# NATURAL RESOURCES INVENTORY
## OF
# LITTLE CHEBEAGUE ISLAND, ME

## March 2014

## by
## Maine Island Ecologists


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# 1. INTRODUCTION

Little Chebeague Island, Maine Coastal Island Registry number 55-324, is located at Lat. 43°42'38" N. Long. 70°8'46" W within the towns of Chebeague and Long Island. The large coastal island measures approximately 86 acres and is roughly 10 miles from the mainland. The island is owned by the Maine Division of Parks and Public Lands (MDPPL) and is managed in partnership by the MDPPL and Maine Island Trail Association (MITA). It is one of many Casco Bay channel islands that has drawn recreationalists since the 19th century. With many attractive, historical and natural features to explore Little Chebeague Island remains an enticing and pursuable destination with over 1,000 visitors each year.

Historic records show that the island was extensively farmed as early as 1823 (MITA 2014). The island stayed in cultivation well into the 20th century until the U.S. Navy took over occupation in 1943. Several hotels and cottages were present as well into the late 1800s, yet the military removed most of these structures due to safety issues. During these periods of farming and military occupation the island was cleared and remained treeless with the exception of a small grove located behind the hotel and main cottage areas. Heavily grazed by large livestock and extensively cultivated, the anthropogenic land once abandoned by its residents was left largely disturbed and impacted. Composed of nutritious organic matter these exposed mineral soils became a rich and productive seed bank for non-native invasive plant species. Left unmanaged and neglected, the island, over time, reverted back to an untypical wild state.

Maine Island Trail Association, founded in 1987, is currently stewarding Little Chebeague Island (LCI) as part of its Maine Island Trail System. MITA stewardship at LCI is under the direct supervision of Maria Jenness, stewardship manager and Erno Bonebakker, on-site supervisor. In the past MITA land managers and stewards dedicated to the protection and enjoyment of wild islands have managed the coastal island for outdoor recreation activities, with the ongoing assurance of protecting the island and keeping it in its natural state. However as problematic invasive plants and anthropogenic and environmental impacts continue to threaten the island's natural state; critical habitats and native ecosystems are at risk of further degradation and losing the ability to function as a healthy environment. MITA land managers, in order to properly manage the island's natural resources, concluded that baseline information was needed and subsequently sought out Maine Island Ecologists (MIE) and University of Southern Maine (USM) Internship Program to collaboratively complete a natural resource study of Little Chebeague Island: 1) to gather baseline information 2) to customize conservation management strategies to protect critical and sensitive habitats 3) to outline control methods, actions and efforts in a collaborative manner with the Maine Division of Parks and Public Lands. From these actions MITA will produce a strategic conservation management plan.

# 2. OBJECTIVE

The goal of this report is to support and inform management planning for MITA's efforts to properly manage critical and sensitive habitats, as well as to enhance the island's value as an outdoor recreation area through the identification of important natural resources found at Little Chebeague Island as well as suitable recommendations to better manage this popular recreation

area as elements of climate change, population rise and invasive marine and plant species threaten to invade, displace and destroy critically sensitive, native marine and terrestrial ecosystems.

# 3. PROFESSIONAL QUALIFICATIONS

The Natural Resource Inventory was completed by Tracy Ames, Kristin Pennock and Heather Storlazzi Ward from Maine Island Ecologists. Ms. Ames, founder of Maine Island Ecologists, (MIE) holds a B.S. in Parks and Recreation Management (concentration in Horticulture) from the University of Maine, Orono and has been working in the field of ecology since 1992 for various federal, state and private agencies conducting field studies involving rare nesting seabirds and shorebirds, plants, small mammals and marine mammals, as well as seabird and plant restoration projects. Tracy owns and operates an organic CSA/CSF and has run her own landscape management and design consulting company for over 10 years designing recreation areas, green spaces on rooftops and commercial and residential landscapes using native plants and organic methods. Ms. Pennock holds a B.S. in Wildlife Management from the University of Maine, Orono. Ms. Pennock has been involved in the field of ornithology since 1992 working with Maine seabird and shorebird populations. She has worked for National Audubon's Seabird Restoration Program (Puffin Project) for over 20 years and has become proficient in identifying birds by sight and sound. Ms. Pennock also sits on the board of Mid-Coast Audubon Society. Ms. Storlazzi Ward holds a B.S. in Natural Resources and Ecology from the University of Maine, Orono and has been working within the ecological and wetland science profession since 1995. She received training in wetland delineation from Environmental Concern, Inc. and has been a New Hampshire Certified Wetland Scientist (CWS #206) since 2000 and a Certified Professional in Sediment and Erosion Control (CPESC #3220) since 2002. She is a member of the Maine Association of Wetland Scientists and the New Hampshire Association of Natural Resource Scientists.

In addition, two interns from the University of Southern Maine contributed to studies found in the Appendices.

# 4. REVIEW OF BACKGROUND INFORMATION

## 4.1 Natural Plant Communities

Using the Maine Natural Areas Program resource guide; Natural Landscapes of Maine: A Guide to Natural Communities and Ecosystems, Little Chebeague Island is classified and described as being composed of natural plant communities consistent with other southern Maine coastal islands in the vicinity of Casco Bay. Rose-Bayberry Maritime Shrubland, (State Rank S4) with dominant characteristic vegetation as bayberry, *Myrica pennslyvania* and rugosa rose, *Rosa rugosa.* Virginia rose, *Rosa virginiana*, rough-stemmed goldenrod, *Solidago rugosa* and poison ivy, *Toxicodendron radicans* found at back dunes, above surrounding bluffs and interior edges. In addition the less stable front dune is identified adjacent to the eastern and southern shores representing a dynamic Dune Grassland community (State Rank S2) and includes beach grasses such as American beachgrass, *Ammophila breviligulata* and Virginia wild rye, *Elymus virginicus* and sea lymegrass, *leymus mollis* which have colonized in the shifting substrate over much of the eastern shoreline edge. Associate salt tolerant vegetation common to the dune include beach pea,

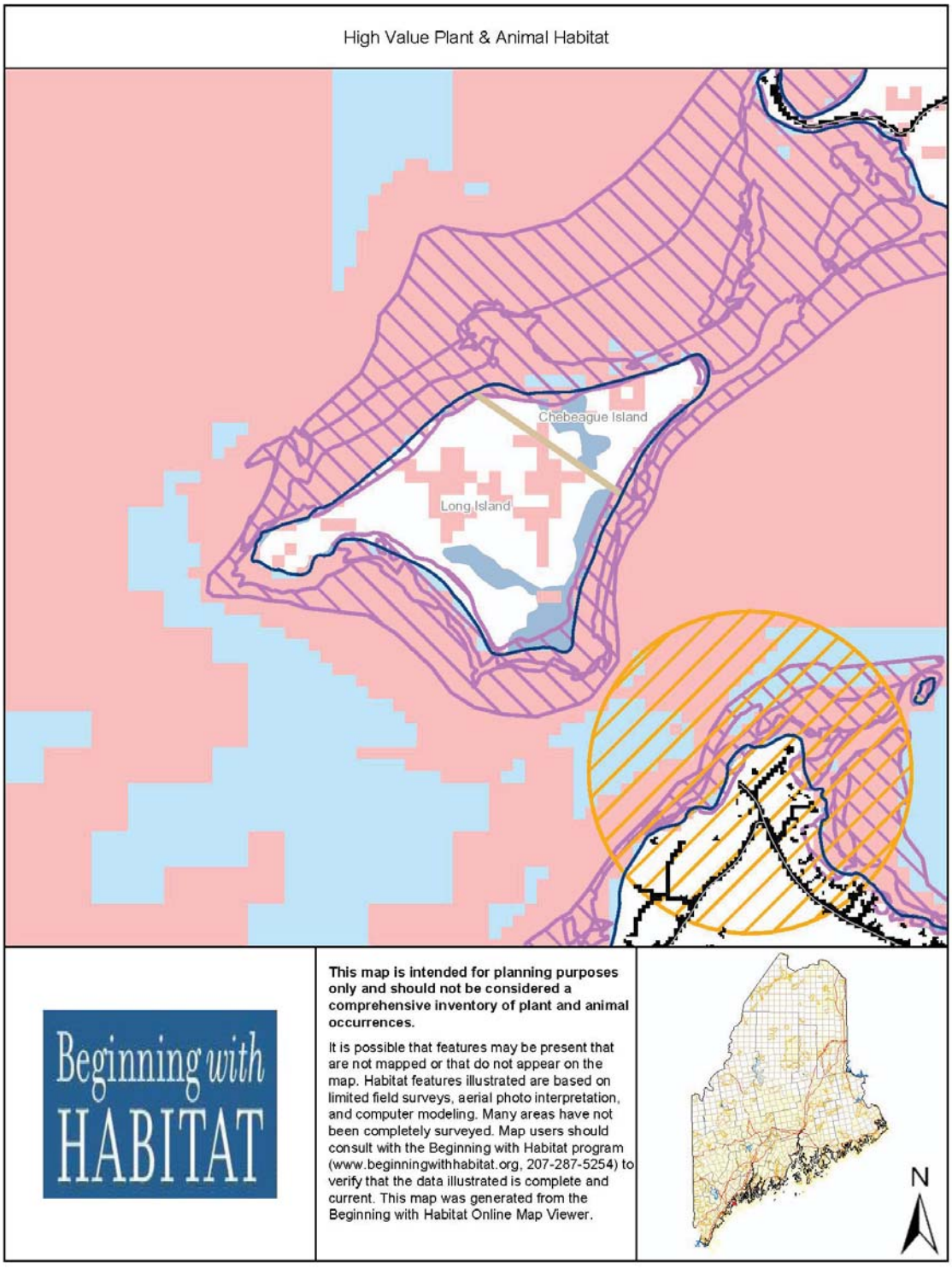
*Lathyrus japonicas,* American searocket, *Cakile edentula* and common milkweed, *Asclepias syriaca* . The evident upper edge Beach Strand (S4) plant community largely visible at the cobble and sand beaches is comprised of wind and salt-tolerant species including white seablite, *Suaeda maritima,* sea milkwort, *Glaux maritima,* salt sand spurry, *Spergularia silena* and associate grasses and members of the Chenopodiaceae family. Pitseed Goosefoot, *Chenopodium berlandieri* present at the foredune ridge is a sensitive plant recently removed from Maine Natural Areas Program "Rare Plant List" due to additional locations identified. Other coastal landscape communities at LCI include Mixed Graminoid-Forb Salt Marsh (S3) where several pocket fringe, coastal cordgrass marshes are located adjacent to shoreline at various protected sites. *Spartina* cordgrasses dominate the high and low marsh zones, however black rush, sea lavender, sea plaintain, seaside goldenrod , salicornia, sea milkwort are some companion plants visible. Interior landscapes are composed of Alder Shrub Thicket (S5), Northern Hardwoods Forest (S5) and Oak-Pine Forest (S5) as well as open meadows and fields and seasonally saturated, palustrine forested, scrub-shrub and emergent wetlands. LCI natural plant communities and their habitat functions are described in greater detail further in the text. A detailed vascular plant list is included in Appendix A of this report.

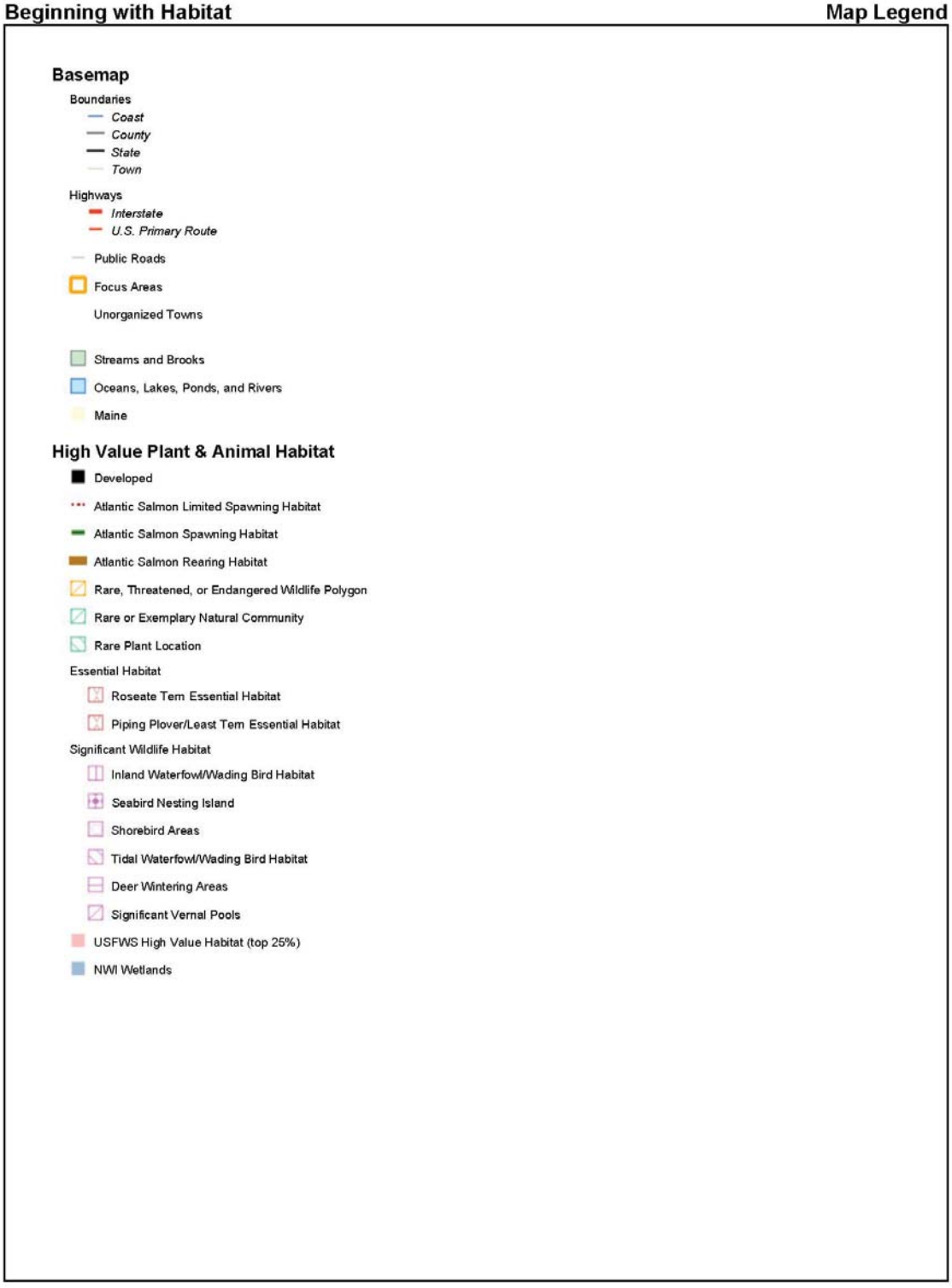
## 4.2 Wildlife

Little Chebeague Island supports suitable habitat for wildlife species. The sandspit located at the northern tip of the island provides an optimal bridge of access from Great Chebeague Island where mammals may search out favorable food sources and cover in more desirable habitat. A wayward juvenile seeking out new territory such as beaver or red fox may also travel during low tides from Great Chebeague Island across the sandspit. Deer are also able to swim from island to island in search of additional food sources. The sandspit and pocket fringe marshes at the northern tip are popular foraging sites for seabirds, shorebirds and sea ducks. More information regarding specific habitats and their functions are emphasized in further detail later in this report. For working inventory lists of mammals, reptiles, insects and birds found and identified at LCI please see Appendices E, F and G.

Beginning with Habitat (BwH), a collaborative program of federal, state and local agencies and non-governmental organizations is a habitat-based approach to conserving wildlife and plant habitat on a landscape scale. It compiles habitat information from multiple sources and integrates it into one package. A map of Little Chebeague Island showing sensitive wildlife habitat was acquired from the BwH website (BwH, Figure 1).

***Figure 1. High Value Plant and Animal Habitat on Little Chebeague Island***

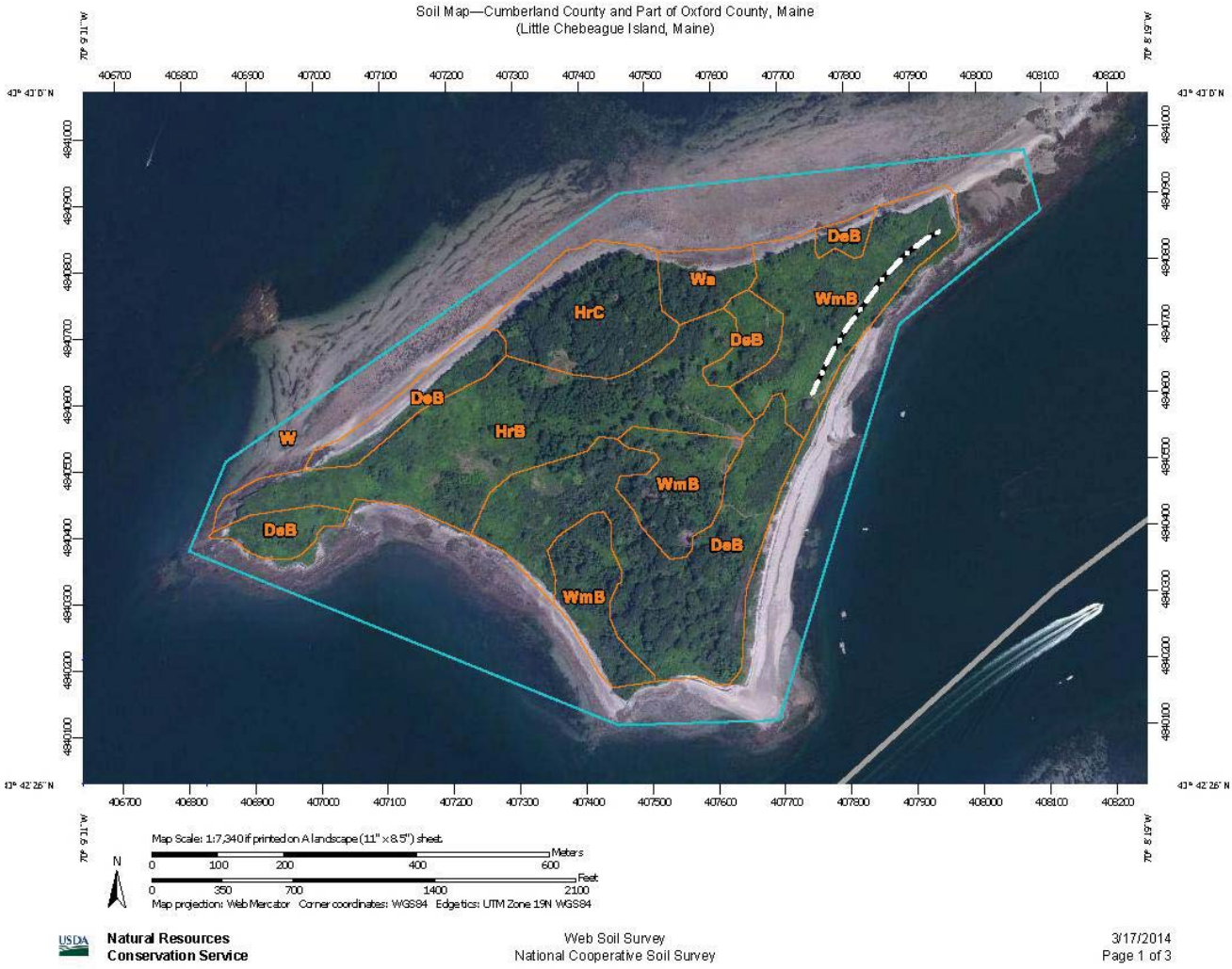



Basemap
Boundaries
Coast
County
State
Town
Highways
Interstate
U.S. Primary Route
Public Roads
Focus Areas
Unorganized Towns
Streams and Brooks
Oceans, Lakes, Ponds, and Rivers
Maine
High Value Plant & Animal Habitat
Developed
Atlantic Salmon Limited Spawning Habitat
Atlantic Salmon Spawning Habitat
Atlantic Salmon Rearing Habitat
Rare, Threatened, or Endangered Wildlife Polygon
Rare or Exemplary Natural Community
Rare Plant Location
Essential Habitat
Roseate Tern Essential Habitat
Piping Plover/Least Tern Essential Habitat
Significant Wildlife Habitat
Inland Waterfowl/Wading Bird Habitat
Seabird Nesting Island
Shorebird Areas
Tidal Waterfowl/Wading Bird Habitat
Deer Wintering Areas
Significant Vernal Pools
USFWS High Value Habitat (top 25%)
NWI Wetlands

## 4.3 Soils

The soils maps used for this report are produced by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). Soil maps are produced by NRCS using a combination of aerial (infrared) photography and on the ground soil surveys. National Wetland Inventory maps are rarely, though sometimes, used to aid in soil mapping. Soil maps of this project area were acquired from the USDA/NRCS online Web Soil Survey (USDA/NRCS, Figure 2).

***Figure 2. Soil Map of Little Chebeague Island***



Soil Map—Cumberland County and Part of Oxford County, Maine
(Little Chebeague Island, Maine)


# Map Unit Legend

| Cumberland County and Part of Oxford County, Maine (ME005) | | | |
|---|---|---|---|
| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
| DeB | Deerfield loamy sand, 3 to 8 percent slopes | 31.1 | 20.3% |
| HrB | Hollis fine sandy loam, 3 to 8 percent slopes | 23.0 | 15.0% |
| HrC | Hollis fine sandy loam, 8 to 15 percent slopes | 10.0 | 6.6% |
| W | Water | 61.9 | 40.5% |
| Wa | Walpole fine sandy loam | 3.2 | 2.1% |
| WmB | Windsor loamy sand, 0 to 8 percent slopes | 23.6 | 15.4% |
| **Totals for Area of Interest** | | **152.8** | **100.0%** |

Soils are dominated within the project area by Deerfield loamy sand, 3-8% slopes (DeB), Hollis fine sandy loam 3-8% (HrC) and Windsor loamy sand, 0-8% slopes (DmB). Smaller inclusions of Hollis fine sandy loam, 8-15% slopes and Walpole fine sandy loam are also found. For this report, only dominant soil types are described.

Deerfield soils, the dominant mapped soil type within the survey area are found in areas of outwash terrace. Formed in sandy glaciofluvial deposits derived from granite and gneiss. These moderately well-drained soils are found scattered throughout the perimeter of the island with the largest area of this map unit found extending from the interior portion of the island, south to the southern end of the island. Deerfield soils tend to have a texture ranging from loamy sand to sand.

Hollis soils, the second largest map unit identified on the island are coarse-loamy supraglacial meltout till derived from mica schist. These somewhat excessively drained soils are frequently situated on hills, both summit and shoulder. Hollis soils are situated within the northwest quadrant, extending from the interior to the western tip. Hollis soils have a restrictive bedrock layer at about 20” with fine sandy loam above that.

Windsor soils are sandy glaciofluvial deposits derived from granite and gneiss. They are commonly situated along the toeslope and form outwash terraces. Windsor soils are somewhat excessively drained soils having a texture of loamy sand in the upper portions to gravelly sand in the lower.

## 4.4 National Wetland Inventory Maps

The National Wetland Inventory (NWI) maps are prepared by the U.S. Fish and Wildlife Service using aerial photography and infrared color photography. The USFWS produce and provide information on the characteristics, extent and status of the nation's wetlands and deep water habitats and other wildlife habitats. Wetland maps of this project area were acquired from the USFWS online Wetland Mapper (USFWS, 2013, Figure 3).

*Figure 3. National Wetland Inventory Map of Little Chebeague Island*


The NWI wetlands within the project area include both freshwater and marine systems. Interior, freshwater wetland systems identified within the NWI maps include seasonally saturated, palustrine forested, scrub-shrub and emergent wetlands. Forested and scrub-shrub wetlands are broad-leaved deciduous wetlands while the emergent wetlands consist of persistent vegetation.

Marine systems are situated around the perimeter of the island and consist of intertidal subsystems dominated by unconsolidated shore and aquatic bed. Sands dominate the subclass within the unconsolidated areas while algal beds dominate the subclass within the aquatic beds.

NWI identifies and classifies wetlands in part using aerial photographs, soil and topographic maps. Lack of ground-truthing to create these maps overlooks the smaller wetlands that fall within the project area. Although meander surveys were done throughout the island, a formal wetland delineation was not performed.

## 4.5 Wetlands of Special Significance (WoSS)

In accordance with Chapter 310 of the Natural Resources Protection Act (NRPA), Wetlands of

Special Significance (WoSS) are wetlands that have been identified as having special significance if they meet one or more of the following listed criteria:

- The freshwater wetland contains an imperiled (S2) or critically imperiled (S1) natural community identified by the Maine Natural Areas Program (MNAP);
- The freshwater wetland contains significant wildlife habitat;
- The freshwater wetland is located within 250 feet of a coastal wetland;
- The freshwater wetland is located within 250 feet of the normal high water line of any lake or pond classified as GPA;
- The freshwater wetland contains at least 20,000 square feet of aquatic vegetation, emergent marsh or open water;
- The freshwater wetland is within a FEMA 100-year floodplain;
- The freshwater wetland contains peatlands; and
- The freshwater wetland is located within 25 feet of a river, stream or brook.

If a wetland meets one or more of the previously listed characteristics its status under the Natural Resources Protection Act (NRPA) is elevated, resulting in greater protection and most times requiring rigorous permitting review due to higher value habitats. Many of the inland freshwater wetlands identified on the Island are partially WoSS wetlands due to their location within 250 feet of a coastal wetland. Wetland areas beyond 250' of a coastal wetland are not considered WoSS, even if jurisdictionally contiguous with WoSS designated wetlands.

## 5. CRITICAL MARINE HABITATS AT LITTLE CHEBEAGUE ISLAND

The Casco Bay watershed hosts critical habitats that are highly sensitive and functional to numerous saltwater and terrestrial species including those that have great economical and recreational value to the state of Maine. As the population in the greater watershed area increases by 4% (Maine BMV 2014) more visits to islands supporting recreational opportunities in Casco Bay are expected. Little Chebeague is easily accessible by boat and by foot from Great Chebeague Island putting it at greater risk for degradation of crucial habitats.

Vital island habitats supporting life in Casco Bay are also impacted by significant environmental issues (accelerated sea level rise, erosion processes and storm surges) as well as other coastal developmental issues (storm water runoff, surface water pollutants, agricultural fertilizers and contaminants) that directly affect the water quality and estuarial ecosystems in the bay and surrounding islands.

To better assess the health and condition of the Casco Bay coastal ecosystem, critical habitats of significant ecological importance in the lower Casco Bay Watershed, have been identified as estuarine health indicators by Arnold Banner and John Libby (USFWS) in the 1995 Casco Bay Estuary Partnership funded project: *The Identification of Important Habitats in the Lower Casco Bay Watershed.* The analysis of the data collected relied on maps of these habitats created by Seth Barker (DMR). See www.gulfofmaine.org/library/casco/casco.htm for the full report.

## 5.1 Eelgrass Habitat

Primarily eelgrass, *Zostera marina* and smooth cordgrass, *Spartina alterniflora* were named as highly ranked evaluation species from the Gulf of Maine Council's Species List due to their major ecological and environmental importance by providing highly suitable habitat (protection against predators, breeding nursery, spawning grounds, foraging area) as well as their vital role as primary producers of organic material (organic carbon) for coastal wetland food chains for the following species: shellfish (softshell clam, blue mussel, northern quahogs, Atlantic sea scallops, lobsters, crabs, etc.), marine worms (bloodworms, sandworms) waterbirds (loons, black ducks, Canada geese), bald eagles, roseate terns, seabirds (common eider, common tern), shorebirds such as least tern *(Sternula antillarum)* and piping plover *(Charadrius melodus)*, wading birds, juvenile and smaller forage finfishes (e.g., hake, cod, haddock, mackerel, killifish, mullet, menhaden and alewife, sandlance, lumpfish, three spined stickleback, mummichug, alligator fish, rock gunnels, longhorn sculpin, anemones, cusk, hagfish, tautog, redfish, wolfish, flounder, rock eels, striped bass, etc.) plus a multitude of microorganisms (e.g., zooplankton) (Larson, Johnson and Doggett 1983; Brown 1993; USFWS 1980, 1995; Wippelhauser, Sherman, Wells, & Freeman 1997).

In 1983 eelgrass habitat flourished in the low intertidal, shallow subtidal, soft-bottom mud flat and sand flat communities, etc. of Casco Bay including Portland Harbor where the faunally rich eelgrass beds supported as many as 120 - 36,380 animals/ square meter (Larsen, Johnson and Doggett 1983). Prolific eelgrass production has persisted in most areas of Casco Bay over the past three decades and is directly related to the improvement of water quality due to measurable advances in conservation management and regulations of coastal development, stormwater runoff and pollution control (Casco Bay Estuary Partnership 2005). The Friends of Casco Bay monitoring the bay from 1993-present have found waters in the vicinity of Little Chebeague Island and Great Chebeague Island tend to be of generally good quality as the result of higher levels of dissolved oxygen saturation and greater water clarity compared to other various test sites in the bay where the water has become cloudy with toxins and phytoplankton. In these areas of less light penetration phytoplankton blooms and sensitive eelgrass shoots are unable to sustain themselves in the unhealthy, shaded, smothered water environment. (Friends of Casco Bay 2005).

As the watershed area develops it is feared by conservation managers that greater amounts of industrial pollutants, agricultural/residential based fertilizers and storm water runoff will place an increasing amount of toxins from the tributary waterway system directly into the Casco Bay estuarine ecosystem. According to NOAA in 2011 the population growing at 4% is expected to approach 300 people per square mile in the Casco Bay watershed by 2040 (Casco Bay Estuary Partnership 2005). Thus, there are significant developmental pressures and alarming concerns of environmental impacts from human activities. Localized disturbances causing extensive degradation or complete loss to the eelgrass habitat also can be attributed to dredge and fill operations, boat propellers, docks, anchors, mooring chains and fishing gear (Howe and Burgess 2009). In addition marine invasive species, such as; European green crab (*Carcinus maenas*), colonial tunicates (ie Golden Star Tunicate) can foul, smother and degrade eelgrass beds. Eelgrass beds are also still recovering from a slime mold caused Wasting Disease responsible for affecting 90% of North America eelgrass beds in the 1930s (Seagrass.LI 2014).

Islands located in Casco Bay play an important role in the development of eelgrass beds and the formation of dense sea grass meadows by offering protection against severe, scouring wave action. Dense eelgrass meadows provide critical ecological functions and values. Subsequently, the ecological health of the subtidal community improves as the eelgrass habitat contributes to the unconsolidated sediment composition by the additional boost of terrestrial organic material. In turn the eelgrass beds improve the stabilization of the substrate, baffle waves and currents and help to improve water quality by filtering sediments and absorbing nutrients (Casco Bay Estuary Partnership 2005).

A marine inventory of Little Chebeague Island's species found in the intertidal zone was conducted by USM/MITA intern, Josiah Brown: *Species Index on Little Chebeague Island June-August 2013*. Special attention was noted of the marine floral and faunal invasive species that were present at LCI tidal zones including European green crabs (*Carcinus maenas*), golden star tunicates (*Botryllus schlosseri*), sea squirts (Urochordata), dead man fingers (*Codium fragile*), etc. Suffocating filamentous green algae was also observed at the mudflats and intertidal zones.

Due to the availability of interns and scope of our natural resource study, we did not include the shallow subtidal region. Yet, Maine Island Ecologists and Brown did conduct informal, unsystematic field observations of eelgrass communities during periods of extreme low tides. These tidal fluctuations revealed the relatively healthy growing condition of the tidal ecosystems showing a broader scope of increased eelgrass populations encompassing the intertidal and shallow subtidal zones of LCI. The evident growth and coverage of the present eelgrass beds indicated the increased productivity of the structural ecology of the shallow subtidal and intertidal regions. The presence of eelgrass beds on the southern side of the island's subtidal and intertidal zones were not recorded, however, dead eelgrass was often sited washed up along the South Beach shoreline. Other segments of dead, washed up eelgrass were also occasionally present throughout the island wrack line areas and perhaps caused by the problematic marine invasive; European green crabs found foraging near the roots of the eelgrass beds in the subtidal unconsolidated sediment and soft-bottom intertidal zones.

European green crabs are largely found in eelgrass and cordgrass habitats as they feed mainly on bivalve shellfish resources including blue mussels, oysters, snails, other crabs and soft-shell clams which directly impact the clamming industry, Maine's third largest fishery. The increase in the green crab population has coincided with the warming of ocean temperatures. A similar cycle occurred in the early 1950s when the ocean temperatures rose and the green crab population increased, devastating the soft-shell clam resource in Maine. This trend reversed during colder winters in the 1960s, effectively reducing the green crab population. (Maine Department of Marine Resources 2014).

Presently the Maine DMR is actively managing the invasive green crab throughout the state of Maine (MDMR 2014) with creating strategic methodologies and cooperative efforts to minimize the problematic impacts caused by this species. Efforts in the private sector are underway to create a viable commercial market for green crabs including attempts to create value-added products, such as: aquaculture feed, commercial compost and bait for the pet food market as well as a

possible food additive paste being created by a University of Maine research group. (MDMR 2014).

The highly valued subtidal unconsolidated sediment which supports the symbiotic relationship between eelgrass and animals is extremely important both economically and ecologically. Maine's commercial fishery valued at $426 million in 2011 (NOAA 2011) relies heavily on the healthy stable condition of subtidal unconsolidated sediments and the structural complexity and biodiversity of eelgrass habitat. In order to plan for the increasing human population in the Casco Bay watershed, MITA managers will need to manage possible threats to the condition of the subtidal unconsolidated sediments, eelgrass habitats and animals within the areas surrounding LCI particularly near the boating areas. The major cause of degradation of the eelgrass habitat is identified by various agencies in Maine as reduced water quality brought on by coastal watershed development, pollution and stormwater runoff; however, localized habitat disturbance can also cause loss to this critical habitat. To avoid these issues of impact, degradation and loss of the eelgrass beds around LCI, the following resources and recommendations are available.

### 5.1.1 Conservation Management Strategies for Eelgrass Habitat Protection

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Establishment of a MITA Task Force to improve island stewardship by implementing a conservation management plan of critical habitats named on LCI in order to define and prioritize human impact, degradation and loss to various habitat types (eelgrass, cordgrass, mudflats, dune/sand beach, ledge, mix coarse and sand flats) by surface water contamination by pollutants and stormwater runoff, invading marine invasive species and green algae blooms.
- Periodic assessment of the condition of the eelgrass habitat, presence, density and impact of marine invasive species, particularly European green crabs in areas of subtidal and intertidal zones by MITA Task Force and volunteers. Baited crayfish traps are used to monitor European Green Crabs in Puget Sound, WA by Puget Sound Restoration Fund Volunteers. Pitfall traps have also proved to be an effective way of trapping the European green crab (Behrens and Gillespie 2008).
- An *Early Detection/Quick Response Program* should be implemented to combat newly introduced marine invasive species, such as; the Asian shore crabs which may become present over time.
- Review and compliance of the aquifer protection provisions named by EPA Zoning Ordinance including implementation of state regulated herbicide usage near freshwater and coastal wetlands by MITA Task Force.
- Initialize cordgrass and eelgrass restoration work to improve marine habitat. This work could be conducted by MITA volunteers. Alternative methods should be utilized to install eelgrass shoot transplants, seeds or plugs rather than digging in the natural meadow. (MITA volunteer coordinator hired to oversee restoration work). For further eelgrass bed restoration information see: http://www.seagrassli.org/restoration/methods.html
- Management of healthy fringe marsh areas adjacent to eelgrass beds by MITA Task

Force. Healthy functions of Cordgrasses include the elimination of excessive nitrogen produced in eelgrass beds leading to the improvement of the condition and performance of the vital seagrass habitat.

- Management of healthy eelgrass beds by establishing regulatory actions of mooring usage, boating operations and use of fishing gear. As the need for mooring installation arises regulations may include; mooring usage in designated areas away from prolific eelgrass habitat or float ropes used with screw moorings instead of mooring chains or sinking rope eliminating damage caused during tidal movements.
- Establish linkages with area nonprofit conservation groups including but not limited to; Maine Island Ecologists, Oceanside Conservation Trust, Friends of Casco Bay, Maine Coast Heritage Trust, Harpswell Heritage Land Trust to combat issues of marine floral and faunal invasive species, educational outreach on topics such as the importance of critical habitats, green algae control and water quality, etc.
- No shading structures or piers should be built in the vicinity of eelgrass.
- Temporary floats located <35 feet from shore be discouraged.

### 5.1.2 Collaborative Efforts to Manage and Monitor Eelgrass Habitat

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Collaboration and participation in the Maine Healthy Beach Program supported by the Maine State Planning Board and funded by U.S. EPA to properly monitor the water quality at the Main/Front Beach. Possible reclassification of water off LCI Main Beach by state regulatory agency may be necessary as usage of area beach increases.
- Collaboration with Maine EPA and Friends of Casco Bay Citizen Stewards Water Quality Monitoring Program and MITA Task Force to periodically conduct water quality studies of tidal zones of Little Chebeague and Great Chebeague Islands with particular focus on nitrogen pollution discharges from fertilizers used on nearby inhabited islands and mainland contributing largely to green algae blooms.
- Collaboration with Towns of Chebeague and Long Island to monitor and assess surface water pollutants and stormwater runoff from areas of significant impervious surfaces near the shoreline, private dwellings and agriculture sites on island. Suggestions of retention ponds, reductions of sediment of runoff, minimizations of impervious surfaces and the usage of natural drainages to improve conditions of surface water have been made for Great Chebeague Island by the Town of Chebeague Island Comprehensive Planning Committee (Town of Chebeague Comprehensive Planning Committe 2009).
- Collaboration with Casco Bay Estuary Partnership and Oceanside Land Trust, nearby island communities and town officers to address the impending loss of critical habitats on islands in Casco Bay due to accelerated sea level rise.

### 5.1.3 Outreach Efforts

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Educate vessel operators about degradation of eelgrass habitat caused by the use of

anchors. Float ropes used with screw moorings instead of mooring chains or sinking rope can eliminate damage caused during tidal movements (Howe and Burgess 2009).

- Create a voluntary "Anchor Free Zone" for local boaters in areas away from protected eelgrass beds. Educate vessel operators about the voluntary "Anchor Free Zone." Because of the soft bottom of the vegetated eelgrass beds, boater safety will benefit greatly from this type of education.
- Work to improve relationships between communities on nearby inhabited islands and MITA by engaging in educational outreach programs focusing on topics such as; water quality, impervious surfaces, surface water runoff carrying fertilizers and pollution and directly depositing them into nearby estuarial waters largely affecting fringe marsh, mudflat, eelgrass habitats.
- Work to improve outreach support with participants that are actively involved in environmentally based recreational and boating activities on or near the vicinity of the island.
- Placement of educational signs to interpret and illustrate the functions of the vitally important eelgrass habitat and the human impact to these beds caused by boaters and recreational enthusiasts using mooring chains, anchors, propellers, fishing gear, etc. and other activities (i.e. swimming, fishing) in the tidal zones.
- Kiosk information listing preservation efforts conducted by MITA conservation managers, volunteers and on site caretaker on LCI.
- Information on Kiosk readily available to recreational enthusiasts of how to actively participate as a MITA volunteer at LCI including website information and contact numbers.

## 5.2 Cordgrass Habitat

In Maine there are three major types of salt marshes: back-barrier marshes, finger marshes and fringe marshes. Fringe marshes are located in wave-sheltered coastal pockets of the estuary occurring as shoreline fringes in coves and islands. Vegetation consists predominantly of species that are inundated twice daily by tides. One species, smooth cordgrass, *Spartina alterniflora* is the dominant species, solely existing at the low marsh zone. Pannes, pools and other areas of the high marsh zone are occupied by a diversified group of graminoids and forbs, yet saltmarsh cord grass and saltmeadow cordgrass, *Spartina patens* are not necessarily preponderant species, but are commonly present in large, dense communities. These *Spartina* saltmarsh communities often form seagrass meadows that are typical of the pocket fringe coastal marshes found on LCI and other coastal islands in the Gulf of Maine.

The biodiversified and productive tidal fringe salt marsh performs vital life-support functions by providing food and habitat to a myriad of plant and animal species in a highly sensitive, self-sustaining, estuarine ecosystem like Casco Bay. During high tides, these fringe salt marshes become feeding grounds for mummichog, stickleback, killifish, tomcod, Atlantic silversides, cunner, rock gunnel, sand lance and other commercially and recreationally important forage finfish (Ward 1999). This three dimensional canopy structure also creates habitat that supports a productive nursery for larval and egg settlement of fisheries, a refuge from predators and weather and a sanctuary of support for plant and algal growth, terrestrial mammals, insects, invertebrates

and birds, waterfowl, wading birds and shorebirds including possible endangered species as the piping plover (*Charadrius melodus*). There are also habitat dependant species that with specialized adaptation live solely within the cordgrass habitat, including: amphipod (*Orchestia uhleri*), snail (*Melamus identities*) and ribbed mussels (*Gukensia demissa*) (Ward 1999).

In addition the salt marsh grasses; saltmarsh cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*), conduct crucial ecological roles of the salt marsh by controlling shoreline and upland erosion from problematic storm surges and harmful wave action from flooding waters. By buffering the water flow and lessening the intense energy of the waves, soil particles and suspended matter caught in the extensive oxygenating cordgrass root system bind together; build sediments, clarifying the water. As the growing sediment base stabilizes, the area becomes more suitable for the invasion of higher level salt marsh vegetation and finally terrestrial flora. As these salt marsh grasses die and decay vast amounts of detrital-bacteria conglomerates and produces rich organic matter to feed fauna that inhabit or frequent the salt marsh, associated estuarial ecosystems and offshore waters. The extent to which salt marshes provide a food source depends on the size, productive and relative degree of flushing tidal waters. Daily flushing tidal cycles bring salt, sediment and recycled nutrients allowing marsh grasses to thrive in a harsh and scouring marine environment (Tiner 1987). In turn these cordgrasses in the spring and summer take up excessive nitrogen from the marsh, adjacent eelgrass beds, mudflats, kelp beds and other estuarial habitats nearby that may otherwise cause algal blooms or eutrophication in the coastal waters. Denitrification of microbial anaerobic bacteria in marsh sediments removes the nitrogen from the ecosystem. Cordgrass plants and microbes also can remove contaminating pollutants, incorporating them into peat and removing them from the food web (Taylor 2008).

Historically as periods of sea level rise occurs the action of sedimentation and conglomeration of peat producing a diatom mat elevates the shoreline in coastal salt marshes keeping pace with rising sea level periods. However, as the global warming trends occur it is anticipated by NOAA climatologists that the sea level rise will increase to an alarming rate of 3-6.6 ft. (.9144m-2.01168m) per year by 2100 (NOAA 2011). The Intergovernmental Panel on Climate Change (IPCC) projects a global atmospheric temperature increase ranging from the typical 2 degrees F to 11.5 degrees F by 2100 (IPCC 2013). A rise in temperature of this magnitude and rate is likely to affect global patterns of storms and precipitation, raise global sea levels by thermal expansion of the oceans and the melting of continental ice, increase ocean temperatures, reduce ocean salinity and affect ocean chemistry (Gulf of Maine Council on the Marine Environment 2006).

Concluded from their research findings of a microtopography study completed in 2008, scientists from the Wells National Estuarine Research Reserve working with the Casco Bay Estuary Partnership offer a preliminary evaluation of sea level rise impacts on coastal fringe marshes and their relation to adjacent uplands. Analysis of their field work indicated several complex scenarios of sea level rise at the coastal marsh shores of Southern Maine. One possibility is that as the sea level rises at a greater than typical rate the marsh boundaries will grow inland, horizontally and vertically, as long as there are no obstructing features such as rocky outcroppings, permanent structures, culverts, etc. restricting tidal flow. If barriers restricting tidal flow are present, deep flooding will occur and the diverse vegetation present at the high marsh

zone will not be able to survive the more frequent deep tidal flooding (Wells Reserve 2014). In addition sediment accretion supply will be influenced by the steepness of the slope of the adjacent uplands, the composition of the adjacent uplands and the presence of structures, armoring of bluffs and banks (U.S. EPA 1995). It is largely agreed upon by area scientists that saltmarsh cordgrasses of the low marsh zone will replace the more sensitive diverse vegetation of the drowning high marsh zone unable to migrate inland (Curtis Bohlen 2014, pers.comm., 24 January) Scientists from the Gulf of Maine Council on the Marine Environment also have made similar predictions of coastal submergence. For Saco and Casco Bays the national expectation is that over 50-250ac of marsh land will be lost over the next 100 years with exacerbated erosion and inundation conditions of a projected shoreline retreat of 17-100m with the alarming scenario of an accelerated 2.0m sea level rise (U.S. EPA 1995). In addition, as the sea level rises at a greater intensity, the natural hardening process of peat sedimentation at the marsh/upland boundary that typically inhibits the slowly advancing salt marsh will drastically be weakened, eroded and lost as the increased intensity and deep flooding of the rising sea brings on stronger influx of storm surges and scouring waves from winter ice action. Lack of buffer boundaries may increase impacts of pollutants and nitrogen on the marsh, encourage invasive plants to establish, decrease nesting habitat and reduce habitat quality (Hanson and Shriver 2006).

*Spartina pocket fringe marsh at Little Chebeague Island*

Four *Spartina* pocket fringe marshes are located at the northern, western and southern temporarily inundated areas of Little Chebeague Island. It is anticipated that as the sea level rises in a greater degree of intensity the diverse plants of the high marsh zone on LCI will become submerged and lost in the deeply flooded, obstructed areas such as the small pocket fringe marsh located between the rocky outcropping and adjacent sandbar on the northern tip of the island. The steeply elevated uplands in this area also obstruct the possible migration of the marsh with scrub-shrub habitat. Areas also at risk include the southwestern shoreline where a smaller fringe marsh exists adjacent to a freshwater wetland behind it. With the loss of the buffering salt marsh habitat the rising salt water will inundate the freshwater habitat with salt and unfiltered

pollutants. The quality of the fragile, sensitive ecosystems will also deteriorate in these surrounding areas. Nesting habitats will diminish and stronger invasive plant species will become established, weakening the functions of flourishing native vegetation habitats. However, it is possible that on the southeastern and western sections of the island, the presence of sandspit or bluffs and landslides will assist in combating sea level rise with their natural processes of adding sediments into the surrounding ecosystems including marsh areas as the bluff/landslide supported uplands erode.

Smooth cordgrass, *(Spartina alterniflora*) is the sole, present species occupying the low marsh zone. Saltmeadow cordgrass, (*Spartina patens*) co-dominates the high marsh zone with several other highly diverse and largely adaptive species including but are not limited to such species as: seabeach sandwort (*Honckenya peploides*), seaside goldenrod (*Solidago sempervirens*), seabeach orach, (*Atriplex arenaria*), white sea-blite (*Suaeda maritima*), sea lavender (*Limonium carolinianum*), seaside dock, (*Rumex pallidus*), black rush (*Juncus roemerianus*), saltmarsh bulrush (*Schoenoplectus maritimus*), etc. Samphire (*Salicornia depressa*), sea milkwort (*Glaux maritime),* seaside plaintain, (*Plantago maritima*) are commonly visible at a localized marsh panne at the northern tip of the island.

Similar invasive marine species to what was found in the intertidal and subtidal habitats by Brown may also be present in the high and low marsh zones at LCI however, were not present in the quadrants. According to Brown's inventory study, the following marine invasive species were identified near the fringe salt marsh on the western edge of the island: European green crab, golden star tunicate, dead man's finger and sea squirt.

The following conservation management strategies for the restoration and improvement of salt marshes on Little Chebeague Island are as follows:

### 5.2.1 Conservation Management Strategies for Cordgrass Habitat Protection

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Gather baseline data of pocket fringe marshes on LCI by assessing the present condition, percent coverage and presence of invasive plant and marine species, water quality, human impacts, potential impacts of sea level rise, storm surges, etc.
- Develop a conservation management plan to monitor and assess the future condition of the fringe marshes located on the island including management strategies to combat issues such as climate change, sea level rise, environmental and human impacts.
- Develop an annual monitoring and assessment protocol using the Integrated Vegetated Management Program as a model to instill such strategies as set forth by the *Early Detection/Quick Response Program* to periodically assess invasive non-native plants and marine species focusing on important habitats such as; pocket fringe marshes, eelgrass beds and mudflats. As a warming trend occurs and storms increase invasive plants may establish themselves in the weekend, critically important and highly sensitive marsh ecosystem as well as adjacent habitats.
- Identify and prioritize coastal marshes, freshwater wetlands that are at risk of obstructions or increased inundation during periods of sea level rise and natural inland

migration of the marsh.

- Identify best conservation management strategies to control erosion of the marsh/upland buffer, to prevent storm surges and increased wave energy from inundating the freshwater wetlands during periods of sea level rise and increased storm surges brought on by climate change.
- Identify and prioritize restoration needs and opportunities.
- Determine what methods of plant restoration and erosion control that will be utilized to increase the marsh horizontal and vertical borders yet eliminate possible obstacles and barriers so that the natural advancement of the marsh can progress inland during periods of climate change, storms and sea level rise.
- Determine restoration efforts to eliminate excessive nitrogen present in nearby eelgrass beds by planting cordgrass plugs on marsh borders adjacent to eelgrass habitats. For further eelgrass bed restoration information see: http://www.seagrassli.org/restoration/methods.html

### 5.2.2 Methods of Control to Prevent Further Degradation of Sites

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Administer soft/ non-structural stabilization techniques featuring restoration marsh plantings or organic matter. Maintains natural habitat features of fringe marsh and water dynamics (NOAA Office of Ocean and Coastal Dynamics). For more information visit: http://coastalmanagement.noaa.gov/initiatives/definitions.html#2
- Use native plantings to restore lost vegetated forest buffers as they are degraded by human impact and rising sea level or erosion. This buffer will allow for the advancement of the marsh without causing flooding as well as preserving the diverse vegetation of the high marsh zone.
- Mitigate additional options to include hybrid stabilization techniques using restoration marsh plantings with stone containment groins. This method is beneficial in areas of greater wave energy but may slightly alter the natural shoreline and water dynamics (NOAA Office of Ocean and Coastal Dynamics 2014). For more information visit: http://coastalmanagement.noaa.gov/initiatives/definitions.html#2
- For native marsh cordgrasses including smooth cordgrass, *Spartina alterniflora* or saltmeadow cordgrass, *Spartina patent* plugs contact: American Native Plants: http://americannativeplants.net (410) 529-0552 or Mellow Marsh Farm: http://mellowmarshfarm.com (919) 742-1200.
- For installation of restoration plants contact Maine Island Ecologists at (207) 375-9090.

### 5.2.3 Collaborative Efforts to Manage and Monitor Marsh

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Collaborate with town managers of Great Chebeague Island and Long Island to minimize impervious surfaces, pollutants and fertilizers and water contamination in the watershed. Increased storm water management reduces runoff of pollutants and contaminants.

- Collaboration with Maine EPA and Friends of Casco Bay Citizen Stewards Water Quality Monitoring Program and MITA Task Force to periodically conduct water quality studies of tidal zones of Little Chebeague and Great Chebeague Islands with particular focus on nitrogen pollution discharges from fertilizers used on nearby inhabited islands and mainland contributing largely to green algae blooms.
- Collaboration with MIE for annual monitoring of the health and condition of the marsh.
- Collaboration with Casco Bay Estuary Partnership, Oceanside Land Trust, nearby island communities and town officials to address the loss of critical habitats on islands in Casco Bay due to accelerated sea level rise.
- Contact Habitat Restoration Partnership. Form a linkage between Gulf of Maine Council on the Marine Environment & NOAA for grant opportunities and how to plan and implement a restoration project. Visit the Gulf of Maine Habitat Restoration Web Portal: http://www.restoration.gulfofmaine.org.

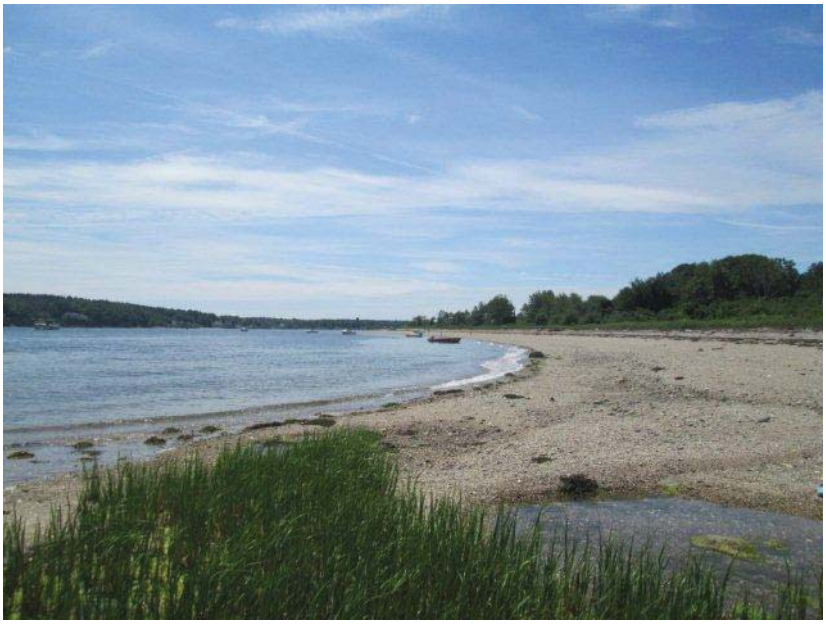
### 5.2.4 Outreach Efforts

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Working to improve relationships between communities on nearby inhabited islands and MITA by engaging in educational outreach programs focusing on topics such as; water quality, impervious surfaces, surface water runoff carrying fertilizers and pollution and directly depositing them into nearby estuarial waters largely affecting fringe marsh, mudflat and eelgrass habitats.
- Working to improve outreach support with participants that are actively involved in environmentally based recreational and boating activities on or near the vicinity of the island.
- Placement of educational signs to interpret and illustrate the functions of the vitally important salt marsh habitat.
- Kiosk information listing preservation outreach efforts conducted by MITA conservation managers, community volunteers and on site caretaker on LCI
- Information on Kiosk readily available to recreational enthusiasts of how to actively participate as a MITA volunteer at LCI including website information and contact numbers.

## 5.3 Sand Beaches and Dune Habitats

Sand beaches in Maine are composed of fine quartz sands derived from glacial deposits and discharges from rivers and streams. (Kelley et al. 1989). Astonishingly, these sand beaches make up only 2% of Maine's intertidal habitat. Of this 2% sand beach habitat, 40% of the beaches are located south of Casco Bay, yet only 24% of the sand beaches are located within Casco Bay and Muscongus Bay (Ward 1999). There are 9 sand beaches in Casco Bay with one of these nine being remotely located at the uniquely precious Little Chebeague Island.



*Main sand beach at Little Chebeague Island*

Longshore drift or littoral drift, an important natural process, is responsible for longshore currents depositing large quantities of sand in an oblique zigzag formation at the shoreline as waves backwash gradually moving sand and pebbles sideways down a shoreline creating a beach. Due to the complimentary process of longshore drift, longshore currents unable to carry all of the sand around a headland, where the direction of the shoreline changes abruptly and recurves at a >30 degree oblique angle, meets the shoreline, backwashes perpendicularly and deposits sand at the headland creating a sandbar. This submerged bar continues to allow littoral drift to continue transporting sand in the direction of the breaking waves forming an aboveground sandspit (Wikipedia 2014).

Seasonal weather conditions largely affect the migration of sand at a beach and sandspit. With gentle summer winds and protected waves baffled by surrounding islands, daily and seasonally sands are shifted in the surf by longshore currents and deposited largely onto sandspits, beaches and dunes creating a dynamic and unstable marine environment. In addition winter storms delivering scouring ice dramatically alter the sand beach and dune ecosystems by removing and redistributing eroded sands. Four processes of barrier beach retreat are aeolian transport; the movement of air, overwash; storm induced surge of water and sand and inlet formation; a storm induced breach of the dune (Trudeau, Godfrey, Timson 1977). Initiation of aeolian transportation is controlled by wind velocity, the characteristics of sediments, beach morphology, moisture content and the degree of roughness elements present (e.g., driftwood and vegetation) (www.nature.com). Aeolian dune retreat, an additional process, involves the active migration of the sand in devegetated dune areas or from beaches into dunes. The accretion of sand builds up the existing dune enabling roots of stabilizing adaptive vegetation to take hold. Dune dynamics of sand transporting over the foredune ridge depends on speed, direction and duration of wind (Trudeau et. al 1977).

Highly diversified small invertebrates, bacteria and algae with specialized adaptations thrive in

an extremely harsh and constantly shifting sand beach environment. Bacteria, benthic diatoms and blue-green algae live in between sand grains and provide food for microscopic protozoan, crustaceans, invertebrate larvae and marine worms (Berrill and Berrill 1981) which subsequently fuel and support food webs for benthic, fish and wildlife species, as well as clarifying and improving the water quality by binding sediments, reducing erosion and improving habitat for rare and endangered plant and animal species. Sand beaches also serve as critical foraging, roosting and temporary staging areas for a multitude of migrating and residential shorebirds, seabirds, waterfowl and terrestrial birds. Endangered piping plovers and least terns nest on dry sand beaches and sand dunes high above the high tide zone where minimal disturbances occur.

Processes of barrier beach retreat, accretions of sand and intense erosion of the foredune ridge are all evident at Little Chebeague Island although further baseline studies including beach profiles are necessary to document processes of barrier beach retreat, accretion of sand and erosional degradation in response to storm surge, sea level rise, human and other environmental impacts. Yet, in order to provide baseline information to accurately measure these impacts USM interns, Brian Aseltine and Josiah Brown took GPS coordinates of set points at the eastern shoreline. From these set points beach migration and anthropogenic impacts can be studied over a longer period. For more information regarding these measurements please refer to Brian Aseltine's research project, *Island History: A Survey of Sensitive Sites at Little Chebeague Island.*

At the Main/Front Beach located on the eastern shoreline of Little Chebeague Island, a low lying, flattened (<1m) foredune ridge acts as a minimal barrier to the dune habitat and is easily flooded by the overwash and inlet formation particularly during high storm tides where surge waters sweep across the dune barrier and either deposit sand further back or etch out widening inlets.

This slightly elevated barrier, common to southern Maine coastline, is largely impacted by the recreation user. The foredune ridge adjacent to the camping and day use sites on LCI largely impacted by trampling and natural processes has eroded away and is lacking as a true barrier. There is presently no existing primary access path from the beach to the sensitive and unstable dune camping and day use areas. Also, camping regulations including restricting the number of camping nights have not yet been enforced. A lack of stewardship of these sensitive sites is resulting in extensive degradation of the foredune ridge. Inevitably the detrimental damage to the at risk dune ridge is a critical concern as population rises in the Casco Bay watershed leading to increased usage of islands for recreational purposes.

In addition the density of plants growing at the Main/Front Beach foredune ridge is relatively low due to the harsh, unstable condition brought on by desiccating winds, high salt exposure, souring winter ice abrasion and trampling of the plants by recreation users. Few plant species highly specialized for water, nutrient and salt stress have become established and are present at the foredune ridge. These hardy plants include sea rocket (*Cakile edentula*), beach pea (*Lathyrus japonicus),* salt sand-spurrey (*Spergularia silena),* pitseed goosefoot, (*Chenopodium berlandieri*) and Seabeach Orach, (*Orache cristata*).

The foredune ridge adjacent to the main camping area has minimal damage caused by foot traffic

and subsequently has a more pronounced foredune ridge barrier providing protection to the upper dune areas. Yet, inlet formations into the dune areas are visible, yet are small in size measuring <3m. These protected dunes are dense with vegetation, primarily graminoids such as American beach grass (*Ammophila breviligulata*) and sea lyme grass (*Leymus arenarius*) and herbaceous plants that are well adapted to the harsh environmental conditions.

Although these dunes are relatively stable, there are patches of disturbed, matted down American beach grasses where infrequent overnight tenting has occurred. According to the Trudeau, Godfrey and Timson study at Popham, Reid and Small Point Beaches once American beachgrass culms or plant branches are broken; they die (Trudeau et. al 1977). Additional prolonged tenting at these areas will create conditions too stressful and intolerable for the American beachgrass to survive. With large areas impacted and totally decimated, wind becomes an important factor moving sand around and preventing other plants from potentially stabilizing the area. Vegetation blowouts can also occur as the sand is minimized at a stressful site.

*Evidence of dune vegetation impacted by overnight camping*

Few herbaceous plants and dune grasses remain at severely impacted foredune areas including the main campsites, adjacent tenting areas and in front of the military burn building. Presently, highly specialized plants dominantly growing at the dune zone at the eastern portion of the island including, but are not limited to such graminoid species; American beachgrass (*Ammophila breviligulata*) and sea lyme grass (*Leymus arenarius*) and forbs such as beach pea, (*Lathyrus japonicus),* American sea rocket (*Cakile edentula*), common milkweed (*Asclepias syriaca*), black mustard (*Brassica nigra*).

*Severely impacted dune grass at main campsite area.*

Sensitive dune areas are stressed, unstable, compacted and becoming void of vegetation. As areas become deprived of dune plants, invasive species such as Oriental bittersweet (*Celastrus orbiculatus*) are quick to establish themselves. With fewer dominant beach grass species anchoring the sand, the area quickly becomes increasingly unbalanced and at risk for complete loss of sand. Although it seems that the impacted camping area would contribute to the natural process of beach retreat, it is probable that without the protection provided by these grasses, aeolian dune retreat is halted and the freshwater wetland directly behind the dune zone will become regularly inundated with saltwater and destroyed as well as the vital habitat, functions and foodweb so critical to the lives it serves including a multitude of terrestrial birds and wildlife that frequently forage there.

Aeolian dune retreat is limited at the eastern shoreline of Little Chebeague Island. With a large freshwater wetland, a dense impenetrable thicket of bittersweet and native shrubs such as bayberry, sweet gale and other upland plants, little space is available for the inland migration of the dune zone. The freshwater wetland encompasses a large area stretching from behind the southern sandspit stretching north past the privy to the second access path near the Clamwalk Trail.

*Eroding bluff contributing to accretion of sand at an LCI cobble beach.*

Historically natural processes causing eroded bluffs contribute to the accretion of sand, elevating the shoreline position and keeping equilibrium with rising sea level periods. As stated previously in this report The Intergovernmental Panel on Climate Change (IPCC 2013) projects a global atmospheric temperature increase ranging from the typical 2 degrees F to 11.5 degree F by 2100. Yet, as these global warming trends occur it is anticipated by climatologists that the sea level rise will accelerate to an alarming 3-6.6ft/year by 2100 (NOAA 2014). The most profound changes and impacts of this drastic sea level rise will likely be experienced at sand beaches. Maine's research team comprised of the Maine State Planning Office, the Marine Law Institute and Maine Geological Survey have developed different scenarios derived from national studies to assess vulnerability to projected changes in shoreline position caused by accelerated sea level rise. Preliminary sea level rise projections anticipate shoreline retreat of 50 to 600meters (150-2,000feet) during the next 100 years using a rise of 0.5m, 1.0m and 2.0m scenarios greater than today (U.S.EPA 1995). Although shoreline changes at beach areas are more difficult than other any other marine environments to evaluate, it is largely believed that if the sand dune system is not protected and the inland movement of the shoreline is obstructed, significant loss of the dry sand portion of the beach and surrounding dune areas due to inundation of sea water will most likely occur.

The natural processes of beach and dune retreat keeping pace with an accelerated sea level rise on LCI is somewhat restricted by the presence of an upland scrub/shrub barrier, a military structure and a large freshwater wetland behind the dune that runs adjacent to much of the eastern shoreline. As periods of climate change bring on substantial sea level rise it is anticipated that more occurrences of major overwash and inlet formations will impact areas of subsiding

land or migrated land with restrictive barriers. Without a substantial dune ridge, eroded foredune area plants will lose rooting stability, becoming submersed and therefore reducing the protection of freshwater wetlands from flooding salt water.

### 5.3.1 Conservation Management Strategies for Beach/Dune Habitat Protection

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Establishment of a MITA Task Force to improve island stewardship by implementing a conservation management plan of critical habitats named on Little Chebeague Island in order to define and prioritize human impact, degradation and loss to various habitat types (eelgrass, cordgrass, mudflats, rocky intertidal, dune/sand) by surface water contamination, by pollutants and stormwater runoff invading marine invasive species and green algae blooms.
- Establishment of a baseline study to further research barrier beach and aeolian dune retreat in response to an accelerated sea level rise. In addition research should address issues of natural barriers and physical obstructions that may prevent or hinder the progression of migration of the dune inland as an accelerated sea level rise occurs.
- Establishment of a baseline study to further research processes of erosion at the foredune, foredune ridge and adjacent bluff areas in response to natural and unnatural conditions. Place stakes to measure annual erosive actions from a permanent structure such as the military burn building or set GPS coordinates.
- Evaluate and prioritize beach and dune areas that are susceptible to flooding and further deterioration due to accelerated periods of sea level rise, human impact, erosion, storm surges and pollution.
- Evaluate carrying capacity for beach, dune and privy use to determine limitations for day use, overnight use and regulatory actions necessary to prevent further degradation of critical habitats. Persistent decline can be detected by utilizing seasonal surveys to assess activity (boating, wilderness based recreation, picnicking), use (camping or day use), size of party (carrying capacity), etc. during high use months of the summer. Surveys could be a responsibility of the on-site caretaker.

### 5.3.2 Methods of Control to Combat Impacts at Beach and Dune Zones

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- To protect and preserve foredune ridge from further deterioration from erosion and human impact place logs against the foredune ridge.
- To restore and accelerate existing vegetative growth at the foredune ridge and devegetated dune areas, plantings of American beachgrass, *Ammophila breviligulata* and Virginia wild rye, *Elymus virginicus*, should be planted and fertilized with seaweed annually to improve beach nourishment. Sowing native forbs and graminoids would also contribute to restoring the foredune ridge to its original state but mycorrhizal fungal inoculants may be needed although this practice is conflicted by restoration ecologists. For more information on restoration planting: Donald Harker's books, *Landscape Restoration Handbook.* (Available in print) or *USDA Restoration Handbook* (available on a CD-ROM).

- To order native grasses and herbaceous plants contact: American Native Plants: http://americannativeplants.net/ (410) 529-0552 or Mellow Marsh Farm: http://mellowmarshfarm.com (919) 742-1200.
- To further protect the adjacent dune areas place Virginia rose (*Rosa virginiana*) and other native plants to control movement to access ways to privy at trail head.
- To prevent use of preexisting trails plant Virginia rose in front of previous access point at the Main/Front Beach dune area.
- To protect the freshwater wetland from being inundated with sea water build a berm composed of small ridges and mounds with native plantings to anchor the soil. Native plantings should be quickly installed to stabilize the dune and should include plugs of grasses, herbaceous plants and woody shrubs with extensive root systems and root balls. Native plants are listed in Appendix A *The Vascular Flora of Little Chebeague Island*.
- To protect and stabilize the integrity of the foredune ridge and devegetated compacted, sand deprived dune areas use temporary wooded slat fencing to close off a portion of the dune that is a high use camping/day use area for 1-3years. A temporary fence should be installed on the beach three to five feet from the foredune.
- To show constant vigilance of habitat degradation caused by uncontrolled recreation use of dune habitat.
- To educate users of dune habitat protection and restoration projects with the use of interpretive measures particularly from July through Labor Day.
- To encourage processes of barrier beach retreat and dune retreat and allow for the natural inland migration remove temporary wooded fences, access boardwalks or temporary obstacles that may prevent sand accretion processes from occurring during winter months.
- To monitor the regeneration capacity of foredune plants the fencing may need to be adjusted accordingly, allowing ample space for beach visitors.
- To educate the public about dune closures place interpretive signs at the closed dune camping/day use areas.
- To alleviate pressures from recreation users encourage camping on the beach, southern sandspit and designated upland camping areas which are more likely to withstand impacts by limited use. During periods of extremely high tidal cycles designate camping in specific dune areas that can be rotated by on-site caretaker limiting the use of camping in dunes. Temporary small slatted platforms for tenting may be built over dune grasses allowing them to grow but ultimately be protected.
- To limit damage to foredune ridge by recreational impacts and natural erosive processes create a primary access trail directly to tenting dune sites. Outline trail with native plantings of graminoids and forbs or a slatted boardwalk so that grasses can grow beneath.
- To improve visitor accountability through regulation, impose a structured list of rules that is visible and understandable by the user at the beach. (Encourage campers to use the privy rather than “behind the bush”). Several sites were witnessed in the dune and upland areas demonstrating that the privy was not being used for campers further away.
- To improve water quality for swimmers encourage recreation users to respect an “Anchor Free Zone”. Designate an area for anchoring boats particularly as boaters and visitors increase.

- To account for increased usage of park consider adding an additional privy on western side of island. This would make the western shoreline more conducive to overnight camping or for a more primitive experience. There are several opportunities for clearing upland areas for possible designation of campsites.

### 5.3.3 Collaborative Efforts to Manage and Monitor Beach and Dune Habitats

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Collaboration and participation in the Maine Healthy Beach Program supported by the Maine State Planning Board and funded by U.S. EPA to properly monitor the water quality at the Main/Front Beach. Possible reclassification of water off LCI Main Beach by state regulatory agency may be necessary as usage of island beach increases.
- Collaboration with Maine EPA and Friends of Casco Bay Citizen Stewards Water Quality Monitoring Program and MITA Task Force to periodically conduct water quality studies of tidal zones of Little Chebeague and Great Chebeague Islands with particular focus on nitrogen pollution discharges from fertilizers used on nearby inhabited islands and mainland contributing largely to green algae blooms.
- Collaboration with Towns of Chebeague and Long Island to monitor and assess surface water pollutants and stormwater runoff from areas of significant impervious surfaces near the shoreline, private dwellings and agriculture sites on island. Suggestions of retention ponds, reductions of sediment of runoff, minimizations of impervious surfaces and the usage of natural drainages to improve conditions of surface water have been made for Great Chebeague Island by the Town of Chebeague Island Comprehensive Planning Committee (Natural Resources of the Town of Chebeague Island Report March 2009).
- Collaboration with Maine Island Ecologists for baseline research, monitoring studies and development of ecological restoration projects.
- Collaboration with Casco Bay Estuary Partnership and Oceanside Land Trust, nearby island communities and town officers to address the loss of critical habitats on islands in Casco Bay due to accelerated sea level rise.

### 5.3.4 Outreach Efforts

*(Performed by MITA Task Force, Caretaker and Volunteers)*

- Work to improve relationships between communities on nearby inhabited islands and MITA by engaging in educational outreach programs focusing on topics such as; water quality, (with impervious surfaces, surface water runoff carrying fertilizers and pollution deposits directly into nearby estuarial waters and largely affecting water quality and safe swimming in these waters).
- Work to improve outreach support with participants that are actively involved in environmentally based recreational and boating activities on or near the vicinity of the island.
- Place educational signs to interpret habitat functions of the highly specialized dune and beach ecosystems.
- Discussions of the growing concern of accelerated sea level rise and the loss of critical habitats, as well as erosion concerns at beaches and bluffs on islands in Casco Bay.

- Kiosk information listing preservation outreach efforts conducted by MITA conservation managers, community volunteers and on site caretaker on LCI.
- Information on Kiosk readily available to recreational enthusiasts of how to actively participate as a MITA volunteer at LCI including website information and contact numbers.

# 6. OTHER SIGNIFICANT MARINE HABITATS

## 6.1 Mudflat Habitat

Mudflats are biologically diversified regions that support large populations of shellfish, shrimp, mussels, quahogs, baitworms, small invertebrates (Larson and Doggett 1991). Organically rich sediments contain high concentrations of benthic diatoms which serve as the base of the benthic food web. Benthic diatoms contribute to clarifying the water by removing nutrients and toxins from mud, binding sediments and reducing coastal erosion. Subsequently, the sedimentation process supports plant growth, eelgrass germination and plant proliferation providing essential nursery and foraging habitat for Maine's vital commercial fisheries (Ward 1999). Bacteria, fungi and other microorganisms present support the food web for macrofaunal species like marine worms. 25 species of migrating and resident shorebirds, six species of herons, two species of egrets, glossy ibis, Canada geese, herring gulls and waterfowl use mudflats as roosting, staging and feeding grounds (USFWS 1980; Larsen and Doggett 1991).

Mudflats also function as storm water buffers to the upland by minimizing tidal and wave energy and impacting coastal shores from erosion processes. According to Maine DEP, mudflats are classified as highly sensitive to anthropogenic influences and are additionally ranked the most sensitive marine habitat to perturbations (Larsen and Doggett 1981). Due to flushing limitations mudflats recover slowly from physical disturbances and pollutants. With lessened wave velocity mudflats act as holding tanks for contaminants often accumulating toxins that are detrimental to the existing mudflat ecosystem.

Mudflats located adjacent to the western shoreline of Little Chebeague Island are productive areas that receive little to no impact by the occasional visitor passing over the adjacent sandspit and venturing out onto the mudflats. No dredging or dragging occurs here as well. However, the close proximity to Great Chebeague Island and the mainland increases the risk for contaminants entering the mudflats by surface and stormwater runoff over impervious surfaces, fertilizers from agricultural farms and nearby industrial point sources, etc. Evidence of green slime algae at the mudflats indicates that too much nitrogen is entering the ecosystem. Yet, stewards of Friends of Casco Bay conducting water quality assessment studies indicate that the water in the mudflat vicinity is generally of good water quality overall in comparison to water from other areas studied in the bay (Friends of Casco Bay 2010) possibly due to the longshore currents created between nearby sandspits. Similar actions to improve and monitor mudflat habitat can be identified at the eelgrass habitat section (5.2) of this report including ways to minimize disturbance, boating and fishing activities, human impact, improvements to water quality and educational interpretation necessary for mudflat habitat conservation.

## 6.2 Mix Coarse and Fine Flat Habitat

Mix coarse and fine flats classified as an additional critical habitat have similar functions as sand

flats and mud flats; however they usually support fewer numbers of animals and are less biologically diverse (Ward 1999). Mix coarse and fine flats located in the low intertidal zone compared to middle or high intertidal zones are classified by the DEP as having moderate to high sensitivity to disturbance because they have greater functions, values and support larger populations of opportunistic species.

Benthic algae, bacteria, small invertebrate occupying mix coarse and fine flat habitat boost the food web and further support the health and condition of the marine habitat. Snails, amphipods, isopods, polychaete and oligochaete worms, nematodes, earwigs, barnacles, limpets, moon snails, sensitive species; nudibranchs, small clams, hydroids, dog winkles and hermit crabs, sand shrimp, oysters and tube worms live in or on mixed coarse flats in Maine (Larsen and Doggett 1981). Macro-algae and eelgrass proliferate as well as and amphipods in adjacent wrack line providing food and foraging habitat for 24 shorebird, American black ducks, great blue herons and wading birds, terns and gulls (USFWS 1980). In addition potential nesting habitat for spotted sandpipers between April and June may be supported at these ever changing environments.

Production of species is high in this unstable, unvegetated environment where greater wave action constantly rolls cobble and gravel creating a sensitive environment where only few species can colonize. Juvenile lobsters are one of them. From May through November juvenile lobsters and other commercial fish are born and live under boulders and cobbles. Lobsters, quahogs, periwinkles, blue mussels, Irish moss, knotted wrack, kelp, rock crabs and mud shrimp all are present in this economically and ecologically rich low intertidal rocky environment (Ward 1999).

Mix coarse and fine flats require continual sources of fine sediments from upland bluffs and coastal erosion to keep surface layers from becoming depleted of fine grains. In areas where mix coarse and fine sediments are eroded away, hard clays left behind alter the species composition and productivity of the flat (Ward 1999). Per our field observations, there are large bluffs measuring 4ft+ contributing to the health and productivity of the mix coarse and fine flat habitats at LCI by depositing fine grain sediment at the northwestern and southeastern beaches and intertidal areas. Renewable resources of fine grain sediments entering these regions largely support the structure and composition of their current condition. As sea level rise accelerates land managers anticipate these erosive bluffs will continue to add fine sediment to the intertidal regions moving landward keeping pace with the rising sea.

However, at the western shoreline (GPS coordinates 43° 42.867" N, 70° 08.939" W) we observed significant erosion has been taking place over an extended period of time where eroded and weakened steep clay bluffs have led to five unstable landslide areas measuring between the smallest slide at 6mx7m, to the largest slide at 11mx24m. All slides show evidence of deep bowl depressions which indicate the weakness and instability of the non-vegetated slump scars or slopes as a result of rapid soil movement. As landslides composed of fine grained clay erode, deposits of sediment directly into the mix coarse and fine flat habitat have occurred at various rates and bluff conditions pertaining to slope, shape and amount of anchored vegetation. As a result of additional heavy clay in the intertidal zone possible degradation of sensitive flora and faunal species such as white seablite (*Suaeda maritima*) and juvenile American lobsters (*Homarus americanus*) may have happened in areas that have terraced with deposited sediments near the base of the bluff. Continual landslides caused by accelerated sea level rise and erosional processes that contribute to

displacing the earth are expected. In order to prevent further landslide damage gabions made of old lobster traps could be installed securing the soil and allowing for revegetation of native plants which could effectively anchor the soil. This remedy is recommended due to the instability of the area, potential high risk of eminent danger and possible threats of liability issues particularly because of the present location the Cottage Trail leading visitors along the edge of the infringing slide. Future studies and actions are needed to assess the extent of damage, as well as environmental and recreational impacts at the tidal habitat and landslide region of the western shoreline.

*Large landslide area located at western side of LCI.*
(*Note the non-native coltsfoot plants moving into disturbed soils*)

## 6.3 Ledge Habitat

Ledge habitats are one of the most valued intertidal ecosystems due to their diverse and productive populations, ecological functions and values. With different levels of resiliency depending on wave velocity, exposure and location within the intertidal zone, species such as macroalgaes and invertebrates (barnacles, mussels, limpets), with specialized adaptations can survive the battering high surf. Ledge habitats found in the high intertidal and subtidal regions experiencing limited pounding surf are more likely to have organisms that are protected from powerful waves and are more commonly submerged at the high intertidal to subtidal regions of the rocky shore such as sea urchins, lobsters, sponges, sea stars, rock crabs, anemones and blood stars.

*Ledge habitat at Little Chebeague Island*

Ledge habitats have three levels of DEP classifications based on their location in the intertidal zone. High rankings have been assigned designating species with an increased sensitivity to disturbance that can only survive in these environments such as species found at the intertidal zones of ledge where supported species are restricted and cannot tolerate disturbance, salinity changes, desiccation or pollution. Mid intertidal zones on the ledge with algae are classified as moderately sensitive to disturbance. Ledges at the mid and high intertidal zones without algae are considered "inhospitable environments" and are subsequently classified as low sensitivity habitats (Ward 1999).

Rockweeds, kelps, other macroalgae and Irish moss compete for optimal attachment sites on the ledges that are less exposed to the elements. As they attach further plants and animals are supported creating a safe marine nursery, foraging ground and shelter from wave and wind exposure, temperature extremes, ice scour, desiccation and other physical factors. Tidepools located at the ledge region provide refuge and habitat for brittlestars, amphipods, scale worms, plants, invertebrate, fish, sea urchins, sponges, hermit crabs, lumpfish, pollock, sticklebacks, sculpins, sea snails, arctic clams, chitons, limpets, sea anemones, sponges, rock gunnel, nudibrachs, invasive tunicates and worms ( Brown 1993). In addition seabirds (including endangered least terns), shorebirds (including endangered piping plover) and sea ducks (including harlequin ducks) prey on snails, mussels, juvenile fish, amphipods and other invertebrates on the rocky shores. Ledges are also foraging sites for mink, terrestrial birds and migrating species such as brant in the spring (USFWS 2013). They also function as "haul outs" for gray seals and harbor seals.

Ecological functions of ledge habitats are valuable to these marine species. Oxygen production by plants anchored in the intertidal ledge zone improves water quality and ecosystem productivity. Ledges intercepting high velocity waves slow the current, subsequently filtering contaminants,

increasing sedimentation and recycling nutrients leading to the formation of soft bottom habitats. As plants and marine organisms die and break down detritus is produced and exported to nearby microbial, estuarine and offshore food webs (Ward 1999).

Direct and indirect threats exist for these critical ledge habitats. Resuspension of sediments from nearby fishing operations and boating activities can damage ledges by smothering animals. Pollution from stormwater runoff from nearby islands and mainland point and non-point sources can contaminate freshwater discharges empting out poisons into the bay. Storm surges and scouring ice from winter storms damage and remove organisms attached. As precipitation and severity of storms increases due to climate change these habitats may be impacted more frequently from scouring ice. However, this tidal marine habitat will see less abuse from rising sea levels in comparison to other coastal habitats due to the structural durability of the rocky ledge. In addition rockweed, kelp and other macroalgaes can be torn away from the rocky ledge shoreline by passing island visitors. Similar actions to improve and monitor ledge habitat can be identified at the eelgrass habitat section (5.2) of this report including ways to minimize disturbance, boating and fishing activities, human impact, improvements to water quality and educational interpretation necessary for ledge habitat conservation.

In addition to these recommendations, monitoring studies could be implemented to evaluate possible adverse biological effects of sedimentary contaminants in marine and estuarine environments surrounding LCI. Research conducted in our country and other countries, such as: Japan, Russia and Taiwan that have high levels of trace metals and other pollutants in their bays study the bioaccumulation of resuspended soft bottom sediments to reveal levels of pollutants in bays as well as monitoring indicator species, such as; ivory barnacle (*Balanus eburneus*), blue mussels (*Mytilus edulis*) and horseshoe crabs (*Limulus polyphermus*). Barnacles have the ability to ingest and store high levels of pollutants and can subsequently predict their habitat state. These species can also be used to study climate change.

# 7. FRESHWATER WETLAND HABITAT

## 7.1 Functional Assessment Methodology

The wetland functional assessment was performed pursuant to the approach described by the Army Corps Highway Methodology Workbook Supplement: Wetland Functions and Values (U.S. ACOE, 1995). In this "Descriptive Approach" to functional assessment, the evaluators first determine if particular functions and values are present and why, followed by a determination of what functions and values are principal and why. Functions and values can be considered "principal" if they are an important physical component of a wetland ecosystem (function only) and/or are considered of special value to society, from a local, regional and/or national perspective. When making determinations on the wetland, evaluators are encouraged to determine whether the wetland has the potential to serve the functions and values as well. Included as Appendix C is a list of standard, but flexible, rationale factors that describe the numbered factors included on the Wetland Function Evaluation Forms in Appendix B.

Below is a brief description of "function" and "value" as they relate to this report followed by a list of commonly accepted functions and values used in this evaluation:

**Functions** are self-sustaining properties of a wetland ecosystem that exist in the absence of society and that result from both living and non-living components of a specific wetland resource. These include all processes necessary for the self-maintenance of the wetland ecosystem such as primary productivity and nutrient cycling, among others. Therefore, functions relate to the ecological significance of wetland properties without regard to subjective human values.

**Values** are benefits that derive from one or more functions and the physical characteristics associated with a wetland. Most wetlands have corresponding societal value. The value of a particular wetland function, or combination of functions, is based on human judgment of the worth, merit, quality or importance attributed to those functions.

*Groundwater Recharge/Discharge:* This function considers the potential for the wetland to serve as a groundwater recharge and/or discharge area. It refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

*Floodflow Alteration (Storage & Desynchronization):* This function considers the effectiveness of the wetland in reducing flood damage by attenuation of floodwaters for prolonged periods following precipitation events and the gradual release of floodwaters. It adds to the stability of the wetland ecosystem or its buffering characteristics and provides social or economic value relative to erosion and/or flood prone areas.

*Fish and Shellfish Habitat:* This function considers the effectiveness of seasonal or permanent watercourses associated with the wetland in providing fish and shellfish habitat.

*Sediment/Toxicant/Pathogen Retention:* This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants or pathogens in runoff water from surrounding uplands, or upstream erosive wetland areas.

*Nutrient Removal/Retention/Transformation:* This function considers the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands and the ability of the wetland to process these nutrients into other forms or trophic levels. One aspect of this function is to prevent ill effects of nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers or estuaries.

*Export:* This function evaluates the effectiveness of the wetland to produce food or usable products for man or other living organisms.

*Sediment/Shoreline Stabilization:* This function considers the effectiveness of the wetland in stabilizing stream banks and shorelines against erosion.

*Wildlife Habitat:* This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and migrating species are considered.

*Recreation:* This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting and other active or passive recreational activities.

*Educational/Scientific Value:* This value considers the suitability of the wetland as a site for an

"outdoor classroom" or as a location for scientific study or research.

*Uniqueness/Heritage:* This value considers the effectiveness of the wetland or its associated waterbodies to provide certain special values, including archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, or its relative importance as a typical wetland class for the geographic location.

*Visual Quality/Aesthetics:* This value considers the visual and aesthetic quality or usefulness of the wetland.

*Endangered Species Habitat:* This value considers suitability of the wetland to support threatened or endangered species.

## 7.2 General Site Conditions and Wetlands Descriptions

Wetland Scientist, Heather Storlazzi Ward, visited LCI on five different occasions in 2013 (April 27, June 14, July 25, October 17 and November 11) to document the presence, approximate extent and quality of freshwater wetlands. Wetland boundaries were estimated and hand-sketched onto a map. Formal wetland delineation was not part of this evaluation. In addition to wetland determinations, a Functional Assessment was performed for each wetland, descriptions follow in section 7.3.

The project area is divided into five general freshwater wetland areas. With the exception of one wetland area (wetland I-2), all wetlands appear to be natural wetlands, not created as the result of anthropogenic activity. Wetlands have been labeled using an alpha-numeric system where "I" indicates Inland position (as opposed to coastal position) and the number indicates the individual wetland. Wetlands I-1, I-2, I-3, I-4 and I-5 are described below.

***Table 1. Estimated Area within Mapped Wetlands and Wetland Classification***

| Freshwater Wetland ID | Wetland Name | Estimated area in acres | Wetland Type | Wetland Classification* |
|---|---|---|---|---|
| Wetland I-1 | Northeast Wetland | 5 acres | Emergent/scrub-shrub | PEM1/SS1E |
| Wetland I-2 | Historic Basement | 1/8 acre | Scrub-shrub, excavated | PSS1Ex |
| Wetland I-3 | Central Wetland | 5 acres | Scrub-shrub | PSS1E |
| Wetland I-4 | Southern Wetland | 10 acres | Forested/scrub-shrub/ emergent | PFO1/SS1/EM1E/J |
| Wetland I-5 | Northwest Wetland | 5 acres | Emergent/scrub-shrub | PEM1/SS1E |

*See Appendix D for Wetland Classification Key

## 7.3 Findings of Functional Assessment

### *7.3.1 Wetland I- 1: Northeast Wetland*

Wetland I-1 is located within the northeast quadrant of LCI and drains along the northern slope in a northerly direction from the interior portions of the island towards the coast. A footpath and some resulting minor erosion is associated with the outlet points of the wetland, closer to the beach where cobble has been placed along the drain in an effort to stabilize the erosion and provide structure to the footpath. Other outlets onto the beach drop off elevated eroded slopes onto cobble and sand beaches situated on the north shore of the island. Wetland I-1 is estimated to be about 5 acres.

*Wetland I-1*

Wetland I-1 is an emergent and scrub-shrub wetland. The classification commonly referred to as the Cowardin Classification identifies this wetland as a palustrine emergent, persistent/scrub-shrub, broad-leaved deciduous wetland that is seasonally saturated/flooded (PEM1/SS1E). Its hydrology is primarily driven by groundwater seeps with atmospheric deposition and runoff contributing to the surface water component. It is dominated by speckled alder (*Alnus incana*), common winterberry (*Ilex verticillata*) and bayberry (*Myrica pennsylvanica*) in the shrub layer. The herbaceous layer is dominated by approximately 80% sensitive fern (*Onoclea sensibilis*). Portions of the wetland canopy are overcome by the invasive oriental bittersweet (*Celastrus orbiculatus*).

A narrow drainage swale (~ 3’ - 4’ wide) within Wetland I-1 was documented during field surveys in April and November, 2013. Although dry at the time of field survey, the scouring impacts of the

surface runoff have created erosion at the outlet. This area is also used as a foot path to enter into the adjacent upland forest. As mentioned above, cobble has been placed along the erosion to provide temporary stabilization. The swale is located at the toe of the slope on the northern boundary of Wetland I-1 and captures a significant quantity of runoff from the road and hillslope.

*Wetland I-1: Eroded outlet/footpath protected with cobble.*

Areas of wetland I-1 within 250 feet of a coastal wetland will be classified as Wetland of Special Significance (WoSS). This status elevates the protection at the state level a wetland receives. Field investigation of Wetland I-1 found that the wetland provides or has the potential to provide the following functions and values: *ground water recharge/discharge, production export, sediment/shoreline stabilization* and *wildlife habitat* (see evaluation form in Appendix B). While the wetland has the capacity to provide all of these functions and values, the principal functions served by Wetland I-1 are:

- Groundwater Recharge/Discharge
- Wildlife Habitat

From a functions standpoint, wetland I-1 has the capacity to discharge freshwater to the soil surface. The wetlands small size diminishes its capacity to collect and discharge water; however the presence of freshwater may be an asset in terms of wildlife habitat, as there are no known perennial or year-round surface water sources on the island. Even seasonal discharge may greatly benefit wildlife habitat on the island as providing a temporary source of moisture to plants and wildlife. In addition, the thick cover of this wetland in comparison to the open understory of adjacent woodlands provides cover to the smaller mammals and passerine bird species. Cover

extends down to the adjacent beaches providing quick shelter from the open beach. No tracks or other wildlife sign were observed during the field assessment in November. The presence of invasive plant species in wetland I-1 limits habitat potential.

### *7.3.2 Wetland I- 2: Historic Basement*

Wetland I-2 is situated centrally within the historic resort complex which thrived in the late 1800's. This wetland appears to be the result of the hotel foundation excavation and is entirely of anthropogenic origin. It is situated near the top of the slope and does not appear to sustain water for long periods of time. Wetland I-1 is estimated to be about 1/8 of an acre.

*Wetland I-2 appears to be the result of anthropogenic activity: hotel related structure foundation.*

Wetland I-2 is classified as a palustrine scrub-shrub, broad-leaved deciduous wetland that has been excavated (PSS1Ex). Its hydrology is primarily driven by surface water runoff, atmospheric deposition and some limited groundwater contribution. Vegetation is sparse and consists of speckled alder and common winterberry in the shrub layer. The herbaceous layer is equally sparse and consisted of very few unidentifiable gramminoids. Similar to wetland I-1, the upland edges of this excavated basin are becoming overcome with invasive plants such as oriental bittersweet.

Wetland I-2 has no inlets or outlets. It is not a candidate for WoSS.

Field investigation of Wetland I-2 found that the wetland provides or has the potential to provide limited *floodflow alteration*. The functions of this wetland are severely limited due to its size,

depth and position in the landscape. There are no principal functions or values associated with this wetland.

### *7.3.3 Wetland I- 3: Central Wetland*

Wetland I-3 is situated within the interior portions of the island within the southwest quadrant of LCI. It is medium sized, approximately 5 acres and while it is jurisdictionally and hydrologically connected to wetland I-4, it has been identified and evaluated separately due to landscape position and characteristics which make it unique. Out of all the wetlands on LCI, wetland I-3 is the least impacted by anthropogenic activity. Its central location surrounded by thick vegetation and no known trail make it relatively difficult to find and access. Wetland I-3 drains both to the north and to the south. Three outlets were observed along the northern coast. Although these outlets can be flashy and appear to release significant quantities of water seasonally, for the most part they are stable and are able to hold water during the drier months of the growing season. At the time of field work water was observed in the channel at a slow trickle. Outlets empty along an eroded slope on the northern shore. Minor and expected erosion is associated with the outlets. As stated, some water drains in a northerly direction, however a majority of the catchment area drains to the south towards wetland I-4. Wetland I-4 is a PFO1/SS1/EM1E/J wetland that is situated along the southern coast of LCI.

*Wetland I-3: Ponded areas within this scrub-shrub wetland may provide habitat for breeding amphibians.*

Wetland I-3 is a palustrine scrub-shrub, broad-leaved deciduous wetland that is seasonally saturated/flooded (PSS1E). Its hydrology is primarily driven by groundwater discharge with

atmospheric deposition and stormwater runoff contributing to the surface water component. It is dominated by speckled alder, common winterberry and broadleaf meadowsweet (*Spiraea latifolia*) in the shrub layer. The herbaceous layer is sparse, tending to have areas of inundation and ponding which prevent prolific establishment of annuals. The herbs that are present include sphagnum moss, sensitive fern (*Onoclea sensibilis*), bristly dewberry (*Rubus hispidus*), lady fern (*Athyrium filix-femina* (L.)) and blueflag iris (*Iris versicolor*). Areas of what is believed to be a watercress species were also found; however the distribution and habit of the plant does not indicate the invasive kind. Watercress (*Rorippa nasturtium-aquaticum* (L.)) was found in semi-aquatic areas of the wetland at about 15%. Wetland borders were observed to have approximately 5% of the invasive bittersweet (*Celastrus orbiculatus*) spreading towards the canopy - a manageable amount that would benefit from maintenance cuts.

Wetland I-3 is a basin-like configuration situated on a relatively flat plateau. This basin-like form allows surface water to pond seasonally, likely creating habitat for amphibians. Ponded water was present at the time of the survey in the fall; approximately 0-6" was observed intermittently throughout the basin, in and amongst rooted elevated sphagnum-covered masses and hummocks. As described earlier, three narrow drainage swales/outlets (~ 3' - 4' wide) within wetland I-3 were documented during field surveys in November, 2013. Although not flowing at the time of field survey, the scouring impacts of the surface runoff have created an eroded channel that appears relatively stable. The channels had about 0-5" of standing water within at survey time. Mucky mineral soils characterize the swale, indicating a relatively low-energy flow. The outlets flow to the north shore beach.

*Wetland I-3: Narrow drainage swale acts as outlet for wetland I-3.*

Portions of wetland I-3 may be situated within 250 feet of coastal wetland. If so, they will be considered WoSS.

Field investigation of wetland I-3 found that the wetland provides or has the potential to provide the following functions and values: *ground water recharge/discharge, floodflow alteration, production export and wildlife habitat* (see evaluation form in Appendix B). While the wetland has the capacity to provide all of these functions and values, the principal functions served by wetland I-3 are:

- Groundwater Recharge/Discharge
- Wildlife Habitat

From a functions standpoint, wetland I-3 has the capacity to discharge freshwater to the soil surface. This wetland is able to collect (and discharge) quantities of water which benefit local wildlife populations. Mammals, reptiles, birds and amphibians alike benefit from the ponded water. A vernal pool survey was not conducted, however waterstaining, water marks, moss lines and other indications of inundation and ponding point to the wetlands ability to provide suitable habitat for amphibian breeding. As stated above, there are no known perennial or year-round surface water sources on the island, increasing the value of this wetland to wildlife. Similar to wetland I-1, the thick cover of this wetland in comparison to the open understory of adjacent woodlands provides cover to the large and small mammals as well as passerine bird species. Cover extends down to the adjacent beaches providing a quick shelter from the open beach. No tracks were observed during the field assessment in November. The presence of invasive plant species in wetland I-3 is currently manageable.

### *7.3.4 Wetland I- 4: Southern Wetland*

Wetland I-4 is situated along the south coast of Little Chebeague Island. It is the largest wetland evaluated in this report totaling approximately 10 acres. While it is jurisdictionally and hydrologically connected to wetland I-3, it has been identified and evaluated separately due to landscape position and characteristics which make it unique from I-3. Out of all the wetlands on LCI, wetland I-4 contains the greatest variety of covertypes and habitats on the island. Some internal areas are relatively undisturbed by human activity, while other areas closer to the coast and hub of activity show its impact by human use. The emergent portion of this wetland in particular is threatened by overuse of adjacent camping. Barrier dune located between the wetland and the beach is often used as tent site for visitors. While it is ideal for overnight camping (flat, well-drained, high-ground, south-facing) the overuse by campers is compacting the soil and crushing the vegetation. Setting up tents on top of the dune grasses will crush the stems while soil compaction will make re-establishment and new plant growth difficult. Once vegetation is devoid in the area soil erosion (via wind and/or water) may take place in effect removing the protective barrier between the ocean and the wetland.

One outlet was observed along the southern coast. This outlet appears to also serve as an inlet during storm surges. During the four visits a broad spectrum of conditions was observed in the channel ranging from flooded to no water within the channel. Soils are sandy and excessively well drained. This wetland is partially situated along a hillside (where it is connected to wetland I-3) however the dominant setting of this wetland is along flat terrain with a long, linear wetland shape.

Wetland I-4 is a combination of three dominant wetland classes: forested, scrub-shrub and emergent. The classification commonly referred to as the Cowardin Classification identifies this wetland as PFO1/SS1/EM1E/J, which means palustrine forested, broad-leaved deciduous/scrub-shrub/emergent persistent wetland that is seasonally saturated/flooded. Its hydrology is primarily driven by groundwater discharge and stormwater runoff with atmospheric deposition contributing to the surface water component. The forested portions of the wetland are situated along the southern-most tip of the island where wetland I-3 drains into I-4. This area of the wetland is dominated by red maple (*Acer rubrum*) in the canopy. The shrub layer contains speckled alder, broadleaf meadowsweet and common winterberry. The herbaceous layer is quite sparse and dominated by sensitive fern.

The emergent (PEM1E/J) portion of the wetland is situated along coast and can be observed and accessed from the beach. It is situated between the forested and scrub shrub portions of this wetland. It appears to pond water seasonally, providing suitable habitat for breeding amphibians. It is contains broad areas dominated by narrowleaf cattail (*Typha angustifolia*); other areas are a relatively even mix of sedges and rushes, including woolgrass (*Scirpus cyperinus*), soft rush (*Juncus effuses*), saltmarsh cordgrass (*Spartina alterniflora*), softstem bulrush (*Schoenoplectus tabernaemontani*) and river bulrush (*Schoenoplectus fluviatilis*). Areas of black bindweed (*Fallopia convoluvus*), sensitive fern and blueflag iris (*Iris versicolor*) were observed as well. This emergent wetland has high structural diversity. Areas of open water are interspersed with vegetation within some portions and other areas a thick with herbaceous plants. This wetland may receive flushes of salt water from infrequent storm surges. As such, species growing within this wetland are salt tolerant.

*Emergent portion of wetland I-4*

*Another photo of emergent portion of wetland I-4*

The scrub-shrub (PSS1E) portion of the wetland is located within two distinct areas of wetland I-4. This portion of the wetland is also situated along the coast and both scrub-shrub areas can be observed and accessed from the beach. One scrub-shrub area is situated far to the east. It is bisected from the PEM portion by a trail leading up the slope to the privey and inland trails network. The second area is located further to the west, closer to the forested wetland covertype. Unlike the PEM portion, it does not pond water and it does not receive salt water flushes, although may receive onshore winds and salt sprays. This portion of the wetland receives its hydrology primarily through groundwater discharge, surface water runoff and atmospheric deposition. The canopy is dominated by speckled alder. Limited amounts of elderberry (*Sambucus canadensis*) were also observed. The herbaceous layer is relatively thick (as compared to other PSS areas) being mainly composed of jewelweed (*Impatiens capensis*) and cleavers (*Gallium* sp.) with less common jack-in –the-pulpit (*Arisaema triphyllum*). Most of the surrounding upland around this wetland is dominated by the invasive Asiatic bittersweet and appears to be closing in on the wetland. The mid-canopy portions of this wetland boundary are becoming populated by the bittersweet and threaten the integrity of the native vegetation within this portion of wetland I-4. Maintenance cuts to keep the bittersweet out of the internal wetland areas would benefit wetland I-4 greatly.

A second, distinct scrub-shrub habitat area within wetland complex I-4 is situated to the west of the emergent area. This scrub-shrub wetland is largely dominated by bayberry (*Myrica pensylvanica*). The area immediately surrounding the wetland is thick with poison ivy (*Toxicodendron radicans*). Other herbs observed at the fringes of this wetland area include dark green bulrush (*Scirpus atrovrirens*), New York aster (*Symphyotrichum novi-belgii*) and beach pea (*Lathyrus japonicas* ).

*Scrub-shrub component of wetland I-4 showing bayberry dominated area.*

The forested component (PFO1E) of wetland I-4 is situated furthest west and extends into higher elevations of the island where it connects with wetland I-3. Wetland I-3 drains in a southerly direction into wetland I-4. They are jurisdictionally and hydrologically contiguous. The canopy of this wetland covertype is dominated by red maple. The understory is composed of speckled alder, broadleaf meadowsweet, common winterberry and sensitive fern in the herbaceous layer.


*Forested component of wetland I-4*

Portions of wetland I-4 within 250 feet of coastal wetlands are Wetland of Special Significance. Field investigation of wetland I-4 found that the wetland provides or has the potential to provide the following functions and values: *round water recharge/discharge, floodflow alteration, production export, sediment/shoreline stabilization, wildlife habitat and uniqueness/heritage* (see evaluation form in Appendix B). While the wetland has the capacity to provide all of these functions and values, the principal functions served by wetland I-4 are:

- Groundwater Recharge/Discharge
- Sediment/Shoreline Stabilization
- Wildlife Habitat

Similar to wetlands I-1 and I-3, wetland I-4 has the capacity to dishcharge freshwater to the soil surface. Sandy soils create a filtration matrix, cleansing the water as it moves through the soil profile. This wetland is able to collect (and discharge) quantities of water which benefit local wildlife populations. Mammals, reptiles, birds and amphibians alike benefit from the ponded water. A vernal pool survey was not conducted, however ponding, waterstaining and other indications of inundation and ponding point to the wetlands ability to provide suitable habitat for amphibian breeding. Infrequent storm surge flushes may inhibit amphibian activity by introducing a source of salt too great for freshwater amphibian activity. A vernal pool survey during late April through early May could confirm the presence/absence of breeding amphibians. As stated above, there are no known perennial or year-round surface water sources on the island, increasing the value of this wetland to wildlife. The diverse nature and structural integrity of this wetland provide several different habitats for area wildlife. Fresh beaver cuttings were observed within the alder scrub-shrub component, although no stream or surface water was observed. Deer scat and beds were observed both within the wetland and surrounding uplands. Wetland areas closer to the coast have the ability to absorb the oceans force during storm surges. Wetlands contain a high density of both herbaceous plants and shrubs which have deeply embedded root systems within the soil profile which act as soil anchors, protecting against erosion. Herbaceous plants protect the soil surface from raindrop impact while shrub root systems protect against more forceful wave action. These wetlands also act to absorb wave action energy, reducing the erosion of beach/dune sand. The basin-like shape of these wetlands acts as a holding basin and has the ability to dissipate excessive energy. In this way these wetlands protect the southeast facing shore.

### *7.3.5 Wetland I- 5: Northwest Wetland*

Wetland I-5 is situated along the northwest coast of LCI, near Target Point. It is a moderately sized wetland estimated to be about 5 acres. It is not believed to be jurisdictionally and hydrologically connected to other wetlands on the island. Wetland I-5 is long and narrow, running parallel to the beach. It is situated on a gently sloping plateau and drains to the north. This wetland does not appear to be highly impacted by visitors, thus it is relatively undisturbed even though it is readily accessible from North Beach. Because it is so close to the shore wetland I-5 likely receives regular salt sprays and possibly some flooding from storm surges. Salt tolerant species were observed in the lower elevation area closer to the shore. No defined outlets were observed, rather the wetland appears to evenly drain from the plateau onto the beach.

Wetland I-5 is a combination of two wetland classes: scrub-shrub and emergent. The Cowardin

Classification identifies this wetland as PSS1/EM1E, which means palustrine scrub-shrub, broad leaf deciduous /emergent, persistent wetland that is seasonally saturated/flooded. Its hydrology is primarily driven by groundwater discharge and stormwater runoff with atmospheric deposition contributing to the surface water component. The emergent components of wetland I-5 are situated along the lower elevations of the wetland, closest to the beach while the scrub-shrub portions sit higher in elevation along the island plateau. A distinct covertype break demarcates these two wetland classification types.

The lower lying emergent areas are dominated by wool grass (*Scirpus cyperinus*), narrowleaf cattail, goldenrod sp., common dodder (*Cuscuta epithymum*) and soft rush. The larger, scrub-shrub wetland component is dominated by speckled alder.

*Emergent portion of wetland I-5 in foreground, scrub-shrub in background.*

Portions of wetland I-5 within 250 feet of coastal wetlands are Wetland of Special Significance. Field investigation of wetland I-5 found that the wetland provides or has the potential to provide the following functions and values: *ground water recharge/discharge, floodflow alteration, production export, sediment/shoreline stabilization, wildlife habitat and uniqueness/heritage* (see evaluation form in Appendix B). While the wetland has the capacity to provide all of these functions and values, the principal functions served by wetland I-5are:

- Groundwater recharge/Discharge
- Sediment/Shoreline Stabilization

Wetland I-5 has the capacity to discharge smaller quantities of freshwater to the soil surface. Water is not detained by a constricted outlet, so the value to local wildlife populations is lower than in those wetlands which have the ability to serve as a freshwater drinking source. This wetland is situated along the north shore of North Beach. Its long, linear shape and position serve to protect uplands from erosive storm surge forces. Wetland areas closer to the coast have the ability to absorb the oceans force during storm surges. Wetland I-5 contains a high density of both herbaceous plants and shrubs which have deeply embedded root systems within the soil profile which act as soil anchors, protecting against erosion. Herbaceous plants protect the soil surface from raindrop impact while shrub root systems protect against more forceful wave action. These wetlands also act to absorb wave action energy, reducing the erosion of beach/dune sand.

# 8. NATURAL RESOURCE MANAGEMENT ISSUES

## 8.1 Ticks and Mice

Large wood tick (*Dermacentor variabilis*) and deer tick (*Ixodes scapularis)* populations exist on Little Chebeague Island. However, it is the latter that carries the causative lyme bacteria agent, *Borrelia burgdorferi*, which is responsible for transmitting Lyme disease and consequently becoming a more problematic natural resource issue for land conservation and natural resource managers providing safe recreational space at coastal islands in Maine.

The deer tick's feeding cycle includes three feeding times in its life cycle. The first bite is in the larval stage. Typically, a deer tick carrying the spirochete bacteria will initially bite a white-footed mouse (*Peromyscus Leucippus*), small rodent or bird. The second bite is in the nymphal stage and usually occurs the following spring or early summer. It is at this life stage that most humans and white-tailed deer (*Odocoileus virginianus*) are bitten and infected with the Lyme bacteria due to its small unnoticeable size (Miller 2013).

Currently the Center for Disease Control and Prevention (CDC) is funding a three year, $900,000 study conducted by Yale University's Connecticut Emerging Diseases Program, Western Connecticut State University and CDC to research the best combination of strategies to combat the spread of Lyme disease (Miller 2013). Many methods of control to eliminate ticks exist including hunting deer and physically removing the tick from the human host however, entomologists believe that applying insecticide, Fipronil, directly on the mouse host may be a productive measure. Kirby Stafford, Conn. Agriculture Experiment Station entomologist, has successfully been using mice bait boxes lined with a Fipronil coated brush applied to mice to minimize deer tick populations for years on Mason Island (Miller 2013).

Although in its primitive phase this management strategy may be a useful method to reduce the deer tick population on LCI. Fipronil usage has been approved by the EPA and is a readily available insecticide.

For further information regarding this study see the following website:
http://wildlife.org/newengland/sites/wildlife.org.newengland/files/stafford.pdf

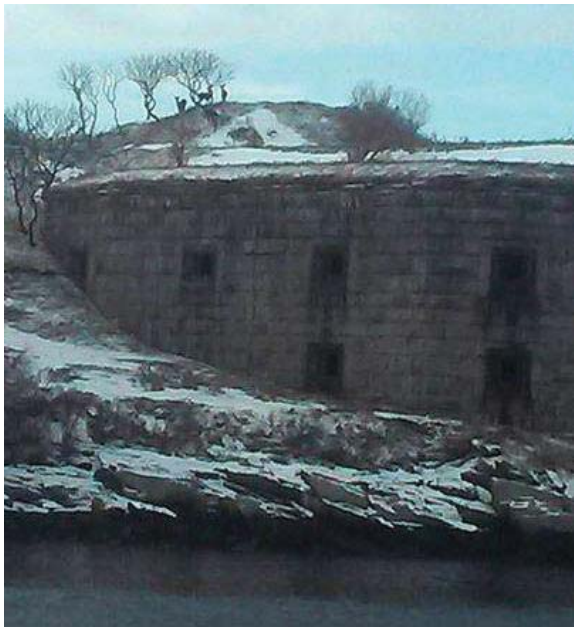
To learn if you are eligible to participate in the tick study, go to
http://www.cdc.gov/ticknet/ltdps/ltdps_bait.html or call 1-855-Baitbox.

## 8.2 White-tailed Deer

White-tailed deer (*Odocoileus virginianus*) are the preferred host for deer ticks in their second year of their life cycle. Lyme disease is increasingly affecting coastal island inhabitants placing more emphasis and greater community pressure on municipalities to unite and increase management control of this host species. According to CT Dept. of Public Health and CT Agriculture Experiment Station entomologists the growth of deer populations greatly parallels incidence of Lyme disease. In order to break the tick life cycle deer need to be reduced below 8-10 per square mile (Fairfield County Deer Management Alliance 2014).

At risk communities with high deer populations, such as Monhegan Island, have taken action to eliminate Lyme disease cases by eradicating deer off the island. Their project began in 1990 and in 5 years their goal was achieved and new cases of Lyme disease dropped from 13% to 0%. Since then forces to eliminate the threat of Lyme disease from other islands where prolific deer reside are underway. The establishment of Fairfield County Deer Management Alliance has developed a website: (http://www.deeralliance.com) with source material on deer reduction studies and management recommendations. Tick Management Handbook prepared in 2004 by Kirby C. Stafford III, Chief Scientist at The Connecticut Agricultural Experiment Station, New Haven, CT is also a valuable resource.

Abundant white-tailed deer populations at Little Chebeague Island and surrounding islands in Casco Bay are partially attributed to a shift in habitat from abandoned farm lands reverting back to forests. White-tail deer prefer habitat composed of forest edges of mix conifer-hardwood and shrubland with adjacent open fields and croplands. During the summer months white-tailed deer forage upon a rich mixture of vegetation including grasses, forbs, leaves, twigs and crops. In the fall and winter and spring coastal deer are more transient swimming from island to island in search of acorns, twigs and buds including young saplings of oak and maple (Curtis and Sullivan 2001). Subsequently it is a more difficult species to assess habitat carrying capacities and population growth trends.



*Transient white-tailed deer at nearby House Island, winter 2014*

Besides being a reservoir host for the Lyme bacteria, white-tailed deer also pose an important natural resource management threat in the regeneration and protection of native plant species at Little Chebeague Island. Additionally white-tail deer contribute to the loss of the biological diversity of the ecosystem by overbrowsing native bramble species, such as: blackberry and raspberry that help suppress the growth of other invasive plant species such as European hayscented fern colonies by becoming established in open forest gaps (McMahon 2012). White-tail deer are also responsible for eliminating red oak and sugar maple seedlings at LCI that help to stabilize the community composition, structure and diversification of the forest. Damage from overbrowsing of other food sources also impact other small mammals and birds competing for similar habitat. As the understory layer deteriorates and becomes more vulnerable to elimination by invasive species and deer, nest sites become more visible and at risk. Consequently many small mammals and birds may move from the area and island seeking more suitable habitat (Curtis and Sullivan 2001).

Signs of beaver, fox and other mammal evidence were sited at Little Chebeague Island during our unsystematic field observations (see Appendix E). Young, wayward male beavers have come to LCI from Great Chebeague to seek out new territory from time to time although do not become established due to limiting habitat resources (Erno Bonebakker 2014, pers.comm.) Currently hunting is an effective management strategy used to control the population at LCI. Additional strategies to be added to the ongoing wildlife management plan include:

- Place 7foot high snow fence or deer netting enclosures around sapling regeneration areas to prevent browsing by deer.
- Encourage and educate “Great Chebeague” and “Long Islanders” to take advantage of the archery, shotgun and muzzleloader deer hunting seasons.
- Work with officials to extend the “Shotgun Season” to an “Expanded Shotgun Season” from November 2 to December 1.
- Work with officials to extend the “Deer Reduction Hunting Season” for Deer Reduction Hunters to the end of March.
- Encourage participation in the “Any Deer Permit” Lottery for Wildlife Management District 29.
- Work with MDIFW to establish a base line study at LCI to monitor and assess health condition, winter carrying capacity and population trends of white-tailed deer.

## 8.3 Hickory Tussock Moth

The hickory tussock moth (*Lophocampa caryae*) is a native moth found throughout Maine. It becomes more troublesome in its larvae phase as a caterpillar with its microscopic barbs on its hair-like setae found in tufted bands that can cause allergic reactions, itching and swelling or serious complications to eyesight if contact occurs (Wikipedia 2014).

Hickory tussock caterpillars were abundantly recorded by state entomologist, Charlene Donahue, forest entomologist, from the Maine Dept. of Conservation who conducted “moth catches” across the state last summer. However, the largest populations were found in the northern portions of the state (Donahue 2013). In addition this communal insect feeds on various trees located including beech, poplar, elm, oak, willow and box elder however they are unlikely to defoliate trees or cause

significant damage (UWM 2013). The hickory tussock moth does pose an issue of concern to MITA stewards and land managers due to its ability to disrupt recreational experiences by potential encounters with the caterpillars' microscopic barbs. Educational and interpretive signage located at both kiosks informing visitors of the hickory tussock moth could help reduce negative interactions with the native insect and further protect the safety of island visitors.

For more information regarding the hickory tussock moth this website is available: http://www4.uwm.edu/fieldstation/naturalhistory/bugoftheweek/hickory-tussock-moth.cfm

## 8.4 Browntail Moth

The browntail moth (*Euproctic chrysorrhoea*) is an invasive insect that was accidentally introduced in the late 19$^{th}$ century to Somerville, MA. The rapid spread of the browntail moth included coastal areas of New England, Nova Scotia and New Brunswick by 1913. Yet, by the 1960s their range became much smaller and limited to Cape Cod, MA and a few islands in Casco Bay, ME due to natural controls slowly eliminating the species (MDACF 2013). However, according to the Maine Forest Service the browntail moth has since extended its range to include coastal towns from Cape Porpoise to Woolwich with scattered locations in Pemaquid, West Gardiner and Randolph (Dube 2008).

The primary concern is the severe dermatitis and asthmatic reactions in humans coming in contact with poisonous caterpillar hairs (setea). The hairs can become impregnated in the skin by microscopic barbs released by live or dead caterpillars or molting casts. Caterpillar hairs can also be transported indirectly through the air particularly on dry windy days.

Browntail moths have a 4 stage life cycle; egg, larval, pupal and adult, however it is the larval stage that is most damaging to trees and shrubs including 26 genera of 13 families threatened by devouring browntail caterpillars (Wikipedia 2014) of which 19 genera are found at Little Chebeague Island. Silky webs are built in trees containing 25-400 browntail tail moth larvae. Larval caterpillars within these large colonies emerge in early spring to begin defoliating host trees and shrubs. At first they exit the web located at the branch tips and return at night. Soon after they remain out on the leaves through the night (MDACF 2013) until they reach a mature size. At this time in early June the caterpillars build cocoons to enter the pupal stage.

More information on browntail moth infestations can be viewed at http://www.maine.gov/dacf/mfs/forest_health/insects/browntail_moth.htm.

To better manage and control the browntail moth the following strategies are listed:

- Develop section of LCI Management Plan and a protocol of control methods and strategies to combat the threats of browntail moth infestations.
- Conduct annual winter browntail moth web surveys. Browntail caterpillar webs (2-4inches long, loosely formed) are located at branch tips. Make further web distinctions between other possible confusing tent caterpillars that also nest in trees such as Eastern tent caterpillars (*Malocosoma americanum*) located in crotch between branches in the spring and fall webworms (*Hyphantria cunea*) located further along branches of ash trees.

- Remove silky webs built by browntail moths at branch tips in winter by hand or with pruning shears.
- Remove by burning silky webs using a long stemmed propane torch for webs that are unreachable.
- Saw thin branches if webs cannot be reached by either control method.
- Educate MITA staff and volunteers of possible safety concerns regarding browntail caterpillars.
- Remove any old clothing or rags stored storage shed that may still contain caterpillar hairs capable of causing a severe reaction.
- During periods of high caterpillar activity and infestations in spring until late June wear protective gear such as face mask, respirator, coveralls while mowing or conducting other landscape tasks.
- Use a cool water shower to remove any hairs after mowing.
- Design and install educational and interpretive signage illustrating the safety concerns of browntail caterpillars. Place signage at high use areas privies and kiosks located at all access points.
- Encourage island visitors to not camp or recreate in interior areas that have infestations as hairs may be airborne in vicinity.
- Limit recreational activities during high infestation periods with temporary closure signs.
- Chemical applications such as aerial spraying of "Sevin" occurred in the early 1990s in Casco Bay. Spraying on site should strictly adhere to rules and regulations prohibiting chemical applications closer than 250ft from mean high water line. These chemical applications may be damaging to the lobster industry so further State of Maine studies of pesticides adverse effects on commercial fisheries is highly recommended.

## 8.5 Poison Ivy

Poison ivy, (*Toxicodendron radicans*) (PI) is a troublesome native nuisance that is abundant and pervasive at Little Chebeague Island. As human populations rise in the Casco Bay watershed an increasing number of visitors seeking recreation on coastal islands will come in contact with this obnoxious plant and its natural oils causing an assortment of allergic reactions, skin irritations and in severe cases upper respiratory problems.

Poison ivy is an important natural resource issue to address due to its aggressive and dominate nature in the landscape. With its aggressive nature to become established in various soils, habitats and cover types, edges of forests, meadows and fields, dunes, wetlands and disturbed areas in full sun, part sun or dense shade are at risk. Poison ivy has a variety of growth habits as well, including, vine, shrub or herb. All three growth forms are present at LCI. Tall and impenetrable PI shrubs are located at the southern tip of the island where a short segmented trail from the southwestern shore quickly ends at a large dominant stand of PI. Other commonly located PI communities in herbaceous and vine forms are visible at higher use areas. Yet, with proper trail design, educational signage and controlled restoration efforts, poison ivy can be avoided.

Although a native nuisance the PI community strategically located at the edge of the eastern back dune is serving an important function providing protection to the freshwater wetland behind it. As sea level rise becomes more of a prevalent issue, poison ivy may be able to lessen the effects of

storm surged saltwater emptying into the highly sensitive freshwater ecosystem.

## 8.6 Invasive Plants

Several non-native plant species including, but not limited to: Oriental bittersweet (*Celastrus orbiculatus*) Japanese knotweed (*Polygonum cuspidatum*), black swallow-wort (*Cynanchum louiseae*), Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multifora*) and Morrow's honeysuckle (*Lonicera morrowii*) are invasive and problematic at Little Chebeague Island as they pose an immediate threat to land managers and island stewards who strive to maintain the native biodiversity of the island ecosystem. Native plants and habitats are at risk as invasive plants move to establish themselves as dominant species by out competing for sunlight and creating dense shade for native herbaceous plants below. Often invasive plants have the advantage of a longer growing season as they leaf out early weeks before native plants break dormancy and maintain foliage weeks after most native plants drop their leaves. Troublesome invasive plants are responsible for changing the soil dynamics by altering the pH, secreting chemicals into the soil inhibiting the growth of neighboring plants, or beneficial fungi beneath the soil, as well as altering the nutrient and hydrology cycle. Invasive plants have productive seed banks capable of producing more than 1,000 seeds per plant annually, can reproduce more than once per year by vegetatively and by seed. With specialized adaptations invasive plants become established more aggressively than native plants postfire or after other natural disturbances or forestry practices clearing sites and exposing mineral soils. In addition non-native plants with invasive qualities, such as Oriental bittersweet, are able to strive in harsh conditions existing at dune environments.

*Invasive Oriental bittersweet growing overtop native plant species.*

Invasive species left unmanaged can become dominant and pervasive monotypic communities and impenetrable thickets. Subsequently it is important to consider the following management

techniques, strategies and recommendations that are put forth as a comprehensive Integrated Vegetation Management (IVM) Program for Little Chebeague Island to combat such invasive species. The following IVM program was adopted and modified from the established IVM program at Odiorne Point State Park.

***Integrated Vegetation Management (IVM)*** *A systematic method that utilizes all available strategies to manage invasive plant species including mechanical, biological, cultural and chemical treatment methods. IVM prevents the spread of invasive plants through proper knowledge of weed species, accurate inventory and mapping, specific design of control methods and strategies, implementation and evaluation and/or modification of strategies to achieve desired goals.* (NH State Parks 2010)

### 8.6.1 Little Chebeague Island Integrated Vegetation Management (IVM) Program

- Establish and design a systematic, methodical protocol to strategize the mechanical, biological, cultural and chemical treatments in order to better manage the invasive plant species on the island. The most effective and long term control strategies will include a combined series of techniques to suppress invasive plant species in order to allow for healthier native plant communities to reestablish, dominate and restore the viable ecosystems once present.

- Implement a spring training program to the MITA team including, but not limited to managers, personnel, care-takers, interns and volunteers in regards to plant identification, flowering times, seed production periods and general knowledge of plant species, community types, rare and sensitive plants, GPS locations, control measures, bird and mammal habitats, etc. giving emphasis to: native, native nuisances, non-natives and non-native invasive plants in order to provide the most effective and long term success of the program.

- Survey accurate inventory of all known locations of the 6 prioritized invasive plant species: *Celastrus orbiculatus* (Oriental bittersweet), *Polygonum cuspidatum* (Japanese knotweed), *Cynanchum louiseae* (black swallow-wort), *Berberis thunbergii* (Japanese barberry), *Rosa multiflora* (multiflora rose) and *Lonicera morrowii* (Morrow‘s honeysuckle) as well as other problematic invasive species: *Solanum dulcamara (*bittersweet nightshade), *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Tussilago farfara* (coltsfoot), *Cuscuta epithymum*, common dodder and *Elaeagnus umbellata*, (autumn olive).

- Map vegetation cover types, rare and sensitive native plant communities, critical habitats of conservation concern, invasive plant densities, areas of invasive plant dominance (monocultures) and areas of impenetrability by invasive plants, etc. Cover type mapping and mapping of rare and sensitive native plant communities are paid services provided by Maine Island Ecologists.

- Identify and grade invasive plant management priorities by parcels giving significance to

ecological, archeological, recreational criteria rather than a subjective ranking of highest to lowest priority for restoration. (See Table 2 for Significance by Parcel Table).

- Initiate a Site Specific Invasive Management Techniques Program for areas specified in Table 2. Site specific control actions should be identified, managed and monitored annually for ecological and land-use areas of priority, importance and effectiveness so that Maine state laws are followed and obeyed particularly concerning vital island and oceanic natural resources. State of Maine laws, specifications and amendments regarding shoreline zoning and management techniques, (such as cutting trees, applying herbicides, pesticides, etc.) in relation to the high tide mark or upland edge of island freshwater wetlands should be reviewed annually and followed appropriately. *Glyphosate* (aquatic formation) or *Imaapyr* should be used for problematic invasive plants near freshwater and coastal wetlands under the direction of a certified licensed herbicide applicator registered with the State of Maine following specifications, regulations and laws set forth by the Maine Board of Pesticide Control. Herbicide applicators should minimize drift in order to protect critical coastal habitats and interior ecosystems. In addition herbicide applications near unconsented recreation areas should be only conducted with proper notification (listing herbicide application date and reentry date) visible on the trail or at the trailhead.

- Create an Annual Management Eradication Plan with grid diagrams for MITA personnel, LCI caretaker and volunteers to utilize each season in planning and scheduling control techniques in order to better improve effective and efficient management of invasive plants. The use of a grid system will systematically identify all areas, critical areas, areas of high and low densities, as well as preventing areas from mismanaged actions by recording number of mowings, sprayings, treatments, etc. conducted. A grid plan will also aid in preventing unwanted stimulated growth as well as minimizing impacts to non-targeted plant communities, critical bird and mammal habitats and sensitive ecosystems.

- Implement general invasive management techniques by utilizing combinations of physical and manual control methods (pulling, tilling, grazing, mowing, prescribed burns) herbicide applications and treatments of biological (eg. *Hypena opulenta*) and cultural (regeneration & revegetation) controls recommended to combat invasive plants on LCI. For specific management control options for individual invasive species see Table 3 USFS/WDNR/ MIE/MNAP Recommendations for Invasive Plant Control.

- ***Hypena opulenta* is an exciting new biological control measure to treat black swallow-wort, (*Vincetoxicum nigrum*).** *Hypena opulenta* was recently found to feed on black swallow-wort in the Ukraine by URI doctorial student, Aaron Weed. Entomologists Professor Richard Cassagrande and Research Associate, Lisa Tewksberry who have been studying the promising biological control agent has sent *Hypena opulent* larvae to partners near Ottawa Canada to test the moth at study plots of black swallow-wort. The Canadian government has already granted permission for this biological control agent however, the U.S. should be granting permission as early as Spring of 2014. (URI 2013). For more information about *Hypena opulenta* see http://www.uri.edu/news/releases/?id=6791 and http://www.uri.edu/cels/ceoc/documents/blackSwallowwort.pdf.

- Develop a plant waste disposal protocol of action procedures to properly remove all eradicated invasive plant material to eliminate the possibility of invasive plants rerooting and reestablishing themselves.

- Develop a Native Plant Restoration Program so that the LCI MITA caretaker, volunteers and/or personnel can quickly disperse native seed and/or native plantings in cleared, managed, weed eradication areas due to burning, grazing, tilling, etc. of invasive plant material. Plant hardy, Maine native plant species suited to conditions and soils. Arrange for an onsite caretaker to conduct regular watering and maintenance practices. Monitor and manage site on a regular basis to allow for success of program. Native plants are available for sale through the New Hampshire Department of Resources and Economic Development, Division of Forests and Lands at their NH State Forest Nursery. Their free catalog is available on line at www.nhnursery.com or by email at mnurseryc@dred.state.nh.us or phone (603) 271-2214. Native seeds are available online at various websites, however, New England Wetland Plants, Inc. has a large selection of New England native seed mixes for plant restoration projects, including; conservation wildlife mix, wetland seed mix, salt tolerant native grass species mix, upland mix, erosion control mix, etc. New England Wetland Plants, Inc. is featured at http://www.newp.com/catalogue-seeds.html. Their free catalog can be found online at http://www.newp.com/pdf/NEWP2011-2012.pdf. The New England Wetland Plants, Inc. can also be reached at (413) 548-8000.

- Initialize an *Early Detection/Quick Response Program* to address the growing threat of invasive plants colonizing in newly established areas. The program consisting of MITA personnel, interns, volunteers and enthusiasts working collaboratively in locating newly established communities or individual sightings should record the location by taking a GPS reading, flagging the site, mapping and photographing the plant for identification. Assessing the situation should follow in order to plan the best method of attack.

- Develop detailed, systematic records illustrating control methods used and their effectiveness, as well as time applied, costs, funding, efficiency of techniques, problems incurred, applicators administering herbicides, tools used, personnel participated, etc.

- Develop a Post Treatment Monitoring & Appraisal Program on a semi-annual, annual, 2-5year basis of the eradicated sites. This program should include a workable, consistent, user-friendly, monitoring protocol so that all levels of participants can properly carry out the functions and action plan of monitoring and surveying the post treatment of invasive plants.

- Collaborative efforts should be sought and engaged particularly with nearby island residents, as well as interested area enthusiasts, schools, college/university interns, kayak groups, non-profit conservation organizations, (i.e. Casco Bay Estuary Partnership: Invasive Plant Network and Maine Island Ecologists), town, state and federal partner agencies and state monitoring groups, etc. to ensure a positive and successful IVM

program. Offering outreach and educational productions with island communities and in the mainland public sector will enhance the program and allow for a further understanding and urgency to the critical issue of "ripping out" invasive plant species on LCI, inhabited/uninhabited islands and natural areas in Maine.

***Table 2. Significance criteria applied to parcels at Little Chebeague Island in 2014***

| Point # | Description | Ecological | Archeological | Recreational |
|---|---|---|---|---|
| 1 | Beach & Dune E (Front/Main Beach) | X | X | X |
| 2 | Beach & Dune SE (Thorntree Point) | X | X | X |
| 3 | South Beach & Bluff (South Beach) | X | X | X |
| 4 | Upland Scrub/Shrub E | X | X | X |
| 5 | Barrier Bluffs W (NE Trail Head to Sandbar) | X | | |
| 6 | Barrier Bluffs NW (NW and NE TrailHeads) | X | X | X |
| 7 | Target Point | X | | X |
| 8 | Front Meadow | X | | X |
| 9 | Upland Scrub/Shrub SE | X | | |
| 10 | Upland Scrub/Shrub S | X | | |
| 11 | Upland Scrub/Shrub SW | X | | |
| 12 | Upland Poplar Forest W | X | X | X |
| 13 | Upland Mixed Forest | X | | |
| 14 | Upland Oak Forest | X | | |
| 15 | Upland Beech Pine Oak Maple Forest | X | X | X |
| 16 | Upland Black Locust Stand | X | X | X |
| 17 | Clamwalk Trail | X | X | X |
| 18 | Barn and Farmhouse Foundation Trail | X | X | X |
| 19 | South Meadow | X | | X |
| 20 | Cannon Field | X | X | X |

***Companion Map for Table 2 above***

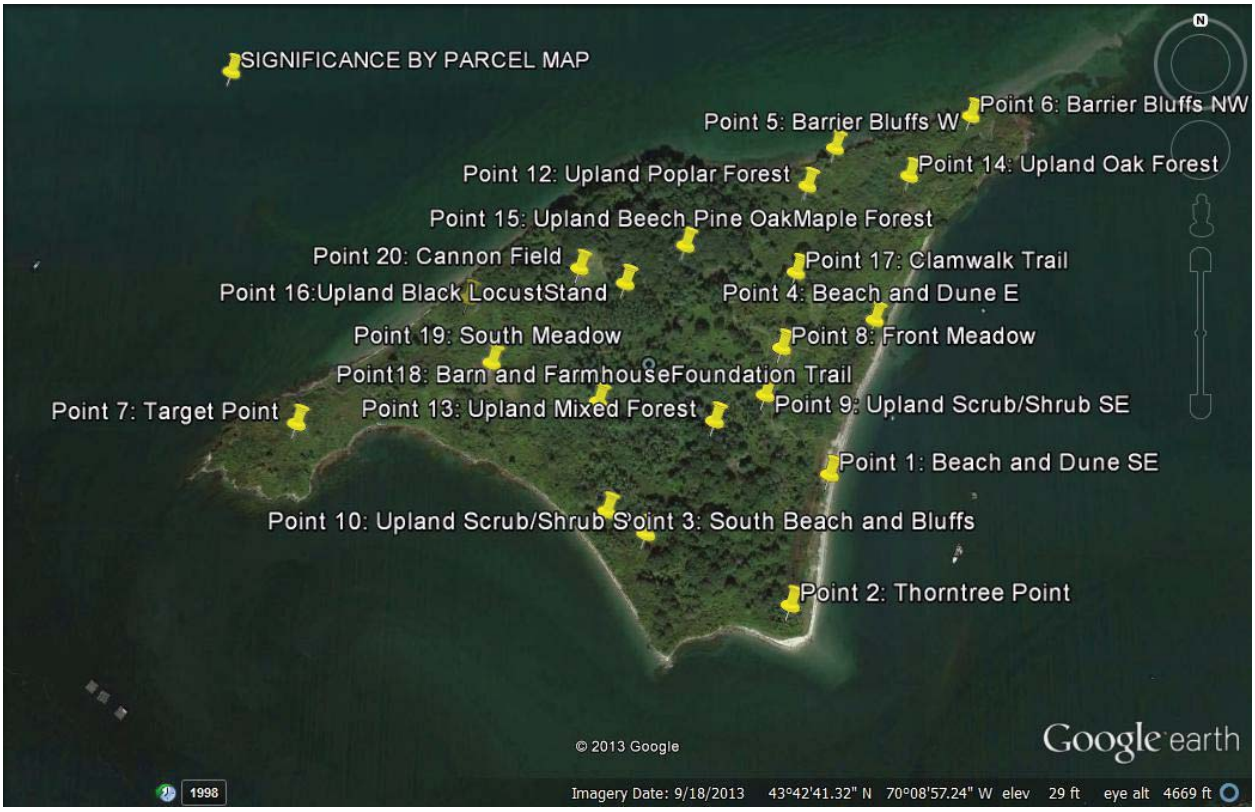


***Table 3. USFS, Wisconsin DNR (WDNR), MIE, MNAP Recommendations for Invasive Plant Control at Little Chebeague Island***

(*) preferred method or time for application.

| Plant Name | Mech. Control<br><br>Mowing or Tilling or Pruning | Mech. Control<br><br>Digging & Pulling or Mulching | Prescribe Burn<br><br>Spot burning | Graze Type<br><br>Goats or Sheep | Chem. Control<br><br>Wicking/ Cut Stump or Foliar Spray or Basal App. | Biolog. Control |
|---|---|---|---|---|---|---|
| ***Cynanchum louiseae,***<br><br>**Black Swallow-wort** | Tilling<br>More Effective<br><br>Over multiple Years<br><br>Mowing<br>Only to prevent seed or prepare site for herbicide application | Mulching<br>More Effective<br><br>(3inches or Tarp for 2 years)<br><br>Apply before seed production | Spring Burns<br><br>Use to prepare site for herbicide application only and to kill germinating seedlings and young plants. | No<br><br>Increase growth from leaf axils & buds on root crown. | As Seed Stage Begins:<br><br>Triclopyr Tahoe 4* (Preferred Herbicide)<br><br>Mix with methylated seed oil (MSO) to improve effect:<br><br>As flower stage begins:<br><br>Glyphosate Round-up | Hypena Opulenta<br><br>Noctuid Moth (URI 2014)<br><br>Contact: URI |

| Plant Name | Mech. Control<br><br>Mowing or Tilling or Pruning | Mech. Control<br><br>Digging & Pulling or Mulching | Prescribe Burn<br><br>Spot burning | Graze Type<br><br>Goats or Sheep | Chem. Control<br><br>Wicking/ Cut Stump or Foliar Spray or Basal App. | Biolog. Control |
|---|---|---|---|---|---|---|
| ***Celastrus orbiculatus***<br><br>**Oriental Bittersweet** | Mowing<br><br>Every two weeks or is not an effective method to deplete Carbohy-drate supply in root zone. | Immediate pulling and removing plants after herbicide treatment. | Not advised due to stimulated growth of sprouts from root crown. | Goats | Apply Mid October* or during dormant months.<br><br>Triclopyr* or Glyphosate application<br><br>Cut stump method (2inches above ground) or after mowing.<br><br>A second treatment following to control sprouting. | Marsso-nina celastri<br><br>Leaf Spot Fungus (in Korea) |
| ***Polygonum cuspidatum,***<br><br>**Japanese Knotweed** | Mowing supported by grazing or herbicide treatments.<br><br>Spring stem cuttings. | Digging & Pulling plants and shallow roots<br><br>Must remove rhizomes deep in soil or will resprout.<br><br>Minimize soil disturbance<br><br>Several layers of black plastic. | Not advised due to stimulated growth of sprouts from root crown.<br><br>May be effective to new seedlings. | Goats and Sheep | Cut Stump* or Foliar spray Application<br><br>Triclopyr* or Glyphosate application<br><br>Cut stump* method (2inches above ground) or after mowing in early spring at leaf out. | Aphalara Itadori<br><br>Japanese Knot-weed Psyilid<br><br>(Dr. Dick Shaw's Study in UK)<br><br>May attack other plant species. |

| Plant Name | Mech. Control<br><br>Mowing or Tilling or Pruning | Mech. Control<br><br>Digging & Pulling or Mulching | Prescribe Burn<br><br>Spot burning | Graze Type<br><br>Goats or Sheep | Chem. Control<br><br>Wicking/ Cut Stump or Foliar Spray or Basal App. | Biolog. Control |
|---|---|---|---|---|---|---|
| ***Berberis thunbergii***<br><br>**Japanese Barberry** | Mow early in the season while native plants are still dormant and carbohy--drate depletion begins in the roots.<br><br>Repeated mowings throughout season | Digging & Pulling plants and shallow roots<br><br>Must remove rhizomes deep in soil or will resprout.<br><br>Minimize soil disturbance. | Not advised due to stimulated growth of sprouts from root crown.<br><br>May survive low severity fires but repeated burns can be effective.<br><br>Or precede burn method with cutting early in the season. Burn before sprouting plants have recovered. | Goats | Cut Stump* or Foliar spray Application<br><br>Triclopyr* or Glyphosate application<br><br>Cut stump* method (2inches above ground) or after mowing in early spring at leaf out. | Non-native<br><br>Tephritid Flies.<br><br>Not used in North America yet. |

| Plant Name | Mech. Control<br><br>Mowing or Tilling or Pruning | Mech. Control<br><br>Digging & Pulling or Mulching | Prescribe Burn<br><br>Spot burning | Graze Type<br><br>Goats or Sheep | Chem. Control<br><br>Wicking/ Cut Stump or Foliar Spray or Basal App. | Biolog. Control |
|---|---|---|---|---|---|---|
| ***Lonicera morrowii***<br><br>**Morrow's Bush Honeysuckle** | Not advised.<br><br>Feasible only as a temp. means of reducing seed production or a pre-treatment to herbicide application<br><br>Repeat cuttings in early spring late summer and early fall. | Digging and pulling to remove entire plant due to shallow roots. | Not advised due to stimulated growth of sprouts from root crown-(USFS)<br><br>Unless subsequent burns done annually or biennially for 5years-(MNAP). | Goats<br><br>Limit.<br><br>May create disturb soii for invasion | Triclopyr* or Glyphosate application<br><br>Cut stump method (2inches above ground) Immed. after mowing in early spring while some natives are still dormant. | Non-native<br><br>Hyadap-his tataricae<br><br>Honey-suckle Aphid |
| ***Rosa multiflora***<br><br>**Multiflora Rose** | Mowing 3-6 Xs/ Season For 2-3yrs. | Digging & Pulling | Not advised due to stimulated growth of sprouts from root crown. | Goats | Foliar Spray<br><br>Triclopyr Crossbow Preferred Herbicide at Flowering Time w/ Mowing, Digging, Pulling for 2-3yrs. | Rose Rosette Disease (RRD) |

## 9. LAND MANAGEMENT RECOMMENDATIONS

The following land management issues contribute to the success of the Integrated Vegetation Management (IVM) Program as it applies to Little Chebeague Island. Information below are

successful strategies and management considerations from national studies conducted by USFS managers, scientists from MIE, federal (USFWS) and state land managers (MNAP) and Wisconsin Department of Natural Resources (WDNR) to eradicate invasive plants.

## 9.1 Maintenance of Healthy, Well Established Native Plant Communities

- When the plan is to not completely eradicate invasive plant species, as in this instance with MITA at LCI, the prevention of spread and annual reduction of the population is necessary until population reaches acceptable levels.

- Strive to maintain the stability and healthy state of the existing ecosystem by enhancing ecosystem invisibility by opening up the canopy, applying fertilizers to strengthen native plant communities and utilizing mechanical and chemical measures to treat infringing infestations of invasive plants (USFS 2014).

- Fertilize newly established restoration sites, well established native specimen plants and existing plant communities with seaweed to accelerate biomass below and above ground. Seaweed may be harvested from the northern tip of island in spring and fall where it has detached and accumulated atop marsh grasses to ensure healthy and productive island ecosystems at both areas. Seaweed permits are not necessary from Maine DMR if harvesting less than 50lbs a day for non-commercial use or harvesting seaweed that is detached.

## 9.2 Selection of Most Feasible and Effective Combinations of Control Methods

1. Eradication of dense, invasive communities may not be feasible when limited resources or degree of pervasive infestation precludes eradication efforts. Identify and understand current distribution and abundance of native and non-native species in region. (USFS 2014)

2. Review budgets, identify and rank degree of invasive plant's density, significance and prioritize control efforts for each individual invasive species.

3. Give low priority to core populations and focus eradication efforts on advancing front (USFS 2014).

4. Adopt "*Early Detection/Quick Response*" methodology to place emphasis on reducing the infringing invasive growth by "heading it back" to the outer fringes of trail perimeter and field edges subsequently maintaining the integrity of native habitat.

5. Choose appropriate combination of methods and strategies that are most effective and economical. No one method will be completely successful.

6. Choose mechanical controls when goals are obtainable. Planning and scheduling enough cuttings in a season will be needed so that regeneration of invasive species does not occur.

## 9.3 Scheduling Mechanical Controls

### 9.3.1 Mowing at LCI fields, meadows, forested areas and trail system

1. Successive mowing of trails, fields and meadows through the season should be conducted to deplete strength and plant vigor 3to 6 times/season for 2-3 years, then monitor future shoots and reassess. (WDNR 2014)

2. The most effective time to initiate mowing operations should begin in July when the plants are ultimately in the vegetative phase and carbohydrates are rich in the upper portion of the plant and root reserves are depleted, but preferably before flower and seed production.

3. Mowing trails, fields and meadows while effective in pushing back invasive plants to outer perimeters can adversely damage native plants. Using spray paint or flagging rare, specimen native plants or sensitive plant communities can be identified, marked and protected while volunteers are selectively mowing.

4. If invasive plants are to be immediately treated with an herbicide, earlier mowings or cuttings can be started in the spring to prepare the site and temporarily reduce seed production.

5. After mass mowings of invasive species in fields and meadows for 2-3 years follow up with foliar herbicide applications to achieve rapid and continual decline for an additional 2-3 years subsequently accomplishing stability of ecosystem by third year of applications. Then apply post treatment herbicide and mechanical controls as needed or alternate years. (USFS 2014, MNAP 2014)

6. In forests removal of lower tree limbs allows for mechanical control devices and tools to access and eradicate invasive plant species in the understory layer.

7. In forested areas where impenetrable invasive plant species occupy significant extent of territory repeated cuttings (3Xs/season/3years) as a primary control measure may be feasible (Luken & Mattimin). This recommendation may be applied to areas such as the Clamwalk trail site where a previous MIE recommendation advised the reestablishment of the island trail with historical significance.

8. MNAP also recommends repeated cuttings in forested areas of bush honeysuckle, Oriental bittersweet in early spring, late summer and early fall. However, if repeated cuttings are unobtainable typical results will include resprouting of populations that are more dense and more productive than pretreatment populations. (MNAP 2014) Structured mowing schedules are necessary.

9. Cut, pull and remove invasive vine species, (Oriental bittersweet), as high as possible from lower tree limbs preventing predators from reaching nesting habitats of terrestrial birds.

10. Mow areas of large monotypic native Hayscented fern (*Denstaedtia punctilobula*) colonies that are invasively aggressive and inhibiting the natural diversity of woody plant species sprouting at wetland forested habitat located at island interior near military privy and elsewhere.

11. Continue to mow back staghorn sumac at meadow area by front kiosk to control its aggressive nature to become reestablished. However, this control measure should be limited to the immediate vicinity of the path to preserve wildlife habitat.

### 9.3.2 Digging and pulling

1. With shallow rooted shrubs digging and pulling can be achieved but can be labor intensive and not feasible.
2. Extensive rugged roots of Oriental bittersweet are problematic and must be removed or regeneration may occur.
3. Proper disposal of plant waste by bagging or burning is necessary so that rerooting does not occur. Invasive plants have a natural ability to resprout from broken, cut, grazed or burned portions.

### 9.3.3 Mulching with carpets, tarps or organic materials

1. Manipulate the environment by applying 3inches of organic or inorganic material for two consecutive years to suppress growth of invasive plants, such as: black swallow-wort.

2. Apply mulch after the onset of flowers, but before the production of seeds when carbohydrate content is at its highest, above-ground level or to increase the effectiveness of technique conduct a first cutting of target species.

### 9.3.4 Grazing by goats and/or sheep

1. Over grazing can limit biodiversity of the ecosystem and ultimately leading to soil disturbance subsequently becoming a more susceptible area to colonization from other invasive seed sources (USFS).

2. Grazing may stimulate growth from leaf axils and perennating buds on root crown (WDNR 2014).

3. Composition of native plant species may be altered. Electric fencing is recommended to protect native plants and the integrity of the ecosystem. (USFS 2014)

4. Grazing by goats typically takes 4 consecutive seasons to control multifora rose (USFS 2014).

5. Common chokecherry (*Prunus serotina)* and common juniper (*Juniperus communis)* are poisonous to goats and sheep and are both growing at LCI. Although livestock animals do inherit some dietary preference to poisonous plants they are able to ingest some levels of toxic plants without being impacted. Dietary guides should be consulted.

(http://burundigoats.tripod.com/Tropical_Emphasis/Eating_Toxic_Plants/eating_toxic_plants.html)

6. Grazing is not typically recommended by USFS as there is very little information available to land managers reflecting success of grazing to control specific invasive species. (USFS 2014)

### 9.3.5 Prescribed burns

1. MNAP recommends prescribed burns during growing season as most effective control with subsequent burns conducted annually or with biennial spring burning for 5 of more years to control bush honeysuckles. (MNAP 2014

2. USFS does not recommend prescribed burns to control bush honeysuckle or black swallow-wort due to the possibility of post fire resprouting from leaf axils or perennating tissue on roots and root crowns protected by insulated soil. (USFS 2014)

3. To further research the effectiveness of prescribed burns as a viable management technique is the Nature Conservancy's Global Invasive Species Team website: www.imapinvasives.org

4. If lack of fuel, high moisture content prevent is a consideration or a large-scale burn is inappropriate, spot treatments using a hand-held, long wand propane torch works well in treating individuals or small communities of plants.(USFS, WDNR, MNAP 2014) Long wand propane torches are available for sale at www.amazon.com for $250.

5. Intensity of fire contributes to the effectiveness of burn especially for the control of black swallow-wort. Speckled alder, commonly present at Little Chebeague Island, is a plant that produces intense heat in a fire and can be utilized in fire management (USFS).

6. According to the Wisconsin DNR natural areas that are badly infested with invasive plants, controlled burns may initially need to be done for several years in a row to reduce the weed seed band and stimulate native species. Burning this frequently is not generally recommended in healthy native plant communities because important insect pupae and eggs may also be destroyed. Burning one- third of a natural area each year on a rotating basis is usually the preferred management strategy and will lead to increased plant and insect diversity (Wisconsin DNR)

## 9.4 Restoration Efforts

1. Soil disturbances caused by mechanical control measures should be minimized unless restoration efforts are followed with immediate replanting of native plants or sowing of native plant seed.

2. Hardy broadleaved native restoration plantings that are quick to break dormancy, provide early season light competition and are less susceptible to insects, disease or transplant shock should be used.

3. Establish new plant communities that are hardy and can thrive in areas where the integrity of the ecosystem has been previously compromised by the abundance and impacts of invasive plant species. Sites should preferable have healthy soils with sufficient pH levels, adequate sunlight, free of insects and disease and risk of immediate competition from germinating non-native seed bank, however native plants with strong resistant qualities are available in the nursery trade.

4. New plantings of graminoids and forbs should be fertilized with a high nitrogen based fertilizer to accelerate nitrogen availability to upcoming shoots.

5. Do not plant graminoids and forbs in understory areas of white pine due to the restrictive availability of phosphorous in acidic soils.

6. Encourage existing large invasive monotypic Hayscented fern (*Denstaedtia punctilobula)* colonies to aggressively move into disturbed landslide or bluff areas.

7. Native plants for ecological restoration projects are available as island transplants or at local nursery sources listed in the IVM section of this report.

## 9.5 Chemical Control: Herbicide Applications by Foliar and Cut Stump Methods

### 9.5.1 Timing considerations of herbicide applications

1. Some herbicides are less effective on woody plants in spring, when the upward flowing sap inhibits movement of herbicide down into the roots. Humidity levels can increase or decrease the effectiveness of adjuvants used in some herbicides to aid absorption, as well as influence prescribed fire behavior (Mich. State Univ. Ext.) Website: http://mnfi.anr.msu.edu/invasivespecies/InvasivePlantsFieldGuide.pdf

2. Some herbicides are volatile in hot July conditions of 80-85 degrees F.

### 9.5.2 Foliar applications

Glyphosate (solution surfactant) *(Recommended by MNAP)*

a) Herbicide has a very short soil life as it quickly binds with soil making it immobile with a low toxicity to animals.
b) Herbicide has a “no vapor” drift risk.
c) Herbicide may be applied from May thru September.
d) Herbicide does not need an AMS additive to make it more effective.
e) Herbicide has a 0-14 grazing restriction for goats or sheep.
f) Herbicide also recommended for “Cut Stump” treatment.
g) Herbicide concentration application varies between 0.75-1.20% v/v

**9.5.3 "Cut stump", wick applications:** *(Recommended by MNAP & Maine Coastal Island NWR)*

Triclopyr "Crossbow" (emulsifiable concentrate)

a) Herbicide safe to use on grasses.
b) Herbicide has a 1 month soil life.
c) Herbicide has no grazing restrictions for goats or sheep.
d) Herbicide doesn't require AMS additive to supplement.
e) Herbicide application recommended for May-early July.
f) Herbicide is volatile in hot weather in July in Maine.
g) Herbicide does produce a vapor drift that can be harmful to native plants in vicinity.
h) Herbicide may be used during dormant months for basal bark treatments.
i) Herbicides such as "Ester" are persistent in aquatic environments and should not be applied near or at wetland habitats. Aquatic versions of herbicide should be used.
j) Herbicide concentration application varies between 1.0-1.50% v/v

## 9.6 Cultural Control Methods: Manipulation of Forest Structure and Composition

1. Maintain a level of canopy closure that impedes shade tolerant invasive species.

2. Develop advanced regeneration species competing with invasive plants before removing the overstory.

3. Reduce susceptible tree species, such as those at risk for damage caused by host insect species subsequently eliminating potential population outbreaks of insects and disease causing organisms (Wisconsin DNR).

4. Restore plantings of hardy, resistant native tree species such as those that are less susceptible to invasive insects and disease as well as having more aggressive growth habits to out compete invasive plant species.

# 10. WILDLIFE MANAGEMENT ISSUES & RECOMMENDATIONS

## 10.1 Wildlife Habitat Restoration Issues

1. Assess, identify, quantify and prioritize suffering wildlife habitats that are being severely impacted by aggressive and invasive plants.

2. Reduce further degradation of wildlife habitat (songbird, gamebirds, butterfly mammal habitats), by giving high preference to plant communities with rich nutritional value and palatability that support valuable, biologically diversified, wildlife habitat that are easily overcome by shading infestations of aggressive non-native plants.

3. Remove impenetrable invasive Oriental bittersweet vines from climbing overtop highly valued food sources of island wildlife and birds including white-tailed deer, upland game

birds, songbirds and other mammals), including but not limited to native shrubs, such as: redoiser dogwood (*Cornus sericea*), red elderberry (*Sambucus racemosa*), American black elderberry (*Sambucus nigra*), winterberry (*Illex verticillata*), speckled alder (*Alnus incana*), staghorn sumac, (*Rhus* hirta), northern bayberry (*Myrica pennsylvanica*).

4. Prioritize cutting and removal of Oriental bittersweet vines from trees and shrubs to protect terrestrial birds from easily being predated upon with easier access to nesting habitat.

5. Monitor browsing by deer populations to prevent overbrowsing of native plants.

## 10.2 Plants with Significant Value for Wildlife Habitat

The following is a list of shrubs and trees common to field, meadow and early successional forest-edge cover types with medium to high nutritional value that should be properly managed in order to provide significant food, cover and protection for mammals and birds on LCI.

**Staghorn sumac**, *Rhus hirta:* These important native trees largely provide habitat and food for many terrestrial birds, game birds, mammals (white-tailed deer, cottontail rabbits) at edges of fields, meadows and pathways.

**Meadowsweet**, *Spireae alba*: Nectar and pollen is harvested by honeybees, adult long-horned beetles and moths. Caterpillars of butterflies and moths feed on buds, flowers and leaves. Rough grouse eat flower buds. Cottontail rabbits forage upon lower leaves and white-tailed deer browse on upper leaves and twigs. (http://www.illinoiswildflowers.info/wetland/plants/meadowsweet.htm)

**Northern bayberry**, *Myrica pennsylvanica*: The winter fruits of bayberry are eaten by many bird species, including songbirds, waterfowl, shorebirds and marsh birds. They are a preferred food of chickadees, red-bellied woodpeckers, tree swallows, catbirds, bluebirds, yellow-rumped warblers and others. Bayberry thickets also provide nesting sites for songbirds, offering excellent protection from raccoons and other nest predators. (http://umaine.edu/publications/2572e)

**Speckled alder**, *Alnus incana*: Wildlife: Speckled alder thickets provide cover for moose, white-tailed deer, rabbits and others. Moose, muskrats, beavers and rabbits browse the twigs and foliage. Songbirds, including redpolls, goldfinches, woodcock and grouse eat the seeds, buds and catkins. Beavers build dams and lodges with speckled alder. (https://plants.usda.gov/plantguide/pdf/cs_alinr.pdf)

**Winterberry**, *Illex verticillata*: Red foxes, cottontail rabbits, white-tailed deer, grey and red squirrels and small mammals are all possible consumers as well as birds such as: yellow-bellied sapsuckers, blue jays, waterfowl (black ducks and mallards), upland game birds, hermit thrush, northern mockingbird, brown thrasher, gray catbird and cedar waxwing, the latter of which also nests in the plant's branches. **Winterberry is poisonous to humans.** (http://www.ehow.com/info_12115043_can-eat-ilex-verticillata.html)

**American black elderberry**, *Sambucus nigra*: Rated by the USDA as an outstanding food source and cover for songbirds, game birds and mammals. Drupes are eaten specifically by gray catbird, northern cardinal, eastern bluebird, northern mockingbird, eastern phoebe, eastern kingbird, white-breasted nuthatch, European starling, American robin, brown thrasher, cedar waxwing, tufted titmouse, blue jay, woodpeckers, white-footed mice, cottontail rabbits (bark), white-tailed deer (leaves and twigs). (http://www.fcps.edu/islandcreekes/ecology/common_elderberry.htm)

**Red elderberry**, *Sambucus racemosa*: This plant is rated by the USDA as a fair to good source of food and

cover for songbirds, mammals and livestock but is **poisonous to humans.**

**Redoiser dogwood**, *Cornus sericea*: Twigs of this dogwood are ranked by USFS as an extremely important and highly valuable winter browse for white-tailed deer. Redoiser dogwood fruits are recorded eaten by 47 different bird species (Limpert 1993) and are foraged upon by beavers, cottontail rabbits, moose and goats. (http://www.fs.fed.us/database/feis/plants/shrub/corser/all.html)

**Pin cherry**, *Prunus pensilvanicus* Twenty-five species of nongame birds, several upland game birds, fur and game mammals and small mammals eat pin cherry fruit. Buds are eaten by upland game birds, especially sharp-tailed and ruffed grouse. Foliage and twigs are browsed by deer. However, the foliage has a high calcium to phosphorous ratio which is undesirable for good deer nutrition. Except in dense thickets, pin cherry provides only fair nesting cover and materials for birds. Beavers cut pin cherry and may completely remove small stands (12). Leaves are poison (hydrocyanic acid) to livestock under certain conditions. However, the toxicity of pin cherry leaves is lower than that of most other cherry species. (http://www.na.fs.fed.us/pubs/silvics_manual/volume_2/prunus/pensylvanica.htm)

**Chokecherry**, *Prunus virginiana*: This plant is highly desirable and important food plant for birds, small mammals, deer, rabbits, butterflies, ants and honeybees for its nesting, cover and browsing habitat, fruit and source of nectar. (http://www.wildflower.org/plants/result.php?id_plant=PRVI)

**Eastern serviceberry**, *Amelanchier canadensis:* Beneficial and important food plant for browsing deer, other wildlife including birds. Recognized by pollination ecologists as having qualities that attract a large number of native bees. This plant also attracts predators and parasitoid insects that prey upon pest insects. (The Xerces Society for Invertebrate Conservation 2014) (http://www.wildflower.org/plants/result.php?id_plant=AMCA4)

## 10.3 Wildlife Habitat Recommendations for Various Cover Types

### 10.3.1 Field and Meadow Cover Type

Boundaries between separate populations or communities such as fields and meadows and forest edges create an "edge effect". The wider the boundary between separate populations or communities the more biodiversity of the habitat is allowed. Field and meadow cover type is an excellent location for wildlife viewing as it provides important habitat for wildlife to breed, forage and hide from predators. In addition terrestrial birds and migratory birds benefit during spring and fall migration. Most migratory birds rely on seed, fruits and insects to sustain themselves through migration (Blake and Hoppes 1986). In order to improve seed, fruit and insect production native plant species should be properly managed using IVM considerations and recommendations previously listed to control invasive species. These species should be given highest priority in the management of this consequential habitat. For location of shrubs identified at the island please refer to Appendix A: *The Vascular Flora of Little Chebeague Island.*

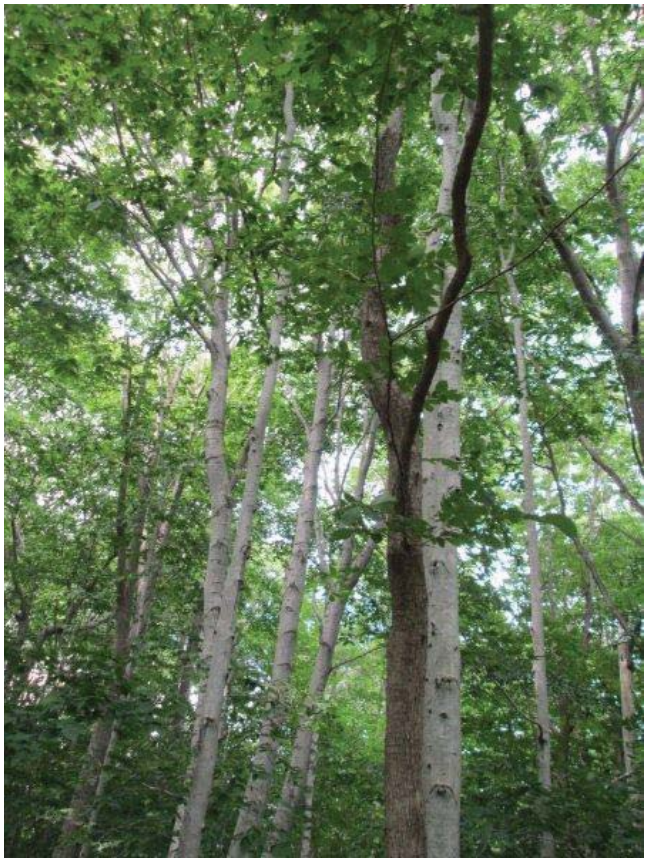
***Strategic recommendations to manage Field and Meadow Cover Type for suitable wildlife habitat***

- A configuration of mechanical and chemical treatments particularly mowing of fields and meadows should be conducted on a rotational basis to allow for native species to rejuvenate and invasive species to be controlled.
- Increased edges of habitat communities or populations will greaten the biodiversity of the area, (e.g. mow fields and meadows at borders of forests to increase biodiversity).

- Yellow Rattle, (*Rhinanthus minor*): A hemi-parasitic herbaceous annual plant that was found growing at the meadow forb closest to the front kiosk. This plant has been utilized in the UK to increase biodiversity in meadows by restricting grass growth; broadcasting 1gm of seed/m in the fall and mowing in July.-www.wikipedia.org.
- An annual prescribed burn plan of fields and meadows should include a 3 to 5 year rotation.
- Develop and consult cover type maps to provide the best mix and configuration of age classes and structural diversity to benefit nesting and migratory birds across the landscape.
- Manage desirable vegetation and refine objectives as needed.

### 10.3.2 Northern Hardwood-Mix Forest Cover Type

The northern hardwood-mix forest cover type is mainly comprised of sugar maple, (*Acer saccharin)* American beech (*Fagus grandiflora*), paper birch (*Betula papyrifera*) and white pine (*Prunus strobus*). This cover type provides valuable habitat for wildlife, nesting land birds and migratory birds. In order to benefit migrating birds, the USFWS recommend maintaining a balance of forest age structures, including mid-succession and late successional forest to provide structural diversity (shrubs and treefall) within the forest (USFWS 2005).



*Northern Hardwood Forest*

Historically island residents and military personnel who dominantly used Little Chebeague Island as a recreation area are largely responsible for clearing most of the island vegetation with the exception of a northern hardwood mix forest grove by the residential cottage area towards the center of the island. After the military and island residents no longer occupied the island, the disturbed, stressed and unstable land became an unmanaged breeding ground for aggressively invasive, non-native and less competitive native plants. 50 to 75 years have passed and forested areas are of both uneven aged and even aged stands with tolerant and intolerant species of trees. Shrubs in the northern hardwood-mix forest understory layer are virtually non- existent other than at the forest edge. However, the herbaceous, non-native European lily of the valley (*Convallaria majalis*) has escaped cultivation and presently dominates the northern hardwood-mix forest floor. Snags and forest debris are present helping to provide habitat, cover and protection for various wildlife species and terrestrial, residential and migratory birds.

### 10.3.3 Black Locust Cover Type

Black locust (*Robinia pseudoacacia*), is a nitrogen fixer and has rapid juvenile growth and has been widely planted as an ornamental, for shelterbelts and for land reclamation. In addition black locust is a pioneer type, usually man-influenced and temporary. It follows disturbances and may be natural or planted and typically found in pure stands such as at Little Chebeague Island. This cover type provides suitable cover for wildlife, browse for deer and cavities for birds (USDA Forest Service website).

*Stand of Black Locust, Robinia pseudoacacia*

Possibly planted by humans or by the “fugitive strategy” or the “buried seed” strategy, very intolerant species such as black locust (*Robinia pseudoacacia* ) are thriving near the northern hardwood mixed forest as a developing stand where more suitable conditions including full sunlight exist. These intolerant species germinated and grew at a much faster rate than the

established tolerant seedlings, growing overtop and dominating the stand. This process of growth is called "advance regeneration". However, the shade cast by these dominant trees does not ultimately prevent further growth as light levels below their crowns are sufficient for the growth of intermediate and tolerant species resulting in a stratified canopy with intermediate species (red oak, *Quercus rubra*) below the canopy and consequently leading to a stand dominated by tolerant trees (Young 1982), such as: red maple, (*Acer rubrum*), sugar maple (*Acer saccharum*) and American beech (*Fagus grandiflora*) which will ultimately reestablish over time with the elimination of shorter intermediate and intolerant black locust trees. However, without the eradication and proper management of invasive species presently threatening the integrity of the ecosystem, the natural processes of forest succession will be adversely affected with other than productive results.

***Strategic recommendations to manage northern hardwood-mix forest and black locust cover types for suitable wildlife habitat:***

- Seek free forester analysis from local Maine forest service chapter.
- Leave snags and debris on forest floor to create habitat for wildlife and birds.
- Prevent further deterioration of wildlife and bird habitat by eradicating problematic invasive species from forest ecosystem.
- Stimulate productivity of the existing native habitat by improving the healthy condition of the forest ecosystem using restorative measures, silviculture practices and removal of intolerant tree species to further manipulate a more desired outcome, uneven aged forest and more biologically diversified ecosystem.
- Encourage regeneration of tolerant species with the convergence of the northern hardwood mixed forest inherent edge with the black locust stand by eradicating bittersweet to prepare the site followed by transplanting sugar maple saplings into the stand to help establish a stratified canopy and ultimately assist in the natural progression and reestablishment of a stand dominated by tolerant species that could otherwise take 100+years.
- Some native and non-native invasive plants are capable of excreting chemicals from their roots that are harmful to other plants. Both white pine (*Pinus strobus*) and black cherry (*Prunus serotina*) are capable of generating allelopathic effects including the inhibition of germination, growth, or metabolism by one plant on another. Harmful effects of allelopathy: include depleting resources, altering the structure, function and diversity of plant communities and is amongst the most probable causes, in addition to competition for light, soil moisture and nutrients of the spatial distribution of tree species (Young 1982).
- Allelopathic effects could be utilized advantageously by installing a natural vegetated barrier of white pine and black cherry to prevent aggressive non-native plants from invading and impacting newly restored native colonies.
- Hire Maine Island Ecologists to refine objectives as new information is gathered through the establishment of baseline studies and cover type mapping.

# 11. RECREATION MANAGEMENT ISSUES AND RECOMMENDATIONS

The mission statement of the Maine Island Trail Association is:

*To establish a model of thoughtful use and volunteer stewardship for the Maine islands that will assure their conservation in a natural state while providing an exceptional recreational asset that is maintained and cared for by the people who use it* (MITA 2014).

Little Chebeague Island has functioned as a recreation site for many area outdoor enthusiasts for over a hundred years. As population increases in the region island managers will address critical recreation management issues in order to provide a safe and stable environment in which all may recreate. The following recommendations are site-specific to the heavily used LCI and suggest further assessment to properly monitor and better manage recreational activities on the island.

## 11.1 Visitor Impact Issues

- Design and develop recreation management plan specifically for Little Chebeague Island to properly monitor future population changes and consequential impacts on fragile island natural resources.
- Refer to Maine Dept. of Agriculture, Conservation, Forestry, Bureau of Public Lands document: *The Recreation Management Plan for the Public Islands on Maine Island Trail: 2004-2014* for specific background information, strategies and objectives.
- Prioritize management issues, strategies and cost considerations to study visitor impacts on sensitive island natural resources.
- Further investigate and determine all critical natural resources, cultural resources, recreational resources, potential indicator species, cover types, soil types, habitat types and ecological interactive sites. (Please see appendices for LCI natural resource inventory maps and natural resource inventories conducted by MIE scientists).
- Use MITA protocol; *Island Monitoring Task Force Three Year Pilot Project 2004-2006* by Natalie Springuel and its companion document: *Methods Manual: Monitoring Recreational Impact on islands* to establish baseline study to measure and monitor degrading ecological, cultural and aesthetic interactions and impacts.
- Evaluate and determine high use areas by studying vegetation and soil resiliency.

  Annual Limits Affecting Soil Resiliency (Maine State Planning Office 1994)

  1. No impacts on vegetation or soils if site visited < 100 people/yr.
  2. Persistent decline expected if used by >500 people/yr.
  3. Active management needed if used by > 1,000 people/yr.

- Refine goals after baseline information is gathered.
- Reassess human impacts on natural resources by establishing monitoring stations and photo points to be checked annually.

Size of Party Affecting Soil Resiliency (Maine State Planning Office 1994)

1. No Impact: 20 people over 3 days/25 visits of 2 people each using site for 2 days.
2. Visible Effects: 100 people over 3 days/10 people over 10days

- Control impacts of camping activities by enforcing Bureau of Public Land implemented camping regulations as needed, such as: limiting duration of stay to 2 nights, group size limit of 10 people (Maine Bureau of Public Lands 2003), along with the addition of temporary closures at degraded campsites (e.g. dune campsites at Main/Front Beach).
- For large groups encourage interior camping away from other campers or visitors who may be searching for the "remote island wilderness experience."

*Severe degradation of dune zones due to high use campsites.*

## 11.2 Assessments of Social Experiences and Carrying Capacities

- Re-measure and re-determine carrying capacity of natural elements and conditions to withstand use by assessing numbers of users and their activities, how visitors accessed the island, where are people from, number in party, duration of stay, location of

recreation, purpose of trip by conducting voluntary monthly surveys during July-August Campsites capable of handling large groups should also be re-evaluated annually.

- Measure and determine carrying capacity of privy to decide if an additional privy is needed. From our periodic field observations and photos recorded, several noticeable sites near the southern sandspit were used as make shift bathrooms during the summer months. Although there are opportunities for individuals to "carry in carry out" it appears that this practice is not followed at this time and subsequently is dangerous to all due to the shallow soils and geology of island.
- Measure and determine carrying capacity for boats anchored in non anchor free zones.
- Measure and determine carrying capacity for beach use at Main/Front Beach.
- Educate and encourage participation in periodic surveys to improve on issues of safety, human impact and management.

## 11.3 Trail Design and Maintenance

- Trails should be well marked by using permanent, weather proof signs, painted blazes upon trees, timber-lined trails, or visible cairns to mark trails in a more primitive manner where suitable.
- Reroute trails that pose significant risk to the recreation user. The Cottage Loop Path should be redirected away from the landslide area and away from attractive nuisances, such as piles of timbers with exposed nails or broken glass located along the trail or at nearby historical sites.
- Close trail spurs that lead to areas of poison ivy communities (eg. trail spur off of Sandbar Trail).
- Reroute trails away from sensitive environments (eg. freshwater wetlands, sand dunes) by using native plantings to encourage traffic flow away from impacting natural resources such as the spur trail from the shoreline to the privy.
- French drains can be established to protect freshwater wetland at the North East Trail Head on the western shoreline. For further information regarding French drains refer to *Island History: A Survey of Sensitive Sites on Little Chebeague Island* by USM intern, Brian Aseltine.
- Reroute trails that may pose a threat to the recreation user's health or discourage travel and exploration off the trail in areas such as high density speckled alder stands in the vicinity of the Cottage Loop Path where populations of fire ants and hickory tussock moths in the larval stage exist.
- Clean up and remove piles of debris from dilapidated cottages that have no or little historical significance so as not to pose a threat to the recreation user.

## 11.4 Kiosk and Trail Signage

- Discourage or control exploration "off the trail" by using educational signage at historical sites, (e.g. island cottages).
- Improve primitive signage along trails and at kiosks to identify, address and respect natural and cultural resource issues (ticks, hickory tussock moths, fire ants, brown tail

moths, invasive marine and plant species, historical sites), as well as "Leave No Trace" ethics and "How to volunteer" with MITA as well as MITA mission statement and Maine State rules and regulations for camping and hunting at Little Chebeague Island.

- Include a Quick Response (QR) Code on trailhead signs, kiosk, map signage or interpretive signs for visitors to download interpretive map or information from MITA website.
- To increase and improve weather proof interpretive trail signs use a router based sign maker.
- Budget for temporary closure signs at restoration sites (e.g. Dune camping areas.) and/or habitat protection signs at sensitive areas (e.g. Fringe marsh habitats).
- To encourage interior camping install signs at designated camping areas at vegetated sites near eastern kiosk and upland area above southwestern shoreline near NW trailhead.
- Remove interpretive sign hung on southern side of military burn building as it is placed near a large population of poison ivy. Placement of sign should be at a more visible site at the front of the burn building.
- All trailhead signs should be placed in visible locations with island maps, sign in booklet, rules and regulations and MITA caretaker contact information.

### 11.5 Revise Trail Map

- Include names of island beaches, fields, trails, trailheads, viewing areas, points of interest, etc.
- Include location of landing areas, updated camping areas (interior sites), caretakers quarters, etc.
- Natural resource issues of concern: deer ticks, dog ticks, hickory tussock moths, brown tail moth, etc.
- Include safety precautions on the back of the trail map, for example: historic features.
- Degree of difficulty to walk the trail system.
- Include a Quick Response (QR) Code on printed maps for visitors to download interpretive map or information from MITA website.

## 12. CONCLUSION

MITA island stewards are facing critically important natural resource management issues at Little Chebeague Island.

Large increases in population and urban development in the Casco Bay watershed region are anticipated throughout the next hundred years subsequently causing alarm to area scientists, land managers and conservation stewards who are studying the probability of estuarial waters becoming increasingly more polluted by point and nonpoint sources, consequently threatening rich marine and terrestrial ecosystems at the mainland and at coastal islands such as Little Chebeague Island. Also expected in the near future is the growing anthropogenic impact on highly sensitive island environments due to the rise in recreationalists searching for the "wilderness experiences", visiting islands that are more easily accessible, in close proximity to the mainland

and adversely contributing to the permanent degradation of the fragile, unstable island habitats. In addition to the moderately deteriorating conditions present at Little Chebeague Island today problematic invasive marine and plant species, warming trends, accelerated sea level rise and storm surges and uncontrolled recreation will continue to significantly degrade the already weakened, human impacted island environment. Without diligent and aggressive management action, stewardship and education these critical and sensitive marine and terrestrial habitats will continue to be damaged and ultimately lost.

Yet, through the development of a sound management plan, adherence to strict natural resource recommendations and ecological, recreational and archeological considerations along with a IVM methodology that includes a combination of controls and strategic actions at prioritized sites highlighted in this report, MITA land managers and island stewards will be better equipped to successfully manage, protect and restore critical and sensitive habitats at Little Chebeague Island.

## ACKNOWLEDGEMENTS

We thank Maria Jenness, MITA stewardship manager, and Brian Marcaurelle, MITA program director, for the opportunity and providing MIE with technical assistance and support. We thank Erno Bonebakker, on-site supervisor of volunteers, for his strong background support and collaborative assistance in providing research information, transportation and assistance with USM interns and linkages with area scientists and conservation organizations. We thank Josiah Brown and Brian Aseltine, USM interns for their dedication and commitment to the research study. We are grateful to the boat captains that delivered us to and from the island including Jeremy Ames, fisherman, David Lenz, MITA volunteer captain, Tom, Bill, Alan - additional MITA volunteer boat captains. We also thank Beth Goettel, MCINWR refuge manager, for her support and information regarding invasive plant control, Glen Mittelhauser, executive director/lead botanist for Maine Natural History Observatory, for his advice and sleuthing skills and Don Cameron, MNAP botanist/ecologist, for helping to identify possible rare plants and invasive plant control. Above all we thank our families for sharing and supporting us through this journey.

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# Appendix A: **THE VASCULAR FLORA OF LITTLE CHEBEAGUE, MAINE**

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***Methods:*** Vascular plants of Little Chebeague Island, Cumberland County, Maine based on field work conducted during 5 visits in 2013 on June 24, June 30, July 31, August 23 and Sept 16 in which unsystematic passes of distinctive island habitats were conducted during each visit by MIE Scientist, Tracy Ames. Periodic botanical identification contributions and species confirmations were made by MIE Ecologists, Kristin Pennock and Heather Storlazzi Ward. Plant communities located at impenetrable, problematic thicket locations such as at a vernal pool and possible bog site were not found although references to these areas are made in MITA records. Further exploratory baseline inventories of these sites are necessary. Plant species are arranged systematically by family name (in bold) in accordance with the "Checklist of the Vascular Plants of Maine" by the Josselyn Botanical Society, June 1995 edition. Plant genius and species follow alphabetically. In addition to Newcomb's and Audubon guides the following three websites were used to identify and classify plants at LCI: http://plants.usda.gov, https://gobotany.newenglandwild.org and http://www.ct-botanical-society.org.

**SPHAGNACEAE**

*Sphagnum* L. [Sphagnum Moss]: Patches commonly found at base of trees at island interior including at the Cottage Loop Trail.

**EQUISETACEAE**

*Equisetum arvense* L. [Field Horsetail]: Weedy in nature, this herbaceous perennial forb grows in patches around the island evident in wet habitats and meadow edges.

*Equisetum hyemale* L. [Scouringrush Horsetail]: located near Front Kiosk, meadow forbs area.

**OSMUNDACEAE**

*Osmunda cinnamomea* L. [Cinnamon Fern]: 2 isolated specimens found growing near interior freshwater wetlands.

**DENSTAEDTIACEAE**

*Dennstaedtia punctilobula* (Michx.) T. Moore [Eastern Hayscented Fern]: Non-native. **Dense, monotypic populations are located at eastern and western uplands, bluff borders and landslide areas. Management and monitoring studies should include this non-native invasive plant that can inhibit prevailing tree and shrub seedlings.**

*Pteridium aquilinum (*L.) Kuhn [Western Bracken Fern]: Located at the bluff area on South Beach and also on the Northeast Trail.

**THELYPTERIDACEAE**

*Thelypteris noveboracensis* (L.) Nieuwl. [New York Fern]: Identified growing at dry woods in the beech/maple forest.

*Thelypteris palustris* Schott var. *pubescens* (Lawson) Fern. [Marsh Fern]: Observed presence at damp, wooded, freshwater wetland area off the Northeast Trail.

*Thelypteris simulata* (Davenport) Nieuwl. [Massachusetts Fern]: Primarily found in the freshwater wetland on the eastern portion of the island, near burn building.

**DRYOPTERIDACEAE**

*Athyrium filix-femina* (L.) Roth *ex m*ertens var. *angustrum* (Willd) Lawson [Lady Fern]: Located on bluffs on the eastern shores.

*Onoclea sensibility* L. [Sensitive Fern]: Growing throughout island particularly in freshwater wetland areas and along trails such as NE Trail.

*Dryopteris carthusiana* (Vill.) H.P. Fuchs [Spinulose Woodfern]: Growing in clumps by historical military privy site on northwest portion of island.

*Dryopteris intermedia* (Muhl. ex Willd.) A. Gray [Intermediate Woodfern]: Clumps noticed at dry wooded area of the maple/beech forest at island interior.

*Dryopteris marginalis* (L.) A. Gray [Marginal Woodfern]: Located near hotel foundation.

**PINACEAE**

*Picea rubens* Sarg. [Red Spruce]: A few young, isolated trees growing in moist upland forested areas near cottages and NE Trail with one healthy, large tree growing at the northeastern meadow perimeter.

*Pinus resinosa* Ait. [Red Pine]: A single tree located on the southern portion of the island near stone beach.

*Pinus strobus* L. [Eastern White Pine]: Mature, old growth trees uncommonly dispersed around the island but mainly in the vicinity of the forested, previously inhabited areas.

**CUPRESSACEAE**

*Juniperus communis* L. var. *depressa* Pursh [Common Juniper]: Clumps of junipers visible at South Meadow.

*Juniperus virginiana* L. [Eastern Redcedar]: A beautiful specimen tree growing in the open area close to the Sandbar Kiosk on the northwestern edge of the island.

**RANUNCULACEAE**

*Coptis trifolia* (L.) Salisb. [Goldthread]: A sole seedling was located at the edge of the Cottage Loop Path.

*Euprasia nemorosa* (Pers.) Wallr. [Common Eyebright]: Directly located on the South Trail pathway.

*Ranunculus septentrionalis* [Swamp Buttercup]: Growing at freshwater wetland southeast of hotel and west of Thorntree Point.

*Xanthorhiza simplicissima* Marshall [Yellowroot]: Located on the interior northern hardwood forest floor of the Cottage Trail area particularly by the work shed and Hotel Foundation‘s Courtyard.

**BERBERIDACEAE**

*Berberis thunbergii* L. [Japanese Barberry]: Non-native. An invasive plant presently being intensively managed and eradicated from the island by MITA and MITA volunteers. Patches of this shrub were found at the Cottage Loop Trail, the Sandbar Trail, Hotel and Cottage Trails, etc.

*Berberis vulgaris* L. [Common Barberry]: Non-native. Attention was overlooked regarding this plant however the previous working plant list received from Erno Bonebakker included it. It was not confirmed by MIE.

**ZOSTERACEAE**

*Zostera marina* L. var. *stenophylla* Aschers & Graebn. [Eel Grass]: Growing in large areas in the subtidal and intertidal zones on the northeastern and northwestern sides of the island.

**ARACEAE**

*Arisaema triphyllum* (L.) Schott. [Jack in the Pulpit]: Few of these species discovered at the edge of the controlled burn site by the Sandbar Kiosk. Others located below the hardwood trees of the interior

by the hotelfoundation and the Cottage Loop Trail.

**CONVALLARIACEAE**

*Maianthemum canadense* Desf. [Canada Mayflower]: Present on northern hardwood forest floor as patches in the vicinity of the cottages.

**BORAGINACEAE**

*Myosotis sylvatica* Erhr. [Woodland Forget-me-knot]: Located on the southeast section of the island.

**IRIDACEAE**

*Iris versicolor* L. [Northern Blue Flag]: Commonly found growing in the freshwater wetland near the eastern shore.

**TYPAHACEAE**

*Typha angustifolia* L.[Narrowleaf Cattail]: Dominating at freshwater wetland adjacent to dune at Main/Front Beach and freshwater wetland adjacent to the western shoreline.

**LILIACEA**

*Asparagus officinalis* L. [Garden Asparagus]: Clump growing along Sandbar Trail in meadow forbs.

*Convallaria majalis* L. [European Lily of the Valley]: Non-native. Dense, monotypic, suffocating patches are visible in large areas on upland northern hardwood forest areas near cottages and hotel foundation on the Cottage Trail and Loop. This plant due to its invasive qualities should be added to the MITA invasive list and be monitored, eradicated and managed.

*Hemerocallis fulva* (L.) L. [Orange Daylily]: Presently growing near northern cottage on the Sandbar Trail.

*Uvularia perfoliata* L. [Perfoliate Bellwort]: Single specimen existing in terrestrial forb area of the northern hardwood forest floor Cottage Loop Trail. This plant is listed as “endangered” in NH.

**IRIDACEAE**

*Iris versicolor* L. [Harlequin Blueflag]: Few inundated clumps present at freshwater wetland adjacent to the upland back dune area.

**JUNCACEAE**

*Juncus effuses* L. [Soft Rush]: Found on the southeastern shore at the high marsh zone and at the freshwater wetland outlet on the western shoreline.

*Juncus roemerianus* Scheele [Black Rush]: Identified on Stone Beach at the southeastern shoreline in the high marsh zone.

*Juncus tenuis* Willd. [Path Rush]: Found along path and adjacent to freshwater wetland near eastern edge of island.

**CYPERACEAE**

*Bolboschoenus maritimus* (L.) Palla [Saltmarsh Tuber-Bulrush]: Identified on the western side of island in the low marsh zone of the intertidal area at foot of access trail to island and freshwater wetland outlet.

*Carex crinita* Lam. [Fringed Sedge]: Located in coastal fringe marsh area.

*Carex hormothodes* Fernald [Marsh Straw Sedge]: Location of this plant was not recorded and thus has not been confirmed. This sedge is state listed as “Threatened” in NY.

*Carex lurida* Wahlenb. [Shallow Sedge]: Growing at the low marsh zone at Stone Beach on the eastern shore and at mouth of freshwater wetland outlet on western shore along trail access.

*Carex rostrata* Stokes [Beaked sedge]: Plant growing at fringe of freshwater wetland visible near Privy Trail.

*Schoenoplectus fluviatilis* (Torr.) M.T. Strong [River Bulrush]: Located at the freshwater wetland above the eastern shoreline.

*Schoenoplectus maritimus* (L.) Lye [Cosmopolitan Bulrush, Saltmarsh Bulrush]: Growing in high marsh zone of the intertidal area.

*Schoenoplectus robustus* (Pursh) M. T. Strong [Sturdy Bulrush]: Located on Stone beach on southern side of island.

*Schoenoplectus tabernaemontani* (C. C. Gmel.) Palla [Softstem Bulrush]: Observed large populations growing in freshwater wetlands mainly on western edge of island at North Beach, near the NW Trailhead and scattered patches at the NE Trailhead.

*Scirpus atrovirens* (Willd.) [Green Bulrush]: Location not recorded.

*Scirpus cyperinus* (L.) Kunth [Wool Grass]: Largely growing in high marsh areas on the northern and southeastern coastal wetland shores with few patches scattered in the interior wetland near the barn foundation.

**POACEAE**

*Agrostis gigantea* Roth [Redtop]: Visible in the upland meadow area on the middle of the island, adjacent to the hotel foundation.

*Agrostis scalbra* Willd [Ticklegrass]: Growing in the upland meadow areas.

*Agrostis perennans* (Walter) Tuck. [Upland Bent Grass]: Existing in the upland forbs/graminoids areas.

*Ammophila breviligulata* Fernald [American Beachgrass]: Growing in upland dune area adjacent to Main Beach along eastern side of the island.

*Anthoxanthum odoratum* L. [Sweet Vernal Grass]: Non-native. Growing in open space/burn test site by second kiosk on the northern end of island.

*Bromus inermis* Leyss. [Smooth Bromegrass]: Located at the Northeast Trailhead growing at freshwater wetland stream outlet.

*Dactylis glomerata* (L.) [Orchard Grass]: Non-native. Sited in graminoids area of island but not noted specifically or confirmed.

*Daschampsia flexuosa* (L.) Trin. [Common Hairgrass]: Spotted at the back dune area growing with other graminoids and herbaceous plants+.

*Elymus pycnanthus* (Godr.) Melderis [Saltmarsh Wheatgrass]: Largely located adjacently to eastern and western shores in the upland dune border.

*Elymus repens* (L.) Gould. [Couch Grass, Witch Grass, or Quack Grass]: Non-native. Present in meadow and upland dune areas.

*Elymus virginicus* (L.) var. *halophilus* (Bickn.) Wieg. [Virginia Wild Rye]: Growing at edge of shoreline on western freshwater wetland outlet at the Northeast Trailhead.

*Leymus mollis* (Trin.) Hara. [Sea Lymegrass]: Growing adjacent to shoreline and throughout dune areas particularly above Main Beach.

*Phalaris arundinaceous* L. [Reed Canarygrass]: Island grass sample was collected but location was not recorded.

*Phleum pratense* (L.) [Timothy]: Non-native. Plants are presently existing in upland meadow, adjacent to hotel foundation.

*Poa pratensis* L. [Kentucky Bluegrass]: Non-native. Commonly distributed throughout the interior sections of the island.

*Spartina alterniflora* Loisel. [Smooth Cordgrass]: Dominantly found in the pockets of low salt marsh habitat on the northern and southern intertidal zones.

*Spartina patens* (Aiton) Muhl. [Salt Meadow Cordgrass, Salt Marsh Hay]: Shared occupancy of high marsh zones around the island mainly noted on the western side at Stone Beach.

*Spartina pectinata* Bosc ex Link [Freshwater Cordgrass, Prairie Cordgrass]: Growing at freshwater outlet and access path on western side of island.

*Spartina cynosuroides* (L.) Roth [Big Cordgrass]: Visible at freshwater wetland foreground adjacent to dune on the eastern side of the island.

*Thinopyrum pycnanthum* (Godr.) Bark worth [Tick Quackgrass]: Non-native. Visible at the Sandbar Trail near the Sandbar Kiosk on the northern tip of the island.

**GROSSULARIACEAE**

*Ribes hirtellum* Michx. [Bristly Gooseberry]: Growing at several locations in various conditions including damp pathways near bluffs, dune areas, by Northeast Trail, Sandbar Trail and subshrub alder areas near the interior wetland by stone foundations.

**POLYGONACEAE**

*Polygonum arenastrum* Jord. ex Boreau. [Oval-leaf Knotweed]: Non-native. There were two patches noted with one being on the south end near the upland trail sign near Target Beach and the other located on the path near the work shed.

*Polygonum convolvulus* L. *convolvulus* [Black Bindweed]: Non-native. **This submerged invasive subspecies was located at the freshwater wetland adjacent to Main/Front Beach and should be added to the invasive plant list to be eradicated from the island due to its aggressive nature.** Identification of this plant will need to be confirmed.

*Polygonum cuspidatum* Siebold & Zucc. [Japanese Knotweed]: Non-native. Three populations were identified on the island at western and southern bluff areas and the largest community being at the farmhouse foundation location. **This is an invasive species that is extremely difficult to eradicate. It is presently being managed and eradicated by MITA using various methods of control**.

*Polygonum persicaria* (L.) [Spotted Lady's Thumb]: Non-native. Identified along the Hotel Trail by shed.

*Rumex acetosella* L. [Common Sheep Sorrel]: Non-native. Common in scattered locations throughout island interior including by privy, meadow by privy and along the Cottage Loop Path.

*Rumex crispus* L. [Curly Dock]: Non-native. Many individuals found on the island with most evident specimens on the eastern upland dune area and growing in meadows along trails to the Sandbar Kiosk.

*Rumex pallidus* Bigelow [Seaside Dock]: Located at the high marsh zone at the western shore near the NE Trailhead on North Beach.

**PLUMBAGINACEAE**

*Limonium carolinianum* (Walt.) Britt. [Sea Lavender]: A small patch found on the northeastern side of the island in the high marsh zone to the east of the northern sandbar to Great Chebeague Island.

**TILIACEAE**

*Tilia americana* (L.) [American Basswood]: Tree located along the Cottage Loop Trail in the grove area on western upland.

*Tilia cordata* Mill. [Littleleaf Linden]: Found isolated tree by back cottages on the Cottage Loop Trail in the grove area.

**PORTULACACEAE**

*Portulaca oleracea* L. [Common Purslane]: Non-native. Present in small numbers near beach zone on upland dune areas on eastern shore.

**CHENOPODIACEAE**

*Atriplex cristata* Humb.& Bonpl. ex. Willd [Seabeach Orach, Crested Orach]: Few individuals identified at sandspit on northern end and dune areas of Main Beach. Typically found south of Maine to Florida and west to Texas. This plant was not verified.

*Atriplex glabriuscula* Edmondston [Edmondston's Atriplex]: Growing along bluffs and periodic inundated high marsh areas at the northwestern edge.

*Atriplex prostrata* Boucher *ex* DC. [Hastate Orache]: Non-native. Particularly scattered along the bluff edges above the eastern and western shorelines.

*Chenopodium berlandieri* Moq. Var. *macrocalycium* (Aellen) Cronq. [Pitseed Goosefoot]: Sporadic plants visible around the foredune areas on the eastern side of the island. **This plant has recently been removed from MNAP's Rare Plant List due to its increasing numbers identified, however it remains to be a plant that should be closely monitored and protected from human impact and other degrading elements**.

*Salicornia depressa* Standl. [Samphire] This oxygenating plant is commonly present in a small panne at the low marsh zone at the northern tip of the island, east of the sandbar.

*Salsola kali* L. ssp. *kali* [Russian Saltwort, Prickly Saltwort]: Non-native. One plant identified on the southern tip of the island near southern sandbar in the dune/beach border and another located by trailhead to privy on the eastern shore.

*Suaeda maritime* (L.) Dumort. ssp. *maritime* [White Sea-blite]: Non-native. Observed in the low marsh zone of the temporary inundated intertidal area on the southern, northern and western sides.

**CARYOPHYLLACEAE**

*Cerastium fontanum* Baumg. Ssp. *vulgare* (Hartman) Greuter & Burdet [Common Mouse-ear Chickweed]: Non-native. Large populations throughout island were noted.

*Honckenya peploides* L. Ehrh. [Seaside Sandplant, Seaside Sandwort]: Sited in the periodically inundated areas of the high marsh zone.

*Moehringia later flora* (L.) Fenzl [Grove Sandwort]: Small patches identified throughout interior of island.

*Soponaria officinallis* L. [Bouncingbet, Wild Sweet William]: Non-native. A dense patch is growing along edge of the Cannon Field.

*Spergularia salina* J. & C. Presl [Salt Sand Spurry, Salt-marsh Sand Spurrey]: Non-native. A low growing succulent visible at the high marsh zone.

**OXALIDACEAE**

*Oxalis stricta* L. [Common Yellow Wood-sorrel]: Growing in upright clumps on pathways throughout island trails.

**CELASTRACEAE**

*Celastrus articulate* Thumb. [Oriental Bittersweet]: Non-Native. Invasively present throughout island from the interior to the upland shoreline borders. Due to its extremely dense and dominantly invasive nature it is currently being extensively managed and eradicated.

**URTICACEAE**

*Boehmeria cylindrical* (L.) Sw. [Smallspike False Nettle]: Growing adjacent to the wetland behind the historical military burn building.

**MYRICACEAE**

*Myrica pennsylvanica* Loisel. [Northern Bayberry]: Extremely common throughout with plants bordering meadows, wooded areas in the interior and on bluffs adjacent to beaches.

*Myrica gale* L. [Sweet Gale]: A large population grows at wetland near military burn building on the eastern side of the island.

**FAGACEAE**

*Fagus grandifolia* Ehrh. [American Beech]: Present as a dominant tree species of the northern hardwood mix forest centrally located at the island interior.

*Quercus rubra* L. [Red Oak]: Mature individuals of the northern hardwood forest present near the center of island interior with others scattered atop bluffs, upland meadows and field perimeters, etc.

**BETULACEAE**

*Alnus incana* (L.) Moenchssp. *rugosa* (Du Roi) Clausen [Speckled Alder]: With many sizeable populations throughout the freshwater wetlands and other habitats, this is one of the most common species on the island.

*Betula papyrifera* Marshall [Paper Birch]: Scattered throughout the island and particularly at the northern and western interior and trails.

*Betula lenta* L. [Sweet Birch]: Found along pathway of Sandbar Trail.

*Ostrya virginiana* (Mill.) K. Koch [Eastern Hophornbeam]: Few fairly young trees located along the Cottage Loop Trail in the cottage and hotel grove areas.

**ROSACEAE**

*Alchemilla mollis* (Buser) Rothm. [Lady's Mantle]: Non-native. One plant identified growing along Cottage Loop Trail near cottages on western side of island.

*Amelanchier canadensis* (L.) Medik. [Canadian Serviceberry]: Visible along access trail to the Lower Clamwalk Trail and at the edge of the surrounding meadow area.

*Fragaria virginiana* Duchesne ssp. *virginiana* [Wild Strawberry]: Scattered throughout the meadow and terrestrial forbs as well as the Cottage Loop Trail on the island.

*Geum aleppicum* Jacq. [Yellow Avens]: Single stem growing in damp wooded area of freshwater wetland habitat near the farmhouse foundation.

*Malus sylvestris* P. Mill. [Apple] Non-native. Trees located along trail to the sandbar from the Sandbar Kiosk; northern cottage area and on western side of island on the Cottage Loop Trail.

*Photinia x floribunda* (Lindl.) Robertson & Phipps [Purple Chokeberry]: Presently growing along the 6Sandbar Trail and is visibly being overtaken by bittersweet.

*Potentilla simplex* Michx. [Common Cinquefoil]: Observed growing in the open meadow forb areas.

*Prunus pensilvanicus* L. f. var. *pennsylvanica* [Pin Cherry]: Recorded growing on the southern side of

the island in a grove adjacent to South Meadow. Other locations visible in upland forests on other parts of the island.

*Prunus serotina* Ehrh. [Black Cherry]: Located growing adjacent to the Cottage Trail, near the hotel foundation.

*Prunus virginiana* L. [Chokecherry]: Location at the interior uplands by the barn foundation. This plant is highly desirable by birds, small mammals, deer, rabbits, butterflies, ants and honeybees for its nesting and cover browsing habitat, fruit and source of nectar. Also, good for erosion control of stream banks due to its spreading by rhizomes.

*Rosa multiflora* Thunb. [Multiflora Rose]: Non-native. **This subshrub with invasive characteristics is a native nuisance which is located in various locations throughout the island including the western and southern bluff and upland areas. MITA management is currently working to eradicate this plant off the island.**

*Rosa rugosa* Thunb. [Salt Spray Rose]: Non-native. Several growing mainly along seaside bluffs and adjacent to freshwater wetlands on the southeastern and western sides and interior of the island.

*Rosa virginiana* Mill. [Virginia Rose]: Present along eastern freshwater wetland by Privy Trail.

*Rubus allegheniensis* Porter [Allegheny Blackberry]: Growing in parts of dense bittersweet areas south of the hotel and towards the barn foundation.

*Rubus hispidus* L. [Swamp Dewberry, Bristly Dewberry]: Situated along paths on the Northwest Trail, Sandbar Trail and wetland areas of the southern portion of the island.

*Rubus idaeus* L. ssp. *idaeus* [Wild Red Raspberry]: Non-native. Plants commonly found adjacent to paths, meadows and in disturbed sites of the interior sections including by barn foundation.

*Spireae alba* Du Roi var. *latifolia* (Ait.) Dippel [Meadowsweet]: Existing in patches adjacent to freshwater wetland and open meadow on eastern side.

**FABACEAE**

*Lathyrus japonicus* Willd. Var. *pellitus* Fern. [Beach Pea]: Non-native. Mainly present on upland dune and bluff areas and adjacent to southern and eastern beach zones.

*Lespedeza procumbens* Michx. [Trailing Lespedeza]: Evident at anthropogenic habitat existing at Cottage Loop Trail.

*Robinia pseudoacacia* L. [Black Locust]: A large persistent grove present at the interior of the island by the hotel foundation and Cannon Field. This native species has invasive qualities and can shade out weaker native species and contribute to the dominance of other harder to control invasivespecies, ie. Oriental Bittersweet. This species should be managed and monitored annually.

*Trifolium pratense* L. [Red Clover]: Non-native. Situated along pathways at the meadow edge past the Front Kiosk.

*Trifolium repens* L. [White Clover]: Non-native. Visible in the meadow forbs and graminoid areas north of the Front Kiosk and also Cannon Field.

*Vicia cracca* L. [Cow Vetch]: Non-native. Commonly located in herbaceous communities of meadows and fields.

*Vicia villosa* Roth [Winter Vetch, Hairy Vetch]: Non-native. Populations identified amongst the meadow forbs and graminoids on island.

**ELAEAGNACEAE**

*Elaeagnus umbellata* Thunb. [Autumn Olive]: Non-native. Two-Three large shrubs are found on

upland bluff areas on the northern end where they have widely suppressed native plants due to shading. **This plant is a problematic invasive plant species that due to its nitrogen fixating capabilities, it can adversely affect the nitrogen cycle of native communities that may depend on low fertility soils. These plants should be eradicated as a single plant can produce 80lbs of fruit annually.**

**CORNACEAE**

*Cornus sericea* L. [Redosier Dogwood]: Identified plants at two locations. One located at the Cannon Field edge in the wooded area. The other was above South Beach. Both sites plants were covered heavily with impenetrable Asiatic bittersweet.

**SALICACEAE**

*Populus tremuloides* Michx. [Quaking Aspen]: Found mainly on the western interior, above the bluffs and also area behind eastern freshwater wetland.

*Salix nigra* Marshall [Black Willow]: One specimen tree growing north of the privy noticed along the Front Kiosk Trail.

**VIOLACEAE**

*Viola macloskeyi* Lloyd [Small White Violet]: Apparent along the Cottage Loop Trail growing along the mossy western understory.

*Viola sororia* Willd. [Dooryard Violet]: One plant observed on the Cottage Loop Trail on western forested edge of island above large landslide.

**CLUSIACEAE**

*Hypericum canadense* L. [Canada St. Johnswort]: Visible growing in the damp, slightly open area of the wooded, freshwater wetland southeast of barn foundation.

*Hypericum perforatum* L. [Common St. Johnswort]: Observations noted along the Meadow Trail to the Sandbar Kiosk and in the dune areas on eastern shore.

*Triadenum virginicum* (L.) Raf. [Marsh St. Johnswort]: Presently distributed behind the burn building on the eastern shore.

**ONAGRACEAE**

*Epilobium ciliatum* Raf. Ssp. *glandulosum* (Legm.) Hoch & Raven [Northern Willow Herb]: Evident along path to privy from the access trail off the beach and at the freshwater wetland nearby and behind burn building.

*Oenothera biennis* L. [Common Evening Primrose]: Often sited growing at eastern uplands and dune areas.

**BRASSICACEAE**

*Babarea vulgaris* W.T .Aiton [Yellow Rocket]: Non-native. One site recorded showed presence near the Northeast Trailhead.

*Brassica nigra* (L.) W.D.J. Koch [Black Mustard]: Non-native. A foredune plant growing in areas of disturbance on the beaches and high use camping areas on the eastern side of island.

*Cakile edentula* (Bigelow) Hook. [American Sea Rocket]: Mainly present in patches at foredune edges on eastern and western sides of the island.

*Capsella busa-pastoris* (L.) Medik. [Sheperd's Purse]: Non-native. Growing in large clumps throughout many parts of the island including the Cottage Loop Trail, Front Kiosk Meadow and along trails.

*Lepidium-densiflorum* Schrad. [Prarie Pepperweed]: Few stems visible along path through freshwater wetland on the privy trail.

*Raphanus raphanistrum* L. [Wild Radish]: Non-native. Common in the dune and bluff areas around the island. Plants were specifically noted on the north, south and eastern dune and bluff locations.

*Rorippa palustris* (L.) Bess. Ssp. *fernaldiana* (Butters & Abbe) Johnsell [Common Yellow Cress]: Visibly located at upland freshwater wetland border at dune area near beaches on the eastern portion of island.

*Rorippa nasturtium-aquaticum* (L.) Hayek [Watercress]: Non-native. An invasive submerged aquatic plant that is visible at the freshwater wetland adjacent to dune area.

**ANACARDIACEAE**

*Rhus hirta* [Staghorn Sumac]: Present throughout field edges, dry areas, disturbed areas and open wooded areas of the island. These important native trees, largely providing habitat and food for many terrestrial birds, game birds, mammals (white-tailed deer, possible rabbits), have been a troublesome invader on the island as they possess a nuisance to trail maintenance with their invasive nature to reoccupy fields, meadows and pathways.

*Toxicodendron radicans* (L.) Kuntze [Poison-ivy]: A native nuisance apparent in large, dense populations and different growth habit ranging from subshrub to forb/herb classifications throughout the island but mainly adjacent to freshwater wetlands on the eastern and southern tips of the island but also growing sporadically in disturbed areas, control burn areas and pathways.

**SAPINDACEAE (includes ACERACEAE and HIPPOCASTANACEAE)**

*Acer rubrum* L. [Red Maple]: Commonly found in the northern hardwood forest of the upland interior and atop bluffs on the western side.

*Acer saccharum* Marshall [Sugar Maple]: Old specimen trees present at the Cottage Loop Trail forested areas on the western side of the island.

*Aesculus hippocastanum* L. [Horse Chestnut]: One specimen tree growing in the Cottage Loop Trail vicinity.

**PRIMULACEAE**

*Lysimachia quadrifolia* L. [Whorled loosestrife]: Seen at meadow forb area adjacent to the Cottage Loop Trail and by the barn foundation in wetland.

*Lysimachia terrestris* (L.) B.S.P. [Swamp Candles]: Identified at the freshwater wetland southeast of the hotel foundation.

*Trientalis borealis* Raf. [Star Flower]: Presently growing in the northern hardwood forest floor of the Cottage Loop Trail vicinity.

*Glaux maritima* L. [Sea Milkwort]: Patches distributed around the island at the high marsh zone. One patch noted at the rocky intertidal at Target Beach and another large patch located in a marsh panne near the sandspit.

**BALAMINACEAE**

*Impatiens capensis* Meerb. [Jewelweed, Spotted Touch-me-not]: Largely common throughout the island interior and wetland areas near beaches, bluffs and landslide.

**ERICACEAE**

*Monotropa uniflora* L. [Indianpipe]: Scattered along edges of monotypic colonies of European lily of the valley and Cottage Trail as well as by barn foundation.

*Vaccinium angustifolium* Aiton [Low Sweet Blueberry]: Present amongst the forest floor vegetation on the Cottage Loop Trail and near the northern tip.

*Vaccinium corymbosum* L. [Highbush Blueberry]: Sparsely evident on the western edge of the Cottage Loop Trail in a localized population.

**CONVOLVULACEAE**

*Calystegia sepium* (L.) R.Br. [Hedge Bindweed]: Located in the dune area of Main Beach near burn building.

**CUSTCUTACEAE**

*Custcuta gronovii* Willd. ex. J. A. Schultes [Common Dodder, Scald Weed]: Two populations found at freshwater wetlands set back from Main Beach and North Beach.

**SOLANACEAE**

*Solanum dulcamara* L. var. *villosissimum* Desv. [Bittersweet Nightshade]: Non-native. Quite prevalent on island growing in large densities throughout upper open wooded, field and wetland areas as either a vine or herbaceous forb. **Bittersweet Nightshade possesses invasive qualities and should not be ignored. This problematic invasive plant is presently being managed, eradicated and controlled at MCINWR coastal islands in Maine.**

**LAMIACEAE**

*Galeopsis bifida* Boenn. [Hemp Nettle]: Non-native. Present at bluff locations.

*Leonurus cardiaca* L. [Common Motherwort]: Growing in freshwater wetland east of hotel foundation.

*Lycopus americanus* Muhl. ex W.P.C. Barton [American Water Horehound]: Established at freshwater wetland area on eastern side of island near Main Beach.

*Lycopus uniflorus* Michx. [Northern Water Horehound, Northern Bugleweed]: Present at the perimeter of the eastern freshwater wetland behind the burn building.

*Mentha arvensis* L. [Wild Mint]: Sample was identified at hotel foundation.

*Nepeta cataria* L. [Catnip]: Non-native. One stem visible on the western bluff area by the NE Trailhead.

*Scutellaria galericulata* L. [Marsh Skullcap]: Noticed growing in two large patches at the edges of the freshwater wetland outlet areas on the southern and western shores.

**OROBANCHACEAE**

*Rhinanthus minor* L. [Yellow Rattle]: A hemi-parasitic herbaceous annual plant that was found growing in the meadow forb closest to the Front Kiosk. This plant has been utilized in the UK to increase biodiversity in meadows by restricting grass growth; broadcasting 1gm of seed/m in the fall and mowing in July.-www.wikipedia.org.

**SCROPHULARIACEAE**

*Euphrasia nemorosa* (Pers.) Wallr. [Common Eyebright]: Two small plants were present along path on South Trail and Cottage Loop Path.

*Linaria vulgares* Mill. [Butter and Eggs]: Non-native. Two patches were found with one being at the perimeter of the Cannon Field and the other being on the upland bluff border on the western edge by the NW Trailhead.

*Digitalis* L. [Foxglove]: Non-native. A secluded patch found along the North West Trail from the cottage area.

*Verbascum thapsus* L. [Common Mullein]: Non-native. Isolated individuals located by pathway near cottages on western side of island and near beaches in dune areas.

**PLANTAGINACEAE**

*Plantago major* L. var. *Intermedia* (DC.) Pilger [Common Plantain]: Observed sporadically on the interior of the island; along trails, adjacent open spaces, dune and bluff areas near south beach and Main/Front Beach.

*Plantago maritima* L. var. *juncoides* (Lam.) Gray [Seaside Plantain]: Visible at pannes of the middle/high marsh zone of the vegetated tidal wetland area on North Beach and by sandbar on southern tip of island.

**APOCYNACEAE**

*Asclepias syriaca* L. [Common Milkweed]: Largely growing in meadows and fields around the island including the front dune areas on the eastern side, the Front Kiosk meadow, Cannon Field, etc.

**RUBIACEAE**

*Galium aparine* L. [Spring Cleavers]: Growing in meadow forbs area along path near the front kiosk.

*Galium mollugo* L. [White Bedstraw]: Non-native. Located at meadow forbs area of Cannon Field.

*Gallium palustre* L. [Common Marsh Bedstraw]: Found in the wetland locations between shoreline and wet areas by Sandbar Trail and Privy Trail.

**CAPRIFOLIACEAE**

*Lonicera morrowii.* A. Gray [Morrow's Honeysuckle]: Non-native. **A noxious weed, this bush honeysuckle occurs invasively throughout the island. Plants noted along trails and amongst the wooded areas of the interior. This troublesome plant is in the top 5 of MITAs invasive plant species listand is being strictly managed and eradicated off the island.**

*Sambucus nigra* L. ssp. *canadensis* (L.) R. Bolli [American Black Elderberry]: Distributed along the uplands on the eastern and southern side of the Island. Rated by the USDA as an outstanding food source and cover for songbirds, game birds and mammals.

*Sambucus racemosa* L. [Red Elderberry]: One specimen growing in open space by Sandbar Kiosk. This plant is rated by the USDA as a fair to good source of food and cover for songbirds, mammals and livestock.

**AQUIFOLIACEAE**

*Illex verticillata* (L.) Gray [Common Winterberry]: Large individual shrubs located throughout the island's fresh water wetlands, damp wooded areas, trails and field perimeters.

**VITACEAE**

*Parthenocissus quinquefolia* (L.) Planch. [Virginia Creeper]: Groundcover patches noted near hotel and farmhouse foundations. This vine's fruit provides food for songbirds, small mammals and deer. It can become invasive and so their growth habit should be monitored annually.

**APIACEAE**

*Angelica lucida* L. [Sea Beach Angelica]: One dead plant visible on northwestern coastal bluff at the fringe of an open upland area.

*Daucus carota* L. [Queen Anne's Lace]: Non-native. Visible at the Reed Cottage along the edge of the Cannon Field and along the Sandbar Trail and Main Beach foredune area.

**APOCYNACEAE (Includes ASCLEPIADACEAE)**

*Asclepias syriaca* L. [Common Milkweed]: Abundantly found in locally pervasive areas at eastern dune areas, edges of fields and within meadow borders.

*Cynanchum louiseae* Kartesz & Gandhi [Louise's Swallow-wort, Black Swallow-wort]: A dense, monotypic colony has formed threatening the native plant species on Little Chebeague Island on the northeastern tip. A second smaller patch located on the bluff of South Beach also was noted. Both populations are being extensively managed with attempts to eradicate.

**ASTERACEAE**

*Achillea millefolium* L. var. *millefolium* [Common Yarrow]: Non-native. Spotted growing along Cottage Loop Trail.

*Ambrosia maritima* [Sea Ragweed]: Presence noted at bluff sites near Target/South Beach.

*Arctium minus* Bernh. [Common Burdock]: Non-native. A large, localized population of this species exists at the northern tip of the barn foundation.

*Cirsium arvense* (L.) Scop. [Canada Thistle]: Non-native. Evident in upland forbs amongst goldenrods between the Lower Clam Walk vicinity near beach. **This is a problematic, invasive plant that is presently being controlled at MCINWR coastal islands in Maine.**

*Cirsium vulgare* (Savi.) Ten. [Bull Thistle]: Non-native. Increasing populations evident in controlled burn areas and scattered patches throughout island meadow forbs, fields, disturbed areas, etc. **This is a problematic, invasive plant that is presently being controlled at MCINWR coastal islands in Maine.**

*Conza canadensis* (L.) Cronq. [Canadian Horseweed]: Present in sections near burn building at the eastern foredune.

*Erigeron philadelphicus* (L.) [Common Fleabane, Philadelphia Fleabane]: Plants situated at backdune graminoid area of Front/Main Beach near upland srcub-shrub border.

*Erechtites hieraciifolia* Raf. ex. DC. [American Burnweed, Fireweed]: Situated in open area near the historical Clamwalk vicinity.

*Hieracium aurantiacum* L. [Orange Hawkweed]: Identified growing in the interior portions of the island mainly as a component of fields and meadows.

*Hieracium piloselloides* Vill. [Glaucous Hawkweed]: Non-native. Visible at the mixed herbaceous forb and graminoid meadow communities near the Front Kiosk and Cannon Field.

*Helianthus annuus* L. [Common Sunflower]: Sole plant at front dune area by burn building.

*Lactuca seriola* L. [Prickly Lettuce]: Non-native. Few stems present at herbaceous forbs of the interior setting.

*Leucanthemum vulgare* Lam. [Ox-eye Daisy]: Non-native. Growing alongside path to the hotel foundation on the Cottage Trail.

*Rudbeckia hirta* L. [Blackeyed Susan]: Identified in the meadow near the Front Kiosk and along the bluff on the northwestern side of the island.

*Solidago canadensis* L. [Canada Goldenrod]: Evident at Cannon Field and work shed area.

*Solidago giganta* Aiton [Giant Goldenrod, Late Goldenrod]: Growing at the vicinity of the hotel foundation.

*Solidago juncea* Ait. [Early Goldenrod]: Commonly pervasive at island meadows and fields.

*Solidago odora* Aiton [Anisescented Goldenrod]: Noted presently at the eastern meadow by Front

Kiosk.

*Solidago rugosa* P. Mill ssp. *aspera* (Ait.) Cronq. [Rough-stemmed Goldenrod]: A popular meadow forb species common throughout the island in vegetated herbaceous communities as fields with mixed forbs and graminoids.

*Solidago sempervirens* L. [Seaside Goldenrod]: Present along rocky outcrops, seaside bluffs and dune areas at the northern and southern tips of the island.

*Sonchus arvensis* L. ssp. *arvensis* [Field Sow Thistle]: Non-native. Apparent in meadow forbs near the center of the island.

*Symphyotrichum novae-angliae* (L.) G.L. Nesom [New England Aster]: Located adjacent to the Sandbar Trail in open spaces of the terrestrial meadow forbs.

*Symphyotrichum novi-belgii* (L.) Nesom. var. *elodes* (Torr. & Gray) [New York Aster]: Commonly growing in meadows, upland and damp bluff/landslide areas throughout island and western shoreline.

*Symphyotrichum lateriflorum* (L.) A. Love and D. Love var. *lateriflorum* [Calico Aster]: Growing along cottage foreground area on The Cottage Loop Path.

*Taraxacum officinale* Wiggers ssp. *officinale* [Common Dandelion]: Growing at Cannon Field and other upland meadow areas.

*Tanacetum vulgare* L. [Common Tansy]: Localized massings near burn building primarily but others were noted by the cottages on the western perimeter.

*Teucrium canadense* L. [Canada Germander, American Germander]: Plants situated at the forb/herb area by fringes of the eastern freshwater wetland.

*Tussilago farfara* L. [Coltsfoot]: Non-native. This plant is locally abundant in patches growing by the Front Kiosk and near the hotel foundation. There is also a sizeable community at the landslides on the western edge of island. This plant can be weedy, have invasive qualities and should be monitored annually and added to the list of invasive species to control. **This problematic, invasive plant is presently being controlled on MCINWR coastal islands by various mechanical controls**

*Tragopogon lamottei* Rouy [Jack Go to Bed at Noon]: Non-native. An individual stem identified at the Privy Trailhead at the dune habitat. An additional, sole stem was identified by the edge of Cannon field on the Cottage Loop Trail.

# Appendix B: Wetland Evaluation Forms

## Wetland Function-Value Evaluation Form

Total area of wetland 1/8 ac Human made? Yes Is wetland part of a wildlife corridor? No or a "habitat island"?

Adjacent land use Abandoned/historic resort site reverted to woodland Distance to nearest roadway or other development > 3 mi

Dominant wetland systems present PSS1Ex Contiguous undeveloped buffer zone present Yes

Is the wetland a separate hydraulic system? Yes If not, where does the wetland lie in the drainage basin?

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. I-2

Latitude Longitude

Prepared by: HSW Date 02/25/2014

Wetland Impact:
Type N/A Area N/A

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y N X

| Function/Value | Suitability Y | Suitability N | Rationale (Reference #)* | Principal Function(s)/Value(s) | Comments |
|---|---|---|---|---|---|
| Groundwater Recharge/Discharge | | X | | | This wetland is seasonally saturated; no evidence of recharge or discharge was observed. |
| Floodflow Alteration | X | | 2, 3, 6, 8 | | This wetland appears to be the result of an excavation - possibly the remnants of the old historic hotel site. |
| Fish and Shellfish Habitat | | X | 1 | | No fish or shellfish habitat present. |
| Sediment/Toxicant Retention | | X | 9 | | No potential for sediment/toxicant retention. |
| Nutrient Removal | | X | | | No potential for nutrient removal. |
| Production Export | | X | | | Very little potential for production export. This is a man-made isolated basin. |
| Sediment/Shoreline Stabilization | | X | | | Wetland is not situated near a waterbody. |
| Wildlife Habitat | | X | | | Wetland provide little if any wildlife habitat. |
| Recreation | | X | | | No recreation potential. |
| Educational/Scientific Value | | X | | | No educational/scientific value. |
| Uniqueness/Heritage | | X | 23 | | No unique values associated with this wetland. |
| Visual Quality/Aesthetics | | X | | | No primary viewing location available. |
| ES Endangered Species Habitat | | X | | | No known or recorded observations of RTE species, but does provide potential valuable habitat for USF&W Priority Trust Species. |
| Other | | | | | |

Notes:

* Refer to backup list of numbered considerations.

# Wetland Function-Value Evaluation Form

Total area of wetland ~5 ac Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"?

Adjacent land use Undeveloped woodland Distance to nearest roadway or other development >3 mi

Dominant wetland systems present PSS1E Contiguous undeveloped buffer zone present Yes

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Upper reaches

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. I-3

Latitude _____ Longitude _____

Prepared by: HSW Date 02/25/2014

Wetland Impact:
Type N/A Area N/A

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y _____ N X

| Function/Value | Suitability Y | Suitability N | Rationale (Reference #)* | Principal Function(s)/Value(s) | Comments |
|---|---|---|---|---|---|
| Groundwater Recharge/Discharge | X | | 10, 11, 12, 15 | X | |
| Floodflow Alteration | X | | 2, 3, 5, 6, 7, 8, 9, 15, 18 | | Water flow impeded by constricted outlets (ephemeral drains), some detention occurring in this well-saturated area. |
| Fish and Shellfish Habitat | | X | 1, 2 | | No fish or shellfish habitat present. |
| Sediment/Toxicant Retention | | X | 3, 4, 5, 7, 8, 9 | | Sediment/toxicants may have the opportunity to settle out within ponded portions of the wetland - however sediment source does not exist. |
| Nutrient Removal | | X | 3, 5, 6, 7, 8, 9, 10, 11 | | Wetland could provide opportunity for nutrient removal - however excess nutrients do not exist. |
| Production Export | X | | 1, 2, 4, 5, 7, 10, 12 | | Outflow is constricted - wetland is assumed to retain most of it's production. |
| Sediment/Shoreline Stabilization | | X | | | Wetland is not directly associated with a watercourse or waterbody, but does aid in constricting floodwater within its' the basin-like depression. |
| Wildlife Habitat | X | | 1, 3, 4, 5, 7, 8, 11, 13, 17, 18, 19, 20, 21 | X | Wetland is a PVP (potential vernal pool) or amphibian breeding ground. It appears that water depths in the spring are of sufficient depth for amphibian breeding. |
| Recreation | | X | 5 | | Wetland is not accessible by marked trail - not easy to find. |
| Educational/Scientific Value | | X | 2, 5, 6 | | No known scientific potential. |
| Uniqueness/Heritage | | X | 5 | | Archaeological sites/midden nearby? Wetland is elevated in state status to a WoSS (wetland of special significance) because it is w/in 250' of a coastal wetland. |
| Visual Quality/Aesthetics | | X | | | No primary viewing location available. |
| ES Endangered Species Habitat | | | | | No known or recorded observations of RTE species, but does provide potential valuable habitat for USF&W Priority Trust Species. |
| Other | | | | | This wetland is jurisdictionally and hydrologically connected to I-4, but has been evaluated separately due to distinct charactaristics & watershed position. |

Notes:

*Refer to backup list of numbered considerations.

# Wetland Function-Value Evaluation Form

Total area of wetland ~10 ac Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"?

Adjacent land use Undeveloped woodland Distance to nearest roadway or other development >3 mi

Dominant wetland systems present PFO/SS/EM1E/J Contiguous undeveloped buffer zone present Yes

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower reaches

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. I-4

Latitude Longitude

Prepared by: HSW Date 02/25/2014

Wetland Impact:
Type N/A Area N/A

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y N X

| Function/Value | Suitability Y | Suitability N | Rationale (Reference #)* | Principal Function(s)/Value(s) | Comments |
|---|---|---|---|---|---|
| Groundwater Recharge/Discharge | X | | 4, 5, 8, 10 | X | Sandy soils within the wetland facilitate groundwater recharge |
| Floodflow Alteration | X | | 5, 7, 8, 9, 15, 18 | | Water flow impeded by constricted outlets (ephemeral drains), some detention occurring in this well-saturated area. |
| Fish and Shellfish Habitat | | X | 1, 2 | | No fish or shellfish habitat present. |
| Sediment/Toxicant Retention | | X | 3, 4, 5, 7, 8, 9 | | Sediment/toxicants may have the opportunity to settle out within ponded portions of the wetland - however sediment source does not exist. |
| Nutrient Removal | | X | 3, 5, 6, 7, 8, 9, 10, 11 | | Wetland could provide opportunity for nutrient removal - however excess nutrients do not exist. |
| Production Export | X | | 1, 2, 4, 5, 7, 10, 12 | | Outflow is constricted - wetland is assumed to retain most of it's production. |
| Sediment/Shoreline Stabilization | X | | 6, 7, 13, 14, 15 | X | Wetland is has the potential to absorb floodwater from storm surges, protecting the beaches and uplands from the oceans erosive forces. |
| Wildlife Habitat | X | | 1, 3, 4, 5, 7, 8, 13, 14, 17, 18, 19, 20, 21 | X | Wetland is a PVP (potential vernal pool) or amphibian breeding ground. Beaver sign observed. |
| Recreation | | X | 5 | | Wetland is not accessible by marked trail - not easy to find. Portions of the wetland are difficult to reach due to thick invasive bittersweet. |
| Educational/Scientific Value | | X | 2, 5, 6 | | No known scientific or educational potential; the site is not easily accessible. |
| Uniqueness/Heritage | X | | 32 | | Archaeological sites/midden nearby? Wetland is elevated in state status to a WoSS (wetland of special significance) because it is w/in 250' of a coastal wetland. |
| Visual Quality/Aesthetics | | X | | | No primary viewing location available. |
| ES Endangered Species Habitat | | | | | No known or recorded observations of RTE species, but does provide potential valuable habitat for USF&W Priority Trust Species. |
| Other | | | | | This wetland is jurisdictionally and hydrologically connected to I-3, but has been evaluated separately due to distinct charactaristics & watershed position. |

Notes:

*Refer to backup list of numbered considerations.

# Wetland Function-Value Evaluation Form

Total area of wetland ~5 ac Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"?

Adjacent land use Undeveloped woodland Distance to nearest roadway or other development >3 mi

Dominant wetland systems present PSS1/EM1E Contiguous undeveloped buffer zone present Yes

Is the wetland a separate hydraulic system? Yes If not, where does the wetland lie in the drainage basin? N/A

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. I-5

Latitude Longitude

Prepared by: HSW Date 02/25/2014

Wetland Impact:
Type N/A Area N/A

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y N X

| Function/Value | Suitability Y | Suitability N | Rationale (Reference #)* | Principal Function(s)/Value(s) | Comments |
|---|---|---|---|---|---|
| Groundwater Recharge/Discharge | X | | 4, 5, 8, 10 | X | Wetland discharges freshwater/groundwater in smaller quantities |
| Floodflow Alteration | X | | 5, 7, 8, 9, 15, 18 | | Stormwater intercepted by wetland however lack of constricted outlet reduces detention time. |
| Fish and Shellfish Habitat | | X | 1, 2 | | No fish or shellfish habitat present. |
| Sediment/Toxicant Retention | | X | 3, 4, 5, 7, 8, 9 | | Sediment/toxicants may have the opportunity to settle out within ponded portions of the wetland - however sediment source does not exist. |
| Nutrient Removal | | X | 3, 5, 6, 7, 8, 9, 10, 11 | | Wetland could provide opportunity for nutrient removal - however excess nutrients do not exist. |
| Production Export | X | | 1, 2, 4, 5, 7, 10, 12 | | Outflow is not constricted however flushing does not occur. |
| Sediment/Shoreline Stabilization | X | | 6, 7, 13, 14, 15 | X | Wetland is has the potential to absorb floodwater from storm surges, protecting the beaches and uplands from the oceans erosive forces. |
| Wildlife Habitat | X | | 1, 3, 4, 5, 7, 8, 13, 14, 17, 18, 19, 20, 21 | | Wetland may provide nesting habitat for resident birds. |
| Recreation | | X | 5 | | No recreation opportunity observed other than passive recreation such as bird watching. |
| Educational/Scientific Value | | X | 2, 5, 6 | | No known scientific or educational potential; although site is easily accessible. |
| Uniqueness/Heritage | X | | 32 | | Archaeological sites/midden nearby? Wetland is elevated in state status to a WoSS (wetland of special significance) because it is w/in 250' of a coastal wetland. |
| Visual Quality/Aesthetics | | X | | | No primary viewing location available. |
| ES Endangered Species Habitat | | | | | No known or recorded observations of RTE species, but does provide potential valuable habitat for USF&W Priority Trust Species. |
| Other | | | | | |

Notes:

* Refer to backup list of numbered considerations.

# Wetland Function-Value Evaluation Form

Total area of wetland ~5 ac Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"? No

Adjacent land use Undeveloped woodland and coastal Distance to nearest roadway or other development >3 mi

Dominant wetland systems present PEM/SS1E Contiguous undeveloped buffer zone present Yes

Is the wetland a separate hydraulic system? Yes If not, where does the wetland lie in the drainage basin? N/A

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. I-1

Latitude _____ Longitude _____

Prepared by: HSW Date 02/25/2014

Wetland Impact:
Type N/A Area N/A

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y _____ N X

| Function/Value | Suitability Y | Suitability N | Rationale (Reference #)* | Principal Function(s)/Value(s) | Comments |
|---|---|---|---|---|---|
| Groundwater Recharge/Discharge | X | | 13 | X | This wetland is situated along a slope & exhibits seepage conditions, variable water levels & drainage patterns consistent with groundwater discharge. |
| Floodflow Alteration | | X | 3, 18 | | This wetland does not retain significant quantities of water for long periods of time. |
| Fish and Shellfish Habitat | | X | 1, 2 | | No fish or shellfish habitat present. |
| Sediment/Toxicant Retention | | X | 4, 7 | | While minimal potential for sediment/toxicant retention exists, there is no current source of sediments or toxicants in the watershed. |
| Nutrient Removal | | X | 7 | | Currently there is no source of excessive nutrients in the watershed. |
| Production Export | X | | 4 | | Some production export exhibited via wetland drains and wildlife use and movement - not a significant function however . |
| Sediment/Shoreline Stabilization | X | | 1, 2, 6, 7, 8, 9, 13, 14 | | Wetland borders coastal/beach area. A small eroded rill has been reinforced with stone to protect against further erosion caused by runoff & foot traffic. |
| Wildlife Habitat | X | | 3, 4, 5, 7, 8, 17 | X | |
| Recreation | | X | 4 | | No significant recreational opportunities exist within this wetland. |
| Educational/Scientific Value | | X | 2, 6 | | No significant educational/scientific opportunities exist within this wetland. |
| Uniqueness/Heritage | | X | 10, 14, 18, 22 | | This wetland may be within 250' of a coastal wetland. If so, it's state status would be elevated to WoSS (wetland of special significance). |
| Visual Quality/Aesthetics | | X | 9 | | No significant visual quality or aesthetics observed. |
| ES Endangered Species Habitat | | X | | | No known or recorded observations of RTE species, but does provide potential valuable habitat for USF&W Priority Trust Species. |
| Other | | | | | |

Notes:

*Refer to backup list of numbered considerations.

GROUNDWATER RECHARGE/DISCHARGE— This function considers the potential for a wetland to serve as a groundwater recharge and/or discharge area. It refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

CONSIDERATIONS/QUALIFIERS

1. Public or private wells occur downstream of the wetland.
2. Potential exists for public or private wells downstream of the wetland.
3. Wetland is underlain by stratified drift.
4. Gravel or sandy soils present in or adjacent to the wetland.
5. Fragipan does not occur in the wetland.
6. Fragipan, impervious soils, or bedrock does occur in the wetland.
7. Wetland is associated with a perennial or intermittent watercourse.
8. Signs of groundwater recharge are present or piezometer data demonstrates recharge.
9. Wetland is associated with a watercourse but lacks a defined outlet or contains a constricted outlet.
10. Wetland contains only an outlet, no inlet.
11. Groundwater quality of stratified drift aquifer within or downstream of wetland meets drinking water standards.
12. Quality of water associated with the wetland is high.
13. Signs of groundwater discharge are present (e.g., springs).
14. Water temperature suggests it is a discharge site.
15. Wetland shows signs of variable water levels.
16. Piezometer data demonstrates discharge.
17. Other

FISH AND SHELLFISH HABITAT (FRESHWATER) — This function considers the effectiveness of seasonal or permanent watercourses associated with the wetland in question for fish and shellfish habitat.



CONSIDERATIONS/QUALIFIERS

1. Forest land dominant in the watershed above this wetland.
2. Abundance of cover objects present.

STOP HERE IF THIS WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE

3. Size of this wetland is able to support large fish/shellfish populations.
4. Wetland is part of a larger, contiguous watercourse.
5. Wetland has sufficient size and depth in open water areas so as not to freeze solid and retain some open water during winter.
6. Stream width (bank to bank) is more than 50 feet.
7. Quality of the watercourse associated with this wetland is able to support healthy fish/shellfish populations.
8. Streamside vegetation provides shade for the watercourse.
9. Spawning areas are present (submerged vegetation or gravel beds).
10. Food is available to fish/shellfish populations within this wetland.
11. Barrier(s) to anadromous fish (such as dams, including beaver dams, waterfalls, road crossing) are absent from the stream reach associated with this wetland.
12. Evidence of fish is present.
13. Wetland is stocked with fish.
14. The watercourse is persistent.
15. Man-made streams are absent.
16. Water velocities are not too excessive for fish usage.
17. Defined stream channel is present.
18. Other

SEDIMENT/TOXICANT/PATHOGEN RETENTION — This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants, or pathogens in runoff water from surrounding uplands or upstream eroding wetland areas.

CONSIDERATIONS/QUALIFIERS

1. Potential sources of excess sediment are in the watershed above the wetland.
2. Potential or known sources of toxicants are in the watershed above the wetland.
3. Opportunity for sediment trapping by slow moving water or deepwater habitat are present in this wetland.
4. Fine grained mineral or organic soils are present.
5. Long duration water retention time is present in this wetland.
6. Public or private water sources occur downstream.
7. The wetland edge is broad and intermittently aerobic.
8. The wetland is known to have existed for more than 50 years.
9. Drainage ditches have not been constructed in the wetland.

STOP HERE IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE.

10. Wetland is associated with an intermittent or perennial stream or a lake.
11. Channelized flows have visible velocity decreases in the wetland.
12. Effective floodwater storage in wetland is occurring. Areas of impounded open water are present.
13. No indicators of erosive forces are present. No high water velocities are present.
14. Diffuse water flows are present in the wetland.
15. Wetland has a high degree of water and vegetation interspersion.
16. Dense vegetation provides opportunity for sediment trapping and/or signs of sediment accumulation by dense vegetation is present.
17. Other

FLOODFLOW ALTERATION (Storage & Desynchronization) — This function considers the effectiveness of the wetland in reducing flood damage by water retention for prolonged periods following precipitation events and the gradual release of floodwaters. It adds to the stability of the wetland ecological system or its buffering characteristics and provides social or economic value relative to erosion and/or flood prone areas.

CONSIDERATIONS/QUALIFIERS

1. Area of this wetland is large relative to its watershed.
2. Wetland occurs in the upper portions of its watershed.
3. Effective flood storage is small or non-existent upslope of or above the wetland.
4. Wetland watershed contains a high percent of impervious surfaces.
5. Wetland contains hydric soils which are able to absorb and detain water.
6. Wetland exists in a relatively flat area that has flood storage potential.
7. Wetland has an intermittent outlet, ponded water, or signs are present of variable water level.
8. During flood events, this wetland can retain higher volumes of water than under normal or average rainfall conditions.
9. Wetland receives and retains overland or sheet flow runoff from surrounding uplands.
10. In the event of a large storm, this wetland may receive and detain excessive flood water from a nearby watercourse.
11. Valuable properties, structures, or resources are located in or near the floodplain downstream from the wetland.
12. The watershed has a history of economic loss due to flooding.
13. This wetland is associated with one or more watercourses.
14. This wetland watercourse is sinuous or diffuse.
15. This wetland outlet is constricted.
16. Channel flow velocity is affected by this wetland.
17. Land uses downstream are protected by this wetland.
18. This wetland contains a high density of vegetation.
19. Other

NUTRIENT REMOVAL/RETENTION/TRANSFORMATION — This function considers the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands and the ability of the wetland to process these nutrients into other forms or trophic levels. One aspect of this function is to prevent ill effects of nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.

CONSIDERATIONS/QUALIFIERS

1. Wetland is large relative to the size of its watershed.
2. Deep water or open water habitat exists.
3. Overall potential for sediment trapping exists in the wetland.
4. Potential sources of excess nutrients are present in the watershed above the wetland.
5. Wetland saturated for most of the season. Ponded water is present in the wetland.
6. Deep organic/sediment deposits are present.
7. Slowly drained fine grained mineral or organic soils are present.
8. Dense vegetation is present.
9. Emergent vegetation and/or dense woody stems are dominant.
10. Opportunity for nutrient attenuation exists.
11. Vegetation diversity/abundance sufficient to utilize nutrients.

STOP HERE IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE.

12. Waterflow through this wetland is diffuse.
13. Water retention/detention time in this wetland is increased by constricted outlet or thick vegetation.
14. Water moves slowly through this wetland.
15. Other

PRODUCTION EXPORT (Nutrient) — This function evaluates the effectiveness of the wetland to produce food or usable products for humans or other living organisms.

CONSIDERATIONS/QUALIFIERS

1. Wildlife food sources grow within this wetland.
2. Detritus development is present within this wetland
3. Economically or commercially used products found in this wetland.
4. Evidence of wildlife use found within this wetland.
5. Higher trophic level consumers are utilizing this wetland.
6. Fish or shellfish develop or occur in this wetland.
7. High vegetation density is present.
8. Wetland exhibits high degree of plant community structure/species diversity.
9. High aquatic vegetative diversity/abundance is present.
10. Nutrients exported in wetland watercourses (permanent outlet present).
11. "Flushing" of relatively large amounts of organic plant material occurs from this wetland.
12. Wetland contains flowering plants that are used by nectar-gathering insects.
13. Indications of export are present.
14. High production levels occurring, however, no visible signs of export (assumes export is attenuated).
15. Other

SEDIMENT/SHORELINE STABILIZATION — This function considers the effectiveness of a wetland to stabilize streambanks and shorelines against erosion.

CONSIDERATIONS/QUALIFIERS

1. Indications of erosion or siltation are present.
2. Topographical gradient is present in wetland.
3. Potential sediment sources are present up-slope.
4. Potential sediment sources are present upstream.
5. No distinct shoreline or bank is evident between the waterbody and the wetland or upland.
6. A distinct step between the open waterbody or stream and the adjacent land exists (i.e., sharp bank) with dense roots throughout.
7. Wide wetland (>10') borders watercourse, lake, or pond.
8. High flow velocities in the wetland.
9. The watershed is of sufficient size to produce channelized flow.
10. Open water fetch is present.
11. Boating activity is present.
12. Dense vegetation is bordering watercourse, lake, or pond.
13. High percentage of energy-absorbing emergents and/or shrubs border a watercourse, lake, or pond.
14. Vegetation is comprised of large trees and shrubs that withstand major flood events or erosive incidents and stabilize the shoreline on a large scale (feet).
15. Vegetation is comprised of a dense resilient herbaceous layer that stabilizes sediments and the shoreline on a small scale (inches) during minor flood events or potentially erosive events.

RECREATION (Consumptive and Non-Consumptive) — This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting, and other active or passive recreational activities. Consumptive opportunities consume or diminish the plants, animals, or other resources that are intrinsic to the wetland. Non-consumptive opportunities do not consume or diminish these resources of the wetland.

CONSIDERATIONS/QUALIFIERS

1. Wetland is part of a recreation area, park, forest, or refuge.
2. Fishing is available within or from the wetland.
3. Hunting is permitted in the wetland.
4. Hiking occurs or has potential to occur within the wetland.
5. Wetland is a valuable wildlife habitat.
6. The watercourse, pond, or lake associated with the wetland is unpolluted.
7. High visual/aesthetic quality of this potential recreation site.
8. Access to water is available at this potential recreation site for boating, canoeing, or fishing.
9. The watercourse associated with this wetland is wide and deep enough to accommodate canoeing and/or non-powered boating.
10. Off-road public parking available at the potential recreation site.
11. Accessibility and travel ease is present at this site.
12. The wetland is within a short drive or safe walk from highly populated public and private areas.
13. Other

WILDLIFE HABITAT — This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered. Species lists of observed and potential animals should be included in the wetland assessment report.[1]

CONSIDERATIONS/QUALIFIERS

1. Wetland is not degraded by human activity.
2. Water quality of the watercourse, pond, or lake associated with this wetland meets or exceeds Class A or B standards.
3. Wetland is not fragmented by development.
4. Upland surrounding this wetland is undeveloped.
5. More than 40% of this wetland edge is bordered by upland wildlife habitat (e.g., brushland, woodland, active farmland, or idle land) at least 500 feet in width.
6. Wetland is contiguous with other wetland systems connected by a watercourse or lake.
7. Wildlife overland access to other wetlands is present.
8. Wildlife food sources are within this wetland or are nearby.
9. Wetland exhibits a high degree of interspersion of vegetation classes and/or open water.
10. Two or more islands or inclusions of upland within the wetland are present.
11. Dominant wetland class includes deep or shallow marsh or wooded swamp.
12. More than three acres of shallow permanent open water (less than 6.6 feet deep), including streams in or adjacent to wetland, are present.
13. Density of the wetland vegetation is high.
14. Wetland exhibits a high degree of plant species diversity.
15. Wetland exhibits a high degree of diversity in plant community structure (e.g., tree/shrub/vine/grasses/mosses)
16. Plant/animal indicator species are present. (List species for project)
17. Animal signs observed (tracks, scats, nesting areas, etc.)
18. Seasonal uses vary for wildlife and wetland appears to support varied population diversity/abundance during different seasons.
19. Wetland contains or has potential to contain a high population of insects.
20. Wetland contains or has potential to contain large amphibian populations.
21. Wetland has a high avian utilization or its potential.
22. Indications of less disturbance-tolerant species are present.
23. Signs of wildlife habitat enhancement are present (birdhouses, nesting boxes, food sources, etc.).
24. Other

EDUCATIONAL/SCIENTIFIC VALUE — This value considers the suitability of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.

CONSIDERATIONS/QUALIFIERS

1. Wetland contains or is known to contain threatened, rare, or endangered species.
2. Little or no disturbance is occurring in this wetland.
3. Potential educational site contains a diversity of wetland classes which are accessible or potentially accessible.
4. Potential educational site is undisturbed and natural.
5. Wetland is considered to be a valuable wildlife habitat.
6. Wetland is located within a nature preserve or wildlife management area.
7. Signs of wildlife habitat enhancement present (bird houses, nesting boxes, food sources, etc.).
8. Off-road parking at potential educational site suitable for school bus access in or near wetland.
9. Potential educational site is within safe walking distance or a short drive to schools.
10. Potential educational site is within safe walking distance to other plant communities.
11. Direct access to perennial stream at potential educational site is available.
12. Direct access to pond or lake at potential educational site is available.
13. No known safety hazards exist within the potential educational site.
14. Public access to the potential educational site is controlled.
15. Handicap accessibility is available.
16. Site is currently used for educational or scientific purposes.
17. Other

VISUAL QUALITY/AESTHETICS — This value considers the visual and aesthetic quality or usefulness of the wetland.

CONSIDERATIONS/QUALIFIERS

1. Multiple wetland classes are visible from primary viewing locations.
2. Emergent marsh and/or open water are visible from primary viewing locations.
3. A diversity of vegetative species is visible from primary viewing locations.
4. Wetland is dominated by flowering plants or plants that turn vibrant colors in different seasons.
5. Land use surrounding the wetland is undeveloped as seen from primary viewing locations.
6. Visible surrounding land use form contrasts with wetland.
7. Wetland views absent of trash, debris, and signs of disturbance.
8. Wetland is considered to be a valuable wildlife habitat.
9. Wetland is easily accessed.
10. Low noise level at primary viewing locations.
11. Unpleasant odors absent at primary viewing locations.
12. Relatively unobstructed sight line exists through wetland.
13. Other

ENDANGERED SPECIES HABITAT — This value considers the suitability of the wetland to support threatened or endangered species.

ES

CONSIDERATIONS/QUALIFIERS

1. Wetland contains or is known to contain threatened or endangered species.
2. Wetland contains critical habitat for a state or federally listed threatened or endangered species.

UNIQUENESS/HERITAGE — This value considers the effectiveness of the wetland or its associated waterbodies to provide certain special values. These may include archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, its relative importance as a typical wetland class for this geographic location. These functions are clearly valuable wetland attributes relative to aspects of public health, recreation, and habitat diversity.

CONSIDERATIONS/QUALIFIERS

1. Upland surrounding wetland is primarily urban.
2. Upland surrounding wetland is developing rapidly.
3. More than 3 acres of shallow permanent open water (less than 6.6 feet deep), including streams, occur in wetlands.
4. Three or more wetland classes are present.
5. Deep and/or shallow marsh or wooded swamp dominate.
6. High degree of interspersion of vegetation and/or open water occur in this wetland.
7. Well-vegetated stream corridor (15 feet on each side of the stream) occurs in this wetland.
8. Potential educational site is within a short drive or a safe walk from schools.
9. Off-road parking at potential educational site is suitable for school buses.
10. No known safety hazards exist within this potential educational site.
11. Direct access to perennial stream or lake exists at potential educational site.
12. Two or more wetland classes are visible from primary viewing locations.
13. Low-growing wetlands (marshes, scrub-shrub, bogs, open water) are visible from primary viewing locations.
14. Half an acre of open water or 200 feet of stream is visible from the primary viewing locations.
15. Large area of wetland is dominated by flowering plants or plants that turn vibrant colors in different seasons.
16. General appearance of the wetland visible from primary viewing locations is unpolluted and/or undisturbed.
17. Overall view of the wetland is available from the surrounding upland.
18. Quality of the water associated with the wetland is high.
19. Opportunities for wildlife observations are available.
20. Historical buildings are found within the wetland.
21. Presence of pond or pond site and remains of a dam occur within the wetland.
22. Wetland is within 50 yards of the nearest perennial watercourse.
23. Visible stone or earthen foundations, berms, dams, standing structures, or associated features occur within the wetland.
24. Wetland contains critical habitat for a state- or federally-listed threatened or endangered species.
25. Wetland is known to be a study site for scientific research.
26. Wetland is a natural landmark or recognized by the state natural heritage inventory authority as an exemplary natural community.
27. Wetland has local significance because it serves several functional values.
28. Wetland has local significance because it has biological, geological, or other features that are locally rare or unique.
29. Wetland is known to contain an important archaeological site.
30. Wetland is hydrologically connected to a state or federally designated scenic river.
31. Wetland is located in an area experiencing a high wetland loss rate.
32. Other

# Appendix D: Wetland Classification Key

## WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| System | M - Marine | | | | | | | |
| Subsystem | 1 - Subtidal | | | | 2 - Intertidal | | | |
| Class | RB – Rock Bottom | UB – Unconsolidated Bottom | AB – Aquatic Bed | RF – Reef | AB – Aquatic Bed | RF – Reef | RS – Rocky Shore | US – Unconsolidated Shore |
| Subclass | 1 Bedrock<br>2 Rubble | 1 Cobble-Gravel<br>2 Sand<br>3 Mud | 1 Algal<br>3 Rooted Vascular | 1 Coral<br>3 Worm | 1 Algal<br>3 Rooted Vascular | 1 Coral<br>3 Worm | 1 Bedrock<br>2 Rubble | 1 Cobble-Gravel<br>2 Sand<br>3 Mud<br>4 Organic |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System | E - Estuarine | | | | | | | | | | | |
| Subsystem | 1 - Subtidal | | | | 2 - Intertidal | | | | | | | |
| Class | RB – Rock Bottom | UB – Unconsolidated Bottom | AB – Aquatic Bed | RF – Reef | AB – Aquatic Bed | RF – Reef | SB – Streambed | RS – Rocky Shore | US – Unconsolidated Shore | EM – Emergent | SS – Scrub-Shrub | FO – Forested |
| Subclass | 1 Bedrock<br>2 Rubble | 1 Cobble-Gravel<br>2 Sand<br>3 Mud<br>4 Organic | 1 Algal<br>3 Rooted Vascular<br>4 Floating Vascular | 2 Mollusk<br>3 Worm | 1 Algal<br>3 Rooted Vascular<br>4 Floating Vascular | 2 Mollusk<br>3 Worm | 1 Bedrock<br>2 Rubble<br>3 Cobble-Gravel<br>4 Sand<br>5 Mud<br>6 Organic | 1 Bedrock<br>2 Rubble | 1 Cobble-Gravel<br>2 Sand<br>3 Mud<br>4 Organic | 1 Persistent<br>2 Non-persistent<br>5 *Phragmites australis* | 1 Broad-Leaved Deciduous<br>2 Needle-Leaved Deciduous<br>3 Broad-Leaved Evergreen<br>4 Needle-Leaved Evergreen<br>5 Dead<br>6 Deciduous<br>7 Evergreen | 1 Broad-Leaved Deciduous<br>2 Needle-Leaved Deciduous<br>3 Broad-Leaved Evergreen<br>4 Needle-Leaved Evergreen<br>5 Dead<br>6 Deciduous<br>7 Evergreen |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| System | R - Riverine | | | | | | |
| Subsystem | 1 - Tidal | 2 – Lower Perennial | 3 – Upper Perennial | 4* - Intermittent | 5* – Unknown Perennial | | |
| Class | RB** – Rock Bottom | UB – Unconsolidated Bottom | SB** – Streambed | AB – Aquatic Bed | RS – Rocky Shore | US – Unconsolidated Shore | EM – Emergent |
| Subclass | 1 Bedrock<br>2 Rubble | 1 Cobble-Gravel<br>2 Sand<br>3 Mud<br>4 Organic | 1 Bedrock<br>2 Rubble<br>3 Cobble-Gravel<br>4 Sand<br>5 Mud<br>6 Organic<br>7 Vegetated | 1 Algal<br>2 Aquatic Moss<br>3 Rooted Vascular<br>4 Floating Vascular | 1 Bedrock<br>2 Rubble | 1 Cobble-Gravel<br>2 Sand<br>3 Mud<br>4 Organic<br>5 Vegetated | 2 Nonpersistent |

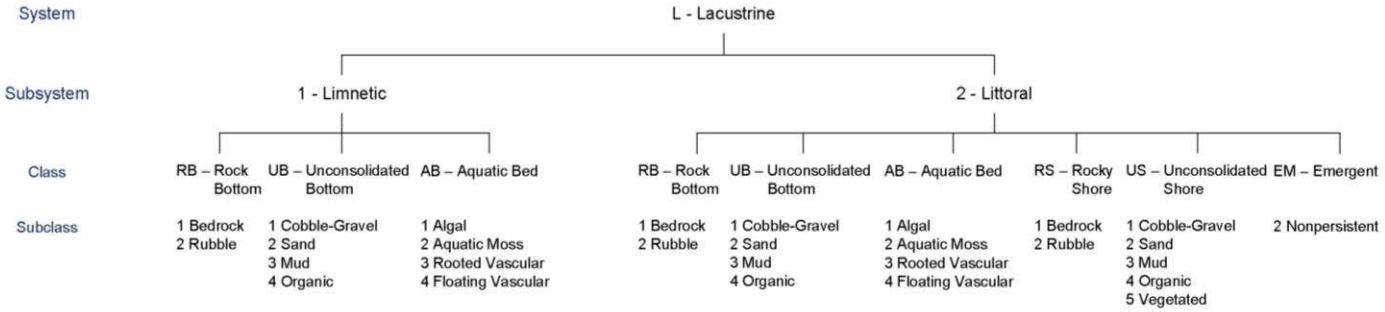
* **Intermittent** is limited to the **Streambed** Class;
**Unknown Perennial** is limited to **Unconsolidated Bottom** Class code **R5UB** only
** **Rock Bottom** is not permitted for the **Lower Perennial** Subsystem;
**Streambed** is limited to **Tidal** and **Intermittent** Subsystems

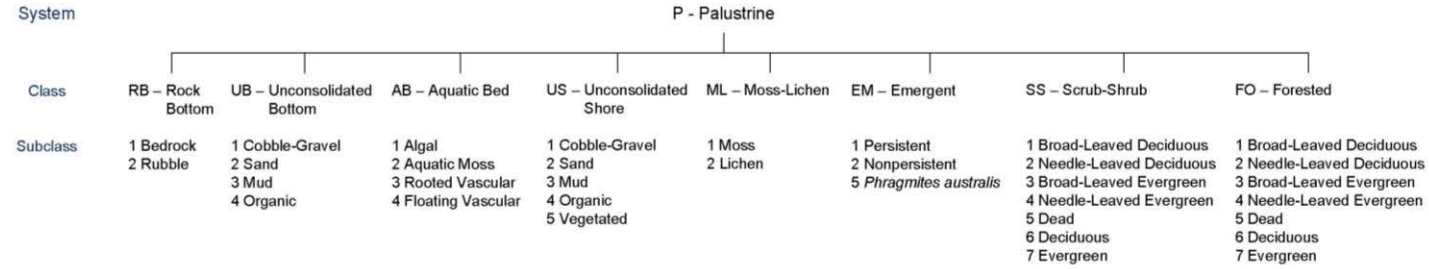


Classification of Wetlands and Deepwater Habitats of the United States, Cowardin *et al.* 1979

February, 2011

# WETLANDS AND DEEPWATER HABITATS CLASSIFICATION




## MODIFIERS

In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

| Water Regime | | | Special Modifiers | Water Chemistry | | | Soil |
|---|---|---|---|---|---|---|---|
| **Nontidal** | **Saltwater Tidal** | **Freshwater Tidal** | | **Coastal Halinity** | **Inland Salinity** | **pH Modifiers for all Fresh Water** | |
| A Temporarily Flooded | L Subtidal | S Temporarily Flooded-Tidal | b Beaver | 1 Hyperhaline | 7 Hypersaline | a Acid | g Organic |
| B Saturated | M Irregularly Exposed | R Seasonally Flooded-Tidal | d Partly Drained/Ditched | 2 Euhaline | 8 Eusaline | t Circumneutral | n Mineral |
| C Seasonally Flooded | N Regularly Flooded | T Semipermanently Flooded-Tidal | f Farmed | 3 Mixohaline (Brackish) | 9 Mixosaline | i Alkaline | |
| E Seasonally Flooded/ Saturated | P Irregularly Flooded | V Permanently Flooded-Tidal | h Diked/Impounded | 4 Polyhaline | 0 Fresh | | |
| F Semipermanently Flooded | | | r Artificial | 5 Mesohaline | | | |
| G Intermittently Exposed | | | s Spoil | 6 Oligohaline | | | |
| H Permanently Flooded | | | x Excavated | 0 Fresh | | | |
| J Intermittently Flooded | | | | | | | |
| K Artificially Flooded | | | | | | | |

[2

# Appendix E: Working Mammal and Reptile Inventory at Little Chebeague Island

| Reptile Name | Latin Name | Type | Amount |
|---|---|---|---|
| Red-bellied snake, | *Storeiria occipitomaculata* | Live | 1 |
| Common garter snake, | *Thamnophis sirtalis* | Live | 1 |

| Mammal Name | Latin Name | Type | Amount |
|---|---|---|---|
| White-footed deer mouse, | *Peromyscus maniculatus* | Live | 6 |
| Vole, | *Microtus pennsylvanicus* | Live | 1 |
| American mink, | *Neovison vison* | Scat | 1 |
| North American Beaver, | *Castor canadensis* | Tree | 1 |
| Red Fox, | *Vulpes vulpes* | Dead | 1 |
| White-tailed deer, | *Odocoileus virginianus* | Scat & Tracks | 10+ |
| Raccoon, | *Procyon lotor* | Scat | 1 |

# Appendix F: Working Insect Inventory List at Little Chebeague Island

**ACRIDIDAE**

*Melanoplus femurrubrum* [Grasshopper]: Located at island interior near Cannon Field.

**APHIDIDAE**

*Prociphilus tessellates* **[**Wooly Alder Aphid]: The larvae often form large cottony masses on twigs of alders for protection from predators. Found on speckled alders at forest edge of Cannon Field.

**APIDAE**

*Bombus sp.* [Bumblebee]: Located at island interior on host plant.

**ARCTIIDAE**

*Ctenucha virginica* [Virginia Ctenucha]: A day moth that was found sucking nectar from a common milkweed flower adjacent to military burn building near eastern shore.

*Lophocampa caryae* [Hickory Tussock Moth or Hickory Halisidota]: **A problematic species of moths that in its larval form can cause skin irritations, and blindness upon contact.** Located near Cottage Loop Trail.

**CEROPOIDEA**

*Aphrophora saratogensis* [Spittlebug (Froghoppers)]: nymphal form: produces a "snake spit" frothy substance found on stems of herbaceous forbs.

**CHRYSOMELIDAE**

*Acalymma vittatum* [Cucumber Beetle]: Identified on host plant at island interior.

**CICADELLIDAE**

[Leaf Hopper]: Located by hotel foundation on vegetation.

**COCCINELLIDAE**

*Coccinella septempunctata* [Ladybug]: Identified on host plant at island interior.

**COENAGRIONIDAE**

*Amphiagrion saucium* [Eastern Red Damsel]: Resting atop bramble at edge of Cannon Field.

**CULICIDAE**

*Culex pipiens* [Common Mosquito]: Frequently found at island interior.

**FORFICULIDAE**

*Forficula auricularia* [Earwig]: Located under log at Cottage Loop Path.

**FORMICIDAE**

*Formica sp.* [Field Ant]: Found at island shoreline.

*Solenopsis invicta* [Fire Ant]: Located at the vicinity of the Cottage Loop Trail.

**HESPERIIDAE**

Subfamily *Hesperiinae* [Grass Skipper]: Adults rest with wings closed or back with hindwings open flat and forewings at an angle (the "jet plane" position), a posture unique to grass skippers. They are fast, erratic fliers. Larvae feed on grasses.

*Epargyreus clarus* [Silver-spotted Skipper]: Present feeding on common milkweed adjacent to the Main/Front Beach in dune area.

**IXODIDA**

*Dermacentor variabilis* [Dog Tick]: Abundant throughout island particularly in spring and early summer.

*Ixodes scapularis* [Deer Tick]: Largely exuberant at all parts of the island especially in the spring

and early summer.

**LIBELLULIDAE**

*Libelluta Purcell* [Twelve Spotted Skimmer]: Individual found flying atop common milkweed at Cannon Field.

**LYCAENIDAE**

*Satyrium calanus* [Banded Hairstreak]: Foraging on common milkweed near military burn building adjacent to Front/Main Beach.

**MUSCIDAE**

*Musca domestica* [House Fly]: Commonly present throughout the island interior.

**MYRMELEONTIDAE**

[Antlion]: Evidence of sandpits built by the larval form of this insect near the equipment shed.

**NYMPHALIDAE**

*Danaus plexippus* [Monarch Butterfly]: Visible on common milkweed at Cannon Field.

**PAPILIONIDAE**

*Papilio glaucus* [Eastern Tiger Swallowtail]: Observed foraging on common milkweed at Cannon Field.

**PENTATOMIDAE**

*Perillus bioculatus* [Two Spotted Stink Bug]: A western species that spread eastward following its principle prey, the Colorado Potato Beetle.

**PIERIDAE**

*Pieris rapae* [Small Cabbage White or Brassica Butterfly]: Single butterfly observed flying at interior of island.

**SCARABAEIDA**

*Popillia japonica* [Japanese Beetle]: Identified on host plant at island interior.

**SILPHIDAE**

*Necrophila americana* [American Carrion Beetle]: Identified on host plant at island interior.

**VESPIDAE**

*Vespula Sp.* [Yellow Jacket]: Identified on host plant at island interior.

<u>UNIDENTIFIED BUTTERFLIES</u>

Creamy yellow with marking on tip; White sulpher type butterfly with blue spots

<u>OTHER</u>

Earth worm
Mealy worm
Slug
Daddy long legs, *Pholcus phalangioides*
Centipede
Pill bug
Sandflea, Talitrudae (Family) Found in the strandline on Main/Front Beach.
Amber shell snail
White-lipped grove snail (*Cepaea hortensis*) or brown-lipped banded snail (*Cepeae nemoralis*)
The white-lipped snail can be identified by a thinner shell and whirls that are more rounded. The namesake appearance of a white or brown lip can't be relied on for identification due to the polymorphic nature of each species.

# Appendix G: Working Bird Inventory at Little Chebeague Island

***Methods:*** Five visits were made to Little Chebeague between May 5 and September 16 of 2013. Point counts were not feasible due to time constraints and the limitations of transportation to and from the island. Rather, bird life on the island was evaluated using methods similar to those utilized in state Breeding Bird Atlas projects. Breeding Codes from Maine's atlas project were applied.

**Breeding Evidence Codes**

| **Code** | **Code description** (see handbook for full description & use suggestions) |
|---|---|
| **PO** Category - possible breeding evidence | |
| - | Species (male or female) observed in suitable nesting habitat during its breeding season. |
| **PR** Category - probable breeding evidence | |
| S | Singing male present (or breeding calls heard) on more than one date in the same place. |
| T | Bird (or pair) apparently holding territory. In addition to territorial singing, chasing of other individuals of the same species often marks a territory. |
| D | Courtship and display, or agitated behavior or anxiety calls from adults suggesting probable presence of nest or young nearby; brood patch on trapped female or cloacal protuberance on trapped male. |
| N | Visiting probable nest site. |
| B | Nest building by wrens or excavation of holes by woodpeckers. |
| **CO** Category - confirmed evidence of breeding | |
| DD | Distraction display or injury feigning; coition. |
| NB | Nest building by any species except wrens and woodpeckers. |
| UN | Used nest found. Must be carefully identified if it is to be accepted. |
| FE | Female with egg in oviduct. (For banders.) |
| FL | Recently fledged young (of altricial species) incapable of sustained flight or downy young (of precocial species) restricted to the natal area by dependance on adults or limited mobility. |
| FS | Adult carrying fecal sac. |
| FY | Adult carrying food for young. |
| ON | Adults entering or leaving a nest site in circumstances indicating occupied nest. To be used for nests which are too high (e.g. the tops of trees) or enclosed (e.g. chimneys) for the contents to be seen. |
| NE | Nest with egg(s), undisturbed nest with a bird in incubation posture, eggshells found below nest, or identifiable dead nestling(s). |
| NY | Nest with young or downy young of waterfowl, quail, waders, etc. |

*Codes from Maine Breeding Bird Atlas project's Handbook. Taken from Breeding Bird Atlas Explorer (online resource). 2014. U.S. Geological Survey Patuxent Wildlife Research Center & National Biological Information Infrastructure.*

Species confirmed breeding on the island include: Barn Swallow *Hirundo rustica*; Gray Catbird *Dumetella carolinensis*; American Redstart *Setophaga ruticilla*; and Song Sparrow *Melospiza melodia*. Probable breeders include: Veery *Catharus fuscescens*; Cedar Waxwing *Bombycilla cedrorum*; Black-and-white Warbler *Mniotilta varia*; Common Yellowthroat *Geothlypis trichas*; Yellow Warbler *Setophaga petechial*; Black-throated Green Warbler *Setophaga virens*; Eastern Towhee *Pipilo erythrophthalmus* and American Goldfinch *Spinus tristis*.

| **Common Name** | ***Genus Species*** | **ABA** | **LCI** | **5/10** | **6/14** | **6/30** | **7/31** | **9/16** | **Breed*** | **Notes** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Loons (Gaviidae)** | | | | | | | | | | |
| Common Loon | *Gavia immer* | 1 | | | | | | 1 | | |
| **Ducks, Geese, and Swans (Anatidae)** | | | | | | | | | | |
| American Black Duck | *Anas rubripes* | 1 | x | | | | | | | |
| Common Eider | *Somateria mollissima* | 1 | | √ | √ | √ | 40 | 60 | | |
| **Cormorants (Phalacrocoracidae)** | | | | | | | | | | |
| Double-crested Cormorant | *Phalacrocorax auritus* | 1 | | √ | √ | 17 | 10 | 25 | | |
| **Bitterns, Herons, and Allies (Ardeidae)** | | | | | | | | | | |
| Great Blue Heron | *Ardea herodias* | 1 | | | 1 | | 1 | | | |
| **Ospreys (Pandionidae)** | | | | | | | | | | |
| Osprey | *Pandion haliaetus* | 1 | x | | | 1 | 1 | | | |
| **Hawks, Kites, Eagles, and Allies (Accipitridae)** | | | | | | | | | | |
| Bald Eagle | *Haliaeetus leucocephalus* | 1 | | | 1 | | 1 | | | |
| **Lapwings and Plovers (Charadriidae)** | | | | | | | | | | |
| Semipalmated Plover | *Charadrius semipalmatus* | 1 | | | | | | 9 | | |
| **Sandpipers, Phalaropes, and Allies (Scolopacidae)** | | | | | | | | | | |
| Spotted Sandpiper | *Actitis macularius* | 1 | x | | | | | | | |
| Ruddy Turnstone | *Arenaria interpres* | 1 | | | | | 14 | | | |
| Semipalmated Sandpiper | *Calidris pusilla* | 1 | | | | | 5 | | | |
| Least Sandpiper | *Calidris minutilla* | 1 | x | | | | 2 | 6 | | |
| Short-billed Dowitcher | *Limnodromus griseus* | 1 | | | | | 2 | | | |
| Wilson's Snipe | *Gallinago delicata* | 1 | | | | 1* | | | | may have been a woodcock |
| **Gulls, Terns, and Skimmers (Laridae)** | | | | | | | | | | |
| Bonaparte's Gull | *Chroicocephalus philadelphia* | 1 | | | | | | 76 | | |
| Laughing Gull | *Leucophaeus atricilla* | 1 | | | | | 1 | | | |
| Ring-billed Gull | *Larus delawarensis* | 1 | | | | | 7 | 4 | | |
| Herring Gull | *Larus argentatus* | 1 | | √ | √ | 20 | 9 | 20 | | |
| Great Black-backed Gull | *Larus marinus* | 1 | | | | | 1 | 2 | | |
| Common Tern | *Sterna hirundo* | 1 | | | | 2 | 6 | | | incls 4 fledlings on 7/31 plus one dead skinny adult |
| **Pigeons and Doves (Columbidae)** | | | | | | | | | | |
| Mourning Dove | *Zenaida macroura* | 1 | x | | | | | | | |
| **Kingfishers (Alcedinidae)** | | | | | | | | | | |
| Belted Kingfisher | *Megaceryle alcyon* | 1 | | | | | | 1 | | |
| **Woodpeckers and Allies (Picidae)** | | | | | | | | | | |
| Downy Woodpecker | *Picoides pubescens* | 1 | | | √ | √ | | 1 | | |
| Hairy Woodpecker | *Picoides villosus* | 1 | | √ | | | 1 | | | |
| **Tyrant Flycatchers (Tyrannidae)** | | | | | | | | | | |
| Olive-sided Flycatcher | *Contopus cooperi* | 1 | x | | | | | | | |
| Eastern Wood-Pewee | *Contopus virens* | 1 | x | | | | | | | |
| Willow Flycatcher | *Empidonax traillii* | 1 | x | | | | | | | 1 Empid spp on 7/31 |
| Least Flycatcher | *Empidonax minimus* | 1 | x | | | | | | | |
| Eastern Phoebe | *Sayornis phoebe* | 1 | | | | | | 1 | | |
| **Vireos (Vireonidae)** | | | | | | | | | | |
| Red-eyed Vireo | *Vireo olivaceus* | 1 | | | | | | 6 | | |

| Common Name | *Genus Species* | ABA | LCI | 5/10 | 6/14 | 6/30 | 7/31 | 9/16 | Breed* | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Jays and Crows (Corvidae)** | | | | | | | | | | |
| Blue Jay | *Cyanocitta cristata* | 1 | x | | 2 | | 1 | 4 | | |
| American Crow | *Corvus brachyrhynchos* | 1 | x | | 50 | 2 | | 2 | | |
| **Swallows (Hirundinidae)** | | | | | | | | | | |
| Purple Martin | *Progne subis* | 1 | | | | | | | | |
| Tree Swallow | *Tachycineta bicolor* | 1 | | | 1 | 1 | | | | |
| Barn Swallow | *Hirundo rustica* | 1 | x | √ | | 13 | 20 | | ON | |
| **Chickadees and Titmice (Paridae)** | | | | | | | | | | |
| Black-capped Chickadee | *Poecile atricapillus* | 1 | | | | | √ | 8 | | |
| **Thrushes (Turdidae)** | | | | | | | | | | |
| Veery | *Catharus fuscescens* | 1 | x | | 2 | 1 | | | S | |
| Swainson's Thrush | *Catharus ustulatus* | 1 | x | | | | | | | |
| American Robin | *Turdus migratorius* | 1 | x | | | | | | | |
| **Mockingbirds and Thrashers (Mimidae)** | | | | | | | | | | |
| Gray Catbird | *Dumetella carolinensis* | 1 | x | | √ | 3 | √ | 3 | FY | |
| Northern Mockingbird | *Mimus polyglottos* | 1 | | 1 | | | | | | |
| **Waxwings (Bombycillidae)** | | | | | | | | | | |
| Cedar Waxwing | *Bombycilla cedrorum* | 1 | x | | 5 | 3 | 7 | 4 | FL | includes 6 fledglings on 7/31 |
| **Wood-Warblers (Parulidae)** | | | | | | | | | | |
| Ovenbird | *Seiurus aurocapilla* | 1 | x | | | | | | | |
| Black-and-white Warbler | *Mniotilta varia* | 1 | x | √ | √ | 1 | 1 | | S | |
| Common Yellowthroat | *Geothlypis trichas* | 1 | x | | | 2 | √ | 5+ | S, D | |
| American Redstart | *Setophaga ruticilla* | 1 | x | | √ | 4 | 2 | 1 | FY | 2 males seen on 7/31 |
| Northern Parula | *Setophaga americana* | 1 | x | | | 1 | | 1 | | |
| Yellow Warbler | *Setophaga petechia* | 1 | x | | √ | 2 | 1 | 1 | S | male on 7/31 |
| Chestnut-sided Warbler | *Setophaga pensylvanica* | 1 | x | | | | | | | |
| Blackpoll Warbler | *Setophaga striata* | 1 | x | | | | | | | |
| Black-throated Blue Warbler | *Setophaga caerulescens* | 1 | x | √ | | | 1 | | | male on 7/31 |
| Yellow-rumped Warbler | *Setophaga coronata* | 1 | x | √ | | | | 7 | | |
| Black-throated Green Warbler | *Setophaga virens* | 1 | x | √ | | | 1 | | S | |
| **Emberizids (Emberizidae)** | | | | | | | | | | |
| Eastern Towhee | *Pipilo erythrophthalmus* | 1 | x | 1 | 1 | 1 | | | S | |
| Song Sparrow | *Melospiza melodia* | 1 | x | √ | √ | 8 | √ | 3 | FY | |
| White-throated Sparrow | *Zonotrichia albicollis* | 1 | x | | | | | | | |
| **Cardinals, Piranga Tanagers and Allies (Cardinalidae)** | | | | | | | | | | |
| Northern Cardinal | *Cardinalis cardinalis* | 1 | | | | | 1 | 1 | | young male on 7/31, 916 |
| Rose-breasted Grosbeak | *Pheucticus ludovicianus* | 1 | x | | | | | | | |
| **Blackbirds (Icteridae)** | | | | | | | | | | |
| Red-winged Blackbird | *Agelaius phoeniceus* | 1 | x | √ | | | | | | |
| **Fringilline and Cardueline Finches and Allies (Fringillidae)** | | | | | | | | | | |
| American Goldfinch | *Spinus tristis* | 1 | x | √ | √ | 5 | 3 | | FL | 2 fledglings w/ adult on 7/31 |

Codes-1 & 2: Regularly occurring North American avifauna. Includes regular breeding species and visitors. Code-1 species more widespread and usually more numerous. Code-2 species have restricted North American range, or more widespread, but occur in lower densities, or more difficult to detect. Code-3: Rare - Species that occur in very low numbers, but annually, in the ABA Checklist Area. This includes visitors and rare breeding residents.

LCI: Birds seen in 2012 on Little Chebeague - courtesy of Wing Goodale and Thomas Urquhart

*BREED: Codes from Maine Breeding Bird Atlas project's Handbook. See attached code descriptions.