Birch Island Harvey Property

Inventory of Natural Resources & Management Recommendations

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By
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1. INTRODUCTION

The Harvey Property is located on Birch Island at Latitude 43°49'18" N. Longitude 70°00'44" W which is under the town jurisdiction of Harpswell with the Coastal Island Registry Number 55-103. This large coastal island measures approximately 300 acres and has a close proximity to towns of Harpswell and Brunswick (350yds from the Mere Point Landing) as well as other coastal islands.

Originally occupied by the Abenaki Indians during the summer months Birch Island served as an important fishing ground and encampment. According to local historians from the Harpswell Historical Society, Birch Island was named the first island settlement in Casco Bay with the initial English settler establishing residency in 1740 (Harpswell Historical Society 2015). With the establishment of Harpswell in 1758, the island population continued to grow through the early 1800s with approximately 10-12 families working the land by cutting timber, farming and fishing. Through the years the island has grown in popularity with summer cottage residents, first arriving by steamer, and making vacation homes for their families (Harpswell Heritage Land Trust 2015).

2. OBJECTIVE

Harpswell Heritage Land Trust (HHLT) is actively pursuing ownership of the 44.3 acre Harvey Property located at the northern edge of Birch Island adjacent to the Birch Island North Property. HHLT Executive Director, Reed Coles requested the assistance of Maine Island Ecologists (MIE) to complete a natural resource inventory of the Birch Island Harvey Property to support its acquisition.

The goal of this report is 1) to inform the HHLT's land managers of property's natural resources, including critically significant marine and terrestrial ecosystems that are potentially at risk, 2) to highlight functions and values of critical or sensitive habitats, 3) to outline recommendations and strategies to manage conservation area upon purchase of said property.

3. PROFESSIONAL QUALIFICATIONS

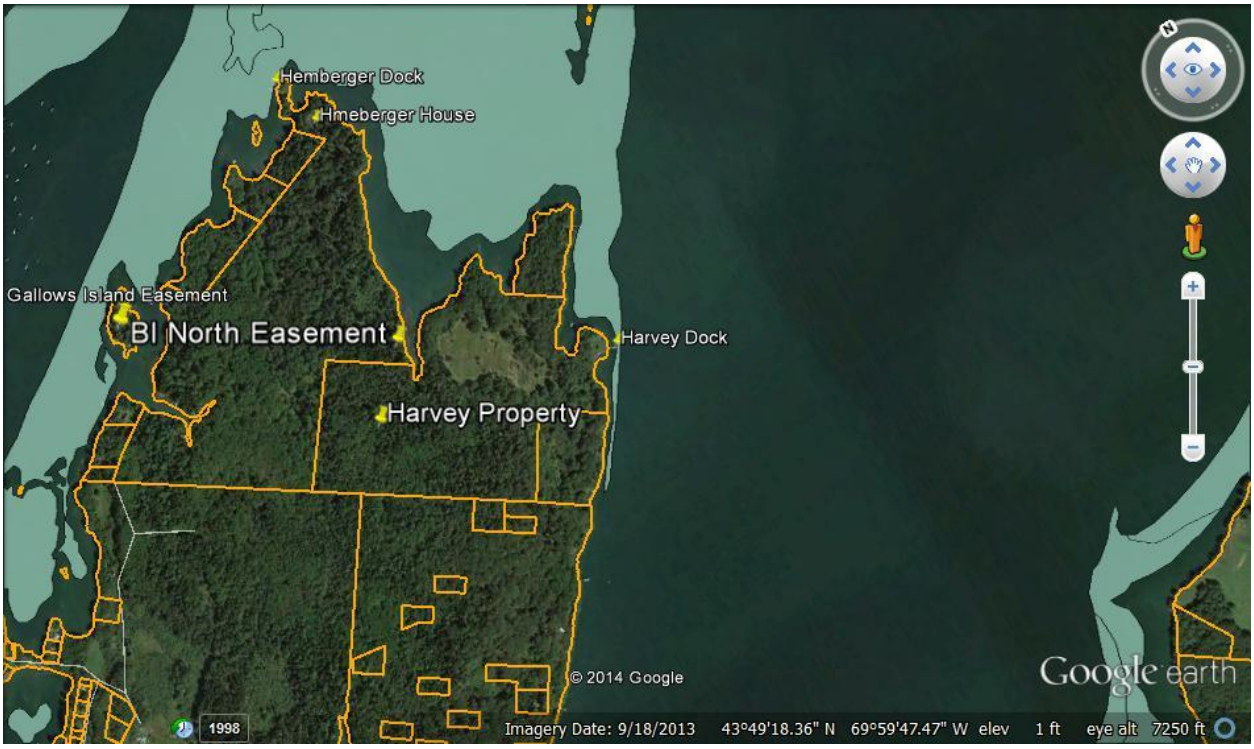
The Natural Resources Inventory was completed by Tracy Ames, Kristin Pennock and Heather Storlazzi Ward from Maine Island Ecologists. Ms. Ames, founder of MIE holds a B.S. in Parks and Recreation Management (concentration in Horticulture) from the University of Maine and has been working in the field 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. 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 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.

4. REVIEW OF BACKGROUND INFORMATION

The following is a map of the Birch Island (BI) Harvey Property and its association with the BI North Easement and will be representational of the natural resources described.

Figure 1. Harvey Property and HHLT's Birch Island North Easement, Harpswell, Maine



4.1 Soils

The soils map used for this report is produced by the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS). Soil maps, produced by NRCS, use 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.
http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx (Photo taken 2010)

Figure 2. USDA/NRCS Soil Map of Harvey Property, Birch Island, Harpswell, Maine

The polygon of the *Area of Interest* (AOI) on map above represents an approximate boundary of area soil types identified which accounts for the acreage discrepancy represented. Walpole fine sandy loam (Wa) soils encompassing18.2 acres dominate the project area at 42.5% of AOI and Lyman loam (LzC, LzB, LyB) at various percent slopes make up 13.6 acres or 31.8% of AOI. Smaller inclusions of Buxton silt loam (BuB) and Belgrade very sandy loam (BgB, BgC2) are also found at various percent slopes. For this report only dominant soil types are described.

Table 1. USDA Soil Map Criteria of the Harvey Property, Birch Island, Harpswell, Maine Cumberland County and Part of Oxford County, Maine (ME005)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BgB	Belgrade very fine sandy loam, 0 to 8 percent slopes	6.9	16.1%
BgC2	Belgrade very fine sandy loam, 8 to 15 percent slopes, eroded	2.4	5.6%
BuB	Buxton silt loam, 3 to 8 percent slopes	0.3	0.7%
LyB	Lyman loam, 3 to 8 percent slopes, rocky	2.5	5.8%
LzB	Lyman loam, 3 to 8 percent slopes, very rocky	7.6	17.8%
LzC	Lyman loam, 8 to 15 percent slopes, very rocky	3.5	8.2%
W	Water	1.4	3.3%
Wa	Walpole fine sandy loam	18.2	42.5%
Totals for Area of Interest		**42.8**	**100%**

Walpole fine sandy loam soils are found at very deep poorly drained areas from the eastern shoreline to central interior portions of the Harvey Property where the forested community

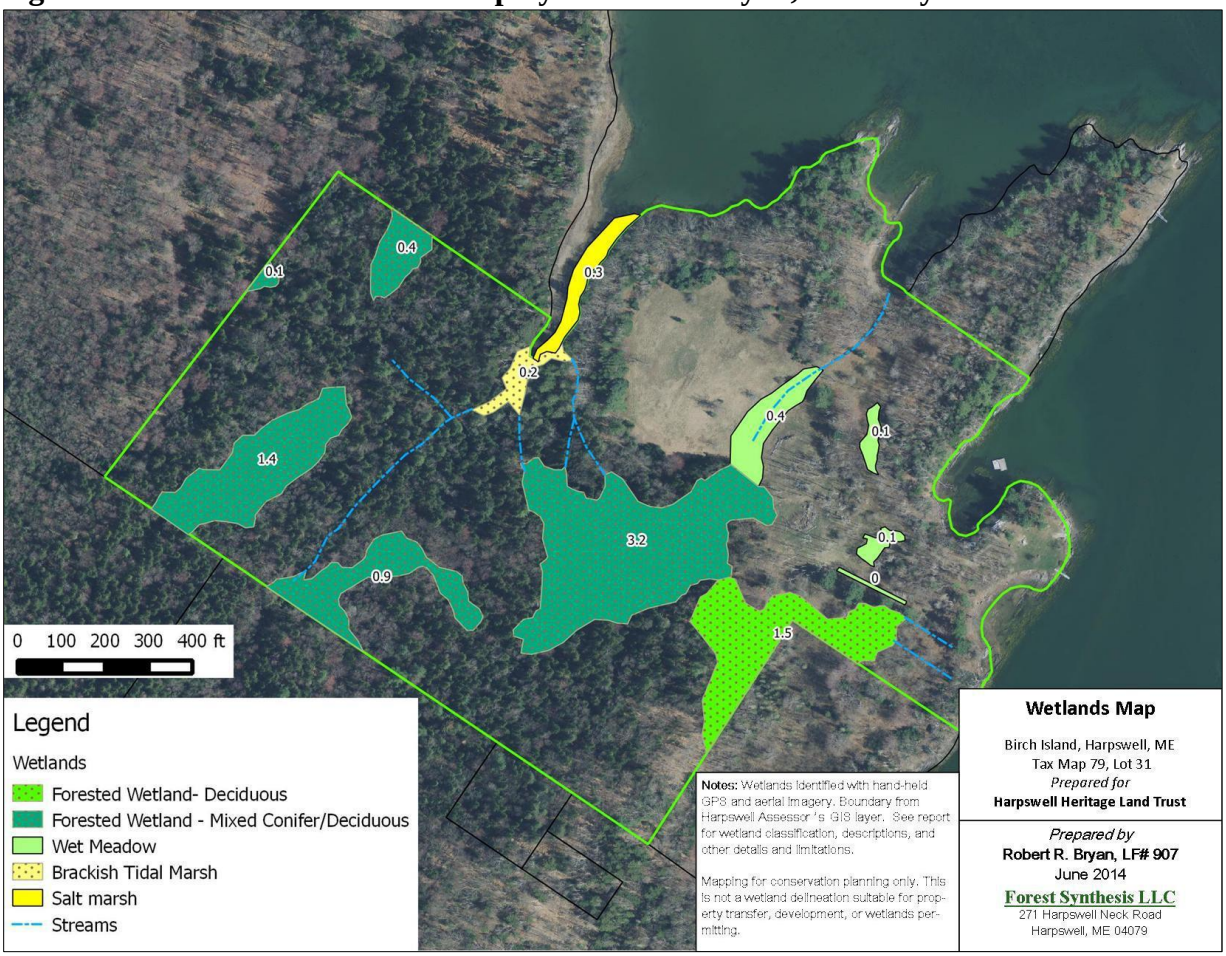
consisting of eastern hemlock *(Tsuga canadensis),* yellow birch *(Betula alleghaniensis)* and red maple *(Acer rubrum)* dominate the canopy layer. According to National Cooperative Soil Survey from the USDA, The Walpole Series are nearly level to gently sloping soils in low-lying positions on terraces and plains formed in areas of outwash and stratified drift. Slope ranges from 0 to 8 percent. Saturated hydraulic conductivity is moderately high or high in the surface layer and subsoil, and high or very high in the substratum. Walpole soils have a water table at or near the surface much of the year (National Cooperative Soil Survey 2015).

Lyman loam soils are found at the Harvey Property perimeter and along the shoreline at shallow to excessively drained areas where common trees consisting of red oak (*Quercus rubra*), yellow birch (*B. alleghaniensis*), paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), and red spruce (*Picea rubens*) are found. These Lyman soils are found at nearly level to very steep glaciated uplands.

4.2 Wetlands

A wetland map of the Harvey Property Project Area was acquired from Robert R. Bryan, M.S. from Forest Synthesis Inc. who classified the wetland at the area of interest in 2014 for HHLT and was used for this project.

Figure 3. Wetland Classification Map by Robert R. Bryan, Forest Synthesis Inc 2014



The Harvey Property includes both freshwater and marine systems. Interior, freshwater wetland systems identified within the wetland map includes 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 Harvey Property and consist of intertidal subsystems dominated by unconsolidated shore and aquatic bed. Cobbles dominate the subclass within the unconsolidated areas while algal beds dominate the subclass within the aquatic beds.

Due to the recent work produced by Robert R. Bryan in 2014 we did not complete a delineation of wetlands. However criteria for Wetlands of Special Significance (WoSS) and "High Value Habitat >25%" ranked by the MDIFW/NWI are identified at interior and coastal wetlands and are discussed in greater detail in the following sections.

4.3 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 is elevated, resulting in greater protection and at most times requiring rigorous permitting review due to higher value habitats. Many of the inland freshwater wetlands identified on the property are partially WoSS wetlands due to their being situated 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.

4.4 Wildlife

The shoreland around the parcel as well as the interior wetlands are categorized as USFWS High Value Habitat (top 25%) with the shoreland being significant Tidal Waterfowl & Wading Bird Habitat. Tidal Waterfowl and Wading Bird Habitat is defined as breeding, migrating/staging, or wintering areas for coastal waterfowl or breeding, feeding, loafing, migrating, or roosting areas for coastal wading birds and include habitats such as aquatic beds, eelgrass, emergent wetlands, mudflats, seaweed communities and reefs. (Beginning with Habitat)

A habitat analysis conducted by the U.S. Fish and Wildlife Service's (USFWS) Gulf of Maine Coastal Program for the U.S. portion of the Gulf of Maine watershed, documents that forest, freshwater wetlands, and intertidal estuarine/marine habitat contained in the parcel are high value (within the top 25%), based on their value for rare or declining species of birds and fish. The analysis also predicts that the Harvey Property provides important habitat for 47 of 91 USFWS priority trust species included in the analysis. Moreover, the property provides particularly high value habitat, in comparison with the rest of the Gulf of Maine watershed, for 28 of those 47 species, including:

Raptors: (none)
Shorebirds: American Oystercatcher, Black-bellied Plover, Buff-breasted Sandpiper, Hudsonian Godwit, Killdeer, Least Sandpiper, Red Knot, Ruddy Turnstone, Sanderling, Semi-palmated Sandpiper, Short-billed Dowitcher, and Whimbrel
Songbirds/other birds: Canada Warbler, Nelson's Sharp-tailed Sparrow, Saltmarsh Sharp-tailed Sparrow, and Sedge Wren
Waterbirds: American Bittern, American Black Duck, Greater Scaup, Lesser Scaup, Little Blue Heron, Osprey, Snowy Egret, Tricolored Heron, and Wood Duck
Federally Endangered/Threatened species: Bald Eagle (recently delisted) and Roseate Tern
Fish and Invertebrates: Horseshoe Crab

See Appendix D for the full analysis. (Courtesy Erin Witham, USFWS, Gulf of Maine Coastal Program)

5. NATURAL PLANT COMMUNITIES

The Maine Natural Areas Program (MNAP) resource guide; Natural Landscapes of Maine: A Guide to Natural Communities and Ecosystems by Susan Gawler & Andrew Cutko was utilized to classify natural plant communities at the Birch Island property. Consistent with other southern Maine coastal islands in Casco Bay, Birch Island is composed of natural plant communities that are biologically diverse with significant importance due to their adaptive abilities to survive in extremely harsh environmental conditions. These plant communities merit future conservation measures.

Distinctive plant communities are described in detail in Table 2 which also highlights the designated state ranking of abundance or rarity of each natural community in comparison across the state of Maine. MNAP's rarity ranks are as follows: S1- Critically imperiled in Maine because of extreme rarity (five or fewer occurrences or very few remaining individuals or acres) or because some aspect of its biology makes it especially vulnerable to extirpation from the State of Maine; S2- Imperiled in Maine because of rarity (6-20 occurrences or few remaining individuals or acres) or because of other factors making it vulnerable to further decline; S3- Rare in Maine (20-100 occurrences); S4- Apparently secure in Maine; S5- Demonstrably secure in Maine. MNAP is particularly interested in *any* example of a natural community type ranked S1, S2, or S3, and outstanding examples (e.g., large, old growth stands) of S4 and S5 types (MNAP).

Table 2. Natural Plant Communities occurring at the Harvey Property, Birch Island, ME.
(With information extracted from MNAP's *Natural Community Factsheets*
http://www.maine.gov/dacf/mnap/features/communities)

Natural Community Type	Acres (ac.) estimated	Maine State Rank	Description of Plant Community
Coastal Wetlands	--	--	
Brackish Tidal Marsh	0.2	S3	Mixture of brackish plant populations such as dominant *Spartina* cordgrasses, alkali bulrush, saltmeadow bulrush and narrow-leaved cattail.
Salt-Hay Saltmarsh	0.3	S3	Low and High marsh dominated by *Spartina* cordgrasses (*Spartina alterniflora* and *Spartina patens*). Patches of salt marsh bulrush, black rush are at upper tidal reach, with sea lavender, sea plantain, and seaside goldenrod at tidal fringe along adjacent property.
Interior Wetlands	--	--	
Alder Thicket	1.5	S5	Speckled alder shrub-dominating thicket occurring in saturated basin wetland with saplings of gray birch, red maple and herbaceous plants of common blackberry, swamp dewberry and sensitive fern. **Invasive oriental bittersweet is present at this plant community.**
Forested Wetland-Deciduous (Synonym: Palustrine Forested Deciduous USFWS Classification)	1.5	-	Possessing an overstory of dominant red maple with a combination of younger trees and shrubs in the understory; such as white pine, green ash, balsam fir, birch and cherry species, speckled alder, winterberry, common juniper and meadow sweet. Herbaceous layer is composed of perennial Canada mayflower, marsh skullcap, lowbush blueberry and woodland ferns.
Hardwood Seepage Forest (Synonym: Palustrine Forested Needle-leaved,Evergreen/Deciduous USFWS Classification)	5.9	S3	Frequent canopy plants in this community type include red spruce, eastern hemlock, red maple, yellow birch, and American beech in a closed to semi-closed canopy wet forest. Red spruce and white pine saplings. Herbaceous New York fern, sensitive fern, and spinulose wood fern, gold thread and jack-in-the- pulpit also are common in the understory seepage patches.
Sedge Meadow	0.7	S4	Dominated by graminoids, such as; sallow, broom sedges and wool grass. Herbaceous plants include goldenrod species, St. Johnswort, etc. with <30% shrub cover, mainly speckled alder. Wet meadow.
Upland Areas	--	--	
Hemlock Forest	5.6	S4	Dominated by eastern hemlock, red spruce and associated yellow birch, paper birch, and red maple, and small saplings of white pine.
Mixed Graminoid –Forb Grassland	5.5	--	The previously mowed field is composed of a mix of graminoids including sedges and grasses as well as herbaceous forbs; including goldenrod and aster species, St. Johnswort, and blue vervain, and **invasive bull thistle**. Regenerative trees and shrubs from perimeter forest edges include speckled alder and white pine. The old field is maintained by mowing to control the field reverting back to forest.

Natural Community Type	Acres (ac.) estimated	Maine State Rank	Description of Plant Community
Oak-Pine Forest	10.1	S5	Closed canopy of mixed deciduous and coniferous trees with dominant components of red oak and white pine. Red maple, American beech and occasional eastern hemlock, and yellow birch are also present components in more mesic soils. Red spruce, paper birch, striped maple, and regenerative saplings are subcanopy associates. Sparse herbaceous vegetation includes lowbush blueberry, Canada mayflower, and starflower. I**nvasive species including Japanese barberry and Morrow's honeysuckle are present on the property at this cover type.**
Rose-Bayberry Maritime Shrubland	0.2	S4	Rugosa rose and northern bayberry are indicative of this plant community, however rugosa roses are absent from within property lines.
Spruce-Northern Hardwoods Forest	12.8	S5	Characterized by the dominant red spruce and yellow birch with sporadic accounts of red maple and white pine. Balsam fir and paper birch are common saplings or smaller trees. **Native eastern hayscented fern is found at this community type near forested wetlands and can be problematic due to its aggressive nature.**
Coastal Wetlands Subtotal	.5	--	This does not include the adjacent marine intertidal mudflats.
Interior Wetlands Subtotal	9.6	--	
Uplands Subtotal	34.2	--	
Total Acreage	44.3	--	

Plant communities without rankings are not designated by MNAP

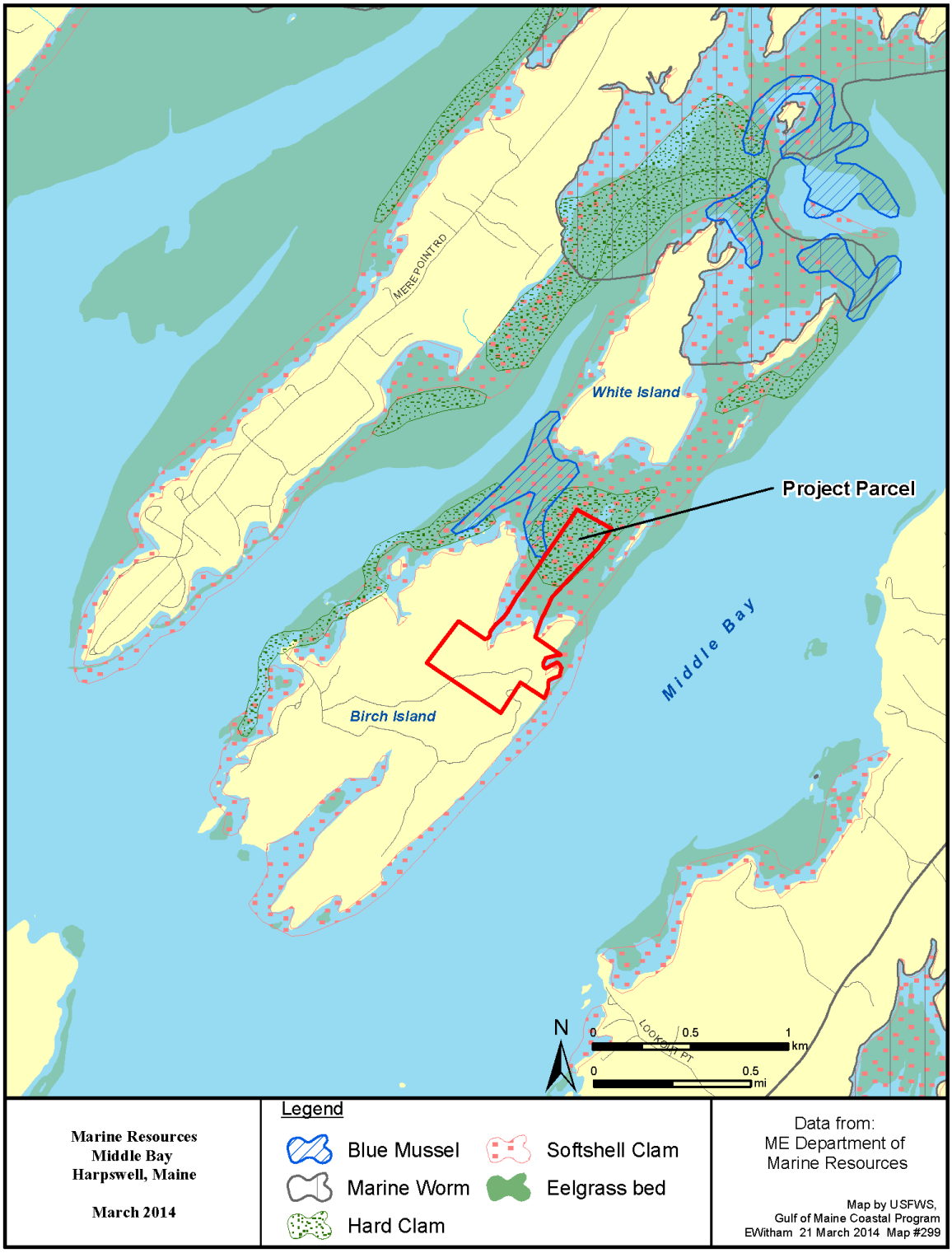
6. CRITICAL MARINE HABITATS

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 Bureau of Motor Vehicles 2014) more boaters are expected to venture out to Casco Bay islands supporting recreational opportunities (pers. comm. Bonebacker 2013). Birch Island and others in close proximity to the mainland are easily accessible by boat making natural habitats on these islands at greater risk of degradation by anthropogenic forces.

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 coastal development issues causing increased storm water runoff and surface water pollutants particularly from point and non point sources that directly impact the water quality and estuarial ecosystems in the bay and surrounding islands (Casco Bay Estuary Partnership 2005).

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.* Two critical habitats – eelgrass and cordgrass - exist on the Harvey Property.

Figure 5. ME DMR Marine Resources Map of the Harvey Property showing eelgrass habitat and other important marine resources such as softshell and hard clams



6.1 Eelgrass Habitat

Both eelgrass (*Zostera marina)* and smooth cordgrass *(Spartina alterniflora)* are 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 (soft-shell 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 (least tern, piping plover), wading birds, juvenile and smaller forage finfishes (e.g., hake, cod, haddock, mackerel, killifish, mullet, menhaden and alewife, sandlance, lumpfish, threes pined 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 Birch Island 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 this 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*) and colonial tunicates (i.e., 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).

Due to time constraints we did not survey the .61miles of mudflats, rocky shoreline and fringe marshes for invasive marine floral and faunal species; including European green crabs, golden star tunicates (*Botryllus schlosseri*), sea squirts *(Urochordata),* dead man fingers (*Codium fragile*), etc. A more intensive baseline survey of the mudflats, fringe marsh, and rocky shoreline is recommended to reveal a more accurate census of invasive marine species. Note that suffocating filamentous green algae was not observed at mudflats and intertidal zones at the time of our surveys.

6.2 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 at seaside coves and islands. Sensitive, highly adaptable vegetation consists predominantly of species that are capable of being inundated twice daily by tides. Due to the highly sensitized environment of the inundated low marsh zone, smooth cordgrass *(Spartina alterniflora)* is often the sole occupier of the low marsh; however in some instances such as at islands found in Casco Bay - including Birch Island, where low wave activity is common and protective coves with accumulative supportive sediments are present - smooth cordgrass and saltmeadow cordgrass *(Spartina patens)* are found together, co-dominating the low marsh zone. The more diverse high marsh zone is occupied by a varied mix of highly adaptable graminoids and forbs, yet smooth and saltmeadow cordgrasses are not necessarily preponderant species, but rather present in large, dense communities. These *Spartina* saltmarsh communities often form meadows that are typical of the pocket fringe coastal marshes found at Birch Island 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 such as the Casco Bay estuary. 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 with specialized adaptations that 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 conduct crucial ecological roles 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 and clarify 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 salt marsh grasses die and decay, vast amounts of detrital bacteria conglomerate and produce rich organic matter to feed fauna inhabiting or frequenting the salt marsh, associated estuarial ecosystems and offshore waters. The extent to which salt marshes provide a food source depends on the size, productivity 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, 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 can also remove contaminating pollutants from the food web by incorporating them into peat (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. Global sea level has risen by about 8 inches since reliable record keeping began in 1880 and is projected to rise another 1 to 4 feet by 2100 (National Climate Assessment Report 2014). The Intergovernmental Panel on Climate Change (IPCC) projects a global atmospheric temperature increase ranging from 2°F to as high as 11.5°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 micro topography 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 conversation 2014). 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 50-250 acres of marsh land will be loss 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, 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 marsh at Birch Island

Spartina pocket fringe marshes are located at the tidal zones of the Harvey Property where inundation of salt water temporarily occurs twice daily. With the impacts of climate change, including sea level rise and increased intensity of winter storm surges with scouring wave actions, it is predicted that the property's mixed cordgrass habitat of the low and high marsh will face great obstacles in the natural process of migrating inland. Adjacent obstructions of the steep, elevated, hardened bluff that once contributed to soil accretion at the marsh may potentially halt the migrating process as bedrock is exposed, and consequently place the longevity and diversity of plants of the high marsh zone at high risk. As erosion occurs, bluff slope characteristics including degree of slope, soil structure, hardening, etc. are important factors in forecasting the degree of impact and loss at these marsh zones. With possible degradation of the fringe marsh, the brackish marsh is subsequently critically threatened by increased salt content and flooding as well. In addition, with the loss of the buffering salt marsh habitat, the rising salt water may inundate the brackish and freshwater habitat with increasing salt content and unfiltered pollutants. The quality of the fragile, sensitive ecosystems will also deteriorate in these surrounding areas. Nesting habitats may diminish and stronger invasive plant species may become established, weakening the functions of flourishing native vegetation habitats. However, it is possible that the functions of the growing sandbar off the northern tip of the island and eroding surrounding island bluffs will continue to contribute additional sediments into the surrounding ecosystems including the marsh areas keeping equilibrium with rising sea level.

Both smooth cordgrass, *(Spartina alterniflora*) and saltmeadow cordgrass, *(S. patens)* co-dominate both the low marsh and the high marsh zone at the Harvey Property with other sporadic accounts of highly diverse and largely adaptive species including, but not limited to such herbaceous perennial and graminoid species as: seaside goldenrod *(Solidago sempervirens)*, sea lavender *(Limonium carolinianum)*, black rush, *(Juncus gerardii)*, alkali rush, *(Schoenoplectus maritimus)* and saltmarsh bulrush *(Schoenoplectus maritimus)* occupying the

upper tidal reach.

6.3 European Green Crabs and other threats to critical marine habitats

European green crabs (*Carcinus maenas*) 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 Department of Marine Resources (DMR) is actively managing the invasive green crab throughout the state of Maine (DMR 2014) through 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 (DMR 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, HHLT managers will need to mitigate possible threats to the condition of the subtidal unconsolidated sediments, eelgrass habitats and animals within the areas surrounding Birch Island 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.

7. OTHER SIGNIFICANT MARINE HABITATS

7.1 Brackish Tidal Marsh Habitat

Brackish tidal marshes are located at exposed areas of low tidal reach and amplitude where tidal estuarine seawater mixes with freshwater as flat elevation and sedimentation increase. Brackish tidal marsh plant community types are designated by MNAP as having an S3 state ranking and considered by the USFWS as "High Valued Habitat" in the top 25% for plants and animals. Due to high ranking habitat attributes these coastal wetlands should receive considerable conservation attention and concern for significant habitat degradation and loss due to climate change. Because brackish tidal marshes have salinity ranges between 2-18 parts per thousand (ppt), they are comprised of highly adaptive specialized plants. The brackish tidal marsh habitat at the Harvey Property is mainly comprised of bands of saltmeadow cordgrass *(S. patens),* with lesser accounts of Saltmarsh tuber-bulrush *(Bolboschoenus maritimus),* Narrow-leaved cattail *(Typha angustifolia)* and Black grass *(Juncus gerardii).* Narrow-leaved cattail is considered by the USDA as both a native and an introduced plant that has been known to have invasive qualities that could prevent diversity of native plants. Other plants that are common and indicative of a brackish marsh include chaffy sedge, chair-maker's rush, and freshwater cordgrass (MNAP 2015). Rare plants and

animal are associated with this community type and include lilaeopsis, Parker's pipewort, pygmyweed, stiff arrowhead, water pimpernel, and American oystercatcher, black-crowned night heron, least bittern, saltmarsh sharp-tailed sparrow, and short-eared owl (MNAP 2015). In addition a multitude of other species depend on the essential nesting and foraging habitat including a wide range of wading birds, Nelson's sharp-tailed sparrow and seaside sparrow which both nest in this wetland type, as well as the New England siltsnail (MNAP 2015).

Brackish marsh at Harvey Property

7.2 Mixed Coarse and Fine Flat Habitat

A mixed cobble and gravel beach is present at the east end of the Harvey Property and classified by Alison Ward from the Maine DEP as one type of the mixed coarse and fine flat intertidal habitat designation. Composed of a mixture of gravel, cobble, boulder, sand, shell, organic detritus, silt and clay sediments the mixed coarse and fine flat intertidal habitat is less protected from sea swells and subsequently have only a small percentage of fine grained sediments. Due to the unstable environment the cobble and gravel beach habitat is less biological diverse than other types of mixed flats. In addition the constant wave action prevents vegetative species from taking hold and colonizing with the exception of Irish moss or patches of kelp attached to larger cobbles and boulders. However, the production of oligochaete, flat, and nemertean worms is often high (Ward 1999). Mixed coarse and fine flats support populations of benthic algae, bacteria, small invertebrates, periwinkles, moon snails, earwigs, barnacles, limpets, amphipods, isopods, polychaete, nudibranchs, soft-shelled clams, blue mussels, hydroids, dog winkles, hermit crabs, sand shrimp and oysters and quahogs (Larsen and Dogggett 1981). According to the USFWS Mixed coarse and fine flats serve as foraging habitat for 24 species of shorebirds, American black duck, great blue heron and wading birds, common tern and the endangered roseate tern. This habitat also functions as roosting habitat for 19 species of shorebirds as well as potential nesting habitat for spotted sandpipers (USFWS 1980).

Mixed cobble and gravel beach at Harvey Property

Among other heavily harvestable species present at the low intertidal zone of the mixed coarse and fine flat habitat, valuable lobster nursery grounds are located under cobbles and boulders. Low energy wave action due to shoal waters surrounding shores, such as at the northeastern shoreline of the Harvey Property, contributes greatly to the fauna and flora abundance, biological diversity, function, stability and economic value of the mixed coarse and fine flat habitat. The ecological sensitivity to disturbance impacted by physical threats to the intertidal habitat is an important management concern. Major loss of habitat can be caused by filling of flats and sediment disposal. Large disturbances of sediments can occur with dredging and dragging activities which can liberate toxics and nutrients from the sediments into the water column (Ward 1999). Alterations to the salinity, temperature, turbidity or physical properties of the water would negatively affect mixed environments (Ward 1999). In addition water quality changes due to pollution from point and non-point sources are especially alarming as potential recreational activities, over-board discharges from boats, beach usage and landing activities increase at both the adjacent Mere Point Landing, nearby marinas and at the Harvey Property Landing Site located at the mixed coarse and fine flat habitat. To review actions being taken by the Town of Harpswell and other organizations to minimize pollution and improve water quality in the bay see (section 7.3) Mudflat Habitats.

With 20% of 10,530acres of mixed coarse and fine flat habitat being located on coastal Maine islands only 5% are found south of Portland. 1,022 acres are situated between Portland and Bailey Island (Ward 1999) and therefore merit conservation protection whenever possible.

7.3 Mudflat Habitat

The Maine Department of Environmental Protection (DEP) assigns high ranks for mudflat habitats in Maine for being biologically diversified regions that support large populations of shellfish, shrimp, mussels, quahogs, baitworms and small invertebrates (Ward 1999). Organically rich sediments contain high concentrations of benthic diatoms which serve as the base of the benthic food web. Benthic diatoms contribute to water clarification 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 macro faunal species like marine worms. Twenty five 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 particularly due to adjacent sand spit off the north end of the Harvey Property, other land formations and shoal waters, mudflats may act as holding tanks for contaminants often accumulating toxins that are detrimental to the existing mudflat ecosystem.

Great blue herons foraging on mudflats adjacent to the Harvey Property

Mudflats located adjacent to the northern shoreline of the Harvey Property, Birch Island are highly productive and functioning areas that receive little to no direct impact by the occasional visitor venturing out onto the mudflats. However, high bacteria levels from human and animal waste by such anthropogenic sources, such as; improperly installed or malfunctioning septic systems, overboard discharge systems, municipal and industrial discharges of wastewater, illegal sewage discharge from boats, and polluted storm water runoff as well as the buildup of wildlife and waterfowl waste in the waters over the mudflats greatly impact the health of the existing mudflat ecosystem (Casco Bay Estuary Partnership 2010). The close proximity of Birch Island to surrounding islands and the mainland also increases the risk for contaminants entering the mudflats by surface and stormwater runoff over impervious surfaces, fertilizers from agricultural farms, boat launches and marinas. As the result of these high levels of bacteria in the water, pathogen pollution or episodic red tide blooms which also can cause paralytic shellfish poisoning in humans (Casco Bay Estuary Partnership 2010), clamming operations are often shut down at

mudflats in Middle Bay, including the northern mudflats adjacent to the Harvey Property as well as a multitude of other clam beds in Maine (Maine.gov 2014). Clamming beds may also be closed by the Maine Department of Marine Resources (DMR) if beds are near marinas or boat launching facilities, such as Birch Island mudflats, if there is a potential threat of sewage dumping from boats (Casco Bay Estuary Partnership 1996).

On a positive note, federal and state municipalities are taking action. Increased Maine DEP regulatory actions along with continual efforts to reduce fecal matter entering into Casco Bay are occurring, including but not limited to, the progression to designate Casco Bay as a "No Discharge Zone", the removal of overboard discharges, and the elimination of combined sewer overflows in Casco Bay. Harpswell Town Officials specifically have utilized a Community Development Block Grant to replace overboard discharges (OBDs), a source of fecal matter, in order to reopen harvestable shellfish areas in their town (Casco Bay Estuary Partnership 2010). State of Maine, Friends of Casco Bay and Casco Bay Estuary Partnership partners and collaborators conducting water quality assessment studies and monitoring waters for pathogens and toxic contaminants indicate that the water in Middle Bay and in the mudflat vicinity is generally of good quality with good clarity and oxygenation and is overall healthy in comparison to water from other areas studied in the bay or nationally (Friends of Casco Bay 2010). Specific categories including nitrogen levels, dissolved oxygen, water transparency, and water temperature can be viewed for Middle Bay at the Casco Bay Estuary Partnership "State of the Bay" 2010 report at http://www.cascobayestuary.org/wp-content/uploads/2014/06/2010_cbep_sob_report.pdf.

In addition, collaborative research studies with local educational institutions and MIE could be implemented to evaluate possible adverse biological effects of sedimentary contaminants in marine and estuarine environments surrounding Birch Island. The U.S. and other countries, such as Japan, Russia and Taiwan that have high levels of trace metals and other pollutants in their bays have researched the bioaccumulation of re-suspended 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. Several horseshoe crabs, a species that has shown a decreased population trend, were found feeding at the mudflats close to the shoreline during our field reconnaissance and further research of this indicator species could help determine more about water quality in Middle Bay.

7.3 Ledge Habitat

Minimal ledge habitat was identified at the eastern shoreline at the intertidal and subtidal zones of the Harvey Property. This habitat type is classified by the Maine DEP as moderately ranked essential habitat due to its algae abundance (Ward 1999).

The Harvey Property has a small area of ledge habitat along its eastern shore

Ledge habitat is one of the most valued intertidal ecosystems due to its 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 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. Tide pools 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 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. Re-suspension 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.

7.4 Sand Bar Habitat

Alongshore drift or littoral drift is an important natural hydraulic process. Alongshore drift is responsible for the transfer and deposition of sediments creating landforms at cove headlands through the forces of re-entrant wave action in a zigzag pattern along an oblique angle and backwashing perpendicularly to the shore (Wikipedia 2014). Alongshore currents, a complimentary building process, assist in the deposit of large quantities of sand and pebble at shorelines along coastal Maine. As these alongshore currents dissipate their load of sand and pebbles are dumped and spread around a headland creating a sandbar. This submerged bar continues to grow as the long shore currents transport the sand in the direction of the breaking waves forming an aboveground sand spit. Without the assistance of the alongshore current, the bar would level off under water (Wikipedia 2014).

Sand bars and sand spits, including the growing sand bar at the northern tip of Birch island, have the ability to house highly diversified small invertebrates, bacteria and algae with specialized adaptations to thrive in extremely harsh and constantly shifting spit environments (Berrill and Berrill 1981). Bacteria, benthic diatoms and blue-green algae live in between sand grains and provide food for microscopic protozoan, crustaceans, invertebrate larvae and marine worms 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 (Berrill and Berrill 1981). Sand spits and sand bars serve as critical foraging, roosting and temporary staging areas for a multitude of migrating and residential shorebirds, seabirds, including the endangered roseate tern *(S. dougallii)*, waterfowl and terrestrial birds.

Sand bars and sand spits are at risk. If sediment loads are interrupted or altered, the growing sand bar can be impacted and sediments dissipated. Although the sandbar at Birch Island is outside of the Harvey Property it is worth mentioning due to its vital role in the health and status of the surrounding coastal ecosystems present at the area of interest and its warranted need for

management and protection.

Sand bar adjacent to Harvey Property.

8. PLANTS WITH SIGNIFICANT VALUE FOR WILDLIFE HABITAT

The following is a list of shrubs and trees common to cover types found at the Harvey Property that possess medium to high nutritional value which should be properly managed in order to provide significant food, cover and protection for mammals, birds and insects. Abundant herbaceous forbs and graminoids are also found on the property and serve as important food, cover and nesting habitat. The information provided is credited to the United States Dept. of Agriculture (USDA), the United States Forest Service (USFS) and various other organizations.

Shrubs and Ground Covers:

Alnus incana, **Speckled alder**: Speckled alder thickets provide cover for moose, white-tailed deer, rabbit, and others. Moose, muskrat, beaver, and rabbit browse the twigs and foliage. Songbirds, including redpoll, goldfinch, woodcock, and grouse eat the seeds, buds, and catkins. Beaver build dams and lodges with speckled alder. https://plants.usda.gov/plantguide/pdf/cs_alinr.pdf

Ilex verticillata, **Winterberry**: Red fox, cottontail rabbit, white-tailed deer, grey and red squirrel and other small mammals are all possible consumers as well as birds, such as; yellow-bellied sapsucker, blue jay, waterfowl (black duck and mallard), 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

Juniperus communis, **Common Juniper**: An important food source and protective cover for small mammals such as chipmunk and squirrel. Also the berries (a scaly edible cone) of this host plant are exceptional for fall migrating birds, such as; hermit thrush, grosbeak, mockingbird, warblers as well as for over-wintering woodpeckers and cedar waxwing. http://www.beautifulwildlifegarden.com/must-have-native-northeast-wildlife-shrubs-juniper.html

Myrica pennsylvanica, **Northern bayberry**: The winter fruits of bayberry are eaten by many bird species, including songbirds, waterfowl, shorebirds, and marsh birds. They are a preferred food of the black-capped chickadee, red-bellied woodpecker, tree swallow, gray catbird, eastern bluebird, yellow-rumped warbler and others. Bayberry thickets also provide nesting sites for songbirds, offering excellent protection from raccoon and other nest predators. http://umaine.edu/publications/2572e

Prunus virginiana, **Chokecherry**: This plant is highly desirable by birds, small mammals, deer, rabbit, butterflies, ants and honeybees for its nesting, cover and browsing habitat, as well as for fruit and source of nectar. http://www.na.fs.fed.us/pubs/silvics_manual/volume_2/prunus/pensylvanica.htm

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

Vaccinium angustifoliu, **Lowbush Blueberry**: Lowbush blueberry is a major food source for birds and small and large mammals (red fox, Eastern cottontail, voles, mice, squirrels, deer, etc). White-tailed deer in particular feed on the browse and over-wintering shoots in early spring. Birds (American robin, rufous- sided towhee, ruffed grouse, black-capped chickadee, whimbrel, brown thrasher, gray catbird, scarlet tanager, Canada goose and herring gull, etc) and mammals will feast on the valuable fruit. http://www.fs.fed.us/database/feis/plants/shrub/vacang/all.html

Trees:

Acer rubrum, **Red Maple**: Browse of the red maple is considered a highly palatable and valuable late winter deer food in Maine. It provides exceptional cover for birds. Screech owl, pileated woodpecker, and common flicker nest in cavities. Red and grey squirrel also will nest in red maples. Samaras are a good source of food for many birds including; red-breasted nuthatch, purple finch and evening grosbeak, etc. http://www.illinoiswildflowers.info/trees/plants/red_maple.html

Acer pensylvanicum, **Striped Maple**: The leaves, shoots, vegetative buds and bark are an important and preferred food source for rabbit, beaver, porcupine, and white-tailed deer. Honey bees also prefer the nectar. http://www.fs.fed.us/database/feis/plants/tree/acepen/all.html

Betula alleghaniensis, **Yellow Birch**: Seedlings of yellow birch are a common food for deer in the summer and green leaves and woody stems in the fall. Seeds are consumed by a variety of songbirds including common redpoll, pine siskin and chickadees. Beaver chew on the bark. Red squirrel favor the catkins. Ruffed grouse prefer the seeds, catkins and buds, and sapsuckers suck the yellow birch sap. http://www.fs.fed.us/database/feis/plants/tree/betall/all.html

Betula papyrifera, **Paper Birch**: This important dietary component for white-tailed deer is considered by the USFS as a secondary-choice food. http://www.fs.fed.us/database/feis/plants/tree/betpap/all.html

Betula populifolia, **Gray Birch**: Wildlife supported by gray birch include ruffed grouse which eat the male catkins, small birds like the pine siskin and chickadees feed on the seeds, and sapsuckers suck the birch sap from the trees. Beaver feed on the bark and wood. White-tailed deer chew on the twigs for a winter browse source. http://www.fs.fed.us/database/feis/plants/tree/betpop/all.html

Fagus grandifolia, **American Beech**: Considered a poor white-tailed deer browse by the USFS American beech is a valuable food source for many other wildlife species including red fox, squirrel, mice, chipmunk, ruffed grouse, ducks and other birds.
http://www.fs.fed.us/database/feis/plants/tree/faggra/all.html

Picea rubens, **Red Spruce**: Seeds, vegetative buds, leaves and twigs are consumed by many types of mice, voles, songbirds (particularly grosbeaks) and small mammals. Deer rarely choose red spruce for a food source. http://www.fs.fed.us/database/feis/plants/tree/picrub/all.html

Pinus strobus, **White Pine**: Seeds and bark from this valuable tree provide a vital food source and habitat supporting a variety of wildlife species; including cavity nesting birds, other wildlife as well as bald eagles which may nest on tree limbs below the crown top. Seeds provide food for songbirds and small mammals. Cottontail rabbit and white-tailed deer browse on foliage and a wide range of mammals forage on the bark. The white pine is considered to be of intermediate preference for white-tailed deer according to the USFS. http://www.fs.fed.us/database/feis/plants/tree/pinstr/all.html

Tsuga canadensis, **Eastern Hemlock**: Mature Eastern hemlock is rated as an excellent food source for a large range of wildlife species, particularly white-tailed deer which highly prefer foliage in winter months. Dense stands provide superior habitat for wildlife particularly nesting cavity dwellers such as black- throated green warbler. http://www.fs.fed.us/database/feis/plants/tree/tsucan/all.html

9. COVER TYPES WITH SIGNIFICANT WILDLIFE HABITAT VALUE

Critical habitats with significant value identified at the Harvey Property support an extraordinary array of wildlife species that are rare and uncommon. The Federal and state listed endangered Roseate tern *(Sterna dougallii)* may be found foraging at prime habitat where a vast tidal mudflat and sandbar meet just off the northern headland from the Harvey Property. Bald eagle *(Haliaeetus leucocephalus)*, a species of special concern in Maine, currently nest nearby and could potentially establish nests atop supracanopy white pine at Birch Island.

Due to time constraints, we only were able to make two field visits to the property, however, a working list of wildlife species encountered at the Harvey Property during MIE field work are included in the Appendices.

9.1 Hemlock Forest Cover Type

MNAP describes the Hemlock Forest Cover Type as having a closed canopy with eastern hemlock dominating the forest by >50% cover or less often co-dominating the forest with red spruce, yellow birch, red maple or red oak. Due to little light being exposed to the forest floor there is sparse vegetation at the herbaceous level on slopes of 5-50% or ravines and in cool microsites at sites near sea level to 1200ft. Soils tend to be shallow and well-drained (MNAP 2015).

Due to being harvested heavily few places in Maine are representational of majestic old age hemlock forests and consist of forest communities of less than 50 acres with few existing on protected lands (MNAP 2015).

Hemlock forest on Harvey Property

MNAP also suggests that maintaining forests on adjacent lands is instrumental in protecting the hemlock forest and its closed canopy structure. In addition protection of these rich hemlock forests is critical as the non-native, destructive and invasive hemlock woolly adelgid moves into nearby counties including York County, Maine (MNAP 2015). The U.S. Department of Agriculture recommends control of the woolly adelgid with a biological control agent called St. beetle (*Sasajiscymnus tsugae*). This biological control agent is also from Japan, the host country for the woolly adelgid (Bledsoe 2012).

Eastern hemlock, an arboreal backbone, provide superb ecological quality and critical habitat for over 142 species (Bledsoe 2012). The eastern hemlock has a high cavity value for wildlife (U.S. Forest Service 2015). Avian species hosted in the critical habitat of the hemlock forest include 95 species; including the yellow-bellied flycatcher, black-throated green warbler, blackburnian warbler, red crossbill, and northern parula to name a few plus 47 mammalian species. Hemlock seeds are eaten by birds and mammals. And in the winter white-tailed deer and snowshoe hare depend on hemlock foliage for winter food. The large branches of the eastern hemlock provide excellent snow interception and winter thermal protection as a cover source. Other companion tree species common to this cover type also provide food, cover and nesting cavities for many

other species as well. Below is a list of strategies developed by the USFS to manage and protect the hemlock forest cover type.

Strategic recommendations to manage Hemlock Forest Cover type for suitable wildlife habitat (as suggested by the USFS)

- Maintain a dense closed canopy to protect the hemlock forest ecosystem.
- Maintain and protect neighboring cover types to prevent light from penetrating into the nearby hemlock forest. Eastern hemlock forests must have at least part shade for establishment.
- Maintain diversity of sapling species and age of trees regenerating in order to encourage the periodic regeneration of the Eastern hemlock which can be influenced by fire, windthrow, drought, and stand conditions. A young dense stand may exclude regeneration for many years because of severe root competition in the upper soil layers, dense low shade, and dry acidic litter. However it is also suggested by the USFS that a disturbance may be necessary for the eastern hemlock to perpetuate itself (USFS 2015).
- Allow for nurse logs and tip-up mounds to accumulate so that young saplings can have a higher rate of success in rejuvenating the forest.
- Prevent invasive plant species from threatening the integrity of the ecosystem.

9.2 Spruce-Northern Hardwood Forest Cover Type

Nearly all forests of this type in Maine have been harvested in the past, and at many sites the spruce has been selectively removed, making this cover type rare though moderately well represented on conservation lands (MNAP 2015). Approximately 12.8 acres of Spruce-Northern hardwood forest exists on the Harvey Property on Birch Island. Forested spruce-northern hardwood forests, left undisturbed on the island for many years, provides significant wildlife habitat and diversity among species particularly at blocks with uneven-aged forests, a mix of tree species and with proximity to wetland seepages.

Spruce-Northern Hardwood Forest on Harvey Property

The Spruce-Northern Hardwood Forest plant community is characterized by MNAP as a mix (>25% of each) of red spruce *(Picea rubens)* and balsam fir *(Abies balsamea)* with less than 25% hardwoods, such as; yellow birch *(Betula alleghaniensis)*, red maple *(Acer rubrum)*, American beech *(Fagus grandifolia)* and paper birch *(Betula papyrifera)*. Scattered supercanopy white pine *(Pinus strobus)* and less common sub-canopy striped maple *(Acer pensylvanicum)* and eastern hemlock *(Tsuga canadensis)* may be occasional. Conifers and deciduous tree saplings are present in the sapling/shrub layer (MNAP 2015). Characteristic groundlayer plants are common wood-sorrel *(Oxalis montana)*, common wood fern *(Dryopteris intermedia)*, shining fir clubmoss *(Huperzia lucidula)*, goldthread *(Coptis trifolia)* and Canada mayflower *(Maianthemum canadense)*.

The spruce-northern hardwood forest cover type provides shelter, foraging and nesting habitat for a large number of passerine birds; including sharp-shinned hawk, cape may warbler, black- throated blue warbler, black-throated green warbler, blackburnian warbler, scarlet tanager, spruce grouse, Swainson's thrush, northern parula, ovenbird, pileated woodpecker, purple finch, red-eyed vireo and golden-crowned kinglet. It also provides habitat for the globally uncommon early hairstreak butterfly (MNAP 2015). Blue–spotted salamanders listed as a Maine Species of Special Concern are found at vernal pools at this cover type. In addition various bat species (also listed as Species of Special Concern ie. Hoary Bat), small mammals such as red fox, mole, vole, raccoon, red and grey squirrel, and several species of snakes are supported by this mixed hardwood-conifer forest habitat (UNH 2015).

Strategic recommendations to manage Spruce-Northern Hardwood Forest Cover type for suitable wildlife habitat: (Strategies adopted from the University of NH, Cooperative Ext.)

- Regenerate and maintain the diversity of tree sizes including old and young trees growing at all levels of the forest enhancing the habitat and diversity of wildlife species.
- Create and maintain patches of regenerating saplings >2acres for forage sources, and wildlife cover including berry patches, hardwood stump sprouts, and berry producing shrubs.
- Maintain patches of at least >5acres to get most benefit for wildlife biodiversity.
- Maintain favorable habitat features (for blue-spotted salamander, bats, snakes and songbirds) such as forested areas near wetlands, streams or seeps, rocky cliffs, large trees (>18" in diam.) and as future snags (dead trees).
- Create openings or clear cuts to maximize on the benefits for wildlife diversity and habitat management.
- Mow and maintain old brushy field near spruce-northern hardwood regenerating forest openings to maximize wildlife habitat for breeding birds.
- Maintain bird-friendly management practices such as softening edges between habitats and limiting management activities during the breeding season (April-August).
- Maintain a presence of snags and cavity trees for cavity dwelling species.
- Discuss land stewarding practices with bordering island residents for support of habitat enhancement practices.
- Follow established best management practices, and harvest timber near wetlands only when the soils are either frozen (winter) or very dry (summer).
- Consult with local forester, Robert Bryan, from Forest Synthesis Inc. for additional management strategies.

9.3 Oak-Pine Forest Cover Type

The Oak-Pine Forest Cover Type, a common forest type in southern Maine, often occupies land that was once cleared for residence, pasture or logged. Fragmented by cottage properties, the Oak-Pine Forests at the Harvey Property offer substantial habitat for various wildlife species. According to the USFS a multitude of birds, small mammals (eastern chipmunk, white-footed mouse, red-backed vole) and white-tailed deer, forage favorably on seed, bark, and foliage of tree species found at this cover type (USFW 2004). However the herbaceous layer including such forbs as low bush blueberry, a possible diagnostic of this community type, are limited with less than 30% cover (MNAP 2015). Herbivorous white-tailed deer depend on valuable acorns from red oak as well as on seeds of white pine as an emergency food source during the winter months. The sporadic accounts of eastern hemlock in the oak-pine forest provide overstory canopy and horizontal cover value for deer wintering habitat (Yamaksaki 2003). With a mixture of hardwoods and conifers in this cover type the diversity of avian species is also greatly improved. Mature stands with a high proportion of oaks offer excellent potential sites for cavity nesters including the rare red-winged sallow moth (MNAP 2015), owls, red-headed woodpeckers, red-breasted nuthatches, bats and red and gray squirrels (Yamasaki 2003). Along with other birds, bald eagles, making a vivacious comeback in Maine, great blue herons whose population numbers are decreasing in Maine, ospreys and other raptors nest and roost at this cover type in associate trees particularly white pine which are unmatched by any other conifer or hardwood species for its important supracanopy habitat element. Exfoliating bark plates of the white pine also offers canopy cover conditions and shelter habitat ideal for bats and brown creepers as well as cavity excavating pileated woodpeckers accessing the decaying core in search of ants. In addition a variety of forest floor elements found beneath white pine encompassing several other associate habitat features make this cover type highly suitable for wildlife species (Yamasaki 2003). Vital vernal pools supporting life of many specialized breeding animals as the spotted salamander and

wood frogs may also be found.

Oak-Pine Forest on the Harvey Property

Along with growing populations of invasive species of Japanese barberry and Morrow's honeysuckle identified at the oak-pine forest, dense communities of Eastern hayscented fern exist at this cover type and impose a potential threat to the biodiversity of the mixed oak-pine forest ecosystem as it has the potential to dominate the forest floor, limiting native species from penetrating through the aggressive matting of root material. Strategic recommendations to manage the oak-pine cover type and invasive species within are listed below.

Strategic recommendations to manage Oak-Pine Forest Cover type for suitable wildlife habitat:

- Seek free forester analysis from local Maine forest service chapter.
- Prevent further deterioration of wildlife and bird habitat by eradicating problematic invasive species from forest ecosystem including Morrow's honeysuckle and Japanese barberry before species become unmanageable.
- Emphasize biodiversity of forest ecosystem and importance of native species by eradicating oriental bittersweet at adjacent forested wetlands.
- Stimulate productivity of the existing native habitat by improving health of the forest ecosystem using restorative measures, silvicultural practices, and removal of intolerant tree species to further manipulate a more biologically diversified ecosystem.
- In order to benefit migrating birds, the USFWS recommend maintaining a balance of forest age structures, including mid-succession and late succession forest to provide structural diversity (shrubs and tree fall) within the forest (USFWS 2005).
- Some native and non-native invasive plants are capable of allelopathic effects by

excreting harmful chemicals from their roots. 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). White pine (*Pinus strobus*), capable of generating allelopathic effects including the inhibition of germination, growth, or metabolism by one plant on another, could be utilized for elimination of non-native plant species.

- Allelopathic effects could be utilized advantageously by installing a natural vegetated barrier of white pine to prevent aggressive non-native plants from invading and impacting newly restored native colonies.
- Leave snags, wind throw and debris in forests and on forest floor to create and sustain habitat for wildlife and birds.

9.4 Sedge Meadow Cover Type

Sedge meadows are restricted in distribution throughout the state of Maine according to the Maine Natural Areas Program warrant protection. These sensitive areas host specialized plants adapted to saturated conditions with common occurrence of standing water that may be seasonal or constant. Sedges, graminoids, secondary species of herbaceous perennials and shrubs <30% occupy the sedge marsh at the Harvey Property with standing water present at the time of our field recognizance.

Sedge Meadow on the Harvey Property

The sedge meadow cover type provides important habitat for wildlife to breed, forage, and hide from predators. Terrestrial birds use sedge meadows and migratory birds benefit greatly from these areas 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 discussed to control invasive

species. These species should be given highest priority in the management of this significant habitat. For plant and bird species identified at the sedge meadow cover type please refer to the appendices of this report.

The sedge meadow wetland ecosystem and wetland buffer at the Harvey Property are at risk due the aggressive nature of invasive species oriental bittersweet, Morrow‘s honeysuckle, Japanese barberry and Bull thistle *(Cirsium vulgare)* present at adjacent plant communities.

Sporadic occurrences of speckled alder *(Alnus incana)*, black locust *(Robinia pseudoacacia)*, white pine and other northern hardwood forest species are also infringing on the sedge meadow from the perimeter forest. The meadow is presently controlled by mowing (Bryan 2014), however could be potentially controlled with spring burns as well. Occasional prescribed burns would also stimulate growth of graminoids and forbs and enhance sedge meadow diversity (Kost and De 2000). Periodic bush hogging around the edges may also be a possible management practice to maintain the wetland buffer and protect the sedge meadow community type from further succession and invasion of woody plants. Enhanced wooded boundaries and wetland buffers between separate community types, such as the field, sedge meadow and forest edge surrounding the perimeter would create an "edge effect" where foraging is more frequent. In addition, the wider the boundary between separate populations or communities the more biodiversity of the habitat is allowed. As the sedge peat accumulates, surface water becomes more seasonal rather than year round, and less mesic conditions develop. Eventually marshy vegetation will disappear giving way to possible infestation of invasive plants and natural processes of forest succession. It is therefore an integral part to manage the hydrology of the surrounding wetlands, seasonally intermittent stream, ground water supporting the sedge ecosystem and occurrences of invasive terrestrial plant species.

Strategic recommendations to manage Sedge Meadow Cover Type for suitable wildlife habitat

- Strive to maintain native plant communities within the sedge meadow cover type.
- Strive to eradicate invasive plant species including oriental bittersweet, Morrow's honeysuckle, Japanese barberry and bull thistle growing at the meadow's edge that are infringing on the sedge meadow.
- Strive to maintain a large wetland buffer between forest edge and sedge meadow in order to maintain "edge effect" and protect against forest regeneration.
- Strive to protect sedge meadow cover type against natural processes of sedge-meadow succession with seasonal repeated mowing at adjacent field.
- Strive to eliminate land use pressures and management objectives at adjacent properties that may result in degradation of cover type (MNAP 2015).
- Strive to maintain wetland buffer with prescribed burns or mechanical means. Prescribed fire can enhance sedge meadow diversity by allowing plant species with different life histories to temporarily share dominance with the more abundant graminoids. Periodic seed inputs by forbs to the wetland seed bank may be a desirable fire management objective for maintaining sedge meadow diversity (Kost and De 2000).
- Strive to maintain hydrology of saturated sedge wetland to protect emergent vegetation.
- Strive to maintain a <30% shrub content in the sedge meadow.
- For further information and direction for prescribed burns the Town of Chebeague whose fire department conducts spring burns at Little Chebeague Island may be able to offer guidance and assistance.

9.5 Grassland Cover Type

Among other important wildlife habitats at the Harvey Property the 5.5acre field being maintained by mowing is of significant value. Open grasslands no matter what size provide vital habitat for migrating songbirds, foraging and nesting ground birds, small mammals, snakes and white-tailed deer. Development and natural forest succession combined cause much of grassland cover types in Maine to be reduced as well as other states in New England. According to the University of New Hampshire's Cooperative Extension Service, "Bird species that depend on grasslands have declined, along with their habitats, faster than any other group of birds in New England" (UNH Cooperative Ext. 2015) and therefore merit protection.

Field/Grassland on Harvey Property

Strategic recommendations to manage Grassland Cover Type for suitable wildlife habitat

- Mow field to control invasive species, such as: bull thistle that may become more aggressive as well as oriental bittersweet, Morrow's honeysuckle and Japanese barberry from invading the field from surrounding wooded areas.
- Mow field to eliminate shrubs and control processes of early succession to keep it from reverting back to a forest.
- Mow field every 2-3 years to encourage diversity of native plants and insects.
- Mow field after breeding season (mid May-July) of ground-nesting birds.
- If mowing must be done earlier, raise blade above 6" or more at high concentration of grassland nest areas (UNH Cooperative Ext. 2015).
- Where possible, remove all shrubs and trees growing in the middle of fields, as these decrease the useable acreage perceived by grassland-nesting birds (UNH Cooperative Ext. 2015.)
- Do not mow at night for roosting grassland birds (UNH Cooperative Ext. 2015).
- If additional mowing is necessary in a single season, wait until late fall after migrating

butterflies have gathered nectar from late blooming wildflowers.

- A rotational mowing schedule of set blocks within the field will allow for different heights of graminoids and forbs within a patchwork configuration creating cover and feeding opportunities for the greatest number of wildlife species (UNH Cooperative Ext. 2015).
- Due to small acreage of grassland present, consider increasing the present field perimeter in order to increase diversity of songbird species with larger habitat requirements.

10. TERRESTRIAL NATURAL RESOURCE MANAGEMENT ISSUES

10.1 Ticks and Mice

During our two-day survey wood tick (*Dermacentor variabilis*) and deer tick (*Ixodes scapularis)* populations were not observed at the property. However, it is highly likely and expected that both wood and deer ticks are present on the island due to the island being inhabited by humans, pets, mice and deer. Several piles of deer scat were found at the property during our field reconnaissance. Deer ticks are responsible for carrying the causative lyme bacteria agent, *Borrelia burgdorferi.* This bacteria agent is directly responsible for transmitting Lyme disease and consequently is 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 BI as the problem becomes a greater issue. 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.

10.2 White-tailed Deer

White-tailed deer (*O. 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 2004: CT community based Lyme's disease prevention projects* by Kirby Stafford is also a valuable resource.

Abundant white-tailed deer populations at Birch 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 shrub land 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). From our findings the Harvey Property possesses good winter habitat particularly due to 5.6 acre hemlock forest community type which provides superior habitat qualities including winter protection from snow interference, insulating thermal functions during deep snow, and an excellent source of winter browse. However because the deer move from island to island it is a more difficult species to assess habitat carrying capacities, and population growth trends.

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 the Birch Island Harvey Property. Additionally white-tail deer contribute to the loss of the biological diversity of the ecosystem by over-browsing native bramble species, such as: blackberry and raspberry that help suppress the growth of other invasive plant species such as Eastern hayscented fern *(Dennstaedtia punctilobula)* that become established in open forest gaps (McMahon 2012). Presently large colonies of hayscented fern with a matted root system occupy immense patches of earth at the Harvey Property's interior. In addition, white-tail deer are most likely responsible for eliminating red oak and red maple seedlings that help to stabilize the community composition, structure and diversification of the forest. Damage from over-browsing 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).

10.3 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 in 2013. However, the largest populations were found in the northern portions of the state (Donahue 2013). No populations of hickory tussock moth were found at the Harvey Property during our field work; yet they have been identified by MIE on other Casco Bay islands in close proximity to the property (Little Chebeague Island) and the adjacent mainland. In addition potential host plants that this communal insect commonly feeds upon includes tree species found at the property; such as beech, poplar, oak and willow. Although there is a potential risk involved, it is unlikely that trees will be completely defoliated or have significant damage (UWM 2013) if these caterpillars were to take up residency. However the hickory tussock moth does pose an issue of concern to HHLT 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 access points to the property informing visitors of the hickory tussock moth could help reduce negative interactions with the native insect and further protect the safety of visitors to the Harvey Property. For more information this website is available: http://www4.uwm.edu/fieldstation/naturalhistory/bugoftheweek/hickory-tussock-moth.cfm

10.4 Browntail Moth

The Browntail moth *(Euproctic chrysorrhoea)* is an invasive insect that was accidentally introduced in the late 19th 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). 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).

Although no evidence of Browntail moth was identified at the Harvey property during our field reconnaissance it is a prevalent ecological, recreational and safety concern for coastal area land managers in Maine.The primary health 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 13 genera have been identified by MIE at or near the Birch Island Harvey Property. Silky webs are built in trees containing 25-400 Browntail 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

10.5 Poison Ivy

Poison ivy (*Toxicodendron radicans*) is a troublesome native nuisance that is quite common to coastal islands in Casco Bay. Our plant surveys conducted at the Harvey Property did not reveal

any populations of poison ivy, however, it is suspected that because poison ivy favors disturbed soils it is most likely present elsewhere on the 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. Yet, with proper trail design, educational signage, and controlled restoration efforts poison ivy can be avoided.

10.6 Invasive Plants

Several non-native plant species including, but not limited to: Oriental bittersweet (*Celastrus orbiculatus*) Japanese barberry (*Berberis thunbergii*), and Morrow's honeysuckle (*Lonicera morrowii*) are invasive and problematic at the Harvey Property. These invasive plants, known for their aggressive nature, pose an immediate threat to land managers who strive to maintain the native biodiversity of an island ecosystem. Native plants and habitats are at risk as invasive plants move to establish themselves as dominant species out compete natives for sunlight and creating dense shade for native herbaceous plants below. Invasive plants often have a longer growing season, leafing out weeks before native plants break dormancy and maintaining 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 and can often reproduce more than once per year either vegetatively and/or by seed. With specialized adaptations, invasive plants become established more aggressively than native plants post-fire or after other natural disturbances or forestry practices when sites are cleared or mineral soils exposed. In addition, invasives, such as Oriental bittersweet, are able to thrive in harsh conditions existing at coastal environments. Invasive species left unmanaged can become dominant, pervasive monotypic communities and impenetrable thickets threatening the vital ecosystem.

Japenese barberry (left) and Morrow's honeysuckle (right) are present on the Harvey Property.

Table 3. Strategies for Invasive Plant Control at Birch Island, ME. (These recommendations are adopted from MNAP, Wisconsin Dept. of Natural Resources (WDNR), United States Forest Service (USFS) and Maine Island Ecologists (MIE) Invasive Plant Programs. (*) = Preferred method or time for application.

Plant Name	**Mechanical Control**	**Mechanical Control**	**Prescribe Burn**	**Graze Type**	**Chemical Control**	**Biological Control**
	Mowing or Tilling or Pruning	**Digging & Pulling or Mulching**	**Spot burning**	**Goats or Sheep**	**Wicking/Cut Stump or Foliar Spray or Basal Application**	**Types**
Celastrus orbiculatus Oriental Bittersweet	Mowing Every two weeks in open area. Generally, not an effective method to deplete carbohydrate 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. Triclopyr* or Glyphosate application Cut stump method (2 inches above ground) or after mowing. A second treatment following to control sprouting.	Marssonina celastri Leaf Spot Fungus (used in Korea)
Berberis thunbergii Japanese Barberry	Mow early in the season while native plants are still dormant and carbohydrate depletion begins in the roots. 4-5 Repeated mowings throughout season	Digging & Pulling plants and shallow roots Must remove rhizomes deep in soil or will re-sprout. Minimize soil disturbance.	Not advised due to stimulated growth of sprouts from root crown. May survive low severity fires but repeated burns can be effective. Or precede burn method with cutting early in the season. Burn before sprouting plants have recovered.	Goats	Cut Stump*or Foliar spray Application Triclopyr* or Glyphosate application Cut stump* method (2inches above ground) or after mowing in early spring at leaf out.	Non-native Tephritid Flies. Not used in North America yet.
Lonicera morrowii Morrow's Bush Honeysuckle	Not advised. Feasible only as a temp. means of reducing seed production or a pre-treatment to herbicide application 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) Unless subsequent burns done annually or biennially for 5years-(MNAP)	Goats Limit. May create disturbed soil for invasion	Triclopyr* or Glyphosate application Cut stump method (2inches above ground) Immediately after mowing in early spring while some natives are still dormant.	Non-native Hyadaphis tataricae Honey-suckle Aphid

11. CONCLUSION

The Harvey Property hosts critical habitats, specialized ecosystems and sensitive plant communities supportive of a multitude of flora and fauna. These include critical marine habitats along the property's shoreline, wetlands of special significance and interior habitat types that are significant wildlife habitat. According to the USFWS analysis, the property provides particularly high value habitat for 28 priority trust species including the federally endangered roseate tern and recently delisted bald eagle, and many listed on the MDIFW "Species of Special Concern" List including those uncommon to southern Maine.

If the property is acquired, MIE strongly recommends that an *"Early detection/Quick Response Methodology*" be implimented to eliminate invasive plant and marine species from the Harvey Property. Without eradication and proper management of invasive species and natural processes of forest succession presently threatening the integrity of the ecosystem, terrestrial and coastal wetland habitats will be altered and will consequently damage the stability of these protected lands. Coastal and freshwater wetlands are also currently threatened by anthropogenic forces and climate change. If the land is acquired further research of critical habitats is highly recommended particularly of the vast mudflat, fringe marsh, brackish marsh and eel grass ecosystems threatened by the invasive green crab.

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Appendix A

THE VASCULAR FLORA OF BIRCH ISLAND HARVEY PROPERTY

BIRCH ISLAND, HARPSWELL, MAINE

Vascular plants of the Harvey Property on Birch Island, Harpswell, Cumberland County, Maine based on field work conducted during 2 visits on 7-30-2014 and 8-14-2014 in which unsystematic surveys of plant communities of various cover types were conducted by MIE Scientists, Tracy Ames and Kristin Pennock. Additional exploratory baseline inventory of particular sites with limited accessibility are recommended to complete this working list particularly critical coastal wetland habitats. Plant species are arranged in bold and systematically by family name 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. The USDA's Plants Database website: http://plants.usda.gov and the New England Wildflower Society's Go Botany website; https://gobotany.newenglandwild.org as well as Newcomb's Wildflowers Guide featuring scientific names and identification information were used to identify and classify plants. Graminoids were identified to the best of my knowledge however were not confirmed. All other species listed were confirmed and noted in the list that follows.

SPHAGNACEAE

Sphagnum L. [Sphagnum Moss]: Patches of this bryophyte commonly found at bases of trees at property interior.

LYCOPODIACEAE

Huperzia lucidula (Michx.) Trevis. [Shining Clubmoss]: Non-vascular plant found at forest floor of spruce-northern hardwood forest cover type.

EQUISETACEAE

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

DENSTAEDTIACEAE

Dennstaedtia punctilobula (Michx.) T. Moore [Eastern Hayscented Fern]: Non-native. **Dense, monotypic populations are visible at moist wetland areas at interior sites. Management and monitoring studies should include this non native invasive plant that can inhibit prevailing native tree and shrub seedlings by creating expansive and impenetrable rooted mats.**

THELYPTERIDACEAE

Thelypteris noveboracensis (L.) Nieuwl [New York Fern]: Large colony near edge of northern hardwood forest and tidal fringe marsh.

DRYOPTERIDACEAE

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 Wood Fern]: Sporadic patches of evergreen wood fern at the understory layer of the spruce forest.

PINACEAE

Picea glauca (Moench) [White Spruce]: A mature individual specimen identified near other conifers at southern portion of property.

Picea rubens Sarg. [Red Spruce]: Dominant tree throughout interior portions of property growing in terrestrial wetland and upland areas.

Pinus strobus L. [Eastern White Pine]: Both mature, old growth trees and young seedlings dispersed throughout the property.

Abies balsamea L. (Mill.) [Balsam Fir]: Interspersed with other mixed conifers anddeciduous trees near forested wetlands and wooded areas.

CUPRESSACEAE

Juniperus communis L. var. *depressa* Pursh [Common Juniper]: Clumps of junipers visible above bluff areas.

RANUNCULACEAE

Coptis trifolia (L.) Salisb. [Goldthread]: large clumps scattered at coniferous forests floors.

Ranunculus L. [Common Buttercup]: Located above the bluffs at the eastern edge of property line.

BERBERIDACEAE

Berberis thunbergii L. [Japanese Barberry]: Non-native. **An invasive plant located on the eastern border of the forest. Due to its extremely dense and dominantly invasive nature it is recommended to be eradicated upon acquisition of Harvey property.**

ZOSTERACEAE

Zostera marina L. var. *stenophylla* Aschers & Graebn. [Eel Grass]: Eel grass is present at the subtidal zone near the shoreline of the Harvey Property.

ARACEAE

Arisaema triphyllum (L.) Schott. [Jack in the Pulpit]: Clumps growing at wooded forest floor.

CONVALLARIACEAE

Maianthemum canadense Desf. [Canada Mayflower]: Present in patches on floor of mixed conifer/hardwood forests.

TYPAHACEAE

Typha angustifolia [Narrowleaf Cattail]: Small populations growing near border of brackish marsh.

LILIACEA

Uvularia perfoliata L. [Perfoliate Bellwort]: Single specimen existing in terrestrial forbs area. This plant is listed as “endangered” in NH.

Maianthemum canadense Desf. [Canada Mayflower]: Sporadic locations throughout forested areas of the property particularly at forested wetlands.

JUNCACEA

Juncus gerardii Loisel. [Saltmeadow Rush, Black Rush]: Identified at the high marsh zone of pocket fringe marsh although not confirmed during flowering stage.

CYPERACEAE

Bolboschoenus maritimus (L.) Palla [Saltmarsh Tuber-Bulrush]: Plants interspersed with cordgrasses at the border between the brackish marsh and tidal marsh where fresh water meets saltwater.

Carex comosa [Longhair Sedge, Bristly Sedge]: Dense coverage at sedge meadow. This plant may have been misidentified and confused with sallow sedge and is my best personal judgment.

Carex lurida Wahlenb. [Shallow Sedge, Sallow Sedge]: A co-dominant component of the sedge meadow and field in association with other graminoids and forbs.

Carex scoparia Schkuhr ex Willd. [Broom Sedge]: Growing abundantly at wet sedge meadow

and open field.

Carex vulpinoidea Michx. [Fox Sedge]: Graminoid densely present with forbs at sedge meadow.

Schoenoplectus maritimus (L.) Lye [Cosmopolitan Bulrush, Alkali Bulrush]: Dominant grass at brackish marsh located at north end of property. This sedge is an excellent restoration plant which can be used for filtering pollutants, and protection against wind and wave action.

Scirpus atrovirens Willd. [Green Bulrush]: Scattered locations at saturated sedge meadow adjacent to field.

Scirpus cyperinus (L.) Kunth [Wool Grass]: Small patches were found at a forested wetland at northwestern interior of property.

POACEAE

Elymus repens (L.) Gould. [Couch Grass, Witch Grass, or Quack Grass]: Non-native. Present in at upland areas near residence on northern point.

Glyceria striata (Lam.) Hitchc. [Fowl Mannagrass]: Perennial grass visible at sedge meadow growing with graminoids and forbs.

Poa pratensis L. [Kentucky Bluegrass]: Non-native. Plant is near border of cottage property.

Spartina alterniflora Loisel. [Smooth Cordgrass]: Short form is dominantly found at the low and high salt marsh habitat on the northern shoreline.

Spartina patens (Aiton) Muhl. [Saltmeadow Cordgrass, Salt Marsh Hay]: Shared occupancy of high marsh zones.

Thinopyrum pycnanthum (Godr.) Bark worth [Tick Quackgrass]: Non-native. Visible at the northern tip of the island near eastern trails.

GROSSULARIACEAE

Ribes hirtellum Michx. [Bristly Gooseberry]: Present at forested wetlands located at the interior of the property.

POLYGONACEAE

Polygonum sagittatum [Arrowleaf Tearthumb]: Commonly growing amidst the herbaceous forbs and graminoids at the interior sedge meadow and open field.

PLUMBAGINACEAE

Limonium carolinianum (Walt.) Britt. [Sea Lavender]: Present along upper rocky intertidal zone on ledges and outcroppings and at fringe saltwater marsh.

Honckenya peploides L. Ehrh. [Seaside Sandplant, Seaside Sandwort]: A seaside herbaceous form sited in the periodically inundated areas of the high marsh zone.

OXALIDACEAE

Oxalis stricta L. [Common Yellow Wood-sorrel]: Growing in upright clumps at open field and along wooded paths.

CELASTRACEAE

Celastrus articulate Thumb. [Oriental Bittersweet]: Non-Native. **An invasive species that is present and specifically concentrated at the eastern portion upland and wetland areas of the property. Due to its extremely dense and dominantly invasive nature it is recommended to be eradicated upon acquisition.**

URTICACEAE

Urtica dioica ssp. *gracilis* [Stinging Nettle]: Single stem growing at disturbed area near concrete slab east of the sedge meadow.

MYRICACEAE

Myrica pennsylvanica Loisel. [Northern Bayberry]: Commonly located above bluff areas bordering upland woods at the border of the eastern property interior.

FAGACEAE

Fagus grandifolia Ehrh. [American Beech]: A component of open mixed deciduous forest

along perimeter trail at northeastern portion of property.

Quercus rubra L. [Red Oak]: Common individuals of the northern hardwood forest present near the interior with others scattered at field perimeters, mixed hardwood stands, etc.

BETULACEAE

Alnus incana (L.) Moenchssp. *rugosa* (Du Roi) Clausen [Speckled Alder]: With many sizeable populations throughout the freshwater wetlands and other interior moist areas.

Betula papyrifera [Paper Birch]: growing along trails at upland areas of open wooded areas.

Betula populifolia Marshall [Gray Birch]: growing along perimeter trail on eastern and central portion of property near forested wetlands.

Betula alleghaniensis [Yellow Birch]: Large, mature yellow birch trees are present as major components of the hemlock- yellow birch forest, growing in moist areas of the interior along ridges and uplands and interspersed with red spruce and other hardwoods nearby. **Yellow birch trees of this size are rare at coastal islands in Casco Bay.**

Ostrya virginiana (Mill.) K. Koch [Eastern Hophornbeam]: One tree was identified near terrestrial wetland at eastern edge of property.

ROSACEAE

Malus sylvestris P. Mill. [Apple] Non-native. Approximately a dozen trees located along eastern trail adjacent to forested wetland.

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

Prunus virginiana L. [Chokecherry]: Location sited near the sedge meadow edge. 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.

Rubus allegheniensis Porter [Allegheny Blackberry]: Growing at eastern portion of property at terrestrial forbs areas.

Rubus hispidus L. [Swamp Dewberry, Bristly Dewberry]: Dense ground cover patches at forested and sedge meadow wetlands.

Rubus idaeus L. ssp. *idaeus* [Wild Red Raspberry]: Non-native. Plants commonly found adjacent to paths of the interior sections to bluff edge.

Spireae alba Du Roi var. *latifolia* (Ait.) Dippel [Meadowsweet]: Existing in patches near meadow and adjacent to wooded path.

Spirea tomentosa L. [Steeplebush]: Clumps of steeplebush were found at forested wetland at western portion of property.

FABACEAE

Lathyrus japonicus Willd. Var. *pellitus* Fern. [Beach Pea]: Non-native. Mainly present on bluff areas.

Robinia pseudoacacia L. [Black Locust]: Non-Native (MNAP 2015). A dead stand along with patches of both live and dead black locust stand at the southeastern edge of large, open sedge meadow and field.

Trifolium pratense L. [Red Clover]: Non-native. Well established at field and pathways.

Trifolium repens L. [White Clover]: Non-native. Plants growing in semi-closed wooded area near edge of property.

SALICACEAE

Populus tremuloides Michx. [Quaking Aspen]: Found mainly at the upland interior of property.

Salix discolor Muhl. [Pussy Willow]: Growing at terrestrial forested wetland.

VIOLACEAE

Viola sp. [Either Small White Violet or Dooryard Violet]: Apparent along the interior trail growing along the mossy western understory.

CLUSIACEAE

Hypericum perforatum L. [Common St. Johnswort]: Observations noted at field and forest edge.

SAPINDACEAE (includes ACERACEAE and HIPPOCASTANACEAE)

Acer rubrum L. [Red Maple]: Commonly found at forested wetlands, northern hardwood forest and other areas of the interior.

Acer pensylvanicum L. [Striped Maple]: Saplings identified at northern edge of property near cottage property growing with white pine and other deciduous trees of northern hardwood forest cover type.

PRIMULACEAE

Glaux maritima L. [Sea Milkwort]: Visible at high marsh zone of intertidal area above mudflat.

Trientalis borealis Raf. [Star Flower]: Commonly present growing in the northern hardwood forest floor near trails.

BALAMINACEAE

Impatiens capensis Meerb. [Jewelweed, Spotted Touch-me-not]: Common throughout the island interior at or near wetland areas.

ERICACEAE

Monotropa uniflora L. [Indianpipe]: Growing along forest floor near forested wetland near eastern hemlock forest.

Vaccinium angustifolium Aiton [Low Sweet Blueberry]: Patches are present amongst the limited forest floor vegetation.

LAMIACEAE

Scutellaria galericulata L. [Marsh Skullcap]: Small community near the freshwater terrestrial wetland outlet areas adjacent to trail at eastern edge of property.

Teucrium canadense L. [American Germander, Canada Germander]: Found at moist thicket of eastern portion of property.

PLANTAGINACEAE

Plantago major L. var. *Intermedia* (DC.) Pilger [Common Plantain]: Observed plants present sporadically at the interior of property.

CAPRIFOLIACEAE

Lonicera morrowii. A. Gray [Morrow's Honeysuckle]: Non-native. **An invasive plant, this bush honeysuckle is pervasive throughout the eastern portion of property only. Plants are noted along trails and amongst the wooded areas. This troublesome plant is on the top 5 of MNAPs invasive plant species list and should be strictly managed and eradicated off the island upon acquisition of property to control further spread.**

AQUIFOLIACEAE

Ilex verticillata (L.) Gray [Common Winterberry]: Located at forested wetland areas at property interior.

APIACEAE

Daucus carota L. [Queen Anne's Lace]: Non-native. Plants are visible along open trails.

VERBENACEAE

Verbena hastata L. [Swamp Verbena]: One plant identified at field growing with members of the Astereceae and Cyperaceae families.

OLEACEAE

Fraxinus pennsylvanica Marshall [Green Ash]: Tree identified growing near forested wetland at eastern portion of the property.

ASTERACEAE

Arctium minus Bernh. [Common Burdock]: Non-native. A localized group found growing near crab apples and speckled alders along trail at eastern edge of Harvey Property.

Bidens frondosa L [Devil's Beggartick]: Present at eastern portion of island near forested wetland area and sedge meadow.

Cirsium vulgare (Savi.) Ten. [Bull Thistle]: Non-native. Increasing populations are evident in scattered patches throughout the field at the property. etc. **This is a problematic, invasive plant that is presently being controlled at MCINWR coastal islands in Maine and should be controlled by HHLT upon land acquisition.**

Euthamia graminifolia (L.) Nutt. var. *graminifolia* [Flat-Topped Goldenrod]: Growing profusely at field and sedge meadow centrally located on property.

Hieracium aurantiacum L. [Orange Hawkweed]: Identified growing in the property border at a cottage residence located on northern tip.

Hieracium piloselloides Vill. [Glaucous Hawkweed]: Non-native. Visible plants at the mixed herbaceous forb and graminoid meadow communities near adjacent cottage property.

Leucanthemum vulgare Lam. [Ox-eye Daisy]: Non-native. A herbaceous forb commonly found growing in field.

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 marsh areas at the northern end of the Harvey property.

Symphyotrichum novae-angliae (L.) G.L. Nesom [New England Aster]: Located at field and sporadically along eastern perimeter trail.

Symphyotrichum novi-belgii (L.) Nesom. var. *elodes* (Torr. & Gray) [New York Aster]: Growing sporadically at field and upland areas in northeastern portion of property.

Symphyotrichum lateriflorum (L.) A. Love and D. Love var. *lateriflorum* [Calico Aster]: Visible in field and mixed with other perennial forbs and graminoids.

Taraxacum officinale Wiggers ssp. *officinale* [Common Dandelion]: Growing in loose patches or as single stems along eastern trail.

Common Name	*Genus Species*	ABA	7/21/2014	8/11/2014	Notes
Ducks, Geese, and Swans (Anatidae)					
Common Eider	*Somateria mollissima*	1	8		
Cormorants (Phalacrocoracidae)					
Double-crested Cormorant	*Phalacrocorax auritus*	1	1		
Bitterns, Herons, and Allies (Ardeidae)					
Great Blue Heron	*Ardea herodias*	1	3	1	
Ospreys (Pandionidae)					
Osprey	*Pandion haliaetus*	1	1		
Gulls, Terns, and Skimmers (Laridae)					
Herring Gull	*Larus argentatus*	1	10+		
Common Tern	*Sterna hirundo*	1	3		
Pigeons and Doves (Columbidae)					
Mourning Dove	*Zenaida macroura*	1		1	
Jays and Crows (Corvidae)					
Blue Jay	*Cyanocitta cristata*	1	1		
Chickadees and Titmice (Paridae)					
Black-capped Chickadee	*Poecile atricapillus*	1		4	
Nuthatches (Sittidae)					
Red-breasted Nuthatch	*Sitta canadensis*	1		1	
Creepers (Certhiidae)					
Brown Creeper	*Certhia americana*	1		1	
Kinglets (Regulidae)					
Golden-crowned Kinglet	*Regulus satrapa*	1		8	
Mockingbirds and Thrashers (Mimidae)					
Gray Catbird	*Dumetella carolinensis*	1		1	
Emberizids (Emberizidae)					
Song Sparrow	*Melospiza melodia*	1		2	
White-throated Sparrow	*Zonotrichia albicollis*	1		1	

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.

Appendix C. Harvey Property Mammal List, Birch Island, Maine

White-tailed Deer, *Odocoileus virginianus* (scat)

Raccoon, *Procyon Lotor* (scat)

Appendix D. *Gulf of Maine Watershed Habitat Analysis Data Summary for Birch Island North East, Harpswell, Maine*

Gulf of Maine Watershed Habitat Analysis Data Summary for Birch Island North East, Harpswell, Maine

	Species	Score											Total Acres with Habitat	Sum of Habitat Unit	Average Habitat Unit Score	Relative Score
		Acres of habitat at the following relative scores (on a 0 to 10 scale, with 0 = unsuitable and 10 = optimal for that species)											Acres in parcel having non-zero habitat values	Sum of [# of acres X respective cell scores] for entire parcel	Sum of habitat units divided by total acreage	Relative score for the parcel, where 1 is average for the GOM watershed
		0	1	2	3	4	5	6	7	8	9	10				
Raptors	Northern Goshawk	38.0					37.4						37.4	186.8	2.5	0.9
	Northern Harrier	75.4														
	Peregrine Falcon, eastern	75.4														
	Red-Shouldered Hawk	75.4														
	Short-eared Owl	75.4														
Shorebirds	American Oystercatcher	44.9	30.5										30.5	30.5	0.4	54.0
	American Woodcock	59.4		6.9	1.6			2.4		0.7		4.4	16.0	83.0	1.1	0.5
	Black-bellied Plover	44.9	1.1	29.4									30.5	59.8	0.8	38.0
	Buff-breasted Sandpiper	60.9	14.5										14.5	14.5	0.2	1.3
	Common Snipe	75.4														
	Hudsonian Godwit	46.0		29.4									29.4	58.7	0.8	80.2
	Killdeer	46.0		29.4									29.4	58.7	0.8	1.3
	Least Sandpiper	44.9		30.5									30.5	60.9	0.8	33.8
	Purple Sandpiper	75.4														
	Red Knot	44.9	1.1	29.4									30.5	59.8	0.8	57.5
	Ruddy Turnstone	46.0	29.4										29.4	29.4	0.4	32.2
	Sanderling	46.0		29.4									29.4	58.7	0.8	53.2
	Semi-palmated Sandpiper	44.9	1.1	29.4									30.5	59.8	0.8	36.7
	Short-billed Dowitcher	44.9	1.1	29.4									30.5	59.8	0.8	43.8
	Solitary Sandpiper	74.7	0.7										0.7	0.7	0.0	0.2
	Upland Sandpiper	75.4														
	Whimbrel	44.9		30.5									30.5	60.9	0.8	11.7
Songbirds and Other Birds	Baltimore Oriole	73.2										2.2	2.2	22.2	0.3	0.4
	Bay-breasted Warbler	75.4														
	Bicknell's Thrush	75.4														
	Blackburnian Warbler	52.3										23.1	23.1	231.3	3.1	0.9
	Blackpoll Warbler	75.4														
	Black-throated Blue Warbler	63.4										12.0	12.0	120.1	1.6	0.4
	Blue-winged Warbler	75.4														
	Canada Warbler	66.1										9.3	9.3	93.4	1.2	1.5
	Cape May Warbler	75.4														
	Chestnut-sided Warbler	64.9										10.5	10.5	104.5	1.4	0.8
	Eastern Meadowlark	75.4														
	Field Sparrow	75.4														
	Golden-winged Warbler	75.4														
	Grasshopper Sparrow	75.4														
	Louisiana Waterthrush	75.4														
	Marsh Wren	75.4														
	Nelson's Sharp-tailed Sparrow	74.3							1.1				1.1	7.8	0.1	4.5
	Northern Flicker	70.5										4.9	4.9	48.9	0.6	0.2
	Olive-sided Flycatcher	72.7		2.7									2.7	5.3	0.1	0.1
	Prairie Warbler	72.7										2.7	2.7	26.7	0.4	0.7
	Red Crossbill	75.4														
	Red-headed Woodpecker	75.4														
	Saltmarsh Sharp-tailed Sparrow	74.3							1.1				1.1	7.8	0.1	8.8
	Seaside Sparrow	75.4														
	Sedge Wren	73.6										1.8	1.8	17.8	0.2	1.3
	Spruce Grouse	75.4														
	Veery	75.4														
	Whip-poor-will	75.4														
	Wood Thrush	59.4	13.3	2.7									16.0	18.7	0.2	0.1
Waterbirds	American Bittern	68.5		0.4	0.9	0.7	4.7					0.2	6.9	31.8	0.4	2.1
	American Black Duck	36.0							10.0			29.4	39.4	363.6	4.8	8.1
	Arctic Tern	75.4														
	Black Scoter	75.4														
	Black Tern	75.4														
	Common Loon	75.4														
	Common Tern	75.4														
	Greater Scaup	46.3					0.2					28.9	29.1	290.2	3.8	24.1
	Least Tern	75.4														
	Lesser Scaup	46.3					0.2					28.9	29.1	290.2	3.8	24.1
	Little Blue Heron	35.6			28.7	1.8	9.3						39.8	139.9	1.9	16.1
	Little Gull	75.4														
	Osprey	6.0	9.6		5.3		7.6			29.4		17.6	69.4	473.9	6.3	9.4
	Pied-billed Grebe	75.4														
	Razorbill	75.4														
	Snowy Egret	44.9				28.7	1.8						30.5	123.7	1.6	29.3
	Surf Scoter	75.4														
	Tricolored Heron	44.9				28.7	1.8						30.5	123.7	1.6	94.7
	White-winged Scoter	75.4														
	Wood Duck	53.4	0.7				8.7			3.3		9.3	22.0	164.1	2.2	2.1
	Yellow Rail	75.4														
Federally Listed Species	Atlantic Salmon	46.0				29.4							29.4	117.4	1.6	0.3
	Bald Eagle	7.8		29.4			38.3						67.6	250.0	3.3	3.7
	Canada Lynx	75.4														
	Eastern Prairie Fringed Orchid	75.4														
	Furbish's Lousewort	75.4														
	Piping Plover	75.4														
	Plymouth Redbelly Turtle	75.4														
	Robbins' Cinquefoil	75.4														
	Roseate Tern	46.0			29.4								29.4	88.1	1.2	62.3
	Shortnose Sturgeon	75.4														
	Small Whorled Pogonia	75.4														
Fish and Invertebrate	Alewife	46.0					29.4						29.4	146.8	1.9	0.4
	American Eel	46.3					29.1						29.1	145.7	1.9	0.2
	American Shad	46.0					29.4						29.4	146.8	1.9	0.4
	Atlantic Sturgeon	46.0					29.4						29.4	146.8	1.9	0.4
	Blueback Herring	46.0					29.4						29.4	146.8	1.9	0.4
	Bluefish	46.0										29.4	29.4	293.6	3.9	0.5
	Horseshoe Crab	46.0							1.3			28.0	29.4	289.6	3.8	1.3
	Winter Flounder	46.3					28.5	0.7					29.1	146.3	1.9	0.2
Extended Fish Values	Alewife - extended	75.4														
	Atlantic Salmon - extended	75.4														
	Blueback Herring - extended	75.4														
	Shad - extended	75.4														

Parcel acreage: approximately 75.4 total acres (including adjacent intertidal wetland acres, if applicable)

Gulf of Maine Watershed Habitat Analysis
Species Directory of Habitat Score Definitions and Ranges Modeled

	Species	Habitat Modeled (see meaning of specific habitat scores under the indicated sequence in table below)
Raptors	Northern Goshawk	A; breeding
	Northern Harrier	A; breeding, wintering
	Peregrine Falcon, eastern	F; nesting
	Red-Shouldered Hawk	A; breeding, wintering
	Short-eared Owl	A; roosting, wintering
Shorebirds	American Oystercatcher	R; breeding, migration
	American Woodcock	A; breeding, migration
	Black-bellied Plover	G; migration
	Buff-breasted Sandpiper	P; migration
	Common Snipe	A; breeding, migration
	Hudsonian Godwit	R; migration
	Killdeer	G; all stages
	Least Sandpiper	G; migration
	Purple Sandpiper	G; migration, wintering
	Red Knot	G; migration
	Ruddy Turnstone	R; migration
	Sanderling	G; migration
	Semi-palmated Sandpiper	G; migration
	Short-billed Dowitcher	G; migration
	Solitary Sandpiper	R; migration
	Upland Sandpiper	A; breeding, migration
	Whimbrel	G; migration

	Species	Habitat Modeled (see meaning of specific habitat scores under the indicated sequence in table below)
Songbirds and Other Birds	Baltimore Oriole	O; breeding, migration
	Bay-breasted Warbler	O; breeding, migration
	Bicknell's Thrush	A; breeding, migration
	Blackburnian Warbler	O; breeding, migration
	Blackpoll Warbler	O; breeding, migration
	Black-throated Blue Warbler	O; breeding, migration
	Blue-winged Warbler	A; breeding, migration
	Canada Warbler	A; breeding, migration
	Cape May Warbler	O; breeding, migration
	Chestnut-sided Warbler	A; breeding, migration
	Eastern Meadowlark	A; breeding, wintering
	Field Sparrow	A; breeding, wintering
	Golden-winged Warbler	O; breeding, migration
	Grasshopper Sparrow	A; breeding, migration
	Louisiana Waterthrush	O; breeding, migration
	Marsh Wren	O; breeding, migration
	Nelson's Sharp-tailed Sparrow	Q; breeding, migration
	Northern Flicker	A; breeding, wintering
	Olive-sided Flycatcher	A; breeding, migration
	Prairie Warbler	O; breeding, migration
	Red Crossbill	O; all stages
	Red-headed Woodpecker	O; breeding, migration
	Saltmarsh Sharp-tailed Sparrow	A; breeding, migration
	Seaside Sparrow	O; breeding, migration
	Sedge Wren	A; breeding, migration
	Spruce Grouse	O; all stages
	Veery	A; breeding, migration
	Whip-poor-will	O; breeding, migration
	Wood Thrush	A; breeding, migration

	Species	Habitat Modeled (see meaning of specific habitat scores under the indicated sequence in table below)
Waterbirds	American Bittern	A; breeding, migration
	American Black Duck	A; all stages
	Arctic Tern	D; breeding, migration
	Black Scoter	A; wintering, migration
	Black Tern	F; breeding, migration
	Common Loon	H; all stages
	Common Tern	D; breeding, migration
	Greater Scaup	A; wintering, migration
	Least Tern	J; breeding, migration
	Lesser Scaup	A; wintering, migration
	Little Blue Heron	S; breeding, migration
	Little Gull	U; wintering
	Osprey	E; breeding, migration
	Pied-billed Grebe	A; breeding, migration
	Razorbill	T; all stages
	Snowy Egret	S; breeding, migration
	Surf Scoter	A; wintering, migration
	Tricolored Heron	S; breeding, migration
	White-winged Scoter	A; wintering, migration
	Wood Duck	A; breeding, migration
	Yellow Rail	O; breeding, migration

	Species	Habitat Modeled (see meaning of specific habitat scores under the indicated sequence in table below)
Federally Listed Species	Atlantic Salmon	B; breeding, migration
	Bald Eagle	E; breeding, wintering
	Canada Lynx	A; all stages
	Eastern Prairie Fringed Orchi	F; all stages
	Furbish's Lousewort	G; all stages
	Piping Plover	K; breeding, migration
	Plymouth Redbelly Turtle	L; all stages
	Robbins' Cinquefoil	F; all stages
	Roseate Tern	D; breeding, migration
	Shortnose Sturgeon	C; all stages
	Small Whorled Pogonia	F; all stages
Fish and Invertebrate	Alewife	C; breeding, migration
	American Eel	C; growth, migration
	American Shad	C; breeding, migration
	Atlantic Sturgeon	C; breeding, migration
	Blueback Herring	C; breeding, migration
	Bluefish	A; growth, migration
	Horseshoe Crab	I; breeding, juvenile, and adult
	Winter Flounder	A; all stages
Extended Fish Values	Alewife - extended	M; breeding, riparian buffer
	Atlantic Salmon - extended	N; breeding, riparian buffer
	Blueback Herring - extended	M; breeding, riparian buffer
	Shad - extended	M; breeding, riparian buffer

Habitat Score Definitions

Sequence	0	1	2	3	4	5	6	7	8	9	10
A	no value	modeled lowest	modeled low value	modeled low medium	modeled medium low	modeled medium	modeled medium	modeled medium high	modeled high medium	modeled higher	modeled highest
B	no value		modeled offshore marine		modeled inshore marine	likely used riverine					recent use riverine
C	no value		modeled offshore marine		potential use freshwater	modeled inshore marine					known use freshwater
D	no value			likely feeding areas	historic nesting	potential nesting					recent nesting
E	no value	modeled low value nesting	foraging	modeled medium value nesting	modeled high value foraging	modeled high value nesting			likely feeding areas	known use wintering areas	known use nest areas
F	no value	modeled lowest		modeled low medium	modeled medium low	modeled medium		modeled medium high			known use
G	no value	modeled lowest	modeled low value	modeled low medium		known some use					known high use
H	no value	modeled lowest	modeled low value			likely used		known some use			known nesting use
I	no value			modeled adult habitat				modeled adult+juvenile			modeled adult + juv.+ breed.
J	no value		modeled nesting	likely feeding areas	past nesting or plover nests	past nesting and plover nest					recent nesting
K	no value		modeled nesting		historic nesting		likely feeding areas		MA heritage use areas	likely feeding areas	recent nesting
L	no value			modeled nesting	modeled nesting	modeled aquatic		known use suitable			known use optimal
M	no value			riparian buffer	potential use freshwater	modeled inshore marine					known use freshwater
N	no value			likely used buffer		likely used	riparian buffer				recent use
O	no value		modeled low value	modeled low medium	modeled medium low	modeled medium		modeled medium high			modeled highest
P	no value	modeled lowest		modeled low medium		known some use					
Q	no value							modeled medium high			known nesting use
R	no value	modeled lowest	modeled low value	known some use		known some use					known high use
S	no value			modeled low value foraging	modeled medium low foraging	modeled medium foraging		modeled high value foraging	historic nesting	feeding areas near recent colonies	recent nesting
T	no value	modeled low value foraging			known winter feeding areas	feeding areas near colonies					recent nesting
U	no value				modeled roosting areas	known feeding areas					