Eastern Shore Archipelago: Conservation and Scientific Assessment

Field Studies of a Range of Sea Islands on the Eastern Shore of Nova Scotia from Clam Harbour to Taylor Head

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NOVA SCOTIA NATURE TRUST

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Contents

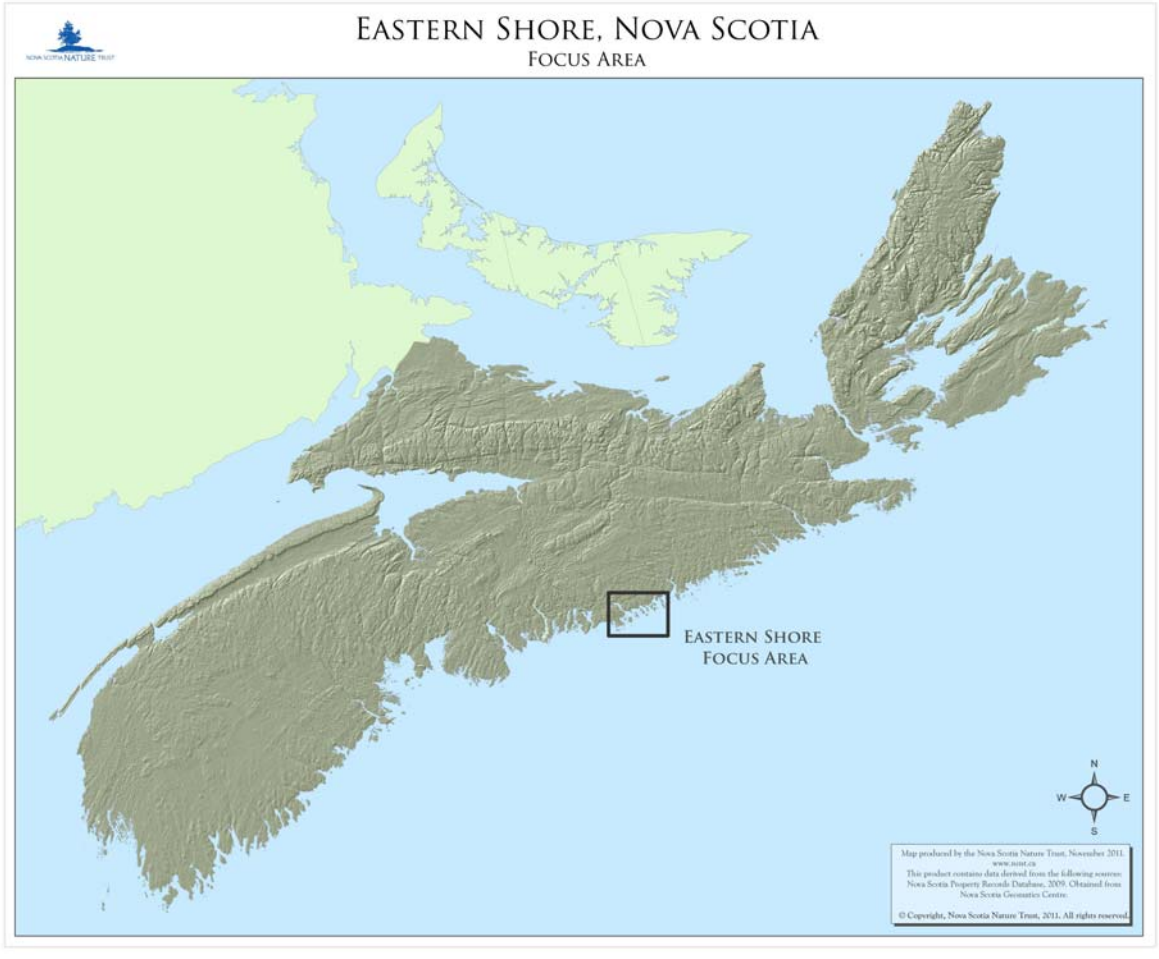
1. INTRODUCTION

During the summer and fall of 2011 the Nova Scotia Nature Trust (NSNT) undertook scientific studies of eight selected islands and two coastal mainland properties located along a stretch of Nova Scotia's Eastern Shore (map 1.1), some 100kms northeast of the city of Halifax. Properties visited are listed in table 1.1 and shown in red outline on map 1.2. This scientific study was carried out in order to assess the ecological conditions of the individual sites, and the archipelago in general, with a view to the potential for a land assemblage of conservation properties within the focus area, as denoted by the area in blue on Map 1.2. The focus area of this project is made up with a mixture of privately owned lands, provincial and federal crown lands and sites with no assigned ownership (i.e. ungranted lands or owner unknown).

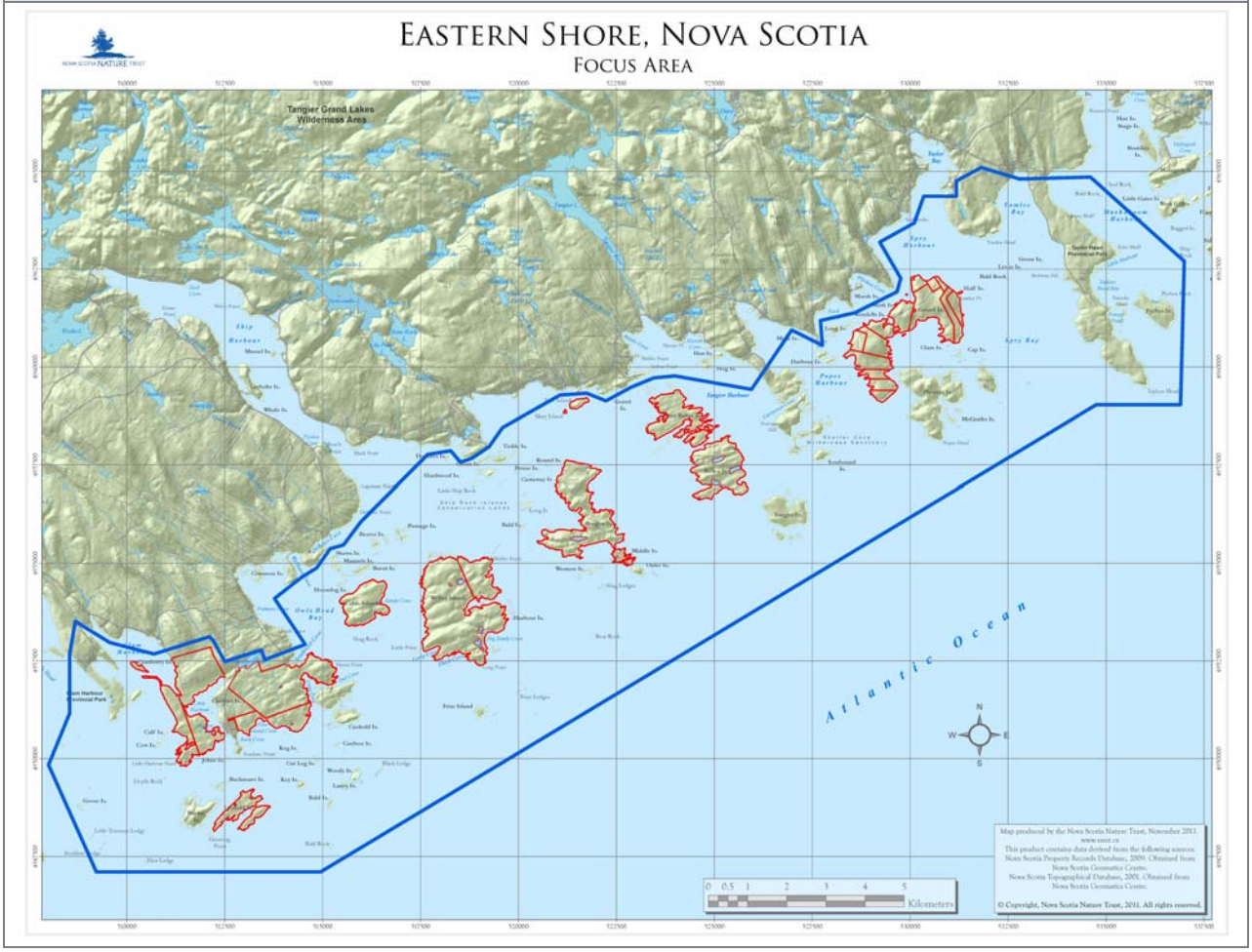
Table 1.1 - List of properties examined as part of the 2011 scientific study	
Borgles Island and Middle Island (Private)	Baltee Island (Crown – Provincial)
Cable Island (Private)	Little Harbour (Private)
Wolfes Island (Crown – Federal and Provincial)	Laybold Island (Private)
Tuff Island (Private)	Gerard Island (Private)
Inner Baltee Island (Crown – Provincial)	Harry's Cove/Cranberry Island (Private)

Map 1.1 - Eastern Shore Focus Area

Nova Scotia Property Records Database, 2009. Data obtained from Nova Scotia Geomatics Centre.



Map 1.2 – Properties examined as part of the 2011 scientific study
Nova Scotia Property Records Database, 2009. Data obtained from Nova Scotia Geomatics Centre.



The study was carried out by a team of personnel with expertise in forestry, avian species identification and plant ecology including vascular plants, mosses and lichens. The field studies began in June and were completed in October 2011.

1.1 Purpose of the Work

To date, much of the characterization of the ecology of the Eastern Shore islands is based on the classifications inferred from those features on the adjacent mainland and through the study of aerial photographs and maps (there is also inferred understanding from data from islands outside the region, e.g. Sable Island or St. Paul Island). Although this approach is reasonable in absence of empirical field study of the islands themselves, it assumes the equivalency of mainland and island ecosystem and community processes. Since we know these not to be equivalent for climatic reasons and for community dynamic process reasons (e.g. island biogeography lessons, see Cody, 2006; or patch dynamic differences, see Forman, 1995), there was a need to base conservation decisions on real data from a selection of islands of the Eastern Shore archipelago. The studies undertaken in this project were conducted to identify and characterize forest/vegetation types, to verify existing photographic

interpretations and to identify the distribution of plant and bird species present on specific properties and islands. The findings from the field work and this report will be used by the Nova Scotia Nature Trust to determine the ecological significance of each island, the overall ecological significance of the island complex as a whole (e.g. importance as avian stop-overs, in maintaining metapopulations of rare boreal shoreline plants, etc) as well as the significance of the group of islands within the provincial context.

1.2 NSNT Mandate

The NSNT is a not-for-profit organization with a mandate to preserve and protect outstanding or unique natural areas through conservation of private lands. The NSNT protects these lands primarily through acquisition and conservation easements. In addition, the organization carries out many campaigns and projects to identify and protect places of unique environmental value and to inform Nova Scotians on how to be responsible stewards of our natural heritage. Conservation projects focus on the preservation of natural features such as old growth forests, wetlands and critical habitat for species of concern. The NSNT has been in operation since 1994 and to date has protected over 2400 hectares of conservation lands throughout the province.

1.3 Contents of Report

This report is presented in sections each containing subsections related to the section topic. **Section 1** introduces the project, the sites and the purpose of the work. **Section 2** provides a description of the area, community, property ownership and includes descriptions of the environmental setting and climate of the area. The field program and methodologies used in the study are described in **Section 3**. **Section 4** summarizes the findings and conclusions of the overall project and describes those features of special interest or environmental concern. References are contained in **Section 5**. **Section 6** - **Component Studies** follows the main body of the text and provides the data collected during the field season and text specifically related to each of the properties covered in this study. The individual component studies are presented in the chronological order in which the work was undertaken.

2. SITE DESCRIPTION

The area considered by this study is situated along a stretch of the Eastern Shore of Nova Scotia (map 1.1), and covers the area between Clam Harbour Provincial Park on the west and Taylor Head Provincial Park on the east (map 1.2). This study area comprises part of a larger region referred to as the Eastern Shore. It falls entirely within the boundary of the Halifax Regional Municipality, and is identified politically as the Ship Harbour district as defined in the Province's Community Counts database (NS Department of Finance, 2006).

2.1 Physical Characteristics

Within the Eastern Shore focus area the density of islands is some three times greater (1.4 islands per km of mainland shoreline) than is found along any other stretch of Nova Scotia's Atlantic coastline areas (i.e. from Yarmouth to Canso). Within the focus area the islands range in size from small exposed rocky ledges to larger well vegetated islands of more than 350 hectares in area. The area features a convoluted coastline with bedrock outcrops creating rocky promontories and headlands which are interspersed with cobble and boulder shorelines, pocket beaches, tidal flats and marshes of various sizes. In the outer part of the island archipelago, south-facing shorelines receive the greatest exposure to wind and wave conditions from storms which occur along the Scotian Shelf. These exposed areas are characterized by wave washed bedrock with little or no soil cover. Less exposed areas are found on the north sides of the islands and on sheltered leeward shorelines. Typically these areas are characterized by wide intertidal zones with boulder and gravel in the upper intertidal zones.

The area has an energetic physical environment with a tidal range during larger tides of more than 2 meters. The coastal geomorphology and ecological habitat have been strongly influenced by the geological formations in the region and physical environment of tidal currents, temperature, precipitation, wind and waves (Davis and Browne, 1996).

2.2 Community History

First Nations people were present in this area of Nova Scotia prior to European settlement. The shallow waters of the coastal bays and islands provided a rich source of fish, shellfish and crustaceans. The presence of shell middens on Baltee Island and on the shore at Little Harbour provides evidence of the use of this area by First Nations people.

European settlement in the Ship Harbour district began in the late 1700's. Fishing was the primary activity of the early settlers of the coastline. Settlers also relied on lumbering and subsistence farming to provide food and income to support the family. An early map of the area by A.F. Church of 1865 shows approximately 10 buildings situated on the north side of Gerard Island. A later map by E. R. Faribault of 1896-97 similarly shows permanent dwellings, as well as a school, a lobster factory, and a road running the length of the north side of the island. The Faribault map also indicates the presence of dwellings situated on the north sides of Borgles Island and Laybold Island. In the early twentieth century, Gerard Island had a population of some 60 people (pers. com. Brian Murphy).

On the mainland, settlement is present along much of the coast in the mid 19th century with more concentrated settlements present towards the west part of the focus area (Little Harbour, Ship Harbour, Murphy's Cove, etc). According to the map records of the 19th century, no permanent settlements were present on Inner Baltee Island, Baltee Island, Cable Island, Wolfe Island or Tuff Island.

Comparison of aerial imagery starting from the 1930s onward indicate that permanent settlements on the islands were in decline in the first half of the 20th century. Observations made during the 2011 field program revealed artefacts of permanent settlements, including building foundations and rock walls, on Borgles Island, Gerard Island, Wolfe Island and Laybold Island.

2.3 Ship Harbour National Park and Eastern Shore Seaside Park System

In August 1972 the Province of Nova Scotia and the Federal Government signed a memorandum of intent regarding the establishment of the Ship Harbour National Park along this stretch of the Eastern Shore. The memorandum produced widespread public opposition due, in part to fears of expropriation. As a result, the provincial government re-examined the whole question of a national park in this area. As an alternative to this proposed national park along the Eastern Shore, the federal government ultimately established what is now known as Kejimkujik National Park Seaside Adjunct.

In December 1973 the Province announced its intention to establish the Eastern Shore Seaside Park System, which would be designed to capture the essence of the Eastern Shore landscape. The provincial alternative differed substantially from the national park concept. No permanent residents were to be displaced from their homes, and disruptive effects on cottage owners and non-permanent residents were to be minimized.

The Eastern Shore Seaside Park System was proposed to extend eastward from Lark Charlotte, near Clam Harbour to Taylor Head, and would have extended 20kms inland from the Atlantic Coast. (D. Smith, June 1980)

Although the Eastern Shore Seaside Park System was never fully realized, elements of the park network were eventually implemented; specifically Clam Harbour and Taylors Head Provincial Parks, and later the Tangier Grand Lake Wilderness Area.

2.4 Community Profile

The Ship Harbour district of the Halifax Regional Municipality includes communities from Clam Harbour on the west to Taylor Head on the East. In 2006, the population in this area was reported as 2,141 people (Nova Scotia Community Counts). Twenty five communities make up the Ship Harbour district. These include:

Table 2.1 – Communities with Eastern Shore Focus Area	
Beech Hill	Pleasant Harbour
Clam Bay	Popes Harbour
DeBaise Cove	River Lake

East Ship Harbour	Ship Harbour
Fern Hill	Southwest Cove
Jacket Lake	Spry Bay
James Settlement	Spry Harbour
Lake Charlotte	Tangier
Little Harbour	Tangier Grand Lake Wilderness Area
Lower Ship Harbour	Taylors Head
Mooseland	Third Lake
Murphy's Cove	Upper Lakeville
Owls Head	

Although it falls within the boundaries of the Halifax Regional Municipality (HRM), the community of Ship harbour can be characterized as a rural coastal community. The inland portion within the community boundary is largely protected wilderness area with a very low population. Most of the population lives in the small coastal communities listed above, most of which were initially established as fishing villages. Over 90% of the population own their homes, and are long term residents of the district (NS Community Counts, 2006 Census).

The demographics of the Ship Harbour district indicate slow population growth and an aging population (NS Community Counts, 2006 Census) which is consistent with many rural areas of the Province. Statistics indicate that employment levels are below the provincial average. Individual and family incomes are below the Provincial averages (NS Community Counts, 2006 Census).

There is little agricultural land within the area; however, forestry still provides employment and income to the population. Fishing remains an important economic activity in the district and is supported with public wharfs at Little Harbour, Owl's Head, Carter Point and Beaver Harbour. As well, private wharfs and boat ramps can be found at various shoreline locations within the district.

The Ship Harbour district contains three Provincial Parks (Clam Harbour, Taylor Head and Spry Bay) along the coastal region, and the large Tangier Grand Lakes Wilderness Area in the inland area of the district.

Within the Ship Harbour District, there are several businesses catering to tourism and outdoors activities along the coastal region. These businesses include:

Table 2.2 – Tourism and Outdoor Businesses of Eastern Shore
1. Murphy's Campground by the Sea – *Campground and Boat Tour Operator*
2. Coastal Adventures – *Sea Kayak Tours and Instruction*
3. Spry Bay Campgrounds and Cabins – *Campground and Cottages*

2.5 Ownership and Land Use

Land ownership within the study area falls into one of four categories: private land, provincial crown land, federal crown land, and ownership unknown/ungranted lands. Table 2.3 shows the ownership, lot

sizes and Property Identification Numbers (PIDs) of the various parcels which make up the studied properties within the focus area. Map 2.1 illustrates the pattern of land ownership.

Presently, the islands are used for occasional recreation by tourists, local tourist businesses and local citizens. In the summer season, boaters and kayakers use some of the islands' shorelines and beach areas for camping. Privately held lands at Little Harbour and Harry's Cove have permanent dwellings which appear to have summer use only. Private camps consisting of semi permanent dwellings were noted on Wolfe Island and Gerard Island.

The local residents have a long history of hunting and fishing activities on the islands and coastal waters. Some larger islands have deer populations that are hunted by local citizens during the fall season (pers. comm. Brian Murphy). Duck hunting is also conducted on some of the islands and in coastal wetlands in the region. Overall, present human activity on the islands can be characterized as mostly recreational use of the beach areas along shorelines and accessible coastal forests.

Present land use, as determined from site observations and anecdotal information, is indicated in the status column of Table 2.3. The crown lands of Wolfe Island, Inner Baltee and Baltee Island follow the designations provided in the NS Department of Natural Resources *Integrated Resource Management Map 2010.*

Table 2.3: Property Identification Numbers (PIDS) and Ownership Details of Selected Properties

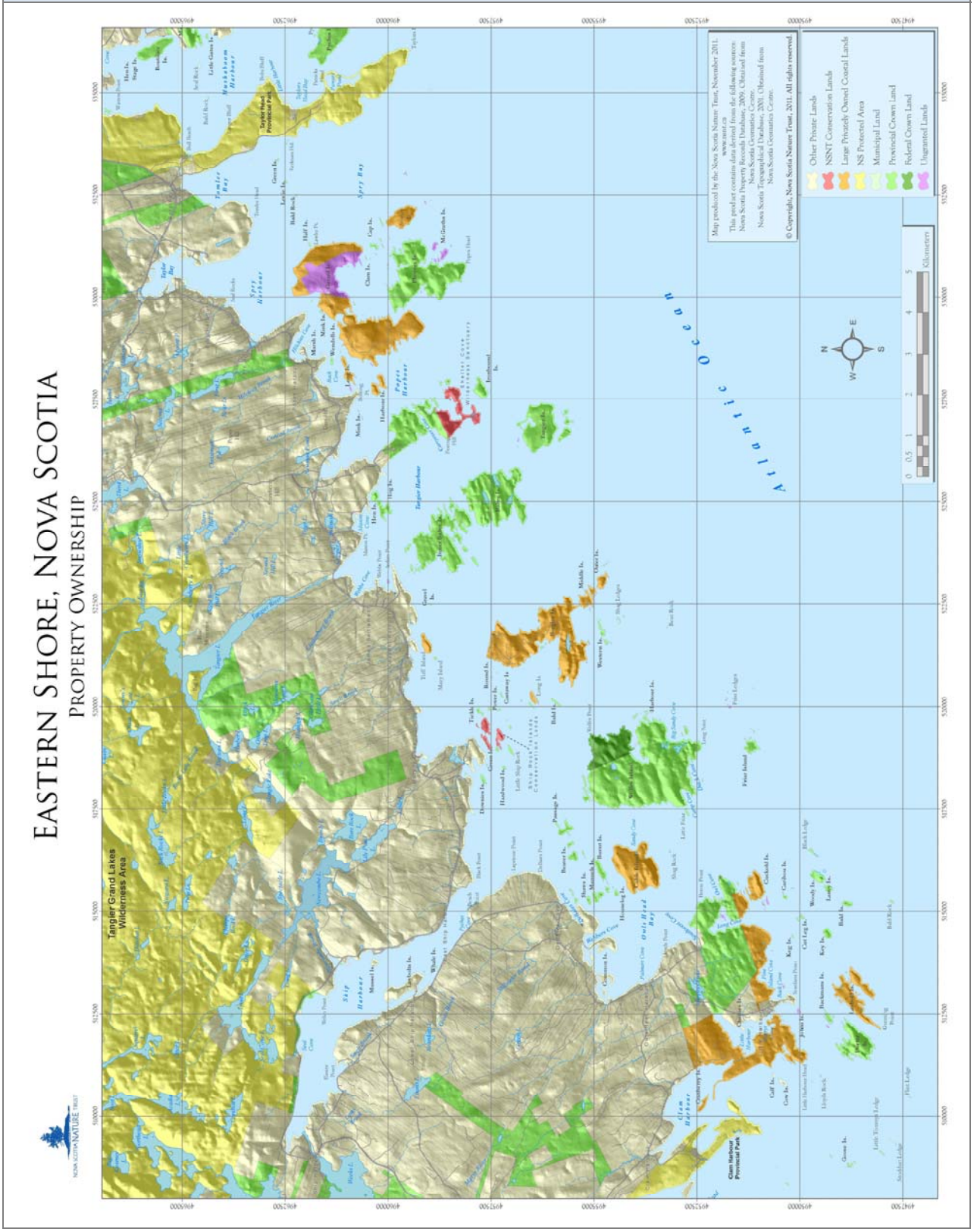
Place Name	Total Area (Hectares)	Owner(s) Name(s)	Property Size (Hectares)	Property Identification Number (PID)	Status (i.e. owner occupied, for sale, crown land, Land Use Classification for Crown Land[1], etc.)
Borgles Island	226	Charles Island Development Inc.	216	00551192	Unoccupied. Borgles Island is currently being marketed online as Charles Island, a proposed luxury residential development, complete with two helipads and marina (http://www.nova-scotia-property.ca/Charles-Island-Properties.php)
		Wilfam Inc.	3.6	41252412	
		Wilfam Inc.	6.9	41252420	
Cable Island	92	Alan & Linda Ruffman	92	00555664	Unoccupied
Wolfes Island	352	NS Crown Land	303	40289985	Unoccupied Provincial Crown Land, Land use classification C2
		Transport Canada	48.5	40289951	Lighthouse, Transport Canada, Land use classification C2
Tuff Island	7.7	Randy Guy Borgal	7.7	00551515	Unoccupied (was for sale)
Inner Baltee Island	81	NS Crown Land	81	00657338	Unoccupied Provincial Crown Land Land use classification C2
Baltee Island	107	NS Crown Land	107	00657346	Unoccupied Provincial Crown Land Land use classification C2
Little Harbour Property	71	Beckwith & Katherine Gilbert	71	40710725	Owner Occupied - Summer Residence
Owl's Head	13	G. S. Beckwith Gilbert	13	00555854	Unoccupied

Laybold Island	56	Sally & Ravi Ravindra, Alan & Linda Ruffman	56	00605790	Unoccupied
Gerard Island	326	John & Janet Abriel	12	40027740	Unoccupied (Some parcels currently for sale). PID 40028201 owned by Herbert Gerard has several small residential structures present on it. It was noted during field visits that one of these structures had recently been burned down.
		John & Janet Abriel	19	40027799	
		Scott Cunningham	14.5	40027906	
		John & Janet Abriel	37	40028078	
		John & Janet Abriel	17	40028136	
		Marc & Elin Miller	36.5	40028086	
		John & Janet Abriel	22	40028144	
		Jonathan Chittick	28	40028151	
		HRM	0.5	40028193	
		Owner Unknown	89	40790966	
		Burris Gerard	0.6	40028243	
		Herbert Gerard	5	40028201	
		Jack, Wilda, Mark & Sherry Holley	4	40028300	
		Burris Gerard	5	40028375	
		Colin & Deborah MacKenzie	18	41102096	
		Scott MacKenzie	17	40028318	
Harry's Cove/Cranberry Island	246	Amsel at Little Harbour Ltd	65.5	00489567	Owner Occupied - Summer Residences
		James Hynes, Terry Jones, Clint Cornish, Ron Egert	63	40189631	
		James Hynes, Terry Jones, Clint Cornish, Ron Egert	118	00605899	

Note 1: Nova Scotia Department of Natural Resources, Land Use Classification C2 – Multiple and Adaptive Use Areas

MAP 2.1 – Eastern Shore Property Ownership

Nova Scotia Property Records Database, 2009. Data obtained from Nova Scotia Geomatics Centre.

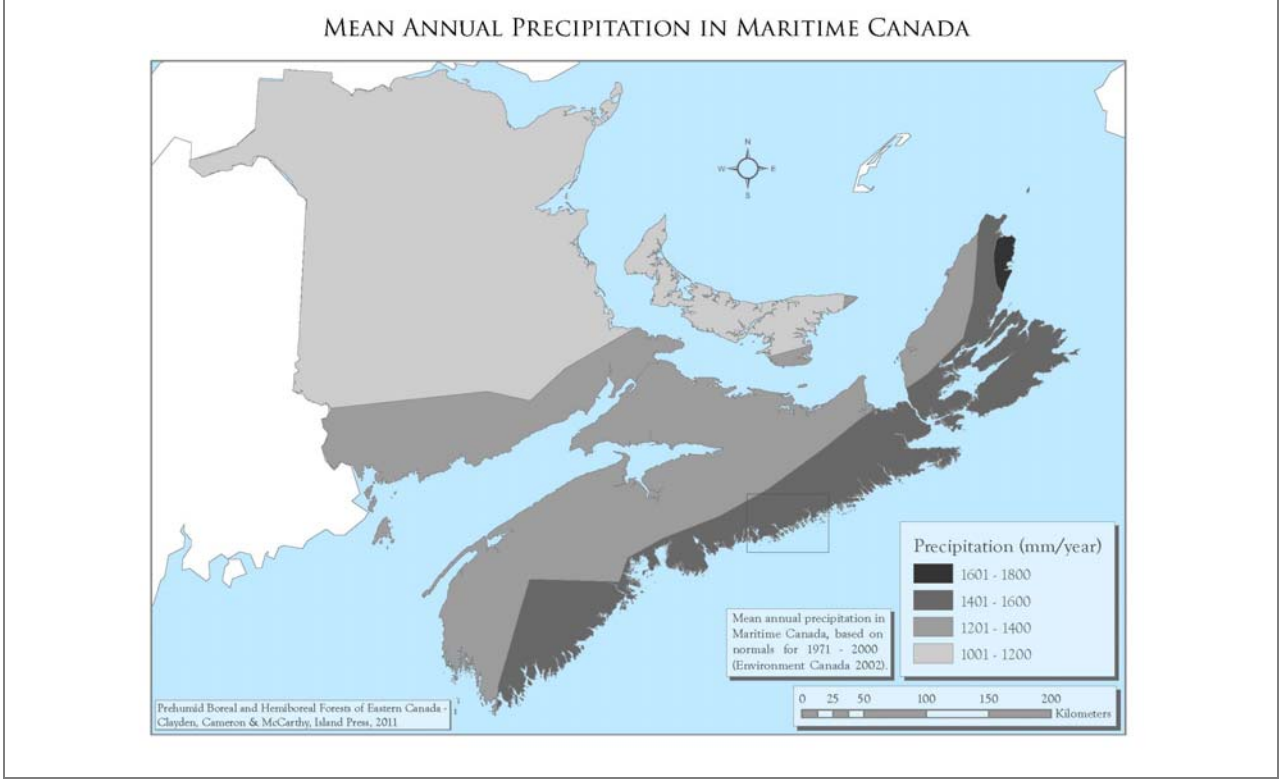


2.6 Climatic Features

2.6.1 Climate

Rainfall, temperature and humidity have important roles in determining the vegetation assemblages which will predominate in an area. This area of the Eastern Shore of Nova Scotia falls easily within the summer climatic range of the boreal forest, having an average July temperature 2.5^{o}C cooler (data from nearest Environment Canada weather station, Ecum Secum) than the 18^{o}C minimum climatic requirement (Elliot-Fisk, 1988). In *Perhumid Boreal and Hemiboreal Forests of Eastern Canada*, Clayden et al. (2011) identify this area as one in which precipitation exceeds evaporation and plant transpiration (see Map 2.3 – Mean annual precipitation in Maritime Canada). Such conditions may be categorized as rainforest climate (Clayden et al 2011). Annual precipitation in the subject area exceeds 1500 mm per year and in coastal areas rainfall is the predominant form of precipitation (Environment Canada). The climatic conditions of the study area are strongly influenced by oceanic water masses and in particular the Labrador Current, which brings cool water temperatures onto the Scotian Shelf. The Labrador Current moves along the Eastern Shore, cooling this coastal zone, then moves away from the province near Cole Harbour (Scarratt, 1982). These conditions result in moderate air temperatures and the frequent occurrence of fog. High precipitation rates result when these cool air masses combine with humid subtropical systems which move into the region from the south (Clayden et al, 2011). Precipitation varies along the Atlantic shore and the Eastern Shore receives 20% more rain in each of the summer months (May-September) than coastal areas that are roughly 100 and 200 km to the southwest respectively (Environment Canada data for Ecum Secum, Halifax and Bridgewater).

MAP 2.3 Mean Annual Precipitation in Maritime Canada
Perhumid Boreal and Hemiboreal Forests of Eastern Canada, Clayden, Cameron & McCarthy. Island Press 2011



2.6.2 Extreme Weather Events

The islands and mainland shoreline of the Eastern Shore are directly exposed to the weather conditions coming in from the Scotian Shelf and Atlantic Ocean. Weather conditions, particularly wind and waves associated with storm conditions can have significant influence on vegetation and geological formations of shorelines. Photos 2.1 - 2.4 illustrate the type of storm damage that was observed across the focus area.

Photo 2.1: Wind damage (blowdown) and forest regeneration on Laybold Island

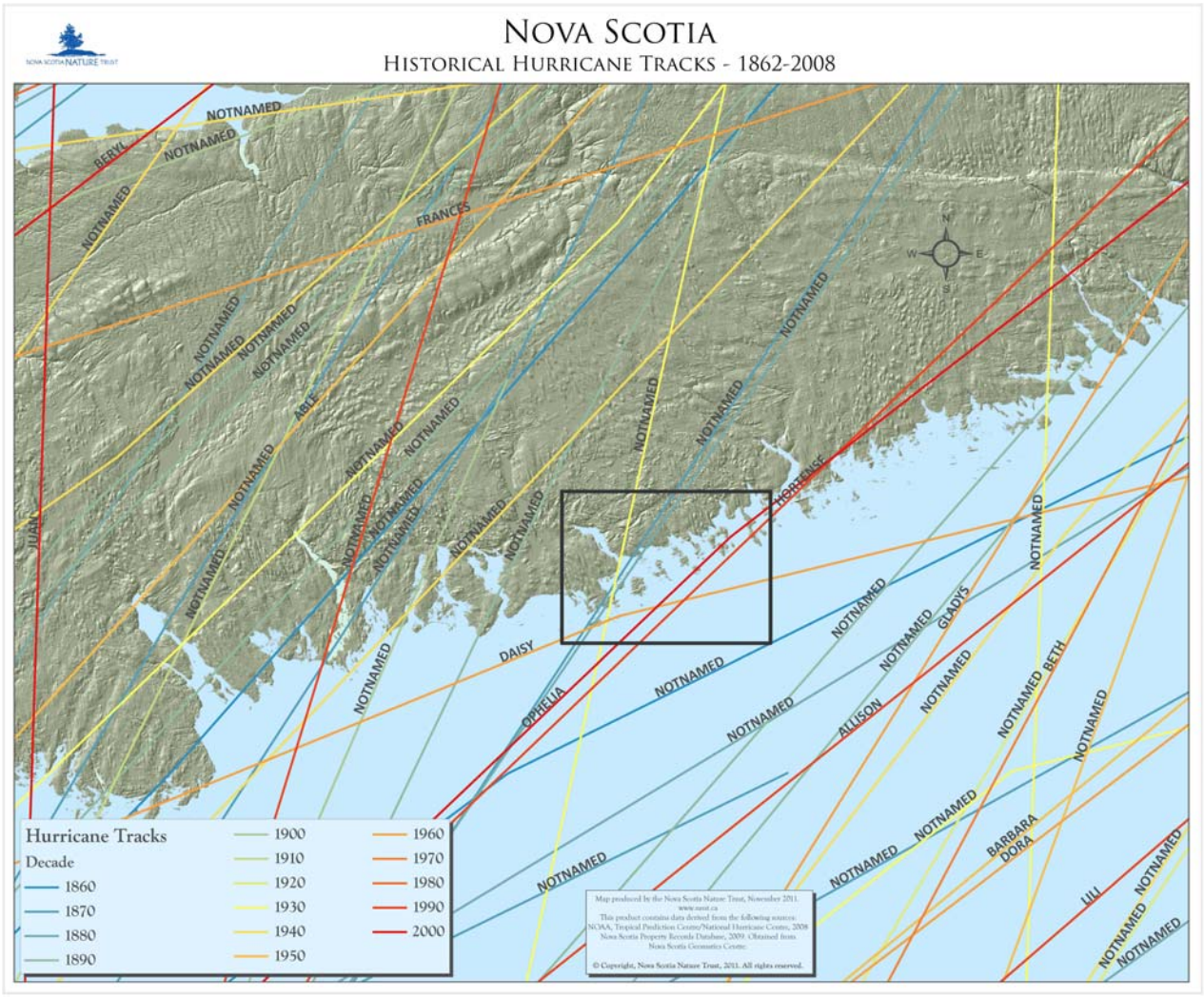
Photo 2.2: Damage to vegetation resulting from salt spray on Borgles Island

Photo 2.3: Shoreline Erosion (scour) due to wave run-up on south side of Laybold Island

Photo 2.4: Wind damage (blowdown) to shoreline trees on south side of Laybold Island

Map 2.4, below shows the tracks of major tropical storms and hurricanes affecting central Nova Scotia between 1862 and 2008. These storms generally approach the province from the southwest, and travel in a southwest-northeast direction.

Map 2.4 - Historical Hurricane Tracks Impacting Nova Scotia - 1862-2008 (NOAA, 2008)



Available storm data from the Canadian Hurricane Centre (CDC) of Environment Canada provides storm tracks and descriptions of severe weather systems affecting the east coast of Canada for the period 1954 to 2010. For this report the data was reviewed to evaluate and assess storm tracks which were considered to have potential impacts on the focus area. Table 2.1 shows the number of storm tracks in each decade which are considered to have had an influence on the study area and identifies those storms having a potential for significant impacts.

The data from the Canadian Hurricane Centre indicates that 42 major storms have affected the Eastern Shore focus area over the 67 year period of available records. Such storms are relatively frequent events, with an average of one every 1.6 years. Of the major storm tracks, there were 30 significant

storms such as hurricanes and tropical storms affecting the study area. The data also identifies those years in which more than one significant storm occurred. Such frequency may exacerbate the level of damage which occurs because there is insufficient time between storm events for natural recovery processes to occur for the affected vegetation and soils.

Table 2.4: Storms Affecting the Study Area by Decade

Period	Number of Storms [1]	Significant Storms [2]
1954 - 1959	4	Hurricane Ione 1955, Hurricane Helene 1958, Tropical Storm (TS) Cindy 1959
1960 - 1969	9	Hurricane Cleo 1960, Hurricane Dora 1964, Hurricane Gladys 1964, Hurricane Blanche 1964, Hurricane Gladys 1968, Hurricane Blanche 1969
1970 - 1979	7	Hurricane Beth 1971, TS Dolly 1973, Hurricane Blanche 1975, Hurricane Evelyn 1977, Sub-tropical #1, 1979
1980 - 1989	5	Hurricane Diana 1984, TS Ana 1985, Hurricane Dean 1989
1990 - 1999	7	Hurricane Bertha 1990, Hurricane Lili 1990, Unnamed Tropical Storm 1991,TS Barry 1995, Hurricane Hortense 1996, Hurricane Edouard 1996
2000 - 2001	9	Un-named Post-tropical Cyclone 2000, Hurricane Gustav 2002, Hurricane Juan 2003, Hurricane Ophelia 2005, Hurricane Alberto 2006, Hurricane Bill 2009
2010	1	Hurricane Earl 2010
Number of Years = 67	**Total Storms = 42**	**Total Significant Storms = 30**

1. Storm Tracks selected as having a potential or documented impact on the study area.
2. Storms with tracks or historical descriptions that were assessed as likely to have a significant impact on the area due to sea states, rainfall and/or wind conditions.

* This information is taken from the Canadian Hurricane Centre. Records are available between 1954 and 2010.

From CHC, 2010, http://www.ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=23B1454D-1

2.7 Ecological Land Classification (NS Department of Natural Resources)

In addition to climatic conditions and extreme events, geographical setting plays a significant role in determining the ecology of the region. The Nova Scotia Department of Natural Resources has developed a system of land classification referred to as the Ecological Land Classification (ELC) (Report DNR 2003-2). An ELC is a mapping tool that identifies and describes areas of similar enduring physical attributes. It is based on features such as climate, elevation, topography, bedrock formation, and vegetation. Within the classification, information is presented and mapped within a hierarchy where broad to specific levels of detail are presented on a series of scale dependant maps. Nova Scotia's Ecological Land Classification (ELC) is comprised of five levels and uses abiotic (physical) and biotic (biological) environmental attributes to define ecosystems. The ELC is recognized as a useful tool for landscape level planning and sustainable management of forests, conservation, wildlife and other land use issues. Table 2.5 describes the classification levels and the criteria used to delineate each level.

Table 2.5: NSLC Levels and Delineating Criteria			
Ecological Unit	**Map Scale**	**# of Units**	**Criteria for Delineating Unit**
Ecozone	1:1000000	1	Global or continental climate as reflected by vegetation
Ecoregion	1:500000	9	Provincial climate as expressed through soils and vegetation
Ecodistrict	1:250000	39	Subdivisions of ecoregions characterized by distinctive assemblages of relief, geology, landform, soils and vegetation
Ecosection	1:50000	637	A repeating pattern of and form/topography, soils and vegetation throughout an ecodistrict. A maximum of 637 combinations of the physical attributes are possible
Ecosite	1:10000	N.A.	A uniformity of parent material, soils, vegetation and hydrology as expressed by slope, position on slope, aspect and exposure

Table 2.6 presents the levels assigned to each property selected in this study under the classifications for *Ecoregion, Ecodistrict and Ecosection*. Map 2.5, below illustrates the distribution of Ecosites within the focus area. Definitions for *Ecoregion and Ecodistrict* which apply to all selected properties are provided in Notes 1 and 2 respectively. At the time of writing, Data for Ecozone and Ecosite were not available for use in this report.

Map 2.5 – Ecological Landscape Classification – EcoSection

Ecological Land Classification Database, 2005. Data obtained from NS Department of Natural Resources

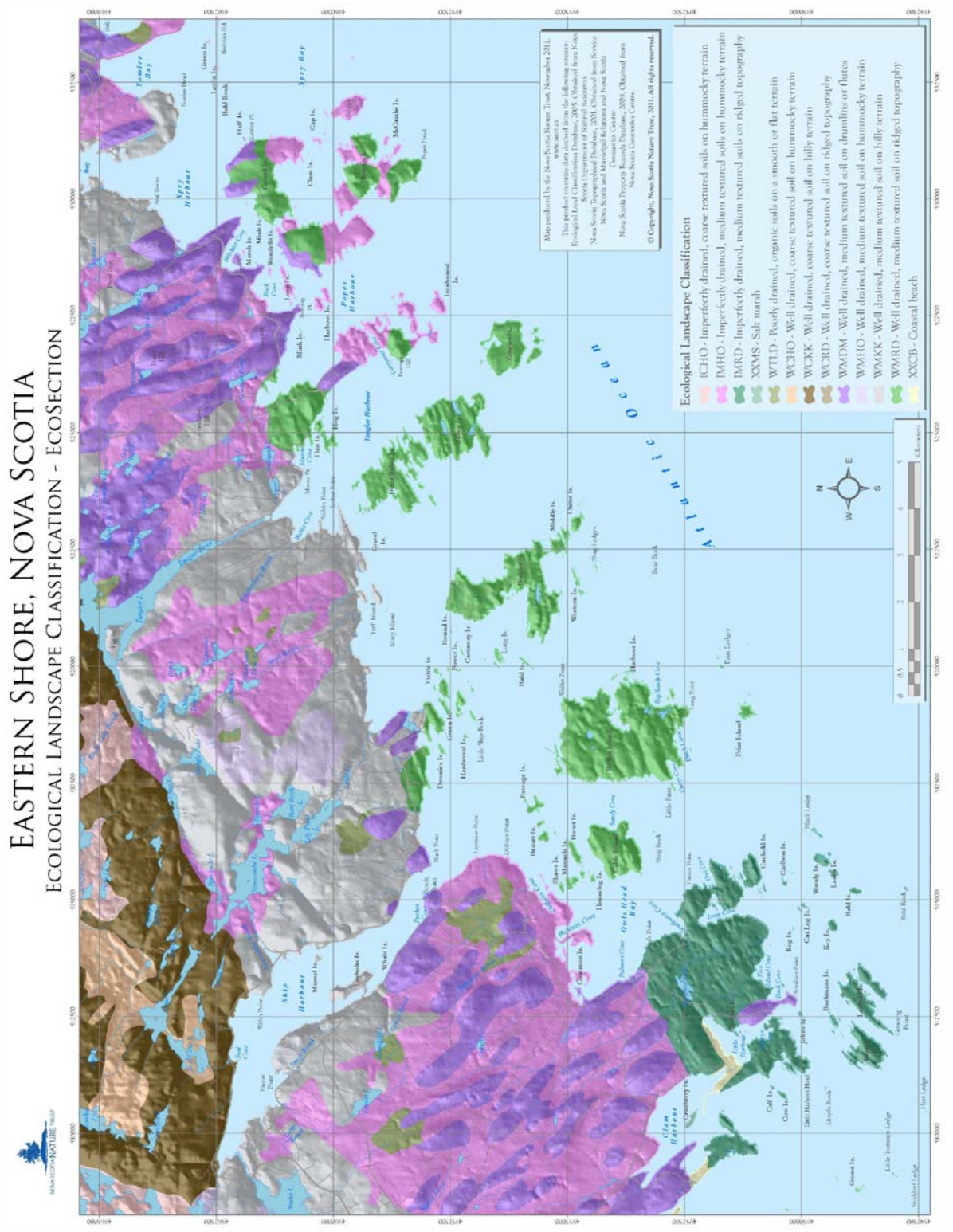


Table 2.6: NSLC Levels Applied to Subject Properties				
Classification	**Ecoregion [1]**	**Ecodistrict [2]**	**Ecosection**	**Ecosection Features**
Borgles Island and Middle Island	800	820	WMRD	Well drained, medium textured soil on ridged topography.
Wolfes Island	800	820	WMRD	Well drained, medium textured soil on ridged topography.
Cable Island	800	820	WMRD	Well-drained, medium textured soil on ridged topography.
Tuff Island	800	820	WMRD	Well drained, medium textured soil on ridged topography.
Inner Baltee Island	800	820	WMRD	Well drained, medium textured soil on ridged topography.
Baltee Island	800	820	WMRD	Well drained, medium textured soil on ridged topography.
Little Harbour	800	820	IMRD	Imperfectly drained, medium textured soils on ridged topography.
Laybold Island	800	820	IMRD	Imperfectly drained, medium textured soils on ridged topography.
Gerard Island	800	820	WMRD, IMHO, WMDM	Well drained, medium textured soil on ridged topography. Imperfectly drained, medium textured soils on hummocky topography. Well drained, medium textured soil on drumlinoid topography.
Harry's Cove/ Cranberry Island	800	820	IMRD	Imperfectly drained, medium textured soils on ridged topography.

Note 1: *Atlantic Coastal Ecoregion (800). This ecoregion extends along the Atlantic coast of the province from Yarmouth to Scaterie Island. The underlying geology is quite varied because of the extent of this ecoregion. However, since most of it is comprised of the lower elevations of the tilting Appalachian peneplain, the bedrock is predominately granite, quartzite or slate on the mainland. The Ecoregion is exposed to high winds, high humidity, salt spray, and fog during the summer and fall. Particularly in the east, significant portions of the ecoregion are covered with deep organic soils that have developed on flat or level topography where drainage has been impeded and the cool moist climate has favoured the development of the peat material. In areas where deeper sandy materials occur, a hardpan formation (also known as an ortstein layer) will be found restricting drainage and creating thick humus layers under forest stands. The total area of the Atlantic Coastal Ecoregion 800* ***is 553****2 km2 or 10 % of the province. The near absence of red spruce delineates this Ecoregion from the adjacent Western and Eastern Ecoregions on the mainland. White spruce is a common forest species on the most exposed sites in the Coastal Ecoregion, i.e. coastal islands and headlands, but becomes less abundant away from the water. Hardwood species take a subordinate role in the coastal forest with red maple and white birch common components of the understory of black spruce and balsam fir forests. Most notably on the nutritionally poor sites along the eastern shore, balsam fir will form dense stands with small diameters, an indication that site conditions do not allow self thinning. Much of the eastern portion is comprised of flat and raised bogs, fens and salt marshes. On sites with wet mineral soils, black spruce is the predominant tree species.*

Note 2*: Eastern Shore Ecodistrict (820). This ecodistrict is characterized by a low, indented coastal landscape dominated by a rocky coastline and abundant islands, and by coastal boreal coniferous undulating terrain. The dominant landscape ecosystem consists of well drained white spruce - black spruce - balsam fir undulating terrain with patch/frequent stand initiating/infrequent stand initiating natural disturbance regime. Starting on the east side of the Halifax peninsula and extending to the town of Canso, the Eastern Shore Ecodistrict spans a varied landscape of landforms, geology and soils. For most of the Ecodistrict, the influence of the ocean seems to extend inland until it reaches the 60 m contour except on the Canso peninsula, where coastal forests are found on*

elevations of 150 m. The total area of the Ecodistrict is 1,677 km2 or 30% of the Ecoregion. A variety of landforms occur across the Ecodistrict. As one travels from the granite barrens of the Halifax peninsula eastward, sand beaches and dunes give way to a proliferation of offshore islands, often drumlin in origin, to the coastal headlands of Guysborough County. Where the soils are well-drained and sheltered from the coastal environment, the conditions for forest growth can be quite favourable for balsam fir. Lakes constitute a significant portion of the Ecodistrict with 9,334 hectares or 5.6% of the Ecodistrict covered in freshwater. Approximately 21.6% of the Ecodistrict (36,350 hectares) is comprised of exposed bedrock, by far the greatest area of any ecodistrict. The absence of red spruce in the coastal forest is a strong indicator of coastal climatic influence. Other species absent because of the coastal influence are white pine, sugar maple and beech. Hardwoods such as white birch and red maple, may also be absent in the overstory but are usually present in an intermediate or suppressed canopy position in the forest stand. A typical coastal forest is comprised primarily of balsam fir, black spruce and scattered white spruce. Where exposure to the ocean is extreme a narrow shoreline band of white spruce will form a krummholz type forest with extremely stunted growth. On the more sheltered sites with deeper soils, especially in the east, balsam fir will predominate over the spruces. These short-lived (usually less than 100 years) coastal forests are constantly being renewed by stand initiating disturbance agents such as blowdown, disease, insects and occasional fires. The moist climate is conducive to regeneration establishment by balsam fir and black spruce and most stands will have already established a layer of advanced regeneration during the break-up of the overstory (McCurdy et al, 2003, Neily et al 2003).

2.8 Natural Landscape Themes (NS Environment, Protected Areas Branch)

The term landscape has human connotations even in its ecological application. The modern ecological sense of landscape is communicated in Forman's Land Mosaics (1995) which sees the landscape as a mosaic and that mosaic is ever-changing and composed of the three spatial elements: patch-corridor-matrix. A landscape is a mosaic of various interacting ecosystems that are repeated in a similar pattern to form a distinct and definable land unit or area. Different landscapes are formed due to the action of different environmental and biotic factors on particular geological tableaus. Landscapes incorporate characteristic sets of ecosystems that differ from those of neighbouring landscapes. The species that comprise the particular biological communities of a landscape share similar environmental tolerances or requirement for limiting resources. Within the Eastern Shore focus area, the overlay of population interactions (competition, disease and parasitism and predation, and mutualism) forms an additional strong filter that determines membership of these biological communities. The biological communities are the biotic delineators of the larger system, the ecosystem, the arena of intense interaction between biotic and abiotic spheres.

In the Nova Scotia context, these concepts have been taken together in the "landscape ecosystem", which has been defined as, “...a group of biotic communities, together with their environment, occurring over a particular portion of the landscape and held together by some common physical or biotic feature. Ecosystems contain climax and related successional communities within them and as an assemblage form distinct broad landscapes. These landscape ecosystems must be mappable at the 1:63,000 scale, using infra-red air photographs.” (Protected Areas Branch, NS Dept of Environment, 2002)

Some characteristic features of a landscape ecosystem include distinctly shaped landforms, plant communities that normally are associated with the landform and that follow particular successional trends over time leading to a characteristic forest community, microclimate, and a distinct

energy/matter pathway (e.g., nutrient cycle, hydrologic cycle). Though climax is a term that has been applied to some communities, this term and concept does not apply to many Nova Scotian settings where in absence of human interference, communities are reset by fire, disease, wind, flood or other agency. Indeed, the sea island landscapes are inhabited by communities that experience such resetting routinely. The essence of the boreal forest is a community adapted to short, moderate summers, cold long winters, moisture availability and recurrent disturbance (Elliot-Fisk, 1988). The island forests match this characterization and fit a climatic definition for moderate summer temperature (< 18^{o}C July average) which few locations in Nova Scotia do.

The majority of the focus area falls within Natural Landscape Theme 37 (Eastern Shore Islands) (see Map 2.6). This theme area consists of a 35,882 hectare low, indented coastal landscape dominated by a rocky coastline and abundant islands, and characterized by coastal boreal coniferous undulating terrain. Drainage is dendritic and parallel and is defined by the lower portions and estuaries of few major rivers and scattered small streams, as well as scattered, small to medium sized lakes (see Table 2.7).

The mainland properties of Little Harbour and Harry's Cove fall within Natural Landscape Theme 33 (Eastern Shore Beaches) (See Map 2.6). This theme area consists of a 42,694 hectare coastal unit characterized by Acadian and boreal coniferous drumlins and undulating terrain. Drainage is dendritic and parallel and is defined by lower reaches and estuaries of several moderate-sized rivers and many lakes. The coast consists of eroding drumlin headlands alternating with barrier beaches, estuaries and salt marshes (See Table 2.8). (Protected Areas Branch, NS Dept of Environment, 2002)

The Eastern Shore Islands and Eastern Shore Beaches Natural Landscapes are considered "partially" represented in the provincial network of protected areas (NSE).

MAP 2.6 – Nova Scotia Natural Landscape Themes for Eastern Shore study area.
The Eastern Shore Islands Natural Landscape is considered "partially" represented in the provincial network of protected areas.
Landscape Boundaries, 2002. Data obtained from Nova Scotia Department of Environment & Labour, Environmental & Natural Areas Management, Protected Areas Branch

Table 2.7 – Nova Scotia Natural Landscape Theme 37 (Eastern Shore Islands)			
Hydrology		**Bedrock**	
Dendritic and parallel drainage, lower portions and estuaries of few major rivers; scattered small rivers; scattered small sized to medium sized lakes.		Major: Cambrian/Ordovician greywacke	95%
		Minor: Cambrian/Ordovician slates	5%
Surficial Materials			
Major: Stony till with scattered silty till drumlins	90%	**Landforms**	
Minor: Glaciofluvial deposits	5%	Well drained undulating terrain; islands.	
Glacially scoured bedrock	5%	**Coastal Environment**	
Soils		Indented, low coast with headlands and abundant, small to moderate sized islands; scattered, small salt marshes.	
Major: Gibraltar (W)	55%	**Dominant Landscape Ecosystems**	
Liverpool (I)	40%	Well drained white spruce - black spruce - balsam fir undulating terrain with patch/frequent initiating/infrequent stand initiating natural disturbance regime; Islands.	
Minor: Rockland (W)	5%		

<table>
<tr><th colspan="4">Table 2.8 – Nova Scotia Natural Landscape Theme 33 (Eastern Shore Beaches)</th></tr>
<tr><td colspan="2">Hydrology</td><td colspan="2">Bedrock</td></tr>
<tr><td colspan="2" rowspan="2">Dendritic and parallel drainage; lower reaches and estuaries of several moderate sized rivers; many small-to-moderate-sized lakes.</td><td>Major: Cambrian/Ordovician greywacke</td><td>75%</td></tr>
<tr><td>Minor: Cambrian/Ordovician slates</td><td>25%</td></tr>
<tr><td colspan="2">Surficial Materials</td><td colspan="2"></td></tr>
<tr><td>Major: Stony till with silty till drumlins</td><td>90%</td><td colspan="2">Landforms</td></tr>
<tr><td>Minor: Silty till with silty till drumlins</td><td>5%</td><td colspan="2">Eroding drumlin headlands and long bays; extensive barrier beaches and salt marshes.</td></tr>
<tr><td>Glacially scoured bedrock</td><td>5%</td><td colspan="2">Coastal Environment</td></tr>
<tr><td colspan="2">Soils</td><td colspan="2">Eroding drumlin headlands and long bays; extensive barrier beaches and salt marshes.</td></tr>
<tr><td>Major: Gibraltar (W)</td><td>70%</td><td colspan="2">Dominant Landscape Ecosystems</td></tr>
<tr><td>Minor: Liverpool (I)</td><td>10%</td><td colspan="2" rowspan="5">Well drained white spruce - black spruce - balsam fir undulating terrain with patch/frequent stand initiating/infrequent stand initiating natural disturbance regime; salt marsh.</td></tr>
<tr><td>Minor: Rockland (W)</td><td>5%</td></tr>
<tr><td>Minor: Barney (W)</td><td>5%</td></tr>
<tr><td>Minor: Queens (I)</td><td>5%</td></tr>
<tr><td>Minor: Wolfville (W)</td><td>5%</td></tr>
</table>

2.9 Colin Stewart Forest Forum

The Colin Stewart Forest Forum (CSFF) is a protected areas planning process initiated by leading environmental non-government organizations (EAC, CPAWS, and later NSNT and NCC) and the four largest forestry companies operating in Nova Scotia (Bowater, J.D. Irving, Neenah Paper and StoraEnso). In July 2005, the provincial government offered to assist the Forum's work with resources and personnel, and integrated the Forum process within its own protected areas planning process.

The Forum's science-based protected areas analysis focused on Crown lands, as well as private lands owned by CSFF partners. These holdings account for 42% of Nova Scotia's land mass. Other lands, including all small private properties, were excluded from the analysis. The analysis focused on the identification and prioritization of large remaining roadless wildlands, areas representative of the range of the province's landscapes and ecosystems, and concentrations of rare or otherwise significant ecological features such as old-growth forests and habitats of species at risk. To a lesser extent, the Forum also considered other values such as ecosystem services and ecological connectivity.

The Forum identified a total of 215,000 ha of "Tier 1" sites as top priorities for new protected areas. An additional 54,000 ha of "Tier 2" sites have been identified as secondary priorities. If implemented, this proposal would dramatically advance the Province's longstanding commitment to a representative network of protected areas by increasing representation level for up to 35 of Nova Scotia's 80 natural landscape regions (see section 2.8 - Natural Landscape Themes). It would also afford protection to many remaining species-at-risk habitats, old forests, unique wetlands, and undeveloped lakes, rivers, and coastline. The cumulative area of sites identified as potential protected areas exceeds what is

required for Nova Scotia to meet its 12%-by-2015 commitment (see section 2.10). This was done to provide government with some flexibility in recognition that it may not be possible to protect all identified areas. (Colin Stewart Forest Forum Final Report, November 2009)

All crown lands within the focus area of this report were ranked as Tier 1 (proposed first slate areas) through the Colin Stewart Forest Forum process (see Map 2.7 – Colin Stewart Forest Forum Lands).

MAP 2.7 –High value conservation lands identified through the Colin Stewart Forest Forum. All crown land within the Eastern Shore focus area was ranked as Tier 1 (proposed first slate areas) through the CSFF process. **Colin Stewart Forest Forum Lands, 2009. Obtained from Nova Scotia Environment (Protected Areas Branch)**

2.10 Twelve Percent Lands for Review

In 2007 the government of Nova Scotia passed the Environmental Goals and Sustainable Prosperity Act, committing to protecting 12 percent of Nova Scotia's landmass by 2015. In November 2009 government received the Colin Stewart Forest Forum report identifying land with high conservation values. Nova Scotia Environment, the Department of Natural Resources and other stakeholders have reviewed the lands identified by the Colin Stewart Forest Forum. This review focused on assessing the natural quality of the lands and confirming ownership.

From this process, the government has identified potential "12 per cent lands" for further review in subsequent steps. These lands include provincial Crown lands, and some lands owned by the major forestry companies operating within Nova Scotia. To provide flexibility in decision making, more than 200,000 hectares of land is included in these 12 per cent selections. These 12 per cent lands are not proposed protected areas. However, government will select most of the proposed protected areas from these lands.

The next step in this "12 Percent" process will include a review of the 12% lands (2011), public consultation (2013) and ultimately a final protected areas plan (2013-2015). Once the final protected areas plan is released to the public, government will then take the steps needed to legally protect each area. (Nova Scotia Environment, Protected Areas Branch, June 2011)

All provincial crown land within the focus area of this project has been included in the 12 Percent Lands for Review process (see Map 2.8 - Lands included in the 12 Percent Lands for Review).

MAP 2.8 - Lands included in the Province of Nova Scotia's 12 Percent Lands for Review.
Nova Scotia 12 Percent Lands for Review. Obtained from Nova Scotia Environment (Protected Areas Branch)

3. FIELD SURVEY METHODOLOGY

3.1 Logistics

The field program consisted of seventeen (17) field trips to ten (10) sites within the Eastern Shore focus area (map 1.2 and table 2.3). The field trips were conducted between June, 2011 and late October, 2011. The start of the field season was delayed due to weather conditions, particularly fog through much of June, which prohibited safe travel to the islands by boat. It should be noted that because due to the delayed start of the field program, the bird surveys did not capture the most productive period of the breeding bird season and the spring migration.

The Eastern Shore Project Team consisted of the following personnel:

- Peter Green - NSNT Coastal Campaign Coordinator
- Tom Windeyer - Eastern Shore Field Program Coordinator
- Robert Guscott - Forestry
- Tom Neily - Plants and Lichens
- Nick Hill - Plants and Lichens
- David Currie - Birds
- Chris Pepper - Birds

Field days for the island surveys were determined by availability of the team members and good weather conditions. Properties on the mainland which were accessible by land were scheduled on days when travel to the islands was not possible. Table 3.1 shows the field program schedule and participants.

Table 3.1: Schedule of Field Visits and Participating Staff

Property	No. Of Visits	Dates Visited (2011)	Participating Team Members/Discipline
Borgles Island	4	28 June, 4 and 5 July, 10 August	**B. Guscott**/Forestry, **T. Neily**/Plants, **D.Currie**/ Birds, **C. Pepper**/Birds
Cable Island	1	13 July	**B. Guscott**/Forestry, **T. Neily**/Plants, **D.Currie**/ Birds, **C. Pepper**/Birds
Wolfe Island	2	20 and 21 July	**B. Guscott**/Forestry, **T. Neily/**Plants, **C. Pepper**/Birds
Tuff & Mary Islands	1	27 July	**B. Guscott**/Forestry, **T. Neily/**Plants, **C. Pepper**/Birds
Inner Baltee Island	1	28 July	**B. Guscott**/Forestry, **T. Neily/**Plants, **C. Pepper**/Birds
Baltee Island	1	5 August	**B. Guscott**/Forestry, **T. Neily/**Plants, **C. Pepper**/Birds
Little Harbour	1	9 August	**B. Guscott**/Forestry, **N. Hill**/Plants, **C. Pepper**/Birds
Laybold Island	1	14 September	**B. Guscott**/Forestry, **N. Hill**/Plants, **C. Pepper**/Birds
Gerard Island	3	21 and 28 September, 7 October	**B. Guscott**/Forestry, **N. Hill**/Plants, **C. Pepper**/Birds
Harry's Cove & Cranberry Island	2	12 and 27 October	**B. Guscott**/Forestry, **N. Hill**/Plants, **C. Pepper**/Birds
Total Number of Field Trips = 17			

The properties for this study cover a large coastal area. As a result field programs were staged so that travel time by boat was minimized. Access to the islands in the western area was provided by Mr. Brian Murphy of Murphy's Camping on the Ocean, who operates a licensed tour boat from his campground wharf at Murphy's Cove. His vessel was chartered for surveys on Borgles Island, Cable Island, Wolfe Island, Tuff Island, Inner Baltee Island and Baltee Island. Access to Laybold Island was provided by Mr. Charlie DeWolfe using his fishing vessel from the private wharf at Carter's Point. Vessel access to Gerard Island was provided by Mr. Dana Wright of WildCoast Conservation from a private wharf at Tomlee Head. A canoe was used on 27 October to access the Cranberry Island section of the Harry's Cove property through channels in the salt marsh.

3.2 Sub-National Ranking System

The plant and lichen species identified in this study were ranked using the sub-national ranking system, which is specific to Nova Scotia as developed by the Atlantic Canada Conservation Data Centre (ACCDC). The ACCDC works with provincial and federal experts to develop rarity ranks for species in New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland & Labrador. Factors considered when ranking include number of element occurrences, distribution, population size, abundance trends, and threats. This ranking system identifies the rarity or conservation status of each species using the following definitions as cited by the Atlantic Canada Conservation Data Centre (ACCDC, December 2010):

Table 3.2 – Sub-national Element Rank Definitions	
S1 – Extremely Rare	May be especially vulnerable to extirpation(typically 5 of fewer occurrences or very few remaining individuals
S2 – Rare	May be vulnerable to extirpation due to rarity or other factors(6 to 20 occurrences or few remaining individuals
S3 – Uncommon	Uncommon or found only in a restricted range, even if abundant at some locations (21 to 100 Occurrences)
S4 – Usually Widespread	Fairly common and apparently with many occurrences, but of longer terms concern(e.g. watch list) (100+ occurrences)
S5 - Widespread	Widespread, abundant, and secure, under present conditions
SE - Exotic	An exotic established in the province (e.g., Purple Loosestrife, or Coltsfoot; may be native in nearby regions.
S? - Unranked	Not yet ranked
For a comprehensive lists of plant and animal species, with a rarity rank and legal status for each, please refer to ACCDC's website: http://www.accdc.com/Products/ranking.html	

3.3 Forest Survey Methods

The forest vegetation surveys carried out on Borgles, Cable, Wolfe, Inner and Outer Baltee and Tuff Islands were conducted by Bob Guscott and Tom Neily. For Little Harbour, Laybold Island, Gerard Island and the Harry's Cove/Cranberry Island Property the surveys were conducted by Bob Guscott and Nick Hill.

The forest vegetation survey used in this report is based on the Nova Scotia Department of Natural Resources, Forest Ecosystems Group's methods. (Neily P. D. 2010) Two or more forest vegetation

inventory plots were established for each of the properties. For representative forests stands a 10m x 10m forest vegetation inventory plot was established. All plant species occurring within the plot were identified and given a percent cover estimate. Percent cover by each plant was estimated in 4 main layers and sub-layers. Table 3.3 – Vegetation Layers Examined describes the 4 main layers and sub-layers

Table 3.3 - Vegetation Layers Examined

Layer	Sub-Layer	Layer Name	Layer Description
A		**Tree Layer**	Includes all woody plants greater than 10 m or what constitutes the main forest canopy. On the eastern shore forest stands rarely exceed 10 m in height. Two sub-layers are recognized.
	A1	**Dominant, Co-dominant and Intermediate Trees**	Includes trees of the main canopy with crowns forming the upper layer of foliage. Typically forms the major portion of the stand.
	A2	**Sub-Canopy Trees**	Includes intermediate, suppressed, and second story trees greater than 10 m tall that are below the main canopy.
B		**Shrub Layer**	Includes woody plants less than 10 m tall. Established tree regeneration less than 10 m in height is also considered as part of the shrub layer. Two sub-layers are recognized.
	B1	**Tall Shrub Layer**	Includes all woody plants 2-10 m tall; including shrubs, advanced tree regeneration and suppressed trees.
	B2	**Low Shrub Layer**	Includes all woody plants less than 2 m high, except dwarf (less than 15 cm tall) woody or trailing plants which are considered part of the herb layer.
C		**Herb Layer**	Includes all herbaceous species (regardless of height) and some low woody plants less than 15 cm tall.
D		**Moss, Lichen and Liverwort Layer**	Includes all bryophytes, terrestrial lichens, and liverworts growing on the forest floor or decayed wood (but excluding organisms growing on stems and branches).

In addition, the age and diameter of 2 trees within each plot were collected from representative dominant or co-dominant trees. Notes were made on the general health of the stand including occurrence of insect or disease outbreaks as well as tree mortality and blow down.

3.4 Plant Survey Methods

The summer vegetation surveys (July and August, 2011) were carried out on Borgles, Cable, Wolfe, Inner Baltee, Baltee and Tuff Islands by Tom Neily. Nick Hill conducted the fall vegetation surveys (September to October, 2011) of Little Harbour, Laybold Island, Gerard Island and the Harry's Cove/Cranberry Island Property.

The surveys were made at a reconnaissance level to permit as much coverage as possible during the visits and to complement the forest vegetation surveys occurring simultaneously that involved team effort. The plant surveys included traversing and/or walking the perimeter of the property or island. Observations during inland traverses noted the presence of human habitation (abandoned fields, etc), wetlands and forest associations. Traverses around the perimeter of the islands concentrated on coastal communities: beaches, headlands and salt marshes. Specimens of unknowns were collected for later identification.

The surveys were not limited to vascular plants but also included lichens and to a lesser extent, bryophytes. While bryophytes and occasional lichens were described on all islands for the forest plots, the bryophyte and lichen community were intensively investigated on Borgles, Cable, Wolfe, Inner Baltee, Baltee and Tuff Islands by Tom Neily. This method fit with the relative expertise of the personnel but was also strategic. Characterization of "cryptogams" is time consuming, but at the start of the project there was little known about the potential value of these island habitats for lichen communities in particular. Neily has described lichen communities in the adjacent mainland forest along the Eastern Shore where he and others have discovered new populations of the endangered Boreal Felt Lichen *(Erioderma pedicellatum)*. A thorough examination of island forests thus was of high priority and some of the islands surveyed by Neily, had greater likelihood of supporting populations of the Boreal Felt Lichen because of the findings of a predictive model from NSDNR, which indicates potential habitat on Borgles Island (see map 3.1), and because larger islands may have more sheltered interior forest conditions suited to the lichen (e.g. Wolfe and Inner Baltee).

MAP 3.1 – Predictive Boreal Felt Lichen Habitat Model (DNR)

The islands surveyed during the project varied in size and therefore required varied amounts of effort. The larger islands involved up to four days to adequately cover the terrain. Smaller islands only required a few hours. Mapping and aerial photos provided by the Nature Trust were used to identify the land cover and habitats, i.e. wetlands, uplands, salt marshes, upland forest, and to determine what areas to cover that would most likely support plant communities containing species of interest. Refer to section 7 (appendices) of this report for aerial and landcover maps for each individual study sites within the focus area.

The surveys described in the results herein are of great value; however, they must be taken as preliminary, regardless of the results and conclusions revealed through this report. *A priori,* it was not known whether inland or coastal ecosystems were of more conservation value and which would house unusual or rare organisms. While rarity is one component among others (e.g. integrity) for such valuation, such exceptional habitats as these islands might be expected to have unique organisms or those not found in abundance on the mainland. The survey method employed in this preliminary survey can be described as “directed cruising”. Neily and Hill have both similarly conducted lakeshore surveys for rare plants, and these island methods were essentially modified to match the time and terrain of the islands. Accordingly, these surveys concentrated on habitats most likely to support rare plants. Plant rarities most often fit into habitats with little vegetative cover (i.e. low biomass) because their rarity most often stems from a lack of ability to compete with other plants (Griggs, 1940). All habitat types were investigated, however, surveys directed most attention to low biomass habitat that might contain rare plants (e.g. salt marsh, bogs, muskeg, dry ridge tops, and sparsely vegetated shoreline areas). In addition to this listing undisturbed coastal forest was scrutinized since these are areas that support a guild of small orchids, and could support the rare southern blade (*Listera australis*).

The plant surveys are also preliminary because of the time of year of the surveys. There is no time which fits all species, however, the fall surveys may have missed summer flowering species (e.g. southern twayblade). This is less a problem here in a boreal ecosystem than in temperate ecosystems where growing seasons are longer and there may be successive flowering.

A list of all species observed was maintained for each island. Species were identified in the field and, if necessary, a small sample was collected in cases where further study was needed in the lab. A number of lichen and bryophyte specimens were collected as these generally require microscopic examination to determine their identity. For vascular plants, the Flora of New Brunswick (Hinds, 2000) and Roland's Flora (Zinck, 1998) were used for identification, in addition to the Flora of North America (eFloras). Nomenclature follows the first flora. Bryophytes were identified using Anderson et al. (2009) for sphagna and Allen (2005) for all other groups. Lichens were identified using Hinds and Hinds (2007).

3.5 Bird Survey Methods

It is likely that the Eastern Shore Islands represented within this report have never been systematically recorded for bird species either on migration or breeding. The bird lists produced through this study may only serve as confirmation of what was already suspected to occur on the islands. However, the

basic information provided by these surveys gives an insight into the abundance of common species occurring on the islands during the summer months.

Maps provided by the Nature Trust identifying forested versus and non-forested habitats were used to plan the avian species survey strategy for each different habitat present on a particular island or property. Two competent birders, Chris Pepper and David Currie conducted the surveys on Borgles Island and Cable Island. Chris Pepper conducted the observations on Wolfes Island, Tuff Island, Inner Baltee Island, Baltee Island, Little Harbour, Laybold Island, Gerard Island and the Harry's Cove/Cranberry Island property.

The survey results are influenced by the late start date with the earliest date for recording being 28 June on Borgles Island. The last bird survey was conducted on 27 October on the Harry's Cove property.

Both observers were experienced in visual and auditory identification of birds. Observations were conducted while traveling over the sites in order to cover as much diverse habitat as possible.

Bird song tends to drop off dramatically by mid morning so earlier starts were preferred. Those sites surveyed earlier in the program were conducted during the period when birds were still tending broods and actively gathering food for young. This provided an opportunity to view most nesting species.

As the season moved on towards late summer, fewer breeding species were recorded. Initially, two observers took part in the survey but the majority of islands visited later in the summer were covered by one observer only. Migratory birds were also observed during the field season towards the late summer and early autumn.

Identification of species was done primarily visually, but one species, Winter Wren (*Troglodytes troglodytes*), was easily heard but not actually seen. In all, actual numbers of species seen or heard were counted, taking care to avoid overlapping areas previously covered by the avian team. With one species on Borgles Island, Common Yellowthroat (*Geothlypis trichas*), estimated numbers were used because of their abundance.

3.6 Other Species

Although the field team did not specifically focus on other biota such as mammals and reptiles, incidental observations were recorded and photographed where possible. As well, signs of mammals such as scat, tracks and dens were recorded by the observers.

4. SUMMARY OF FINDINGS AND CONCLUSIONS

4.1 Ecological Context of the Eastern Shore Focus Area

The Eastern Shore survey covered 8 islands and 5 mainland properties over a 35 km stretch of coast between Clam Harbour and Spry Bay. This area forms the southwestern part of the eighteen league (ca. 90km) wide "Baie de Toutes Isles" that Denys describes in 1654. Though it is not a bay, this region refers to the collection of more than a hundred islands from Clam Harbour to Liscomb. Despite their wilderness state, this complex of sea islands has had little in-depth, ecological study. The islands constitute a set of shorelines and associated maritime terrestrial ecosystems that have had profound influence on one another. The harsh abiotic environment and the changing sea levels have always meant that the shoreline communities were extremely dynamic and rich in both stress tolerant and ruderal (weeds and other disturbance adapted species) organisms.

There has been an on-going ecological and adaptive interplay between ecosystems and the communities of the upper shore and lower shore as sea levels have risen, fallen and then risen once more. The shoreline communities have tracked these changes, and their diversity depends upon their stress tolerance and colonizing abilities. While this process has been largely uninterrupted on most of the island shores, in contrast on the mainland, human settlement and development of communities, has resulted in highly modified shorelines where biological communities often reflect human impacts as much as that of natural process.

Denys (1658) noted the stark gradient from the small outer islands through the larger islands to mainland communities: from rock, to shrub heath and fir, to more attractive fir (larger islands), to fine woods on good land with beautiful and pleasant spots on the adjacent mainland. There has been a major alteration of forest ecosystem process stemming from repeated clearcutting over much of the mainland forested areas which has particularly affected the soil nutrient capital (Goldsmith, 1980), but much of the forest landscape on these islands has not been cleared though they have been repeatedly blown down. This difference is not a subtlety, for the island forests are by definition boreal coastal wilderness forest where structure and process reflects long-term, natural disturbance regimes. The conservation values of this sea island wilderness are multiple and over the short shoreline section where island density is more than three-fold that of other Atlantic shoreline areas (i.e. 1.4 islands per km of mainland shoreline), the total length of undisturbed island wilderness shoreline may be as great as that of the nearby modified shores of the mainland. This collection of islands has had little ecological study but collectively, this set of shorelines and naturally disturbed forest habitats, present extremes in ecological conditions that are uncommon on the mainland and in mainland coastal ecosystems. The value of these shorelines and coastal zones is not simply that they represent a much larger fraction of the ecosystems present than is the case on mainland Nova Scotia, rather, these island coastal ecosystems are unique, they surpass the mainland in their extremes of natural disturbance, and are little modified by a legacy of anthropogenic disturbances.

This set of more than 100 nested islands within the Eastern Shore focus area is one of few cases where the natural world and its biological communities continue to respond to and reflect natural environmental forces. It is a wilderness seascape of obvious value to a Canadian and an international

community of scientists, naturalists and ecotourists. Its potential societal value is similar to that of the San Juans (WA), the Broken Island Group (BC) or the Shetlands (UK). Conservation of the 8 islands in this survey and of the surrounding islands in the Eastern Shore focus area should be a priority for conservation of biological communities which are by nature dynamic, and are composed of populations that have a great degree of turnover. While all of the rare elements that were encountered on these islands can be found outside this Eastern Shore Zone, the prediction from ecological theory would be that the density of populations of rare organisms will be greater where the distances between islands is shortest. Because of both their integrity and their arrangement, these islands must be a focus of conservation. These shoreline landscapes are among the most naturally disturbed in Nova Scotia and this disturbance is projected to increase considerably due to both the predicted rise in sea level and to the projected increase in the frequency and intensity of storms given climate change. The persistence of individual populations in metapopulation arrangement among these densely aggregated sea islands may be increasingly threatened with the increase in shoreline disturbance projected over the next century. Under this scenario, there is a need to keep all of the habitat pieces, especially for the most vulnerable species such as the shoreline rarities discussed herein.

4.2 Ecosystems of the Coast

4.2.1 Exposed Shoreline

Natural disturbance of shoreline ecosystems is greatest on the southerly exposures of these islands and of headlands (Canadian Climate Normals, 1970 -2000). South facing shores had greatest development of beaches. This environment is exceptionally harsh for vascular plants but there is a plant community on beaches that is composed both of native and exotic plants (Hill and Blaney, 2010). This is a diverse guild of disturbance-adapted plant species whose populations are spread over the islands of the eastern shore of Nova Scotia from Clark's Harbour to Canso. While some of the native plants, such as the sea-rocket (*Cakile edulata*) which grows in cobbles and decomposing seaweed (Keddy, 1980), are common, this guild of shoreline plants includes rare species whose populations on individual islands are small and consist of discreet patches which have a short temporal window between their initial establishment and final destruction by natural beach disturbances.

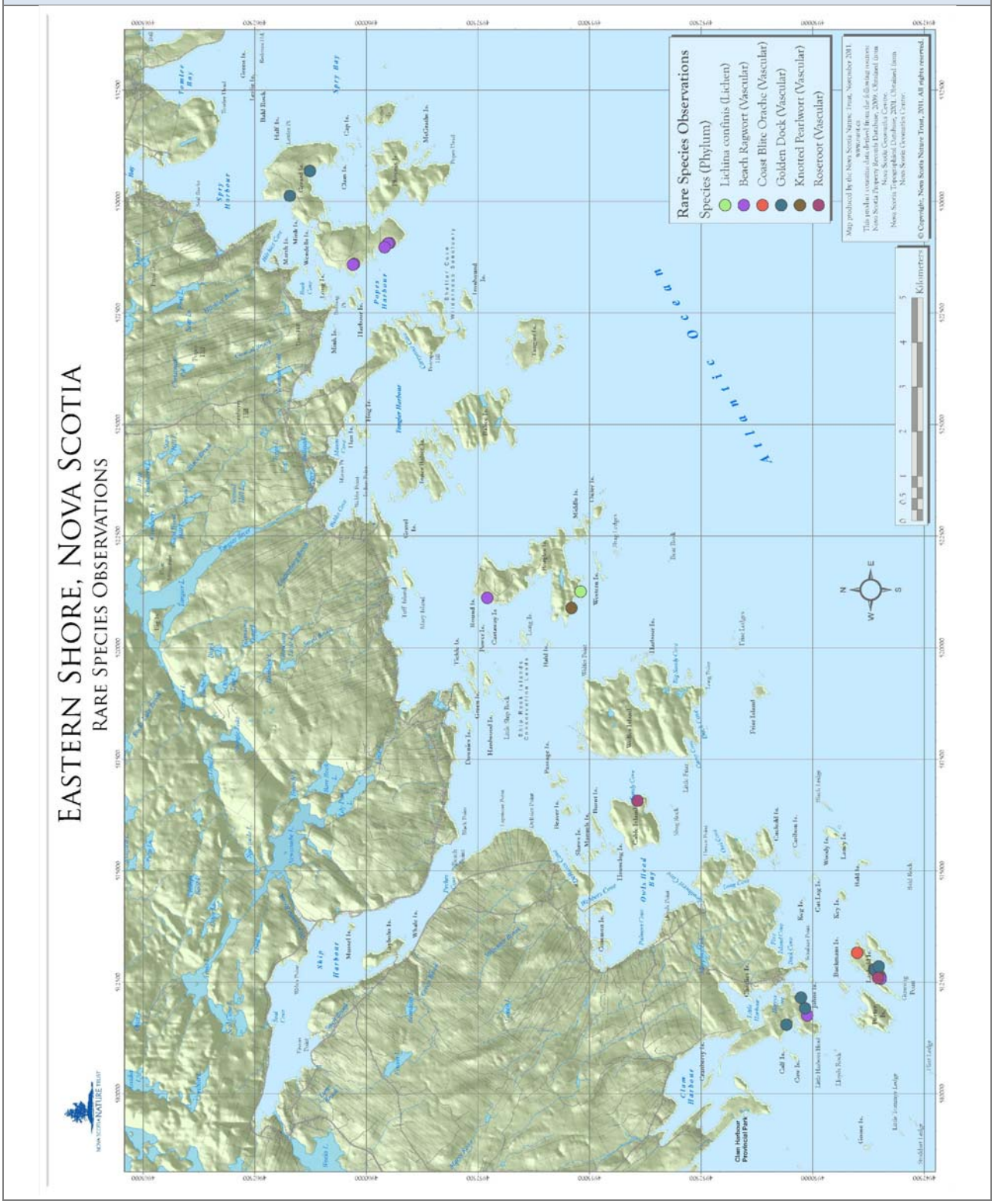
Not all islands support members of this guild of rare plants and these populations persist in a balance between new patch establishments and patch destruction. Maritime sea levels are rising and are projected to rise by 70 cm by 2050 (Forbes et al., 2004). Storm events may become more frequent and severe according to some climate models. The island shores may permit the persistence of beach flora to a greater degree than mainland seashores where communities are often subject to coastal squeeze between the rising sea and inhospitable infrastructure (roads and development).

Three vascular plants were documented on the islands that have provincial status ranks ranging from S1? to S3. Of these three species of vascular plants, island frequencies ranged from between 12 to 50% (i.e. for the 8 islands surveyed, these species were observed on between 1 to 4 islands). The playing surface for these rare organisms appears to be restricted to exposed shorelines to the south and the west of the islands. The number of patches (plants within a 50m shoreline stretch) of the rare plants on the islands where they occurred ranged from one to three (see Map 4.1 Rare plant observations) per

species. These rare plant species are vulnerable on any given island, and their security may depend on rare habitat availability throughout the complex of islands.

MAP 4.1 – Rare Plant Observations of the Eastern Shore Focus Area

Rare species observations made during field surveys, 2011.



4.2.2 Salt marsh Shoreline

Offshore islands have less salt marsh than mainland shoreline, where it occurs frequently along coves that are sheltered from the sea, and where larger rivers transport sediments to the salt marshes. Salt marsh on the islands is similarly best developed in coves or in the lee of barrier beaches where freshwater seeps meet inflow of seawater. Two unusual plants of salt marshes were found; one a native golden dock (S3-S4) typical of open communities at the edge of either salt marsh or brackish marshes. The other, a new exotic (brass buttons from South Africa), is known to the Conrad's Beach area, but is the first time it has been documented outside that area. Both of these plants show that disturbance of the salt marsh is enough to maintain a diversity of species that include those observed but also those that we did not observe but which we would expect to find in Atlantic Shore salt marshes.

4.2.3 Coastal Shrublands

Much of the interior shrubland may be anthropogenic in development as it regenerates rapidly from buried rhizomes after fire. Coastal shrub associations in some cases are similarly regenerating from a human disturbance such as grazing (old pastures become shrub) or fire. Coastal shrublands are as wella natural ecosystems featuring persistent plant community associations (Burley and Lundholm, 2010). On many of the islands, we noted a coastal fringe of black crowberry or more extensive crowberry barrens. These habitats typically were maintained by wind and sea spray on south-facing promontories. No rare species were observed in this community, however, the ecosystem itself is limited in area in Nova Scotia (though widespread) and the area of this ecosystem may be declining as at Gaff Point, NS, where up to 70% of some crowberry heathland has been lost to the sea since 1980 (Hill et al., 2012). Island headlands are particularly valuable for this community since there are no anthropogenic barriers to the landward retreat of the crowberry association. This was observed best on Gerard Island where the boundary between black spruce woodland and crowberry mat ecosystem appeared to be moving inland as substantial (ca. 2-10 m wide) areas of crowberry are lost to the sea on the seaside, and trees were being lost landward of the crowberry zone. This phenomenon depends upon the effective dispersal of the berry producing crowberry and also its ability to become established in the shade of the standing tree zone. These crowberry systems are a natural ecosystem that supports a community of wildlife (mink, gulls and juncos) that disperse its berries. It is also a system threatened both by climate change and anthropogenic development; as storms may become more intense, some of these areas will be lost to the sea and others will successfully shift their landward boundary to keep pace with blow-downs affecting the seaward edge of the spruce zone but this can only work in absence of anthropogenic hardscaping.

Photo 4.1 - Dynamic coastal boundary

4.2.4 Coastal Forest

The coastal forests are landscapes dominated by conifers that are growing in moist mossy woodlands which have been described as "perhumid coastal" woodlands (Clayden et al., 2011). The forests are made up of comparatively small, young trees (maximum tree age: about 100 years, average age of largest trees: 50 years), but most of these are forests that have developed without human disturbances. Where areas are seen to have been cleared (e.g. marked by stone walls), the forests are white spruce *(Picea glauca*) dominated but in other areas, the dominant spruce is black (*Picea mariana*). In the most naturally disturbed forests, a dense association of balsam fir (*Abies balsamea*) results.

These perhumid forests stay moist because of the constant inputs of fog into a system where the evapotranspiration rates are low (Clayden et al., 2011). Unlike other island forests (e.g. southwestern Nova Scotia, or immediately North of the Focus area at Sober Island and Islands farther North), the coastal forests have not typically formed a krummholz association where the tree leader retreats on an angle away from the coastal winds so forming an angled face to the maritime edge of the forest. In the forests of the Eastern Shore focus area, periodic disturbance seems to blow down forest that faces the south winds. In addition to disturbance, the dominant conifers in these forests frequently exhibit broom growths which may be caused by eastern mistletoe (*Arceuthobium pusillum* for white or black spruce), or by several rusts (e.g. *Chrysomyxa arctostaphyli*) which may use various of the heath family members as a definitive host (e.g. Labrador tea). The understory mat along the coastal fringe of these forests is composed of three dominant berrying shrubs (black crowberry, snowberry and foxberry), which are of obvious value to small mammals and birds.

These forests support two watch listed (S4) orchids (e.g. *Goodyera tesselata*, rattlesnake plantain orchid; and *Platanthera obtusata*, blunt-leaf orchid) in more sheltered coastal areas. It should be determined whether there are other rarer orchids (e.g. *Listera australis*, southern twayblade, S1) in these moist communities.

Much of the island forests have not been anthropogenically modified, and therefore these can be considered naturally disturbed wilderness forest.

4.3 Ecosystems of the Islands Interiors

4.3.1 Bogs

While the forest structure of these islands reflects largely the time since a blow down event or a fire or in some cases, the clearing of the land, the structure of the discreet bogs on most of the islands reflects only the landforms and associated drainage. There was a range of bog types from those that were truly bogs with self-contained water flows, to bogs that were at the edge of the island and which slowly graded into saline marsh. No rare vascular plants were seen in either formation, however, there were two uncommon (S4) *Sphagnum* species (*Sphagnum angermanicum* and *S. lindbergii*).

Photo 4.2: *Sphagnum lindbergii* (S4?) in bog located on Borgles Island.

4.3.2 Treed bog

There is an acidic muskeg –like swampland that is common on many of the islands. Within these bog environments the trees are scraggly black spruce, the shrubs are Labrador tea and lambkill, the ground flora is pitcher plant and three-leaved false Solomon's seal, and the mosses are predominantly *Sphagnum* spp. These are systems with good ecological integrity, although are common throughout Nova Scotia and have largely local value for wildlife, drainage and water quality.

4.3.3 Barrens

On many islands there were outcrops that were exposed and were shrub associations or "barrens". In some cases, there were large areas of dry or mesic (moist rather than a wet fen type of shrub land) landscape that was shrub dominated because the forest had been destroyed in a fire. This was most noticeable on Cranberry Island where over half of the landscape was shrub barrens (e.g. lambkill, huckleberry, juniper, crowberry, wild raisin). These are extremely resistant communities and if fire returns, essentially the same community structure will persist.

4.3.4 Inland Forest

The inland forests of these islands are similar to those observed along the coast, although away from the coast, the moisture of the ground is lower and there may be less wind disturbance. The inland woods have fewer berry producing shrubs than the coastal gallery forest described above. The island forest fit

into the same "perhumid coastal" forest as is described by Clayden et al. (2011). Because of their indicator value for ecological processes, these forests are discussed in greater detail below. The islands studied varied greatly in the extent to which they were settled and cleared in the past, and as well the history of fire varied greatly from island to island.

4.4 Forest Species Summary

4.4.1 Forests of the Eastern Shore

The Nova Scotian forest is composed of both temperate and boreal tree elements and Halliday dubbed the overall forest mix, the "Acadian Forest" (Halliday, 1937). The signature trees of the Acadian forest concept were the red spruce and hemlock (Weaver at al., 2009). While red spruce (*Picea rubens*) is a dominant tree over much of the mainland of Nova Scotia and it dominates forests along the Fundy coast of Maine (Davis, 1966), the present study of the Eastern Shore coniferous forest of the studied islands revealed a mixture of black and white spruce (*Picea mariana* and *Picea glauca*). These occur together with balsam fir (*Abies balsamea*), a fast-growing, shade-tolerant tree that regenerates at high densities in many Nova Scotian forest types. All of these three conifers are part of the Boreal Forest mixture (Elliot-Fisk, 1988) and this boreal vegetation, particularly the dominance of the black spruce, is a reflection of the unique climatic nature of the Eastern Shore. The southern limit of the Boreal Forest is defined by the 18^{o}C July isotherm, where the average temperature in July is less than 18^{o}C. While locations along the middle of the Atlantic shore of Nova Scotia are above this July minimum (Halifax Citadel = 18.6^{o}C, Bridgewater= 18.9^{o}C) on the northern end of this shore, at Ecum Secum the temperature is well inside this range with an average July temperature of 15.4^{o}C.

Davis and Browne (1996) described a white spruce, fir, maple, birch mixedwood forest as the "climax" forest of the province's rocky and exposed south-western to north-eastern coastline (with stunted trees from severe wind exposure and salt spray - a krummholz condition). White spruce tends to occupy habitats along the immediate coast with balsam fir further inland. Red maple and white birch may be found inland with the spruce and fir as a result of fire or cutting activities. Along the eastern shoreline they report that black spruce assumes as much importance as balsam fir. The understory vegetation is dominated by Schreber's moss (*Pleurozium schreberi*) and broom moss (*Dicranum scoparium*) with wood fern (*Dryopteris intermedia*), wood sorrel (*Spiraea Ulmaria*), wild lily-of-the-valley (*Maianthemum canadense)*, blue bead lily (*Clintonia borealis)*, and starflower (*Trientalis borealis*), goldthread (*Coptis trifolia*), bunchberry (*Chamaepericlymenum canadense)* and wood aster (*Aster acuminatus*) as associates.

Although the above authors refer to a "climax" forest, much of the Boreal Forest is far from such a state. Elliot-Fisk describes how the Boreal Forest is a disturbance forest, much of it adapted to regular fires and in fact, the black spruce has semi-serotinous (opening to release seeds after fire) cones (Elliot-Fisk, 1988). Unlike the spruces (black or white) which retain some seeds on the tree, balsam fir sheds all its seeds and is not a fire-adapted plant. The island forests are a patchwork of different ages of forests that have regenerated after different disturbance events. Most of the disturbance is wind-driven but the scale of the different events varies from those described as "microbursts" of wind affecting narrow bands of trees to those driven by hurricanes (e.g. Hurricane Juan in 2003).

Neily (2004) looked at 7 study sites on the Eastern Shore mainland and suggested that the oldest cohort of trees within forest stands seldom exceeds 100 years of age. Limitations to growth, imposed by both the local climate (e.g. salt spray, exposure to winds, cool temperatures) and soil and site influences such as moisture deficit and excess, and low nutrient availability give rise to an edaphic climax of balsam fir and black spruce. Neily (2008) describes 72% of the forest associations of the Atlantic coastal ecoregions as originating from frequent stand level disturbances created by hurricanes and wind storms, insects, senescence, and occasionally fire.

The resulting forest is a patchwork of stands of fir that alternate with those of black spruce or white spruce near old homesteads. In many cases these intermingle and may contain other tree taxa that all belong to the Boreal Forest community described by Elliot-Fisk (1988; e.g. paper birch, wire birch, larch, quaking aspen). Both fir and black spruce are, with larch, at the wet end of a moisture gradient of boreal forest tree communities (Larsen, 1980). In addition to being a cooler pocket of Nova Scotia, the island coastal zone receives much moisture input from easterly winds and it has been referred to as part of the "Perhumid Forest", which Clayden et al. (2011) liken to a "rainforest". Perhumid is used in the sense of Thornwaite (1948) to describe areas where precipitation inputs exceed evapotranspiration losses, and the Eastern Shore stands apart again in this context. While other Atlantic shore weather stations show similar annual precipitation to the Eastern Shore pocket, the Eastern Shore (Ecum Secum station) receives 20% more rain (mean – May to September: 124 mm) than the other two Atlantic stations (Halifax Citadel and Bridgewater, mean – May to September: 104 mm) in the summer months when evapotranspiration rates are highest. This means that these islands, which also receive more sea fog inputs, conform to the "rainforest" ideal of the Perhumid Forest (Clayden et al., 2011) more so than other areas in the province.

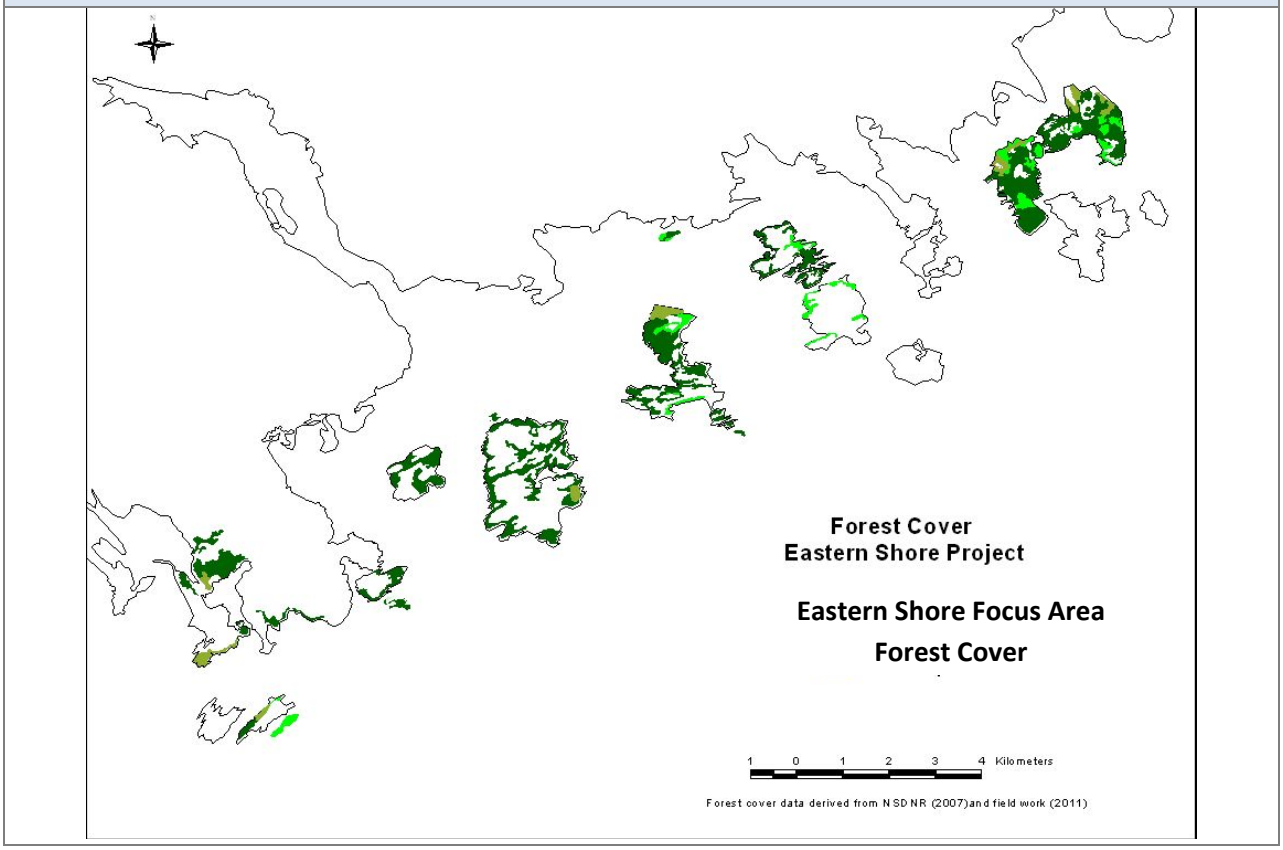
What is left is a forest that is mostly impenetrable, either because of the density of the regenerating firs, the layering (lowest branches root) growth of black spruce, or the tangle of downed dead trees (usually blown down in one main direction), or the wetlands (treed bog/muskeg or bogs) located within the depressions between ridges away from the shore. Forest productivity is very low due to a mostly thin and nutrient-deprived soil. There is a large amount of natural disturbance including single and multiple tree fall gaps, as well as complete forest levelling. This has led to a large amount of woody debris on the forest floor. There is also an abundance of moss and lichen flora which contributes to a thick duff layer. This comes as a direct result of a cool moist climate and slow decomposition rates. Dead wood is a notable ecological feature. On most of the islands except where fires or old settlements removed logs, there is a constant input of woody material into the organic soils where it quickly becomes covered over by a thick layer of bryophytes (mosses and leafy liverworts) which helps retain moisture. These forest ecosystems convert this organic input mainly into fungal biomass, and there is a community of mushrooms (including the chanterelles, *Cantherellus cibaricus* and *Craterellus cornucopoides*) that thrive in the organic moist habitat. In addition to various herbs and mosses, there are patches of two uncommon orchids which may indicate the potential for the presence of the endangered twayblade (*Listera australis*).

Thus, this Eastern Shore coastal forest is a unique example of the Boreal Forest that is very much a product of rugged geology and a particular maritime climate that is influenced by the summer cooling of the Labrador Current, the sea wind moisture inputs that contribute to its rainforest status and the storms that continually reset forest stand composition.

The forest of this area is a complex of trees all belonging to the boreal forest assemblage (Elliot-Fisk, 1988). Map 4.2 shows the distribution of the three dominant conifers throughout the Eastern Shore focus area (DNR, 2002). Where a forest cover has developed, black spruce (*Picea mariana)* dominates. Balsam fir (*Abies balsamea)* occurs in occasionally pure stands but is highly susceptible to insect outbreaks. White spruce (*Picea glauca)* is found usually close to shorelines especially behind dunes and in sheltered areas but often this tree has developed in old settlement areas where the better soils were chosen for pastures. All these forests are young (average age approximately 55 years) and stands represent cohorts that have established after microbursts, hurricanes or more rarely, insect and disease outbreak.

This Nova Scotian Perhumid Boreal forest is a wilderness ecosystem, and while any part of the forest quilt patchwork is young, in many areas (e.g. black spruce and balsam fir) the same process of destruction, decay and regrowth has been at work largely uninterrupted by human activity for 10,000 years, shortly after the close of the Younger Dryas event[1] (dates from Clayden in Hinds, 2000). This unassuming forest is a coastal, old-process, boreal rainforest.

MAP 4.2 - Eastern Shore Focus Area - Forest cover by species (DNR, 2002)



1. The Younger Dryas event, also referred to as the *Big Freeze*, was a geologically brief (1,300 ± 70 years) period of cold climatic conditions and drought which occurred between approximately 12,800 and 11,500 years before present. (Wikipedia, 2012)

4.4.2 Forest Study Results

4.4.2.1 Forest Disturbance

The story of the Eastern Shore near shore and island forests is one of great and dynamic change. Natural disturbance in the Eastern Shore coastal forests includes windthrow of individual trees, stand level blowdown, forest insect pests and pathogens. Windthrow appears to be the major disturbance and its scale varies spatially and temporally. Forests facing the prevailing ocean winds are most often disturbed, but over time the destruction can vary from individual tree falls to "microbursts" to forest stand-level destruction caused by major storms (e.g. Hurricane Juan, 2003 and major storms of 2009, 2010). Disturbance frequency varies and in the recent past wind disturbance may have been particularly high. Dr. Scott Cunningham (pers. comm. to NMH, 2012) who has long kayaked among these islands, indicated that there is far more blow down now and the forest is harder to walk through than was the case when he began exploring these islands 30 years ago.

The average age of the forests studied over the 8 islands was approximately 55 years, and that very young age largely reflects the recurrence of natural disturbance events. The intensity of forest clearing for settlement, pasture and fuel wood ranges from slight (e.g. on the southern ends of all islands) to major (e.g. on the northern ends of islands) from one island to another. White spruce is most often associated with settlement areas (determined by old rock walls, foundations or persistence of exotic species) and black spruce and balsam fir forest covers the large part of most islands, indicating that the forest succession has been directed by natural environmental factors, overall. Conventional old growth definitions have tended to stress the age of resident trees, and the uneven age of forests. Neither of these criteria are met by any of the island forests (except if patches are coalesced, in which case, the forests have uneven age) and this is in keeping with the natural disturbance regime that gives these islands their conservation value. The boreal forest is a disturbance system (Elliot-Fisk, 1988). The disturbance of these boreal woodlands is mainly wind driven and this process has been at work uninterrupted for large tracts of most of the islands. By an ecological definition, this means that on most islands there are large tracts where old process has been uninterrupted by anthropogenic disruptions. The resident organisms have had perhaps 10,000 years (according to Clayden, in Hinds (2000) the forests of this region appear to have returned shortly after the cooling of the Younger Dryas event) to adapt to recurring wind disturbance that by calculation, has reset this forest approximately 130 times (taking the average between the average age of a forest and the maximum age, 100 years, of a forest). We have few other cases of such uninterrupted ecological process where trees have tracked a natural disturbance regime in the forests of Nova Scotia. The only criterion for old growth that fits these boreal assemblages is an abundance of coarse woody debris and most woodlands have coarse woody debris over and under a carpet of mosses and liverworts.

Photo 4.3 - Blowdown damage, Baltee Island

Photo 4.4 - Blowdown damage, Tuff Island

Stand level disturbance can also be generated by outbreaks of forest pests and these are a natural feature in the dynamics of the boreal forest (Elliot-Fisk, 1988). Both hemlock looper (*Lambdina fiscellaria)* and balsam fir sawfly (*Neodiprion abietis)* outbreaks have occurred along the eastern shore in the last 2 decades and have killed many balsam fir stands. Many stands wiped out in the 1990s still have stems standing. Others have blown down from wind and rot. These forest stands are now regenerating back to even-aged balsam fir stands. The introduced balsam woolly adelgid (*Adelges piceae*) is now endemic throughout coastal Nova Scotia, and where it is not checked by low winter temperatures populations build up and can kill many balsam fir trees. It is not known whether fir mortality on islands relates to such outbreaks.

Photo 4.5 – "Witches' broom" growth, Gerard Island

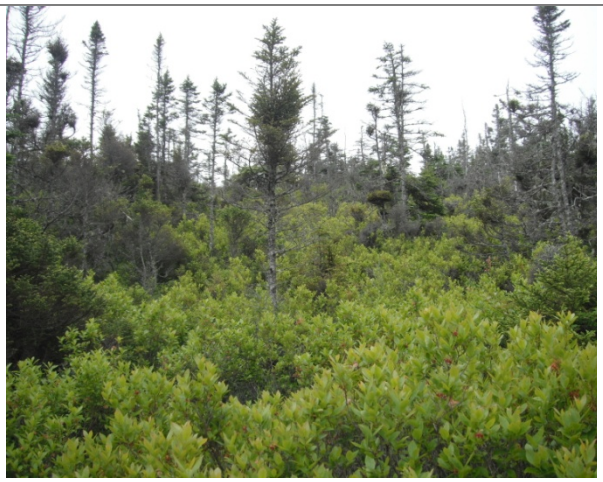


Photo 4.6 – "Witches' broom" growths on black spruce on Borgles Island

The Eastern dwarf mistletoe (*Arcethobium pusilum)* is a parasitic plant that primarily affects black spruce. This tiny plant grows on spruce boughs that then develop abnormal "witches' brooms" (see photos 4.5 - 4.6) distal to the infection site. Broom growth forms were present on all islands visited. Several fungi also cause brooms in both spruce and in fir. An area of black spruce with a high density of

brooms where the undersides of needles were erupting in sporangia typical of *Chrysomyxa* sp. infections was observed.

Many of these fungi have definitive hosts that are part of the understory community of ericaceous shrubs. From an ecological perspective, the forest pathogens are part of the complex forest ecological web and they have impact on flows of carbon (i.e. dead trees are recycled into organic matter) and on the succession from one forest tree to another (e.g. as loopers or sawfly select against fir, and eastern dwarf mistletoe selects against spruce, the forest balance shifts).

4.4.2.2 Human Disturbance

White spruce (*Picea glauca)* is present in pure stands as a result of past clearing by settlers to produce pasture for animal grazing. Significant stands of old field pasture spruce were encountered on Borgles, Gerard, and Laybold Islands (see photos 4.7 and 4.8). These old-field white spruce stands occur primarily on the sheltered north side of the islands where shallow soils occur. This white spruce growth in abandoned fields is readily seen when comparing historical and recent aerial photography, as seen in photos 4.9 - 4.12, below.

Photo 4.7 - Old field white spruce on Gerard Island

Photo 4.8 - Pasture spruce on Laybold Island

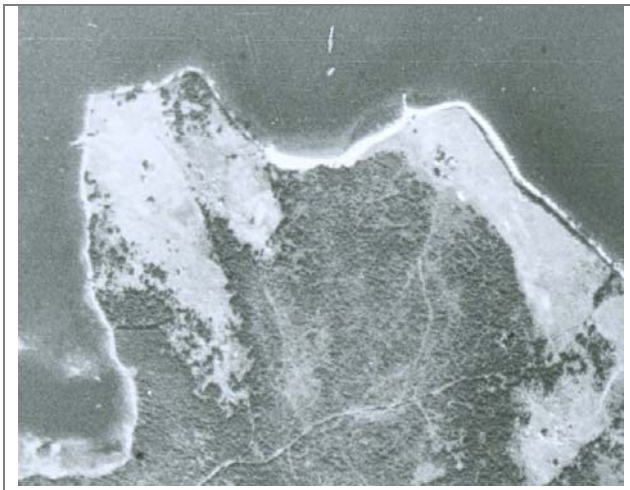


Photo 4.9 – Northeast side of Gerard Island, 1947

Photo 4.10 – Northeast Side of Gerard Island, 2003

Photo 4.11 - North end of Borgles Island, 1935

Photo 4.12- North end of Borgles Island, 2003

4.4.2.3 Geology

The makeup and orientation of the bedrock synclines throughout the focus area has a dramatic impact on the forest composition on many of the islands. The east west orientation tends to provide shelter in the lee of the ridges. The tops of the ridges tend to be barren while the sheltered north side of the ridges have larger diameter trees. The north sides of the ridges also tend to have more moisture contributing to better growing conditions for trees but occasionally when drainage is truncated swamps or wetlands are formed (see photos 4.13 - 4.15).

Photo 4.13 - Pond formed between ridges

Photo 4.14 - Wetland formed between ridges on Inner Baltee Island

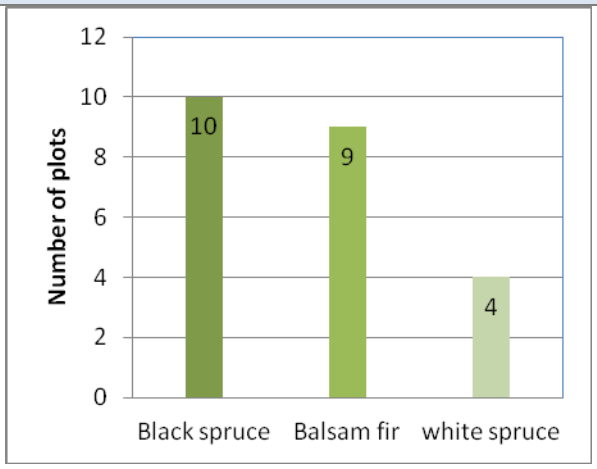
Photo 4.15 – Characteristic dense forest found between ridges on Gerard Island

4.4.3 Forest Vegetation Plot Data

In the course of the 17 field trips visiting 10 properties, a total of 23 forest vegetation plots were examined. The findings from the data collected from these 23 plots are presented below. It should be noted that these near shore and island forests are so disturbed that for many properties it was difficult to find an intact forest. In fact, with the amount of blowdown conditions present on these properties, travel was difficult and only feasible in some cases by following deer trails.

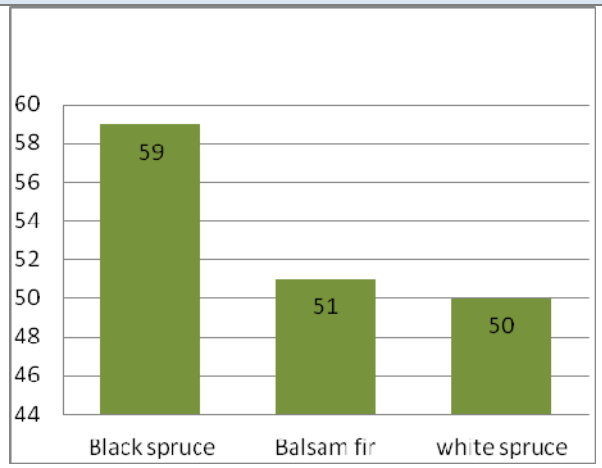
The Eastern Shore forest represents a dynamic boreal coastal rain forest. These forests are heavily influenced by forest insects, diseases and a harsh, storm wracked climate. These forest ecosystems are in a continuous state of flux brought about by waves of defoliation and mortality caused by forest pests, interspersed by extreme storm events that can level whole forests. It is no surprise therefore to find only a few tree species able to survive in this environment. This coastal coniferous forest is made up of essentially 3 species: Black spruce (*Picea mariana)*, balsam fir (*Abies balsamea)* and white spruce (*picea glauca)*. White birch (*Betula papyrifera)* is a minor component, while tamarack (*Larix laricina)* and red maple (*Acer rubrum)* were observed in trace amounts. Black spruce was the primary forest species in 10 plots, balsam fir (9 plots) and white spruce (4 plots) (see graph 4.1, below).

Graph 4.1 - Primary forest tree species by plot (23 plots)

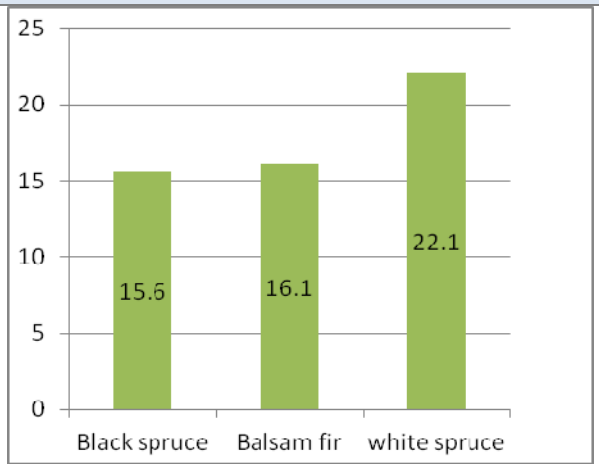


The average breast height age of the 3 primary softwood species was black spruce (59 years), balsam fir (51) and white spruce (50 years) (see graph 4.2, below) Breast height age is taken at 1.3 m above ground. The actual age of the tree is approximately 5 years older.

Graph 4.2 - Average age of forest plot trees (n=46)



Graph 4.3 - Average diameter (cm) of forest plot trees (n=46)



The black spruce age of 59 years is considerably younger than the Maritime average of 82 years. (Davidson, A., G., 1957) The balsam fir age of 51 is also younger than would be expected elsewhere in Nova Scotia. The old field white spruce stands are also young but are more a reflection of occupying sheltered sites and time elapsed since abandonment. The low average diameter by species of black spruce and balsam fir (see graph 4.3) can be explained by poor site and harsh growing conditions throughout the area, and likely mean that commercial forests were never present. Between the extremely harsh climate and a suite of forest pests the black spruce and balsam fir forests are being continually turned over and recycled.

The higher than average white spruce diameter is an indicator of somewhat better soils and sheltered conditions allowing for better health and growth. We identified 3 islands with forest stands of old field

white spruce. These areas are found on the northern sheltered sections of Gerard, Borgles and Laybolds islands. These white spruce forests have developed in old pastures which were cleared of their original forests starting in the early 1800's. One can only speculate on the composition of these pre settlement forests.

It is interesting to note that the oldest and largest trees encountered during this study were two red spruce trees some 95-100 year old on Borgles and Gerard Islands (see photo 4.16 and 4.17).

Photo 4.16 - Red spruce, 43cm dbh, 100 years old, Borgles Is.

Photo 4.17 - Red spruce, 59cm dbh, 95 years old, Gerard Island

Tables 4.1 – 4.4 are a tally of the 6 most common species identified for each layer of the 23 forest vegetation plots based on the Nova Scotia Department of Natural Resources, Forest Ecosystems Group's methods (Neily, P. D., 2010). Table 4.5, below is a summary of the forest vegetation data by plot, including average age of dominant tree, and dominant shrub, herb and moss species.

Table 4.1 - Six most common tree species within the Eastern Shore focus area

Rank	Species		Total sample m^2	% Frequency N=23
1	Balsam fir	*Abies balsamea*	482	73
2	Black spruce	*Picea mariana*	464	56
3	White spruce	*Picea glauca*	230	21
4	White birch	*Betula papyrifera*	42	30
5	Tamarack	*Larix laricina*	5	13
6	Red maple	*Acer rubrum*	5	1

Table 4.2 - Six most common species in shrub layer within the Eastern Shore focus area

Rank	Species		Total sample m^2	% Frequency N=23
1	Balsam fir	*Abies balsamea*	94	73
2	Lowbush blueberry	*Vaccinium angustifolium*	25.3	69
3	Black Spruce	*Picea mariana*	25.1	39
4	Lambkill	*Kalmia angustifolia*	25	30
5	Alder	*Alnus*	21.5	30
6	Mountain Ash	*Sorbus americana*	19.8	30

Table 4.3 - Six most common herb species within the Eastern Shore focus area

Rank	Species		Total sample m^2	% Frequency N=23
1	Wood sorel	*Oxalis acetosella*	71.45	39
2	Twinflower	*Linnaea borealis*	52.79	39
3	Partridge-berry	*Mitchella repens*	41.5	52
4	Wood fern	*Dryopteris intermedia*	37.9	39
5	Creeping snowberry	*Gaultheria hispidula*	31.3	34
6	Bunchberry	*Chamaepericlymenum canadense*	22.71	54

Table 4.4 - Six most common moss/lichen species within the Eastern Shore focus area

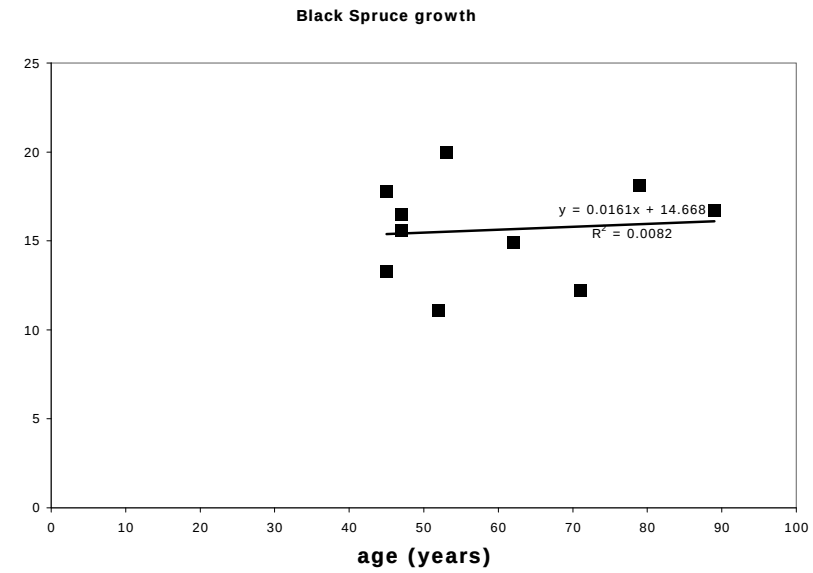
Rank	Species		Total sample m^2	% Frequency N=23
1	Schrebers	*Pleurozium schreberi*	848	91
2	Bassania	*Bazzania trilobata*	425	86
3	Sphagnum sp.	*Sphagnum spp.*	182	43
4	Stair step moss	*Hylocomium splendens*	129	52
5	Broom moss	*Dicranum scoparium*	30.2	69
6	Plume moss	*Ptilium crista-castrensis*	6	30

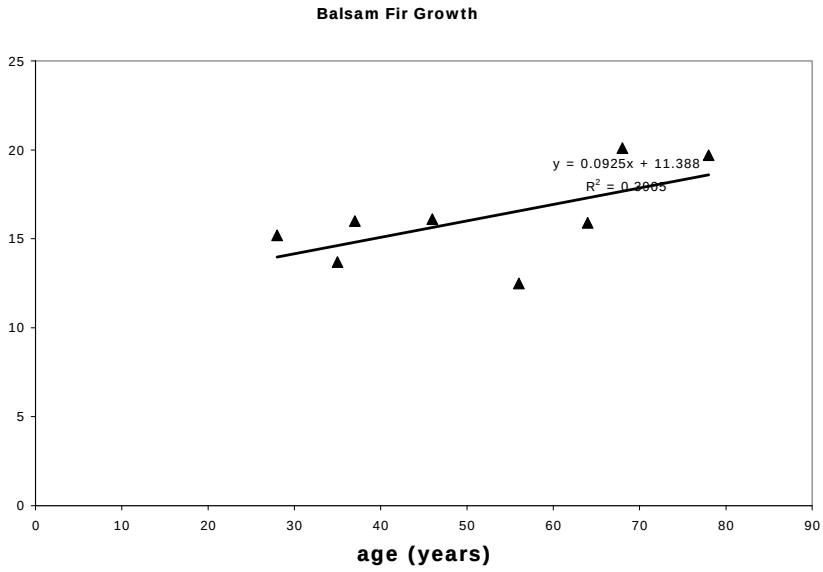
Table 4.5: Forest Vegetation Plot Data Summary									
Site	**Plot**	**UTM East**	**UTM North**	**Forest Species 1** (1)	**Ave Age** (2)	**Ave dia dbh** (3)	**Shrub Species 1**(4)	**Herb Species 1** (5)	**Moss Species 1** (6)
1	Borgles 1	522424	4955238	Balsam fir	-	-	Alder	Partridgeberry	Schreber's
	Borgles 2	521001	4955830	Black Spruce	45	17.8	Balsam fir	Partridgeberry	Schreber's
2	Cable 1	516451	4953902	Black spruce	45	13.3	Black spruce	Bunchberry	Schreber's
	Cable 2	516517	4954283	Black Spruce	47	15.6	Black spruce	Snowberry	Schreber's
3	Wolfes 1	518940	4954220	Black Spruce	89	16.7	Lowbush blueberry	Partridgeberry	Schreber's
	Wolfes 2	519207	4955042	Black Spruce	47	16.5	Balsam fir	Partridgeberry	Schreber's
	Wolfes 3	519329	4953341	Black Spruce	52	11.1	Balsam fir	Huckleberry	Schreber's
	Wolfes 4	519163	4952715	Balsam fir	78	19.7	Black spruce	Partridgeberry	Schreber's
4	Tuff 1	521667	4959162	Balsam fir	68	20.1	Balsam fir	Wood sorel	Bazzania
	Tuff 2	521590	4959049	Balsam fir	35	13.7	Balsam fir	Wood sorel	Bazzania
5	Inner Baltee 1	524046	4959216	Balsam fir	46	16.1	Balsam fir	Bunchberry	Schreber's
	Inner Baltee 2	524502	4958138	Balsam fir	64	15.9	Lambkill	Partridgeberry	Schreber's
6	Baltee 1	525586	4956965	White spruce	76	25.5	White spruce	Twinflower	Schreber's
	Baltee 2	525350	4958047	Balsam fir	37	16	Balsam fir	One flowered pyrola	Schreber's
7	Little Hbr 1	513275	4950984	Black Spruce	71	12.2	Mountain Ash	Bunchberry	Schreber's
	Little Hbr 2	514464	4950855	White spruce	27	20.4	Alder	Wood aster	Schreber's
8	Laybold 1	512916	4948976	Black Spruce	53	20	Balsam fir	Partridgeberry	Bazzania
	Laybold 2	513291	4948711	White spruce	60	20	Balsam fir	wood fern	Schreber's
9	Gerard 1	530292	4962156	White spruce	39	22.8	Balsam fir	Starflower	Stair step
	Gerard 2	529754	4960904	Balsam fir	56	12.5	Balsam fir	Wood sorel	Schreber's
	Gerard 3	529195	4959759	Balsam fir	28	15.2	Balsam fir	Wood sorel	Bazzania
10	Harry's 1	511396	4952101	Black Spruce	62	14.9	Balsam fir	Snowberry	Sphagnum
	Harry's 2	511555	4951547	Black Spruce	79	18.1	Black spruce	Partridgeberry	Schreber's

Notes:
1 - Forest Species 1: The species with the highest percent cover in the tree area
2 - Ave age: The average age (years) of the dominant or co-dominant tree in the plot (based on 2 trees per plot)
3 - Ave dia dbh: Average diameter (cm)of dominant or co-dominant trees in the plot measured at breast height (1.3 m)
4 - Shrub Species 1: The species with highest percent cover in the shrub layer (includes woody vegetation < 10m)
5 - Herb Species 1: The herb species with highest percent cover
6 - Moss/Lichen Species 1: The moss or lichen with the highest percent cover

Graph 4.4, below plots the relationship of age versus diameter for all trees sampled across the study area. The graph reveals a linear relationship area between growth and age for balsam fir, but not for black spruce. This supports the view that while the former tree is opportunistic and fast-growing, it may put less into stress tolerance and disease resistance than the black spruce. Black spruce was the dominant tree in the most stressed habitats (e.g. the water-logged muskeg), and in these situations this plant persists in a pole like state often to great age (e.g. 80 years in a bog) while exhibiting broom-like outgrowths.

Graph 4.4: Age and diameter values for trees cored over all island and mainland sites. There is a significant relationship ($p<0.05$) for balsam fir ($r^2= 0.395$) but not for black spruce.





4.4.4 Fire Disturbance

Fires are a significant cause of forest disturbance for much of Nova Scotia. Natural or lightning caused forest fires account for 3% of fires in Nova Scotia while those caused by humans account for 97%. Fires are a rare event because of the moist and foggy conditions along the Eastern Shore. While direct evidence (charred wood) of forest fire could not be established in an anomalous area of felled dead trees on the northeastern corner of Gerard Island, NSDNR records a human caused fire at that site in 1992 which burned approximately 6 ha (photo's 4.18-4.19).

Photo 4.18 – 2003 Aerial Image - 1992 forest fire Gerard Island. Approximately 6 has in size.

Photo 4.19 - Fallen down white spruce, killed by wild fire on Gerard Island

The largest burned area encountered over the surveyed properties was one that affected at least half of the landscape of Cranberry Island. Here whitened dead snags remained but the stumps of the branches were black charcoal (see photo 4.2). As a result, a large area that was formerly a tree community on this island has been transformed to shrub. Low lying areas and areas around small streams survived and in some moist low areas by the sea that were naturally protected from the fire, grew two uncommon orchids, rattlesnake plantain and blunt-leaf orchid (*Goodyera tesselata* and *Platanthera obtusata*). There may be other rarer orchids in such seaside black spruce forest.

Photo 4.20 - Fire damage on Cranberry Island

4.5 Plant Summary

4.5.1 Rare species and rare habitat

Of the properties studied, only coastal communities supported rare or uncommon plants (see table 4.6, below). This result was found by both Hill and Neily working on different sets of islands. It is to be expected because while the seashore habitats have a constant availability of disturbed patches for colonization by short-lived herbs adapted to a fugitive lifestyle, the interior habitats consist largely of forest, shrub barren or bog. The forest is a disturbed landscape at the decadal or century scale but there is not a species pool of rare trees to exploit disturbed patches, rather there are a few woodland trees (e.g. paper birch and fir) that readily fill in after black spruce patches are blown down. In the forest understorey stratum, the rarest herbs are a few less common, slow-growing orchids that require relatively undisturbed conditions rather than disturbances that produce large openings in the forest matrix. Shrub barrens were composed of common and competitive shrubs but in the main, these habitats were without the waterlogging stress that might be suitable for a rare birch (e.g. Betula michauxii). The bogs have a few *Sphagnum* species that are uncommon (S4, *Sphagnum angermanicum* and *S. linbergii* on Borgles Island, Photo 4.2) but none of the very rare (S1) *Sphagnum* species such as those that have been found in wetlands in the southwest of the province (e.g. Cameron et al., 2009).

This Eastern Shore archipelago is valuable for the habitats that other landscapes in Nova Scotia lack: seashore wilderness that is undisturbed by humans. The majority of rare species are rare because they are adapted to a habitat type that is rare. Rare plants are often poor competitors and so they occupy environments where natural stress levels or disturbance minimize the importance of plant to plant competition. For plants these are low biomass habitats that are infertile (e.g. low nutrient, waterlogged or saline soils) or are fertile but the biomass (plant materials) is constantly removed by disturbance (e.g. wave action, ice scour). This is the case for the rarest plants in Nova Scotia, the southern Atlantic Coastal Plain Flora whose diversity depends upon flood-associated stresses and disturbance found on the shores of large watershed area lakes, a rare class of habitat by area in Nova Scotia (Hill and Keddy, 1992). The sea islands of the Eastern Shore represent a gradient of natural disturbance from the most disturbed shorelines in eastern Canada (i.e. the southern, most exposed points of the islands in the outer part of the archipelago), to less disturbed, sheltered shorelines that face north or are in the inner part of the archipelago and are sheltered in the lee of the mainland or other islands. The most disturbed island shoreline habitat with adequate fine sediments from glacial tills is uncommon and the subset of that habitat that is both boreal and pristine is rare. These islands offer a rare, boreal coastal wilderness with disturbance regimes that maintain a mobile plant community of rare boreal plants.

TABLE 4.6: Rare (S1-S2) or uncommon (by rank (S3) or distribution*) plant species found at five islands.								
Common name	**Scientific name**	**Rank**	**Habitat**	**Borgles**	**Cable**	**Laybold**	**Gerard**	**Cranberry**
Coastblite	*Chenopodium rubrum*	S1?/GS 2	Shore Wrack			**X**		
Golden Dock; Tierra del Fuego Dock	*Rumex fueginus*	S3S4/GS4 200 km from next nearest	Upper Saltmarsh			**X**	**X**	**X**
Knotted Pearlwort	*Sagina nodosa*	S2S3/GS4	Cobble shores	**X**		**X**		
Beach Ragwort	*Senecio pseudoarnica*	S2/GS3	Cobble shores	**X**		**X**	**X**	**X**
Lichen	*Lichina confinis*	* One location on mainland NS	Sea Headlands	**X**				
Total rare or uncommon				**3**	**1**	**5**	**2**	**2**

Photo 4.21 - Coastblite (*Chenopodium rubrum*) (FoNI, 2010)

Photo 4.22 - Golden Dock (*Rumex maritimus*)

Photo 4.23 - Knotted Pearlwort (*Sagina nodosa*)

Photo 4.24 - Beach Ragwort (*Senicio pseudoarnica*)

	
	Photo 4.26 - *Lichina confinis*

As would be expected, both Hill and Neily found a guild of rare stress and disturbance adapted plants, largely boreal (beach ragwort, knotted pearlwort) in distribution, in the coastal plant communities (see Table 4.6). Rare and uncommon species discussed here are status S1 through S3, or are rare for the Atlantic shore section.

The most disturbed habitats were the beaches, and these featured the rare (S2) seabeach ragwort (*Senecio pseudoarnica*) and the very rare (S1?), coast blite (*Chenopodium rubrum*) on top of the cobble beaches. Knotted pearlwort (S2/S3, *Sagina nodosa*) occupied gravel habitats beyond the crest of beaches . The habitat of each of these species was different; while the perennial seabeach ragwort occupied areas of cobble where the chance of disturbance from cobbles rolling was high and where fertility (seaweed source) was intermittent.

The annual coastblite habitat is similar but it occurs with a host of exotic annuals and the exotic sowthistle on temporarily stable beach tops where fertility is high from beds of rotting seaweed. The perennial knotted pearlwort colonized headland areas inland of the beach crests where biomass is reduced by the build up of salt from wave spray and the removal of organics by constant winds. These are areas colonized by perennials (e.g. *Plantago maritima*) and growth is slow. This microsite is limited spatially and the plants accordingly have only limited dispersal ranges, enough to remove them from parents but to disperse them outside the zone. Knotted pearlwort has splash cup dispersal that responds to hygroscopic pressure as well as bulbils which are large vegetative units suited for very local establishment near the parent plant.

There are also lichens such as the boreal *Lichina confinis,* (reported only once on mainland Nova Scotia, restricted to Cape Breton and the Avalon Peninsula of Newfoundland) observed on headlands of Borgles Island that similarly are quite salt tolerant. In addition, this salt spray zone is colonized by two salt-tolerant mosses (Ireland, 1982), *Grimmia maritima* and *Ulota phyllanthus*.

Lastly, there were rare plants found near salt marsh zones. The (S3/S4) golden dock (*Rumex fueginius*) was found in gaps near rank vegetation in brackish conditions. There is much of this habitat where freshwater seeps meet salt marsh. This habitat also may be formed when once closed barrachois are

ripped apart and a large amount of freshwater peat becomes salty or brackish. The annual golden dock fits such a disturbed niche where fertility is high but communities are becoming organized after a change in salinity or a disturbance in a salinity transition zone. This small prostrate annual always occurred with the tiny seaside buttercup and it often occurred next to a 3-square bulrush (*Schoenoplectus pungens*) near cattails (*Typha latifolia*).

This suite of rare plants occurred on several islands (see table 4.6 and map 4.1). Most of these occurrences were noted on the most windswept, southwest shorelines of the islands. Eighty percent of the vascular plants obeyed this pattern in general as did the lichen, *Lichina confinis*. Only the coastblite, found in a high biomass zone of annuals on rotting seaweed showed an unsimilar pattern.

Threatened habitat is also part of this island complex. The shoreline, though disturbed and subject to sea level rise, appears to be in a state of dynamic equilibrium: as sea levels rise, the shoreline essentially moves inland and in the conversion of terrestrial into inter-tidal, substrates are bared and are available for colonization by various salt-tolerant vascular plants. This is a mobile community of plants and their adaptations to disturbance are various; some respond to disturbance by their growth capabilities (e.g. beach groundsel can be overturned in cobbles and emerge through rhizomes to the new surface in spring), others are capable of rapid regeneration via seeds or bulbils (knotted pearlwort).

Above this zone of disturbance adapted plants, however, is a very restricted heath type, the black crowberry barrens (photo 4.27). While we cannot say that this is a rare habitat, it is restricted to south-facing headlands and headland areas of islands and these heathlands are being eroded into the sea and may be taxed by rising temperatures.

Crowberry is a stress adapted, slow-growing shrub that outlasts other woody plants by its prostrate growth and evergreen growth strategy (nutrient conservation and year-round photosynthesis). There is evidence from the south shore of Nova Scotia that this heath community is being lost at rates (as much as 70% in one instance, Hill et al. in review) that are in no way compensated for by the disturbance suffered by the spruce forest. This community association is not specific to bedrock type (Porter 2013), but in a provinicial context is found most frequently underlain by granite, a very hard bedrock type that is resistant to erosion. In these areas, crowberry communities would not face the same pressures. Most barrens are underlain by the hardest bedrock types (Oberndorfer 2009; Porter 2013).

On Gerard Island and elsewhere, we found wide crowberry heaths that appeared to be in equilibrium with the blow down of the forest trees. Crowberry regenerates from seed in the shade of the spruce forest and can then take over when trees die. On other islands (Laybold) where disturbance is greater, the loss of heath at the shoreline margin may outpace the gains of heathland at the woods' margin. This crowberry heathland produces a large berry crop (photo 4.28), as do other heather family shrubs (snowberry and foxberry) that are part of the seashore gallery forest. These berries are part of a food web that needs further investigation.

Photo 4.27 – Black Crowberry barrens - a restricted heath type - southern shoreline of Laybold Island.

Photo 4.28 - Black Crowberry fruit
(Nova Scotia Wild Flora Society, 2009)

This boreal forest should contain typical boreal forest rodents (meadow vole, red-backed vole, southern bog lemming and the woodland jumping mouse ---*Microtus pennsylvanicus, Clethrionomys gappii, Synaptomys cooperi* and *Napaeozapus insignis*) that may be part of such a food web (Hebda, A.,pers comm. To NMH 2012) .

Nothing in the highly disturbed, young boreal forest of black spruce and fir indicated that it had high conservation value for the plant community itself. There were two orchids (tesselated rattlesnake plantain and blunt-leaf orchid; Goodyera *tesselata* and *Platanthera obtusata*) (photos 4.29 and 4.30, respectively) that are part of a guild of small orchids (also includes *Listera cordata,* common twayblade) that inhabits moist, Atlantic coastal spruce woods with much decaying wood in the moss layer.

Photo 4.29 - Tesselated Rattlesnake Plantain

Photo 4.30 - Blunt-Leaf Orchid

These are not uncommon plants, and though the rattlesnake plantain has not been reported this far north along the Eastern Shore (Munden, 2001) this reflects an overall lack of botanizing in this region. The blunt-leaf orchid is a northern plant that is scattered along cool moist coastal areas of Nova Scotia (Munden, 2001). The inland shrublands are competitive arenas filled with common species (e.g. lambkill, wild raisin, huckleberry, leatherleaf, Labrador tea). Open and treed bogs inland have not yet revealed

any unusual plants though several of the species found indicate a boreal tendency in the herbaceous flora (e.g. buckbean, bakeapple, swamp cinquefoil; *Menyanthes trifoliata, Rubus chamaemorus, Comarum palustris*). Various sphagnum mosses were recorded which though not abundant, are not judged as uncommon (S4 rankings). Some lichens (observed in detail with mosses by Neily in this preliminary survey) were of interest, in particular *Coccocarpia palmicola* and *Moeleropsis nebulosa* from Borgles Island. These are known associates of the boreal felt lichen (*Erioderma pedicellatum*) whose habitat was predicted by a NSDNR model to occur on Borgles, however, foliose lichens as a group were poorly represented in island forests and no rare woodland lichens were observed.

4.5.2 Plant Survey Conclusions

The rare plant community discovered to occur on at least half of the islands surveyed in this archipelago, may be maintained in a metapopulation way as disturbances create patches that become colonized in a variety of ways. Plants have propagules that can be blown between islands (e.g. beach ragwort, or *Lichina confinis*) or that can float (e.g. knotted pearlwort) or are transported by waterfowl (e.g. golden dock, coastblite). Plants may be one of the most responsive groups to the evolutionary forces associated with islands and they may well reflect the influence of area and isolation as was encapsulated in the theory of Island Biogeography (Cody, 2006). We do not yet understand the scale or relative importance of these processes and Forman (1995) has somewhat discounted the impact of isolation in determining the diversity of biological communities on islands or island analogues; it is clear, however, that these islands are an ideal evolutionary landscape and populations here track environmental conditions on islands that are pristine and in large measure unaffected by anthropogenic disturbance. This in itself is rare, and on this scale of more than 100 islands is of global significance for scientific and conservation reasons. In this preliminary study, we have identified a mobile community of rare plants that can be found on half of the islands and that have very strong association with the most disturbed shorelines, the south and west-facing island shores. These plants are associated with natural disturbance regimes and they appear much less frequent on the shores of the adjacent mainland.

This is a boreal coastal wilderness and this may be a factor that explains why the rare plants have persisted on the island shores. The guild of rare coastal plants is largely a boreal group and two of these (*Senecio pseudo-arnica* and *Sagina nodosa*) are also rare plants of the coastal boreal zone in New Brunswick on the north shore of Fundy (Hinds, 2000). These rare plants are indicators of the natural disturbance regime. The plants discovered so far give insight to the disturbance pattern in this landscape and there are more than twenty other rare plants (S1 to S3, see below) that potentially inhabit these coastal communities. These are mostly Atlantic shoreline species, some are known from Sable Island (Sable has 3 of the rare plants (*Chenopodium rubrum, Rumex fueginius, Senecio pseudo-arnica*) found here), some are known from coastal bogs, and many are boreal in distribution. Given the range of exposure conditions among the complex of islands on the Eastern Shore, we will continue to add rare species to this island list.

Table 4.7: List of 21 potential rare seashore and seashore wetland plants on Eastern Shore islands. Note Carex vididual is also nationally rare (N1, G5T1). Iris prismatica is also nationally rare (N1) and Suaeda richii has not been previously recorded in ACCDC databases. Species marked "sable" may have been found on sable island.			
Species Name	**Sub-National Ranking**	**Species**	**Sub-National Ranking**
Carex livida	S1	*Euphorbia polygonifolia* (seaside spurge)	S3
Carex rariflora	S1	*Juncus brachycephalus, J. bulbosus*	S1 , (Sable)
Carex viridula (vars. *elatior* and *saxilittoralis*)	S1,	*J. greenei* and *J. vaseyi* (4 rushes)	S1, S1, S1/S2, S1, respectively
Centunculus (Anagalis) minima (chaffweed)	S1 (Sable)	*Polygonum buxiforme Smalls knotweed*	S2/S3, exotic
Cochlearia tridactylites (limsetone scurvygrass)	S1	*Ranunculus scleratus* (cursed crowfoot)	S1/S2
Coeloglossum viride (bracted orchid)	S2S3 , (Sable)	*Blysmus Rufus* and *Schoenoplectus americanus*	S1 and S3, respectively
Cyperus lupulinus (slender flatgrass)	S2	*Stellaria humifusa (*creeping sandwort)	S2
Iris prismatica (slender iris)	S1	*Suaeda richii*	S1
Empetrum eamesii (Eames' Crowberry)	S3	*Suaeda calciformis*	S2/S3

4.6 Bird Survey Summary

4.6.1 NSNT Bird Survey

From the results it can be seen that Borgles Island is particularly important for common breeding birds with high numbers of common yellowthroat plus noteworthy populations of yellow-bellied flycatcher, blackpoll warbler and fox sparrow. Fortunately, this island was covered by two observers early in the project which presented a realistic reflection of numbers. However, the diversity and suitability of habitat on Borgles for the bird species found indicates this island to be significant for the number and density of common birds. With a limited area of the island covered during the survey the potential extrapolated numbers of birds recorded for Borgles Island is likely to be high.

Also, Borgles Island is probably representative of bird species likely to be found on most of the Eastern Shore Islands. Some of these bird species are not represented within later lists for the other Eastern Shore Islands perhaps due to the lateness of the surveys, but would possibly have been recorded if the islands had been surveyed 4-6 weeks earlier in the season.

A total of 76 species was recorded during the survey period. This figure includes waterfowl and shorebirds returning on fall migration.

4.6.2 Other Bird Surveys

During the summer of 2008, as part of bird recording for the Maritime Breeding Bird Atlas, Dr. Ian McLaren surveyed a number of islands located within Clam Harbour and around Little Harbour. While some of the islands surveyed by Ian McLaren are situated just to the southwest of the Eastern Shore

focus area (Barren Island, Duck Island, Roger Island and Long Island), a number of the islands visited by Dr McLaren are found within the Eastern Shore Focus area (Laybold Island, Porter Island, Egg Island, Goose Island, Key Island, Bald Island, Black Ledge and Bald Rock). A complete list of the birds observed during Dr McLaren's survey can be found in appendices I-K, located at the end of this document.

In general, Dr. McLaren's recorded observations for the Maritime Breeding Bird Atlas made during the summer of 2008 corroborate the observations made during the summer of 2011 by the Nature Trust's observers. Although many of the same birds were observed during this two different field surveys, Dr. McLaren's survey did turn up five additional birds not observed by the NSNT surveyors. Of particular note are the Leach's Storm Petrels, which tend to nest in localized colonies on the outer islands where there is less predation. Dr. McLaren made two observations of the Leach's Storm Petrels; one on Barren Island and one on Bald Island. Of these two islands, Bald Island is situated within the Eastern Shore focus area, just to the east of Laybold Island.

Dr. McLaren's observations for the islands indicate the benefit of visiting earlier in the breeding season (June). Visiting earlier in the season would likely increase the overall list of birds present on this group of islands.

4.7 Incidental Observations

Although mammals and reptiles were not studied in detail during the field surveys, incidental observations made by the team were recorded.

4.7.1 Borgles Island

Garter snakes were observed only on Borgles Island although no attempt was made to look for them by turning over rocks. Deer and squirrels were also observed on Borgles Island and signs of varying hare were noted. Anecdotal information indicates that Borgles Island is a popular location for hunting deer in the fall season.

4.7.2 Gerard Island

Gerard Island is also known for its deer population and is a popular hunting area during the deer season. A notable feature of Gerard Island is the Bawleen which is a bay surrounded by Gerard Island, Phoenix Island, Stoney Island and Cap island (see appendix H.1 – Aerial Image – Gerard Island). This bay features shallow water with many rock outcrops and an open area in the center with a depth of approximately 5 meters. Because of the shallow water, sunlight penetrates to the seabed in many areas. A rich diversity of sea plants were observed on the seabed on entering the area. The Bawleen provides habitat for seals and may provide ideal habitat for a large number of marine biota. Further field studies and documentation in this area is warranted.

4.7.3 Harry's Cove/Cranberry Island

A large salt marsh is located between the mainland property of Harry's Cove and Cranberry Island. The main channel through this marsh runs from Little Harbour northward into large tidal bay. Much of the marsh is exposed and drained at low tide by numerous channels that spread into the marsh. At high

tide the north portion of the marsh is covered by seawater, however a section in the southern area remains above high tide under most conditions. During extreme tidal conditions it is likely that this area will flood as well. This salt marsh provides habitat for a wide range of bird species, plants and marine biota. Further field studies and documentation in this area is warranted.

4.7.4 Geomorphology and Landscape

Although not directly mandated in this study, the landscape value and geological features on the properties were frequently noted by members of the study team. The coastal view in the Ship Harbour area as well as local geological features found on some sites have considerable aesthetic appeal. Some of these features are demonstrated in photographs throughout this report.

4.8 Overall Discussion

The islands are more than a collection, they are an archipelago complex which works well as a unit to provide migration feeding opportunities for a large fly-through population of birds, to maintain a mobile population of rare, boreal vascular plants, to serve as an evolutionary cauldron for a variety of groups still to be enumerated (e.g. rodents and plants), and to provide a habitat base for boreal communities faced with climatic change. These islands provide these ecological and evolutionary services in a pristine landscape.

We found 5 rare plants and one rare lichen among the island flora and their distribution provided two conservation insights:

1) rare plants are restricted to the shoreline habitats, and,
2) more than 90% of their 20 occurrences are on the most wind exposed (south-southwest) coastline.

These findings suggest that it is the shorelines of these islands that are most valuable for conservation of regional diversity. Second, the consistent within-island pattern of rare plants occupying the southernmost, most naturally disturbed shorelines (and not the shores adjacent to mainland) of islands, strongly indicates that this mobile guild of rare plants is better represented on islands and that they may depend upon islands for their regional persistence. The majority of the shores of these islands are fashioned by the natural disturbance regime while many on the mainland are anthropogenically modified. The shorelines of these islands require a stewardship management plan.

We have an understanding of the importance of islands for this group of mobile stress-tolerant and disturbance adapted plants but there are likely other groups (e.g. the lichen, *Lichina confinis)* that depend upon this unbroken record of natural disturbance.

In addition, these islands are arguably, if not boreal old growth forest, boreal old-process forest. The forest survey gave valuable insight into tree dynamics and showed that while none of the forests were old, the large majority of forest stands appeared to reflect a continual influence of natural stress and disturbance and only rarely, human disturbances. Although we cannot properly appreciate or communicate this, an unbroken record of thousands of years of only natural disturbance, places the

ecological and scientific value of these island forests at the forefront of conservation importance. Given this record and an average stand lifetime of 75 years (taking an average of the average tree age from 24 plots (ca 50 years) and the maximum age (ca. 100 years) overall) there may have been 130 sequential tree generations to have established and reseeded on these islands since the glaciation (assumed 10,000 years). For whatever ecological process we want to consider in this maritime island forest, we have the perfect model system for its study and the ideal incubator to search for boreal forest organisms, from microbe to *Microtus* voles.

Lastly, this habitat is boreal wilderness facing a changing climate and sea-level. Monitoring these ecosystems on the frontline of climate change will provide the most clear ecological understanding of the resistance, resilience and adaptive potential of natural systems.

4.9 Recommendations for additional work

This information gathered in this study provides a useful data set on the ecology of the islands and shoreline of the coastal area of between Little Harbour and Spry Bay. The observations made in this field program can be used to confirm characterizations of the area which have previously been inferred from field data on the mainland. This by definition was a preliminary study and as such, it points the way for follow up work.

4.9.1 Aquatic and Wetland Studies

A number of the islands have ponds and wetlands which warrant further investigation. Recommended parameters for future studies include: water quality, phytoplankton, zooplankton, fish, benthic organisms, aquatic vegetation and reptiles. The locations of the wetlands ponds require significant effort for limited one day programs. More comprehensive studies will require a longer duration field program at each location and further logistics support. Access to wetland areas and ponds will require a small boat or vessel and would benefit from specialized field equipment and a base camp to support a more comprehensive program involving sample analysis and preservation.

The Bawleen which is surrounded by Gerard Island, Phoenix Island and Stoney Island is a sheltered shallow water bay which appears to have a rich diversity of marine life. Recommended studies include: marine vegetation, the benthic community and fish.

4.9.2 Avian Studies

Bird observations should be undertaken to coincide with the early spring migration and the nesting season. Observation programs should be initiated early in the day in order to optimize the observation program. Timing these observations in the region is hampered by spring fog conditions which limit safe navigation to some islands. Camping on the islands for a few days early in the season would provide the observers with an early start times for their programs.

4.9.3 Plant Species

The islands support a group of rare seashore plants. Ninety percent of their distribution (and 90% of the overall distribution of rare organisms found in this study) occurs on the most naturally disturbed shorelines at the southern tips of islands. Follow up study is needed for this habitat type to widen our map to include other islands that are part of this island complex and to search with an image of the other rare species possible (see the list of 21 potential additional rare plants). This study should take place, preferably, in July or August. From our preliminary map, we can predict what areas are most likely to house rare plants and a thorough survey for rare flora could be done in a day for most islands. This could be reduced to half a day per island, if resources were scarce.

4.9.4 Boreal Organisms and Communities

All of the rare plants were boreal or alpine (with one exception). The forest vegetation was characteristically boreal. Many of the birds observed are boreal and these require an increasingly rare, boreal climate that may be longer available on these islands than on the mainland. These islands are one of the few truly boreal landscapes in Nova Scotia and they are disjunct from the boreal of Cape Breton or the Fundy coast. We need to describe this anthropogenically undisturbed boreal forest for its microflora (bacteria, fungi, soil invertebrates) and its rodents. We could only speculate on the species that might be found but anything found would be benchmark data for this boreal coastal wilderness area.

Monitoring studies of the rate of change in the boreal communities will be of use to climate change research. Transects should take in seashore, the gallery forest and interior woodland and bogland communities. The first of such studies will set a benchmark that will be the reference for succeeding surveys. We know that the shoreline is the most dynamic community and here, we need a design that can separate chance change from changes that are directional. Such a monitoring study will have international utility since we are dealing with pristine natural ecosystems on the frontline of climate change and on the cusp between boreal and incipient temperate climates. These studies should focus on plants and the structure of the community but there should be investigation of the decomposer community (fungi, bacteria, microfauna etc.), and the insect and vole communities. It will also be most useful to have a focus on forest health to gauge objectively how pest attacks are or are not increasing in pristine, boreal forest ecosystems where the covariable of harvesting impact is absent.

5. RATIONALE FOR CONSERVATION

5.1 Summary

The islands that make up the Eastern Shore archipelago are a true wilderness area. One that represents a wilderness that is increasingly rare in Nova Scotia and that is even more so along the province's Atlantic shores. Despite Nova Scotia's long history of settlement, this flotilla of more than a hundred or so islands has for millennia been left to the ravages of wind, wave, storm and fog, experiencing little in the way of disturbance from man.

Cold, wet, stormy and forgotten; these are the ingredients required to create a pristine coastal boreal wilderness area. Such are the conditions found along the Eastern Shore of Nova Scotia. We can estimate that this island wilderness has grown more than 130 successive generations of boreal forest stands since the last ice age some 10,000 years ago. In this scenario, the forest stands set up for 50 to 100 years, only to be knocked down by the ravages of Mother Nature. Short rotations of coniferous forest trees, such as the black spruce and fir found throughout this area are typical of a natural boreal forest, and nowhere else in Nova Scotia can one find boreal woodlands that truly reflect natural processes.

These islands represent a true conservation bonanza within a larger landscape that has mostly been left to a short term forest management technique known as clear-cutting. This group of islands is some of the only untouched boreal forest found on peninsula Nova Scotia, and is disjunct, by some 200 km from pristine remnants found in the Cape Breton Highlands.

Although these island woodlands do not fit within the definition of "old growth", they can be considered "old process" systems that have provided, and still provide a continuity of habitat to a community of decay fungi, beetles and small mammals. These are globally significant benchmark forests that can inform conservation and forest management about nutrient supply, decomposition, microbial dynamics, and forest soil biodiversity. Benchmark systems are of great value to our understanding of climate change since most forests have local anthropogenic factors (compaction, organic matter, and nutrient capital depletion) that confound the signal from climate change.

This preliminary study has laid the groundwork, establishing the integrity and sensitivity of the forest and habitats on these islands, and of the bird communities that reflect its boreal nature. As is, these islands provide a laboratory to understand forest process in pristine natural systems, and to serve as an early indication of how climate change may affect forest processes, food webs and diversity patterns.

The boreal forest of these islands is underlain with an assortment of boreal dwarf shrubs, including crowberry, foxberry and snowberry, which feed a community of rodents and small birds. Of particular interest are the dwarf shrubs that become a coastal crowberry heathland on the windswept southern exposure of the islands. These heathlands are a fragile habitat, and are threatened by a number of factors. These include disturbance from man through the alteration and hardening of shorelines, as well as the winter warming caused by climate change. Becuase of these factors the heaths of these boreal islands may become refuges for this ecosystem throughout the province.

The mosaic of interconnected and interdependent habitats found on these islands consists of open and treed bog, and forest within the interior of the islands, and saltmarsh, barachois pond, headland, beach and rocky shore at the seaside. The various island shapes reveal how wind and sea erosion take geology and generate shoreline complexity. Island saddles are broken through to form tombolo beaches, barachois ponds become spits with organic saltmarsh, and the saltmarsh in turn is worn down, as are headlands and even forested shorelines. Landform transformation is an evolution of landform, and in this process of creation and destruction of numerous shoreline niches (sand beach, cobble shore, organic saltmarsh, organic pondshore), gaps open up for a guild of fugitive plants. The biodiversity of the shoreline community depends upon the constant turnover of these places: the eradication of a patch, the creation of a gap (or "niche") and the colonization of that gap by one of a number of mobile plant elements.

This landform transformation is possible in pristine areas without anthropogenic interference. Where the landforms are abridged by forest clearance, drainage, hardscaping of roads, wharf construction and infilling, the shoreline niche diversity is gone. In this preliminary survey, a guild of mobile rarities has been observed that are boreal stress-tolerant plants adapted to salt-spray and disturbance. These rarities include the showy beach ragwort, the knotted-pearlwort and coast-blite. In addition to rare plants a lichen, *Lichina confinis*, was found that is wholly European in its known range.

This biodiversity is dependent upon the 100 kms of naturally disturbed, south-facing shorelines. In just 17 days of unfocused plant exploration, this survey has managed to increase the known sites for the beach ragwort for the province by 67% (4 new sites). Additionally, there is a suite of 21 other rare coastal plants (11 are considered endangered) that occur on Sable Island, St. Paul's Island and Cape Breton that we might find in this area. With our mapped findings as a predictive tool (i.e. southern shores with fetch), future field work will surely populate these islands with other rare plants.

Like the island archipelagos of the San Juan Islands in Washington State, and the Broken Group Islands in Barkley Sound, British Columbia, we have along the Eastern Shore of Nova Scotia a group of a hundred near pristine islands of variable size, shape and distance from each other and from shore. This group of islands represents a landscape that has been lost along much of coastal Nova Scotia, and the conservation of them is of obvious value to scientists, naturalists and eco-tourists alike.

The group of islands that make up this Eastern Shore archipelago presents a significant opportunity to conserve one of the last remaining large, undisturbed areas of Nova Scotia's Atlantic coastline. As revealed through this survey, this group of islands represents a wilderness that is both dynamic and ever changing, and one in which natural processes are allowed to continue with relatively little anthropogenic disturbance. But it is also a fragile and sensitive environment, and one that is in need of protection before it is lost.

The uniqueness of this area of the Eastern Shore has not gone unnoticed. During early exploration of this area in the 17th century, Nicolas Denys noted of this group of islands, that they "are not wanting fine woods and good land, and spots beautiful and pleasing."

In more modern times, the area has been considered for designation as the Ship Harbour National Park in the early 1970's. Following this, the provincial government recognized the area for its potential as a network of protected areas that would have been known as the Eastern Shore Seaside Park System. This park system was intended "to capture the essence of the Eastern Shore landscape".

While neither of these parks was ever fully realized, elements of the Eastern Shore Seaside Park System were implemented: Clam Harbour Provincial Park, Taylor Head Provincial Park. These two provincial parks bookend the Nature Trust's Eastern Shore focus. There are a number of additional protected areas within this region of the province, including Tangier Grand Lakes and Ship Harbour Long Lake Wilderness Areas, as well as two Nova Scotia Nature Trust conservation areas: Ship Rock Islands Conservation Lands, near Murphy's Cove, and Shelter Cove Wilderness Sanctuary, near Tangier. Like the rest of the Eastern Shore focus area, these conservation lands provide critical habitat and ecosystems for a diversity of wildlife. Despite this wealth of protected areas within the Eastern Shore focus area, this region of the province, according the provincial governments Natural Landscape Themes of Nova Scotia, is only considered to have "partial" representation within the provincial network of protected areas.

Through the Colin Stewart Forest Forum process, Nova Scotia's large forestry companies, provincial ENGOs and the provincial government worked together to identify and prioritize across the Province large remaining roadless wildlands, areas representative of the range of the province's landscapes and ecosystems, and concentrations of rare or otherwise significant ecological features such as old-growth forests and habitats of species at risk. Through this process, all crown land within the Eastern Shore focus area has been identified as "Tier 1 – First Slate". It has been recommended that the Province should immediately work towards designating such areas as these are "high-priority sites located entirely on public land that have low conflict with forestry and can be implemented with little cost".

This same group of islands has been included as part of the province's 12% Lands for Review process. Through this review process, the provincial government intends to identify, and ultimately protect "the best natural areas in the province". To accomplish this, the provincial government is using the "4-Rs" approach to identifying those lands that will be included as part of the 12%: remote, representative, rich and rare – qualities that apply to this coastal island wilderness area.

For a multitude of reasons from conservation, to responsible recreation, education, and scientific understanding, this Eastern Shore Archipelago should be put on the national and international map. We have lost this opportunity over much of coastal Nova Scotia and these islands are the only group that is still mainly pristine and preserved. We passed by this opportunity twice before (National and Provincial Park plans) and with the unplanned and unpredicted development of other remote coastal regions of Nova Scotia as a warning, we know that if we fail act boldly this chance to seize a conservation showcase may pass us by.

5.2 Recommendations

Based on the findings from this ecological study, the conclusion of this report is that that the Nova Scotia Nature Trust should proceed with a focused land assembly project within the Eastern Shore island archipelago. This opinion is based on the following rationale:

1.) Undisturbed Landscape

The Eastern Shore island archipelago represents a landscape that is rapidly disappearing from much of Nova Scotia's Atlantic coast, if not from much of the eastern seaboard of North America. Where this landscape does exist, it tends to be small in size and fragmented. Over many millennia, the local conditions found along this stretch of the Eastern Shore coastline has produced a true boreal rainforest that has experienced little disturbance from man, and that consequently continues to reflect natural change, process and disturbance. This landscape is a rarity in this province, and can be compared with other well-known groups of protected islands, such as the Broken Group Island in British Columbia and the San Juan Islands in Washington State. With its concentration of biodiversity (including 76 species of birds and 6 rare plants observed during 17 days of field work), old process forests and its variety of different interconnected habitats, the Eastern Shore island archipelago offers the best, and possibly last opportunity to conserve such an important part of our Canada's natural heritage.

2.) Threats to Coastal Islands

Unlike other coastal areas of Nova Scotia, such as Mahone Bay or St. Margarets Bay, the Eastern Shore has not experienced the degree of settlement pressure facing these other regions of the province. And this is an opportunity that should be seized. This Eastern Shore island archipelago remains a pristine wilderness area that certainly has many of the natural elements that make it a desireable place to live, and although this area of the province isn't facing significant development pressures now, how long before it does? With development will come an inevitable disruption to the natural processes occurring on this group of islands, and a lost opportunity for a wilderness refuge on the Eastern Shore.

3.) Land Assemblage

The Eastern Shore focus area is made up of 100 or more islands, ranging anywhere from a fraction of a hectare up to 350 hectares in size. Roughly half these islands are crowned owned, and are currently under consideration for formal protection through the province's 12 percent protected areas planning process. This process, which aims to protect at least 12 percent of Nova Scotia's land mass, is considering for designation selected crown owned land, and some larger forestry lands across the province based on natural values such as biodiversity and habitat for wildlife, and whether those lands fit within the "4-Rs"approach – Remote, Representative, Rich and Rare. This group of islands ticks all of these boxes. In partnership with the Nature Trust, this large assembly of islands could represent one of the most significant protected areas along the coast of Nova Scotia.

4.) National Park and Provincial Park

This area of the province has twice been considered for protected areas status before. First, in 1972 the area was proposed for designation as Ship Harbour National Park. However, due to plans for the expropriation of local residents and businesses that produced widespread protest, the government eventually retracted its plans to create such a park. Following the demise of the proposed national park, the provincial government, with assurances of no expropriation, proposed the creation of the Eastern Shore Seaside Park System. Although this park was never completly realized, we do today benefit from elements of this plan: Taylor Head Provincial Park, Clam Bay Provincial Park, and later the Tangier-Grand Lake Wilderness Area. Additionally, the Nature Trust already has two conservation lands in this area: Ship Rock Islands and Shelter Cove Wildenerss Sanctuary, and is currently in early discussions with other private landowners to protect a number of other islands. With the 12 percent protected areas planning process currently under way, the provincial government now has the chance to continue on with the creation of a park system along the Eastern Shore. In partnership with the Nature Trust, we may one day realize what was originally planned back in the 1970's.

5.) Other Values

Although not the mandate of the Nova Scotia Nature Trust, the Eastern Shore island archipelago concept could present some significant economic opportunities for an area where individual and family incomes are currently below the Provincial average (NS Community Counts, 2006 Census). With the increased awareness of this area, and the rest of the Eastern Shore eco-tourism opportunitieswithin this part of the province could be significant with such a large protected area.

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7. COMPONENT STUDIES

Plant Species List for Surveyed Islands

The following component studies summarize details for each of the 8 islands and 2 mainland properties visited during the field survey. The freshwater wetland and shoreline plant community data has been taken from the summer and fall surveys of Tom Neily and Nick Hill, respectively and is presented for each island in Tables 6.1 - 6.4.

Table 6.1: Summer survey of freshwater wetland plants on five islands and a mainland coast.

Common Name	Scientific Name	Borgles	Cable	Wolfe	Inner Baltee	Baltee	Little
SHRUBS							
leatherleaf	*Chamaedaphne calyculata*	X	X	X	X	X	X
black crowberry	*Empetrum nigrum*	X	X	X	X	X	X
snowberry	*Gaultheria hispidula*						X
black huckleberry	*Gaylussacia baccata*	X	X	X	X	X	X
bog huckleberry	*Gaylussacia dumosa*	X		X	X	X	
Canada holly	*Ilex verticillata*						X
common juniper	*Juniperus communis*	X	X	X		X	X
sheep-laurel	*Kalmia angustifolia*	X	X	X	X	X	X
bog laurel	*Kalmia polifolia*		X	X	X	X	X
sweet gale	*Myrica gale*	X	X	X	X	X	X
northern bayberry	*Myrica pensylvanica*	X	X	X	X	X	X
false holly	*Nemopanthus mucronata*						X
black chokeberry	*Photinia melanocarpa*	X			X	X	X
rhodora	*Rhododendron canadense*	X	X	X	X	X	X
common Labrador tea	*Rhododendron groenlandicum*	X	X	X	X	X	X
cloudberry	*Rubus chamaemorus*	X	X	X		X	X
large cranberry	*Vaccinium macrocarpon*	X	X	X		X	
small cranberry	*Vaccinium oxycoccos*	X	X	X	X	X	
foxberry	*Vaccinium vitis-idaea*	X	X	X	X	X	X
witherrod	*Viburnum nudum*	X	X	X	X	X	X
HERB DICOTS							
bog aster	*Aster nemoralis*	X					X
bunchberry	*Chamaepericlymenum canadense*	X	X	X	X	X	X
roundleaf sundew	*Drosera rotundifolia*	X	X	X	X	X	X
bog buckbean	*Menyanthes trifoliata*	X					
northern pitcher-plant	*Sarracenia purpurea*	X	X	X	X	X	X

marsh St. John's-wort	*Triadenum fraseri*		X	X		X	
marsh blue violet	*Viola cucullata*	X					
bladderwort	*Utricularia* sp.			X			
HERB MONOCOTS							
swamp-pink	*Arethusa bulbosa*	X					
grass pink	*Calopogon tuberosum*		X	X			
sedge	*Carex atlantica*		X				X
sedge	*Carex brunnescens*		X				
sedge	*Carex interior*			X			
sedge	*Carex limosa*						X
sedge	*Carex magellanica*	X	X		X	X	
sedge	*Carex nigra*	X					
sedge	*Carex pauciflora*	X					X
sedge	*Carex stipitata*		X				
sedge	*Carex stricta*						X
sedge	*Carex trisperma*		X	X	X		
tall cotton-grass	*Eriophorum angustifolium*				X		
tawny cotton-grass	*Eriophorum virginicum*	X	X	X		X	X
tussock cotton-grass	*Eriophorum vaginatum*						
blue flag	*Iris versicolor*	X	X	X		X	X
soft rush	*Juncus effusus*	X					
three-leaf Solomon's-Seal	*Maianthemum trifolium*	X			X	X	X
ragged orchid	*Platanthera lacera*					X	
small purple-fringed orchid	*Platanthera psycodes*						X
white beaked-rush	*Rhynchospora alba*				X	X	X
three-Square	*Schoenoplectus pungens*			X			
deergrass	*Trichophorum caespitosum*	X	X	X	X	X	
FERNS							
Sensitive Fern	*Onoclea sensibilis*					X	
Cinnamon Fern	*Osmunda cinnamomea*	X	X	X		X	X

Table 6.2: Summer survey of coastal plants on three islands and a mainland coast.								
Common Name	**Scientific Name**	**Borgles**	**Cable**	**Wolfe**	**Tuff**	**Inner Baltee**	**Baltee**	**Little**
SHRUBS								
black crowberry	*Empetrum nigrum*	X	X	X	X	X	X	X
HERB DICOTS								
silverweed	*Argentina anserina*	X	X	X	X	X	X	X
orache	*Atriplex patula*	X						X
beggar's ticks	*Bidens frondosa*	X			X			X
sea rocket	*Cakile edentula*	X	X	X	X		X	X
Rand's eyebright	*Euphrasia randii*					X	X	
three-cleft bedstraw	*Galium trifidum*	X	X					
sea primrose	*Glaux maritima*		X		X	X		
hog parsnip	*Heracleum maximum*	X					X	X
seabeach sandwort	*Honckenya peploides*	X	X				X	
jewelweed	*Impatiens capensis*	X					X	X
beach pea	*Lathyrus maritimus*	X			X		X	X
Scotch lovage	*Ligusticum scothicum*	X			X		X	
sea lavender	*Limonium carolinianum*				X	X		
sea lungwort	*Mertensia maritima*	X						
seaside plantain	*Plantago maritima*	X	X				X	X
seashore buttercup	*Ranunculus cymbalaria*	X		X				
roseroot (rare on coast)	*Rhodiola rosea*		X					
water dock	*Rumex orbiculata*	X					X	X
knotted pearlwort (S2/S3)	*Sagina nodosa*	X						
pearlwort	*Sagina procumbens*	X	X		X		X	
samphire	*Salicornia europea*	X				X		
marsh skullcap	*Scutellaria galericulata*	X	X	X			X	
beach ragwort (S2)	*Senecio pseudo-arnica*	X						
saltmarsh goldenrod	*Solidago sempervirens*	X						X
seaside sand spurrey	*Spergularia canadensis*							
sea spurrey	*Spergularia marina*	X	X			X		
sea-blite	*Suaeda maritima*					X	X	
arrow-grass	*Triglochin maritima*						X	X
stinging nettle	*Urtica dioica*						X	
HERB MONOCOTS								
marram	*Amophila breviligulata*	X		X			X	X
sedge	*Carex paleacea*	X				X	X	X
sedge	*Carex projecta*							X
sedge	*Carex silicea*					X		

blue flag	*Iris versicolor*	X	X	X	X		X	X
arctic rush	*Juncus arcticus*	X		X		X		X
"black grass"	*Juncus gerardii*						X	X
American dune grass	*Elymus mollis*				X			X
bulrush (lg. round stemmed)	*Schoenoplectus acutus*						X	X
short-stemmed, triangular bulrush	*Schoenoplectus pungens*			X		X		
freshwater cordgrass	*Spartina alterniflora*					X		X
salt hay	*Spartina pectinata*	X						
cattail	*Typha latifolia*	X				X		X

Table 6.3: Fall survey of freshwater wetland plants on three islands and a mainland coast.

Common Name	Scientific Name	Laybold	Gerard	Cranberry	Mainland
SHRUBS					
bog rosemary	*Andromeda glaucophylla*	X		X	
leatherleaf	*Chamaedaphne calcyculata*	X	X	X	X
broom crowberry	*Corema conradii*	X	X		
snowberry	*Gaultheria hispidula*	X	X	X	X
huckleberry	*Gaylussacia baccata*	X	X	X	X
bog huckleberry	*Gaylussacia dumosa*	X			
Canada holly	*Ilex verticillata*	X	X	X	X
common juniper	*Juniperus communis*	X	X	X	X
bog laurel	*Kalmia polifolia*	X			
sweet gale	*Myrica gale*	X	X	X	X
bayberry	*Myrica pensylvanica*	X	X	X	X
false holly	*Nemopanthus mucronata*	X	X	X	X
chokeberry	*Photinia melanocarpa*	X	X	X	X
rhodora	*Rhodora canadensis*	X	X	X	X
Labrador tea	*Rhododendron groenlandicum*	X	X	X	X
bake apple	*Rubus chamaemorus*	X			
blueberry	*Vaccinium angustifolium*	X	X	X	X
cranberry	*Vaccinium macrocarpon*	X	X	X	X
little cranberry	*Vaccinium oxycoccos*	X	X	X	X
foxberry	*Vaccinium vitis-idaea*	X	X	X	X
HERB DICOTS					
woodland aster	*Aster acuminatus*	X	X		X
bog aster	*Aster nemoralis*	X	X		X
marsh cinquefoil	*Comarum palustris*			X	
bunchberry	*Chamaepericlymenum canadense*	X	X	X	X
goldthread	*Coptis groenlandica*	X	X	X	X

spatulate-lvd. sundew	*Drosera intermedia*	X			
round-lvd sundew	*Drosera rotundifolia*	X	X	X	X
Canada St. Johnswort	*Hypericum canadense*	X	X		
bugleweed	*Lycopus uniflorus*	X	X		
yellow candle	*Lysimachia terrestris*	X	X	X	X
pitcher plant	*Sarracenia purpurea*	X	X	X	X
bog goldenrod	*Solidago uliginosa*	X	X	X	X
marsh St. Johnswort	*Triadenum fraseri*	X	X	X	X
horned bladderwort	*Utricularia cornuta*				X
HERB MONOCOTS					
grass pink	*Calopogon tuberosus*	X			
sedge	*Carex disperma*	X	X	X	X
sedge	*Carex nigra*	X	X	X	X
sedge	*Carex paupercula*	X	X		X
sedge	*Carex stricta*	X	X		
cottongrass	*Eriophorum sp.*	X	X	X	X
blue flag	*Iris versicolor*	X	X	X	X
Canada rush	*Juncus canadenis*			X	X
softrush	*Juncus effusus*	X	X	X	
thread-rush	*Juncus filiformis*				X
mud rush	*Juncus pelocarpus*	X	X	X	X
three-lvd. false Solomon's seal	*Maianthemum trifolium*	X	X	X	
white beakrush	*Rhynchospora alba*	X	X	X	X
tawny beakrush	*Rhynchospora fuscum*	X	X	X	X
deer grass	*Trichophorum caespitosum*		X		

Table 6.4. Fall survey of coastal plants on three islands and one mainland coastline

Common Name	Scientific Name	Laybold	Gerard	Cranberry	Mainland
SHRUBS					
black crowberry	*Empetrum nigrum*	X		X	X
mountain fly honeysuckle	*Lonicera villosa*	X	X		X
HERB DICOTS					
silverweed	*Argentina anserina*	X	X	X	X
orache	*Atriplex patula*	X		X	X
beggar's ticks	*Bidens frondosa*	X			
sea rocket	*Cakile edentula*	X	X	X	X
coast blite (S1?)	*Chenopodium rubrum*	X			
brassbuttons (exotic, new arrival?)	*Cotula coronopifolia*		X	X	X
Rand's eyebright	*Euphrasia randii*	X			
three-cleft bedstraw	*Galium trifidum*	X		X	
sea primrose	*Glaux maritima*	X	X	X	X

hog parsnip	*Heracleum lanatum*	X	X		
seabeach sandwort	*Honckenya peploides*			X	
spotted touch-me-not	*Impatiens capensis*	X	X		
beach pea	*Lathyrus maritimus*	X	X	X	X
Scotch lovage	*Ligusticum scothicum*	X	X	X	X
sea lavender	*Limonium carolinianum*	X	X	X	X
sea lungwort	*Mertensia maritima*	X	X	X	
seaside plantain	*Plantago maritima*	X	X	X	X
seashore buttercup	*Ranunculus cymbalaria*	X	X	X	
roseroot (rare on coast)	*Rhodiola rosea*	X			
golden dock (S3/S4)	*Rumex maritimus var fueginius*	X	X	X	
water dock	*Rumex orbiculata*	X	X	X	
pearlwort	*Sagina procumbens*	X	X	X	
knotted pearlwort (S2/S3)	*Sagina nodosa*	X			
samphire	*Salicornia europea*	X	X	X	X
marsh skullcap	*Scutellaria galericulata*	X	X	X	X
beach ragwort (S2)	*Senecio pseudo-arnica*	X	X	X	
saltmarsh goldenrod	*Solidago sempervirens*	X	X	X	X
seaside sand spurrey	*Spergularia canadensis*	X	X	X	
sea spurrey	*Spergularia marina*	X	X	X	
sea-blite	*Suaeda maritima*	X	X	X	X
arrow-grass	*Triglochin maritima*	X	X	X	X
HERB MONOCOTS					
bentgrass	*Agrostis alba*	X	X	X	X
marram	*Amophila breviligulata*	X	X	X	X
sedge	*Carex hormathodes*		X		
sedge	*Carex silicea*	X	X	X	X
sedge	*Carex paleacea*				X
sedge	*Carex recta*				X
spikegrass	*Distichlis spicata*			X	X
sea spikerush	*Eleocharis parvula*	X	X	X	
slender wheat grass	*Elymus trachycaulus*	X	X	X	X
wild rye grass	*Elymus virginicus*	X	X	X	X
red fescue	*Festuca rubra*	X	X	X	X
sweetgrass	*Hierocloe odorata*	X	X	X	X
sea flag	*Iris setosa*	X			
blue flag	*Iris versicolor*	X	X	X	X
arctic rush	*Juncus arcticus*	X	X	X	X
"black grass"	*Juncus gerardii*	X	X	X	X
American dune grass	*Elymus mollis*	X	X	X	X
pondweed	*Potamageton filiformis*				X

ditchgrass	*Ruppia maritima*			X	X
bulrush (lg. round stemmed)	*Schoenoplectus acutus*	X	X	X	
short-stemmed, triangular bulrush	*Schoenoplectus pungens*	X	X	X	X
cordgrass	*Spartina alterniflora*	X	X	X	X
salt hay	*Spartina patens*	X	X	X	X
freshwater cordgrass	*Spartina pectinata*	X	X	X	X
cattail	*Typha latifolia*	X	X	X	X

A. Borgles (Charles) Island and Middle Island

A.1 General

Borgles Island, also known as Charles Island, is a large island (236 ha) near the mouth of Ship Harbour. Oriented in a mostly north-south direction, Borgles Island displays a diverse set of landscapes and forest ecosystems. The shoreline seascapes are varied. The island's coastline is highly indented and extreme weathering of the landscape has created beaches and much exposed headland along the southern coast. A tombolo beach connects the southeast corner of the island with the adjacent Middle Island. The forest and barrens comprise 56% and 22% of the island's area, respectively (NS DNR, 2002). See appendices A.1 – Aerial Images and A.2 -Land Cover.

Borgles Island has significant evidence of past human disturbance. The sheltered northern tip of the island was cleared in the late 1800's and used for sheep pasture. A failed development from the 1970s has left a series of east-west and north-south roads which are now overgrown. A large linear cut-out in the southern part of the island is a failed attempt to build an airstrip. In addition, abandoned camp/cottage sites can be found on the northwest and northeast corners of the island. At the time of writing, Borgles Island is currently being marketed online as Charles Island, a proposed luxury residential development, complete with two helipads and marina (http://www.nova-scotia-property.ca/Charles-Island-Properties.php).

A.2 Forest Communities

Apart from the northern tip, which had early settlement and clearing of soils that may be richer than on the windward side, the island forests are dominated by black spruce and balsam fir (map 4.2). These have been much wind disturbed, especially on the south west island sides.

The two plots described showed the two most common forest communities on the islands, a balsam fir (Plot 1) and a black spruce (Plot 2) stand. Each forest type had a small contribution of the other dominant coniferous tree (i.e. both had both black spruce and balsam fir present as adult trees) and deciduous trees were scarcely present (traces of paper birch). While the balsam fir plot had more (6 vs. 4) clonal herb species (e.g. wild lily of valley, bunchberry, partridge berry), this was the most frequent vascular plant life form in the forest understories. Both of these seaside stands had patches of the checkered rattlesnake plantain orchid. The bryophyte (mosses and liverworts) flora of both stands was dominated by shreber's moss (*Pleurozium shreberi*) and the black spruce stand was co-dominated by stairstep moss (*Hylocomium splendens*). Both stands had minor amounts of the leafy liverwort, *Bazzania trilobata.*

Table A.1.1 - Borgles Island Forest Vegetation Plot Data
Data collected by Bob Guscott and T. Neily on 4-5 July, 2011

		Borgles 1	Borgles 2
Tree 1 Species/age at breast height		na	bS/58
Tree 1 Diameter at breast height/cm		na	16
Tree 2 Species/age at breast height		na	bS/58
Tree 2 Diameter at breast height/cm		na	18

Tree Layer % cover			
Black Spruce	*Picea mariana*	5	40
Balsam fir	*Abies balsamea*	40	10
White birch	*Betula papyrifera*	1	2
Shrub Layer % Cover			
Balsam fir	*Abies balsamea*		1
Mountain Ash	*Sorbus americana*	4	
Alder	*Alnus incana*	5	
Herb Layer % Cover			
Wild lily of the valley	*Maianthemum canadense*	2	0.2
Starflower	*Trientalis borealis*	4	
Bunchberry	*Chamaepericlymenum canadense*	3	1
Goldthread	*Coptis trifolia*		0.2
Partridge-berry	*Mitchella repens*	7	0.5
Wood aster	*Aster acuminatus*	2	
Evergreen Wood fern	*Dryopteris intermedia*	5	
Wood sorel	*Oxalis acetosella*	2	
Pinesap	*Monotropa hypopithys*		0.1
Checkered rattlesnake plantain	*Goodyera tesselata*	0.25	0.25
Pink Ladyslipper	*Cypripedium acaule*		0.2
Lambkill	*Kalmia angustifolia*		
Rock polypody	*Polypodium virginianum*		0.01
Sedge	*Carex spp.*	1	
One flowered pyrola	*Moneses uniflora*	2	
Black crowberry	*Empetrum nigrum*	0.001	
Huckleberry	*Gaylussacia baccata*	0.001	
Moss/Lichen Layer % Cover			
Schrebers	*Pleurozium schreberi*	80	40
Stair step	*Hylocomium splendens*		40
Bazzania trilobata	*Bazzania trilobata*	5	5
Plume moss	*Ptilium crista-castrensis*		1
Sphagnum	*Sphagnum spp.*	2	

Photo A.1 – Forest Vegetation Plot 1 – Balsam fir with black spruce

Photo A.2 – Black spruce with balsam fir and white birch

A.3 Plant Species

Borgles Island was one of the 5 islands that supported rare plants. Of six representative communities described (tables 6.1 and 6.2) as part of the inventory, rare plants occur only in shoreline communities. The rare beach ragwort, *Senecio pseudoarnica* (S2 status) was found in the highly disturbed cobble zone on the western shore. The uncommon, knotted pearlwort, *Sagina nodosa* (S2/S3 status) was in gravel in a salt accumulation zone on the south end of the island in close proximity to *Lichina confinis* (map 4.1). This island had open bog communities and these were low biomass, high diversity systems where the S4 ranked dragon's mouth orchid (*Arethusa bulbosa*) and buckbean (*Menyanthes trifoliata*) and two less common *Sphagnum* moss species (S4 and S4? ranked, *Sphagnum angermanicum* and *S. linbergii*) were observed. Though Bog buckbean (*Menyanthes trifoliata)* is only ranked S5 in Nova Scotia, it is limited to certain peaty wetland and wet barren habitats. It has been casually observed in local abundance but to occur relatively infrequently, i.e. not at all ubiquitous in these habitats (personal communication Bob Guscott, Katie Porter).

A.4 Avian Species

On Borgles Island, bird surveys were conducted during a period when birds were still tending broods and actively gathering food for young which allowed for a reasonable opportunity to view most nesting species. A total of 20 hours or 40 party hours were spent on the island over a three day period. Identification of species was done primarily visually, but one species, winter wren (*Troglodytes hiemalis)*, was easily heard but not actually seen. With one species, common yellowthroat (*Geothlyphis trichas)*, numbers were estimated because of their extraordinary abundance.

Table A.3.1 lists the bird counts by species for each of the field days. Adult birds, fledged young and juveniles were included in the totals. There was confirmation that 18 of the 46 species identified were breeding there and it is likely that another 14 species breed there as well based on their abundance, behaviour and habitat.

Although it can be expected that all off-shore islands serve as resting or temporary stop, the time at which these surveys were conducted was not in a season suitable for recording migrants. Many birds, especially passerines migrate during the night and islands provide at least temporary refuge and resting areas after long flights.

Birds of particular interest on Borgles Island included breeding fox sparrow (*Passerella illaca)*, Lincoln's sparrow (*Melospiza lincolnii)* and blackpoll warbler (*Mniotilta varia).* This should be expected on these somewhat isolated Eastern Shore areas of Nova Scotia as it provides prime habitat for them to breed. The numbers of common yellowthroats (*Geothlyphis trichas)* were impressive with an estimated 500 on the island. Yellow-bellied flycatchers (E*mpidonax flaviventris)*, both Hermit and Swainson's Thrushes (*Catharus guttatus, Catharus ustulatus*) were common. Of interest was the possibility of 2 Great Horned Owls (*Bubo virginianus*). One was seen on July 4 and another sighting was made on July 5 in a different area of the island. Although there was some sign that Varying Hare inhabit Borgles Island, it did not appear they were very plentiful.

Table A.3.1 - Borgles Island Bird Sightings by Species and Number
Data collected by Dave Currie and Chris Pepper on 4-5 July, 2011

No.	Common Name	Species	28-Jun-11	04-Jul-11	05-Jul-11	Est. Highest Number
1	**Common Eider**	*Somateria mollissima*	40	25	50	50
2	Double-crested Cormorant	*Phalacrocorax auritus*	20	25	20	25
3	Great Cormorant	*Phalacrocorax carbo*	1	-	-	1
4	Great Blue Heron	*Ardea Herodias*	2	2	4	4
5	**Osprey**	*Pandion haliaetus*	2	2	2	2
6	Bald Eagle	*Haliaeetus leucocephalus*	1	-	-	1
7	Herring Gull	*Larus argentatus*	1	25	20	25
8	Great Black-backed Gull	*Larus marinus*	2	12	14	14
9	Common Tern	*Sterna hirundo*	2	2	5	5
10	Black Guillemot	*Cepphus grille*	1	1	1	1
11	**Mourning Dove**	*Zenaida macroura*	-	2	1	2
12	**Great Horned Owl**	*Bubo virginianus*	-	1	1	1
13	**Ruby-throated Hummingbird**	*Archilochus colubris*	-	1	-	1
14	Belted Kingfisher	*Megaceryle alcyon*	-	1	-	1
15	**Hairy Woodpecker**	*Picoides villosus*	-	-	1	1
16	**Black-backed Woodpecker**	*Picoides articus*	-	-	1	1
17	Northern Flicker	*Colaptes auratus*	1	2	2	2
18	**Yellow-bellied Flycatcher**	*Empidonax flaviventris*	1	10	5	25
19	Alder Flycatcher	*Empidonax alnorum*	1	-	-	2
20	**Gray Jay**	*Perisoreus Canadensis*	-	-	2	2
21	**American Crow**	*Corvus brachyrhynchos*	4	4	8	8
22	**Common Raven**	*Corvus corax*	1	1	1	2
23	**Boreal Chickadee**	*Poecile hudsonicus*	6	10	4	30
24	**Winter Wren**	*Troglodytes hiemalis*	5	1	-	6
25	**Golden-crowned Kinglet**	*Regulus satrapa*	4	7	2	20
26	**Ruby-crowned Kinglet**	*Regulus calendula*	4	2	2	6
27	**Swainson's Thrush**	*Catharus ustulatus*	4	10	8	30

28	Hermit Thrush	*Catharus guttatus*	10	24	7	30
29	American Robin	*Turdus migratorius*	-	1	2	2
30	Nashville Warbler	*Oreothlypis ruficapilla*	5	6	5	10
31	Yellow Warbler	*Dendroica petechia*	-	1	2	2
32	Magnolia Warbler	*Dendroica magnolia*	1	15	12	50
33	Yellow-rumped Warbler	*Dendroica coronate*	16	20	35	100
34	Black -throated Green Warbler	Dendroica virens	1	2	-	4
35	Palm Warbler	Dendroica palmarum	3	10	2	20
36	Blackpoll Warbler	Dendroica striata	20	6	6	30
37	Black and White Warbler	Mniotilta varia	-	1	4	6
38	American Redstart	*Setophaga ruticilla*	6	12	18	30
39	Common Yellowthroat	*Geothlyphis trichas*	10	100	100	500
40	Fox Sparrow	*Passerella iliaca*	5	5	3	12
41	Song Sparrow	*Melospiza melodia*	6	3	3	10
42	Lincoln's Sparrow	*Melospiza lincolnii*	2	3	2	6
43	White-throated Sparrow	*Zonotrichia albicollis*	1	4	1	6
44	Dark-eyed Junco	*Junco hyemalis*	10	20	30	50
45	Purple Finch	*Carpodacus purpureus*	-	-	1	1
46	American Goldfinch	*Carduelis tristis*	1	-	-	1
Species Count (by day)			35	38	38	
Species Count (total)						46
Individuals Count (by Day)			200	379	387	
Individuals Count (Total)						1138
Confirmed breeders						18
Probable breeders						14

A.5 Incidental Observations

The vegetation and birds surveys provided the opportunity to make incidental observation of other terrestrial species on the island. Table A.4.1 lists other species observed during the course of the survey. A mink den is shown in Photo A.11.

Table A.4.1 - Borgles Island Other Species Sightings
Observations made by D. Currie, C. Pepper, T. Neily and R. Guscott

No.	Species		Features	Quantity
1	Garter Snake		Individual seen	2
2	Mink		Den	1
3	Deer		Individual seen	1
4	Squirrel		Individual seen	1

The geomorphology of Borgles Island has a number of features which can be considered unusual or dramatic. There is an outstanding example of a tombolo beach at the southern tip of the island as shown on the aerial photograph in appendix A.1 and photos A.3 and A.4. As well, there is a freshwater pond on the southwestern end of Borgles Island which appears to be perched in the bedrock and drains

to the south through a small brook (photo A.3). Further investigation of the ecology of this pond is warranted.

A.6 Selected Annotated Photographs

Photo A.3 - Aerial Photo showing the tombolo beach between Borgles Island and Middle Island, as well as the large freshwater pond situated near the southwestern side of Borgles Island (Photo: R. Guscott, 2007)

Photo A.4 - Tombolo sand beach between Borgles and Middle Island

Photo A.5 - A large glacial erratic granite boulder on the shore of Middle Island.

Photo A.6 - A rock cut on Borgles Island ("the Devil's Bake Oven") which is known to the local population for creating a dramatic seawater spray during high wave conditions.

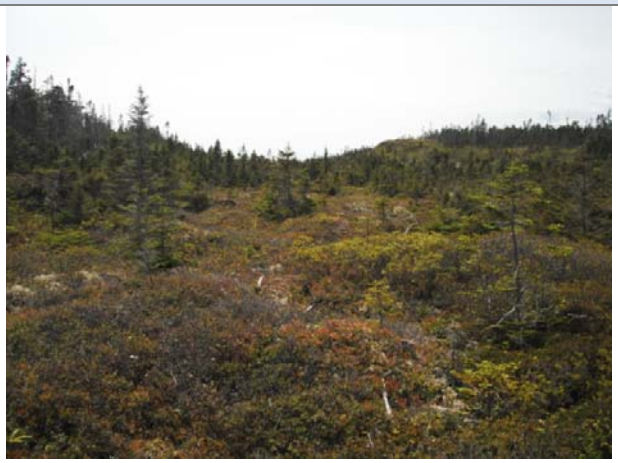
Photo A.7 - Excellent examples of iron pyrite crystals were found on coastal rocks at Clam Bay on Borgles Island.

Photo A.8 - A geological formation known as a "sand volcano" on Borgles Island

Photo A.9 - Borgles Bluff. Note the insect killed balsam fir stand.

Photo A.10 - Looking Southwest from Tuckers Head

Photo A.11 - Mink Den found on Borgles Island, showing signs of recent activity

Photo A.12 – Wind damage (blowdown) on Borgles Island	Photo A.13 - Eastern Dwarf Mistletoe damage in black spruce stand with huckleberry shrub in foreground
	
Photo A.14 – Section of overgrown road running the length of Borgles Island	**Photo A.15 - Airstrip cut out on south side of Borgles Island**

B. Cable Island

B.1 General

Cable Island is sheltered from west wind by the Owl's Head promontory and the large area of Wolfe Island. The outline of Cable Island is little indented and overall, there is less wind exposed and eroded habitat than on other islands. The forest (black spruce) and shrub (brush and alders) comprise 47% and 46% of the island area, respectively (NS DNR, 2002). See appendices B.1 – Aerial Images and B.2 – Land Cover

B.2 Forest Communities

The forest plot data confirms the available GIS forest cover data. The island forests are primarily black spruce (*Picea mariana)* with a secondary component of balsam fir (*Abies balsamea)* and minor amounts of white birch (*Betula papyrifera)* and red maple *(Acer rubrum)*. The ridges tend to have sparse forest cover and are dominated by extensive tracts of huckleberry (*Gaylussacia baccata)*. The ages of black spruce trees in the plots range between 43 and 49. This is well below the black spruce average for all of the Eastern Shore at 59 years. Black spruce is prominent in the shrub layer along with lambkill *(Kalmia angustifolia)*, blueberries *(Vaccinium angustifolium)*, alder *Alnus incana* and balsam fir. The herb layer was exceptionally sparse having only three berry-producing, clonal species: bunchberry (*Chamaepericlymenum canadensis*), foxberry *(Vaccinium vitis-idaea)* and creeping snowberry *(Gaultheria hispidula)*. The Moss layer is dominated by schreber's moss *(Pleurozium schreberi)* but the substantial amount of the leafy liverwort, *Bazzania trilobata*, and sphagnum *(Sphagnum spp)* shows these stands retain moisture.

Table B.1.1 - Cable Island Forest Vegetation Plot Data
Data collected by B. Guscott and T. Neily on 13 July, 2011

		Cable 1	Cable 2
Tree 1 Species/age at breast height		bS/43	bS/49
Tree 1 Diameter at breast height/cm		14	16
Tree 2 Species/age at breast height		bS/48	bS/46
Tree 2 Diameter at breast height/cm		12.7	15.3
Species			
Tree Layer % cover			
Black Spruce	*Picea mariana*	75	55
Balsam fir	*Abies balsamea*	20	15
White birch	*Betula papyrifera*		5
Red maple	*Acer rubrum*	5	
Shrub Layer % Cover			
Black Spruce	*Picea mariana*	10	3
Balsam fir	*Abies balsamea*		3
Speckled Alder	*Alnus incana*	2	
Wild raisin	*Viburnum nudum*	0.01	

Velvet leaved blueberry	*Vaccinium myrtilloides*	2	
Lowbush blueberry	*Vaccinium angustifolium*	4	2.5
Lambkill	*Kalmia angustifolium*	5	
Herb Layer % Cover			
Bunchberry	*Chamaepericlymenum canadensis*	1	0.25
Foxberry	*Vaccinium vitis-idaea*	1	
Creeping snowberry	*Gaultheria hispidula*	1	0.5
Moss/Lichen Layer % Cover			
Schreber's moss	*Pleurozium schreberi*	50	50
Leafy liverwort	*Bazzania trilobata*		40
Broom moss	*Dicranum scoparium*		5
Sphagnum	*Sphagnum spp.*	20	
Cup reindeer lichen	*Cladonia maxima*	3	
Green reindeer lichen	*Cladonia arbuscula*	2	1
Stairstep moss	*Hylocomium splendens*	10	
Liverwort	*Class Hepatopsidae*	10	

Photo B.1 – Forest Vegetation Plot 1

Photo B.2 – Forest Vegetation Plot 2

B.3 Plant Species

Of coastal rock communities and bog(see coastal and wetland plants in tables 6.1 and 6.2), most interesting were the observations in bogs of S4 ranked grass-pink orchid (*Calopogon tuberosum)* and the boreal, S4 ranked bake apple (*Rubus chamaemorus*).

B.4 Avian Species

The island was split geographically by the avian surveyors in order to cover as much diverse habitat as possible in the time allotted.

At the time of the survey, 13 July, the nesting season was well underway for most songbirds and over for many seabirds. Bird activity was low perhaps because of the time of arrival of the study team and the windy conditions

The habitat was mostly stunted conifer and huckleberry barren. This provides adequate breeding space for most migratory songbirds that prefer this scrubby terrain. This terrain provides little breeding opportunity for larger resident species (e.g. Spruce Grouse or Gray Jay) that prefer a more intact coniferous forest. The sandy beach near the northeastern end of the island did not appear very active. From the beach many common terns (*Sterna hirundo)*, including juveniles were observed fishing near a smaller island at short distance away.

This island has a boreal habitat and is attractive to species like Swainson's thrush (C*atharus usulatus*), yellow-bellied flycatcher (E*mpidonax flaviventris)*, yellow-rumped warbler (Dendroica auduboni), Blackpoll Warbler (D*endroica coronate)* and common yellowthroat (G*eothlyphis trichas)*. These species were common on this island. Both adult and fledged young were counted in the totals.

Although collectively just 27 species were observed, it would be expect that, based on the habitat, closer to 35 species should be found in and around this island. Of those 27 species seen, 10 species were confirmed to be breeding there.

Table B.3.1 - Cable Island Bird Sightings by Species and Number
Data collected by D. Currie and C. Pepper on 13 July, 2011

No	Common Name	Species	Number Observed
1	Common Loon	*Gavia immer*	1
2	**Common Eider**	*Somateria mollissima*	40
3	Double-crested Cormorant	*Phalacrocorax auritus*	25
4	Great Blue Heron	*Ardea Herodias*	2
5	Northern Flicker	*Coloptes auratus*	1
6	**Ruffed Grouse**	*Bonasa umbellus*	1
7	Herring Gull	*Larus argentatus*	15
8	Great Black-Backed Gull	*Larus marinus*	3
9	Common Tern	*Sterna hirundo*	28
10	**Spotted Sandpiper**	*Actitis macularia*	1
11	Black Guillemot	*Cepphus grille*	2
12	**Yellow-bellied Flycatcher**	*Empidonax flaviventris*	6
13	**Golden-crowned Kinglet**	*Regulus satrapa*	5
14	Swainson's Thrush	*Catharus usulatus*	2
15	**American Crow**	*Corvus brachyrhynchos*	4
16	**Boreal Chickadee**	*Poecile hudsonicus*	13
17	Cedar Waxwing	*Bombycilla cedrorum*	1

18	Magnolia Warbler	*Dendroica magnolia*	11
19	Yellow Rumped Warbler	*Dendroica coronata*	10
20	Palm Warbler	*Dendroica palmarum*	1
21	Blackpoll Warbler	*Dendroica striata*	1
22	American Redstart	*Setophaga ruticilla*	4
23	Common Yellowthroat	*Geothlyphis trichas*	30
24	Song Sparrow	*Melospiza melodia*	1
25	Lincoln's Sparrow	*Melospiza lincolnii*	2
26	White-throated Sparrow	*Zonotrichia albicollis*	2
27	Dark-eyed Junco	*Junco hyemalis*	2
Species Count			**27**
Individuals Count			**214**
Confirmed breeders			**4**
Probable breeders			**3**

B.5 Incidental Observations

Features of note on Cable Island include a fine sand beach (photo B.3). A freshwater pond (photo B.4) and wetland are located within the interior of the island. Further investigation of these features is warranted. The island also featured a steeply inclined bedrock outcrop forming part of the shoreline on the northwest side of the island (photo B.6).

B.6 Selected Annotated Photographs

Photo B.3 - Sandy beach on the east side of Cable Island.

Photo B.4 - Freshwater pond surrounded by wetlands on Cable Island.

Photo B.5 - Bedrock erosion on the shoreline of Cable Island which produced a honeycomb-like pattern.

Photo B.6 - Steeply inclined bedrock ridge with Zanthoria lichen on the northwest shoreline of Cable Island.

Photo B.7 - An example of a Pink Orchid found on Cable Island.

Photo B.8 - Boulder covered with Zanthoria lichen on Cable Island.

Photo B.9 - White sand beach at Sandy Cove.

Photo B.10 - Huckleberry barren on top of ridge.

C. Wolfes Island

C.1 General

Wolfes Island is a large island situated in the mouth of ship Harbour. During the mid 1800's it was referred to as Nichol Island. This island has a great variety of habitats including: fresh and saltwater ponds, barrens and brush, a large sheltered cove and a spectacular white sand beach. More than half (56%) of the island's large area (352 ha) is barren shrub land. Forest accounts for 34% of the island land cover (NS DNR, 2002). See appendices B.1 – Aerial Images and C.2 – Land Cover

C.2 Forest Community

The forest stand composition ranges between 70 and 100% black spruce. The remaining 10% land cover comprises coastal cliffs, beaches and wetlands. See appendices C.1 – Aerial Images and C.2 – Land Cover. The forest cover on Wolfes Island is the typical black spruce *(Picea mariana)* /balsam fir *(Abies balsamea)* forest found throughout the Eastern Shore Islands. Four stands were described with ages ranging from 56 to 91 years (taken from oldest tree cored). Interestingly, there was no indication that age was relatable to diversity of the understory community. It is possible that on an island level, that these older forests have greater representation of *Cladonia* related lichens than is observed on other islands. Less balsam fir is evident on this island and consequently there is less insect damage. Wind and storm damage is prevalent near south facing shorelines. Eastern dwarf mistletoe (*Arcethobium pusilum)* is present and having a significant impact on the health of the black spruce. The east/west orientation of the quartzite ridges also impacts on the development of forest trees. Trees growing on the sheltered north side of the ridges tend to grow larger and escape the most extreme winds from storms. The parallel drainage pattern formed by the ridges can also lead to various ecological habitats ranging from bogs through treed bogs and forest stands.

Table C.1.1 - Wolfes Island Forest Vegetation Plot Data
Data collected by R. Guscott and T. Neily on 20-21 July 2011

		Wolfes 1	Wolfes 2	Wolfes 3	Wolfes 4
Tree 1 Species/age at breast height		bS/91	bF/56	bS/55	bS/91
Tree 1 Diameter at breast height/cm		18.7	19	11.7	19.7
Tree 2 Species/age at breast height		bS/88	bS/39	bS/50	bF/65
Tree 2 Diameter at breast height/cm		14.7	14	10.5	19.8
Species					
Tree Layer % cover					
Black Spruce	*Picea mariana*	50	35.5	41	15
Balsam fir	*Abies balsamea*	5	15		25
White birch	*Betula papyrifera*				4
Tamarak/Larch	*Larix laricina*	5			
Shrub Layer % Cover					
Black Spruce	*Picea mariana*	6		2	1
Balsam fir	*Abies balsamea*	3	2	3	8
White birch	*Betula papyrifera*				1

Mountain Ash	*Sorbus americana*				10
Alder	*Alnus incana*			2	
Wild raisin	*Viburnum nudum*	0.1			
Lowbush blueberry	*Vaccinium angustifolium*	10	1	2	1
Lambkill	*Kalmia angustifolum*	2			
Labrador tea	*Rhododendron groenlandicum*	0.5			
Huckleberry	*Gaylussacia baccata*	0.5		3	1.5
Herb Layer % Cover					
Wild lily of the valley	*Maianthemum canadense*		0.5		
Starflower	*Trientalis borealis*		0.1		0.1
Partridge-berry	*Mitchella repens*	1	0.1		2.5
Evergreen Wood fern	*Dryopteris intermedia*				0.2
Cinnamon fern	*Osmunda cinnamomea*				
Twinflower	*Linnaea borealis*		0.25		
Foxberry	*Vaccinium vitis-idaea*			1	
Creeping snowberry	*Gaultheria hispidula*			0.5	
Moss/Lichen Layer % Cover					
Schreber's moss	*Pleurozium schreberi*	70	85	90	80
Leafy liverwort	*Bazzania trilobata*	10	2	1.5	5
Broom moss	*Dicranum scoparium*	2	1	1	0.5
Plume moss	*Ptilium crista-castrensis*			0.5	
Cup Lichen/Reindeer	*Cladonia spp.*	3			
Sphagnum	*Sphagnum spp.*	10			1.25
Cup reindeer lichen	*Cladonia maxima*			1	
Green reindeer lichen	*Cladonia arbuscula*		0.25		
Irish reindeer lichen	*Cladonia uncinalis*	1	0.25		
Leafy liverwort	*Ptilidium pulcheriium*			1	0.5

Photo C.1 – Forest Vegetation Plot 1

Photo C.2 – Forest Vegetation Plot 2

Photo C.3 – Forest Vegetation Plot 4

C.3 Plant Species

A range of wetland and coastal habitats (coastal black spruce, bog, pond behind dune, barrens) were described during the inventory of this island (see plants in Table 6.1 & 6.2) but no uncommon or rare plants were observed. More searching should be conducted all around the southern shore (Little Friar to Big Sandy Cove) in dunes (photo C4), headlands and in dune to bog transition zones where 3-square bulrush (*Schoenoplectus pungens*) and saltmarsh buttercup (*Ranunculus cymbalaria*) were found (habitat of golden dock, *Rumex fueginius*). The headlands should also be targeted to find possible occurrences of beach ragwort and knotted pearlwort. There are good examples of black crowberry heaths (photo C10) which appear to be in equilibrium with the forest which is retreating due to salt spray damage. Clearly, there are enough maritime disturbances and reworking of the shoreline to provide opportunities for the guild of rare salt-tolerant herbs described in section 4.

The island has a large interior zone and this often alternates between shrubby ridges and some of the oldest black spruce forest found on any of the islands. This region appears to be of little significance for plant diversity and rarities but this is boreal woodland and the listing of birds (below) underscores its importance for avian fauna (e.g. spruce grouse). Other groupings of animals (e.g. beetles, rodents) known for from the boreal fauna need to be investigated.

C.4 Avian Species

By the time Wolfes Island was surveyed the nesting season was coming to an end for most birds. This is a large island with lots of breeding opportunities available for birds of a variety of species. However, due to time constraints, observations were limited to the eastern portion of the island above and below long creek.

Many songbird species were observed using the island for breeding, most notably Blackpoll Warbler (*Dendroica striata)* and Fox Sparrow (*Passerella iliaca)* which were relatively abundant. Most of the habitat is huckleberry barren, but the areas between ridges on the island provide habitat for birds that

prefer to nest in more coniferous forest. Large diameter trees are uncommon providing little opportunity for cavity nesters. There are a few freshwater ponds and several bogs scattered throughout the island that could turn out to be much more productive at sunrise in early June. The shoreline could use more adequate coverage, particularly the large beach at Big Sandy Cove which looked like good breeding habitat for Piping Plovers. The salt marsh, which turns into mud at low tide looks equally as good habitat for migrating shorebirds.

Table C.3.1: Wolfe Island Bird Sightings by Species and Number
Data collected by C. Pepper on 20-21 July 2011

No.	Common Name	Species	Number Observed
1	Northern Gannet	*Morus bassanus*	*1*
2	Double-crested Cormorant	*Phalacrocorax auritus*	*2*
3	Great Blue Heron	*Ardea Herodias*	*2*
4	Osprey	*Pandion haliaetus*	*4*
5	Bald Eagle	*Halioeetus leucocephalus*	*1*
6	Spruce Grouse	*Falcipennis canadenis*	*4*
7	Ruffed Grouse	*Bonasa umbellus*	*1*
8	Greater Yellowlegs	*Tringa melanoleuca*	*5*
9	Willet	*Catoptrophorus semipalmatus*	*4*
10	Herring Gull	*Larus argentatus*	*3*
11	Great Black-backed Gull	*Larus marinus*	*5*
12	Common Tern	*Sterno hirundo*	*2*
13	Black Guillemot	*Cepphus grille*	*1*
14	Northern Flicker	*Coloptes auratus*	*1*
15	Yellow-bellied Flycatcher	*Empidonax flaviventris*	*5*
16	American Crow	*Corvus brachyrhynchos*	*4*
17	Black-capped Chickadee	*Poecile atricapilla*	*2*
18	Boreal Chickadee	*Poecile hudsonia*	*7*
19	Golden-crowned Kinglet	*Regulus satrapa*	*9*
20	Swainson's Thrush	*Catharus usulatus*	*3*
21	Hermit Thrush	*Catharus guttatus*	*4*
22	Nashville Warbler	*Vermivora ruficapilla*	*4*
23	Magnolia Warbler	*Dendroica magnolia*	*15*
24	Yellow-rumped Warbler	*Dendroica coronata*	*25*
25	Palm Warbler	*Dendroica palmarum*	*3*
26	Blackpoll Warbler	*Dendroica striata*	*22*
27	Black-and-White Warbler	*Mniotilta varia*	*1*
28	American Redstart	*Setophaga ruticilla*	*2*
29	Common Yellowthroat	*Geothlyphis trichas*	*49*
30	Fox Sparrow	*Passerella iliaca*	*6*

31	Song Sparrow	*Melospiza melodia*	*1*
32	Swamp Sparrow	*Melospiza geogiana*	*3*
33	White-throated Sparrow	*Zonotrichia albicollis*	*13*
34	Dark-eyed Junco	*Junco hyemalis*	*19*
Species Count			**34**
Individuals Count			**235**
Confirmed Breeders			**10**

C.5 Incidental Observations

One of the largest white sand beaches within the focus area is located at Big Sandy Cove on the southeast corner of Wolfes Island (photo C.4). A deep rock crevice was noted on Wolfe Island (photo C.5). The walls provide unique habitat for bryophytes which warrants consideration for further examination.

C.6 Selected Annotated Photographs

Photo C.4 – White sand beach at Big Sandy Cove, southeast corner of Wolfes Island.

Photos C.5 - Deep rock crevice on Wolfe Island. A number of bryophyte species were observed growing on the walls of the crevice. This is considered unique habitat for these species.

Photo C.6- Geological formation known as a "sand volcano" on Wolfe Island.

Photo C.7 - One of several camps observed on Wolfe Island.

Photo C.8 - Possible eastern dwarf mistletoe damage in black spruce stand

Photo C.9 - Coastal storm damage on Wolfes Island

Photo C.10 - Salt damage from winter storms along the shoreline of Wolfes Island

Photo C.11 - Blowdown damage in white spruce stand

	
Photo C.12 - Treed Bog between ridges within the interior of Wolfes Island	**Photo C.13 – Typical huckleberry barren on top of ridge within the interior of Wolfes Island**

D. Tuff Island

D.1 General

Tuff Island is a very small island, measuring some 7.9 has in size. Oriented east west this island is separated by less than 100 meters from the mainland. This island is mostly forest covered (87% of area) (NS DNR, 2002).

D.2 Forest Community

The forest composition consists primarily of black spruce and balsam fir with a sprinkling of intolerant hardwoods. See appendices D.1 – Aerial Images and D.2 – Land Cover. Much of the forest cover on Tuff Island has been blown down or killed by insects. In fact, it was difficult to find intact forest for plot location. On the south and south-west facing side of the island there is tremendous damage within 50 to 100m from the exposed shoreline. The forest vegetation plots reveal a very low diversity in all 4 vegetation layers. Plot 1 with the older balsam fir (*Abies balsamea)* (average age 68 years) has 8 species in total while plot 2 (average age 35 years) has only 7 species. Both plots are dominated by balsam fir in both the tree and shrub layers. Wood sorrel (*Oxalis acetosella)* and the leafy liverwort, *Bazzania trilobata,* dominate the herb and moss layers in both plots.

Table D.1.1 - Tuff Island Forest Vegetation Plot Data
Data collected by R. Guscott and T. Neily on 27 July 2011

		Tuff 1	Tuff 2
Tree 1 Species/age at breast height		bF/65	bF/36
Tree 1 Diameter at breast height/cm		18.7	13.8
Tree 2 Species/age at breast height		bF/71	bF/35
Tree 2 Diameter at breast height/cm		21.6	13.7
Species			
Tree Layer % Cover			
Black Spruce	*Picea mariana*	5	
Balsam fir	*Abies balsamea*	78	62
Shrub Layer % Cover			
Balsam fir	*Abies balsamea*	1	5
White birch	*Betula papyrifera*		0.25
Herb Layer % Cover			
Evergreen Wood fern	*Dryopteris intermedia*	5	2
Wood sorel	*Oxalis acetosella*	35	5
Moss/Lichen Layer % Cover			
Stair step	*Hylocomium splendens*	0.5	0.5
Bassania trilobata	*Bazzania trilobata*	90	65
Broom moss	*Dicranum scoparium*	0.25	

Photo D.1 - Forest Plot 1

Photo D.2 - Forest plot 2

D.3 Tuff Island Plant Species

There were very few species on this island because of its small area and because of the lack of diversity of habitats. No freshwater wetlands were observed. Coastal habitat was mostly a rocky shore and there was no developed saltmarsh area or any barachois ponds. There was little topographical relief and so no headland habitats were formed. Not surprisingly, there was a greater proportion of coastal than of freshwater wetland plants represented on this depauperate island (12 of 43 possible coastal species versus 6 of 53 wetland species) (table 6-1 & 6.2). As might be anticipated, there were no uncommon or rare species found.

It is useful to have conserved islands such as Tuff to understand area-to-species diversity relationships and also habitat diversity-to-species diversity relationships. In general, the results from this island suggest that as habitat diversity declines, and is restricted to rocky shore and blown down forest the group of short-lived species in the shoreline community (e.g. saltmarsh annuals, sea buttercup) is lost since there is not the elevated terrain to break into suitable substrates for colonization by poorly competitive plants. It is noteworthy that the bird survey findings also suggest that with less area or less habitat diversity, there is low biological diversity. Tuff had the lowest diversity scores for plants and birds of all islands that were visited in the archipelago.

D.4 Avian Species

Table D.3.1: Tuff Island Bird Sightings by Species and Number
Data collect by C. Pepper on 27 July 2011

No.	Common Name	Species	Number Observed
1	Great Blue Heron	*Ardea Herodias*	2
2	Spotted Sandpiper	*Actitis macularia*	1
3	Boreal Chickadee	*Poecile hudsonia*	2
4	Golden-crowned Kinglet	*Regulus satrapa*	4

5	Swainson's Thrush	*Catharus ustulatus*	3
6	American Robin	*Turdus migratorius*	1
7	Magnolia Warbler	*Dendroica magnolia*	1
8	Common Yellowthroat	*Geothlyphis trichas*	6
9	Fox Sparrow	*Passerella iliaca*	4
10	Dark-eyed Junco	*Junco hyemalis*	10
Species Count			**10**
Individuals Count			**34**
Confirmed Breeders			

D.5 Incidental Observations

The shoreline and interior of Tuff Island was similar to those of other properties surveyed. No features of special interest were observed during the limited survey of Tuff Island. The below photos show some of the features and the condition of the forests on Tuff Island and nearby Mary's Island.

D.6 Selected Annotated Photographs

Photo D.3 - Area of dead trees with new growth on the forest floor.

Photo D.4 - New growth on the forest floor on Tuff Island.

Photo D.5 - Steep cobble and boulder southern shoreline of Tuff Island.

Photo D.6 - Gently sloping, protected north shoreline of Tuff Island.

Photo D.7 – Southern shoreline of Tuff Island with the smaller Mary Island to the left.

Photo D.8 – Mary Island. Mink den and Osprey nest with fledglings observed on this small crown owned island to the southwest of Tuff Island.

E. Inner Baltee Island

E.1 General

The shoreward edge of Inner Baltee Island is less than a kilometer from the mainland. The island is surrounded by other islands and headlands in the inner reaches of Tangier Harbour but there is substantial fetch distance to the west and due south of the island. The island is highly weathered, which has created many smaller satellite islands and has produced an island convoluted in shape with many bays and headlands running in a southwest to northeast direction. With a total area of 117 ha, forest cover accounts for 62 ha or 52% of the total land area. Rocky barrens and alders account for 49.9 ha or 42 % of the island. Wetlands make up 5.1 ha or 4.3% of the island (NS DNR, 2002). See appendices E.1 – Aerial Images and E.2 – Land Cover.

E.2 Forest Communities

Black spruce dominates the forest community and there are small amounts of balsam fir within these stands as well as occasional pockets of fir. The southwest facing shoreline exhibited characteristic scouring, salt-spray damage and tree blow down from storm activity.

The forest plot data reveals the characteristic coastal spruce fir forest ecosystem. Forest were of intermediate age (41 to 71 years) and were dominated by black spruce but had a substantial presence of smaller balsam fir. The vascular plants in the understory were poorly represented and of low diversity. The bryophyte flora was dominated by schreber's moss but in one plot, there was a substantial amount (20%) of sphagnum moss indicating wetland forest conditions.

Table E.1.1 – Inner Baltee Island Forest Vegetation Plot Data

		Inner Baltee 1	Inner Baltee 2
Tree 1 Species/age at breast height		bS/52	bS/71
Tree 1 Diameter at breast height/cm		17.1	18
Tree 2 Species/age at breast height		bS/41	bS/57
Tree 2 Diameter at breast height/cm		15.1	13.8
Species			
Tree Layer % cover			
Black Spruce	*Picea mariana*	47	21
Balsam fir	*Abies balsamea*	10	21
White birch	*Betula papyrifera*	5	
Tamarak/Larch	*Larix laricina*	0.001	
Shrub Layer % Cover			
Black Spruce	*Picea mariana*		2
Balsam fir	*Abies balsamea*		1
Wild raisin	*Viburnum nudum*		0.1
Velvet leaved blueberry	*Vaccinium myrtilloides*	0.01	
Lowbush blueberry	*Vaccinium angustifolium*		1.5
Lambkill	*Kalmia angustifolia*		2.5

Chokeberry	*Photinia spp.*		0.25
Labrador Tea	*Rhododendron groenlandicum*		0.1
Herb Layer % Cover			
Bunchberry	*Chamaepericlymenum canadense*	0.01	
Partridge-berry	*Mitchella repens*		0.2
Lampkill	*Kalmia angustifolia*	0.001	
Moss/Lichen Layer % Cover			
Schrebers	*Pleurozium schreberi*	40	35
Stair step	*Hylocomium splendens*		0.01
Leafy liverwort	*Bazzania trilobata*	3	3.5
Broom moss	*Dicranum scoparium*	3	0.01
Plume	*Ptilium crista-castrensis*	0.25	
Sphagnum	*Sphagnum spp.*		20
Cup reindeer lichen	*Cladonia maxima*		1.5
Hypnum moss	*Hypnum spp.*	0.01	

Photo E.1 - Forest vegetation plot 1

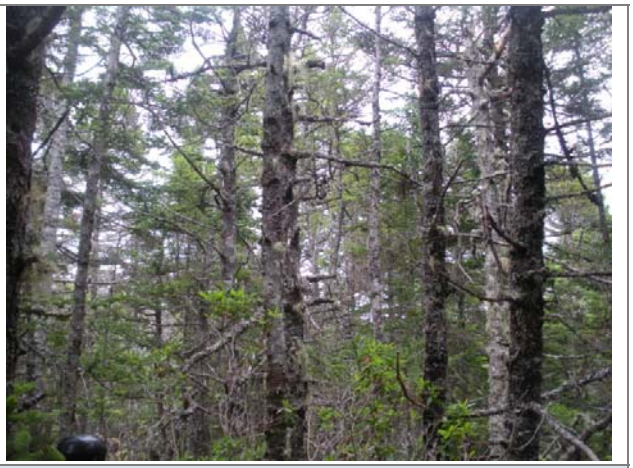


Photo E.2 - Forest vegetation plot 2

E.3 Plant Species

There are diverse inland bog and coastal salt marsh ecosystems. The bog supports low biomass vegetation indicated by the presence of bog laurel (*Kalmia polifolia*) and bog huckleberry (*Gaylusaccia dumosa*). While there were no rare plants observed in these bogs, there is still the possibility of rare sedge to be found. Similarly, the salt marsh had a diverse flora and a cattail-saltmarsh described will likely reveal the golden dock (*Rumex fueginius*) since this species often occurs with the S3, 3-square bulrush, *Scirpus pungens*, that occurred near the cattails.

E.4 Avian Species

Table E.3.1 - Inner Baltee Bird Sightings by Species and Number Data collected by C. Pepper on 28 July 2011			
No.	**Common Name**	**Species Name**	**Number Observed**
1	Common Loon	*Gavia immer*	2
2	Double-crested Cormorant	*Phalacrocorax auritus*	10
3	Great Blue Heron	*Ardea Herodias*	1
4	Common Merganser	*Mergus merganser*	15
5	Osprey	*Pandion haliaetus*	2
6	Bald Eagle	*Haliaeetus leucocephalus*	2
8	Spruce Grouse	*Falcipennis canadenis*	1
9	Greater Yellowlegs	*Tringa melanoleuca*	1
10	Herring Gull	*Larus argentatus*	1
11	Great Black-backed Gull	*Larus marinus*	2
12	Mourning Dove	*Zenaida macroura*	2
13	Ruby-throated Hummingbird	*Archilochus colubris*	1
14	Hairy Woodpecker	*Picoides villosus*	1
15	Northern Flicker	*Colaptes auratus*	1
16	Yellow-bellied Flycatcher	*Empidonax flaviventris*	2
17	American Crow	*Corvus brachyrhynchos*	5
18	Boreal Chicakee	*Poecile hudsonicus*	6
19	Golden-crowned Kinglet	*Regulus satrapa*	6
20	Swainson's Thrush	*Catharus ustulatus*	5
21	Hermit Thrush	*Catharus guttatus*	3
22	American Robin	*Turdus migratorius*	3
23	Cedar Waxwing	*Bombycilla cedrorum*	3
24	Magnolia Warbler	*Dendroica magnolia*	2
25	Yellow-rumped Warbler	*Dendroica coronate*	6
26	Palm Warbler	*Dendroica palmarum*	3
27	Blackpoll Warbler	*Dendroica striata*	7
28	Common Yellowthroat	*Geothlyphis trichas*	14
29	Fox Sparrow	*Passerella iliaca*	5
30	Song Sparrow	*Melospiza melodia*	3
31	Lincoln's Sparrow	*Melospiza lincolnii*	4
32	White-throated Sparrow	*Zonotrichia albicollis*	3
33	Dark-eyed Junco	*Junco hyemalis*	12
Species Count			33
Individuals Count			134
Confirmed Breeding			

E.5 Selected Annotated Photographs

Photo E.3 - Spruce Grouse (*Falcipennis canadenis)* on Inner Baltee Island.

Photo E.4 – Coastal wetland on west side of Inner Baltee Island.

Photo E.5 – Coastal barrens within the interior of Inner Baltee Island.

Photo E.6 - Quartz dyke near southern shoreline of Inner Baltee Island.

Photo E.7 - Wind damaged forest on Inner Baltee Island.

Photo E.8 - Typical forest stand in the interior of Inner Baltee Island.

	
Photo E.9 - Saltwater wetland at the head of a small bay on Inner Baltee Island.	**Photo E.10 - Rock formation on the bedrock ledges on the shoreline of Inner Baltee Island.**

F. Baltee Island

F.1 General

Less than 200 m to the southeast of Inner Baltee Island is a larger (142 ha) outer island called Baltee. This island should experience greater winds than its sister inner island but its shape is less broken, presumably because of the greater elevation above sea level of this larger island. It features a freshwater lake, salt water marshes, exposed rocky headlands, beaches and substantial tracts of shrub barrens. Forest cover accounts for less than 14% of the island area, most of the remainder (80%) being shrub barrens (NS DNR, 2002). See appendices E.1 – Aerial Images and E.2 – Land Cover.

F.2 Forest Community

Unlike most of the other islands surveyed, the Baltee woodlands were composed mostly of balsam fir and not the typical black spruce. This could be related to greater storm activity (e.g. a large area of tree mortality was noted between Murphy's Cove and Baltee Back Cove) but it may also be linked to the same process that transformed 80% of the island cover into a shrub barren. This type of island vegetation clearly has the potential to burn, as was evident from the large burn shrub barren encountered on Cranberry Island.

In addition to the pockets of balsam fir, which are largely coastal, there was an isolated stand of white spruce sheltered from seawinds in the lee of a hill at the south end of the island. This white spruce (*Picea glauca)* stand was Plot 1 (below, and map E.2) and it is among the oldest white spruce stand encountered over all of the eastern shore islands. At an average age of 76 (two cored trees of 84 and 68 years), this stand is much older than the average of 50 years. This is likely because this is a natural stand and not a result of clearing for agriculture and subsequent development into old field or pasture white spruce. The shrub layer is very diverse with 6 species, dominated by alder and bayberry. The herb layer has 15 species with the highest amounts of twinflower *Linnaea borealis* and partridge-berry *(Mitchella repens)*. The moss/lichen layer is less developed with minor amounts of schreber's (*Pleurozium schreberi)* and leafy liverwort *(Bazzania trilobata)*.

Forest vegetation plot 2 is in a rare intact balsam fir (*Abies balsamea)* stand. The plot is situated in a well sheltered location on the north side of the island. In addition to the ravages of wind and storm damage, many of the forest stands of balsam fir have been killed or damaged by forest insects. There is a high percent cover of balsam fir in plot 2 with minor amounts of white spruce (*Picea glauca)* and white birch *(Betula papyrifera)*. The shrub layer is not well developed with just trace amounts of balsam fir and lowbush blueberry *(Vaccinium angustifolium)*. The herb layer is relatively undeveloped with one flowered pyrola *Moneses uniflora* having the largest percent cover. The moss/lichen layer is dominated by 3 species, schreber's *Pleurozium schreberi*, stair-step (*Hylocomium splendens)* and liverwort *(Bazzania trilobata)*.

Table F.1.1 - Baltee Island Forest Vegetation Plot Data			
		Baltee 1	**Baltee 2**
Tree 1 Species/age at breast height		wS/84	bF/42
Tree 1 Diameter at breast height/cm		26.7	17.1
Tree 2 Species/age at breast height		wS/68	bF/32
Tree 2 Diameter at breast height/cm		24.4	14.9
Species			
Trees Layer % cover			
Balsam fir	*Abies balsamea*	2	65
White birch	*Betula papyrifera*		4
White Spruce	*Picea glauca*	30	5
Shrub Layer % Cover			
Balsam fir	*Abies balsamea*		1.5
Mountain Ash	*Sorbus americana*	0.5	
Alder	*Alnus incana*	4	
Wild raisin	*Viburnum nudum*	0.1	
Lowbush blueberry	*Vaccinium angustifolium*	1	0.1
Bayberry	*Morella pensylvanica*	4	
Chokeberry	*Photinia spp.*	1	
Herb Layer % Cover			
Starflower	*Trientalis borealis*	1	0.1
Bunchberry	*chamaepericlymenum canadenseChamaepericlymenum canadense*	2	
Partridge-berry	*Mitchella repens*	20	
Wood aster	*Aster acuminatus*	0.25	
Evergreen Wood fern	*Dryopteris intermedia*	5	0.5
Wood sorel	*Oxalis acetosella*	7	0.75
Viola	*Viola spp.*	4	
Twinflower	*Linnaea borealis*	40	0.1
One flowered pyrola	*Moneses uniflora*	0.1	2
Black crowberry	*Empetrum nigrum*	2	
Creeping snowberry	*Gaultheria hispidula*	0.1	
Dewberry	*Rubus hispidus*	1	
Cranberry	*Vaccinium oxycoccos*	1	
swamp candle	*Lysimachia terrestris*	0.25	
Enchanter's nightshade	*Circaea lutetiana*	0.25	
Moss/Lichen Layer % Cover			

Schreber's moss	*Pleurozium schreberi*	2	15
Stair step	*Hylocomium splendens*		10
Leafy liverwort	*Bazzania trilobata*	1	10
Broom moss	*Dicranum scoparium*		0.5
Plume moss	*Ptilium crista-castrensis*		0.05
Sphagnum	*Sphagnum spp.*		0.25
Hypnum moss	*Hypnum spp.*	0.25	
Ruffled freckled pelt lichen	*Peltigera leucophlebia*	0.1	

Photo F.1 - Forest vegetation plot 1

Photo F.2 - Forest vegetation plot 2

F.3 Plant Communities

As would be expected, the barrens community (80% of island land cover) offered few surprises. These are systems with dense cover of low-growing shrubs and feature huckleberry and bayberry associations with taller clumps of wild raisin. In wetter areas, Labrador tea comes into the community and in lower biomass areas, there is black crowberry. This mix is essentially the same as that observed in the recently burned Cranberry Island barrens.

Though there are pockets of fir and white spruce woodland, these were not found close to harbour members of the coastal woodland, small orchid guild (e.g. checkered rattlesnake plantain, blunt-leaf orchid and common twayblade = *Goodyera tesselata, Platanthera obtusata* and *Listera cordata*) typical of foggy coastal forest. A bog exhibited a similar complement of low biomass species as were found on Inner Baltee and also included the boreal cloudberry, *Rubus chamaemorus*. There were saltmarsh associations behind cobble beaches as well as sand beaches but no unusual flora was observed. These habitats can support golden dock and beach groundsel respectively, and more surveying may reveal these and others from the south and west facing coastal areas.

F.4 Avian Species

Table F.3.1 lists the avian species observed on Baltee Island. The total bird count was 94 individuals which accounted for 25 species. Similar to other islands blackpoll warbler (*Dendroica striata*) and common yellowthroat (*Geothlyphis trichas*) and boreal chickadee (*Poecile hudsonicus)* were plentiful. Observations included eleven ring-necked ducks *(Aythya collaris)*. This species was not detected at other sites.

Table F.3.1 - Baltee Island Bird Sightings by Species and Number
Data collected by C. Pepper 0n 5 Aug 2011

No	Common Name	Scientific Name	Number Observed
1	Common Loon	*Gavial immer*	1
2	Ring-necked Duck	*Aythya collaris*	11
3	Osprey	*Pandion haliaetus*	2
4	Greater Yellowlegs	*Tringa malanoleuca*	1
5	Common Tern	*Sterna hirundo*	5
6	Ruby-throated Hummingbird	*Archilochus colubris*	1
7	Alder Flycatcher	*Empidonax alnorum*	2
8	Boreal Chickakee	*Poecile hudsonicus*	9
9	Golden-crowned Kinglet	*Regulus satrapa*	1
10	Ruby-crowned Kinglet	*Regulus calendula*	1
11	Hermit Thrush	*Catharus guttatus*	3
12	American Robin	*Turdus migratorius*	2
13	Cedar Waxwing	*Bombycilla cedrorum*	2
14	Yellow Warbler	*Dendroica petechia*	4
15	Magnolia Warbler	*Dendroica magnolia*	4
16	Yellow-rumped Warbler	*Dendroica coronata*	7
17	Palm Warbler	*Dendroica palmarum*	1
18	Bay-breasted Warbler	*Dendroica castanea*	1
19	Blackpoll Warbler	*Dendroica striata*	12
20	American Redstart	*Setophaga ruticilla*	1
21	Common Yellowthroat	*Geothlyphis trichas*	12
22	Fox Sparrow	*Passerella iliaca*	3
23	Song Sparrow	*Melospiza melodia*	1
24	White-throated Sparrow	*Zonotrichia albicollis*	1
25	Dark-eyed Junco	*Junco hyemalis*	6
Species Count = 25			
Individuals Count = 94			

F.5 Selected Annotated Photographs of Baltee Island

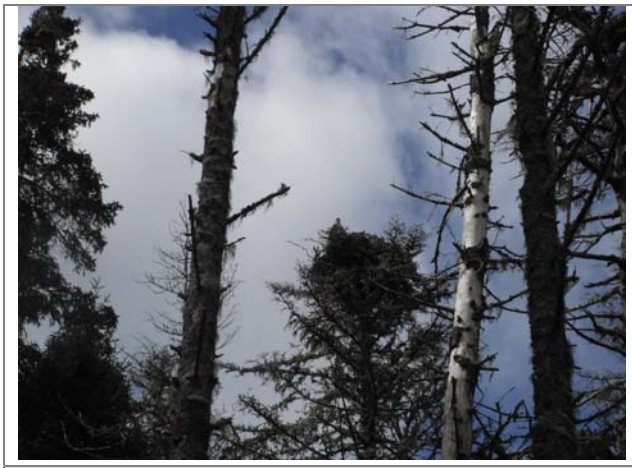


Photo F.3 - View of an osprey on its nest on Baltee Island.

Photo F.4 - View of brackish pond on the south shore of Baltee Island.

Photo F.5 - View of the boulder and cobble beach on the south shore of Baltee Island.

Photo F.6 - View of Murphy's Cove, Baltee Island.

Photo F.7 - View of huckleberry barren, southeast Baltee Island.

Photo F.8 - View brackish pond on Eastern side of Baltee Island.

G. Little Harbour Property

G.1 General

This property is situated immediately to the East of the fishing village of Little Harbour. The property includes a long shoreline with extended sandy beach areas protected by an outer island system. The majority of this property is comprised of barrens with a fringe of forest along the shoreline.
The property area is 71 ha and 27% of this is largely black spruce woodland, though there is a minor presence of white spruce woods on sand dune (NS DNR, 2002). See appendices F.1 – Aerial Images and F.2 – Land Cover.

G.2 Forest Community

The forest vegetation plots on this property describe a 71 year old coastal black spruce (*Picea mariana)* stand and a young (30 year old) sand dune white spruce (*Picea glauca)* stand. The black spruce plot 1 reveals a much more diverse assembly of woody shrubs (6), herbs (9) and moss/lichens (8) than the white spruce plot 2, shrubs (2), herbs (8) and moss/lichens (3). Plot 1 has minor amounts of Mountain ash (*Sorbus americana)* and lambkill *(Kalmia angustifolia)* in the shrub layer. The 3 most common herbs are bunchberry *(chamaepericlymenum canadenseChamaepericlymenum canadense)*, sarsaparilla (*Aralia nudicaulis)* and twinflower *(Linnaea borealis)*. The moss layer is dominated by schreber's *Pleurozium schreberi* and stair-step moss *(Hylocomium splendens)*. The less diverse plot 2 has alder (*Alnus incana)* and white spruce (*Picea glauca)* only, in the shrub layer. Minor amounts of wood aster *(Aster acuminatus)*, twinflower (*Linnaea borealis)* and hair grass *(Deschampsia flexuosa)* in the herb layer and trace amounts of schreber's moss (*Pleurozium schreberi)* in the moss/lichen layer.

Table G.2.1 - Little Harbour Forest Vegetation Plot Data			
		Little Harbour 1	**Little Harbour 2**
Tree 1 Species/age at breast height		bS/75	wS/33
Tree 1 Diameter at breast height/cm		12.1	22
Tree 2 Species/age at breast height		bS/67	wS/26
Tree 2 Diameter at breast height/cm		12.4	18.8
Trees Layer % cover			
Black Spruce	*Picea mariana*	46	
Balsam fir	*Abies balsamea*	1	
White Spruce	*Picea glauca*		80
Shrub Layer % Cover			
Balsam fir	*Abies balsamea*	1	
White Spruce	*Picea glauca*		2
Mountain Ash	*Sorbus americana*	3	
Alder	*Alnus incana*		7
Wild raisin	*Viburnum nudum*	1	
Lowbush blueberry	*Vaccinium angustifolium*	1	
Lambkill	*Kalmia angustifolia*	2.5	

False holly	*Nemopanthus mucronata*	1	
Herb Layer % Cover			
Wild lily of the valley	*Maianthemum canadense*	0.25	0.1
Starflower	*Trientalis borealis*	0.5	0.25
Bunchberry	*Chamaepericlymenum canadenseChamaepericlymenum canadense*	5	0.25
Sarsaparilla	*Aralia nudicaulis*	5	
Blue bead lily	*Clintonia borealis*	0.5	
Wood aster	*Aster acuminatus*		2
Viola	*Viola spp.*		0.1
Twinflower	*Linnaea borealis*	4	1
Pink Ladyslipper	*Cypripedium acaule*	0.25	
Black crowberry	*Empetrum nigrum*		0.25
Foxberry	*Vaccinium vitis-idaea*	0.5	
Common hair grass	*Deschampsia flexuosa*		1
Bracken	*Pteridium aquilinum*	1	
Moss/Lichen layer % Cover			
Schrebers	*Pleurozium schreberi*	60	2
Stair step	*Hylocomium splendens*	10	
Bassania trilobata	*Bazzania trilobata*	2	
Broom moss	*Dicranum scoparium*	0.25	0.5
Plume moss	*Ptilium crista-castrensis*	0.25	
Cup Lichen/Reindeer	*Cladonia spp.*		2
Sphagnum	*Sphagnum spp.*	0.4	
Cup reindeer lichen	*Cladonia maxima*	0.25	
Leafy liverwort	*Ptilidium pulcheriium*	0.25	

Photo G.1 – Plot 1 - Black spruce stand

Photo G.2 – Plot 2 - Dune with white spruce

G.3 Plant Species

Inland, Little Harbour coastal plant communities are largely shrub ridge, black spruce woodland and bog. Only the latter has the potential for unusual plant species, and there were observed the low biomass indicator plants, bog laurel (*Kalmia polifolia*) and the boreal bog shrub, cloudberry (*Rubus chamaemorus*). While the coastal fringe has good salt marsh for waders and migrating birds, there was nothing to indicate suitable habitat for the guild of rare coastal plants that are present on the islands.

G.4 Avian Species

Due to scheduling issues, bird observations were not conducted at Little Harbour.

G.5 Selected Annotated Photographs

Photo G.3 - Shoreline blowdown

Photo G.4 - Coastal barren

Photo G.5 - South-east facing rocky shoreline

Photo G.6 – Private residence at Little Harbour property

Photo G.7: Coastal barrens with coniferous forest between ridges within the interior of Little Harbour property

Photo G.8 – Tidal marsh near south shoreline of Little Harbour property

H. Laybold Island

H.1 General

Laybold Island is composed of two thin islands whose parallel main axes run southwest to northeast. The neighbouring Porter Island, situated to the northwest appears part of the same geological land mass and has similar aspect and orientation. These islands, having no outer land masses for protection, are exposed to the full brunt of the Atlantic winds and storms. Laybold is 1.5 km oceanward of the end of Little Harbour's promontory and Scanlan Point. Based on prevailing wind and storm direction, the exposed position of Laybold Island suggests that it is the most naturally disturbed by storms of any of the islands in this study. Significantly, this island has rarer shoreline plants than any other island in the study. Forest covers only 31% of the island and this consists primarily of black spruce and balsam fir. The balance consists of much shrub land (1-3m high), bog, muskeg and salt marsh (NS DNR, 2002). See appendices G.1 – Aerial Images and G.2 – Land Cover.

H.2 Forest Communities

Many of the forests on Laybolt Island are blown down and are regenerating in mainly balsam fir. Two plots were described: Plot 1 is on the northern island, and Plot 2 is on the lee shore of the southern island.

Plot 1 is a typical black spruce/balsam fir stand that is being regenerated by balsam fir *Abies balsamea* and black spruce (*Picea mariana)* in the shrub layer. Other minor woody shrubs include huckleberry *(Gaylussacia baccata)*, false holly *Nemopanthus mucronata* and alder *(Alnus incana)*. Most common were clonal vining herbs (twinflower and partridge berry = *Linnaea borealis* and *Michella repens*). A thick bryophyte layer is dominated by sphagnum (*Sphagnum spp)* and leafy liverwort (*Bazzania trilobata)* with minor amounts of schreber's moss (*Pleurozium schreberi)* and stair-step moss *(Hylocomium splendens)*. The sphagnum and leafy liverwort cover as well as the presence of sundew, all suggest that this is a wetland forest.

Plot 2 is a well- sheltered natural white spruce (*Picea glauca)* stand situated in the lee of an east-west ridge. The tree layer has minor components of white birch (*Betula papyrifera)* and balsam fir (*Abies balsamea)* while the shrub layer is primarily balsam fir. The herb layer is dominated by evergreen wood fern (*Dryopteris intermedia)* and wood sorrel *(Oxalis acetosella)*. The bryophyte layer is dominated by schreber's moss (*Pleurozium schreberi)* and leafy liverwort (*Bazzania trilobata)* with lesser amounts of stair-step moss (*Hylocomium splendens)* and broom moss *(Dicranum scoparium)*.

Table H.2.2 - Laybold Island Forest Vegetation Plot Data

		Laybold 1	Laybold 2
Tree 1 Species/age at breast height		bF/43	ws/70
Tree 1 Diameter at breast height/cm		14	21
Tree 2 Species/age at breast height		bF64/	ws/51
Tree 2 Diameter at breast height/cm		26	19

Tree Layer % cover			
Black Spruce	*Picea mariana*	55	
Balsam fir	*Abies balsamea*	20	5
White birch	*Betula papyrifera*		5
White Spruce	*Picea glauca*		30.2
Tamarack/Larch	*Larix laricina*	0.01	
Shrub Layer % Cover			
Black Spruce	*Picea mariana*	3	
Balsam fir	*Abies balsamea*	8	8
Mountain Ash	*Sorbus americana*		0.1
Alder	*Alnus incana*	1	
Serviceberry	*Amelanchier spp.*	0.1	
Wild raisin	*Viburnum nudum*	0.3	
Lowbush blueberry	*Vaccinium angustifolium*	0.2	0.1
Lambkill	*Kalmia angustifolia*	2	
Huckleberry	*Gaylussacia baccata*	3	0.1
False holly	*Nemopanthus mucronata*	0.05	
Winterberry	*Ilex verticillata*		0.1
Herb Layer % Cover			
Starflower	*Trientalis borealis*		0.1
Partridge-berry	*Mitchella repens*	3	
Wood aster	*Aster acuminatus*		0.1
Dwarf raspberry	*Rubus pubescens*	0.2	1
Evergreen Wood fern	*Dryopteris intermedia*		20
Wood sorel	*Oxalis acetosella*		15
Viola	*Viola spp.*		1
Twinflower	*Linnaea borealis*	3	
Rock polypody fern	*Polypodium virginianum*		1
Creeping snowberry	*Gaultheria hispidula*		0.1
Enchanters nightshade	*Circaea lutetiana*		1
Skunk current	*Ribes glandulosum*	0.2	0.5
Roundleaved sundew	*Drosera rotundifolia*	0.01	
Tickle grass	*Agrostis hyemalis*		0.1
Three-seeded Sedge	*Carex trisperma*		1
Moss/Lichen Layer % Cover			
Schreber's moss	*Pleurozium schreberi*	15	30
Stair step	*Hylocomium splendens*	10	5
Bassania trilobata	*Bazzania trilobata*	30	30
Broom moss	*Dicranum scoparium*	5	5
Cup Lichen/Reindeer	*Cladonia spp.*		1.2
Sphagnum	*Sphagnum spp.*	30	

Cup reindeer lichen	*Cladonia maxima*	0.9	
Old man's beard	*Usnea spp.*	0.2	
Phoenix moss	*Fissidens spp.*		5
Haircap moss	*Polytrichum spp.*		5
Carpet moss	*Mnium spp.*		0.1

Photo H.1 – Forest vegetation plot 1 – Black spruce and balsam fir

Photo H.2 - Forest vegetation plot 2 – Well sheltered natural white spruce stand

H.3 Plant Species

There is a mark of anthropogenic disturbance on the vegetation of the northern island. Some of the coastal white spruce woodland appears to have succeeded after forest clearing and it is thick with Schreber's moss and poor in native herb diversity. A large clearing nearby had grown up in raspberry, fir and wild raisin after a recent forest fire. Concentrations of exotic plant species inland indicated where pasture was succeeded by woodland because European pasture components (bent grass, Kentucky bluegrass and sweet vernal grass and weeds, Canada thistle and sheep's sorrel) were still apparent. Near an old foundation, the exotic strawberry and chrysanthemum testify to an earlier anthropogenic footprint and support the use of exotics (inland only) for locating settlements.

Wetlands

Native plant communities inland alternated between uplands on ridges and wetland in between ridges. The ridges were dominated by a series of tall shrubs (false holly (*Nemopanthus mucronata*), huckleberry (*Gaylussacia baccata*), Black chokeberry (*Photinia melanocarpa*), downy alder (*Alnus crispa*), Canada holly (*Ilex verticillata*) and wild raisin (*Viburnum nudum*) and black spruce (*Picea mariana*). Wetlands included the shrubs Labrador tea (*Rhododendron groenlandicum*), rhodora (*Rhododendron canadense*), leatherleaf (and sweet gale). The flooding stress of wetlands allows smaller plants to occur and in addition to these included have a more diverse flora and some wet heathland communities were common. Many were a mix of tall shrub (huckleberry, wild raisin and lambkill dominants with frequent addition of common juniper and Labrador tea). Another common wetland was a black spruce treed bog where cinnamon fern clumps occurred in a matrix of sphagnum moss that supported small wetland

herbs. Seeps that intergrade with salt marsh are of greatest ecological interest and these are systems that are always changing as salinity changes after storms. The bog community near the sea is dominated by sweet gale (*Myrica gale*) with a saltmarsh rush (*Juncus arcticus*) and various forbs (e.g. swamp candle, pitcher plant and marsh St. Johns wort) and this changes to a typical low nutrient acid bog with starry false solomons seal, bake apple, grass-pink orchid and the small cranberry. A seep also demonstrated the abrupt changes in nutrient and salinity conditions where a robust saltmarsh bulrush stand (*Bulboschoenus validus*) grew next to the insectivorous pitcher plant. This barachois/bog (where a beach meets a lagoon that is a peat bog) featured many small, poor competitors (bog huckleberry, beakrushes, spatulate sundew, bog rosemary and the small cranberry). None of the inland communities at Laybold Island featured rare species but the landscape has integrity and the strong vegetation patterns reflect the long term influence of wind on the upland ridge communities and flooding in the trapped boglands or black spruce muskeg communities.

Seashore

The seashore communities were greatly disturbed both by storms and subsidence. Perhaps of all the islands visited, Laybold, the most southern and the most exposed to uninterrupted ocean fetch, is most naturally disturbed. Spruce and fir were falling into the water and in many places there was no transition zone between the seawater habitats and forest habitat. At other islands (e.g. Wolfe and Gerard), we see some natural heaths of crowberry (*Empetrum nigrum)* where the wind and salt keeps trees at bay and there is a low shrub zone of the sweet-smelling crowberry. At Laybold, there was evidence that much of the crowberry habitat has been lost because of storm damage (i.e. salt water or the turning over of crowberry mats).

This is the island which has the rarest or uncommon plants of those surveyed. Beach ragwort (*Senecio pseudo-arnica*) (ranked as sensitive) is known for 6 sites in NS. Populations were observed in upper beach areas. In addition, there was one population of coast blite orache (“may be at risk”) found among other native and exotic annual plants at the top of cobble beach. In windswept sea grass communities knotted pearlwort (*Sagina nodosa was found).* There was a small population of the uncommon but secure, knotted pearlwort on salt-sprayed peat among boulders.

H.4 Avian Species

Table H.3: Laybold Island Bird Sightings by Species and Number
Data collected by C. Pepper on 14 Sept 2011

No.	Common Name	Species	Number Observed
1	Common Loon	*Gavia immer*	2
2	Northern Gannet	*Morus bassanus*	1
3	Double-crested Cormorant	*Phalacrocorax auritus*	5
4	American Black Duck	*Anas rubripes*	21
5	Sharp-shinned Hawk	*Acipter striatus*	1
6	Merlin	*Falco colunbarius*	1
7	Semipalmated Plover	*Charadrius semipalmatus*	20
8	Spotted Sandpiper	*Actitis macularia*	2
9	Sanderling	*Calidris alba*	5
10	Semipalmated Sandpiper	*Calidris pusilla*	9
11	Least Sandpiper	*Calidris minitilla*	1
12	Ring-Billed Gull	*Larus delawarensis*	3
13	Herring Gull	*Larus argentatus*	5
14	Great Black-backed Gull	*Larus marinus*	2
15	Belted Kingfisher	*Ceryle alcyon*	2
16	Northern Flicker	*Coloptes auratus*	1
17	Boreal Chicakee	*Poecile hudsonicus*	7
18	Red-breasted Nuthatch	*Sitta canadensis*	2
19	Golden-crowned Kinglet	*Regulus satrapa*	9
20	Ruby-crowned Kinglet	*Regulus calendula*	1
21	Hermit Thrush	*Catharus guttatus*	2
22	Northern Parula	*Parula americana*	1
23	Magnolia Warbler	*Regulus satrapa*	2
24	Black-throated Green Warbler	*Dendroica virens*	1
25	Palm Warbler	*Dendroica palmarum*	3
26	Blackpoll Warbler	*Dendroica striata*	5
27	Black-and-White Warbler	*Mniotilta varia*	1
28	Common Yellowthroat	*Geothlyphis trichas*	2
29	Fox Sparrow	*Passerella iliaca*	2
30	Song Sparrow	*Melospiza melodia*	12
31	Dark-eyed Junco	*Junco hyemalis*	3
Species Count = 31			
Individuals Count = 134			

H.5 Selected Annotated Photographs

Photo H.3 – Northwest shoreline of Laybold Island with Porter Island in the background

Photo H.4 - Rounded granite glacial erratics in coastal saltmarsh

Photo H.5 - Drowned forest in cove on northeast side of Laybold Island

Photo H.6 – Crowberry heath on Southwest tip of Laybold Island

Photo H.7 – Forest blowdown on Laybold Island

	
Photo H.8 - Sea scoured quartzite on south shoreline of Laybold Island	**Photo H.9 – Coastal barachois pond on northeast shoreline of Laybold Island**

I. Gerard Island

I.1 General Condition

Gerard Island, a crescent shaped island, is one of the largest in the Eastern Shore focus area. It is situated less than 1 km from the mainland. Prevailing winds from the south are, in part blocked by the nearby Phoenix Island. Together with Stoney Island, these three islands shelters a large cove called the Bawleen. Gerard Island was one of the few Eastern Shore islands that have supported a permanent settlement. In the late 1800s and early 1900s up to 40 people lived on the island with houses, wharfs, and a school, connected by a road running across its northern side. There remains a small group of cabins situated on the islands northeast corner, although it was noted during field surveys that the largest of the buildings had recently been destroyed by fire.

Most (87%) of the island area (321 ha) is forest covered. Forests consist of white spruce stands (32 ha) succeeding on old fields or pasture, balsam fir (50 ha) and black spruce (201 ha) (NS DNR, 2002). See appendices H.1 – Aerial Images and H.2 – Land Cover.

I.2 Forest Communities

Gerard Island forests exhibit a full range of disturbed and undisturbed forest habitats. Most of the Northern section of the island was cleared and used as pasture throughout the 1800's and early 1900's. This was likely because there was a suitable soils and shelter in these areas. Most of the old pastures have now reverted to white spruce.

Parts of the southern section of the island front onto the Bawleen, a large sheltered lagoon. This rugged southern rocky shoreline is mostly undisturbed and reveals important marine and bird habitats. Much of the southern section of the island demonstrates the typical black spruce, balsam fir coastal forest. Recent storms have created large blown down areas, especially along the south facing shoreline and inland on unprotected south facing slopes. Eastern Dwarf mistletoe is evident throughout the southern part of the island in black spruce stands and is causing extensive mortality. In some cases huckleberry barrens are expanding into black spruce areas as the mistletoe slowly kills the spruce trees.
Because of the cool moist climate on the Eastern Shore there is little forest fire occurrence. The only evidence of forest wildfire was an old burn site encountered on the north-east end of the island. This was the result of a man made forest fire on 22 May, 1992 which burned 6 ha of old field white spruce.

There were 3 forest vegetation plots located on Gerard Island. Plot 1 was located in a 40 year old field white spruce (*Picea glauca)* stand on the north-west end of the island. This plot had a very sparse shrub and herb layer. The more substantial moss/lichen layer was dominated by schreber's (*Pleurozium schreberi)* and stair step moss *(Hylocomium splendens)*.

Plot 2 was located close to the southern shoreline on the Bawleen, in a 56 year old balsam fir (*Abies balsamea)* stand with a moderate component of white birch *(Betula papyrifera)*. The shrub layer was dominated by balsam fir with minor amounts of white spruce and white birch. The most common herb was wood sorel (*Oxalis acetosella)* followed by checkered rattlesnake plantain *(Goodyera tesselata)*. The

bryophyte layer was dominated by schreber's moss (*Pleurozium schreberi)* and leafy liverwort *(Bazzania trilobata).*

Plot 3 was located on the western side of the island in a rare young and healthy balsam fir (*Abies balsamea)* stand (27 years). This is one of the few forest areas that appear to have been harvested in the recent past. (The 1954 aerial photography reveals a trail or road system throughout) The tree layer also had minor amounts of white birch (*Betula papyrifera)* and black spruce *(Picea mariana)*. The shrub layer had trace amounts of black spruce and balsam fir. The most common herb was wood sorel (*Oxalis acetosella)* followed by twinflower *(Linnaea borealis)*. The bryophyte layer was dominated by leafy liverwort (*Bazzania trilobata)* and stair step moss *(Hylocomium splendens)*.

Table I.2.1 - Gerard Island Forest Vegetation Plot Data				
		Gerard 1	**Gerard 2**	**Gerard 3**
Tree 1 Species/age at breast height		wS/52	bF/52	bF/28
Tree 1 Diameter at breast height/cm		28.6	10.4	14.4
Tree 2 Species/age at breast height		wS/27	bF/60	bF/27
Tree 2 Diameter at breast height/cm		17	14.6	16.1
Trees Layer % cover				
Black Spruce	*Picea mariana*			3
Balsam fir	*Abies balsamea*		65	80
White birch	*Betula papyrifera*		15	4
White Spruce	*Picea glauca*	85		
Shrubs Layer % Cover				
Black Spruce	*Picea mariana*			0.1
Balsam fir	*Abies balsamea*	0.2	40	0.1
White birch	*Betula papyrifera*	0.1	1	
White Spruce	*Picea glauca*		3	
Wild raisin	*Viburnum nudum*	0.1	0.1	
Velvet leaved blueberry	*Vaccinium myrtilloides*			
Lowbush blueberry	*Vaccinium angustifolium*	0.3	0.2	
Herb layer % Cover				
Wild lily of the valley	*Maianthemum canadense*	0.2	0.1	
Starflower	*Trientalis borealis*	1	0.2	0.1
Bunchberry	*Chamaepericlymenum canadenseChamaepericlymenum canadense*		0.1	0.1
Goldthread	*Coptis trifolia*		0.1	
Partridge-berry	*Mitchella repens*	0.1	0.1	
Wood aster	*Aster acuminatus*	1		
Dwarf raspberry	*Rubus pubescens*	0.3		
Evergreen Wood fern	*Dryopteris intermedia*	0.1		0.1
Wood sorrel	*Oxalis acetosella*	0.7	2	4

Viola	*Viola spp.*			
Twinflower	*Linnaea borealis*		0.4	1
checkered rattlesnake plantain	*Goodyera tesselata*		0.5	
Sedge	*Carex spp.*	0.1		
Creeping snowberry	*Gaultheria hispidula*		0.1	
Dewberry	*Rubus hispidus*	0.1		
Buttercup (exotic)	*Ranunculus repens*	0.1		
Blackberry	*Rubus spp.*	0.2		
Rough cinquefoil	*Pottentilla norvegica*	0.1		
Rough goldenrod	*Solidago rugosa*	1		
Flat-topped aster	*Aster umbulatus*	1		
Indian pipe	*Monotropa uiniflora*		0.2	
Moss/Lichen Layer % Cover				
Schreber's	*Pleurozium schreberi*	8	45	1
Stair step	*Hylocomium splendens*	25	4	15
Bassania trilobata	*Bazzania trilobata*	0.5	45	75
Broom moss	*Dicranum scoparium*			2
Old man's beard	*Usnea spp.*			2

Photo I.1 – Forest Vegetation Plot 1 - Old field white spruce

Photo I.2 – Forest Vegetation Plot 2 – Balsam fir and white birch

Photo I.3 – Forest Vegetation Plot 3 – Young, healthy balsam fir

I.3 Plant Species

Table 6.3 and 6.4, above, list the plant species observed on Gerard Island in coastal area and freshwater areas, respectively.

Wetlands

Two discrete, hummocky sphagnum bogs were visited on the east half of the island. They are very low vegetation and they stand out as small ovals (ca. 80 by 40m each) in aerial surveys (map H.1). The first features shrubs the small cranberry (*Vaccinium oxycoccos*), Labrador tea (*Rhododendron groenlandicum*), crowberry (*Empetrum nigrum*) and common juniper (*Juniperus communis*). Distinctive bog herbs include the meagre and the black sedge (*Carex exilis, Carex nigra*), cottongrass (*Eriophorum virginicum*), and bog aster and goldenrod (*Aster nemoralis*, *Solidago uliginosa*). The second is inland and is more diverse. There are different sedges (*Carex paupercula* and *Carex pauciflora*), the addition of two beakrushes (*Rhynchospora fusca* and *R. alba*), more tussocks of cinnamon fern, and insectivorous plants (round leaved sundew and pitcher plant).

The south western half of the island, overall, was boggier and in general, there were less discrete hummock bogs. Here we saw more intergrading of saltmarsh and wetland near the shores and areas of more flooded treed bog supported stunted black spruce that was similar in composition to the second peat bog above.

Seashore and Headlands

On all islands, die-back or the physical undermining of the coastal trees, and of seashore heath and of saltmarsh sods was noted. This likely results from a combination of sea level rise and increased frequency of storms. Gerard Island has a less abrupt transition between the terrestrial woodland ecosystems and the marine. There was more intact fringing saltmarsh (cordgrass and salthay: *Spartina alterniflora* and *S. patens*). Extensive saltmarsh shoreline development was restricted to a few select places : where topography provides shelter from the proximate forces that are causing the erosion of shoreline, in the context of the high energy Atlantic coastline, where sediment load can sufficiently accumulate.

Although Gerard Island supports many saltmarsh species, the disturbance regime facing the island is naturally much greater than at those mainland sites mentioned. Islands are valued as islands, and sea islands are subject to a wider range of natural disturbance than shorelines of the mainland. Unlike the mainland, the shores of islands are largely unaltered by anthropogenic disturbances.

The beaches of these islands are particularly valuable in this regard for they reflect the long-term balance of the natural disturbance regime. This disturbance regime, however, makes them ideal for a guild of exotic annual and perennial herbs (see Hill and Blaney, 2010). A similar guild was found on Gerard as on Laybold, however, on Gerard we have the invasion of the upper salt marsh by the southern African "brass buttons" (*Cotula coronopifolia*) which has invaded many coastal areas of western North

America, Europe and the antipodes but so far is very limited in eastern North America. In Nova Scotia it is only known from the area around Conrad's Beach.

This plant is a marker of the process that maintains diversity. It signifies that there is disturbance (from ice, wind or rotting material) in saltmarsh sites that create openings for the establishment of plants both native and exotic. Golden dock (*Rumex maritimusS3/S4*4 Secure) is similar in habit (weak competitor) and size to brass buttons, and it also occurs along a shoreline stretch that is somewhat sheltered where it occupies the upper saltmarsh zone with two native species: the triangular-stemmed bulrush (*Bolboschoenus maritimus*) and weedy seaside buttercup (*Ranunculus cymbalaria*).

On the most exposed coast of Gerard Island, the west-facing southwest promontory, the exposure regime creates great disturbance and cobble beaches are formed and there is scant development of any saltmarsh. The beach ragwort (*Senecio pseudo-arnica*) which is judged rare in the province (S2Sensitive; ACCDC data) sets up in the upper cobbles of these shores.

Also on this most exposed point, we have the best development of natural coastal heath of Gerard Island and of all three islands visited. The understory under the seaside black spruce or fir is made up of a berried heathland of crowberry and foxberry. This is of significance in the diet of birds (e.g. junco) and mammals (e.g. mink). At the most wind stressed sites (e.g. the southwest promontory), wind has shaped a crowberry shrub community that is as much as 10m wide. The development of these crowberry communities occurs only on southern promontories within the Bay of Islands. There has been great natural loss in some areas (e.g. 70% of the shrub base cited in Hill et al.,(In Press) at Gaff Point). Islands such as Gerard are important because these communities are unaffected by trampling, trail construction and development. As the sea continues to rise, and storm intensity and frequency increases, these communities have the best chance in the province of regenerating in response to the disturbances. There are good nursery areas (where seedlings of crowberry regenerate) in the shade of standing black spruce. As trees die, these seedlings are advanced placements to both regenerate the crowberry mat and maintain genetic diversity therein.

Lastly, the influence of sea winds affects the shoreline forest. There is a range in forest states from those that are regenerating in young fir after blow down or disease to those that are more stable or have escaped recent disturbance. The orchid, the checkered rattlesnake plantain (*Goodyera tesselata*) is scattered around the Atlantic coast of mainland Nova Scotia and the population reported for Gerard Island is roughly 50 km from the nearest reported population near Musquodoboit Harbour (Munden, 2001). Both findings on Gerard were in seaside forest that was more elevated than adjacent seaside sites and in both cases, the sites are on the more sheltered eastern shore of the island and were facing a south sea wind. This rattlesnake plantain is part of a guild of little orchids (including *Platanthera obtusata* and *Listera cordata*) that grow in moist, fog-bound forests (i.e. the "perhumid" eastern shore forests of Nova Scotia, Clayden et al., 2011). *Goodyera tesselata* also grows inland. In these forests, precipitation exceeds transpiration and evaporation for most the year keeping forest soils moist. The rattlesnake orchid was most common in the forest plot 3, where the most common bryophyte was the moisture-requiring leafy liverwort, *Bazania* sp. These sites are also characterized by a large amount of

fallen dead wood and though not exclusively a saprophyte, such woodlands often have the "indian pipe" (*Monotropa uniflora*) which was observed on the island in association with the orchid. More orchid species will likely be discovered on Gerard during further field work.

I.4 Avian Species

Table I.3.1: Gerard Island Bird Sightings by Species and Number
Data collected by C. Pepper, Sept 21 and 28 2011

No	Common Name	Species	Number Observed
1	Double-crested Cormorant	*Phalacrocorax auritus*	2
2	Great Blue Heron	*Ardea herodias*	1
3	Canada Goose	*Branta canadensis*	8
4	Belted Kingfisher	*Ceryle alcyon*	1
5	Black-backed Woodpecker	*Picoides arcticus*	2
6	Northern Flicker	*Coloptes auratus*	1
7	Gray Jay	*Perisoreus canadensis*	2
8	American Crow	*Corvus brachyrhynchos*	3
9	Black-capped Chickadee	*Poecile atricapilla*	2
10	Boreal Chicakee	*Poecile hudsonicus*	26
11	Red-breasted Nuthatch	*Sitta canadensis*	6
12	Brown Creeper	*Certhia americana*	1
13	Golden-crowned Kinglet	*Regulus satrapa*	19
14	Hermit Thrush	*Catharus guttatus*	3
15	Blue-headed Vireo	*Vireo solitarius*	1
16	Yellow-rumped Warbler	*Dendroica coronata*	15
17	Blackburnian Warbler	*Dendroica fusca*	1
18	Palm Warbler	*Dendroica palmarum*	2
19	Blackpoll Warbler	*Dendroica striata*	7
20	Black-and-White Warbler	*Mniotilta varia*	2
21	Common Yellowthroat	*Geothlyphis trichas*	1
22	Fox Sparrow	*Passerella iliaca*	2
23	White-throated Sparrow	*Zonotrichia albicollis*	2
24	Dark-eyed Junco	*Junco hyemalis*	13
25	White-winged Crossbill	*Loxia leucoptera*	2
26	Pine Siskin	*Carduelis pinus*	10
Species Count			**26**
Individuals Count			**135**

I.5 Selected Annotated Photographs

Photo I.4 – Forest blowdown

Photo I.5 - Eastern dwarf mistletoe

Photo I.6 – Bog and black spruce forest of the interior of Gerard Island

Photo 1.7 – Aerial photo of east area of Gerard Island. `The Bawleen` (body of water in the middle of the

Photo I.8 - `The Bawleen` shoreline on the south side of Gerard Island.

image) is a well protected basin between Gerard, Phoenix and Stoney Islands. (B. Guscott)	

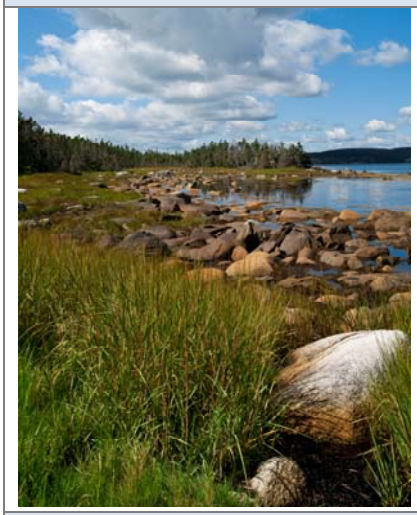



Photo 1.9 –Sheltered north shoreline of Gerard Island	**Photo 1.10 – Burned, abandoned field on north side of island**
	
Photo I.11 - Remnants of interior road on north side of island	**Photo I.12 – Recently burned house on northeast side of island. Other structures were noted within this cleared area.**

J. Harry's Cove and Cranberry Island

J.1 General Condition

Harry's Cove is a mainland property located immediately to the west of Little Harbour. This is a very scenic property with diverse habitats including; a large salt marsh and tidal flats, protected rocky shoreline, rocky barrens and coastal forest.

The Harry's Cove/Cranberry Island property encompasses a total of 240 ha. The coastal forest is subdivided into 14 stands composed of very high percentages of black spruce (70 - 100%). A very large burn of 81 ha or 34% of the total area is observed on Cranberry Island. Brush accounts for 35 ha or about 15% of the property while wetlands, barrens and beach make up the remaining 15% (NS DNR, 2002). See appendices F.1 – Aerial Images and F.2 – Land Cover.

J.2 Forest Communities

The forest is the typical black spruce/balsam fir coastal forest. As with all the properties there is considerable blowdown forest damage especially close to the shoreline. Both plots were located in black spruce stands and shared many similarities in species and percent cover. Plot 1 was about 62 years old and had a minor amount of balsam fir (*Abies balsamea)* present in the tree layer. The shrub layer had balsam fir, lambkill *(Kalmia angustifolia)*, mountain ash (*Sorbus americana)* and black spruce *(Picea mariana)*. The herb layer was dominated by creeping snowberry *Gaultheria hispidula*, with lesser amounts of bunchberry *(Chamaepericlymenum canadenseChamaepericlymenum canadense)*, cinnamon fern *(Osmunda cinnamomea)* and twinflower *Linnaea borealis*. The bryophyte community was primarily sphagnum moss (*Sphagnum spp.)* with lesser amounts of schreber's moss (*Pleurozium schreberi)* and stair step moss *(Hylocomium splendens)*. This is a wetland forest.

The older black spruce (*Picea mariana)* plot 2 (79 years) also had balsam fir (*Abies balsamea)* as a secondary forest species. The shrub layer had black spruce, lambkill (*Kalmia angustifolia)* and balsam fir. The most common herbs were partridgeberry *(Mitchella repens)*, cinnamon fern*) Osmunda cinnamomea*), creeping snowberry (*Gaultheria hispidula)* and bunchberry *(Chamaepericlymenum canadenseChamaepericlymenum canadense)*. The moss/lichen layer had large amounts of schreber's (*Pleurozium schreberi)* and sphagnum moss (*Sphagnum spp.)* with lesser amounts of stair step (*Hylocomium splendens)* and broom moss *(Dicranum scoparium)*. The large fraction of sphagnum (30%) indicates that this is a wet forest floor.

Table J.2.1 - Harry's Cove Forest Vegetation Plot Data

		Harry's 1	Harry's 2
Tree 1 Species/age at breast height		bS/72	bS/71
Tree 1 Diameter at breast height/cm		14.3	18.2
Tree 2 Species/age at breast height		bS/53	bS/88
Tree 2 Diameter at breast height/cm		15.6	18
Tree Layer % cover			
Black Spruce	*Picea mariana*	41	50

Balsam fir	*Abies balsamea*	13	10
Shrub layer % Cover			
Black Spruce	*Picea mariana*	1	7
Balsam fir	*Abies balsamea*	8	1
White birch	*Betula papyrifera*	0.2	
Mountain Ash	*Sorbus americana*	2	0.2
Alder	*Alnus incana*	0.5	
Serviceberry	*Amelanchier spp.*	0.2	0.5
Wild raisin	*Viburnum nudum*	0.3	0.5
Lowbush blueberry	*Vaccinium angustifolium*	0.1	0.3
Lambkill	*Kalmia angustifolia*	6	5
Bayberry	*Myrica pensylvanica*		0.1
Chokeberry	*Aronia spp.*		0.3
False holly	*Nemopanthus mucronata*	0.4	0.1
Labrador Tea	*Rhododendron groenlandicum*		0.2
Herb Layer % Cover			
Wild lily of the valley	*Maianthemum canadense*	0.2	0.5
Starflower	*Trientalis borealis*	0.1	0.1
Bunchberry	*Chamaepericlymenum canadense*	8	2
Goldthread	*Coptis trifolia*	0.1	
Sarsaparilla	*Aralia nudicaulis*		0.1
Blue bead lily	*Aralia nudicaulis*		4
Partridge-berry	*Mitchella repens*	1	6
Cinamen fern	*Osmunda cinnamomea*	4	6
Bracken fern	*Pteridium aquilinum*		2
Twinflower	*Linnaea borealis*	3	
Pinesap	*Monotropa hypopithys*		0.1
Pink Ladyslipper	*Cypripedium acaule*	0.1	
Sedge	*Carex spp.*	0.1	.
Black crowberry	*Empetrum nigrum*		0.5
Creeping snowberry	*Gaultheria hispidula*	25	4
Swamp candle	*Lysimachia terrestris*		0.2
Blue flag	*Iris versicolor*		1
Bog Solomon's seal	*Maianthemum trifoliata*		0.1
Moss/Lichen Layer % Cover			
Schreber's moss	*Pleurozium schreberi*	10	40
Stair step	*Hylocomium splendens*	6	3
Leafy liverwort	*Bazzania trilobata*	2	
Broom moss	*Dicranum scoparium*	1.2	3
Plume moss	*Ptilium crista-castrensis*	3	1
Sphagnum	*Sphagnum spp.*	70	30

Caribou lichen	*Cladonia stellaris*	0.2	
Old man's beard	*Usnea spp.*		2
Haircap moss	*Polytrichum spp.*		0.3

Photo J.1 – Forest vegetation plot 1 – Black spruce with balsam fir stand

Photo J.2 – Forest vegetation plot 2 – Black spruce with balsam fir stand

J.3 Plant Community

J.3.1 Harry's Cove Mainland

The upland landscape undulated so that there were dry ridges covered in Cladonia spp. lichens, juniper, lambkill and crowberry and inter-ridge depression that typically had Sphagnum spp. and Labrador tea. Black spruce (*Picea mariana*) grew overall and spread largely by layering. The shore between the upland and the island is an extensive shoreline used by many shorebirds (e.g. greater yellowlegs in October).

Table J.1.1 and J.1.2, below, present the species lists for the mainland portion of this property for freshwater plants and coastal plants respectively.

Seashore

All the elements of the saltmarsh flora are present on this property. The subtidal is eelgrass, the intertidal is cordgrass, pools are filled with ditchgrass and pondweed, just above tide are flats of marsh hay, the transition before woody shrub is a mix of wild ryes, sweetgrass, sedge , rush and iris (*Elymus* spp., *Hierocloe, Carex paleacea, Juncus arcticus* and *Iris versicolor*).

Wetlands

Much of the area is wetland between ridges but diversity is low because of a covering of thick shrub and black pine. This landscape is broken up by the occasional low shrub bog of *Sphagnum* spp., heaths (lambkill, juniper, small cranberry, and crowberry= *Kalmia angustifolia, Juniperus communis, Vaccinium oxycoccos*, and *Empetrum nigrum*), bog aster and bog goldenrod (*Aster nemoralis, Solidago uliginosa*) with pitcher plants (*Sarracenia purpurea*).

Headland/Human Settlement

As with other sites, the early clearings and structures of human occupation are still perceptible but on the headland, shrubs have replaced the pasture and only the lack of trees, a few persistent pasture plants (buttercup and bentgrass, *Ranunculus repens* and *Agrostis alba*), and some piled rocks show that this was cleared. The succession of pasture to shrubland is a general feature of seashore headlands in NS (Burley and Lundholm, 2010) and here, we see anthills were part of that succession but are now getting succeeded in turn by shrubs. In the adjacent woods, there is a standing rockwall that is now surrounded by white spruce (*Picea glauca*) instead of the black spruce (*Picea mariana*) that dominates the uncleared landscape.

Species of Significance

The strong patterning in the upland vegetation (ridge and hollow floras) and especially in the saltmarsh show that this habitat has integrity and that the mark of past settlement has been limited to the point at the headland. However, this is a competitive landscape with a swath a shrub and black spruce in the uplands and layers of salt hay in the marsh. These are not the habitats that usually harbour rare flora.

J.3.2 Cranberry Island

This island is separated from the mainland at low tide only by a saltwater creek that runs through extensive saltmarsh. The terrestrial vegetation is for the most part a mix of different sorts of shrub barrens that have gained greater hold after a recent fire which affected the majority of the plant communities . Aerial views (map F.1) show those areas that were not burned as dark patches representing the black spruce woods. A small peninsula to the southwest of the island was not visited, but it clearly has survived and should be investigated for woodland orchids. The island has exceptional saltmarsh that flanks the entire northwest side. This habitat had various shorebirds each time it was visited. In addition, there is a secluded saltmarsh pond inlet on the east side used by duck and frequented by falcon.

Table 6.3 and 6.4 present the species lists for the Cranberry Island portion of the Harry's Cove property for freshwater plants and coastal plants respectively.

Seashore

Seashore communities fall into two extremes at Cranberry Island. The east side is more sheltered and so supports more saltmarsh community. The northeast shore is a saltmarsh that connects it to the mainland at low tide, save for a narrow channel. Subtidal flats of eelgrass (*Zostera marina*) occur. The saltmarsh has a diversity of habitats including low marsh dominated by cordgrass (*Spartina alterniflora*), ponds with *Ruppia maritima* (ditchgrass), high marsh of salt hay and salt grass (*Spartina patens* and *Distichlis spicata*) where seaside goldenrod is ubiquitous and where an assortment of smaller herbs are found (see list under seashore plants). The saltmarsh is fringed by tall freshwater cordgrass (*Spartina pectinata*) and in seep areas by hardstem bulrush (*Schoenoplectus acutus*) and cattail (*Typha latifolia*). A variety of smaller plants are found throughout this area. The saltmarsh and creeks support a variety of shorebirds from small sandpipers to yellowlegs. The southeast side that gets full exposure to south wind

supported the rare beach ragwort (*Senecio pseudoarnica*) on cobbles. Also, golden dock (*Rumex fueginus*) occurred on the lee side of small barrier beaches on the same shore as well as on the same position on the western shore. Much of the western shore was extremely exposed and the exotic wild radish (*Raphanus raphanistrum*) dominated the top of the cobble beaches.

Headlands

The widespread fire generally would have shifted the flora from woodland to shrubbery. Shrub barrens cover most of the island. On the northwest tip, these barrens are dominated by crowberry (*Empetrum nigrum*) and further to the southwest, the composition shifts to a greater representation by *Cladonia* spp. lichens with foxberry (*Vaccinium vitis-idaea*) or teaberry (*Gaultheria procumbens*). Other heathland plants included huckleberry, (*Gaylussacia baccata*), blueberry (*Vaccinium angustifolium*), juniper (*Juniperus communis*) and bunchberry (*Chamaepericlymenum canadense*). The seaside headland crowberry barrens occur over a wider area than they would without fire and hence, much of the barrens area on Little Harbour Island conforms to the "dynamic" barrens type of Burley and Lundholm (2010). Without fire, persistent crowberry barren may occur only as a coastal fringe seaward of conifer woodland on wind exposed headlands.

Despite the conversion of a large fraction of the island to shrub barren, relativelyuncommon orchids were found in the seaside woodlands at the south end of the island that had escaped fire. There were three populations of the S4 ranked blunt-leaved orchid (*Platanthera obtusata*) in moist woods at the southwest of the island and two populations of the S4 ranked checkered rattlesnake plantain (*Goodyera tesselata*) on either coast at the south of the island. This latter orchid inhabits slightly drier coastal woodland that the former.

J.4 Avian Species

Table J.2.1: Harry's Cove Bird Observations by Species and Number
Data collected by C. Pepper on 27Oct 2011

No.	Common Name	Species	Number Observed
1	American Black Duck	*Anas rubripes*	9
2	Green-winged Teal	*Anas crecca*	4
3	Ruffed Grouse	*Bonasa umbellus*	1
4	Great Blue Heron	*Ardea herodias*	7
5	Black-bellied Plover	*Pluvialis squatarola*	8
6	Greater Yellowlegs	*Tringa melanoleuca*	8
7	Herring Gull	*Larus argentatus*	2
8	Mourning Dove	*Zenaida macroura*	5
9	Hairy Woodpecker	*Picoides villosus*	1
10	Black-backed Woodpecker	*Picoides arcticus*	1
11	Northern Flicker	*Coloptes auratus*	1
12	Gray Jay	*Perisoreus canadensis*	3
13	American Crow	*Corvus brachyrhynchos*	4

14	Black-capped Chickadee	*Poecile atricapilla*	2
15	Boreal Chickadee	*Poecile hudsonicus*	6
16	Red-breasted Nuthatch	*Sitta canadensis*	1
17	Golden-crowned Kinglet	*Regulus satrapa*	7
18	American Robin	*Turdus migratorius*	29
19	Dark-eyed Junco	*Junco hyemalis*	1
20	Purple Finch	*Carpodacus purpureus*	2
21	American Goldfinch	*Carduelis tristis*	3
Species Count			**21**
Individuals Count			**105**

J.5 Selected Annotated Photographs

Photo J.3 - View of Harry's Cove showing saltmarsh at high tide and Cranberry Island in background

Photo J.4 - High tide in main channel of saltmarsh separating Harry's Cove and Cranberry Island

Photo J.5 - View along mainland shoreline near Harry's Cove with upland forest in the background

Photo J.6 - Small brook on the mainland at Harry's Cove which runs westward into saltmarsh

Photo J.7 – Forest blowdown damage along trail

Photo J.8 - View of forest habitat on mainland at Harry's Cove.

Photo J.9 - Small brook on mainland of Harry's Cove where it discharges into saltmarsh

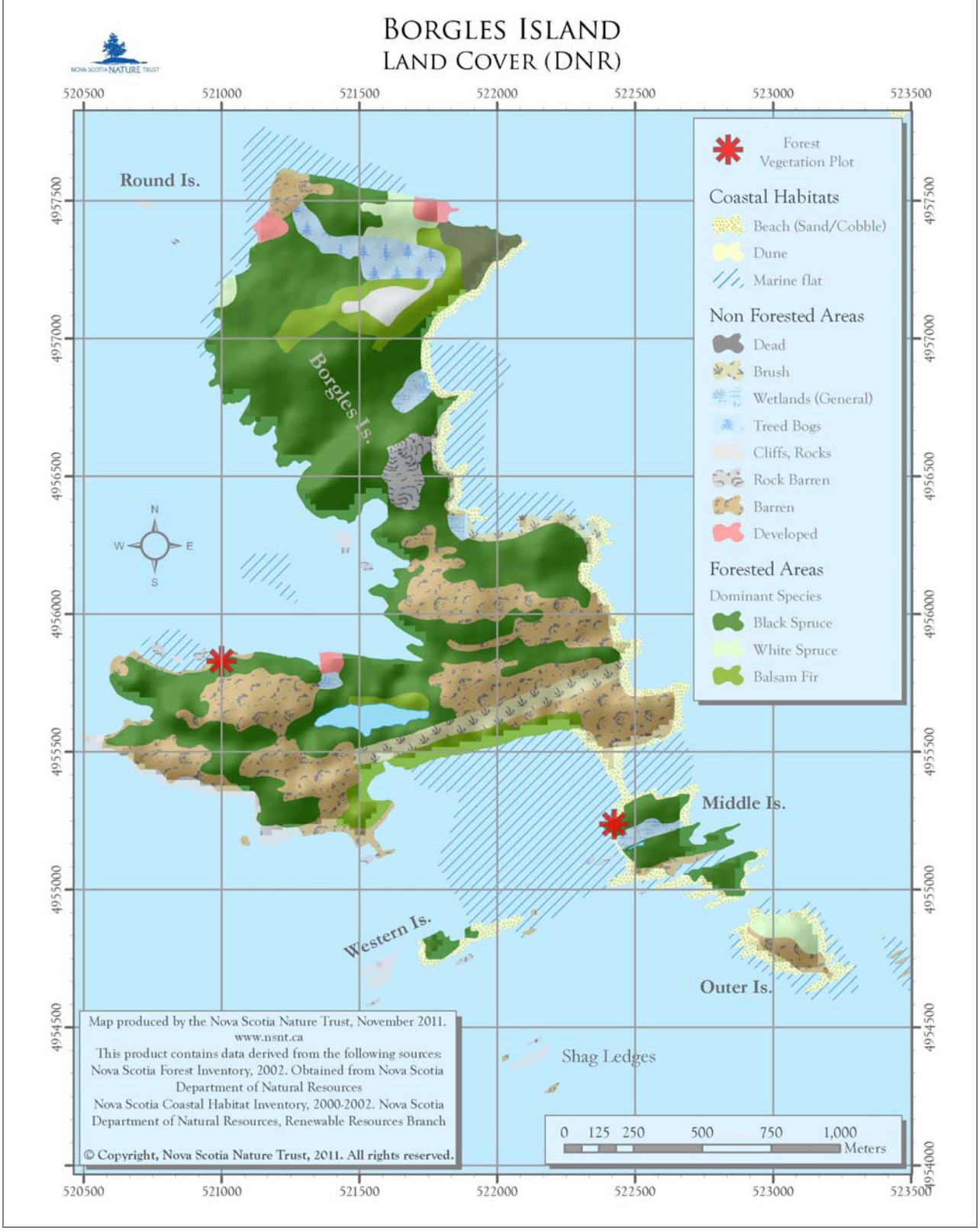
Photo J.10 - Old bridge foundation over stream

Photo J.11 - View of forest on the mainland at Harry's Cove showing a remnant stone foundation from previous settlement.

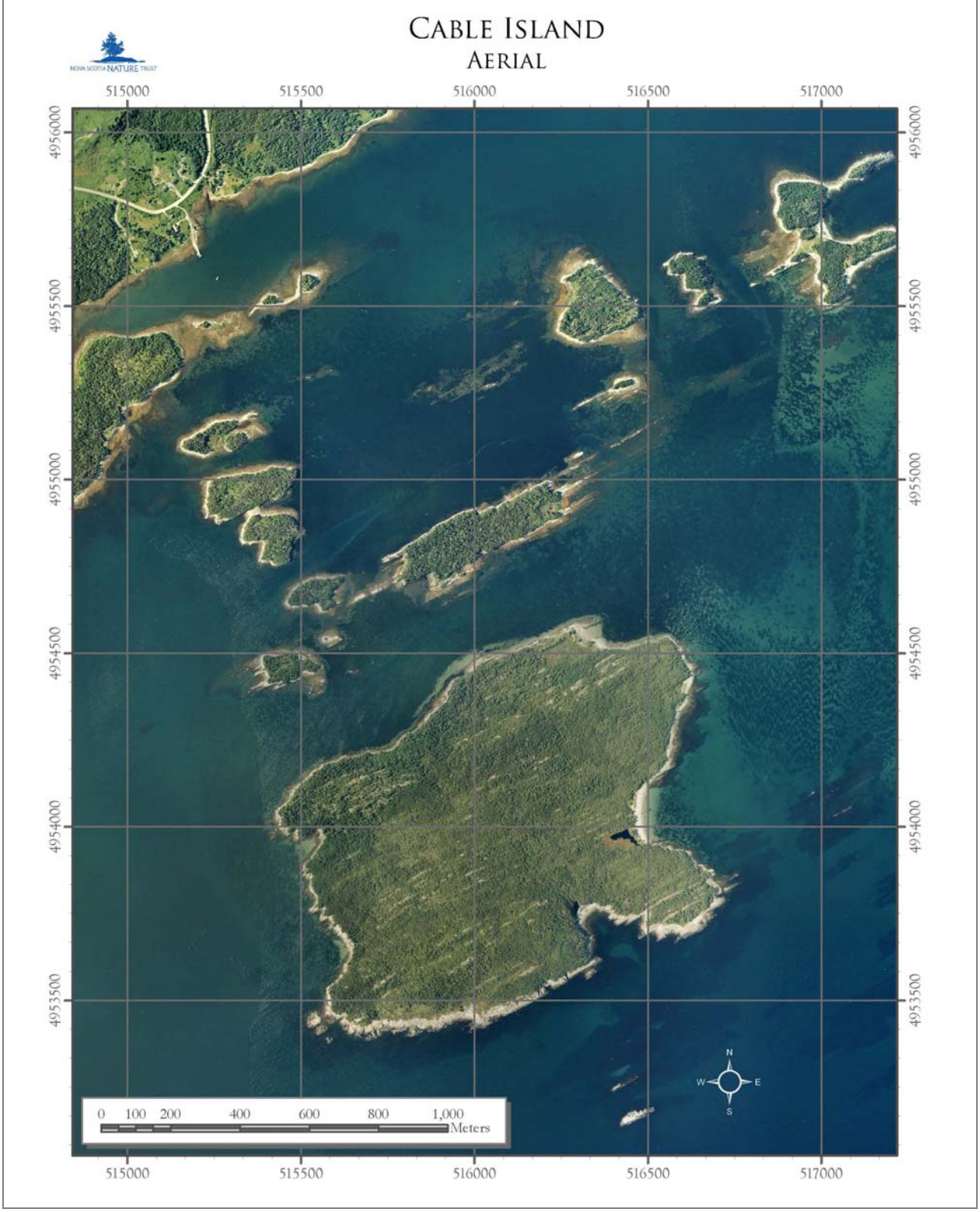
8 APPENDICES

Appendix A.1 – Aerial Image - Borgles Island (2003)

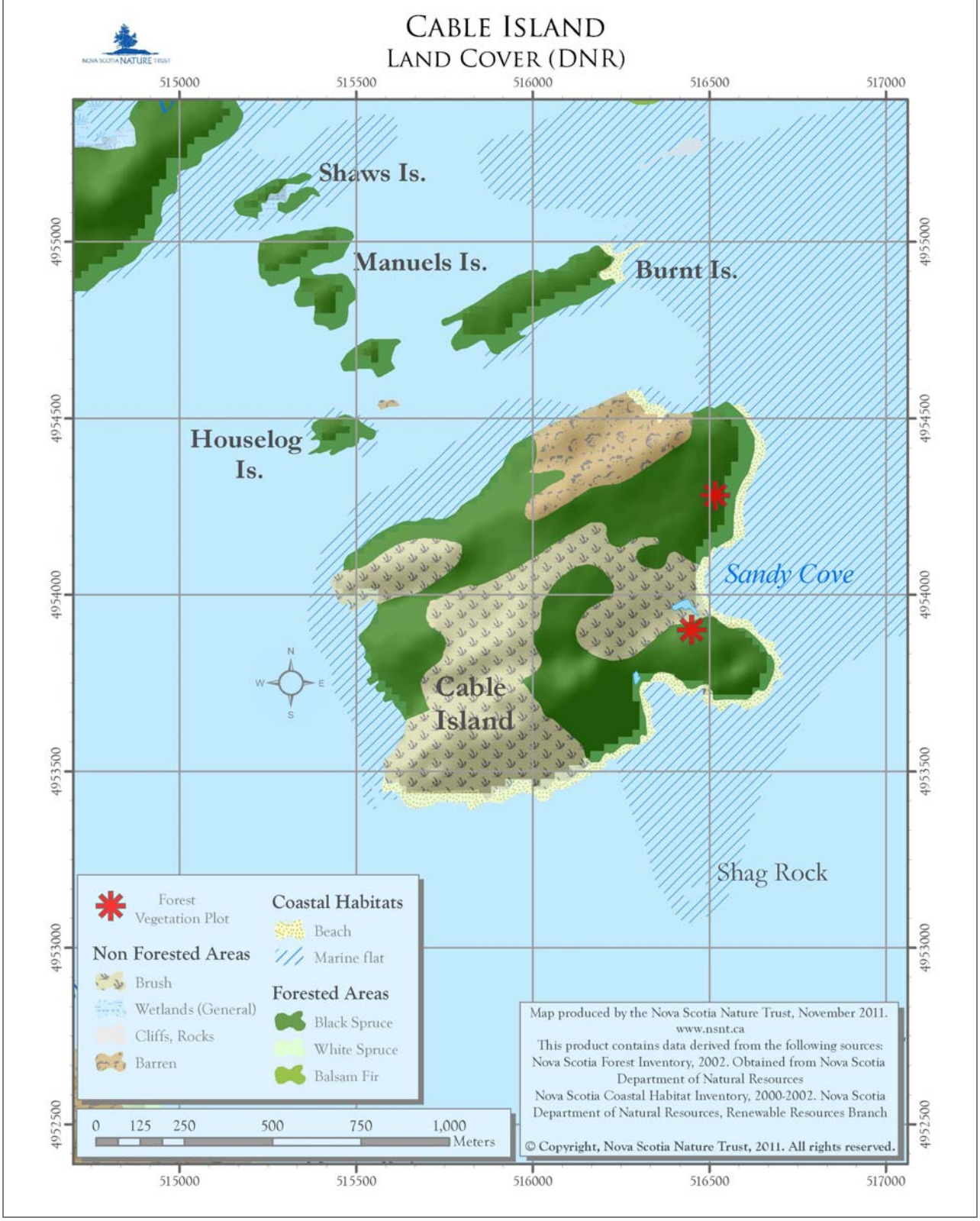
Appendix A.2 – Land Cover – Borgles Island
(DNR, 2002)



Appendix B.1 – Aerial Image – Cable Island
(2003)

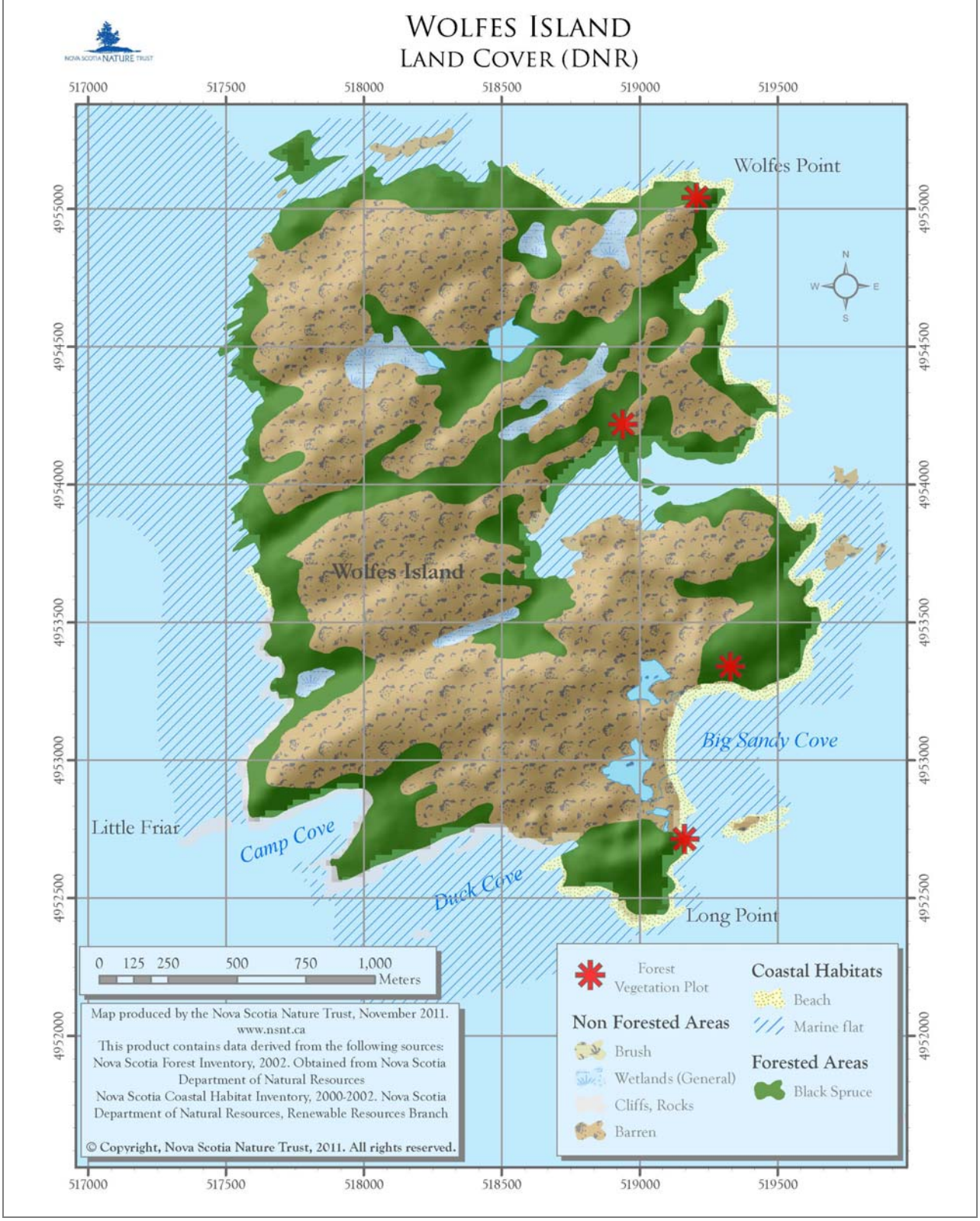


Appendix B.2 – Cable Island – Land Cover
(DNR, 2002)



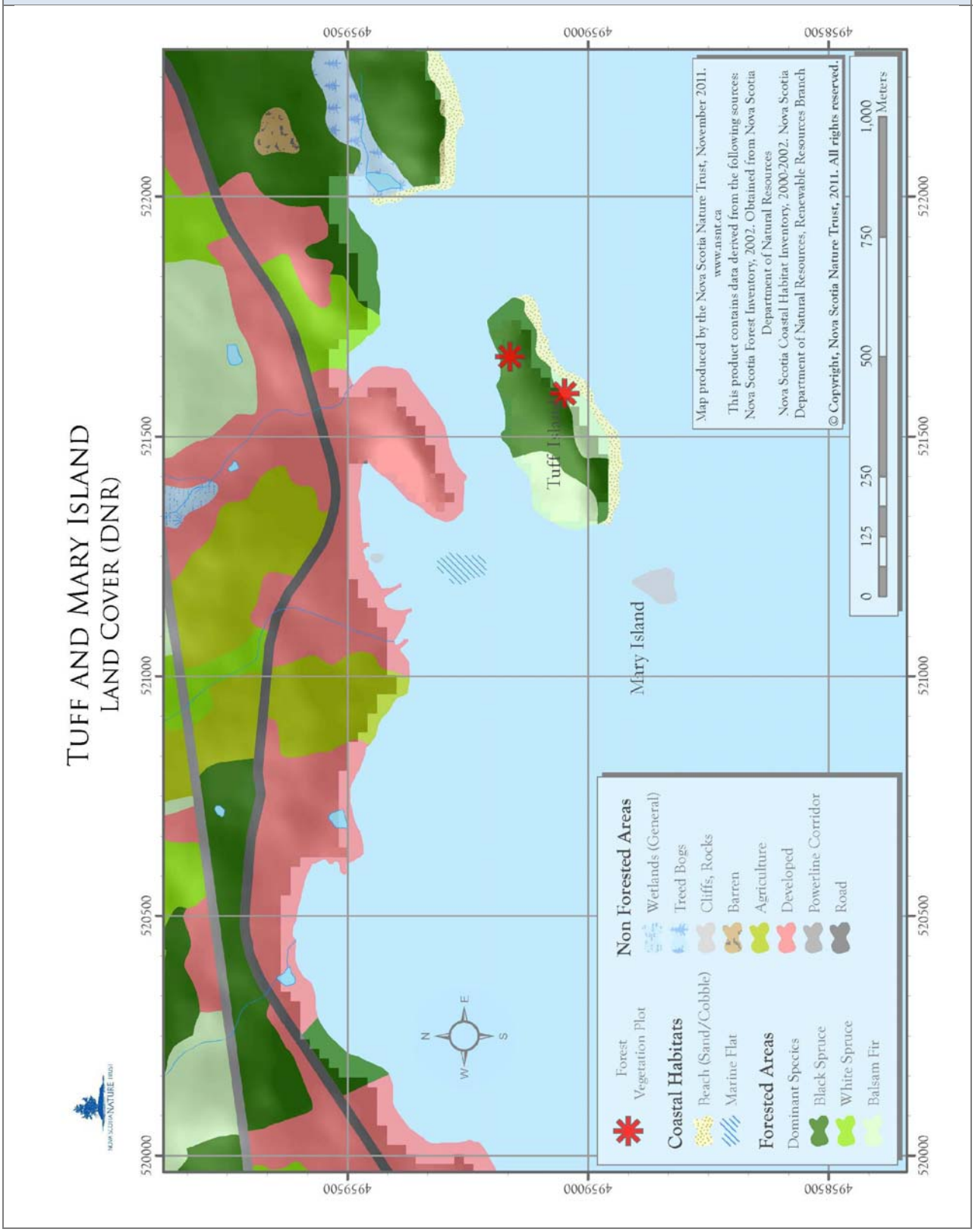
Appendix C.1 – Aerial Image – Wolfes Island
(2003)

Appendix C.2 – Land Cover – Wolfes Island
(DNR, 2002)



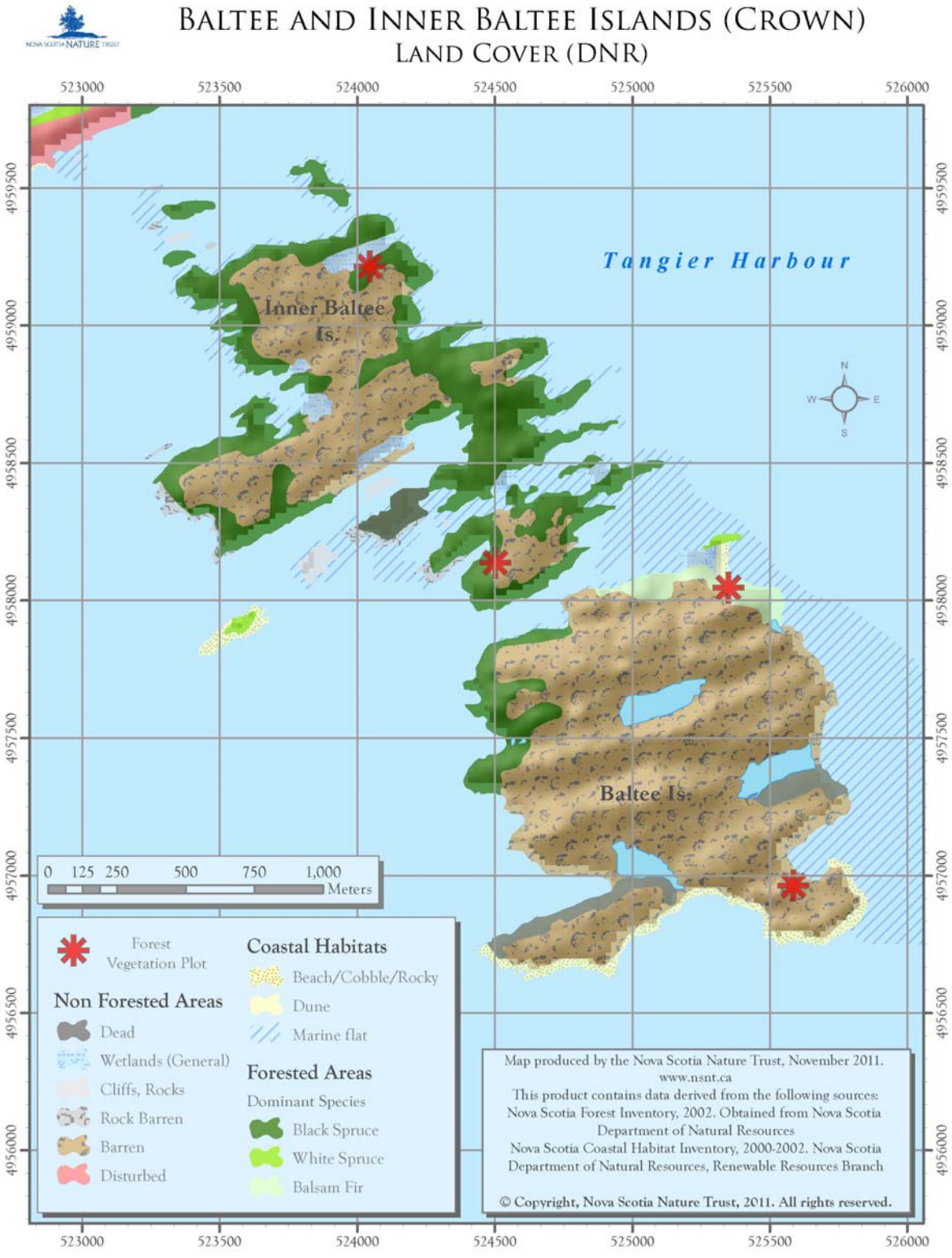
Appendix D.1 – Aerial Image – Tuff & Mary Island (2003)

Appendix D.2 – Land Cover – Tuff Island and Mary Island
(DNR, 2002)

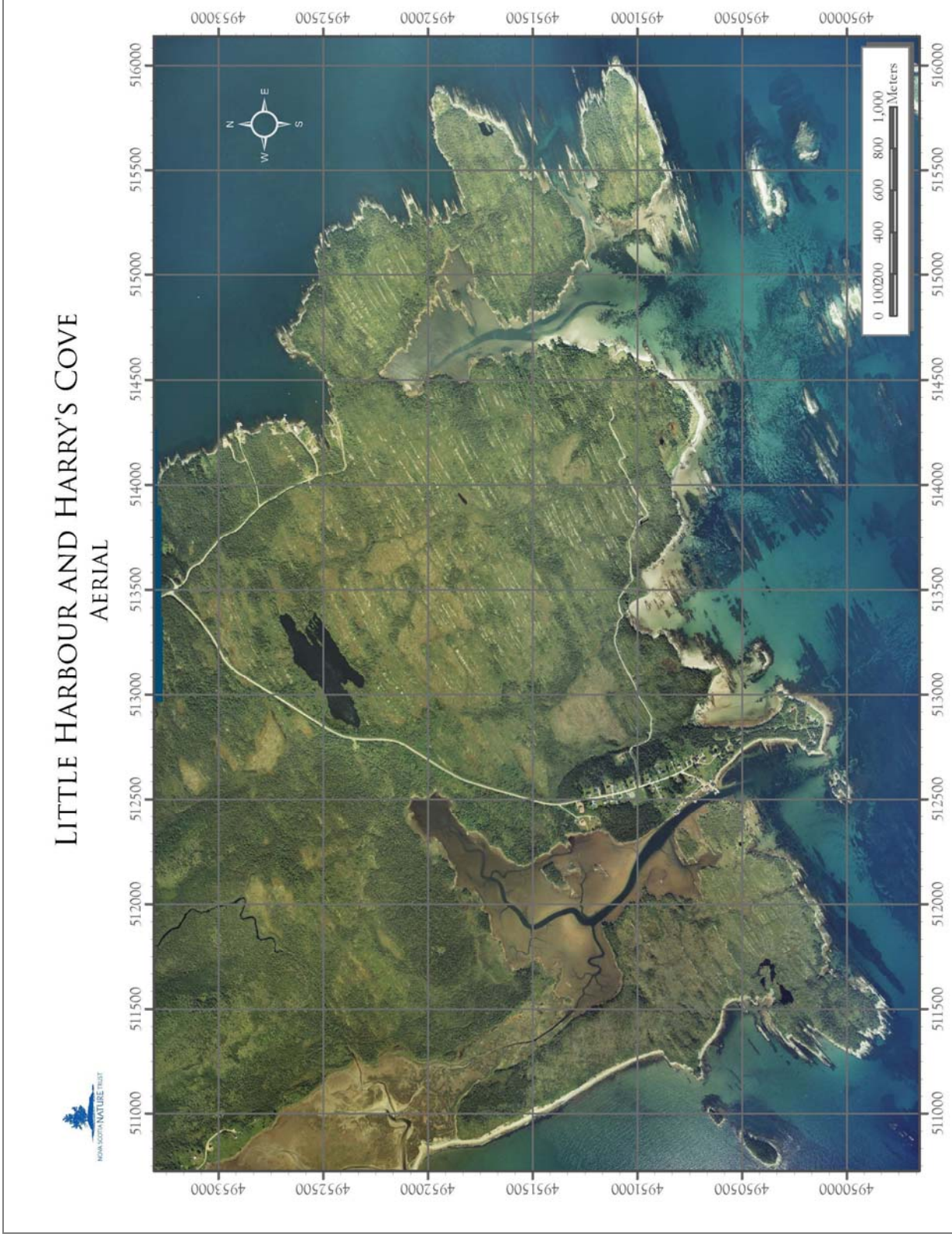


Appendix E.1 – Aerial Image – Baltee Island and Inner Baltee Island (2003)

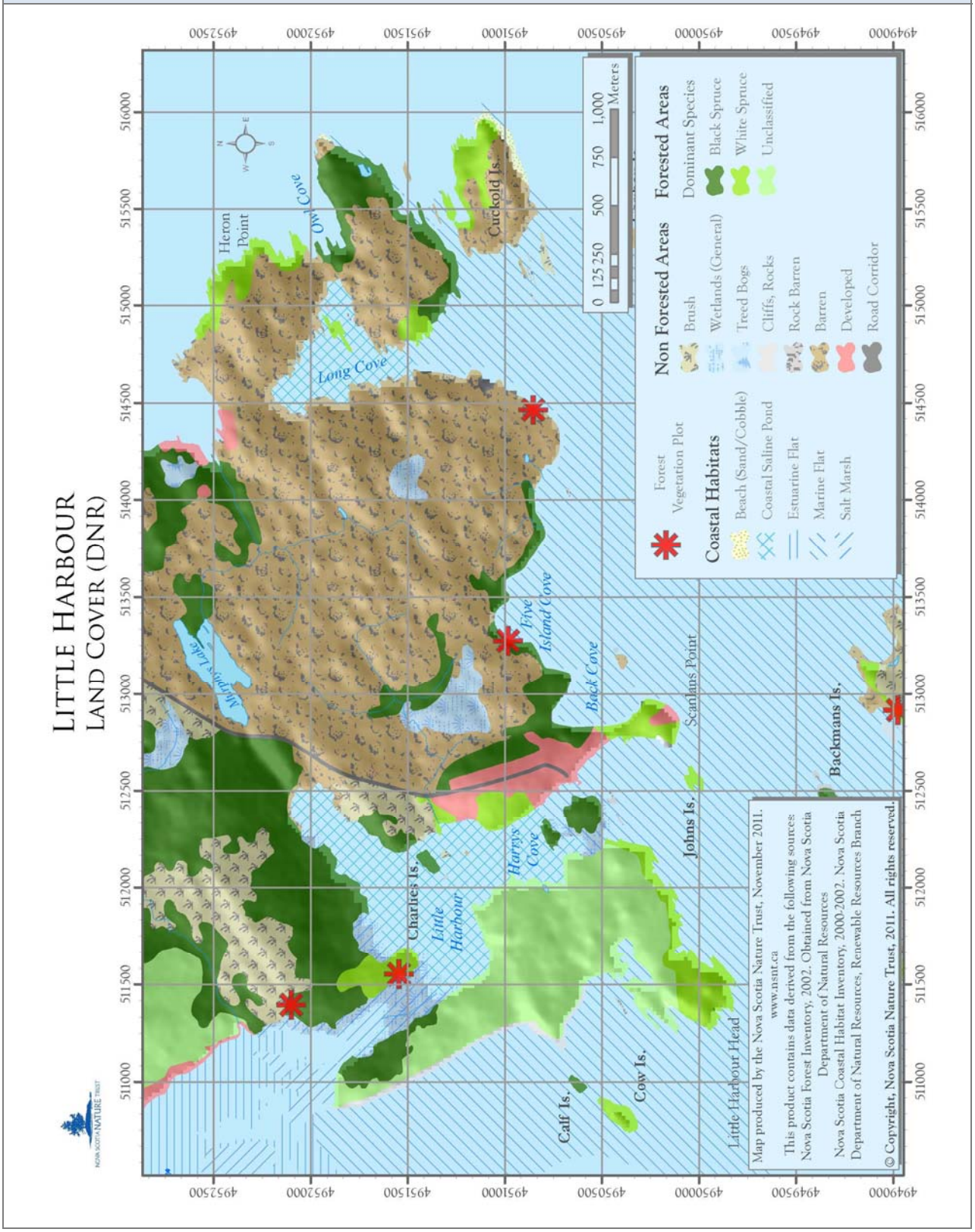
Appendix E.2 – Land Cover – Baltee Island and Inner Baltee Island (DNR, 2002)



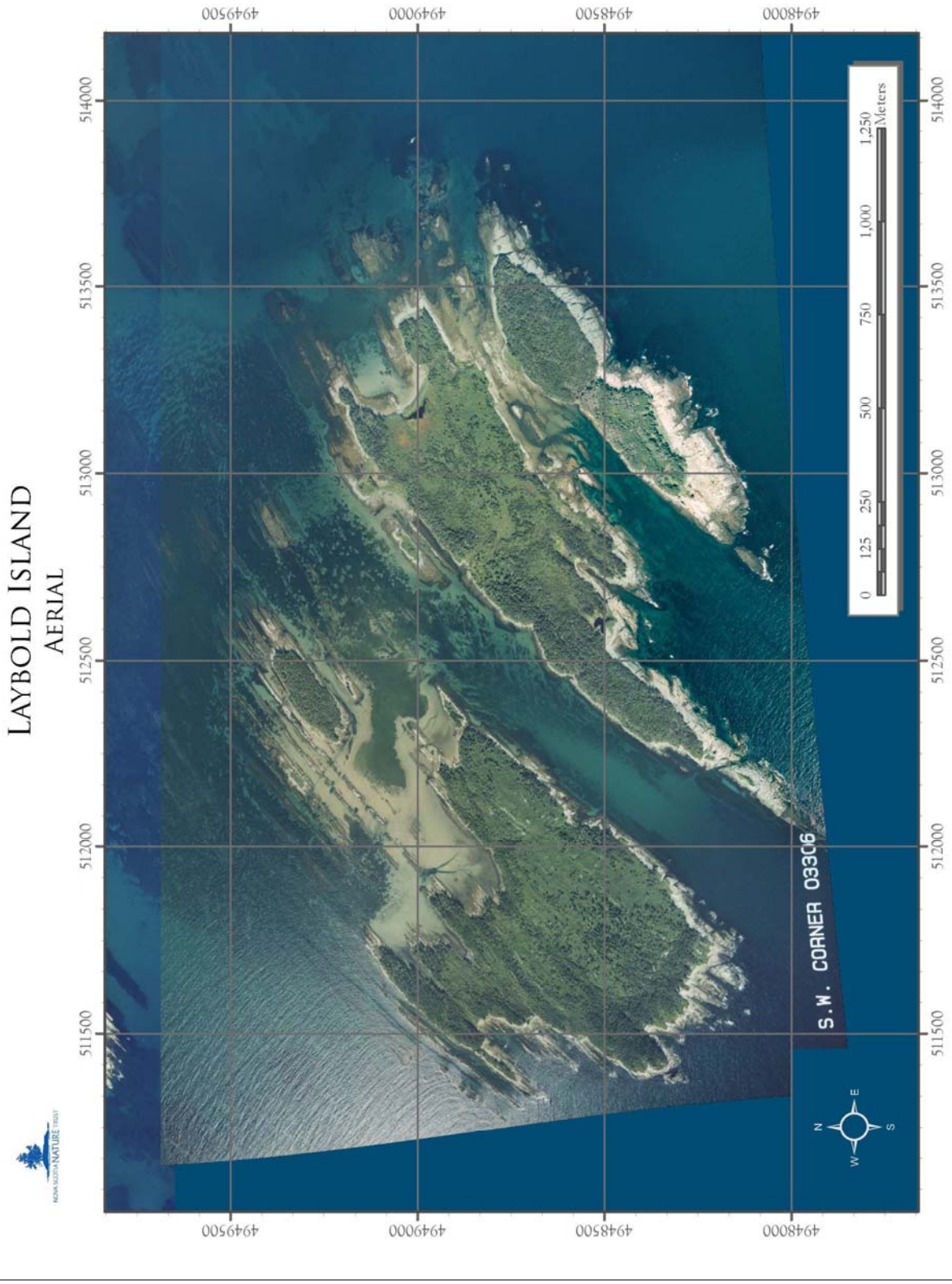
Appendix F.1 – Aerial Image - Little Harbour and Harry`s Cove (2003)



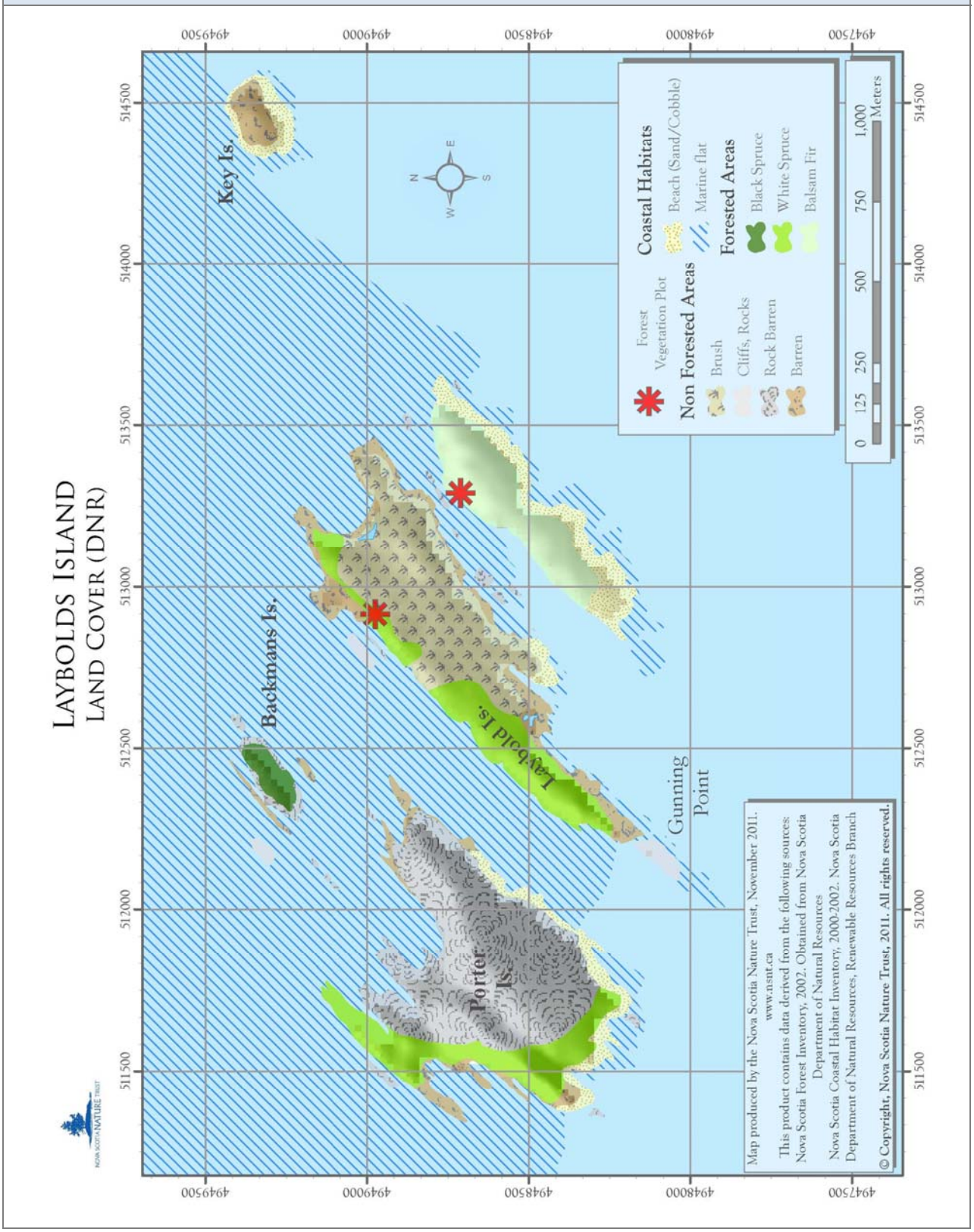
Appendix F.2 – Land Cover
(DNR, 2002)



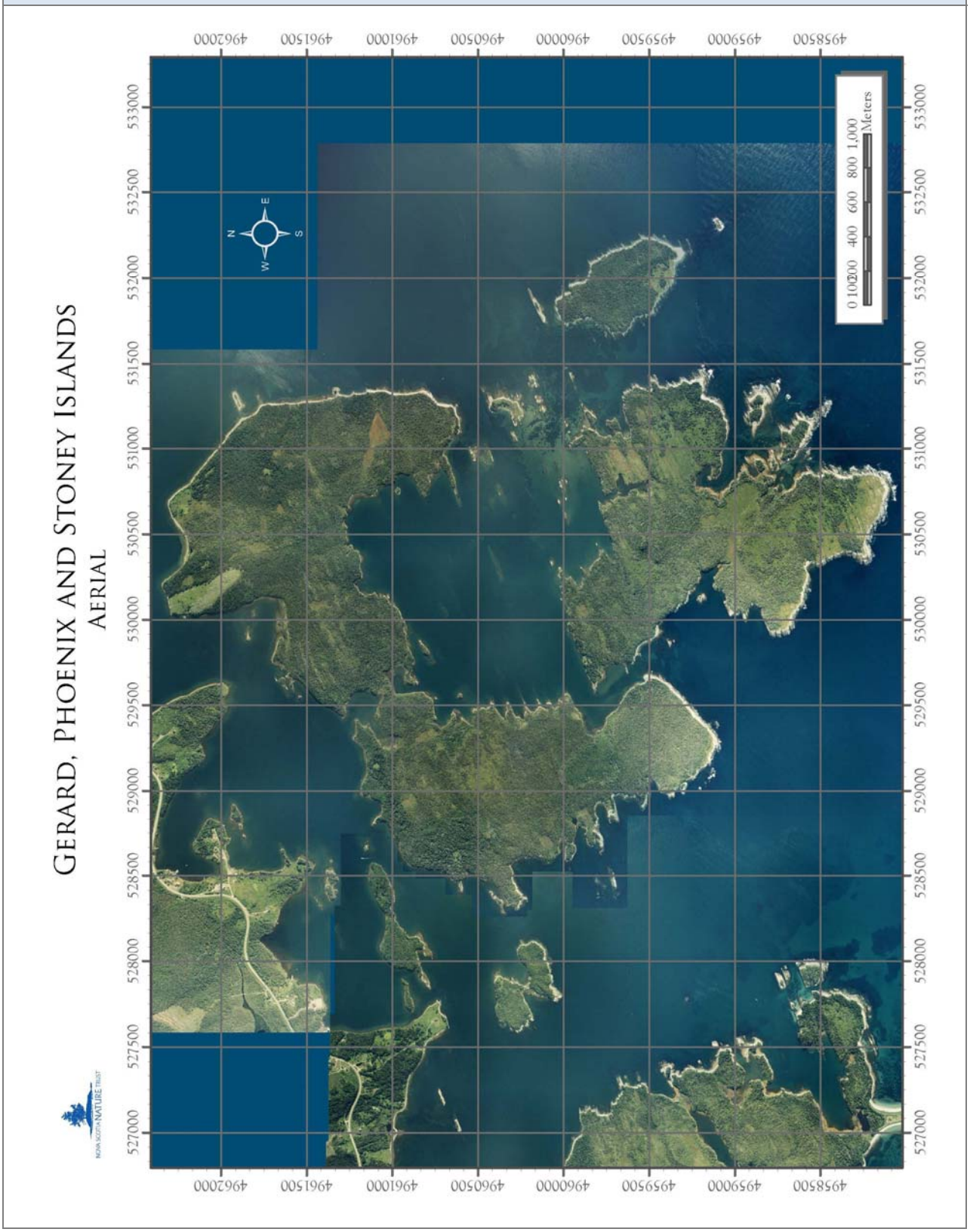
Appendix G.1 – Aerial Image – Laybold Island
(2003)



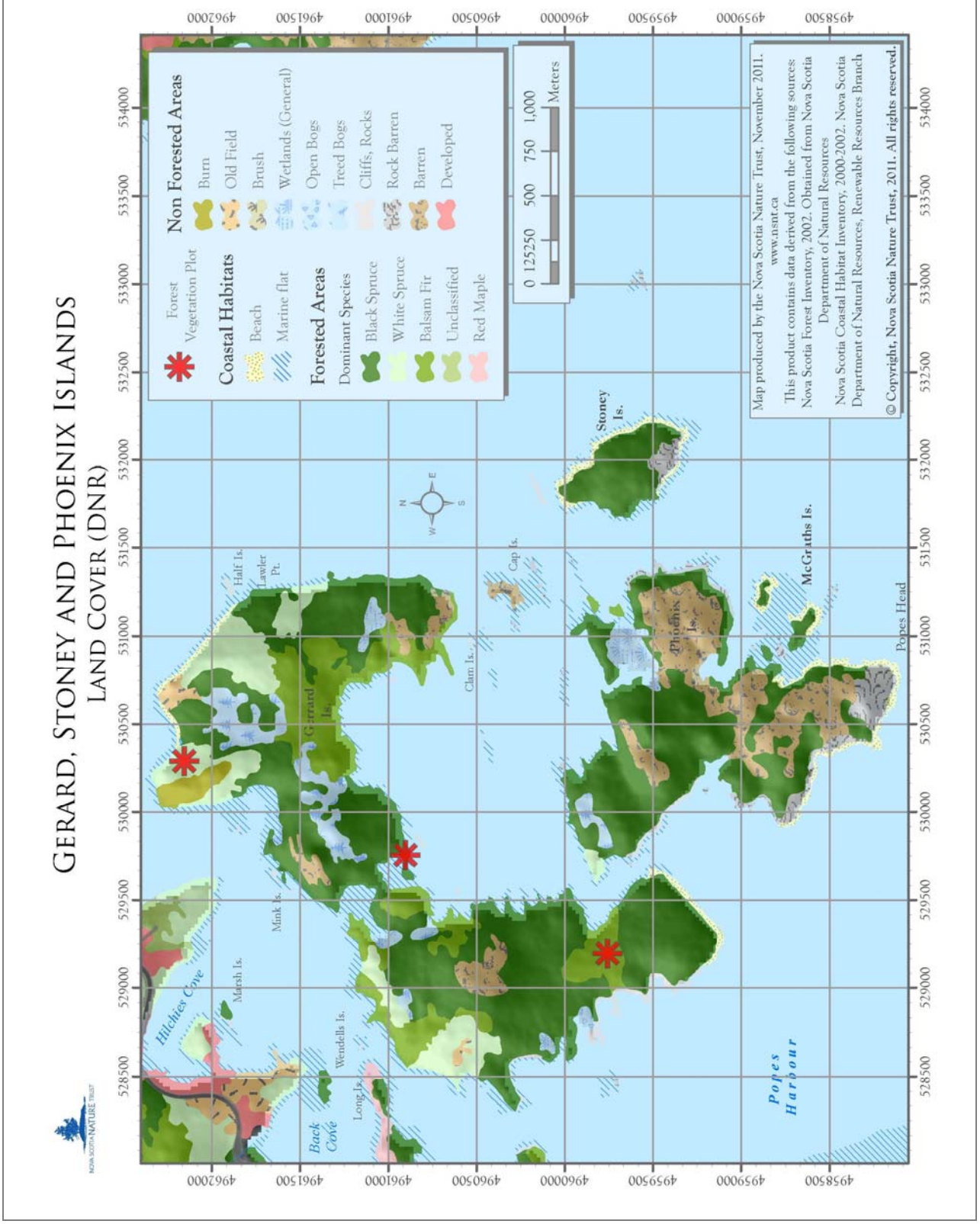
Appendix G.2 – Land Cover – Laybold Island and Porter Island
(DNR, 2002)



Appendix H.1 – Gerard Island, Phoenix Island and Stoney Island (2003)



Appendix H.2 – Land Cover – Gerard Island, Phoenix Island and Stoney Island (DNR, 2002)



Apendix I - Maritime Breeding Bird Atlas - Bird Observations for Barren, Goose, Duck, Roger, and Long Islands

Non Priority Square 20NQ04 - Data collected Ian McLaren - 19 June 2008 (5 Hours)

Observations made from boat and on land. Small numbers, small islands, square completed.

No	Common Name	Species	Number Observed
Barren Island			
1	Common Eider	*Somateria mollissima*	25+ females, one nest
2	Leach's Storm Petrel	*Oceanodroma leucorhoa*	a "few" burrows
3	Great Blue Heron	*Ardea herodias*	Colony, 35+ active nests
4	Herring Gull	*Larus argentatus*	6 birds, one young chick
5	Great Black-backed Gull	*Larus marinus*	10 birds, one grown chick found
6	Black Guillemot	*Cepphus grylle*	20, two leaving clefts
7	Raven	*Corvus corax*	1 pair, nest
8	American Crow	*Corvus brachyrhymchos*	2 pairs
9	Fox Sparrow	*Passerella iliaca*	1 singing male
Goose Island			
10	Common Eider	*Somateria mollissima*	5+ eider nests (or hidden chicks - flushed females)
11	Great Black-backed Gull	*Larus marinus*	30
12	Common Tern	*Sterna hirundo*	130
13	Artic Tern	*Sterna paradisaea*	20
14	Black Guillemot	*Cepphus grylle*	18
Duck Island			
15	Common eider	*Somateria mollissima*	200 females
16	Double-crested Cormorant	*Phalacrocorax auritus*	52 nests
17	Herring Gull	*Larus argentatus*	20 adults
18	Great Black-backed Gull	*Larus marinus*	60 adults
19	Black Guillemot	*Cepphus grylle*	20 adults
Roger Island			
20	Common Eider	*Somateria mollissima*	36 females
21	Herring Gull	*Larus argentatus*	65 adults
22	Great Black-backed Gull	*Larus marinus*	25 adults
23	Black Guillemot	*Cepphus grylle*	50+ adults
24	Song Sparrow	*Melospiza melodia*	1 agitated pair
Long Island			
25	Common Eider	*Somateria mollissima*	70 females, including 2 creches
26	Double-crested Cormorant	*Phalacrocorax auritus*	190 adults

27	Osprey	*Pandion haliaetus*	5 occupied nests, agitated adults, chicks
28	Willet	*Catoptrophorus semipalmatus*	One pair, agitated
29	Herring Gull	*Larus argentatus*	150 adults, chick
30	Great Black-backed Gull	*Larus marinus*	55 adults
31	Black Guillemot	*Cepphus grylle*	55 adults, two leaving clefts
32	Common Raven	*Corvus corax*	2 adults
33	American Crow	*Corvus brachyrhymchos*	2 pairs
34	Fox Sparrow	*Passerella iliaca*	One pair attending to nest

Apendix J - Maritime Breeding Bird Atlas - Bird Observations for Bald Rock and Black Ledge
Priority Square 20NQ14 **-** Data collected Ian McLaren - 19 June 2008 (1-2 Hours)
Observations made from boat with brief landing.

No	Common Name	Species	Number Observed
Bald Island			
1	Common Eider	*Somateria mollissima*	2 broods, 20 females
2	Leach's Storm Petrels	*Oceanodroma leucorhoa*	Several active burrows
3	Double-crested Cormorant	*Phalacrocorax auritus*	Several present (breeding?)
4	Black Guillemot	*Cepphus grylle*	Several adults
5	Osprey	*Pandion haliaetus*	1 occupied nest
6	Gray Jay	*Perisoreus canadensis*	One seen
7	Alder Flycatcher	*Empidonax alnorum*	1 singing male
8	Fox Sparrow	*Passerella iliaca*	1 pair
9	Song Sparrow	*Melospiza melodia*	1 pair

Apendix K - Maritime Breeding Bird Atlas - Bird Observations for Bald, Key, Porter, Laybold and Egg Islands
Priority Square 20NQ14 **-** Data collected Ian McLaren - 03 July 2008 (6.5 hours)
Observations made from boat and on land. Very heavy going among deadfalls on wooded islands. Transport ledges not visited, but observed from Egg Island as devoid of cover and birds

No	Common Name	Species	Number Observed
Bald Island			
1	American Crow	*Corvus brachyrhymchos*	1 present (not breeding)
Key Island			
2	Great Blue Heron	*Ardea herodias*	2 nests with young
3	Yellow-bellied Flycatcher	*Empidonax flaviventris*	2 present
4	Alder Flycatcher	*Empidonax alnorum*	2 males present

5	Common Raven	*Corvus corax*	1 pair calling (=agitated??)
6	Cape May Warbler	*Setophaga tigrina*	1 male present
7	Yellow-rumped Warbler	*Dendroica coronata*	1 present
8	Fox Sparrow	*Passerella iliaca*	1 pair
9	Song Sparrow	*Melospiza melodia*	1 present
10	Purple Finch	*Carpodacus purpureus*	1 present
11	American Goldfinch	*Carduelis tristis*	1 present
Porter Island and Laybold Island			
12	Osprey	*Pandion haliaetus*	1 flushed off nest
13	Willet	*Catoptrophorus semipalmatus*	1 present, probably not breeding
14	Herring Gull	*Larus argentatus*	1 (?) pair, one large young nest
15	Northern Flicker	*Colaptes auratus*	1 present
16	Least Flycatcher	*Empidonax minimus*	2 present
17	Alder Flycatcher	*Empidonax alnorum*	3 present
18	Olive-sided Flycatcher	*Contopus cooperi*	1 present (drifter)
19	American Crow	*Corvus brachyrhymchos*	9+ present (much calling, including 1 fledgling)
20	Swainson's Thrush	*Catharus ustulatus*	1 singing on suitable terrain, and calling
21	Magnolia Warbler	*Dendroica magnolia*	1 male present
22	Cape May Warbler	*Setophaga tigrina*	1 male present
23	Yellow-rumped Warbler	*Dendroica coronata*	10 present, 1 with food
24	Blackpoll Warbler	*Dendroica striata*	12 present, 1 female with food
25	Black & White Warbler	*Mniotilta varia*	1 present
26	American Redstart	*Setophaga ruticilla*	1 male
27	Common Yellowthroat	*Geothlypis trichas*	4 individuals, including agitated pair
28	Fox Sparrow	*Passerella iliaca*	1 (4 pairs?) present, 1 agitated pair
29	Song Sparrow	*Melospiza melodia*	7 present, 1 carrying food
30	White-throated Sparrow	*Zonotrichia albicollis*	1 pair, +6 individuals (2 pairs?)
31	Dark-eyed Junco	*Junco hyemalis*	4 present, 1 singing male on terrain
32	Purple Finch	*Carpodacus purpureus*	2 present
33	American Goldfinch	*Carduelis tristis*	3 present (1 pair?)
Egg Island			
34	Common Eider	*Somateria mollissima*	Circa 35 Females, +1 large young
35	Double-crested Cormorant	*Phalacrocorax auritus*	8 empty nests, only three adults, one nest with a large young
36	Great Black-backed Gull	*Larus marinus*	20+ individuals, young present
37	Herring Gull	*Larus argentatus*	40+ individuals, young present
38	Arctic Tern	*Sterna paradisaea*	160 individuals, many nests, young

39	Common Tern	*Sterna hirundo*	9 (4 pairs) present, 2 carrying food,
40	Fox Sparrow	*Passerella iliaca*	8 individuals, nests uncertain: presumably, as agiated
41	Black Guillemot	*Cepphus grylle*	30+ individuals, some with prey