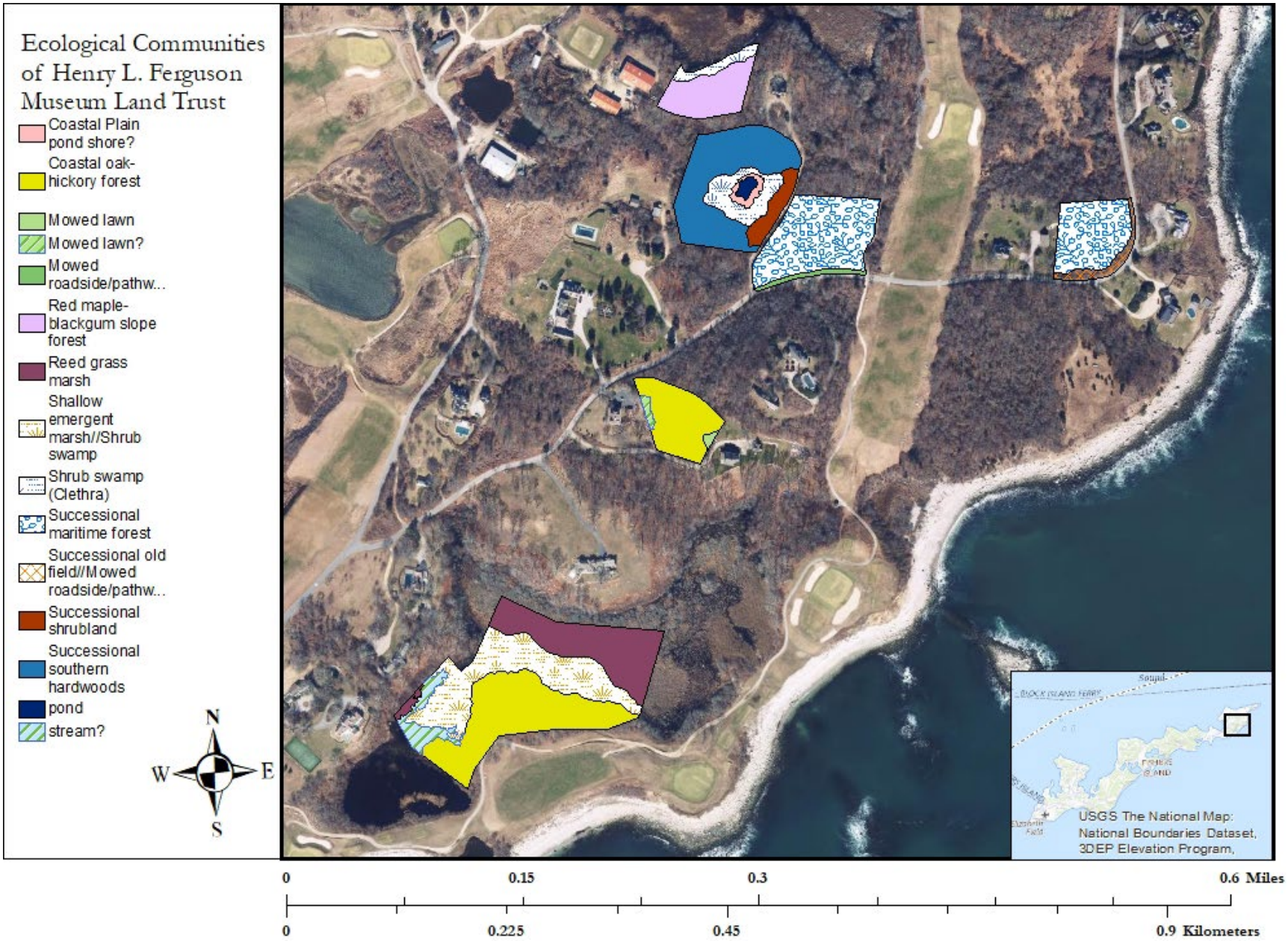

Figure 12. Ecological communities of Henry L. Ferguson Museum Land Trust parcels (7 of 7): Far east end.

Significant Natural Community Occurrences

There are nine natural community occurrences of statewide significance on Fishers Island (Table 4, Figure 13). Three occurrences are adjacent to Land Trust parcels in saltwater (two marine eelgrass meadows and one coastal salt pond); three are mostly off Land Trust property, but have small sections of larger shoreline occurrences on Land Trust parcels (marine rocky intertidal, maritime beach, and maritime bluff); one shrub swamp is mostly on Land Trust land, but a small part of it extends off the parcel; and two are fully contained within Land Trust parcel boundaries (shrub swamp and coastal oak-hickory forest).

Of the nine significant community occurrences on Fishers Island, five are newly documented occurrences as a result of this study; and one is a previously documented occurrence (marine rocky intertidal community) that was updated with data collected during our 2021 ecology surveys (Table 4). We are aware of more recent eelgrass data than 2012 but updating that occurrence was beyond the scope of this project.

Table 4. Significant natural community occurrences on Fishers Island.

EOID	Community Name	Survey Site	EO Rank	Acres	Land Trust Acres	Last Obs.
15049	Marine eelgrass meadow	Fishers Island – South Block Island Sound	AB - Excellent or good estimated viability	142	0	2012
15050	Marine eelgrass meadow	Fishers Island – North	B - Good estimated viability	264	0	2012
17532	Coastal oak-hickory forest	Fishers Island – Parcels 4, 33, 36a, 36b, 39, and 44	BC - Good or fair estimated viability	26	26*	2022
2925	Coastal Salt Pond	Fishers Island – Island Pond and Beach Pond	B - Good estimated viability	52	0?	2022
3294	Marine rocky intertidal	Fishers Island – Fishers Island Parcels 5, 37, and 38	B - Good estimated viability	113	12	2022
17561	Maritime Beach	Fishers Island	B - Good estimated viability	62	10	2022
17535	Maritime Bluff	Fishers Island – Parcels 5, 23, 38, and E-04	B - Good estimated viability	7	1	2021
17533	Shrub Swamp	Fishers Island Parcels 4 and 36b	BC - Good or fair estimated viability	7	6.3	2021
17534	Shrub Swamp	Fishers Island Parcels 9, 11, 23, and 24	BC - Good or fair estimated viability	8	8*	2022

*Two occurrences are fully contained within Ferguson Museum Land Trust parcels listed. All other community occurrences are mapped to their full extent on Fishers Island beyond the Ferguson Museum Land Trust parcels listed.

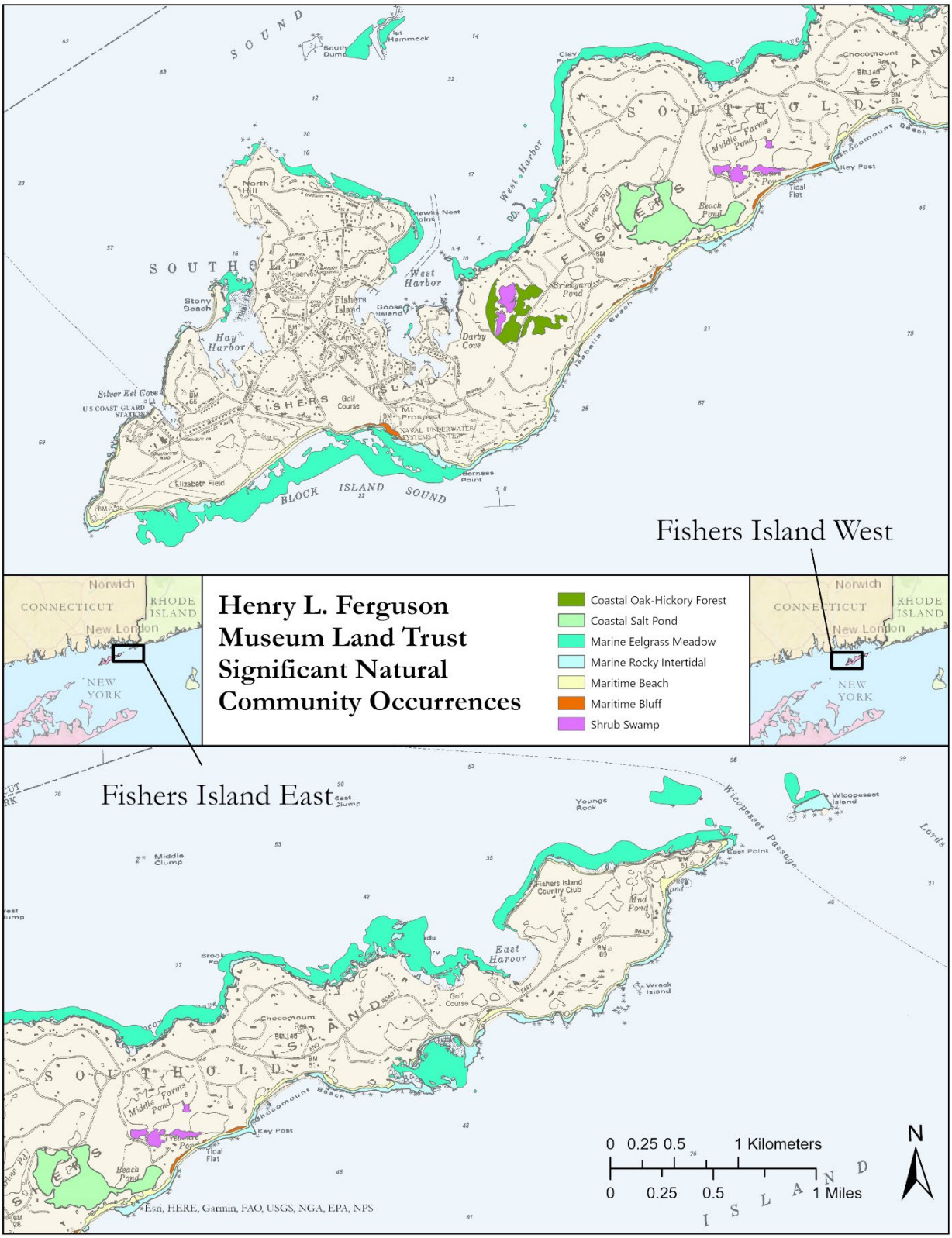

Figure 13. Significant natural community occurrences on and adjacent to Land Trust parcels.

Marine Eelgrass Meadows – Fishers Island North Shore and South Shore

There are two occurrences of marine eelgrass meadow on Fishers Island: one on the south shore (EOID 15049) and one on the north shore (EOID 15050). While this community does not fall on any Land Trust parcels, it does occur in the subtidal areas just offshore of several parcels that have a marine shoreline (Figure 13).

We did not survey marine eelgrass meadows during this study, but we did include this community in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the two marine eelgrass meadow Element Occurrence Records (EOID_15049.pdf and EOID_15050.pdf) are included in the set of project deliverables.

The two marine eelgrass meadow occurrences on Fishers Island are relatively small compared to the other 12 occurrences currently tracked by NYNHP, but they are in good to very good condition. Members of the Fishers Island Seagrass Management (FISM) Coalition are looking into ways to maintain healthy eelgrass meadows around the island as a refuge in response to its decline in Long Island Sound (https://fergusonmuseum.org/fishers-island-seagrass-management/).

Coastal Salt Pond – Island Pond and Beach Pond

Island Pond and Beach Pond together comprise one occurrence of coastal salt pond of statewide significance on Fishers Island (EOID 2925. Figure 14). It was the first coastal salt pond occurrence entered into NYNHP's Biotics database in 1990; and at 52 acres, currently the second largest of nine coastal salt ponds tracked by NYNHP; with the largest one at Oyster Pond at 136 acres on Long Island.

While the ponds are not on Land Trust property per se, they are surrounded by eight Land Trust parcels as follows: Island Pond – Parcel 35a to N and W; Parcel 2 central island; Parcel 19 to E; and Parcel 38 to S. Beach Pond – Parcel 20 to NW; Parcel E-03 to NE; Parcel 3 to SE; and Parcel 38b to SW.

We did not survey the coastal salt pond occurrence during this study, but we did include this community in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the coastal salt pond Element Occurrence Record (EOID_2925.pdf) is included in the set of project deliverables.

In addition, small examples of coastal salt pond were found on the following Land Trust parcels: one in good condition on Parcel 25 (Stony Beach); and one invaded by Old World reed grass (*Phragmites australis*) on Parcel 29. The pond on Parcel 37 may be transitioning to this type as it appears more brackish since NYNHP surveys in 2003. See more on this topic in the Parcel 37 section of the Land Trust Parcel Compendium (Edinger 2023b; Appendix B).

Figure 14. Coastal salt pond on Island Pond, facing W from Parcel 19 (19.03).

Marine Rocky Intertidal – Fishers Island

The marine rocky intertidal community (EOID 3294) occurs discontinuously along the southern and northern shoreline of Fishers Island wrapping around the west and east points of the island and continuing onto the west and north shore nearly encircling the island. It is one of 13 occurrences tracked by NYNHP; and at 113 acres, is by far the largest marine rocky intertidal community in the database – more than the combined size of the second largest at Napeague Bay (54 acres) and third largest at Montauk Point (53 acres).

Figure 15. Parcel 38. Marine rocky intertidal community facing E toward Parcel 38b (left); Marine rocky intertidal community in Parcel 37 (quadrat 37A_10m) with Meaghan McCormack (right).

The marine rocky intertidal community occupies the rocky area between mean low water (MLW) and mean high water (MHW). The community consists of a gently sloping rocky shore with dense macroalgae on a substrate of pebbles, cobbles, and large boulders. *Ascophyllum nodosum* and *Fucus vesiculosis* are the dominant algae, but several other species are present, including the exotic invasive *Codium fragile*. Fauna include mussels, barnacles, periwinkles, and sea stars.

Portions of the marine rocky intertidal community occurrence were found on, or just offshore of, the following 11 Land Trust parcels during our ecology surveys: South shore parcels – 3, 5, 23, 37, 38, and 38b (Figure 15); North shore parcels: 16b, 25 (Stony Beach), 26, 29, and CC2. Survey information and photographs of the marine rocky intertidal community at each of these parcels are included in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) organized by parcel number.

More information on the marine rocky intertidal community can be found in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the Fishers Island Marine Rocky Intertidal Survey Addendum (Appendix D). For the rocky intertidal survey, Greg Edinger and Meaghan McCormack surveyed this community on the shores of three Land Trust parcels as follows: Parcel 37 on 9/14/2021 with two transects one with 4 and one with 3 quadrats (1 m^2) (Figure 15); Parcel 38 on 9/15/2021 two transects one with 6 and one with 2 quadrats; and Parcel 5 on 9/16/2021 one transect with 5 quadrats.

Lastly, the marine rocky intertidal community Element Occurrence Record (EOID_3294.pdf) is included in the set of project deliverables.

Maritime Beach – Fishers Island

This rocky variant of maritime beach (EOID 17561, Figure 16) occurs almost continuously along the southern shoreline of Fishers Island wrapping around the west and east points of the island and continuing onto the west and north shore for a short distance from those points. The maritime beach on Fishers Island is one of 15 occurrences currently tracked by NYNHP. At 62 acres, this beach is smaller than the average beach occurrence size of 185 acres, most of which are sandy beaches on Long Island. Fishers Island fairs better when its size is compared to other maritime *rocky* beaches (Plum Island – 33 acres and Montauk Point – 54 acres). If maritime rocky beach was classified separate from maritime sand beach in NY, then Fishers Island would likely be the largest occurrence in the best condition in the state.

Figure 16. Top: Maritime rocky beach at point 37.03a facing west; Middle: Maritime rocky beach (vegetated) at point 38b.02 facing east; Bottom: Maritime sand beach at point 43.02 facing west.

The community consists of a gently sloping rocky shore with two substrate variants: 1) mostly rocky variant with pebbles, cobbles, and large boulders; and 2) a few small areas with sandy substrate. The maritime rocky beach is mostly unvegetated to sparsely vegetated (<10% vegetation cover), but there are also patches that are mapped as "maritime rocky beach (vegetated)" with an average herb cover of 30% (Figure 16). More information on the three types of maritime beach can be found in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the maritime beach Element Occurrence Record (EOID_17561.pdf) included in the set of project deliverables.

The maritime rocky beach essentially corresponds to the extent of the marine rocky intertidal community described above, since both communities share the same substrate. Therefore, it is not surprising that both communities are found at the same Land Trust parcels: South shore parcels – 3, 5, 23, 37, 38, and 38b; North shore parcels: 16b, 25 (Stony Beach), 26, 29, and CC2. Sand beaches were only found at three locations on Land Trust parcels (Parcel 43, Parcel CC2, and on the line between Parcel 38 and Parcel 38b). Survey information and photographs of the maritime beach community at each of these parcels are included in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) organized by parcel number.

Noteworthy Statistics:

- The majority of Fishers Island's shoreline is maritime rocky beach. Small, sandy beaches were only found on the following Land Trust parcels: Parcel 43, Parcel CC2, and on the line between Parcel 38 and Parcel 38b.
- The three parcels that comprise the barrier beach of Island Pond and Beach Pond have the top three best Landscape Condition Analysis (LCA) scores of the 77 Land Trust parcels assessed in this study (Parcel 38b LCA: 0.0; Parcel 3 LCA: 3.3, and Parcel 38 LCA: 13.1; LCA score range 0 to 1728). The LCA is a spatial model that cumulatively depicts key anthropogenic stressors across the NYS landscape at a 30 x 30-m resolution (Feldmann and Howard 2013). These low scores objectively confirm that this area is likely set in one of the least-disturbed landscapes on Fishers Island. See Landscape Condition Analysis (LCA) of Ferguson Museum Land Trust Parcels (Appendix F) for full list of parcel LCA scores.
- The cobble spit landform with no sand at Stony Beach may be a unique geologic feature for New York (Figure 17). Most back-barrier lagoons in the state are set behind barriers of sandy substrate, such as sand spits and barrier islands with dunes, like those along the south shore of Long Island. However, more surveys of this type are needed to prove this "one-of-a-kind" claim.

Figure 17. Maritime rocky beach on Stony Beach in Parcel 25 (25.08e).

Maritime Bluff – Fishers Island South Shore

The maritime bluff occurrence (EOID 17535) is comprised of six discontinuous bluff faces totaling one mile in length within a three-mile stretch of the south shore of Fishers Island. The six bluff patches occur in three clusters: the first at Treasure Pond is comprised of three polygons (length along shore east to west: 160 m, 65 m, and 270 m); the second at Isabella Beach is comprised of two polygons (length along shore east to west: 405 m and 95 m); and the third at Mount Prospect is comprised of one polygon (length along shore east to west: 545 m). This community ranges from actively eroding unvegetated slopes to areas with sparse shrubs, herbs, and vines. Portions of the maritime bluff occurrence were

Figure 18. Maritime bluff in background on Fishers Island.

found on the following three Land Trust parcels during our ecology surveys: Parcel 5, Parcel 23, and Parcel E-04 (Figure 13). Survey information and photographs of the maritime bluff community at each of these parcels are included in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) organized by parcel number.

The maritime bluff occurrence on Fishers Island is one of four currently documented in the state by NYNHP. Covering 6-7 acres, it is the smallest of the four: Montauk Point – 41 acres; Shadmoor Ditch Plains – 25 acres; and Plum Island – 12 acres. More information on the maritime bluff community can be found in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the maritime bluff Element Occurrence Record (EOID_17561.pdf) included in the set of project deliverables.

Figure 19. Coastal oak-hickory forest on Fishers Island in Parcel 4.

Coastal Oak-Hickory Forest - L. F. Boker Doyle Sanctuary and Clay Pit Trail

The coastal oak-hickory forest in the L. F. Boker Doyle Sanctuary appears to be the best example on Fishers Island (EOID 17532). The forest is dominated by mature black oak with lesser amounts of red maple, mockernut hickory, blackgum, and sweet birch in the canopy. The forest forms a horseshoe-shape polygon on the slopes and hills around a 10-acre wetland basin. The forest has well-developed shrub and tree layers. The forest is comprised of two patches, one 18-acre, horseshoe-shaped polygon in the Sanctuary, west of East End Rd. and one irregular-shape, 7-acre patch east of East End Rd in Parcel 33 and Parcel 44 (Clay Pit Trail area). The forest is dominated by native species in all strata. Lack of deer browse is evident with good canopy tree recruitment and diverse herb layer (about 17 species, 13% cover avg.). A small (<1-acre) inclusion of coastal oak-beech forest is located at point 04.05.

This occurrence of coastal oak-hickory forest is found on the following Land Trust parcels: 4, 33, 36a, 36b, 39, and 44. Survey information and photographs of the coastal oak-hickory forest at each of these parcels are included in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) organized by parcel number.

The coastal oak-hickory forest occurrence on Fishers Island is one of nine currently documented in the state by NYNHP. Covering about 26 acres, it is the smallest of the nine (size range 26 acres on Fishers Island to 446 acres at Mashomack Preserve on Shelter Island; avg. 176 acres). More information on the coastal oak-hickory forest can be found in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the coastal oak-hickory forest Element Occurrence Record (EOID_17532.pdf) included in the set of project deliverables.

Noteworthy Statistics:

- The southern half of the L. F. Boker Doyle Sanctuary may have been continuously forested, and perhaps uncut, for the last 100 years. The southern half of the Sanctuary is depicted as forested on the circa 1958 USGS 7.5 minute topographic map, and is among the few

forested areas on the mid-1920s black and white air photo. See Parcel 4 section in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) for more information.

- Six of the top ten highest Floristic Quality Index (FQI) scores generated for this study, five of which are in this coastal oak-hickory forest occurrence, are in Parcel 4 and Parcel 36b in the L. F. Boker Doyle Sanctuary (Appendix E). These scores help confirm that the Sanctuary is in very good condition floristically and worthy of protection into the future.
- We were fortunate to sample an observation point (36b.01) in 2021 at the same GPS coordinates sampled by the same NYNHP Chief Ecologist in 2003 (C2). The Floristic Quality Assessment scores of the two points are very similar. Glossy buckthorn (*Frangula alnus*) was the only invasive recorded in both years (2003 – 5%; 2021 – 2%). Not surprisingly, the native trees and shrubs recorded in both years are similar, with one noticeable exception – witch hazel (*Hamamelis virginiana*) has vanished from this location. See Parcel 4 section in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) for more information.

Shrub Swamp – L. F. Boker Doyle Sanctuary

Straddling the boundary between Parcel 4 (to the east) and Parcel 36b (to the west) at about the center of the L. F. Boker Doyle Sanctuary is an impressive 7-acre shrub swamp of statewide significance (EOID 17533; Figure 20). The shrub swamp is surrounded by an occurrence of coastal oak-hickory forest that is also of statewide significance described above.

Although this shrub swamp is very small compared to others in the state, it is likely one of the larger ones co-dominated by water willow (*Decodon verticillatus*) and sweet pepperbush (*Clethra alnifolia*). We are looking into the possibility of splitting out "water willow shrub swamp" as a new community type in NY. Until that time we will record new occurrences of this type under the broader shrub swamp concept in the NYNHP Biotics database. Data collected under this project will help further our goal of recognizing this new community.

The shrub swamp is comprised of two vegetation associations: 1) short (1.3 m) water willow (*Decodon verticillatus*)-dominated patches (5.98 acres, 82% of occurrence); and 2) tall (3.2 m) sweet pepperbush (*Clethra alnifolia*)-dominated patches (1.35 acres, 18% of occurrence). A narrow band of red maple-blackgum swamp lines the margin of the shrub swamp basin. The wetland basin is surrounded by a horseshoe-shaped polygon of coastal oak-hickory forest (36-acre natural area) with a network of hiking trails which is surrounded by roads on four sides (43-acre roadless block), East End Rd. is along the southeast boundary and Brickyard Rd. loops around the forest block along the west and north margins.

Figure 20. Shrub swamp (Decodon verticillatus) in L. F. Boker Doyle Sanctuary Parcel 4 (04.01) face S from lawn.

More information on the shrub swamp in the L. F. Boker Doyle Sanctuary can be found in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the shrub swamp Element Occurrence Record (EOID_17533.pdf) included in the set of project deliverables.

Noteworthy Statistics:

- A new population of the state-rare coastal manna grass (*Glyceria obtusa*) was found in the water willow shrub swamp during our 2021 ecology surveys.
- The shrub swamp dominated by sweet pepperbush (*Clethra alnifolia*) in Parcel 36b at point 36b.04 has the highest Weighted Floristic Quality Index Score (FQI 22.15) for that community found during our ecology surveys.
- The shrub swamp dominated by water willow (*Decodon verticillatus*) in Parcel 36b at point 36b.02 has the highest Weighted Floristic Quality Index Score (FQI 29.60) for that community found during our ecology surveys.
- Point 36b.02 also has the second highest number of native species (22) recorded at any point sampled during our ecology surveys. Point 50.01 in Parcel 50 is #1 with 25 native species in the red maple-blackgum slope forest; however, point 36b.02 is invasive free (i.e., 100% native) compared to point 50.01 which has three invasive plant species.
- The wetland boundaries in Parcel 4 and Parcel 36b appear unchanged since the mid-1920s black and white air photo. See Parcel 4 section in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) for more information.

Shrub Swamp – Charles B. Ferguson Sanctuary

This 8-acre occurrence is comprised of several shrub swamp patches located in small coves along the south shore of Middle Farms Pond and the west shore of Treasure Pond (EOID 17534) in the Charles B. Ferguson Sanctuary. The shrub swamp is comprised of two vegetation associations: 1) short (1.3 m) water willow (*Decodon verticillatus*)-dominated patches (5.15 acres, 62% of occurrence); and 2) tall (3.5 m) sweet pepperbush (*Clethra alnifolia*)-dominated patches (3.12 acres, 38% of occurrence). A narrow band of red maple-blackgum swamp lines the margin of the shrub swamp basin.

Figure 21. Shrub swamp (Decodon verticillatus) in Parcel 9: Charles B. Ferguson Sanctuary (20.18).

More information on the shrub swamp can be found in the Land Trust Parcel Classification (Edinger 2023a; Appendix A); and the shrub swamp Element Occurrence Record (EOID_17534.pdf) included in the set of project deliverables.

Noteworthy Statistics:

- The shrub swamp in Parcel 9 has the largest patch of *Sphagnum recurvum* (40% cover) found during our ecology surveys at point 23.11
- The Parcel 9 Landscape Condition Analysis Score of 267.98 (#11 overall) falls in the top 25th percentile of the 77 Land Trust parcels (LCA score range 0 to 1728). See Parcel 9

section in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B) for more information.

- The 8-acre shrub swamp occurrence is entirely on Land Trust property.

Botany

Fishers Island Flora

The plants of Fishers Island can be considered part of the flora of the Atlantic coastal plain of New York. Since Fishers Island is part of the same glacial moraine (the Orient Point-Fishers Island Moraine), it is geologically similar and has many of the same rare plants as those found at Orient Point and Plum Island, although Fishers Island has more rarities than either of those locations.

Since the island has been heavily disturbed over the last 400 years many new exotic plants have been introduced and a few of them have become invasive monocultures in some parts of the island. The interior upland meadows and forested areas generally have a higher percentage of invasive plants as compared with the coastal beaches and freshwater wetlands, although Old World reed grass, *Phragmites australis*, is a problem in both brackish and freshwater wetlands. The uplands are also recovering from centuries of agricultural use from settlement in the 1640's into the early 20^{h} century.

Earlier Botanical Studies

Charles B. Graves, a noted botanist from Connecticut visited Fishers Island beginning in the 1890's and made important early botanical collections, including some rarities not noted again by subsequent botanists. Charles Hanmer, a Fishers Island resident in the early 20th century, made extensive collections of the island's Flora, and published a catalogue in 1940 (Hanmer 1940). Many of his collections are held by the University of Connecticut Museum. Hanmer described the habitat for many of his collections as "pasture," testifying to the changes in land use on Fishers over the last century.

In 1990 and 1991, Gordon Tucker of the New York State Museum and Ed Horning of Fishers Island conducted a study of the island's flora and were able to relocate many of the rare species Hanmer had documented decades earlier.

Prior to the surveys we report on here, the results of these earlier botanical studies of Fishers Island (Hanmer 1940, Horning 1999), as well as previous efforts by NYNHP were consulted. All voucher specimens of rare plants from these earlier studies were added to the NYNHP database. The locational precision of these records varied – some could be mapped to a particular pond, parcel, or woodlot, while other lacked precise locational data, and so were mapped to a broader stretch of coastline or larger area.

Botany Field Methodology

In this study, Land Trust-owned parcels where rare plant species had been previously recorded were prioritized for survey, along with parcels without known records, but deemed to have appropriate habitat for rare plants on aerial photo interpretation. Mosses, lichens, and fungi were not included in survey efforts and marine algae were recorded during some Ecological Community studies and are covered in that section.

In conducting surveys on the ground, we used standard rare plant search inventory methodology developed by The Nature Conservancy, NatureServe, and the Natural Heritage Network. General survey methodology for rare plants involves collecting data on the following for each targeted plant occurrence: directions to each group of plants, condition of the plants, size of the occurrence in numbers or area, habitat description including associated species, surrounding landscape description, threats, and management comments. In addition to gathering data on rare plant locations, we completed lists of all vascular plants observed (e.g., Figure 22) at each survey location (Appendix G). Plants that could not be identified in the field were collected and later identified under microscopy at the NYNHP lab.

For rare plant populations of sufficient size, collections were made; these were preserved and will be deposited at the herbarium of the New York State Museum. Smaller populations that could be impacted by collection were documented using diagnostic photos and stored in the NYNHP Digital Image Database.

Taxonomic nomenclature followed the NY Flora Atlas (Werier et al. 2023) and rare plant ranks followed the New York Rare Plant Status List (Ring 2022). For each visit to a survey site, plant species lists, habitat information, and rare plant data were recorded using either a field notebook and Garmin 60csx GPS recorder (2021 surveys) or a Samsung Galaxy tablet (2022 surveys). These data were later transcribed to our Field Form and Biotics databases. Photos of the rare plants and their habitats were taken with the iPhone 10 Pro. A map of all botany points surveyed is shown below in Figure 23.

*Figure 22. (Left) Cinnamon Fern (*Osmunda cinnamomea*) at the Matthiessen Preserve and (Right) Glasswort (*Salicornia *sp.) at Stony Beach.*

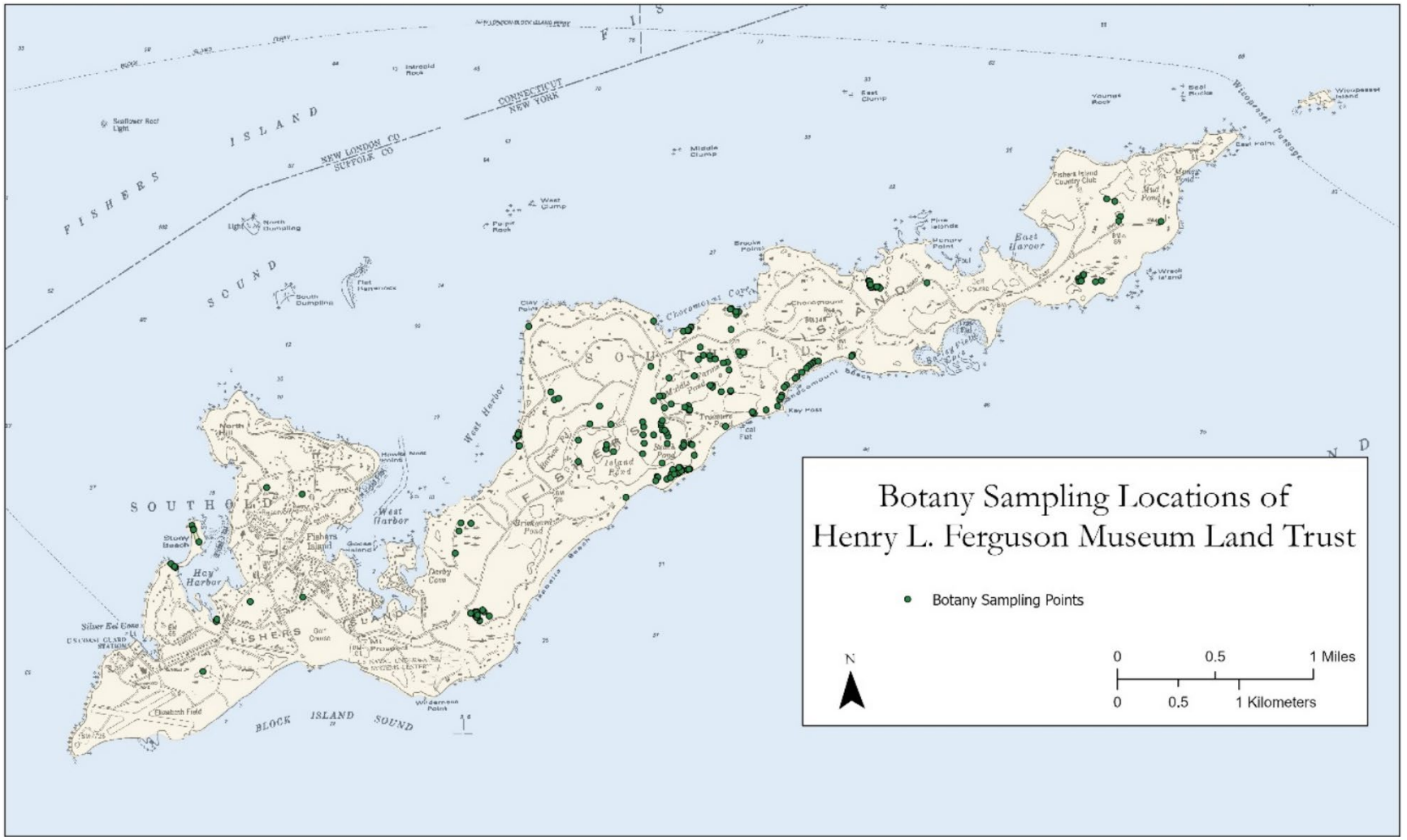

Figure 23. Locations visited for botany surveys in 2021 and 2022.

Element Occurrence Ranking

For each rare plant population discovered or updated during fieldwork, the condition, size, and landscape context of each was assessed in relation to other occurrence of the species in New York. These factors were weighed in order to assign an Element Occurrence Rank (EO Rank), which NYNHP uses to compare populations statewide. This ranking provides a baseline for future monitoring efforts as well as a way to prioritize conservation efforts. The "E" rank, for Extant, was applied to those species documented by Tucker and Horning (Tucker and Horning 1993, Horning 1999) but not re-located during the present study. Some of these taxa may yet persist in the seed bank or be rediscovered in future surveys.

Rare and Protected Plants of Fishers Island

With 65 rare plant taxa having been recorded, including in historical studies, Fishers Island has the greatest concentration of rare plants of any single site in New York state (e.g., Figure 24). Thirty-five of these rare species are currently regarded as extant by the NYNHP, having been observed since 1984 (Table 5). Of these 35 extant rare plant species, 28, or 83%, have been documented on Land Trust property (Figure 25). Table 5 lists the extant rare species occurrences on Land Trust property, their State Ranks (S-ranks), locations, and Element Occurrence Ranks. Coastal beaches, salt marshes and salt ponds, and the grasslands of the Matthiessen Preserve had the largest number of rare plant populations.

*Figure 24. (Left) American Saltmarsh Bulrush (*Bolboschoenus maritmus *ssp.* paludosus*) and (Right) Botanist Katie Beeles gawking at Seabeach Sandwort (*Honckenya peploides *ssp.* robusta*).*

Table 5. Occurrences of extant rare plant species on Fishers Island (EO =Element Occurrence).

Scientific name	Common name	S-rank	Location (Parcel Number)	NYNHP EO ID	EO Rank	Last observation date
Angelica lucida	Sea-coast Angelica	S2	Chocomount Trail (32 and 37)	3280	C	1984-08-02
			Parcel 55	30	E	1991-06-25
			Parcel 16b	3316	E	1991-07-25
Atriplex glabriuscula	Glabrous Orach	S1	Parcels 26 and CC2	17758	CD	2022-09-20
Bartonia paniculata ssp. *paniculata*	Green Screwstem	S1	Middle Farms Pond	3036	E	1990-07-30
Bolboschoenus maritimus ssp. *paludosus*	American Saltmarsh Bulrush	S2	Matty Matthiessen Wildlife Sanctuary (E-03)	17761	C	2022-09-21
Carex mitchelliana	Mitchell's Sedge	S1S2	Parcel 31	5618	B	1990-07-30
Carex straminea	Straw Sedge	S1	Parcel 31	9152	E	1990-07-30
Chenopodium berlandieri var. *macrocalycium*	Large-calyxed Goosefoot	S1S2	Matty Matthiessen Wildlife Sanctuary (38) and Chocomount Trail (32)	17309	A	2021-08-04
			Parcels 26 and CC2	17763	B	2022-09-22
			Stony Beach (25)	8709	C	2021-08-03
Crocanthemum dumosum	Bushy Rock Rose	S2	Charles B. Ferguson Sanctuary (23)	4351	E	1990-09-18
Erechtites hieraciifolius var. *megalocarpus*	Coastal Fireweed	S1	Stony Beach (25)	6925	B	1990-09-17
Eutrochium dubium			Matty Matthiessen Wildlife Sanctuary (20)		B	2021-07-17
Fuirena pumila	Dwarf Umbrella Sedge	S2	Matty Matthiessen Wildlife Sanctuary	17402	CD	2022-09-21

Scientific name	Common name	S-rank	Location (Parcel Number)	NYNHP EO ID	EO Rank	Last observation date
			(Parcels E-03 and 20)			
Glyceria obtusa	Coastal Manna Grass	S2?	Parcels 4 and 36b	17406	A	2021-09-28
			M and M Harry Cant Wildlife Sanctuary (13)	17310	AB	2021-09-03
			Middle Farms Pond	16224	B	2022-07-27
Honckenya peploides ssp. *robusta*	Seabeach Sandwort	S3	Parcels 26 and CC2	17749	B	2022-09-22
Hottonia inflata	American Featherfoil	S2	Parcels 4 and 36b	12730	B	2021-06-29
Hydrocotyle umbellata	Many-flowered Marsh Pennywort	S2	Parcel 32	17311	A	2021-10-01
			Middle Farms Pond (20, 35b, 11)	16911	B	2021-10-01
Iris prismatica	Slender Blue Flag	S2	Matty Matthiessen Wildlife Sanctuary (20)	17305	BC	2021-09-01
Juncus dichotomus	Forked Rush	S2	Matty Matthiessen Wildlife Sanctuary (20)	17307	C	2021-07-01
			Island Pond Northwest (35a)	17402	E	1992-07-27
Ligusticum scoticum ssp. *scoticum*	Scotch Lovage	S1	Hay Harbor (14)	1034	C	2004-08
Limosella australis	Atlantic Mudwort	S2	Matty Matthiessen Wildlife Sanctuary (E-03)	17400	E	1990-07-30
Myriophyllum pinnatum	Cut-leaved Water Milfoil	S1	Charles B. Ferguson Sanctuary (23)	6061	A	1991-08-17
Oxybasis rubra var. *rubra*	Red Pigweed	S2	Parcel 38	6258	E	1991-08-14

Scientific name	Common name	S-rank	Location (Parcel Number)	NYNHP EO ID	EO Rank	Last observation date
Plantago maritima var. *juncoides*	Seaside Plantain	S2S3	Parcel 25	17294	B	2021-09-29
Potamogeton pulcher	Spotted Pondweed	S2	Matthiessen Pond (2)	9375	BC	1991-06-26
Potentilla anserina ssp. *pacifica*	Coastal Silverweed	S2	Parcel 25	17293	C	2021-06-28
			Island Pond (35)	706	CD	1985-07-11
			Hay Harbor (14)	17306	CD	2021-06-29
Rumex fueginus	American Golden Dock	S1	Beach Pond	244	C	1990-09-18
Spiranthes vernalis	Grass-leaved Ladies' Tresses	S1S2	Parcel 53a	17312	C	2021-08-02
			Matty Matthiessen Wildlife Sanctuary (20 and 35)	17296	CD	2021-08-02
Symphyotrichum subulatum var. *subulatum*	Annual Saltmarsh Aster	S2S3	Stony Beach (25)	10230	E	1990-09-17
Symphyotrichum tenuifolium var. *tenuifolium*	Perennial Saltmarsh Aster	S2	Stony Beach (25)	16685	B	2021-09-29

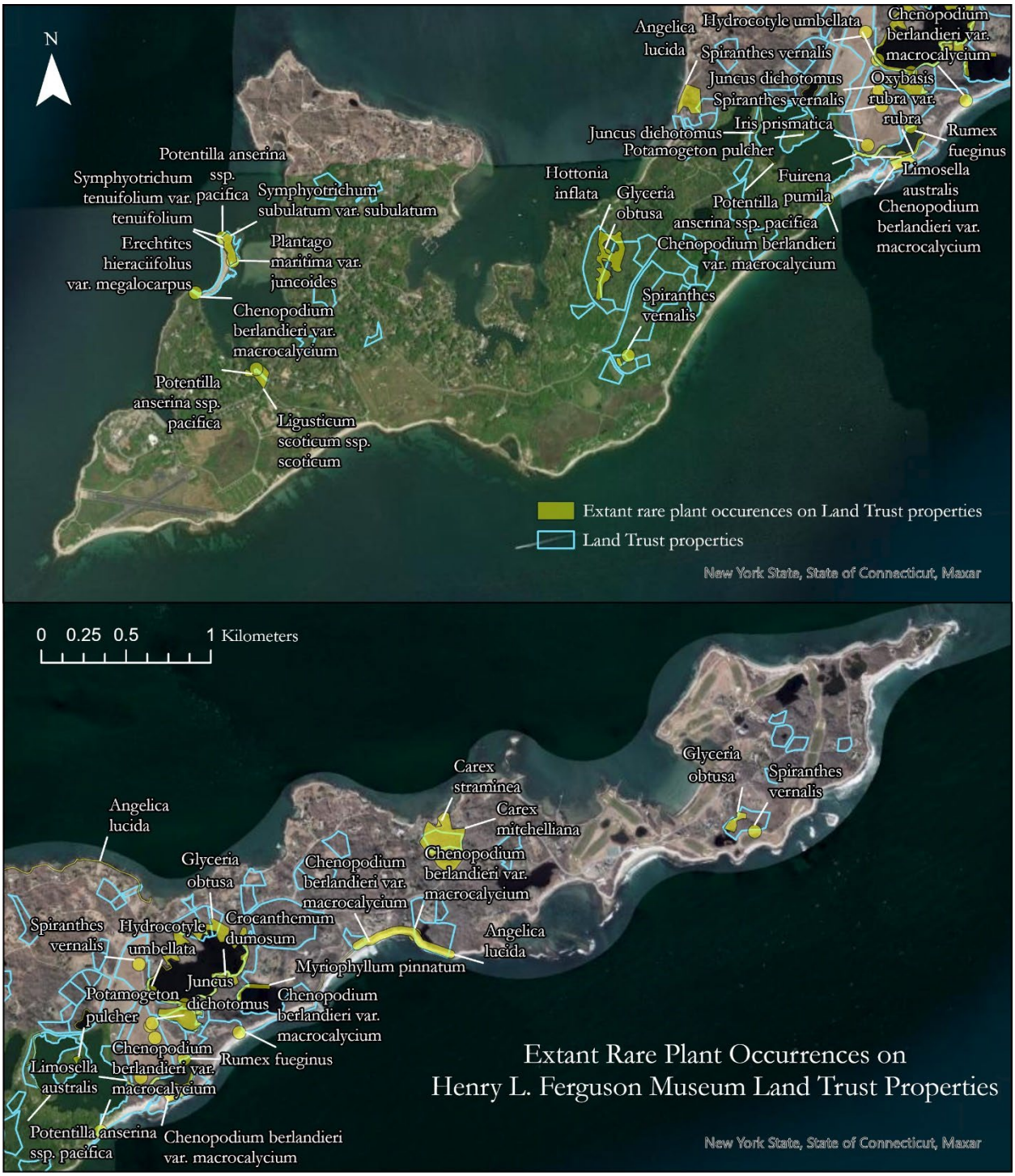

Figure 25. Rare plant occurrences on Fishers Island.

Conservation guides for all NYNYP-tracked rare plants recorded from Fishers Island are available at http://guides.nynhp.org/.

Another category of protection under NY law, Exploitably Vulnerable, covers those native plants that are usually showy and likely to be picked or dug up although they are not rare in the state. They include ferns, orchids, certain shrubs, and certain showy wildflowers. There are 22 plant species in this category that occur on the island (Table 6). These are species not tracked (and therefore not mapped) by NYNHP. Many of these species were found in upland forest or meadow habitats away from the coastline. (*Spiranthes vernalis* Grass-leaved Ladies' Tresses, is the one NYS Threatened species tracked by NYNHP which also appears here on the Exploitably Vulnerable list.)

Table 6. Exploitably Vulnerable plants known from Fishers Island.

Scientific Name	Common Name	S-Rank
Asclepias tuberosa	Butterfly Weed	S4
Athyrium angustum	Northern Lady Fern	S5
Chimaphila maculata	Spotted Wintergreen	S4
Drosera intermedia	Spatulate-leaved Sundew	S4
Dryopteris carthusiana	Spinulose Wood Fern	S5
Dryoptheris intermedia	Evergreen Wood Fern	S5
Ilex laevigata	Smooth Winterberry	S5
Kalmia angustifolia var. *angustifolia*	Sheep Laurel	S5
Lilium superbum	Turk's Cap Lily	S5
Limonium carolinianum	Sea Lavender	S5
Matteuccia struthiopteris var. *pensylvanica*	Ostrich Fern	S5
Morella caroliniensis	Bayberry	S5
Osmunda claytoniana	Interrupted Fern	S5
Osmunda regalis var. *spectabilis*	Royal Fern	S5
Osmundastrum cinnamomeum var. *cinnamomeum*	Cinnamon Fern	S5
Platanthera lacera	Ragged Fringed Orchid	S4
Polystichum acrostichoides	Christmas Fern	S5
Rhododendron periclymenoides	Pinxter Flower	S5
Rhododendron viscosum	Swamp Azalea	S5
Spiranthes vernalis	Grass-leaved Ladies' Tresses	S1S2
Amauropelta noveboracensis	New York Fern	S5
Thelypteris palustris var. *pubescens*	Marsh Fern	S5

Zoology

Building on Past and Ongoing Surveys

As with rare plants, our surveys for rare animals built on a history of prior surveys and opportunistic observations. A key source was Tucker and Horning's (1993) ecological component of the Fishers Island watershed study. They compiled decades of field studies and anecdotes to yield species lists and detailed observation information for all vertebrates and select invertebrates. Their report provided many leads for our surveys.

Fishers Island has an active iNaturalist community, encapsulated by the "Fishers Island Biodiversity" project (www.inaturalist.org/projects/fishers-island-biodiversity) started by seasonal resident Murray Fisher (username: swampchicken). As of this writing this project tallies over 5,000 observations of plants, animals, and fungi, including rare species. While there are limitations to photography for identifying some species, iNaturalist and other online data sources are a phenomenal resource for scientists and nature lovers.

Bats

Bats are among the most imperiled vertebrate species groups (BCI and NABCA 2023). Recent surveys on Long Island have shown that it's a stronghold for the Endangered Northern Long-eared Bat (*Myotis septentrionalis*). The Tricolored Bat (formerly Eastern Pipistrelle, *Perimyotis subflavus*) was recently listed as Threatened. However, neither species has been detected on Fishers Island to date. Tucker and Horning (1993) noted just two bat species occurring on Fishers Island: the Little Brown Bat (*Myotis lucifugus*) and Silver-haired Bat (*Lasionycteris noctivagans*), but acoustic technology was in its infancy at that time. In June and July 2018, the NYS DEC placed acoustic recorders at four locations: three on the west end of the island and one near Middle Farms Pond. Due to personnel changes, they were never able to analyze the call files fully. While this report was in review, we were made aware of these surveys and obtained the call files from DEC. We used Kaleidoscope software to confirm DEC's preliminary impression that most calls were of Big Brown Bat (*Eptesicus fuscus*) and Silver-haired Bat.

Figure 26. Acoustic recorder set in a powerline near Chocomount Road.

In 2021, we surveyed for bats in five locations (Table 7; Figure 29) using Wildlife Acoustics SM4Bat recorders (Figure 26). Detectors were left out for 2-3 nights and sonograms of call files (Figure 27) were identified to species in the off-season using Kaleidoscope software. Between four and seven species were documented (Table 7). Interpreting calls can be challenging, and species cannot always be reliably distinguished from one another. For example, Big Brown Bat and Silver-haired Bat cannot always be separated, and Northern Long-eared Bat and Tricolored Bat are both listed as "possible" based on the quality and frequency of calls obtained. These results must be considered preliminary. Mist-net or other live-capture methods, while much more time consuming and intensive, will be the best way to determine with certainty which bat species occupy Fishers Island.

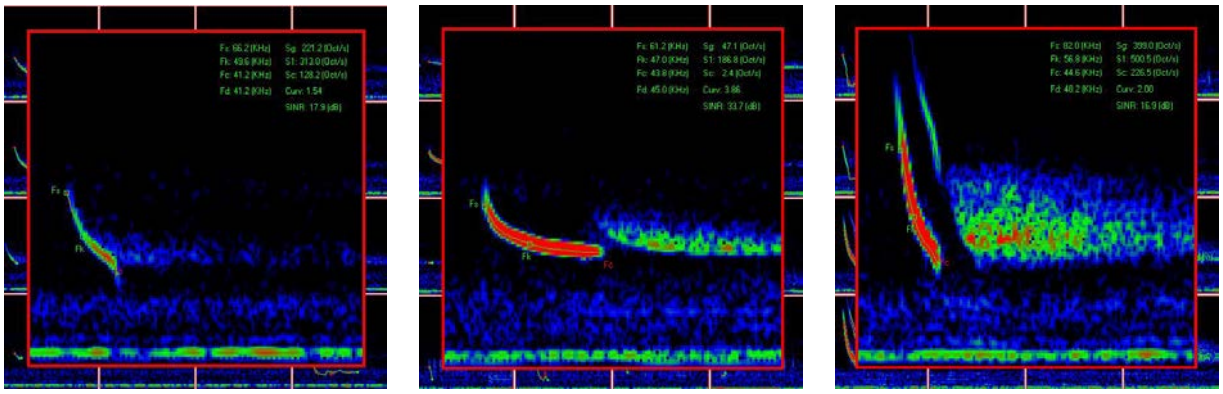

*Figure 27. Sonograms of bat calls from Fishers Island. Left: Little Brown Bat (*Myotis lucifugus*); Middle: Likely Trcolored Bat (*Perimyotis subflavus*); Right: Likely Northern Long-eared Bat (*Myotis septentrionalis*).*

Table 7. Locations, dates, and species detections of acoustic bat surveys in 2021. Big Brown Bat and Silver-haired Bat are lumped because distinguishing them from calls is challenging. Possible detections are noted with a ?.

Site	Dates	Big Brown Bat/Silver-haired Bat	Northern Red Bat	Hoary Bat	Little Brown Bat	Northern Long-eared Bat	Tricolored Bat
Chocomount Rd powerline	8/14-16	X	X	X	X		?
Brickyard wetland	9/13-16	X	X		?	?	?
Middle Farms lawn	9/13-16	X	X	X	X	?	?
Middle Farms Pond	8/14-16	X	X		X		?
Isabella Road powerline	6/15-18	X	?	X			

Small Mammals

The diversity of small mammals on islands is typically low. Tucker and Horning (1993) reported only the White-footed Mouse (*Peromyscus leucopus*) and Norway Rat (*Rattus norvegicus*) as occurring on Fishers Island; no voles, shrews, or other mice were recorded. They referred to Connor's (1971) mention of Meadow Vole (*Microtus pennsylvanicus*) and Short-tailed Shrew (*Blarina brevicauda*) as occurring on the island but could not confirm either species in their surveys.

Our interests in trapping small mammals on Fishers were twofold. First, as we did on Plum Island (Schlesinger et al. 2016), we wished to investigate the possibility that mice on Fishers were a distinct subspecies, as is the case on Martha's Vineyard and Monomoy Island. In addition, Meadow Voles from Great Gull Island and Little Gull Island were classified as a distinct subspecies, but are now considered extinct. We intended to see if any mice and voles captured were genetically distinct from mainland populations. Second, we wished to contribute to the ongoing New York Mammal Survey (NYMS; www.nymammals.org), a project NYNHP is involved in to document the distribution and status of all the state's terrestrial and freshwater mammals. A full survey of the small mammals of Fishers was beyond the scope of this project.

*Figure 28. White-footed Mouse (*Peromyscus leucopus*).*

We used an adapted NYMS protocol in two locations in September 2021: Middle Farms grassland (Parcel 35b) and Brickyard Woods (Parcel 4). With help from Adam Murray's class at Fishers Island School, we set 20 Sherman live traps and 10 pitfall bucket traps at Middle Farms and conducted a reduced effort at Brickyard. We checked traps daily for 4 days. For animals caught in traps, we identified them to the lowest taxonomic level possible, photographed them, and took tissue samples for genetic analysis.

Only mice were caught, and only in Sherman traps. We sent tissue samples to the Whipps genetic lab at SUNY ESF, where their analysis confirmed the mice were white-footed mice as opposed to the closely related deer mouse (*P. maniculatus*). There was no evidence that mice from Fishers Island were genetically different from mice from the mainland.

Figure 29. Locations for zoological sampling in 2021-2022. This is not an exhaustive map of all locations surveyed.

Birds

While birds were not a primary focus of our inventory work, NYNHP is coordinating New York's third Breeding Bird Atlas (BBA; https://ebird.org/atlasny) and at the start of the project there were few atlas records for the island. Thus, we conducted some atlas surveys in 2021 and 2022 and surveyed for nightjars, a group of particular concern.

We took advantage of an offer by Julie Hart, NY Breeding Bird Atlas III Coordinator, and Daniel Schlaepfer, to spend a week conducting BBA surveys of the island in June 2022. They completed 48 "checklists" (a checklist is eBird's term for a stationary, traveling, or incidental bird survey) ranging from 1 – 39 species, for a total of 83 species. Many of these were on Land Trust properties, though they did not limit themselves to those parcels. Their full eBird trip report is here: https://ebird.org/tripreport/64668.

Highlights were a fledgling Common Eider (*Somateria mollissima*; Figure 30) and a probable breeding Worm-eating Warbler (*Helmitheros vermivorum*). Common Eiders, the largest sea ducks in the Northern Hemisphere, have been confirmed to breed in New York State only on Fishers and Plum islands (Schlesinger et al. 2016).

*Figure 30. Common Eiders (*Somateria mollissima*) with fledgling, confirming breeding, just off Fishers Island in 2022. Photo by Daniel Schlaepfer.*

Incredibly high numbers of Gray Catbird (*Dumetella carolinensis*), House Wren (*Troglodytes aedon*), Yellow Warbler (*Setophaga petechia*), Common Yellowthroat (*Geothlypis trichas*), Eastern Towhee (*Pipilo erythrophthalmus*), Great-crested Flycatcher (*Myiarchus crinitus*), and Osprey (*Pandion haliaetus*) were encountered. Rarer species found at only a single location include Rose-breasted Grosbeak (*Pheucticus ludovicianus*), Eastern Wood-Pewee (*Contopus virens*), Worm-eating Warbler, Brown Thrasher (*Toxostoma rufum*), American Black Duck (*Anas rubripes*), Wood Duck (*Aix sponsa*), Snowy Egret (*Egretta thula*), Cooper's Hawk (*Accipiter cooperii*), Bald Eagle (*Haliaeetus leucocephalus*), American Woodcock (*Scolopax minor*), Turkey Vulture (*Cathartes aura*), Barred Owl (*Strix varia*), Common Raven (*Corvus corax*), Red-breasted Nuthatch (*Sitta canadensis*), Blue-winged Warbler (*Vermivora cyanoptera*), Chestnut-sided Warbler (*Setophaga pensylvanica*), and Yellow-billed Cuckoo (*Coccyzus americanus*). Missing were raptors, a lot of warblers, grosbeaks and tanagers, buntings, and Hairy Woodpecker (*Dryobates villosus*). Both Rich Ring and Matt Schlesinger confirmed Virginia Rail (*Rallus limicola*) fledglings off Middle Farms Road.

The Eastern Whip-poor-will (*Antrostomus vociferus*) has never been confirmed breeding on the island (Tucker and Horning 1993) but was recorded in numerous locations in midsummer as recently as the 1990s (eBird). It is of regional concern due to documented declines, tied mainly to loss of early successional habitat and decline in insect prey (Spiller et al. 2022). We conducted the NYS DEC and NY BBA III nightjar survey protocol (https://ebird.org/atlasny/news/help-monitor-nightjars) in 2021 to survey for whip-poor-wills and other nocturnal birds using a standard protocol. In brief, this survey involves routes of 10 points spaced one mile apart at which observers

listen just after sunset and again after moonrise for 6 minutes each during predetermined date windows.

We conducted nightjar surveys on May 24 and June 17, 2021. The eight stations we could fit on Fishers were adjacent to Land Trust properties whenever possible (Figure 29). We detected Barred Owls during these surveys but no other nocturnal birds.

Three Element Occurrences (EOs) of Heritage-tracked rare birds are present on Fishers Island: Piping Plover (*Charadrius melodus*), Least Tern (*Sternula antillarum*), and Common Tern (*Sterna hirundo*) (Figure 31). The NYS Department of Environmental Conservation conducts regular surveys of these "colonial waterbirds" throughout Long Island, so we did not attempt to update these occurrences as part of this project.

Freshwater Turtles

Several species of freshwater turtle are known to inhabit Fishers Island, including common species such as the Painted Turtle (*Chrysemys picta*; S5) and Common Snapping Turtle (*Chelydra serpentina*; S4S5), as well as several species of conservation concern: the Spotted Turtle (*Clemmys guttata*; S3, Special Concern), Diamond-backed Terrapin (*Malaclemys terrapin*; S3), and Eastern Box Turtle (*Terrapene carolina*; S3, Special Concern) (Tucker and Horning 1993). Additionally, the Common Musk Turtle (*Sternotherus odoratus*; S4) has been reported from Middle Farms Pond and a non-native Red-eared Slider (*Trachemys scripta elegans*) was reported during the NYS Herp Atlas ((New York State Department Environmental Conservation 2014). Wood Turtle (*Glyptemys insculpta*) is listed as occurring on Fishers Island in a report on the Navy property (NUWCDIV Newport (Naval Undersea Warfare Center) 1997, Tetra Tech, Inc. 2017) but the record is undocumented and seems unlikely given the species' absence from Long Island (Gibbs et al. 2007) and lack of suitable stream habitat on Fishers.

We focused our surveys with two targets in mind: 1) confirming the continued persistence of the Spotted Turtle on Fishers Island, a species that is declining in New York and across its range (New York State Department of Environmental Conservation 2013, Willey et al. 2022) and 2) ascertaining the presence of the NYS endangered Eastern Mud Turtle on Fishers Island. The Eastern Mud Turtle has never been reported on Fishers Island, but it occurs on eastern Long Island with extant populations in the Peconic Bay. To target these two species, we trapped at selected wetlands (pond edges, shrub swamps, shallow wetlands with emergent vegetation, and brackish ponds) in nine locations (Figure 29) using collapsible hoop nets with a 12-inch hoop diameter (TR-503, Promar, California, USA) baited with canned sardines (Chaloux et al. 2010, Spotted Turtle Working Group 2019). Traps (n = 33) were set in June for 5 days and in checked daily (Table 8). This time period corresponds to the active season for Spotted Turtles before they enter summer aestivation (dormancy; Spotted Turtle Working Group 2019), as well as when surveys for Eastern Mud Turtles have been successful on Long Island (Meyer 1988, Cook et al. 2010). We conducted additional trapping (n = 12 traps) in September 2022 targeted at ascertaining the presence of the Common Musk Turtle in Middle Farms Pond. This trapping followed the same procedure as the June trapping session (Table 8).

Figure 31. Rare animals of Fishers Island. Does not include many species of rare moths.

Table 8. Turtle trap locations, dates, and trapping effort. Traps = number of traps set. Trap Nights = number of nights trapping multiplied by the number of traps (e.g., 4 nights of trapping using 5 traps yields 20 trap nights).

Location	Parcel	Date Start	Date End	Traps	Trap Nights
Brickyard Wetland	26b	12-Jun-22	17-Jun-22	10	40
Golf Course Pond	13	12-Jun-22	17-Jun-22	5	20
Island Pond Channel	20	12-Jun-22	17-Jun-22	5	20
Middle Farms Ponds South	11	12-Jun-22	17-Jun-22	2	8
Middle Farms Ponds Wetland	9	12-Jun-22	17-Jun-22	8	32
Wilderness Point	*Private*	12-Jun-22	17-Jun-22	3	12
North End of Island Pond	32	25-Sep-22	27-Sep-22	2	2
Middle Farms Ponds East	23	25-Sep-22	27-Sep-22	4	4
Middle Farms Ponds West	36b	25-Sep-22	27-Sep-22	6	6
			Total	45	144

We documented 3 species of turtle during our trapping surveys (Painted Turtle, Common Snapping Turtle, and Spotted Turtle). Painted Turtles (Figure 32) dominated our captures and documented this species in all surveyed wetlands except the brackish channel connecting Island Pond and Beach Pond. While we selected a trap size that would exclude most adult Common Snapping Turtles, our traps detected several juveniles of this species in Golf Course Pond (Figure 32). We captured Spotted Turtles at Brickyard Wetland (4 individuals) and Wilderness Point (1 individual), where a road-killed individual was also observed in 2021. While we did not trap any Diamondback Terrapins, we observed several in Island Pond near the oyster farming operation during our June survey.

*Figure 32. The catch. (Left) Young Common Snapping Turtle (*Chelydra serpentina*) stacked with two Painted Turtles (*Chrysemys picta*); (Right top) A trap with many Painted Turtles; (Right bottom) A Painted Turtle portrait.*

The Spotted Turtle is a species of Special Concern in New York and suffering from range-wide declines (New York State Department of Environmental Conservation 2013, Spotted Turtle Working Group 2019). The presence of Spotted Turtles on Fishers Island was a welcome finding (Figure 33). This species was previously reported to be extremely rare on the island and possibly even extirpated in the early 1990s (Tucker and Horning 1993). We captured one juvenile at Wilderness Point, and the other four (three adult females and one adult male) were found in the Brickyard Wetland. All captured Spotted Turtles were marked with a unique notching code on the shell. The roadkill observed in 2021 and the juvenile we captured in 2022 suggests a breeding population exists at Wilderness Point. The presence of three adult females in the Brickyard wetland suggests a breeding population may exist there as well. These adult turtles had 8-10 annuli (akin to growth rings on trees), suggesting successful reproduction occurred as recently as 2015 at this location. Intensive trapping efforts would be necessary to generate a statistically valid estimate of population size at each wetland and additional trapping in similar habitats may reveal additional populations (see Future Inventory, Monitoring, and Research section).

*Figure 33. Spotted Turtles (*Clemmys guttata*) captured at Brickyard Wetland.*

We did not detect Eastern Box Turtles, Eastern Mud Turtles, Common Musk Turtles, or Red-eared Sliders. Like Spotted Turtles, Eastern Box Turtles are declining throughout the northeast (Erb and Roberts 2023). This species is primarily terrestrial (although often found near water) and would not be captured during our aquatic trapping. Tucker and Horning (1993) reported this species was rare on the island, having declined since the 1960's. While the occasional individual is reported (P. Rafferty, personal communication), it remains unclear if a breeding population of Eastern Box Turtles is still present on Fishers Island, as this species can live for decades, and lone individuals can persist on the landscape after viable populations have collapsed (Nichols 1939, Lovich et al. 2018). Similarly, the status of the Common Musk Turtle is unclear. We did not capture any Musk Turtles during 50 trap nights in Middle Farms Pond, the only location they have been reported on the island (Tucker and Horning 1993). The lack of Eastern Mud Turtle captures was not surprising, as this endangered species persists at just a few localities on Long Island and has never been reported from Fishers Island and its presence would have been noteworthy. We were, however, pleased not TO

detect any Red-eared Sliders, a species commonly released from captivity and labeled one of the worst invasive species on the planet (Invasive Species Specialist Group (ISSG) 2013). Native to the Mississippi River drainage, established populations of Red-eared Sliders exist on Long Island and in Connecticut, but are very rare on Fishers Island, where residents are ostensibly responsible pet owners.

Finally, we encountered several non-target species while turtle trapping. We captured numerous Green Frogs (*Rana* [= *Lithobates*] *clamitans*, S5) and American Bullfrogs (*Rana* [= *Lithobates*] *catesbeiana,* S5), including tadpoles. Green Frogs were widely distributed, while Bullfrogs were most numerous at the North End of Island Pond trapping location. Both species are native to New York and are an expected component of the herpetofauna community on Fishers Island (Tucker and Horning 1993, New York State Department Environmental Conservation 2014). We also captured three species of fish and one crab: the Pumpkinseed (*Lepomis gibbosus,* S5), Largemouth Bass (*Micropterus salmoides,* S5), Golden Shiner (*Notemigonus crysoleucas,* S5) and invasive European Green Crab (*Carcinus maenas*). All three fish are listed as occurring on Fishers Island by Tucker and Horning (1993). The crabs were from the Island Pond Channel. This species has been reported from several of the island's inlets on iNaturalist.

*Figure 34. American Bullfrogs (*Rana catesbeiana*; left) captured in a turtle trap and (center) keeping an eye on our activities. (Right): largemouth bass (*Micropterus salmoides*) captured in a turtle trap.*

Snakes and Salamanders

Fishers Island supports a depauperate snake and salamander community relative to Long Island and mainland Connecticut (Klemens 1993, Tucker and Horning 1993, New York State Department Environmental Conservation 2014). However, many species of herpetofauna are hard to detect and without systematic and targeted sampling these species may go unnoticed (Durso et al. 2011). After the first survey summer of 2021, we decided to implement a systematic artificial cover object (ACO) survey in suitable habitats on Museum properties to better target snake and salamander diversity. Artificial cover objects are designed to simulate natural refugia (e.g., coarse woody debris, rocks, or other debris) used by snakes and salamanders (Grant et al. 1992). This approach can assist in a targeted sampling effort in specific areas, minimizes observer bias, and limits damage to natural

refugia (Houze Jr. and Chandler 2002). Over the winter of 2021, we conducted a literature review and considered logistics for a herpetofauna ACO survey. Suitable habitats were identified using aerial imagery and final transect placement was determined in the field. We targeted moist forest habitat, adjacent wetlands, vernal pools, and edges of ponds for salamanders and forest-edges and open field habitats for snakes (Figure 35).

Artificial cover objects were deployed in March 2022 as a collaborative effort that included NYNHP staff, Ferguson Museum staff, Fishers Island School students, and others. Salamander ACOs consisted of 2-in x 1-ft x 1-ft Douglas Fir boards. Fir was chosen for the ACO material as other materials, such as cedar or plywood, may be less preferred by salamanders, and 2-in fir boards can provide more thermal stability than other types of wood and thicknesses (Hesed 2012). Snake ACOs consisted of ½-in x 4-ft x 4-ft fir plywood boards. Jack Schneider (Stewardship Coordinator, Land Trust, The Henry L. Ferguson Museum), Adam Murray (Ag. Tech. Teacher, Fishers Island School), and students from Fishers Island School graciously volunteered their time to cut the lumber into the specified dimensions and assisted with transect placement. In all, 120 ACOs were set out at 12 different sites (Table 9). Each site had a transect of 10 ACOs set approximately 10 meters apart. NYNHP staff checked the coverboards during visits to Fishers Island. These visits were spaced approximately 1 month apart from April through October 2022. More frequent surveys have the potential to reduce use by our target groups (Hesed 2012). During each survey, we checked under the coverboards and recorded the species and number of individuals observed.

Figure 35. Snake cover board.

Table 9. Locations of the twelve artificial cover object survey transects, along with the Land Trust parcel number and NYNHP ecological community.

Group	Location	Parcel	Ecological Community
Salamander	Betty Matthiessen	2	Coastal oak-beech forest, Coastal oak-hickory forest
	Brickyard Pond	4	Red maple-blackgum forest, Red maple-blackgum forest (fringe), Coastal oak-hickory forest
	Clay Pit	E-08a	Red maple-blackgum forest, Successional southern hardwoods
	Golf Course	13	Coastal oak-hickory forest
	Isabella Beach	E-08b	Red maple-blackgum forest (fringe)
	Middle Farms	11	Coastal oak-hickory forest, Red maple-blackgum forest (fringe)
Snake	Brickyard Pond	4, 36b	Coastal oak-hickory forest

Group	Location	Parcel	Ecological Community
	Chocomount Cove	CC1, CC2	Successional old field
	Isabella Field	53a, 53b	Successional old field, Cropland/Field crop/Mowed Lawn
	Isabella Hill	54	Successional old field/Successional shrubland
	Middle Farms	35b	Successional northern sandplain grassland
	Penni's Path	20	Successional northern sandplain grassland

The Eastern Red-backed Salamander (*Plethodon cinereus*, S5) was the most common salamander detected during cover board surveys. We detected this species 78 times at 9 transects (75%). The absence of this species from the Penni's Path, Middle Farms, and Chocomount Cove snake transects was expected, as the Eastern Red-backed Salamander is a woodland species, and the three transects without Eastern Red-backed Salamander observations were all grasslands. We detected both the striped and unstriped ("leadback") morph of this species (Figure 36), and many additional individuals were observed under logs. No additional salamander species were observed under cover boards.

*Figure 36. (Left) Unstriped ("leadback") and (Right) striped Eastern Red-backed Salamanders (*Plethodon cinereus*) found under cover boards.*

In addition to Red-backed Salamanders, we detected 2 Spotted Salamanders (*Ambystoma maculatum*, S5; Figure 37) under logs around Brickyard Wetland. This species is fossorial and highly cryptic outside its early spring breeding season. It was reported from several locations throughout the island in Tucker and Horning (1993), and museum board member Terry McNamara reportedly saw the species regularly in the early 2000s. However, we failed to detect Four-toed Salamanders (*Hemidactylium scutatum*; S4) via either our ACO surveys or targeted visual surveys. This species was first reported from Fishers Island in 2019 by Terry McNamara. A single Four-toed Salamander was found in suitable habitat at the south end of the Shrub Swamp in Parcel 36b, and a photo voucher was submitted to iNaturalist

*Figure 37. Spotted Salamander (*Ambystoma maculatum*).*

(https://www.inaturalist.org/observations/31743003). Mr. McNamara also reportedly found a Four-toed Salamander in 2018 under a log on the northwest side of the peninsula at Betty Matthiessen Wildlife Sanctuary, as well as a Marbled Salamander (*Ambystoma opacum*; S3) "just off Peninsula Road" in 2006, but no photos were taken. It is unclear if the Marbled Salamander represents a single individual perhaps introduced via landscaping material, or an otherwise undiscovered population.

*Figure 38. (Left) Ringneck Snake (*Diadophis punctatus*); (Right) Eastern Ribbonsnake (*Thamnophis sauritus*).*

The Ring-necked Snake (*Diadophis punctatus*; S5; Figure 38) was the most common snake detected during cover board surveys. We detected this species 11 times at 4 transects (33%). The next most common snake was the Eastern Ribbonsnake (*Thamnophis sauritus*, S4; Figure 38), which we detected 4 times at 4 transects (33%), along with several incidental observations. We detected the Racer (*Coluber constrictor*, S4) 2 times at 2 transects (17%) (Figure 40). Interestingly, we did not detect the Common Gartersnake (*Thamnophis sirtalis*, S5) during our cover board surveys, although we observed several incidentally while conducting surveys for other taxa (Figure 39). These four snake taxa represent all known species known to inhabit Fishers Island (Tucker and Horning 1993, NYSDEC 2014). However, a preserved Dekay's Brownsnake or simply Brown Snake (*Storeia dekayi*) sits on a shelf at the museum; its provenance is unknown and the species has not otherwise been recorded on the island.

*Figure 39. Eastern Ribbon Snake (*Thamnophis sauritus*) from Wilderness Point (left) and Common Garter Snake (*T. sirtalis*) from Island Pond Channel (right).*

Figure 40. One of several Racers (Coluber constrictor) detected under an Artificial Cover Object at Isabella Field.

Frogs

We conducted calling surveys for Atlantic Coast Leopard Frog (*Rana* [= *Lithobates*] *kauffeldi*), in April 2022. This recently described species (Feinberg et al. 2014) was formerly known from as close as Long Island's East End and is extant in southern Connecticut (Schlesinger et al. 2018) but would have been an unlikely discovery on Fishers Island because of the biogeography of New York's islands and the history of glaciation in the area (see Schlesinger et al. 2012, also Klemens et al. 2021). In addition, no records exist for leopard frogs on Fishers Island.

We surveyed at seemingly suitable wetlands and ponds (Figure 29), primarily targeting Land Trust properties after dark on April 20, 2022, with the help of Lydia Doucette, Eliza Schlesinger, and Flora Schlesinger. The only frogs we heard were Spring Peepers (*Pseudacris crucifer*). These tiny but loud beasts are notorious for drowning out other sounds. However, given that that leopard frogs call during the day for a portion of the breeding season when peepers are quiet, and there is no other evidence of leopard frogs, we do not believe they occur on Fishers Island.

Insect Pollinators

We surveyed for pollinators by focusing on specific habitats or opportunistically when floral resources were present and when survey conditions were met. Pollinator surveys should be conducted when environmental conditions are warm (>60°F), sunny (casting a shadow), and calm (<8 mph). We used visual surveys and insect nets to confirm individuals to species. Two timed surveys were completed primarily to assess the bumble bee (*Bombus*) community. Bumble bees are an accessible group to recognize in the field and often do not require additional time in the lab under a microscope. We documented additional pollinators that we could confidently identify to species while in flight, visiting flowers, or in hand after netting (Figure 41).

Bumble bees in particular are important pollinators and have experienced significant declines (Cameron et al. 2011). Five species of bumble bees were observed on Fishers Island including the Two-spotted Bumble Bee (*Bombus bimaculatus*; S4 – Apparently Secure), Brown-belted Bumble Bee (*B. griseocollis*; S4; Figure 41), Common Eastern Bumble Bee (*B. impatiens*; S5 - Secure), Confusing Bumble Bee (*B. perplexus*; S3 - Vulnerable), and Half-black Bumble Bee (*B. vagans*; S5). We expect additional species are present on Fishers Island. Most of the species observed are relatively common and widespread (Wood et al. 2019). One species, the Confusing Bumble Bee, appears to be stable in most of its range (Hatfield et al. 2014); however, it is considered Vulnerable and is a less common

species overall (Novotny et al. 2021, White et al. 2022). This species can be difficult to identify in the field as it shares many characteristics with the Half-black and Sanderson's Bumble Bee (*B. sandersoni*). Bumble bees are considered generalists; however, some groups have floral preferences. For example, long-tongued bumble bees prefer flowers with longer corollas, whereas short-tongued bumble bees visit more open, accessible flowers. Wood et al. (2019) found that bumble bees that utilize fewer plant species for floral resources have experienced decline. Interestingly, the Confusing Bumble Bee appears to utilize fewer flowering species than other bumble bees (Pierce 2018).

*Figure 41. Brown-belted Bumble Bee (*Bombus griseocollis*) seen in a vial for confirmation (left) and visiting Butterfly Milkweed (*Asclepias tuberosa*; right) in the open field off Isabella Road (Parcel 53 a-c).*

Other common pollinators were observed in addition to the bumble bees listed. The Eastern Carpenter Bee (*Xylocopa virginica*) is a common species in the eastern U.S. and was common on Fishers Island. Also present on the island is the Tiger Bee Fly (*Xenox tigrinus*) which preys on Eastern Carpenter Bee nests. The female Tiger Bee Fly will lay an egg at the entrance of a Carpenter Bee nest and the larvae will make its way in to feed on the pollen and the Carpenter Bee larva. This fascinating relationship is a good signal of a healthy environment and may help regulate the Carpenter Bee populations. Our surveys did not detect this parasitoid; however, multiple iNaturalist observations documented its presence. This species is not yet ranked in New York but has been ranked as Vulnerable (S3) in Canada (NatureServe 2023b).

While the Monarch butterfly (*Danaus plexippus*; S5) is considered secure in New York, the global population has experienced drastic declines. Threats include climatic factors, habitat loss, disease, and agricultural insecticide use (Thogmartin et al. 2017). In particular, the loss of the Monarch's host plant, milkweed (*Asclepias* spp.), is a major contributor to its decline (Pleasants and Oberhauser 2012). Monarchs appeared to be common on the island during our surveys (Figure 42). Fishers Island may serve as an important breeding or resting spot for the eastern migratory population, especially in areas where milkweed is abundant. Another interesting butterfly observed was the Red-banded Hairstreak (*Calycopis cecrops*; SU – Unrankable). New York is at the northern portion of the range for this species, and it becomes less common in the periphery of its range (Brock and Kaufman 2003). However, it appears that the Red-banded Hairstreak may be expanding its range

northward (New York Natural Heritage Program 2023b). There may be a healthy population on Fishers Island since its host plants (e.g., sumacs and oaks) are present.

*Figure 42. Monarch butterfly (*Danaus plexippus*) nectaring on Butterfly Milkweed (*Asclepias tuberosa*) in open field off Isabella Road (parcel 53 a-c).*

Other rare species that our surveys did not detect but ones that iNaturalist Community Scientists did document include: the Broad-handed Leafcutter Bee (*Megachile latimanus*; S3), the possibly rare Sumac Cellophane Bee (*Colletes nudas*), and Sumac Cellophane-cuckoo Bee (*Epeolus lectoides*). The amount of sumac present on Fishers Island may provide these specialist bees with the host plants and habitat they need to thrive.

Overall, our surveys yielded 28 pollinator species, including bees, butterflies, wasps, and beetles (Table 10). This is far from a comprehensive list. Many pollinators were present on the island but not documented during our surveys due to the scope of the project. Voucher specimens of many pollinators are needed to confirm an individual to species. Of the pollinators we observed, 43% were butterflies and skippers (Lepidoptera), 39% were bees and wasps (Hymenoptera), 11% were flies (Diptera), and 7% were beetles (Coleoptera). While bees are typically thought of as the most important pollinators, non-bee pollinators contribute similar levels of pollination services and can make up 25-50% of flower visits (Rader et al. 2016). Supporting a diverse pollinator community will contribute to ecosystem resilience which is becoming increasingly important (Senapathi et al. 2015).

Table 10. Pollinator observations during the 2021-2022 field seasons.

Scientific Name	Common Name	Locations observed (Sector)	Parcel	May	Jun	Jul	Aug	Sep	Oct
Agapostemon virescens	Bicolored Striped Sweat Bee	Brickyards South	53a-c			X			
Atalopedes campestris	Sachem	Isolated	43					X	
Bombus bimaculatus	Two-spotted Bumble Bee	Betty Matthiessen & Island Pond Shore	2			X			

Scientific Name	Common Name	Locations observed (Sector)	Parcel	May	Jun	Jul	Aug	Sep	Oct
Bombus griseocollis	Brown-belted Bumble Bee	Betty Matthiessen & Island Pond Shore	2			X			
		Brickyards South	53a-c			X			
Bombus impatiens	Common Eastern Bumble Bee	Middle Farms & Treasure Pond	5					X	
		Isolated	43					X	
		Middle Farms South	35b			X			
		Betty Matthiessen & Island Pond Shore	2			X			
		Brickyards South	53a-c			X			
Bombus perplexus	Confusing Bumble Bee	Brickyards South	53a-c			X			
Bombus vagans	Half-black Bumble Bee	Isolated	43					X	
Calycopis cecrops	Red-banded Hairstreak	Betty Matthiessen & Island Pond Shore	2					X	
Celastrina ladon	Spring Azure	Brickyards South	53a-c			X			
Cercyonis pegala	Common Wood-nymph	Middle Farms South	35b					X	
		Brickyards South	53a-c			X			
Danaus plexippus	Monarch	Middle Farms South	20			X		X	
		Middle Farms South	35b			X			
		Betty Matthiessen & Island Pond Shore	2			X			
		Brickyards South	53a-c			X			
		Middle Farms South	20			X			
Epargyreus clarus	Silver-spotted Skipper	Middle Farms South	20					X	
Eremnophila aureonotata	Gold-marked Thread-waisted Wasp	Middle Farms South	35b					X	
Everes comyntas	Eastern Tailed-Blue	Brickyards South	53a-c			X			
Halictus confusus	Confusing Furrow Bee	Brickyards South	53a-c			X			

Scientific Name	Common Name	Locations observed (Sector)	Parcel	May	Jun	Jul	Aug	Sep	Oct
Hedychrum sp.	Cuckoo Wasp	Brickyards South	53a-c			X			
Megacyllene robiniae	Locust Borer	Isolated	43					X	
Megisto cymela	Little Wood Satyr	Brickyards South	53a-c			X			
		na	E-08b	X					
		Middle Farms South	20			X			
Nymphalis antiopa	Mourning Cloak	Brickyards North	4						X
Polites mystic	Long Dash	Middle Farms South	20		X				
Sphaerophoria sp.	Globtail Syrphid Fly	Middle Farms South	20			X			
Sphex ichneumoneus	Great Golden Digger Wasp	Middle Farms South	35b					X	
Tetraopes tetrophthalmus	Milkweed Beetle	Brickyards South	53a-c			X			
Toxomerus germinatus	Eastern Calligrapher	Betty Matthiessen & Island Pond Shore	2			X			
Toxomerus marginatus	Margined Calligrapher	Brickyards South	53a-c			X			
Vanessa atalanta	Red Admiral	Middle Farms & Treasure Pond	23			X			
		Brickyards South	53a-c			X			
Vanessa cardui	Painted Lady	Middle Farms South	35b			X			
Xylocopa virginica	Eastern Carpenter Bee	Elizabeth Field	na					X	

Dragonflies and Damselflies

We completed dragonfly and damselfly (odonate) surveys on Fishers Island during the 2021-2022 breeding season. We targeted potential adult breeding habitat on the island, including freshwater and brackish water communities. We performed visual searches to identify odonates to species level when possible. To assist with species identification, we used insect nets to capture individuals. After capturing an individual, we would carefully

*Figure 43. Female Seaside Dragonlet (*Erythrodiplax berenice*) observed near salt marsh breeding habitat (parcel 20).*

photograph and then release individuals in the same location and habitat in which they were captured. As needed, we examined physical characters with a hand lens to aid identification. In addition to these targeted surveys, odonate species were noted when foraging in habitats away from breeding grounds. To complement the adult surveys, dragonfly exuviae were opportunistically collected during surveys. Dragonfly exuviae, the last moult of a dragonfly nymph before adulthood, is always exciting to find. The benefits to collecting exuviae instead of larvae or adults include: 1) exuviae are easier to collect than catching flying adults; 2) exuviae presence indicates successful breeding as they are relatively fragile and breakdown in the landscape fairy quickly; and 3) we can potentially verify a species without causing harm to or taking a live specimen.

We confirmed two rare species, Seaside Dragonlet (*Erythrodiplax berenice*; S2; Figure 43) and Rambur's Forktail (*Ischnura ramburii*; S2S3), during our surveys. Seaside Dragonlets were observed at Middle Farms South (parcels 20 and 35b) in 2021 and 2022 and Betty Matthiessen and Island Pond Shore (parcel 2) in 2021. Their suitable breeding habitat, brackish marsh, is present at the Island Pond inlet (Figure 44). The Seaside Dragonlet is known from coastal brackish sites in the southern U.S. and along the east coast and it is the only dragonfly in the U.S. that can breed in saltwater (Paulson 2011). The New York Dragonfly and Damselfly survey documented this species in only 3 counties, Bronx, Nassau, and Suffolk counties (White et al. 2010). Future inventory could include additional surveys in the saltmarsh habitat in July and August to observe adults mating, females ovipositing, or nymphs to confirm the breeding habitat.

Rambur's Forktail was observed in a wetland at the East End (parcel 13) of Fishers Island in September 2021. It has been reported from Staten Island, Brooklyn, Queens, Nassau, and Suffolk counties (White et al. 2010). This species prefers pond, marsh, and sometimes brackish water habitat with grasses and sedges present (Paulson 2011). It's large size, when compared to other forktails, and bright coloration make the Rambur's Forktail relatively easy to identify (Paulson 2011). Water contamination from roadways or adjacent properties may negatively impact this species (New York Natural Heritage Program 2023c). The East End

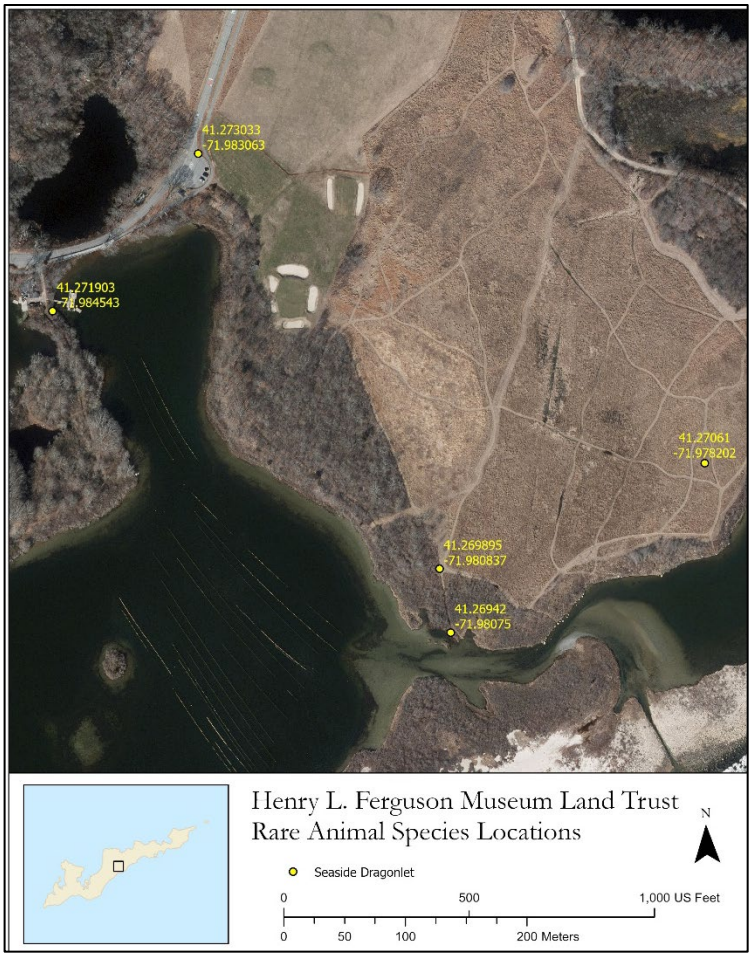

*Figure 44. Seaside Dragonlet (*Erythrodiplax berenice*) locations near Island Pond.*

parcel, also known by the Museum name M&M Harry Cant Wildlife Sanctuary, is surrounded by a large privately owned golf course that may be a source of runoff.

*Figure 45. (left) Rambur's Forktail (*Ischnura ramburii*), parcel 13 wetland and (right) one of the many Common Green Darner (*Anax junius*) dragonflies seen flying over the open field habitat at Middle Farms (parcel 20).*

Overall, we observed 43 individual odonates during our 2021-2022 inventory and were able to identify 74% to species, 23% to genus, and 2% to family. All the exuviae collected were in the Libelluidae family; however, exuviae can be very difficult to identify to genus and species. The exuviae collected have been identified to genus to the best of our ability and are listed in Table 11. None appear to be species of conservation concern. Our surveys documented 18 different species, and an additional 4 genera that couldn't be confirmed to species (Table 11); however, this is not a complete list of odonates that occupy Fishers Island (see Future Inventory, Monitoring, and Research section). In July 2021, we observed what was likely a Needham's Skimmer (*Libellula needhami*; S3) in flight but were unable to confirm it, so future survey effort should be directed toward this species.

Many of the odonate species observed are ubiquitous throughout the state, common in lentic habitats, and are likely breeding in the wetlands present on Fishers Island. For example, Common Green Darners (*Anax junius*; S5) have striking coloration (Figure 45) and are one of the most common dragonflies throughout North America. While it is extremely common, it is no less interesting than some of the rare odonates in New York. Common Green Darners are long-distance migrants, unlike most dragonfly species. A single generation can migrate over 400 miles (Hallworth et al. 2018). Fall swarms of migrating darners can be seen in New York and were observed on Fishers Island in September 2022. High numbers were present along the forest-meadow edge near the Penni's Path Trail resting on shrubs along the mowed field and would dive into Middle Farms Pond field when startled. Fishers Island is likely an important migratory stopover as large migrations of dragonflies typically follow coastlines and other linear features (Russell et al. 2009).

Table 11. Dragonfly and damselfly observations during the 2021-2022 breeding season. Rare species are noted with an asterisk (*) and exuviae are noted with a plus sign (+).

Scientific Name	Common Name	Locations observed (Sector)	NHP Parcel	Jun	Jul	Aug	Sep
Anax junius	Common Green Darner	Middle Farms & Treasure Pond	23	X			
		Middle Farms South	20				X
		Middle Farms South	E-01		X		
		Brickyards North	4		X		
Celithemis elisa	Calico Pennant	Middle Farms South	20		X		

Scientific Name	Common Name	Locations observed (Sector)	NHP Parcel	Jun	Jul	Aug	Sep
Celithemis eponina	Halloween Pennant	Chocomount Cove	CC1	X			
		Middle Farms South	35b		X		
		Brickyards South	53a-c		X		
Celithemis sp.+	Pennant	Middle Farms & Treasure Pond	11	X			
Enallagma civile	Familiar Bluet	Middle Farms South	20		X		
Enallagma geminatum	Skimming Bluet	Middle Farms & Treasure Pond	11	X			
Enallagma signatum	Orange Bluet	Middle Farms South	E-01		X		
Enallagma vesperum	Vesper Bluet	Middle Farms & Treasure Pond	9	X			
Epiaeschna heros	Swamp Darner	Chocomount Cove	CC2				X
Epitheca sp.	Baskettail	Middle Farms Pond	35b		X		
Erythemis simplicicollis	Eastern Pondhawk	Middle Farms & Treasure Pond	23	X	X		
*Erythrodiplax berenice**	Seaside Dragonlet	Middle Farms South	20	X			
		Middle Farms South	35b		X		
		Betty Matthiessen & Island Pond Shore	2		X		
Ischnura posita	Fragile Forktail	Middle Farms & Treasure Pond	23	X			
		Betty Matthiessen & Island Pond Shore	2		X		
*Ischnura ramburii**	Rambur's Forktail	East End	13				X
Lestes sp.	Spreadwing	Middle Farms North	32				X
Libelluidae+	Meadowhawk or Whiteface	Middle Farms & Treasure Pond	23		X		
Libellula incesta	Slaty Skimmer	Chocomount Cove	CC1	X			
Libellula sp.	Skimmer	Middle Farms South	35b		X		
		Betty Matthiessen & Island Pond Shore	2		X		
Nehalennia gracilis	Sphagnum Sprite	Middle Farms & Treasure Pond	23	X			
Pachydiplax longipennis	Blue Dasher	Chocomount Cove	CC1	X			
		Middle Farms & Treasure Pond	23	X			
		Brickyards North	4		X		
Pantala sp.	Glider	Middle Farms Pond	35b		X		
Perithemis tenera	Eastern Amberwing	Chocomount Cove	CC1	X			
		Isolated South Beach	37				X

Scientific Name	Common Name	Locations observed (Sector)	NHP Parcel	Jun	Jul	Aug	Sep
		Middle Farms North	32				X
		Middle Farms South	E-01		X		
Plathemis lydia+	Common Whitetail	East End	13	X			
Sympetrum sp.	Meadowhawk	Brickyards North	4		X		
		Brickyards South	53a-c		X		
Sympetrum sp.+	Meadowhawk	Middle Farms & Treasure Pond	23	X			
Tramea carolina	Carolina Saddlebags	Brickyards North	4		X		
		East End Beach	-		X		
Tramea lacerata	Black Saddlebags	East End Beach	-		X		

*Rare species; +Exuvia

Moths

We surveyed for rare moths using blacklight traps (Figure 46) in four locations (Table 12; Figure 29) from May – October 2022. We chose locations to represent the diversity of ecological communities on Land Trust parcels and none were closer than 2 km from one another. Traps were set within 7 days of the new moon with specimens collected in the morning. We aimed to sample each of the four locations throughout spring and summer and into early fall, but equipment problems precluded this. In some cases weather or other problems resulted in a poor catch. We ended up with 36 trap-nights of surveys. Moths were delivered to Hugh McGuinness of Washington, D.C. for identification. Hugh is an expert lepidopterist formerly from Sag Harbor, NY with whom we have worked for many years. He posted images of most species to iNaturalist as well, especially when he felt second opinions were needed.

We supplemented trapping with opportunistic blacklighting (Figure 46) and diurnal observations of caterpillars, with individuals identified in the field and/or posted to iNaturalist. Two-thousand five-hundred and forty-nine individual specimens were sorted by Hugh McGuinness during this survey, resulting in the identification of 393 unique taxa (Appendix H). Of these, 142 species were micromoths and 251 were macro moths. Several expected species were not encountered during the study, and future lepidopterists should attempt to establish their presence on Fishers Island. A particular surprise was the absence of *Parasa indetermina*, which has been recorded on Fishers several times on iNaturalist.org. The species flies in July, which was the month of our poorest catch due to sampling issues. On Long Island, this species is only currently known from Montauk and Shelter Island. In addition, only one species of *Datana* was recorded during the survey, when we should expect several.

Figure 46. Blacklight trap (left) and Dr. Carmen Greenwood at mercury vapor light (right).

Notably, three species were documented in New York State for the first time, and five species were recorded on Long Island for the first time (Table 13). Twenty-seven other rare species were recorded (Figure 47). The identity and number of individuals encountered by date, plus comments on some species, are shown in Appendix H.

Fourteen species of introduced moths were encountered during the survey (Table 13), none of which were concerningly abundant. The most newsworthy was the capture of several specimens of *Calamotropha paludella*, which has only recently been recognized as occurring in North America. While these are not NY's first records, they indicate that *C. paludella*, which feeds on cattails (*Typha* spp.) is probably already well established and here to stay. There is no indication yet that it will cause harm to cattails.

Table 12. Locations and dates of moth traps. A "-" means a trap was not set during that period or there were equipment failures.

Trap	Locality	Parcel #	Habitats	Latitude	Longitude	May 6	May 25-26	Jun 2-6	Jun 27	Jul 2-8	Jul 28	Aug 20-21	Sep 2	Sep 26	Sep 30	Oct 21
1	Middle Farms Rd	E03	Successional northern sandplains grassland, adjacent to successional shrubland	41.27092	-71.97746	X	X	X	X	X	X	X	X	X	X	X
2	Chocomount Rd.	34	Successional maritime forest	41.27723	-71.97165	X	-	X	X	X	X	X	X	X	-	X
3	Island Pond beach	38	Maritime dunes, adjacent to maritime shrubland and high salt marsh	41.26849	-71.98019	-	-	X	X	X	-	-	X	X	X	X
4	Brickyard Rd.	36b	Coastal oak-hickory forest	41.26336	-72.00021	-	X	-	X	X	X	X	X	X	X	X

Table 13. Notable moth species recorded.

First New York Records

*Elachista aristoteli*ella—previously only known from FL & NJ
Cabera quadrifasciaria—previously occurring as far north as NJ. Another record was documented during June 2022 in Westchester County, NY.
Spodoptera latifascia—this is a tropical species that strays north during summers.

NYNHP Tracked Species

*Citheronia regalis**--In the last 30 years this species has only been observed in Montauk, Shelter Island and Staten Island.
*Sphinx gordius**
Virbia aurantiaca†
*Renia nemoralis**†
Marimatha nigrofimbria
Apamea inordinata
*Apamea lintneri**
*Papaipema duovata**
Dargida rubripennis
Dichagyris acclivis
*Abagrotis benjamini**

NYNHP Watch List Species

*Megalopyge crispata**
*Doryodes spadaria**
*Metaxaglaea semitaria**

Other Rare Species

*Spinitibia hodgesi**—at the northern limit of its range.
*Henricus edwardsiana**‡—uncommon everywhere.
*Argyrotaenia ivana**—Only known from a few locations on LI.
*Pelochrista oraria** Only known from a few locations on LI, although apparently common at Jones Beach and Fishers Island.
*Pelochrista pallidipalpana**—fairly common on LI.
*Peoria gemmatella**—fairly common in sandy habitats and grasslands on LI.
Darapsa versicolor‡—infrequently encountered throughout the state.
*Tacparia zalissaria**‡—encountered in dunes and grasslands on LI.
Metarranthis n. sp. nr *homuraria**‡—this is an undescribed species that is patchily distributed on LI.
*Bleptina inferior**—at the northern limit of its range.
*Catocala muliercula**‡—uncommon everywhere.
*Homorthodes lindseyi**—fairly common on LI.
*Abagrotis magnicupida**—on LI, found mainly in grasslands.

First Long Island Records

Homosetia costisignella
Bondia crescentella
*Epinotia mediovirida*na
Sphinx poecila
"Platypolia" mactata

Introduced Species

Tineola bisseliella
Plutella xylostella
Atteva aurea
Promalactis suzukiella
Calamotropha paludella—recently recognized as introduced in NE US although HM has a specimen from 2008. Currently known only from eastern LI, Block Island, and nearby CT.
Aphomia sociella
Etiella zinckenella
Sclerocona acutella
Ostrinia nubilalis
Paracorsia repandalis
Apamea unanimis
Oligia latruncula
Rhizedra lutosa
Noctua pronuba

* Known in New York only from Long Island
† Consider removing from NYNHP Tracked Species List
‡ Strongly consider adding to NYNHP Tracked Species List

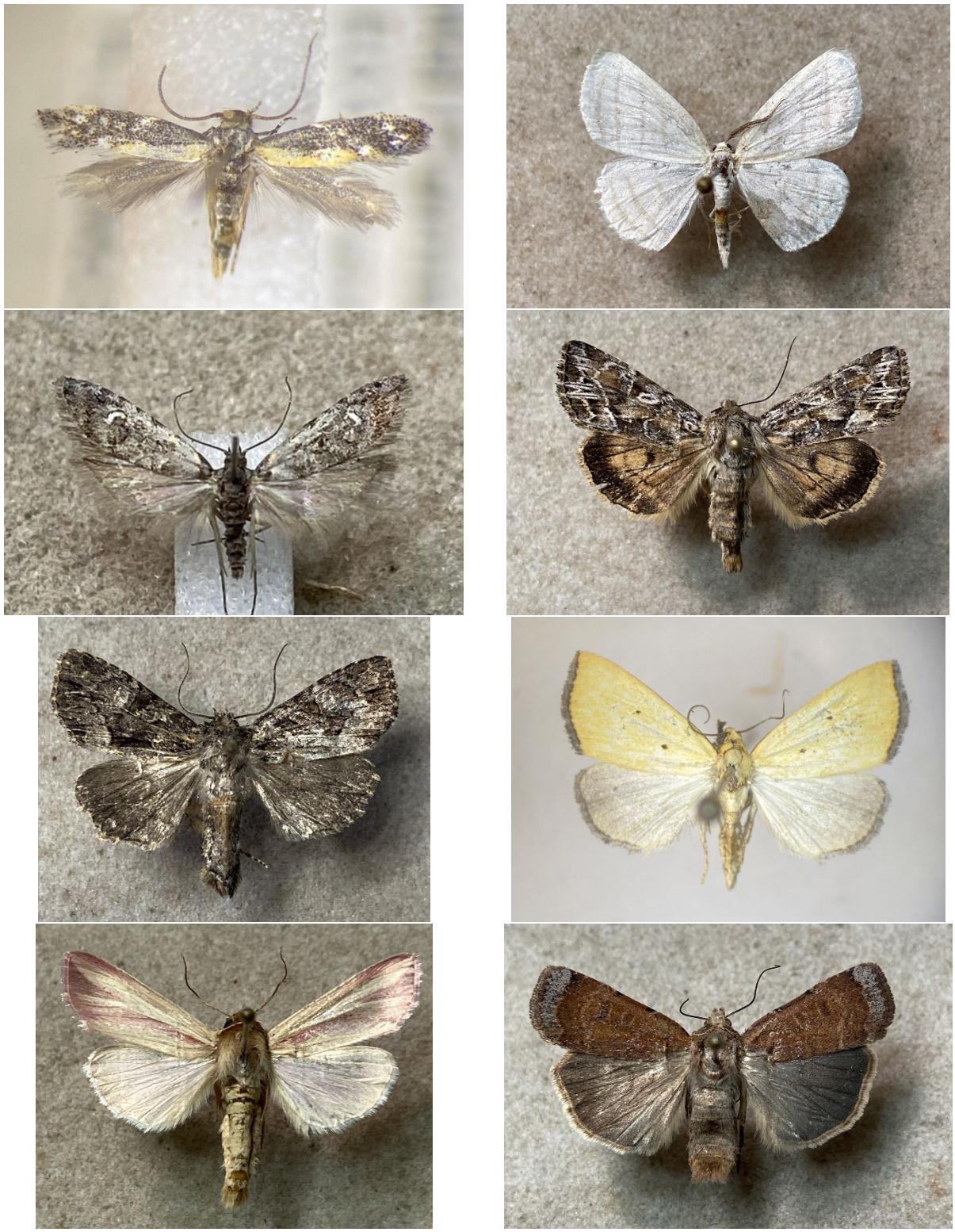

Figure 47. Some rare moths of Fishers Island, clockwise from top left: Elachista aristoteliella, Cabera quadrifasciaria, Apamea inordinata, Marimatha nigrofimbria, Abagrotis benjamini, Dargida rubripennis, "Platypolia" mactata, Bondia crescentella. Photographs by Hugh D. McGuinness.

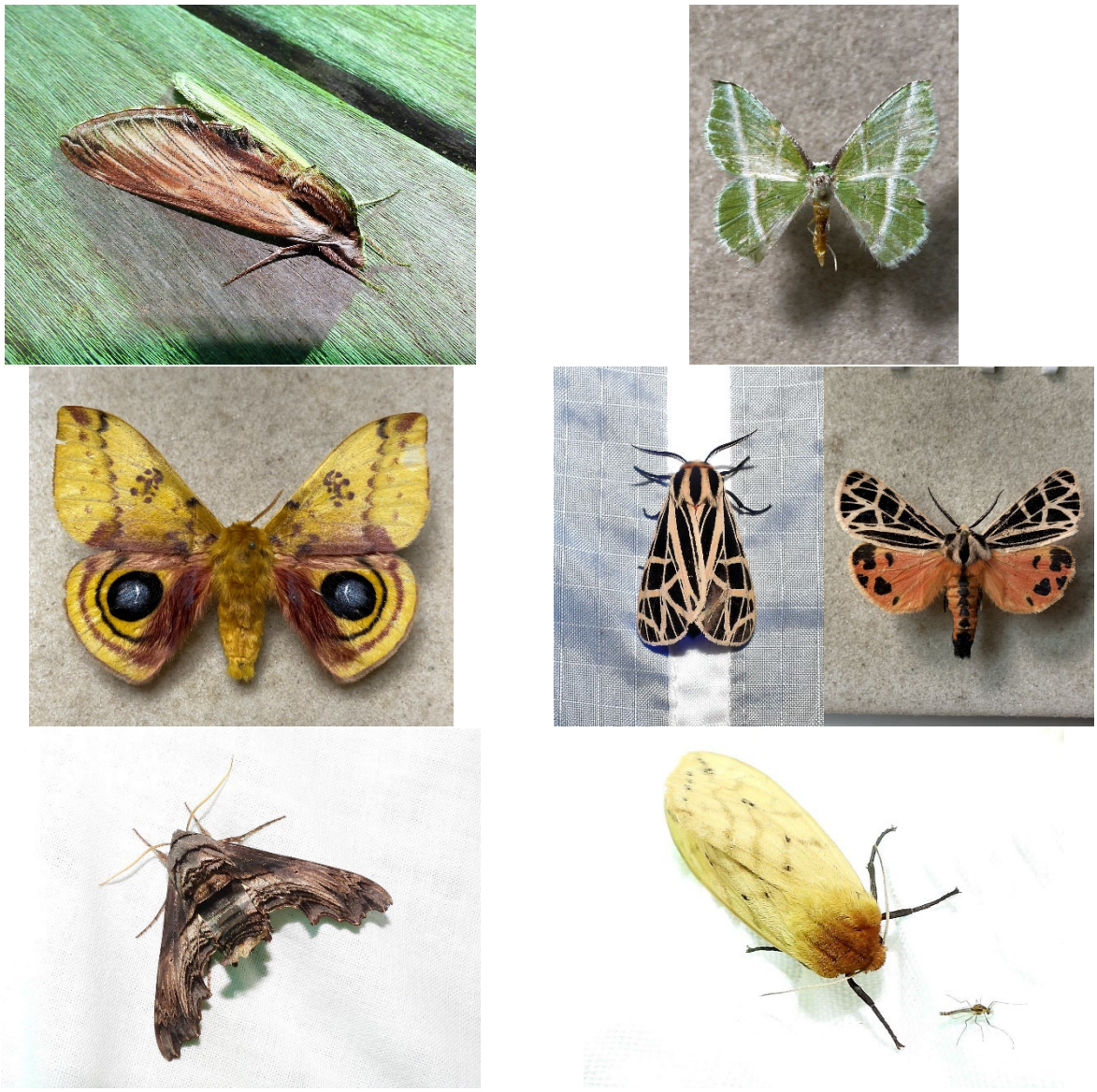

*Figure 48. Some showy moths of Fishers Island, clockwise from top left: Laurel sphinx (*Sphinx kalmiae*), Showy Emerald (*Dichorda iridaria*), Parthenice Tiger Moth (*Apantesis parthenice*), Isabella Tiger Moth (*Pyrrharctia isabella*), Abbott's Sphinx (*Sphecodina abbottii*), Io Moth (*Automeris io*).*

Carrion Beetles

Fishers Island is close geographically to the last remaining native population of the American Burying Beetle (*Nicrophorus americanus*; ABB) in the Northeast. This large carrion beetle, federally listed as Threatened, once occurred throughout the eastern U.S. but declined starting in the mid-20th Century (Sikes and Raithel 2002). It is known currently only from Block Island and a re-introduced population on Nantucket (U.S. Fish and Wildlife Service 2008). We surveyed for ABB on nearby Plum Island in 2015, but did not detect the species there (Schlesinger et al. 2016). To our knowledge, no surveys had been conducted on Fishers Island prior to ours in 2021. We were fortunate to have guidance and assistance from Drs. Carmen Greenwood and Jim Hardin of SUNY

Cobleskill. Dr. Greenwood researched ABB in Oklahoma and is leading an effort to reintroduce them to New York.

Surveying for carrion beetles is disgusting. Bait, the smellier the better (we used dead laboratory rats), is placed in a 3-gallon bucket containing peat substrate that is wired to a tree (Figure 49). Beetles attracted to the bait (from as many as several km away) crawl under the rain cover and drop into the bucket, where they remain in an enchanted state, discouraged from trying to escape by the stink of the rat and the coziness of the peat. We checked buckets daily and left them out for five days.

Figure 49. (Left) Drs. Jim Hardin and Carmen Greenwood attach a carrion beetle trap to a tree. (Right) A trap at par.

In 2021 we surveyed five locations; in 2022 we surveyed three locations (Figure 29). We did not detect ABB, but Fishers Island has a sizable complement of other native carrion beetles. Four species were detected: *Nicrophorus orbicollis*, *N. sayi*, *N. tomentosus*, and *Necrophila americana* (Figure 50). On June 14, 2022, we counted 63 carrion beetles in one bucket!

Other Insects

A complete survey of Fishers Island's insects was beyond the scope of our work, but we incidentally documented other species in our surveys (Table 14). There are many more observed on iNaturalist.

Figure 50. (Top left) Catch of carrion beetles from a single bucket in one day. (Top right). Showing the diagnostic feature to tell Nicrophorus orbicollis *(left) from* N. sayi *(right) – the straight versus curved hind tibia (circled). John's dirty fingers not necessary for ID. (Bottom left) American carrion beetle* (Necrophila americana; *photo by Murray Fischer*). *(Bottom right) Tomentose Burying Beetle (*Nicrophorus tomentosus*).*

Table 14. Other insects encountered during 2021-2022 surveys.

Scientific Name	Common Name	NY Native?
Cicindela repanda	Bronzed Tiger Beetle	Y
Cicindela punctulata	Punctured Tiger Beetle	Y
Dolichovespula maculata	Bald-faced Hornet	Y
Dytiscus sp.	Diving Beetle	Y
Galerita bicolor	False Bombardier Beetle	Y
Halyomorpha halys	Brown Marmorated Stink Bug	N
Harmonia axyridis	Asian Lady Beetle	N
Megacyllene robiniae	Locust Borer	Y
Platydracus maculosus	Brown Rove Beetle	Y
Popillia japonica	Japanese Beetle	N
Tenodera sinensis	Chinese Mantis	N
Vespula vidua	Widow Yellowjacket	Y

Marine Intertidal

We surveyed two intertidal habitats in addition to the marine rocky intertidal community described in the Ecology section. The primary survey target at the tidepool in parcel 38 (Figure 52) survey was the non-native rockpool shrimp *Palaemon elegans*, which was confirmed (Figure 51). The species is native to the Northeast Atlantic. The first documented occurrence in the Northwest Atlantic was in Massachusetts in 2010. It is likely becoming a very abundant shrimp species in New England, but to date there are few records from NY. Other more well-established non-natives included the green algae Dead man's fingers (*Codium fragile)*, which has been present on Long Island since the 1950s, Asian shore crab (*Hemigraspus sanguineus*), and the common periwinkle (*Littorina littorea)*. In terms of native species, there were several hermit crabs (*Pagurus* spp.*),* which we were not able to identify to species.

We conducted seining off the beach at two parcels, Chocomount Cove (Parcel CC2) and Stony Beach (Parcel 25), targeting nearshore fish and other marine life. Chocomount Cove is a good location for beach seining, especially in the center of the cove. Eelgrass is present on the west end of the cove. Here we documented the following native species (Figure 53): tautog (*Tautoga onitis*), winter flounder (*Pseudopleuronectes americanus*), mummichog (*Fundulus heteroclitus*), and sand shrimp (*Crangon septemspinosa*) We also found non-native Rockpool shrimp (*Palaemon elegans*) and European green crab (*Carcinus maenas*) (Figure 53).

*Figure 51. Non-native Rockpool Shrimp (*Palaemon elegans*) found in the tidepool.*

We also had some success seining at Stony Beach (Parcel 25) (Figure 29), although the site is more challenging to get to. There we found mummichog (*Fundulus heteroclitus*) and sheepshead minnows (*Cyprinodon variegatus*) (Figure 53).

Figure 52. View of the tidepool facing southeast (left) and northwest (right).

*Figure 53. (Top row) Sand shrimp (*Crangon septemspinosa*) and European Green Crab (*Carcinus maenas*) caught in seine in Chocomount Cove. (Middle row) Winter flounder (*Pseudopleuronectes americanus*) and tautog (*Tautoga onitis*) caught in seine in Chocomount Cove. (Bottom row) Mummichog (*Fundulus heteroclitus*) and sheepshead minnows (*Cyprinodon variegatus*) caught in seine in Stony Beach.*

Management and Restoration

Parcel-specific management recommendations may be found in the Land Trust Parcel Compendium (Edinger 2023b; Appendix B), many of them focused on removing problematic invasives for restoring natural communities. Below we summarize some of the key management issues we observed during our inventory. Online conservation guides for natural communities, rare plants, and many of the rare animals we detected during the study are available here: https://guides.nynhp.org.

Beach Flora and Fauna

Because beaches are such sought-after sites for recreation, their dependent plants and animals are frequently subject to trampling and/or harassment. On much of Long Island, small sections of beach are roped off during the Piping Plover and Least Tern nesting season (May to August), but these short-term measures are often insufficient for other dependent species like the Seabeach Amaranth (Marinelli 1998) and beach tiger beetles including *Cicndela dorsalis dorsalis*, extirpated from New York, and the Hairy-necked Tiger Beetle (Knisley et al. 1987, Mawdsley et al. 2013).

The preservation of habitat on Fishers Island's sandy beaches and the associated rare plant populations at Chocomount Cove, Stony Beach, and the barrier beach south of Beach Pond (Parcel 3), among others, is remarkable. We recommend continued low levels of recreation that allow the native plant communities to persist. The low level of recreation, especially the lack of vehicles, is similarly benefitting the Hairy-necked Tiger Beetle, which occurs in small but likely persistent populations at several sandy beaches around the island. Along with the population on Plum Island (Schlesinger et al. 2016) and select other Suffolk County beaches where driving is not allowed, Fishers Island represents a stronghold for maritime beach populations of this species in New York.

Some concern exists on the island about impacts of recently arrived predators on nesting shorebirds. As neither predator nor prey were the target of our inventory work, our discussion here is based on literature review and our professional opinion. Coyotes (*Canis latrans*) and American Mink (*Neogale vison*) likely arrived on Fishers Island from Connecticut in recent decades, as records for both species on Fishers Island were scarce or nonexistent in Connor (1971) and Tucker and Horning (1993), and the rest of Suffolk County has only recently seen Coyote appear (Nagy et al. 2017) and lacks mink. Both species appear to have established robust populations on Fishers Island along with River Otter (*Lontra canadensis*), which has recolonized much of Long Island in this century (Bottini 2013, 2019). All of these recolonizations are likely natural occurrences following historical extirpations caused by the fur trade and a long history of predator demonization. As such, these mammals should be considered native components of Fishers Island's fauna, with management actions considered only if the predators can be shown to have an outsized impact on species of concern.

Mammalian carnivores, particularly Red Fox (*Vulpes vulpes*) but also American Mink, are known to depredate nests of Piping Plover (Gratto-Trevor and Abbott 2011) and other shorebirds. Greg Edinger and Meaghan McCormack observed a mink foraging in the intertidal, and several observations of mink on or near the shoreline have been posted to iNaturalist, suggesting the potential for mink to prey upon nesting shorebirds. Predator exclosures are often a preferred method of managing nest predation over managing predator populations, although exclosures come with their own set of challenges (Gratto-Trevor and Abbott 2011). A detailed treatment of nest

predator management is beyond the scope of this report, and we encourage a study of the effects of these recent carnivore arrivals on Fishers Island's other wildlife.

Grassland Management

The management of the Middle Farms maritime grassland has successfully provided habitat for a number of rare plants, such *Spiranthes vernalis, Juncus dichotomous, Eutrochium dubium,* and *Iris prismatica.* Murray Fisher's 2021 discovery of Regal Moth (*Citheronia regalis*) caterpillars, known Hickory Horned Devils, chowing down on Winged Sumac (*Rhus copallinum*) shows that rare insects are benefitting from this maintained habitat. Continued management along this vein and monitoring/management of invasive plants will allow these rarities to persist.

As with any preserve land open to the public, balancing recreation and management for biodiversity can be challenging. In response to a question in early 2023 from Land Trust Stewardship Coordinator Jack Schneider, we provide the following thoughts on trail mowing in the grassland for maximum benefits to biodiversity. If recreation needs were not a concern, we would suggest that fewer trails are better—there is a loss of grassland habitat in a mown 8- or 10-ft wide trail, and greater fragmentation of contiguous grassland can alter animals' movement patterns within the ecosystem. Another concern with an extensive trail network is the potential for people and their dogs to be allowed closer to (for example) nesting birds that might otherwise select habitat that is less fragmented. Human disturbance of this direct nature can have as great or greater an impact on biodiversity than habitat loss in some situations. However, if recreational needs are such that keeping something like the current trail network may be desirable, using trail counters or wildlife cameras to document the number of users the trails get may provide data to support any desired trail closures via cessation of mowing.

Grassland birds are primary targets of conservation efforts in the Northeast, suffering from loss of habitat in the Midwest and regrowth of northeastern farms and fields (Brennan and Kuvlesky Jr. 2005). The shrubby components of the grassland render it unlikely to provide habitat for classic grassland birds like Bobolink (*Dolichonyx oryzivorus*) or Eastern Meadowlark (*Sturnella magna*), but shrubs have other biodiversity value (see above). Should increasing the suitability of Middle Farms grassland for birds be a management goal, the NYS DEC has recently produced useful resource for managing grassland habitat for birds (New York State Department of Environmental Conservation 2022).

Invasive Species Issues for Rare Species

The rare plants documented along many of the interior wetland shorelines such as at Island Pond and Beach Pond are threatened by colonies of the invasive Old World reed grass (*Phragmites australis).* Populations such as the *Juncus dichtomous* and *Potentilla anserina* ssp. *pacifica* found in 1991 along the western shore of Island Pond, for example, appear to have been crowded out by it. However, it is possible that they persist in the seed bank, and/or could repopulate the site from nearby populations. Effective removal and control of this species is difficult and requires a long-term approach (Lombard et al. 2012). The *Fuirena pumila* and *Bolboschoenus maritimus* ssp. *paludosus* populations discovered during this study at Beach Pond are growing around the edges and among a colony of Old World reed grass. Management and restoration efforts could be prioritized along such shorelines which are home to these imperiled populations of rare plants.

Phragmites also chokes many of Fishers Island's wetlands, including those near Wilderness Point where a Spotted Turtle population may be barely hanging on. Should these wetlands be acquired by the Land Trust in the future or management allowed while they remain in private ownership, reducing the *Phragmites* infestation would likely give the Spotted Turtle population a better chance of persisting.

Active management to control Black Swallow-wort (*Vincetoxicum nigrum*) is recommended. This invasive plant not only displaces native plant communities but can serve as a sink for Monarch butterflies (*Danaus plexippus*). The monarch population appears to be healthy on Fishers Island; the abundance of Butterfly Milkweed and Common Milkweed on Museum Property along Isabella Road is a great example, but Black Swallow-wort was documented on Museum properties and its presence could impact the population. Female Monarchs will oviposit on Black Swallow-wort mistaking it as a suitable host plant and larvae are unable to complete development (Casagrande and Dacey 2007).

Future Inventory, Monitoring, Research

We have been grateful for the opportunity to conduct a thorough inventory of rare species and natural communities of Fishers Island. The work of biodiversity inventory and assessment is never quite finished, however, because all findings raise new questions and because populations and communities change over time. In this section we suggest future inventory, monitoring, and research needs regarding Fishers Island's biodiversity.

Ecology

For parcels that have gaps in ecological community data, we provided parcel-specific ecology survey needs in the Henry L. Ferguson Museum Land Trust Parcel Ecological Community Compendium (Edinger 2023b, Appendix B). Below is a summary of survey needs grouped by type:

1) Collecting tree cores of exceptionally large trees with an increment borer to confirm the age of forested communities. Large trees worthy of coring were found in the following parcels: 7, 11, 13, 18, 23, 31, 36b, 37, 44, 49, 50, and 55. Most of these large trees are blackgum (*Nyssa sylvatica*) and red maple (*Acer rubrum*) in swamps or slope forests, but there are also several upland trees, such as black oak (*Quercus velutina*), sweet birch (*Betula lenta*), and yellow birch (*Betula alleghaniensis*). Search the Land Trust Parcel Compendium (Edinger 2023b, Appendix B) for "DBH" to find observation points with large trees.
2) Collecting soil cores to confirm wetland classification of the red maple-blackgum swamps in the following parcels: 07, 18, and 44.
3) Continuing to resample observation points where we have 2003 and 2021 data in the following parcels: Parcel 36b (2003: C1 and 2021 36b.01) and Parcel 11 (2003: F1 and 2021 11.02). Search for missing witch hazel (*Hamamelis virginiana*) at point 36b.01 that was recorded at this point (C1) in 2003.
4) Surveying interior portions of parcels that were inaccessible due to impenetrable shrub and vine thicket in the following parcels: 5, 6, 23, 28, 30, 31, 32, 34, 44, 54, E-07, E-08. The following parcels were not surveyed, because they were either very low priority or difficult to access: 14 Hay Harbor Strip; 52 Clay Point Road North; 21b Barlow Pond North Top; and E-04 Vartanian Easement.

5) Resampling the marine rocky intertidal transects on a 5-10-year rotational basis to document changes in community structure and composition. Marine rocky intertidal zone descriptions and transect locations in parcels 5, 37, and 38/38b are included in the Fishers Island Marine Rocky Intertidal Survey Addendum (Appendix D).
6) Looking for species to help confirm tentative community classifications. For example, look for hickory trees (*Carya* spp.) on Millers Point (Parcel 11) and in Parcel 28 to confirm their classification as coastal oak-hickory forest (despite not finding hickory on our ecology surveys). In addition, it would be good to find an independent botanist or forester to confirm our hickory tree identification in Parcel 55 at point 55.02 (are there four species of hickory at this location?).
7) With permission, surveying neighboring lands for significant occurrences of natural communities. For example, survey the field that extends northwest of Parcel 8 to West Harbor (maritime grassland?), and the FIDCO property east of Parcel 31 that appears to have dozens of large trees (possibly old-growth?) and a red maple-blackgum swamp with large trees.
8) Surveying the margin of ponds adjacent to Land Trust parcels via canoe to confirm the following: ground-truth the community map in areas not accessible by foot; document the extent of the state-rare many-flowered marsh pennywort (*Hydrocotyle umbellata*); and document the spread, or new introduction, of invasive plants along pond margins.
9) Surveying the pond in Parcel 48 for rare plants when the water level is drawn down. Research into the land-use history of this parcel is needed to determine if this pond is of natural or artificial origin. For example, is there evidence that this is an excavated farm pond from when this area was used as a pasture?
10) Searching the kettle hole wetland in Cedar Ridge Road Parcel (Kettle Hole Trail) more thoroughly for rare plants.
11) With permission from neighboring landowners, surveying the full extent of the significant shoreline communities on Fishers Island: marine rocky intertidal community, maritime beach, and maritime bluff.
12) Marine eelgrass meadow surveys – although this community is not on Land Trust property, and marine subtidal biodiversity was not a focus of this project, eelgrass meadows are important from a statewide perspective and add to the overall biodiversity significance of Fishers Island. At a minimum, eelgrass meadow data gathered by partner organizations should be incorporated into the two marine eelgrass meadow occurrence records (one north, one south of the island) on a regular basis.

Botany

1) Thirty rare plants are considered historical since they were first documented more than 40 years ago and were not encountered during the course of our study (Table 15). There is still habitat present for many of these species and they may be present in the seedbank or in areas not surveyed during the current study, or could one day be rediscovered. Phenology and habitat information for most of these species is available in NYNHP's Conservation Guides (https://guides.nynhp.org/plants).

Table 15. Plant species historically documented from Fishers Island but not encountered since 1984.

Scientific Name	Common Name	State Status	S-Rank
Amelanchier nantucketensis	Nantucket Serviceberry	T	S2
Arethusa bulbosa	Dragon's Mouth Orchid	T	S2
Asclepias verticillata	Whorled Milkweed	T	S2
Carex emmonsii	Emmons' s Sedge	R	S3
Cuscuta pentagona	Five-Angled Dodder	R	S3
Elatine americana	American Waterwort	E	S1
Eupatorium pubescens	Hairy Thoroughwort	E	S1
Eutrochium dubium	Coastal Plain Joe Pye Weed	R	S3
Gaylussacia bigeloviana	Bog Huckleberry	E	S1S2
Gratiola virginiana	Virginia Hedge Hyssop	E	S1
Lechea minor	Thyme-leaved Pinweed	R	S3
Lespdeza frutescens	Bushy Bush Clover	R	S3
Liatris scariosa var. *novae-angliae*	New England Blazing Star	T	S2
Lycopodiella alopecuroides	Foxtail Bog Clubmoss	T	S2?
Lysimachia hybrida	Lowland Loosestrife	E	S1
Paspalum setaceum var. *psammophilum*	Sand Bead Grass.	E	S1
Pityopsis falcata	Sickle-leaved Golden Aster	R	S3
Polygala cruciata	Cross-leaved Milkwort	R	S3
Polygonum buxiforme	American Knotweed	E	S1S2
Ptilmnium capillaceum	Mock Bishopweed	R	S3
Pycnanthemum muticum	Short-toothed Mountain Mint	T	S2S3
Ranunculus cymbalaria	Seaside Buttercup	E	SH
Ranunculus micranthus	Small-flowered Buttercup	R	S3
Spiranthes tuberosa	Little Ladies-Tresses	T	S2
Solidago latissimifolia	Elliott's Goldenrod	E	S1
Suaeda linearis	Southern Seablite	E	S1S2
Coryphopteris simulata	Massachusetts Fern	R	S3
Tripsacum dactyloides var. *dactyloides*	Eastern Gamma Grass	T	S2
Veronica peregrina ssp. *xalapensis*	Glandular Speedwell	R	S3
Viola pedata var. *pedata*	Bird's Foot Violet	T	S2
Zostera marina	Eel Grass	R	S3

2) Additional searches for rare plants documented in Tucker and Horning (1993), but not seen in the current study, would be worthwhile. These occurrences are mapped in Figure 25, and are ranked "E" for extant but not assessed by Heritage staff in Table 5.
3) We recommend ongoing monitoring of the rare plants, as well as the extent of Old World reed grass (*Phragmites australis)* at Beach Pond and the connected outlet of Island Pond. This could be coupled with focused management of the Common Reed at the NE end of Beach Pond where the rare Dwarf Umbrella Sedge and American Saltmarsh Bulrush were found

amid encroaching Common Reed. Management of this species is labor-intensive and requires multi-year efforts (Lombard et al. 2012). However, it would benefit the rare plants observed there during the current work as well as rarities recorded in the vicinity during Tucker and Horning's study in the early 1990s, such as Atlantic Mudwort and American Golden Dock.

4) Surveys for rare plants, particularly rare frostweeds (*Helianthemum dumosum* or *H. propinquum)*, on the Cedar Ridge Road parcel (Kettle Hole Trail) are recommended. Surveys by NYNHP botanists during the current study observed a species of *Helianthemum* on the property, but the lack of flowering material prevented identification to species.
5) There are records of Seaside Angelica (*Angelica lucida)* along several sections of the Fishers Island coastline, including in the vicinity of Clay Point, North Hill, and Hungry Point. Fishers Island once was home to the most occurrences of this plant in NY. NYNHP botanists searched for this plant on Land Trust properties, but additional surveys for this Endangered plant along undeveloped coastline are indicated.
6) With permission, the maritime grasslands and other open habitats of the western end of Fishers Island (Race Point, Elizabeth Field, etc.) should be surveyed for rare plants. Mitchell and Horning's study documented Eastern Grama Grass, Purple Milkweed, Slender Blue Flag, Coastal Silverweed, and Marsh Straw Sedge in the area, and there is potential for additional rarities.
7) Non-vascular flora (mosses and lichens) were not included in the current study. Future efforts could establish a baseline list of non-vascular flora.

Zoology

1) Mist-netting surveys to confirm presence of the federally endangered Northern Long-eared Bat on the island. It can be difficult to determine with certainty whether these bats are present from acoustic recordings alone because their calls can be variable and confused with other species. We found evidence to suggest they may occur on the island, but mist-netting could confirm a population exists. Mist-netting would also allow us to determine if reproduction is occurring.
2) Additional acoustic surveys for Tri-colored Bats. There were some promising calls recorded, but we would need more positive recordings to be able to say with more certainty whether this species occurs on the island. Because Tri-colored Bats are rarely captured with mist-nets, we would need to conduct more acoustic surveys to make this determination.
3) Further surveys for small mammals may reveal species we did not document in our limited effort. We did not find Meadow Voles nor Short-tailed Shrews, both of which may be expected. We would not expect rare small mammal species on the island.
4) Additional surveys for Spotted Turtles to determine which wetlands on the island are occupied, along with targeted and intensive trapping at Brickyard and Wilderness Point wetlands to estimate population size, demographic parameters, and the probability of long-term persistence. Potentially occupied wetlands include the Shrub Swamps around Middle Farms Pond and Treasure Pond (LF Boker Doyle Wildlife Sanctuary, Charles B. Ferguson Sanctuary, and other parcels), the Shrub Swamps and Reed Grass Marsh in Parcels 34 and 37, the Shallow Emergent Marsh/Shrub Swamp in Parcel 13 (M&M Harry Cant Wildlife

Sanctuary), and the Shrub Swamp in Parcel 50 and nearby wetlands around Ice, Money, and Mud Ponds.

5) Targeted surveys for Eastern Box Turtles to determine if this species is still extant on Fishers Island. When densities of box turtles are low, visual surveys are often inconclusive, and little research has been conducted on the feasibility of terrestrial trapping for this species. Surveys using trained detector dogs may be fruitful at identifying remnant population.
6) Nesting surveys and targeted trapping for Diamondback Terrapins to determine if a permanent breeding population exists on Fisher's Island. It is unclear if the island's terrapins are residents or dispersing individuals from Connecticut.
7) Targeted surveys to determine the extent of the Four-toed Salamander population (known from just a single vouchered observation), as well as to determine if Eastern Newts (one observation, unvouchered), Marbled Salamanders (one observation, unvouchered), or other undocumented species occur on the island (such as the Blue-spotted Salamander, which was hypothesized to colonize New England via Long Island). Repeated monitoring of the remaining cover boards by the Fishers Island School and the Land Trust may yet turn up one of these rarities.
8) Regular monitoring of the mesopredator population (Raccoons, Virginia Opossums, and Striped Skunks) on Fishers Island either by mark-recapture or camera trapping. These mesopredators are major predators of turtle nests and nesting female turtles. Long-term persistence of the island's turtle population may depend, in part, on keeping the mesopredator population on Fishers Island at low levels. Population management could be considered if monitoring efforts reveal an increase in the Raccoon population or the discovery of an incipient population of Virginia Opossum or Striped Skunk.
9) Surveying for and studying midsized mammal populations would have the added benefit of helping determine potential impacts to nesting shorebirds and other wildlife, and whether Fishers Island may be serving an important role as a stepping stone for animals such as Eastern Coyote (*Canis latrans*), North American River Otter (*Lontra canadensis*), and American Beaver (*Castor canadensis*) in their ongoing recolonization of Long Island.
10) Executing a full pollinator survey, with a combination of pan traps and timed surveys, at various Museum properties would undoubtedly detect rare or specialist species not detected during our survey effort. This effort would require additional time to process specimens and identify to species in a lab.
11) Additional dragonfly and damselfly surveys to target rare taxa including: *Enallagma* spp. (Bluets), *Epitheca semiaquea* (Mantled Baskettail; S2), *Libellula needhami* (Needham's Skimmer; S3), *L. auripennis* (Golden-winged Skimmer; S1S2) and others is recommended (Table 16).

Table 16. Rare odonates that could potentially occur on Fishers Island.

Scientific Name	Common Name	Activity period	S rank
Anax longipes	Comet Darner	June - July	S2
Brachymesia gravida	Four-spotted Pennant	August	S1
Celithemis martha	Martha's Pennant	May - July	S2
Celithemis verna	Double-ringed Pennant	May - July	S1
Enallagma daeckii	Attenuated Blue	June - August	S1
Enallagma doubledayi	Atlantic Bluet	June - July	S1

Scientific Name	Common Name	Activity period	S rank
Enallagma laterale	New England Bluet	late May - early June	S3
Enallagma minusculum	Little Bluet	July	S1
Enallagma recurvatum	Pine Barrens Bluet	June	S1
Epitheca semiaquea	Mantled Baskettail	May - July	S2
Ischnura ramburii	Rambur's Forktail	July - August	S2
Libellula auripennis	Golden-winged Skimmer	June - July	S1S2
Libellula axilena	Bar-winged Skimmer	May - September	S1
Libellula flavida	Yellow-sided Skimmer	August	S1
Libellula needhami	Needham's Skimmer	June - July	S3
Nehalennia integricollis	Southern Sprite	July	S1
Progomphus obscurus	Common Sandragon	May - July	S1

12) Additional moth surveys. Several species that were not detected would be expected, including *Parasa indetermina,* many *Datana* species, *Sympistis riparia, Apamea burgessi, Leucania extincta, Eucoptocnemis fimbriaris, Euxoa pleuritica,* and *Euxoa violaris*. Our equipment failures and other sampling issues, especially in July, meant that our efforts underperformed at times. Some samples lacked micromoths entirely, so that component of the fauna could use additional work.

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Literature Cited

Anderson, M. G., K. Lombard, J. Lundgren, B. Allen, S. Antenen, D. Bechtel, A. Bowden, M. Carabetta, C. Ferree, M. Jordan, S. Khanna, D. Morse, A. Olivero, N. Sferra, and M. Upmeyer. 2006. The North Atlantic Coast: ecoregional assessment, conservation status

report and resource CD. The Nature Conservancy, Eastern Conservation Science, Boston, MA.
Bailey, R. G. 1995. Description of the ecoregions of the United States. USDA Forest Service Miscellaneous Publication 1391, Washington, DC.
BCI and NABCA. 2023. State of the bats. Bat Conservation International and the North American Bat Conservation Alliance. https://digital.batcon.org/state-of-the-bats-report/2023-report/.
Bottini, M. 2013. River Otter (Lontra canadensis) survey of Fishers Island, Southold, N.Y. Long Island Nature Organization.
Bottini, M. 2019. The natural recolonization of Long Island, New York by the North American river otter (Lontra canadensis). Long Island Nature Organization.
Brennan, L. A., and W. P. Kuvlesky Jr. 2005. North american grassland birds: An unfolding conservation crisis? The Journal of Wildlife Management 69:1–13.
Brock, J., and K. Kaufman. 2003. Kaufman field guide to butterflies of North America [Online]. Available: https://www.barnesandnoble.com/w/kaufman-field-guide-to-butterflies-of-north-america-jim-p-brock/1103959112. [Accessed: 28-Mar-2023].
Cadwell, D. H. 1989. Surficial geologic map of New York: Lower Hudson sheet. New York State Geological Survey.
Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, and T. L. Griswold. 2011. Patterns of widespread decline in North American bumble bees. Proceedings of the National Academy of Sciences 108:662–667.
Casagrande, R. A., and J. E. Dacey. 2007. Monarch butterfly oviposition on swallow-worts (Vincetoxicum spp.). Environmental Entomology 36:631–636.
Chaloux, A. M., J. W. Jaycox, J. D. Corser, M. D. Schlesinger, H. Y. Shaw, and Elizabeth. A. Spencer. 2010. Surveying for New York's high priority reptiles and amphibians: implications for standardized protocols. New York Natural Heritage Program, Albany, NY. 261 pages.
Connor, P. F. 1971. The mammals of Long Island, New York. University of the State of New York, Albany, NY.
Cook, R., D. Brotherton, and J. Behler. 2010. Inventory of amphibians and reptiles at Fire Island National Seashore. National Park Service, Fort Collins.
Durso, A. M., J. D. Willson, and C. T. Winne. 2011. Needles in haystacks: Estimating detection probability and occupancy of rare and cryptic snakes. Biological Conservation 144:1508–1515.
Edinger, G. J. 2006a. Ecological communities of Long Island, New York: Part 1. Long Island Botanical Society Newsletter 16:22–28.
Edinger, G. J. 2006b. Ecological communities of Long Island, New York: Part 2. Long Island Botanical Society Newsletter 16:36–45.
Edinger, G. J. 2023a. Classification of natural and semi-natural communities of the Henry L. Ferguson Museum Land Trust parcels. New York Natural Heritage Program, Albany, NY.
Edinger, G. J. 2023b. Henry L. Ferguson Museum Land Trust parcel ecological community compendium. New York Natural Heritage Program, Albany, NY.
Edinger, G. J., D. J. Evans, A. D. Finton, D. M. Hunt, L. Lyons-Swift, and A. Olivero. 2000. Community field form instructions: Community Forms 1, 2, & 3. New York Natural Heritage Program.
Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero. 2014. Ecological communities of New York State, second edition. New York Natural Heritage Program, Albany, New York. 136 pages.

Faber-Langendoen, D., D. Cameron, A. V. Gilman, K. J. Metzler, R. M. Ring, and L. Sneddon. 2019. Development of an ecoregional floristic quality assessment method for the northeastern United States. Northeastern Naturalist 26:593–608.

Feinberg, J. A., C. E. Newman, G. J. Watkins-Colwell, M. D. Schlesinger, B. Zarate, B. R. Curry, H. B. Shaffer, and J. Burger. 2014. Cryptic diversity in Metropolis: Confirmation of a new leopard frog species (Anura: Ranidae) from New York City and surrounding Atlantic Coast regions. PLOS ONE 9:e108213.

Feldmann, A., and T. Howard. 2013. Landscape Condition Assessment (LCA2) for New York. New York Natural Heritage Program, Albany, NY.

Fisher, D. W., Y. W. Isachsen, and L. V. Rickard. 1970. Geologic map of New York: Lower Hudson Sheet, scale 1:250,000 (bedrock geology). The University of the State of New York, Albany, NY.

Gibbs, J. P., A. R. Breisch, P. K. Ducey, G. Johnson, J. L. Behler, and R. Bothner. 2007. Amphibians and reptiles of New York state: identification, natural history and conservation. Oxfor University Press, London.

Grant, B. W., A. D. Tucker, J. E. Lovich, A. M. Mills, P. M. Dixon, and J. W. Gibbons. 1992. The use of coverboards in estimating patterns of reptile and amphibian biodiversity. Pages 379–403 in *in* D. R. McCullough and R. H. Barrett, editors. Wildlife 2001: Populations. Springer Netherlands.

Gratto-Trevor, C. L., and S. Abbott. 2011. Conservation of Piping Plover (Charadrius melodus) in North America: science, successes, and challenges. Canadian Journal of Zoology 89:401–418. NRC Research Press.

Hallworth, M. T., P. P. Marra, K. P. McFarland, S. Zahendra, and C. E. Studds. 2018. Tracking dragons: stable isotopes reveal the annual cycle of a long-distance migratory insect. Biology Letters 14:20180741.

Hanmer, C. C. 1940. Plants of Fishers Island. Torreya 40:65–81. Torrey Botanical Society.

Hatfield, R., S. Colla, S. Jepsen, L. Richardson, R. Thorp, and S. Foltz Jordan. 2014. IUCN assessments for North American Bombus spp. [Online]. Available: https://xerces.org/sites/default/files/publications/14-065.pdf. [Accessed: 28-Mar-2023].

Hesed, K. M. 2012. Uncovering salamander ecology: a review of coverboard design. Journal of Herpetology 46:442–450. Society for the Study of Amphibians and Reptiles.

Horning, E. H. 1999. Sleuthing for rare plants on Fishers Island, Suffolk County, New York. Long Island Botanical Society Newsletter 9:13–15.

Houze Jr., C. M., and C. R. Chandler. 2002. Evaluation of coverboards for sampling terrestrial salamanders in South Georgia. Journal of Herpetology 36:75–81. Society for the Study of Amphibians and Reptiles.

Invasive Species Specialist Group (ISSG). 2013. Global invasive species database [Online]. Available: http://www.issg.org/database/species/ecology.asp?si=217&fr=1&sts=sss&lang=EN. [Accessed: 11-Jan-2013].

Klemens, M. W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut Hartford, USA.

Klemens, M. W., H. J. Gruner, D. P. Quinn, and E. R. Davison. 2021. Conservation of amphibians and reptiles in Connecticut. Connecticut Department of Energy and Environmental Protection, Hartford, CT.

Knisley, C. B., J. I. Luebke, and D. R. Beatty. 1987. Natural history and population decline of the coastal tiger beetle, Cicindela dorsalis dorsalis Say (Coleoptera: Cicindelidae). Virginia Journal of Science 38:293–303.

Lombard, K. B., D. Tomassi, and J. Ebersole. 2012. Long-term management of an invasive plant: lessons from seven years of Phragmites australis control. Northeastern Naturalist 19:181–193.
Lovich, J. E., J. R. Ennen, M. Agha, and J. W. Gibbons. 2018. Where have all the turtles gone, and why does it matter? BioScience 68:771–781.
Marinelli, J. 1998. Stalking the wild amaranth: gardening in an age of extinction. Henry Holt and Company.
Mawdsley, J. R., M. D. Schlesinger, T. Simmons, and O. J. Blanchard. 2013. Status of the tiger beetle *Cicindela hirticollis* Say (Coleoptera: Cicindelidae) in New York City and on Long Island, New York, USA. Insecta Mundi 0317:1–7.
Meyer, M. E. 1988. Investigating the eastern mud turtle (*Kinosternon subrubrum subrubrum*). New York State Department of Environmental Conservation, Stony Brook, NY.
Nagy, C., M. Weckel, J. Monzón, N. Duncan, and M. R. Rosenthal. 2017. Initial colonization of long Island, New York by the eastern coyote, Canis latrans (Carnivora, Canidae), including first record of breeding. Check List 13:901–907.
NatureServe. 2023a. Panicum virgatum - (Andropogon virginicus) ruderal meadow| NatureServe Explorer [Online] [Online]. Available: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.816015/Panicum_virgatum_-_(Andropogon_virginicus)_Ruderal_Meadow. [Accessed: 10-Jul-2023].
NatureServe. 2023b. Xenox tigrinus | NatureServe Explorer [Online]. Available: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.921036/Xenox_tigrinus. [Accessed: 28-Mar-2023].
New York Natural Heritage Program. 2023a. Online conservation guide for maritime grassland [Online]. Available: https://guides.nynhp.org/maritime-grassland/. [Accessed: 10-Jul-2023].
New York Natural Heritage Program. 2023b. Online conservation guide for red-banded hairstreak [Online]. Available: https://guides.nynhp.org/red-banded-hairstreak/. [Accessed: 28-Mar-2023].
New York Natural Heritage Program. 2023c. Rambur's forktail conservation guide [Online]. Available: https://guides.nynhp.org/ramburs-forktail/. [Accessed: 24-Mar-2023].
New York State Department Environmental Conservation. 2014. Herp Atlas Project. https://www.dec.ny.gov/animals/7140.html.
New York State Department of Environmental Conservation. 2013. Species Status Assessment, Spotted Turtle. https://www.dec.ny.gov/docs/wildlife_pdf/sgcnspotturtle.pdf.
New York State Department of Environmental Conservation. 2022. NYSDEC strategy for grassland bird habitat management and conservation 2022-2027. New York State Department of Environmental Conservation, Albany, NY. www.dec.ny.gov/docs/wildlife_pdf/gbirdstrafinal.pdf.
Nichols, J. T. 1939. Data on size, growth and age in the box turtle, Terrapene carolina. Copeia 1939:14–20. [American Society of Ichthyologists and Herpetologists (ASIH), Allen Press].
Novotny, J. L., P. Reeher, M. Varvaro, A. Lybbert, J. Smith, R. J. Mitchell, and K. Goodell. 2021. Bumble bee species distributions and habitat associations in the Midwestern USA, a region of declining diversity. Biodiversity and Conservation 30:865–887.
NUWCDIV Newport (Naval Undersea Warfare Center). 1997. Natural resources management plan: Fishers Island Annex, Fishers Island, New York. Prepared for NUWCDIV Newport by Louis Berger & Associates, Inc., Providence, RI.
Paulson, D. R. 2011. Dragonflies and damselflies of the East. Princeton University Press, Princeton, NJ.

Pierce, E. 2018. Bumblebee diversity and floral resource preferences: Working toward the development of comprehensive ecological conservation strategies for North American bumblebees [Online]. Available: https://web.wpi.edu/Pubs/ETD/Available/etd-020718-131853/unrestricted/Pierce.EC.MSThesis.pdf. [Accessed: 28-Mar-2023].

Pleasants, J., and K. Oberhauser. 2012. Milkweed loss in agricultural fields because of herbicide use: effect on the monarch butterfly population. Insect Conservation and Diversity:1–10.

Rader, R., I. Bartomeus, L. A. Garibaldi, M. P. D. Garratt, B. G. Howlett, R. Winfree, S. A. Cunningham, M. M. Mayfield, A. D. Arthur, G. K. S. Andersson, R. Bommarco, C. Brittain, L. G. Carvalheiro, N. P. Chacoff, M. H. Entling, B. Foully, B. M. Freitas, B. Gemmill-Herren, J. Ghazoul, S. R. Griffin, C. L. Gross, L. Herbertsson, F. Herzog, J. Hipólito, S. Jaggar, F. Jauker, A.-M. Klein, D. Kleijn, S. Krishnan, C. Q. Lemos, S. A. M. Lindström, Y. Mandelik, V. M. Monteiro, W. Nelson, L. Nilsson, D. E. Pattemore, N. de O. Pereira, G. Pisanty, S. G. Potts, M. Reemer, M. Rundlöf, C. S. Sheffield, J. Scheper, C. Schüepp, H. G. Smith, D. A. Stanley, J. C. Stout, H. Szentgyörgyi, H. Taki, C. H. Vergara, B. F. Viana, and M. Woyciechowski. 2016. Non-bee insects are important contributors to global crop pollination. Proceedings of the National Academy of Sciences 113:146–151.

Ring, R. M. 2016. Coefficients of conservatism values for a Flora Quality Assessment Index of the native vascular plants of New York. New York Natural Heritage Program, Albany, NY.

Russell, R., M. May, K. Soltesz, and J. Fitzpatrick. 2009. Massive swarm migrations of dragonflies (Odonata) in eastern North America. The American Midland Naturalist 140:325–342.

Schlesinger, M. D., J. A. Feinberg, N. H. Nazdrowicz, J. D. Kleopfer, J. C. Beane, J. F. Bunnell, J. Burger, E. Corey, K. Gipe, J. W. Jaycox, E. Kiviat, J. Kubel, D. P. Quinn, C. Raithel, P. A. Scott, S. M. Wenner, E. L. White, B. Zarate, and H. B. Shaffer. 2018. Follow-up ecological studies for cryptic species discoveries: Decrypting the leopard frogs of the eastern U.S. PLOS ONE 13:e0205805. Public Library of Science.

Schlesinger, M. D., A. L. Feldmann, and S. M. Young. 2012. Biodiversity and ecological potential of Plum Island, New York. New York Natural Heritage Program, Albany, NY. 63 pages. www.nynhp.org/PlumIsland.

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. 101 pages. http://www.nynhp.org/PlumIsland.

Senapathi, D., J. C. Biesmeijer, T. D. Breeze, D. Kleijn, S. G. Potts, and L. G. Carvalheiro. 2015. Pollinator conservation—the difference between managing for pollination services and preserving pollinator diversity. Current Opinion in Insect Science 12:93–101.

Sikes, D. S., and C. J. Raithel. 2002. A review of hypotheses of decline of the endangered American burying beetle (Silphidae: Nicrophorus americanus Olivier). Journal of Insect Conservation 6:103–113.

Spiller, K., D. King, and J. Bolsinger. 2022. Foraging and roosting habitat of Eastern Whip-poor-wills in the northeastern United States. Journal of Field Ornithology 93. The Resilience Alliance. https://journal.afonet.org/vol93/iss1/art6/.

Spotted Turtle Working Group. 2019. Regional spotted turtle assessment protocol. https://www.northeastturtles.org/uploads/3/0/4/3/30433006/spotted_turtle_assessment_protocol_-_march24_2019.pdf.

Swink, F., and G. Wilhelm. 1994. Plants of the Chicago region. Indiana Academy of Science, Indianapolis, IN.

Taft, J. B., G. S. Wilhelm, D. M. Ladd, and L. A. Masters. 1997. Floristic quality assessment for vegetation in Illinois, a method for assessing vegetation integrity. Erigenia 15:3–95.

Tetra Tech, Inc. 2017. Integrated natural resources management plan addendum for outlying parcels: Fishers Island Annex, Seneca Lake Detachment, and Dodge Pond Field Station. Navy Region Mid-Atlantic Naval Facilities Engineering Command Mid-Atlantic Naval Station Newport, Newport, RI.

Thogmartin, W. E., R. Wiederholt, K. Oberhauser, R. G. Drum, J. E. Diffendorfer, S. Altizer, O. R. Taylor, J. Pleasants, D. Semmens, B. Semmens, R. Erickson, K. Libby, and L. Lopez-Hoffman. 2017. Monarch butterfly population decline in North America: identifying the threatening processes. Royal Society Open Science 4:170760.

Todorovic-Jones, A., and M. Becker. 2016. Management plan: Henry L. Ferguson Museum and Land Trust (unpublished draft). Yale School of Forestry and Environmental Studies, New Haven, CT.

Tucker, G. C., and E. H. Horning. 1993. Fishers Island water supply and watershed study: ecological component. Albany, NY and Fishers Island, NY.

Uchytil, R. J. 1993. Panicum virgatum. In: fire effects information system, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory [Online]. Available: https://www.fs.usda.gov/database/feis/plants/graminoid/panvir/all.html.

U.S. Department of Agriculture Natural Resources Conservation Service. 1995. Soil Survey Geographic (SSURGO) data base; data use information, publication number 1527. United States Department of Agriculture Natural Resources Conservation Service, Fort Worth, Texas. 31 pages.

U.S. Fish and Wildlife Service. 2008. American burying beetle (Nicrophorus americanus) 5-year review: summary and evaluation. New England Field Office, Concord, NH.

Werier, D., K. Webster, T. Weldy, R. Mitchell, and R. Ingalls. 2023. New York Flora Atas [Online]. Available: https://newyork.plantatlas.usf.edu/.

White, E. L., J. D. Corser, and M. D. Schlesinger. 2010. The New York Dragonfly and Damselfly Survey 2005-2009: distribution and status of the odonates of New York. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY. 450 pages. http://www.dec.ny.gov/animals/31061.html.

White, E., M. Schlesinger, and T. Howard. 2022. The Empire State Native Pollinator Survey 2017-2021 [Online]. Available: https://www.nynhp.org/documents/178/ESNPS_Final_Report_30June2022.pdf. [Accessed: 28-Mar-2023].

Willey, L. L., M. K. Parren, and M. T. Jones. 2022. Status assessment and conservation plan for spotted turtles in the eastern United States. Technical Report to the Virginia Dept. of Wildlife Resources and the U.S. Fish and Wildlife Service. https://www.northeastturtles.org/uploads/3/0/4/3/30433006/clgu_conservation_plan_10_13_22.pdf.

Wood, T. J., J. Gibbs, K. K. Graham, and R. Isaacs. 2019. Narrow pollen diets are associated with declining Midwestern bumble bee species. Ecology 100:e02697.