Cape Breton Habitat Conservation Strategy

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EXECUTIVE SUMMARY

This Habitat Conservation Strategy (HCS) is one of a series of HCSs with contiguous boundaries that will consider all areas of the Maritime Provinces and was developed through collaboration with input from the Federal and Provincial governments as well as other partner conservation groups. These strategies are intended to respond to a need to better communicate, coordinate, and inform conservation actions taken by regional and local conservation organizations, to highlight opportunities for collaboration, and to identify on-the-ground action gaps. The purpose of this HCS is to identify and assess the current state of species and ecological communities of conservation priority for the Cape Breton bioregion, to present a series of mapping approaches to identify their location within the bioregion, and to identify the planned conservation and stewardship actions of organizations to enhance partnerships, reduce redundancies, and facilitate decision-making. Each organization is guided by its own particular mission, vision, and/or guiding principles; as such, the information presented in this document is intended to serve as a transparent, decision-making tool for more detailed organizational prioritizations and prescriptive analyses.

A shared approach

Habitat Conservation Strategies and their bioregional boundaries are based on meaningful ecological units and important watershed boundaries, and are scaled in a way that captures regional conservation context, priorities, threats, and conservation actions. They are also scaled to facilitate the implementation of conservation actions, from land securement to stewardship.

In the first section (Conservation Context), each HCS presents descriptions, in general terms, of the spatial extent and ecological significance of the bioregion. Conservation priority species that are found within its boundaries are discussed with a focus on species at risk, rare taxa, and Bird Conservation Region 14 priority birds. Existing protected areas and conservation lands in the bioregion as well as the social and economic considerations relevant to regional conservation work are also discussed. The approach taken in the development of the narrative is meant to be thorough but not exhaustive, emphasizing reference to more detailed work and in-depth studies.

The second section discusses the significance of important habitat types for the identified conservation priority species. Threats to conservation priority habitats and species are also identified, assessed, and where possible, mapped at the bioregional scale. A series of mapping approaches to landscape prioritization of the bioregion are presented, including a habitat prioritization map (composite), a series of priority species composites derived from best available occurrence data for each species, and a Conservation Value Index (CVI) map, which combines the priority habitat and species prioritizations. For various reasons, including introduced bias, the CVI map, priority habitat composite, and various multi-species composites can present contrasting perspectives on spatial priorities. This is expected and also reflects the reality that contrasting approaches may be required for the conservation of different species, species' assemblages, and the habitats that host them (e.g., land acquisition versus stewardship). No single map can provide decision support that aligns fully with all priorities of conservation partners. As such, users of this and other HCSs are encouraged to carefully consider the full suite of maps and information presented to obtain the decision support that is most appropriate for their needs.

Finally, each HCS presents conservation and stewardship actions that organizations plan to undertake to mitigate identified threats and contribute to the conservation of priority habitats and the species they host over the course of a five-year planning period. In addition to presenting avenues for collaboration in the implementation of actions, this matrix presents gaps that can be interpreted as potential

opportunities for development of new complementary conservation actions. Conservation groups seeking government funding to undertake conservation actions within the bioregion (e.g., Aboriginal Fund for Species at Risk, Habitat Stewardship Fund for Species at Risk, National Conservation Plan – National Wetland Conservation Fund) are strongly encouraged to make specific reference to relevant information contained within the appropriate HCS.

Cape Breton Bioregion – Scope and Significance

The Cape Breton bioregion shares its boundaries with Cape Breton Island, a rugged and irregularly shaped island with an area of 1,174,904 ha and 3170 km of coastal shoreline (Summary—Figure 1). Its landmass generally slopes upward from south to north, peaking in the highlands of northern Cape Breton at over 500 m. From rich coastal ecosystems to the northern highlands plateau, the Cape Breton bioregion is one of the most ecologically diverse regions of Nova Scotia. The natural landscapes found within the bioregion contain an assorted array of ecosystems that provide habitat for a wide range of species, including 35 COSEWIC-assessed, 24 federally-listed, and 28 provincially-listed species at risk. The most dominant natural feature on the island is the elevated plateau in Northern Cape Breton known as the Cape Breton Highlands. Dissected by steep-walled river canyons, the Cape Breton Highlands consist of alpine and sub-alpine ecosystems that contain some of the province's only significant summit and steep slopes (Anderson *et al.* 2006) and host species that are unique within Nova Scotia.

The bioregion contains a high density of intact, unprotected forested landscapes. The interior forests of the bioregion provide key habitat for several large mammals including Moose, Canada Lynx, and American Marten (Parker *et al.* 1983). Within Cape Breton Highlands National Park, old growth forests in excess of 350 years old can be found on steep, inaccessible slopes and in deep ravines, making them some of the oldest forest stands in the province (Parks Canada 2010). There are a number of other examples of forest stands representative of old-growth, climax conditions in the bioregion, located primarily within provincial wilderness areas and nature reserves (NSE 2016).

The bioregion encompasses an extensive network of freshwater lakes, rivers, streams, and wetlands, including critical occurrences of freshwater wetland and riparian ecosystems (Anderson *et al.* 2006), and the largest natural freshwater lake in Nova Scotia, Lake Ainslie. A number of the bioregion's rivers, with their cool temperatures, excellent water quality, and a relatively low level of damming, provide some of the best habitat for Atlantic Salmon in Nova Scotia (CHRS 2017; Robichaud-Leblanc & Amiro 2004).

The Cape Breton bioregion contains a high concentration of critical coastal complexes (Anderson *et al.* 2006), including barrier beaches, salt marshes, barachois ponds, and Eelgrass dominated mud flats. These coastal complexes support distinct and high levels of biodiversity, including rare taxa, and in many cases act as nurseries for marine fish and shellfish populations. The Bras d'Or Lakes in the interior of Cape Breton consist of a large, complex network of estuarine bodies (i.e., coastal water bodies where fresh and sea water mix) linked together in a manner that forms a unique coastal ecosystem within the Nova Scotia coastline (Parker *et al.* 2007). In 2011, the Bras d'Or Lakes and their watersheds were designated as a UNESCO Biosphere Reserve, which recognizes the collaborative efforts among people in the biosphere to promote the sustainability of local economies and communities, as well as the conservation of ecosystems.

One of the most regionally unique and significant elements of biodiversity within the Cape Breton bioregion are gypsum, limestone, and marble derived ecosystems. These calcareous natural ecosystems are rare in northeastern North America and globally uncommon. Although exposed gypsum and karst landscapes are relatively uncommon in Nova Scotia, they are far more widespread and frequent in the province than in any other jurisdiction in the glaciated portion of northeastern North America, with a

significant proportion occurring within the boundary of the Cape Breton bioregion. The unique conditions of calcareous soils, along with their occurrence as isolated islands within primarily non-calcareous areas, have resulted in the evolution of narrow endemic plant species in many calcareous regions (Blaney and Mazerolle 2013), and consequently support rare and uncommon species and communities.

Goals

The conservation goals that have been identified to guide the development of this HCS are:

1) Identify areas that are important for conservation priority habitats and species.
2) Establish, support, and enhance conservation partnerships to facilitate decision-making and focus collective conservation efforts.
3) Maintain healthy, intact, and fully functioning ecosystems by building on existing conservation work by the partnership and informing efforts to acquire land for conservation.
4) Support the management of and protect corridors between existing protected areas and other conservation lands through land securement, partnerships, and community outreach.
5) Support the recovery of populations of species at risk through collective conservation actions by the partnership, further informed by federal and provincial resources on species at risk.
6) Support the advancement of collaborative ecosystem and species research to inform decision-making and planning.
7) Support the advancement of community support and understanding of biodiversity values, and inform local stewardship initiatives.

Conservation priority habitats

Based on habitat affinities of conservation priority species (rare species, species at risk, and priority birds), though independent of spatial patterns of species occurrence, the following nine habitat types were determined to be conservation priorities for the Cape Breton bioregion:

1) Barachois ponds
2) Beaches, dunes, rocky shores, and cliffs
3) Coastal islands
4) Estuaries and tidal flats
5) Aquatic and riparian systems
6) Freshwater wetlands
7) Acadian and boreal forest
8) Barrens
9) Grasslands/agro-ecosystems

A map was generated depicting the spatial location of overall conservation priority habitats based on habitat uniqueness, representation in protected areas, and patch size (Summary—Figure 2). This overall conservation priority habitat composite does not incorporate information on occurrence records of rare species, species at risk, or conservation priority birds. Different perspectives on species-based prioritizations are presented in the priority species composite maps that illustrate the distribution of priority species assemblages derived from best available occurrence data for each species. The reader is cautioned that best available occurrence data for most species remains incomplete, to varying degrees, with availability being a function of survey timing and survey effort, leading to variable but important bias in some related maps. As such, multi-species composite maps and all other maps derived from the individual species maps are also vulnerable to bias.

The integration of priority habitat data (the priority habitat composite) and priority species information (the priority species composite for all priority species) results in the Conservation Value Index (CVI) map for the bioregion (Summary—Figure 3). This map was developed to identify sites within the Cape Breton bioregion that have the highest conservation value in terms of priority habitat attributes and priority species, given the available data. Given that no single map can be expected to provide one 'best' answer, the reader is advised to compare and contrast the priority habitat composite map with the Conservation Value Index (CVI) map when using this document for decision support.

Threats

The following threats (following IUCN nomenclature) have been identified as medium to high across the conservation priority habitats in the Cape Breton bioregion:

1.1 Housing and urban area development (Threat status: Medium)
2.1 Incompatible agricultural practices (Threat status: Medium)
4.1 Road fragmentation (Threat status: Medium)
5.3 Forest harvesting practices (Threat status: Medium)
6.1 Recreational activities (Threat status: Medium)
7.2 Dams and water management (Threat status: Medium)
8.1 Invasive non-native species (Threat status: Medium)
11.1 Climate change and Habitat Shifting (Threat status: Very High)

Conservation actions

The following summary presents the conservation actions undertaken by organizations working in the Cape Breton bioregion to mitigate identified threats and contribute to the conservation of priority habitats and the species they host over the course of a five-year planning period. Though they cannot be considered comprehensive, actions are presented for each partner organization. A more detailed list of conservation actions structured according to IUCN categories, including links to the threats associated with each of the different conservation priority habitats, is presented in Table 12 (p.108).

National and Provincial Partners

<u>Government of Nova Scotia</u>

- Protect an additional 21,800 ha under the Parks and Protected Areas Plan
- Complete ecological risk assessments of threats to species and ecosystems within existing and proposed protected areas. Create a spatial layer of sensitive habitats and ecosystems to aid in planning and an action plan for protected area managers.
- Continue to locate, map, and assess potential old growth stands on private and public lands using adaptations of the NSDNR's old forest scoring methods to refine parcel prioritization, inform conservation efforts, and help maintain old forests and associated biodiversity for landscape connectivity according to Nova Scotia's *Old Forest Policy*.
- Assess air quality and climate change using lichens within permanent sample plots.
- Undertake wildlife and environmental enforcement activities (EC Wildlife Enforcement, Environmental Enforcement); address illegal hunting and disturbance, illegal activities and habitat destruction
- Acquire properties for wetland conservation through purchase, and owners unknown process (unknown ownership, transfer to the Crown)

- Continue working with farmers in the development of Agriculture Biodiversity Conservation Plans
- American Marten and Canada Lynx – testing efficacy of program, distribution of predators and prey on the highlands (monitoring tracks), compiling information gathered over the years since the introduction of marten.
- Regional biologists will continue using trail cams to identify areas in the lowlands where marten may be and review forest harvesting plans for those areas. Winter cameras will be used in the highlands where marten were released to determine presence and numbers.
- Develop a pilot project exploring multiple values on the landscape/framework to assess tradeoffs of various needs/interests (mainly for crown land).
- Continue to maintain the Nova Scotia Bat Conservation website www.batconservation.ca and engage the public on bat conservation issues. Increase public awareness of White Nose Syndrome in Nova Scotia bats and promote the proper use of bat houses through the Backyard Biodiversity project.

<u>Department of Fisheries and Oceans</u>

- Contributing and administering the Marine Protected Areas planning program toward the goal of 10% protection by 2020
- Provide a lead role in fulfilling the Department's mandate in the management and stewardship of Canada's Oceans (Oceans Act), aquatic Species at Risk (Species at Risk Act), and commercial, recreational and Aboriginal fisheries (Fisheries Act) through its Ecosystem Management Branch.
- The Oceans and Coastal Management Division leads integrated oceans and coastal management initiatives in the Maritimes Region, including the designation and management of marine protected areas, marine protected area network planning, the coordination of marine planning activities with other government departments and stakeholders, and the provision of information, tools, and advice for marine spatial planning and decision making.
- The Species at Risk Management Division provides overall coordination and leadership for the administration of the Species at Risk Act to undertake activities in protection of species at risk, recovery of species at risk, evaluation, and regulatory compliance.

<u>Parks Canada</u>

- Contributing to Marine Protected Areas planning toward the goal of 10% protection by 2020
- Continue ecological integrity monitoring to assess the state of forest, aquatic, wetland, barren, and coastal ecosystem health in Cape Breton Highlands National Park through the monitoring, analysis, and reporting of ecological integrity indicators of ecosystem health (e.g., owls, salamanders, lichens, water quality, freshwater mussels, , Atlantic Salmon) and by summarizing these finding in the *State of the Park Report*.
- Moose management within Highlands National Park to promote forest regeneration in moose damaged areas.
- Engage the public in active park resource management activities including the establishment of a Citizen Science program for monitoring, restoration, and invasive species control.
- Complete the development of a monitoring program that measures aquatic connectivity using a GIS tool to assess the connectivity impacts of all road and trail stream crossing structures, and develop a prioritized list of structures requiring remediation. Ensure all new culvert installations meet PC requirements for fish passage.

- Examine current road salt application practices which impact adjacent sensitive wetlands; identify and implement mitigation measures such as application reductions in these zones and alternatives to current salt application.
- Mitigate the impacts of invasive species. Educate and promote stewardship in order to prevent incidental species invasions.
- Continue the current removal program to reduce the invasive Spiny-cheeked Crayfish population in Freshwater Lake to restore aquatic ecosystem health of the lake and to prevent the spread to other waterbodies. Re-establish elements of native biodiversity where feasible, such as white perch. Continue to enhance visitor and general public awareness of crayfish to help lessen the spread to other waterbodies. Work with external agencies to collaborate on education and mitigation strategies.
- Continue to work with Unama'ki Institute of Natural Resources to collaboratively manage common interests (e.g., moose population monitoring, American Eel research, American Marten). Establish a Collaborative Management Committee through terms of reference between Parks Canada and local Mi'kmaq communities on Cape Breton to act as a forum for discussing shared management objectives and broader interests in both natural and cultural resource management.

<u>Canadian Wildlife Service and Environment and Climate Change Canada</u>

- Implement and enforce the Migratory Bird Convention Act, Canada Wildlife Act, Species at Risk Act, Canadian Environmental Protection Act, and promote the Federal Policy on Wetland Conservation.
- Offer support to ENGOs, communities, aboriginal organizations, and academia via EC Employment Programs, including the Science Horizons Youth Internship Program and the International Environmental Youth Corps.
- Offer support to ENGOs, communities, aboriginal organizations, and academia via Community Action Programs for the Environment, including work on habitat and ecological system conservation/stewardship through direct and in-kind support (e.g., EcoAction Community Funding Program, Environmental Damages Fund, National Conservation Plan – National Wetland Conservation Fund, National Conservation Plan – Gulf of Maine Initiative, Atlantic Ecosystem Initiatives, Ecological Gifts Program, Habitat Stewardship Program – Prevention Stream, Aboriginal Fund for Species at Risk – Prevention Stream
- Offer support to ENGO and aboriginal organizations for work specifically on species at risk via the Habitat Stewardship Program – Species at Risk Stream, and Aboriginal Fund for Species at Risk.
- Support the activities described within species at risk recovery documents for the completion of schedule of studies for the identification of critical habitat.
- Engage and consult with all partners in development of recovery documents for species at risk.
- Support the Eastern Habitat Joint Venture (EHJV), and provide science guidance to conservation partners on conservation actions and priorities for migratory birds, species at risk, and their habitats, including through development, refinement and implementation of this HCS and of the NS Bird Conservation Region 14 Strategy.
- Identify important areas for marine birds.
- Continue to strengthen partnership with Atlantic Canada Conservation Data Centre (ACCDC) through annual submission of monitoring findings on conservation lands.
- Contributing to Marine Protected Areas planning toward the goal of 10% protection by 2020

- Inform and implement the North American Waterfowl Management Plan (NAWMP) and conduct waterfowl surveys as required by the plan.
- Implement management plans for Sea Wolfe (Margaree) Island National Wildlife Area and Big Glace Bay Lake Migratory Bird Sanctuary.
- Assess the feasibility of establishing a consortium of conservation interests operating in Nova Scotia to provide a platform for collaboration and communication, information exchange, and high level strategy and planning on key issues.
- Communicate, inform, and increase awareness related to funding opportunities for conservation: North American Wetland Conservation Act (NAWCA)/Eastern Habitat Joint Venture (EHJV), North Atlantic Landscape Conservation Cooperative (NALCC); National Conservation Plan (NCP): Atlantic Ecosystems Initiative (AEI), Habitat Stewardship Program (HSP), Aboriginal Fund for Species at Risk (AFSAR), National Wetland Conservation Fund (NWCF).
- Implement and encourage the use of EC Ecological Gifts (Ecogifts) program.

Bird Studies Canada

- Continue to survey and assess the status of Bicknell's Thrush (*SAR – Threatened*) in Cape Breton, including the Cape Breton Highlands, coastal headlands, and offshore islands, through BSC's High Elevation Landbird Program and in partnership with the province and Cape Breton Highlands National Park
- Work with NS DNR, ECCC-CWS and industry partners to implement BMPs for Bicknell's Thrush, which mitigate incidental take and habitat loss for this species.
- Support conservation of Important Bird Areas in Cape Breton through Canada's Important Bird Area Program.
- Coordinate recovery activities for endangered Piping Plover and conservation of beach and dune ecosystems through NS Piping Plover Conservation Program.
- Actively support public education, stewardship and conservation of aerial insectivores, particularly Chimney Swifts and Barn Swallows (both *SAR-Threatened*), at roost and nest sites in Cape Breton, through BSC's Maritimes Swiftwatch Program

Atlantic Canada Conservation Data Centre

- Enhance data management and information on biodiversity in the bioregion through the maintenance of the most comprehensive and current database on the distribution of biological diversity in Atlantic Canada.
- Due for completion in 2018, conducting 3 years of calcareous plant species surveys to better understand the distribution of calcareous ecosystems in Atlantic Canada with a focus on Cape Breton
- Conduct botanical surveys of rare and uncommon cyanolichens to refine parcel prioritization.

Nature Conservancy of Canada

- Secure 1,500 ha of high priority sites containing exposed gypsum and/or calcareous ecosystem occurrences
- Secure 250 ha of high priority sites containing intact floodplain ecosystems
- Secure 500 ha of high priority sites containing intact mature Acadian forest
- Assist local land trusts in acquisition of 100 ha of high priority coastal sites

- Designate NCC lands protected in the bioregion under provincial legislation to protect them from mining, and acquire severed gypsum rights to any property NCC secures.
- Conduct outreach and build relationships with key industrial gypsum companies to identify potential large scale securement opportunities
- Provide results of NACP analyses to Crown Share Land Legacy Trust to facilitate the refinement of their 'A-list' of priority lands for acquisition.
- Work collaboratively with partners and neighbours to adaptively manage NCC conservation lands in the bioregion, including the development of management plans and baseline inventories, and undertake priority site management activities. Monitor key threats on NCC properties, and where possible, take direct action to mitigate threats posing an imminent impact to conservation priority habitats.
- Research, document and map industrial mining ownership in the bioregion, as well as the extent of gypsum/limestone subsurface title rights within key areas for conservation.
- Delineate the 'Active River Area' of major rivers in the bioregion to identify and map floodplain habitats.
- Conduct a spatial analysis of agricultural proximity to priority Aquatic and Riparian Systems and determine current scope, severity.
- Develop public education materials describing the natural history and ecological significance of the bioregion, with a focus on calcareous ecosystems. Produce mapping products that demonstrate the distribution of known calcareous ecosystems located within central Cape Breton Island.
- Identify a NCC-owned site in the bioregion suitable for public access and interpretation and develop a facilitated interpretive experience.
- Establish a structure to facilitate collaboration and strategic decision making regarding invasive species control techniques (e.g., Invasive Species Alliance).
- Develop relationships/partnerships with Port Hawkesbury Paper, Bras d'Or Biosphere Reserve, Margaree Salmon Association, Bras d'Or Preservation Trust and other conservation partners to communicate key conservation messages, with a focus on significance of calcareous ecosystems.
- Explore the opportunity to develop an incentive program that provides recognition for woodlot owners that promotes sustainable harvesting and protection of biodiversity on woodlots.

Nova Scotia Nature Trust

- Create baseline reports and management plans for all properties formally protected by NSNT in the bioregion. Manage protected sites for biodiversity conservation through regular monitoring and stewardship activities.

Cape Breton Regional Partners

Atlantic Coastal Action Program (ACAP) Cape Breton

- Developing education programs focussed on ecological monitoring and habitat restoration.
- Continue stream restoration projects – culvert modification to improve fish passage.
- Conduct Piping Plover surveys
- The Malagawatch living shoreline project - erosion mitigation and shoreline stabilization. Includes planting grasses, shrubs, and trees to stabilize soil, adding hay to increase biomass and reduce slope grades, and weaving brush mats to protect exposed areas from wind and wave action

- Continue bat monitoring for white nose syndrome. This includes ultrasonic, hibernation site, and maternity colonies monitoring.

Bras d'Or Institute for Ecosystem Research

- Studies ongoing to model the movement of water within the Bras d'Or Lake estuaries including nutrient budget modelling.
- Continue to study the ecology and hydrology of barachois ponds of the Bras d'Or
- Research and promotion into taking an ecosystems based approach to coastal management planning

Bras d'Or Lake Biosphere Reserve Association

- Ongoing education and promotion of biodiversity conservation and sustainable economic development within the UNESCO biosphere reserve.
- Working to complete a walking trail around the biosphere reserve.
- Bras d'Or Watch Program – an annual day of citizen science in the biosphere reserve.

Bras d'Or Preservation Nature Trust

- Continue to manage properties and conservation easements and seek out new opportunities for easements and land acquisitions.

Bras d'Or Stewardship Society

- Continue to advocate for an appropriate strategy for conservation, restoration and protection of the Bras d'Or lakes through public meetings, newsletters, educational activities and bringing environmental issues to the attention of the general public.

Margaree Salmon Association

- Fin clipping and release program at the Margaree fish hatchery
- Fish habitat restoration – in-stream installations to improve fish habitat.
- Provides volunteers to assist with DFO Salmon capture, tag and re-capture activities
- Working with Province in support of Salmon brood stock collection on Margaree, Middle, and Baddeck Rivers.
- Working with Inverness South Anglers Association on brood stock collection for Mabou and Graham Rivers.
- Woking with UINR on Canadian Aquatic Bio-monitoring Network (CABIN) within Margaree Watershed.
- Commissioned a fluvial morphology study of the Margaree River
- Working with forestry companies to reduce impacts of forestry within the Margaree watershed.

Inverness South Anglers Association

- Re-examining the relationship between communities and watersheds
- Continue freshwater habitat restoration – bank stabilization, salmon pool creation, waterflow re-direction, erosion reduction.
- Atlantic Salmon stock enhancement on the Mabou River

- Integrating conservation and restoration with economic development with the communities' interest at heart

Cape Breton Wildlife Association

- Continue to partner on culvert remediation projects in and around West Bay
- Working to prevent illegal dumping
- Ongoing habitat management

Nova Scotia Landowners and Forest Fibre Producers Association

- Continue to provide management planning, silviculture and contractor information for private woodlot owners in Cape Breton
- Continue to administrate the group FSC certification program for NS private woodlot owners
- Completing a High Value Conservation Framework for FSC certified woodlot owners
- Exploring opportunities for private woodlot participation in the carbon market

First Nations

Eskasoni Fish and Wildlife Commission (EFWC)

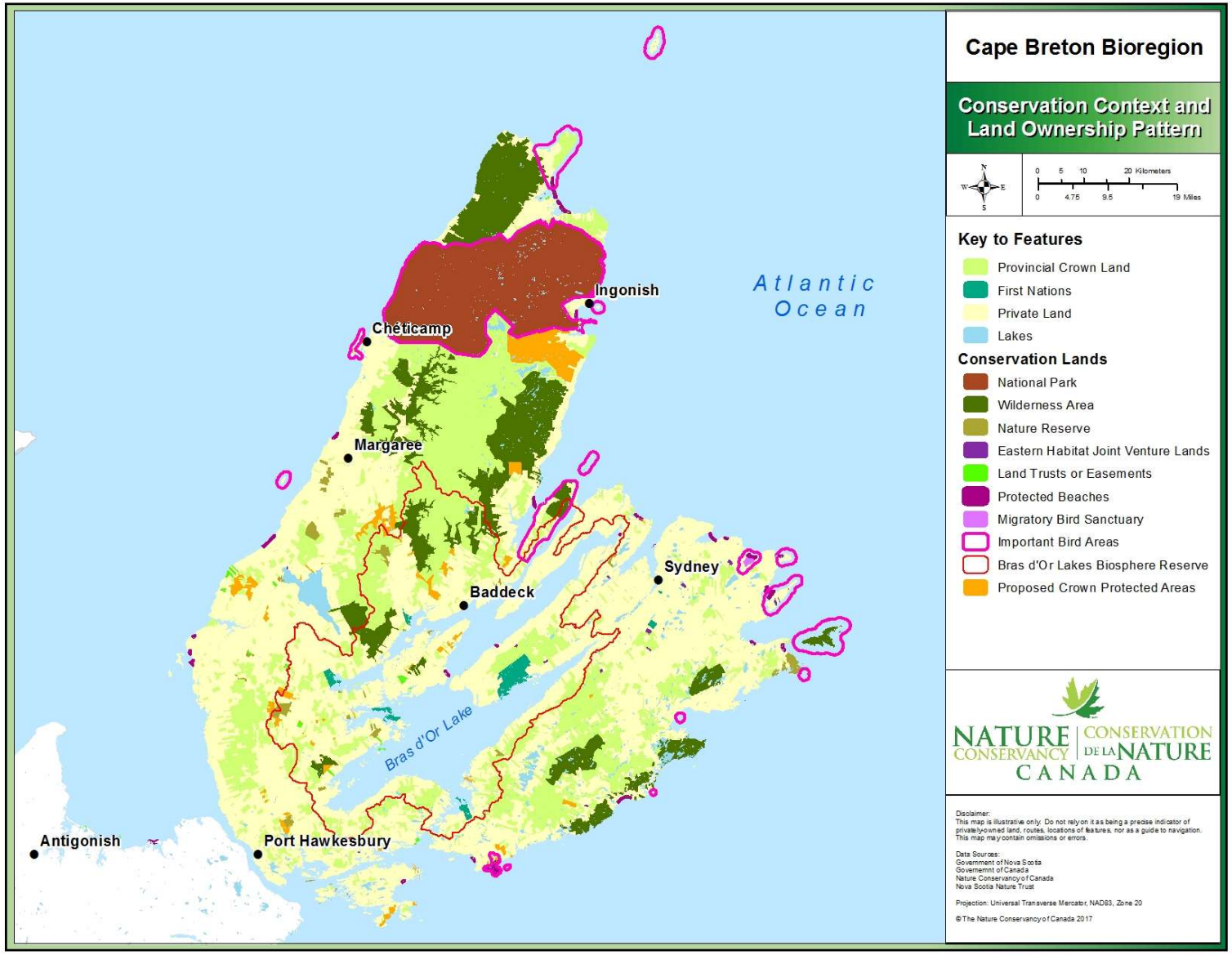
- Continue to manage the indigenous food fishery
- Continue to study cod, lobster, striped bass in the Bras d'Or Lakes
- Explore ways in which to preserve the forest to reduce issues from run-off from clear cuts surrounding communities
- Continue to address the invasive beech weevil within Eskasoni community
- Continue river restoration projects (digger logs, deflectors etc)

Unama'ki Institute of Natural Resources

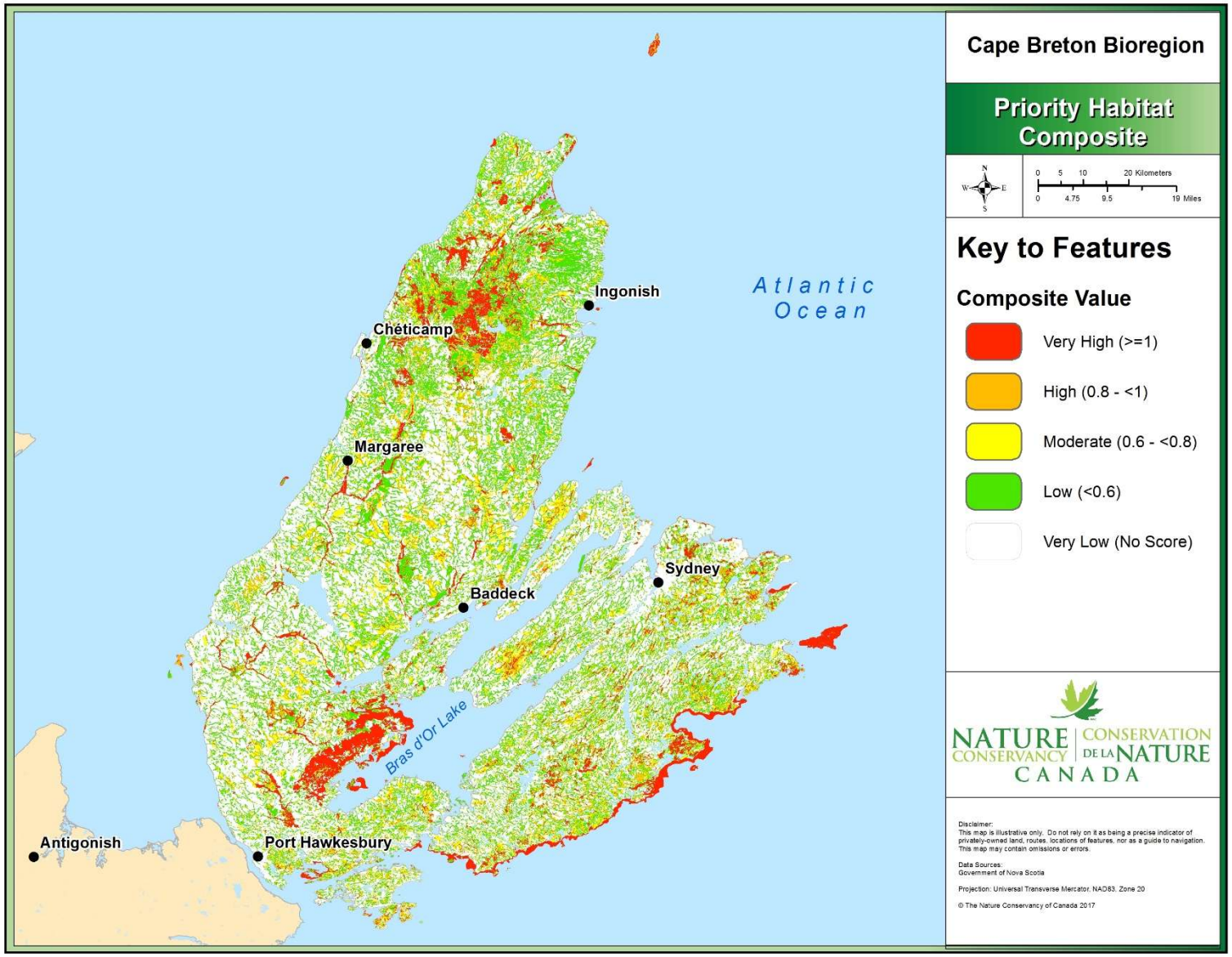
- Continue to represent Cape Breton's Mi'kmaw voice on natural resources and environmental concerns.
- Continue to increase participation by member communities in the management direction of Cape Breton fisheries.
- Continue to strengthen relationships between forestry industry and Mi'Kmaw people and identify economic opportunities for Cape Breton Mi'kmaw communities within a sustainable forestry sector
- Continue to lead the Moose Management Initiative – A management plan for Moose that puts the responsibilities that accompany Mi'kmaq treaty rights into practice
- Continue to liaise the Guardian Program with Federal and Provincial governments – a coordinated and collaborative effort to protect natural resources within Cape Breton.
- Continue to produce and circulate educational materials on the work undertaken at UINR.
- Continue to partner with Parks Canada, Fisheries and Oceans Canada, Cape Breton University, Port Hawkesbury Paper, the province of Nova Scotia, Cape Breton municipalities, and a host of other government departments and organizations, to ensure that Mi'kmaq perspective and knowledge are an integral part of Cape Breton projects.

Bras d'Or lakes Collaborative Environmental Planning Initiative (CEPI)

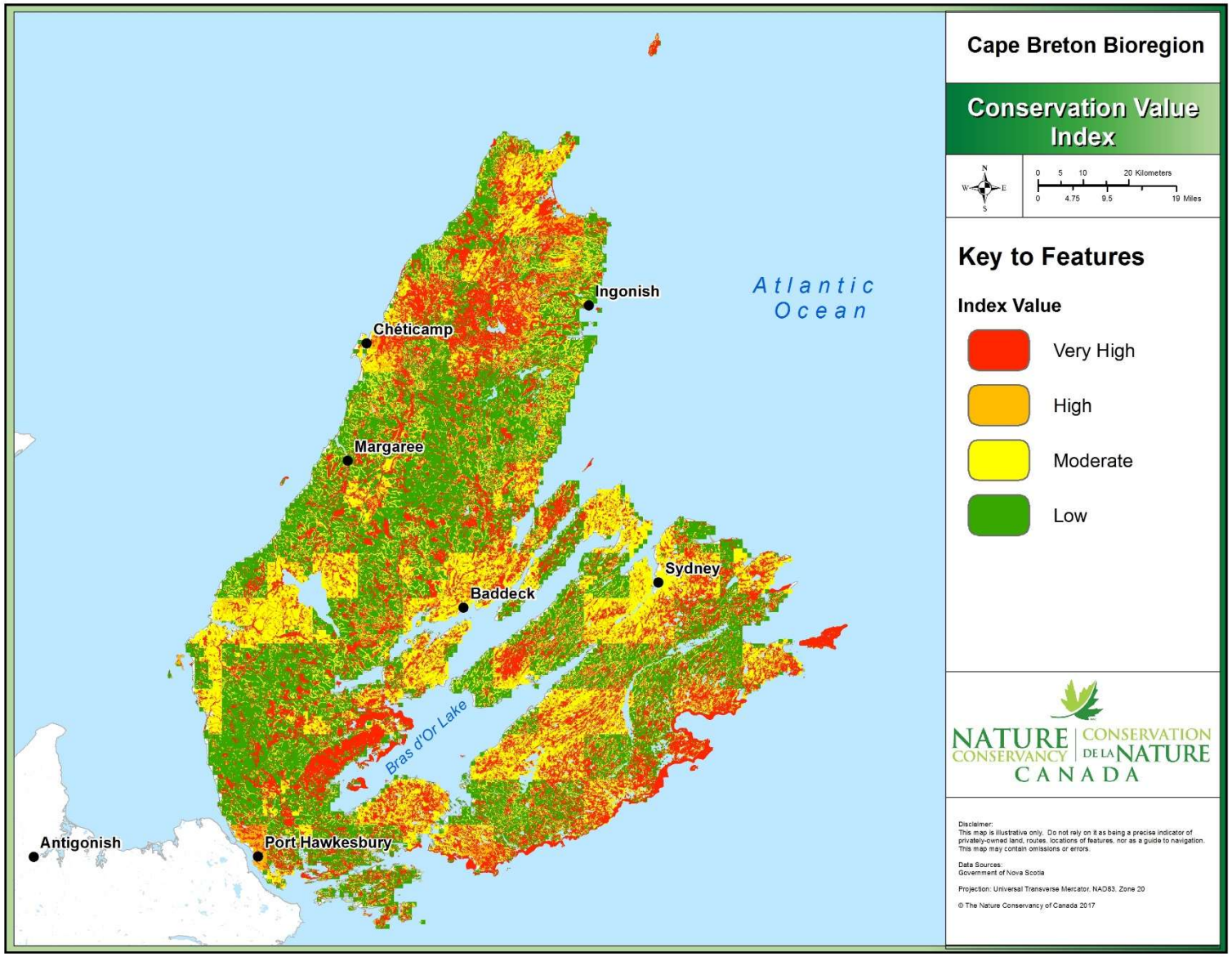
- Continue to promote the use of "Two Eyed Seeing" in the approach taken to natural resource use and sustainable economic development.
- Continue to lead the collaborative effort to incorporate Mi'kmaq and western perspectives in the development and delivery of an overall management plan for Bras d'Or Lakes Watershed ecosystems.



Summary–Figure 1. Conservation context and overall land tenure in the Cape Breton bioregion. Permanently protected land includes federal, provincial and land trust holdings.



Summary–Figure 2. Priority habitat composite for the Cape Breton bioregion



Summary–Figure 3. Conservation value index (CVI) for the Cape Breton bioregion.

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1. CONSERVATION CONTEXT

A. Bioregion Scope

i. Location and Size

The Cape Breton bioregion[1] shares its boundaries with Cape Breton Island, a rugged and irregularly shaped island approximately 175 km long by 135 km at its widest. Cape Breton Island makes up the northeastern tip of the province of Nova Scotia, separated from the mainland by a narrow body of water known as the Strait of Canso (Figure 1). Its landmass generally slopes upward from south to north, peaking in the highlands of northern Cape Breton at over 500 m. It is surrounded by 3,170 km of shoreline with the Atlantic Ocean to the south and east, the Gulf of St. Lawrence and St. Georges Bay to the west, and the Bras d'Or Lakes in the interior, representing approximately 26% of Nova Scotia's total shoreline. The Bras d'Or Lakes make up one of the world's largest salt water lakes, and consist of a series of estuarine bodies linked together in a manner that forms a unique coastal ecosystem within the Nova Scotia coastline (Parker *et al.* 2007). The terrestrial extent of Cape Breton is 1,066,304 ha; when combined with the area of the Bras d'Or Lakes, the total extent of the bioregion is 1,174,904 ha, representing just over 20% of the area of the province.

Nova Scotia falls within the Atlantic Maritime Ecozone (Ecological Stratification Working Group 1995), and the Northern Appalachian-Acadian Ecoregion (Anderson *et al.* 2006), which are broad-scale, generalized ecological land units that share similar boundaries within Canada. The Cape Breton bioregion encompasses all or portions of five provincial 'ecoregions', including eight nested 'ecodistricts', as delineated within the Nova Scotia Department of Natural Resources' Ecological Land Classification (NSDNR ELC 2015; Table 1; Figure 2). All of the terrestrial portions of Maritime Canada fall within the Atlantic Northern Forest (Bird Conservation Planning Region 14), while the offshore areas of Nova Scotia belong to the Scotian Shelf and Gulf of Maine bioregions (Marine Biogeographic Units 11 and 12; Fisheries and Oceans Canada 2009; Environment Canada 2013) (Figure 3).

The bioregion is made up of 392,085 ha of Provincial Crown-owned land (37%), a further 94,946 ha of federally-owned lands managed by Parks Canada Agency and Environment and Climate Change Canada (9%), and the remaining 54% made up of a small proportion of municipal and Aboriginal lands, with the majority privately owned. The island is divided politically into four counties, Cape Breton, Inverness, Richmond, and Victoria.

[1] ***Bioregions*** *are geographic areas defined by natural boundaries (i.e., physical and environmental features), including watershed boundaries and soil and terrain characteristics.*

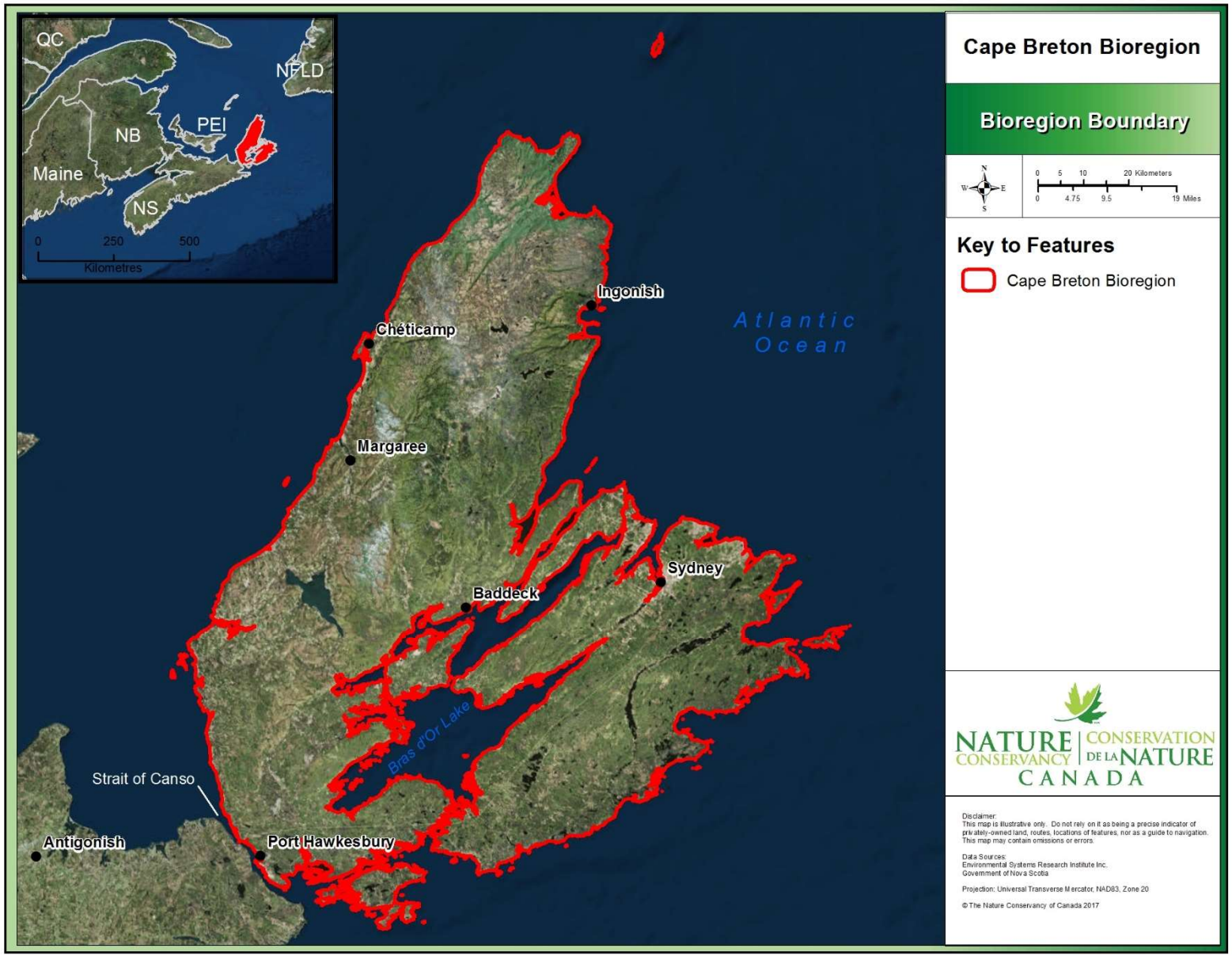

Figure 1. Boundary of the Cape Breton bioregion.

Table 1. Ecological Land Classifications for the Cape Breton bioregion.

NAAP Subregion[1]	**Ecoregion**[2] **-Ecodistrict**	**Ecoregion Characteristics** (Neily *et al.* 2005)
Acadian Highlands	Northern Plateau - Northern Plateau	-Gently undulating terrain atop the highlands plateau with elevations exceeding 450 m. -Characterized by stunted conifers, raised bogs, barrens, exposed bedrock, and extreme weather. -Mostly contained within Cape Breton Highlands National Park and Jim Campbells Barren Wilderness Area.
	Cape Breton Highlands -Cape Breton Highlands -Victoria Lowlands	-Includes lowlands, some steep slopes and plateau, extending from the waters of the Cabot Strait to the mountains east of Lake Ainslie. -Most of the region is between 300 and 450 m. -Mountainous terrain, boreal fir spruce forest on plateau with tolerant hardwoods on slopes.
Acadian Uplands	Nova Scotia Uplands -Cape Breton Hills -Inverness Lowlands	-Hilly topography, elevations of 150 to 300 m. -Characterized by hardwood hills (sugar maple, beech, red maple, yellow birch) with hardwood, spruce and balsam fir mixedwoods on valleys and slopes, with hemlock in steep ravines. -Areas of karst topography found at lower elevations (Iona, Marble Mountain, and Inverness).
Northumberland – Bras D'Or Lowlands	Northumberland Bras d'Or Lowlands -Bras d'Or Lowlands -St. George's Bay	-Sheltered lowlands, most of the region is between 25 to 60 m, although up to 150 m. -Black spruce common on lowland sites, tolerant hardwoods (Sugar Maple, Yellow Birch, Beech) on well-drained hills. White Pine, Red Spruce and Hemlock occur on steep slopes, and ravines. -Windsor Group limestone, gypsum, and karst topography relatively common.
Atlantic Coast	Atlantic Coast -Cape Breton Coastal	-Frequent high winds, high humidity, salt spray, and fog, with the coastal influence extending up to 12 km inland on Cape Breton Island. -Coastal forest dominated by White Spruce, Balsam Fir, and Black Spruce with less common Red Maple and White Birch.

[1] *Northern Appalachians-Acadian Plan (NAAP; Anderson et al. 2006)*

[2] *Nova Scotia Department of Natural Resources Ecological Land Classification (NSDNR ELC 2015)*

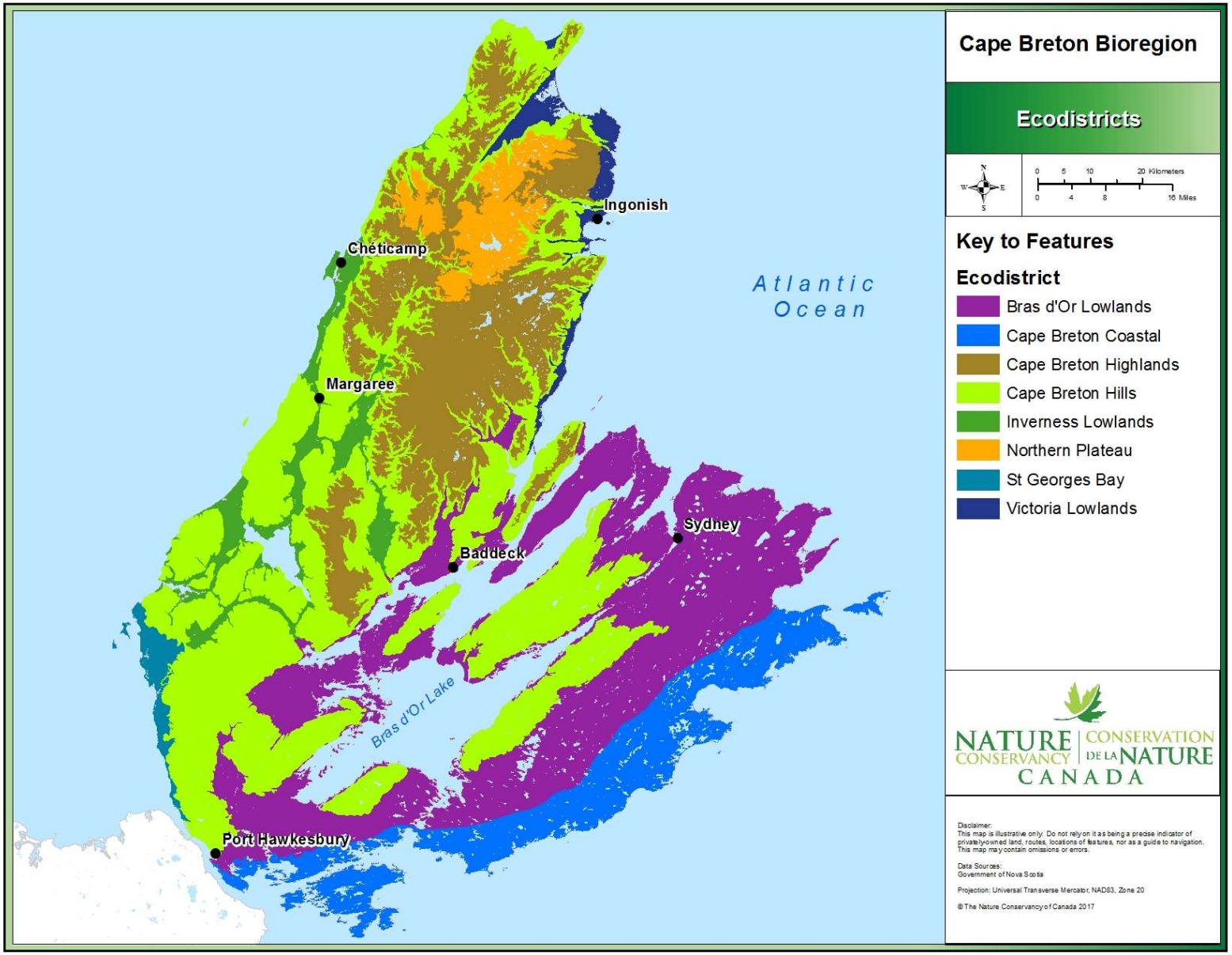

Figure 2. Ecodistricts within the Cape Breton bioregion (NS DNR ELC 2016).

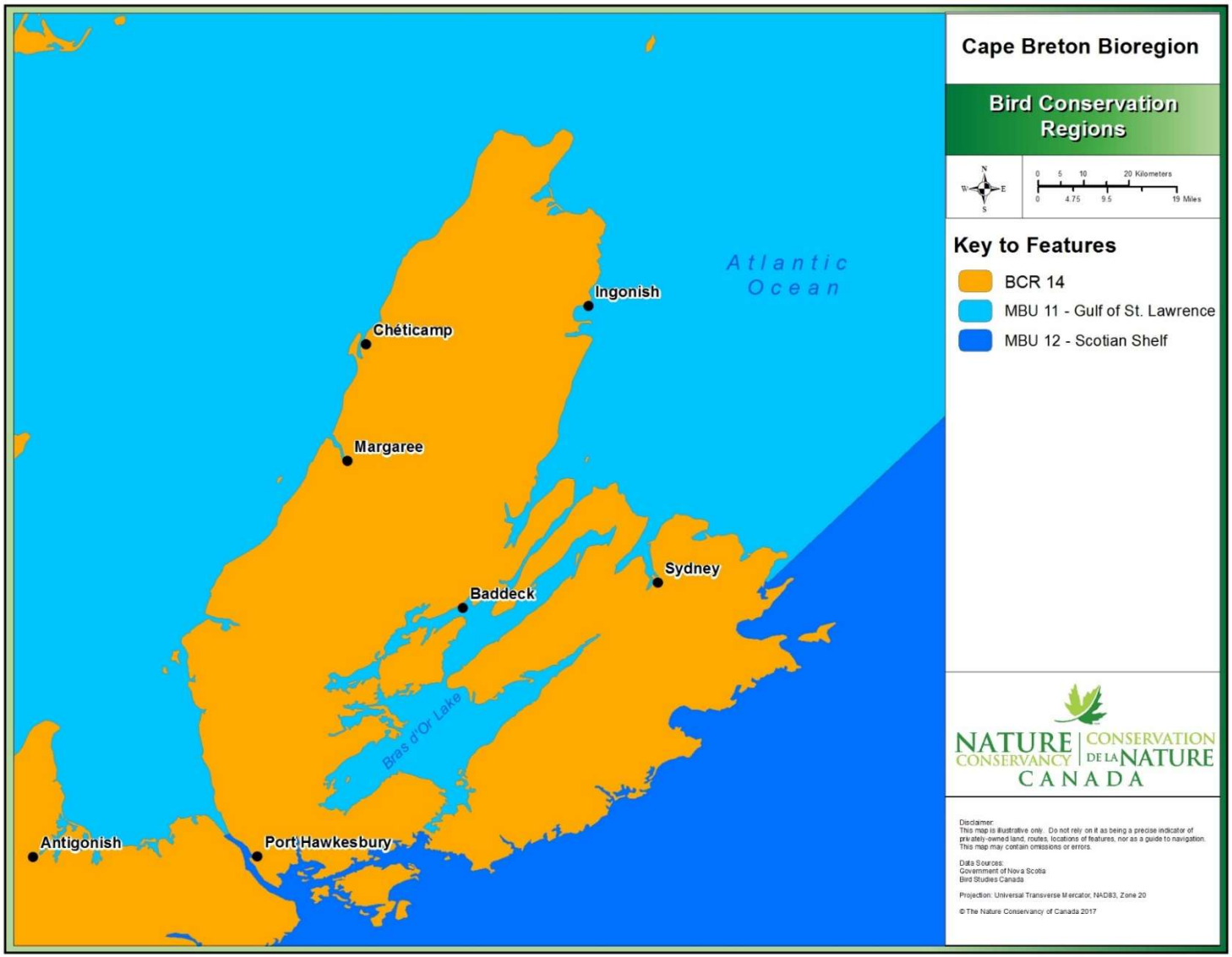

Figure 3. Bird Conservation Region 14 (BCR 14) and Marine Biogeographic Units 11 and 12 (MBU 11, MBU 12)

ii. Boundary Justification

The boundary of the Cape Breton bioregion is delineated by the geographical boundary of Cape Breton Island, which is separated from mainland Nova Scotia by a narrow body of water known as the Strait of Canso. By including the whole of Cape Breton within the boundary, the Cape Breton bioregion includes the full extent of ten provincially-delineated primary watersheds (Figure 4; NSE 2011). Watersheds are widely recognized as an important planning and management unit, providing the opportunity to address broad-scale threats occurring in the upper reaches of watersheds that may have significant impacts on the lower reaches of those watersheds, including coastal and marine targets (Environment Canada & Parks Canada Agency 2010). Watershed management is also common practice in other jurisdictions, and an attractive landscape unit for local watershed and stewardship groups.

iii. Ecological Significance

From rich coastal ecosystems to the northern highlands plateau, the Cape Breton bioregion is one of the most ecologically diverse regions of Nova Scotia. The natural landscapes found within the bioregion contain a diverse array of ecosystems that provide habitat for a wide range of species, including 35 species assessed as at risk by COSEWIC, and 28 species listed under the Nova Scotia *Endangered Species Act.* The most dominant natural feature on the island is the elevated plateau in Northern Cape Breton known as the Cape Breton Highlands. Divided by steep-walled river canyons, the Cape Breton Highlands consist of alpine and sub-alpine ecosystems that contain some of the province's only significant summit and steep slopes (Anderson *et al.* 2006) and host species that are unique within Nova Scotia. The wide range of elevations in northern Cape Breton enables the coexistence of Boreal and Taiga species and communities on the plateau and Acadian Forest species and communities in the valleys and lowlands (Parks Canada 2010a).

The bioregion contains possibly the highest density of intact, unprotected forested landscapes in Nova Scotia. There are nine Tier One matrix forest blocks within the bioregion identified by the Northern Appalachian Acadian Plan (NAAP; Anderson *et al.* 2006); these large forested areas greater than 10,000 ha with few roads and mostly intact interior habitat are important for the conservation of a wide range of plant and animal species, from soil invertebrates and fungi to forest interior birds, large herbivores, and wide ranging predators. The interior forests of the bioregion provide key habitat for several large mammals including Moose (*Alces alces andersoni*), Canada Lynx (*Lynx Canadensis)* (Parker *et al.* 1983), and American Marten (*Martes americana*). Within Cape Breton Highlands National Park, old growth forests in excess of 350 years old can be found on steep, inaccessible slopes and in deep ravines, making them some of the oldest forest stands in the province (Parks Canada 2010a). There are a number of other examples of forest stands that are representative of old-growth, climax conditions in the bioregion. They are located primarily within provincial wilderness areas and nature reserves (NSE 2016).

The bioregion encompasses an extensive network of freshwater lakes, rivers, streams, and wetlands, including critical occurrences of freshwater wetland and riparian ecosystems (Anderson *et al.* 2006) including the largest natural freshwater lake in Nova Scotia, Lake Ainslie. The Margaree River drains Cape Breton's largest watershed and is a designated Canadian Heritage River for outstanding natural and recreational values (Canadian Heritage Rivers System 2017). With its cool temperatures and high pH, the Margaree River supports the largest, most consistent Atlantic Salmon (*Salmo salar*) population in Nova Scotia. Middle River and Baddeck River also support significant Atlantic Salmon populations with excellent water quality and no significant impediments to fish migration (Robichaud-Leblanc & Amiro 2004).

The 3,170 km of shoreline on Cape Breton Island contain a high concentration of critical coastal complexes (Anderson *et al.* 2006), including barrier beaches, salt marshes, barachois ponds, and Eelgrass dominated mud flats. These coastal complexes support distinct and high levels of biodiversity, including

rare taxa, and in many cases act as nurseries for marine fish and shellfish populations. The Bras d'Or Lakes in the interior of Cape Breton consist of a large, complex network of estuarine aquatic ecosystems (i.e. coastal water bodies where fresh water and sea water mix) linked together in a manner that forms a unique coastal ecosystem within the Nova Scotia coastline (Parker *et al.* 2007). In 2011 the Bras d'Or Lakes were designated as a UNESCO Biosphere Reserve, which are internationally recognized as an area in the world that is deemed to demonstrate a *"balanced relationship between humans and the biosphere"*. The designation recognizes the collaborative efforts among people in the designated area to promote the sustainability of local economies and communities, as well as the conservation of ecosystems.

One of the most regionally unique and significant elements of biodiversity within the Cape Breton bioregion are gypsum, limestone, and marble derived ecosystems. These calcareous (calcium rich) natural ecosystems are rare in northeastern North America and globally uncommon. Although exposed gypsum and karst landscapes are relatively uncommon in Nova Scotia, they are far more widespread and frequent in the province than in any other jurisdiction in the glaciated portion of northeastern North America. A significant proportion occurs within the boundary of the Cape Breton bioregion. The particular conditions of calcareous soils, along with their occurrence as isolated islands within a non-calcareous matrix, have resulted in the evolution of narrow endemic plant species in many calcareous regions (Blaney & Mazerolle 2013). While there is little endemism in NS, gypsum is uncommon at the surface in temperate areas generally, and NS is exceptional worldwide. Consequently, these ecosystems support globally rare and uncommon floral communities (Sean Blaney - Personal Communication).

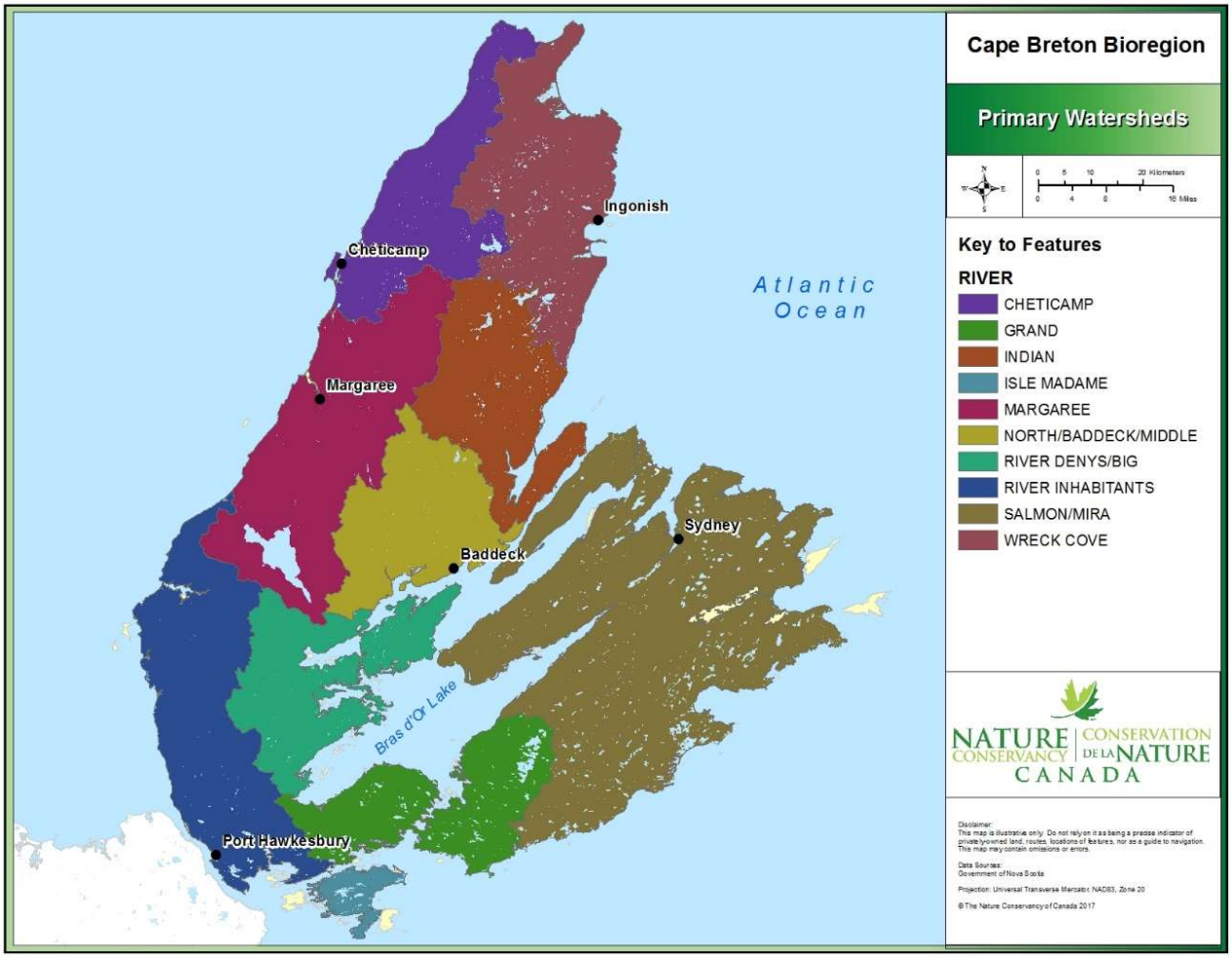

Figure 4. Ten provincially-delineated primary watersheds encompassed by the Cape Breton bioregion.

B. Ecological Context

i. Climate and Geology

Nova Scotia is essentially a peninsula situated between the relatively warm, shallow Gulf of St. Lawrence and the much colder Atlantic Ocean. These ocean waters directly influence climate by moderating seasonal temperatures and creating humidity, resulting in generally cooler summers and milder winters than on the North American continent. This is described as a modified continental climate, with proximity to the coast and elevation determining significant local climatic variation (Davis & Browne 1996a).

The climate of Cape Breton Island is generally cooler and wetter than mainland Nova Scotia. Coastal regions are cooler than inland and are subject to strong offshore winds. The lowland areas around the Bras d'Or Lakes have a moderated climate due to their close proximity to the lake and the shelter of the surrounding uplands (Neily *et al.* 2005). From the lowlands at sea level, elevations on Cape Breton range greatly from sea level to more than 500 m. The Cape Breton Highlands resemble more boreal conditions due to their high elevation and cooler annual temperatures. Differences in aspect and slope can also influence climate, with steep, north-facing slopes generally experiencing cooler conditions (Parks Canada 2010a). These factors, in addition to the modifying influence of the Gulf of St. Lawrence and the Atlantic Ocean on either side of northern Cape Breton, are responsible for creating a distinct climatic

region in the Cape Breton Highlands (Parks Canada 2010a). The average annual temperature for the island is around 6°C, with winter temperatures averaging around -5°C, whereas summer temperatures average 20°C for July and August and rarely exceed 30°C. Total annual precipitation on the island exceeds 1000 mm/year, with the highest precipitation experienced in the highlands (1600 mm/year), where annual snowfall can be as high as 400 cm/year (Parks Canada 2010a).

The present landscape of the bioregion is very diverse, reflecting its variable bedrock material and extensive glacial history, including repeated glaciation events, which had a profound effect upon the landscapes of Nova Scotia. The last glaciation (i.e., Wisconsin) started approximately 75,000 years ago, peaked around 21,000 years ago, and finally ended approximately 10,000 years ago (Davis & Browne 1996a; Shaw *et al.* 2002). This glaciation resulted in extensive scouring of the Cape Breton Highlands, which have very little glacially-derived cover, and voluminous till deposition in lowland areas around the Bras d'Or Lakes, where some areas of deposition are tens of metres thick. This has contributed to a variety of landforms, including drumlins, eskers, kames, and outwash deposits (Davis & Browne 1996a).

The Bras d'Or Lakes consist of a series of low-salinity lakes occupying an area of 1,082 km^2 in central Cape Breton Island. The series of channels and bays that make up the lakes vary widely in depth from generally shallow in the western part of the lake to over 280 m in St Andrews Channel (BLBRA 2010). The lakes and surrounding lowlands are underlain by Carboniferous sandstone, shale, limestone, and gypsum; the deep channels of the lakes were carved from these readily erodible sedimentary rocks between resistant uplands of crystalline Precambrian rocks by ancient rivers during the Tertiary Uplift when relative sea level was far below present (BLBRA 2010). Originally fresh water, the Bras d'Or Lakes were flooded by seawater sometime between 6000 and 4000 years ago (Davis & Browne 1996a; Shaw *et al.* 2002), when rising sea levels during the post-glacial period overcame a bedrock sill in the Great Bras d'Or Channel at approximately 25 m below present sea level (BLBRA 2010). There are only two narrow openings and a small canal connecting the lakes to the Atlantic Ocean, leading to considerable variability in salinity in the brackish waters of the estuarine system (BLBRA 2010). Much of the coastline of the Bras d'Or Lakes consists of unconsolidated glacial deposits, subject to erosion from storm events at exposed locations, though rocky shores so occur (BLBRA 2010; Shaw *et al.* 2002).

Within the surrounding Bras d'Or lowlands, where bedrock is Windsor Group limestone and gypsum, karst topography is common and thick deposits of gypsum, anhydrite, and salt occur (Neily *et al.* 2005). The extensive coal seams of the Sydney coalfield and Mabou-Inverness coalfield formed during the Late Carboniferous period when the Windsor Group sediments were deposited. The Sydney coalfield contains the largest coal resource in eastern Canada, and for many decades was the center of coal mining in Nova Scotia. Along the Atlantic Coast of Cape Breton Island, older Precambrian rocks predominate, and soils for the most part are thin and stony (Neily *et al.* 2005).

The geology of the intervening Bras d'Or Uplands is diverse and complex, with remnants of the Cretaceous peneplain surface, composed of metamorphic, intrusive and volcanic rocks of the Precambrian to Paleozoic eras. Areas of karst topography are found throughout the uplands region at lower elevations, most notably on the Iona peninsula, at Marble Mountain, and near Mabou, Port Hood/Judique, and Inverness (Neily *et al.* 2005). The basement rock of the Cape Breton Highlands plateau derives from the early Appalachian Mountains of eastern North America, which were formed by the collision of two continents beginning about 380 million years ago (Calder *et al.* 1993). These very old, highly resistant rocks underlie the gently rolling plateau with many knolls, small hills, hummocks, and gently sloping valleys (Davis & Browne 1996a). The soils of the plateau are generally sandy loams, with large imperfectly or poorly drained areas (e.g., bogs). On the slopes of the highlands, soils are well-drained with extremely high seepage potential.

ii. Conservation Priority Species

Conservation priority species are objectively defined as:

- Any species with a federal assessment (COSEWIC[1]) of Special Concern, Threatened or Endangered (including all species on Schedule 1 of the *Species at Risk Act*[2])
- Any species at risk with a provincial listing (*Nova Scotia Endangered Species Act*[3]) of Vulnerable, Threatened, or Endangered
- Any species with a provincial rank of S1, S2, or S3 - with a global rank of G1, G2, or G3, by the Atlantic Canada Conservation Data Centre (ACCDC)
- Any Bird Conservation Region (BCR) 14 or Marine Biogeographic Unit (MBU) 11 or 12 priority bird species that occurs with regularity in the bioregion (Environment Canada 2013)

Due to its unique geological and climatic history, Nova Scotia hosts a number of peripheral and disjunct populations of temperate flora and fauna (McAlpine & Smith 2010). The majority of these species occurrences are concentrated in the southwest of the province, however, there are several found in discrete locations in the Cape Breton bioregion, often listed as species at risk. Within the bioregion the total list of 42 species at risk includes 23 species listed on Schedule 1 of the *Species at Risk Act* (SARA), an additional 11 species assessed as at risk by COSEWIC, and 32 species listed in the *Nova Scotia Endangered Species Act* (NS ESA), four of which are not assessed or listed as species at risk nationally (Table 2). Additionally, a total of 22 globally significant species (G1-G3G4) are identified within the bioregion, eight of which are also federally listed species at risk (Table 3). See the ACCDC for a complete glossary of biodiversity and conservation ranks (www.accdc.com). Appendix C provides the complete list of priority species found within the Cape Breton bioregion with their conservation status, source of occurrence data, and coarse filter habitat associations. This HCS primarily targets terrestrial species; the treatment of aquatic species is cursory in this report.

Table 2. Nationally assessed and provincially listed species at risk in the Cape Breton bioregion, listed alphabetically by common name within their respective taxonomic group.

Common Name	Scientific Name	COSEWIC	SARA	NS ESA
Invertebrates				
Monarch	*Danaus plexippus*	Special Concern	Special Concern	Endangered
Yellow Banded Bumble Bee	*Bombus terricola*	Special Concern		Vulnerable
Yellow Lampmussel	*Lampsilis cariosa*	Special Concern	Special Concern	Threatened
Fishes				
American Eel	*Anguilla Rostrata*	Threatened		
Atlantic Salmon – Eastern CB Population	*Salmo salar*	Endangered		

[1] *The Committee on the Status of Endangered Wildlife in Canada is a committee of independent experts that assesses the national status of wildlife species in Canada based on the best available scientific, community, and Aboriginal traditional knowledge, and recommends a classification for their legal protection.*

[2] *The* Species at Risk Act *(2003) is the federal legislation that provides for the protection and recovery of wildlife species, subspecies, and distinct populations that are listed as extirpated, endangered, or threatened on Schedule 1 of the Act; once a species is listed, the provisions of the Act apply to protect and recover the species.*

[3] *The* Nova Scotia Endangered Species Act *(1999) is a provincial commitment to protect species in Nova Scotia that have been assessed and determined to be at risk of extinction.*

Common Name	Scientific Name	COSEWIC	SARA	NS ESA
Atlantic Sturgeon	*Acipenser oxyrinchus*	Threatened		
Striped Bass	*Morone saxatilis*	Special Concern		
Birds				
Bank Swallow	*Riparia riparia*	Threatened	Threatened	Endangered
Barn Swallow	*Hirundo rustica*	Threatened	Threatened	Endangered
Barrow's Goldeneye - Eastern Population	*Bucephala islandica (Eastern pop.)*	Special Concern	Special Concern	
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Threatened	Endangered
Bobolink	*Dolichonyx ory*	Threatened		Vulnerable
Buff-breasted Sandpiper	*Tryngites subruficollis*	Special Concern		
Canada Warbler	*Wilsonia canadensis*	Threatened	Threatened	Endangered
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Threatened
Eastern Wood-Pewee	*Contopus virens*	Special Concern		Vulnerable
Evening Grosbeak	*Coccothraustes vespertinus*			Vulnerable
Harlequin Duck - Eastern Population	*Histrionicus histrionicus*	Special Concern	Special Concern	Endangered
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	Threatened
Peregrine Falcon	*Falco peregrinus*	Special Concern	Special Concern	Vulnerable
Piping Plover	*Charadrius melodus melodus*	Endangered	Endangered	Endangered
Red Knot rufa spp	*Calidris canutus rufa*	Endangered	Endangered	Endangered
Red Necked Phalarope	*Phalaropus lobatus*	Special Concern		
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern	Endangered
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern	
Reptiles				
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable
Wood Turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened
Mammals				
American Marten	*Martes americana*			Endangered
Canada Lynx	*Lynx canadensis*			Endangered
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered
Long Tailed Shrew	*Sorex dispar*		Special Concern	
Northern Long-eared Bat	*Myotis septentrionalis*	Endangered	Endangered	Endangered
Lichens				
Blue Felt Lichen	*Degelia plumbea*	Special Concern		Vulnerable
Boreal Felt Lichen	*Erioderma pedicellatum*	Endangered	Endangered	Endangered
Eastern Waterfan	*Peltigera hydrothyria*	Threatened		Threatened
Frosted Glass Whiskers	*Sclerophora peronella*	Special Concern	Special Concern	

Common Name	Scientific Name	COSEWIC	SARA	NS ESA
Vascular Plants				
Black Ash	*Fraxinus nigra*			Threatened
New Jersey Rush	*Juncus caesariensis*	Special Concern	Special Concern	Vulnerable
Prototype Quillwort	*Isoetes prototypus*	Special Concern	Special Concern	Vulnerable
Sage (Hoary) Willow	*Salix candida*			Endangered

Table 3. Globally significant species (G1-G3G4) in the Cape Breton bioregion, listed alphabetically by common name within their respective taxonomic group.

Common Name	Scientific Name	Global Rank
Invertebrates		
Salt Marsh Copper	*Lycaena dospassosi*	G2G4
Short-Tailed Swallowtail	*Papilio brevicauda*	G3G4
Tidewater Mucket	*Leptodea ochracea*	G3G4
Yellow Banded Bumble Bee	*Bombus terricola*	G2G4
Yellow Lampmussel	*Lampsilis cariosa*	G3G4
Fishes		
Atlantic Sturgeon	*Acipenser oxyrinchus*	G3
Birds		
Piping Plover	*Charadrius melodus melodus*	G3TNR
Reptiles		
Wood Turtle	*Glyptemys insculpta*	G3
Mammals		
Little Brown Myotis	*Myotis lucifugus*	G3
Northern Long-eared Bat	*Myotis septentrionalis*	G1G3
Lichens		
Boreal Felt Lichen	*Erioderma pedicellatum*	G1G2Q
Powdered Honeycomb Lichen	*Cavernularia hultenii*	G3
Tree Pelt Lichen	*Peltigera collina*	G3G4
Vascular Plants		
Acadian Quillwort	*Isoetes acadiensis*	G3Q
Fernald's Serviceberry	*Amelanchier fernaldii*	G2G4Q
Frankton's Saltbush	*Atriplex franktonii*	G2G4
Laurentian Bladder Fern	*Cystopteris laurentiana*	G3
Little Curlygrass Fern	*Schizaea pusilla*	G3G4
New Jersey Rush	*Juncus caesariensis*	G2G3
Northern Meadowsweet	*Spiraea septentrionalis*	G2G3Q
Prototype Quillwort	*Isoetes prototypus*	G2G3
Robinson's Hawkweed	*Hieracium robinsonii*	G2G3

Invertebrates

The Yellow Lampmussel is a bivalve mollusc currently known in Canada in only two watersheds, the lower Saint John River in New Brunswick, and the Sydney River in Cape Breton, a small system of about 14,000 ha that drains northeast to the Atlantic Ocean at Sydney Harbour (COSEWIC 2004). The main centre of the Yellow Lampmussel population in the Sydney River system is at Blacketts Lake, which occurs at the river's headwaters. Location of the Nova Scotia population of Yellow Lampmussel within a

suburban environment, with associated pollution and development issues, is of concern (COSEWIC 2004). Two other disjunct freshwater mussels (Tidewater Mucket (*Leptodea ochracea*) and *Elliptio complanata*), along with a disjunct aquatic isopod (*Caecidotea communis*), also occur in the Sydney River system (COSEWIC 2004).

Fishes

Fish species at risk found in the bioregion's freshwater aquatic habitats include Atlantic Salmon (Endangered), Striped Bass, and American Eel. Threats to freshwater fish species include climate change, overfishing, habitat loss and degradation, dams and other migration barriers, contaminants, aquaculture, invasive species, and changes to ocean systems that may affect some anadromous species (e.g., Atlantic Salmon, Striped Bass).

Atlantic Salmon require rivers or streams that are generally clear, cool and well-oxygenated for reproduction and the first few years of rearing. Deep pockets of oxygen-rich cold water habitat are important as summer refugia for Atlantic Salmon and other salmonids (e.g., Brook Trout). Atlantic Salmon found within watersheds draining into the Gulf of St. Lawrence (e.g., the Margaree and Mabou Rivers) are part of the Gaspe-Southern Gulf of St. Lawrence population (Special Concern), whereas Atlantic Salmon that breed in Cape Breton rivers draining into the Atlantic Ocean and the Bras d'Or Lakes are genetically distinct and make up the Eastern Cape Breton population, designated as Endangered in 2010 (COSEWIC 2010a). Both of these populations have suffered considerable declines over at least the past century, historically impacted primarily by dams that have impeded spawning migrations and flooded spawning and rearing habitats. Other influences, such as pollution and logging, have also reduced or degraded freshwater habitats (COSEWIC 2010a). The population is currently threatened by poor marine survival related to substantial but incompletely understood changes in marine ecosystems (COSEWIC 2010a).

Birds

In 2013, Environment Canada completed a strategy for BCR 14, incorporating consideration of MBU 11 and MBU 12 for Nova Scotia. The strategy, one of a suite for each bird conservation region across Canada, is designed to serve as a framework for implementing bird conservation for the region's priority bird species (Environment Canada 2013). Priority species identified in the strategy include those species that occur regularly in the region that are vulnerable due to population size, distribution, population trend, abundance, and threats; some widely distributed and abundant 'stewardship' species that typify the national or regional avifaunal and/or have a large proportion of their range or continental population in the region; and some species of management concern when they are at (or exceed) their desired population objectives but require ongoing management due to their socio-economic importance as game species or because of their impacts on other species or habitats. The BCR 14 Nova Scotia Strategy (Environment Canada 2013) identified 99 priority species, primarily for conservation, but also management action. There are 62 priority bird species identified in BCR 14 and 47 priority bird species identified in MBU 11 and 12 marine habitats in Nova Scotia (with some overlap; Appendix D), 59 and 30 have occurrences in Cape Breton respectively. The list is dominated by landbirds (40 species) but also includes 20 species of shorebirds, 25 species of waterbirds, and 14 species of waterfowl. Wetlands are used by the greatest number of species (45%), followed by forests (35%), and cultivated and managed areas (34%).

Important Bird Areas

Primarily within the coastal zone of the bioregion, but also within the high-elevation boreal forest, there are 14 nationally designated Important Bird Areas (IBAs; Figure 5**Error! Reference source not found.**),

most of which are identified as globally significant for congregatory or threatened species. Canada's Important Bird Areas Program is a science-based initiative to identify, highlight, conserve, and monitor a network of sites that provide essential habitat for Canada's bird populations (IBA Canada 2012). These areas of international significance for the conservation of birds may support threatened species, large groups of congregatory species, or species restricted by range or by habitat, however the designation does not imply that these areas are legally protected (IBA Canada 2012). IBAs may encompass private or public land, and they may or may not overlap partially or entirely with legally protected sites. A number of the IBA sites in the bioregion contain globally significant breeding sites for Great Cormorants (70% of the North American population breed in Nova Scotia), while others contain breeding sites for Leach's Storm Petrel (Scaterie Island) and Black-legged Kittiwakes. IBAs in the bioregion also contain breeding habitat for the endangered Piping Plover and threatened Bicknell's Thrush (see www.ibacanada.ca for more information on individual IBAs).

Piping Plover

Seven beaches in the bioregion have supported one or more breeding Piping Plover pairs over the past ten years: Shipping Point (Port Hood), West Mabou, Inverness, North Harbour, Middle Harbour, South Harbour and Glace Bay Bar (BSC unpublished data). Average annual number of beaches occupied by one or more breeding pairs was 4 (SD 0.7). The eastern subspecies of Piping Plover is a small shorebird that is found only in North America. Piping Plovers lay eggs in shallow scrapes on exposed sand and cobble and rely on camouflage and isolation to reduce the likelihood of predation and disturbance by mammals and other birds (COSEWIC 2013b). Their numbers remain extremely low and the population continues to decline despite concerted conservation efforts. Key threats are predation (primarily of eggs and chicks), human disturbance, and habitat loss or degradations (COSEWIC 2013b). As of 2017, the population of breeding pairs in Eastern Canada and St. Pierre and Miquelon Islands, France was 169 representing a decline of 37% since 2007 (CWS unpublished data). Aboriginal Traditional Knowledge indicates that Piping Plovers may have been present in the Cape Breton interior on the Bras d'Or Lakes (COSEWIC 2013b), however currently critical habitat for Piping Plovers on Cape Breton Island includes eight beaches (including historic nesting site of Dominon beach) on the exterior coasts (Environment Canada 2012; Sue Abbot per. Comm.) Beaches and dunes are also important for breeding habitat for Arctic and Common terns, Willet and Spotted Sandpiper. A number of other congregatory shorebirds, including the Semipalmated Sandpiper, Black-bellied Plover, Killdeer, Sanderling, and Dunlin use beaches during migration; as a group, shorebirds have been exhibiting major declines across North America (NABCI 2012).

Bicknell's Thrush

Bicknell's Thrush has one of the most restricted breeding ranges among the forest birds of North America (COSEWIC 2009). It is a habitat specialist, generally occupying dense, high-elevation stands of coniferous forest (primarily Balsam Fir) from the northeastern United States (Appalachian and Catskill mountains) to the Gaspe Peninsula of Quebec, and in isolated patches in northern New Brunswick and Nova Scotia. In Nova Scotia, it only breeds in the highlands of northern Cape Breton, with the exception of St. Paul and Scaterie Islands off the coast of Cape Breton (Erskine 1992; Stewart *et al.* 2015). On these coastal islands, cool sea breezes and high precipitation levels maintain dense spruce-fir stands selected locally by Bicknell's Thrush (COSEWIC 2009).

All available indices for this species indicate significant declines in their population and area of occupancy. Results from the second Maritime Breeding Bird Atlas (Stewart *et al.* 2015) show a greater than 40% decline in the distribution of the species over 10 years, while data from Bird Studies Canada's High Elevation Landbird Program indicate population losses of over 70% from 2002 to 2008 (COSEWIC

2009). While reasons for the decline are unclear, dramatic habitat losses on their wintering grounds, management practices such as pre-commercial thinning in regenerating forests and climate change are all contributing to a reduction of suitable high-elevation habitat (COSEWIC 2009). Unsustainable forest practices on the breeding grounds, and the conversion of suitable habitat on their wintering grounds (Hispaniola Island, Haiti, and the Dominican Republic) for human land uses are likely the main driving factors in the species' decline (International Bicknell's Thrush Conservation Group 2010).

In Nova Scotia much of the habitat of Bicknell's Thrush (55%) falls within protected areas (Cape Breton Highlands National Park and Nova Scotia Protected Areas; COSEWIC 2009). Of the remaining 45% of potential habitat, the majority is crown land managed for forestry. Pre-commercial thinning plays a significant role in reducing the time frame in which habitat remains suitable for Bicknell's Thrush, as well as potentially contributing to incidental take of this species (adults, nests, eggs and chicks) during the breeding season; thus, forest management practices such as pre-commercial thinning, within potential Bicknell's Thrush habitat, are relevant to the discussion of population and habitat trends for this species (COSEWIC 2009).

Reptiles

The Wood Turtle is declining across much of its northeastern North American range, and occurs in small, increasingly disjunct populations (COSEWIC 2007). It is generally more terrestrial than most freshwater turtles, but is still semi-aquatic and is most often associated with riparian areas, and rivers and streams with sand or gravel bottoms. Other habitats used less frequently by Wood Turtles include bogs, marshy pastures, meadows, upland forest, and hayfields (COSEWIC 2007). Threats to Wood Turtles across their range include collection for the pet trade, increased mortality of adults on roadways, off-highway vehicle trails, and agricultural machinery, loss of nesting and riparian habitat, and nest predation (COSEWIC 2007).

The Snapping Turtle, Canada's largest freshwater turtle, remains fairly common in most watersheds in Nova Scotia and is regionally assessed as demonstrably widespread, abundant, and secure (ACCDC 2013). Nonetheless, populations of Snapping Turtle are limited by slow recruitment, late maturity, and high juvenile mortality, and are experiencing increasing anthropogenic threats. Nest failure and adult mortality are intensified by females nesting in gravel shoulders along roadways and in quarries (COSEWIC 2008).

Mammals

Canada Lynx (*Lynx canadensis*), which formerly occurred in areas with suitable habitat across Nova Scotia, is currently found only in the Cape Breton Highlands in a small and isolated population (MTRI 2008; NSDNR 2013b). Similarly, the American Marten, which was trapped extensively throughout Nova Scotia since the 1700's, was thought to be extirpated from mainland Nova Scotia and restricted to a small and isolated population in Cape Breton, however recent records have confirmed the existence of marten in southwest Nova Scotia, though the status of the population is unknown (NSDNR 2013b).

Two species of forest-dwelling bats found on Cape Breton Island, the Little Brown Myotis and the Northern Myotis, were designated as Endangered (COSEWIC, SARA and the NS ESA) in response to the spread of a fungal pathogen responsible for White Nose Syndrome (WNS) that has decimated bat populations throughout eastern North America (COSEWIC 2012). The condition is caused by *Pseudogymnoascus destructans*, a cold-loving fungus likely introduced from Europe that thrives in cave conditions and impacts bat populations directly during the winter hibernation period (Blehert 2012; Lorch *et al.* 2011). White Nose Syndrome is responsible for the death of an estimated 5.7 - 6.7 million hibernating bats in the eastern North America between 2006 and 2012 (COSEWIC 2012). First

documented in Nova Scotia in April 2011, WNS decimated five known mainland Nova Scotia hibernacula in the winter of 2012-2013, with declines in the range of 91 to >99% in one year (H. Broders, per. comm.; Meller 2013) It was first detected on Cape Breton Island during the winter of 2013-2014 (USFWS 2017). Researchers believe that WNS could lead to local extinctions of hibernating bat species (Frick *et al.* 2010).

Vascular Plants

The Cape Breton Highlands support a diverse array of provincially rare plants. Arctic-alpine ecosystems, rare in Nova Scotia, occur along coastal cliffs and on high ridges in the Cape Breton Highlands. Arctic flora such as Diapensia (*Diapensia spp*), Blue Mountain Heather (*Phyllodoce caerulea*), Pink Crowberry (*Empetrum eamesii*), Northern Blueberry (*Vaccinium boreale*), and Alpine Bilberry (*Vaccinium uliginosum*), can he found at these sites, while rare Maidenhair Fern (*Adiantum pedatum*), Frog Orchid (*Coeloglossum viride),* Nodding Fescue *(Festuca subverticillata), and* Sweet Cicily *(Osmorhiza longistyli)* occur in the deep humid canyons with mature deciduous forest that cut through the plateau (NSE 2016; S. Blaney – Personal Communication). Other rare species occur on the peatlands and barrens of the highland plateau (Mazerolle *et al.* 2014).

Recent botanical surveys at a number of riparian and barren sites in the Cape Breton Highlands have documented dozens of provincially rare vascular plants, including Nodding Saxifrage (*Saxifraga cernua*) from cliffs along the Blair River, the second extant Nova Scotia location of the extremely threatened calciphile Maidenhair Fern from floodplain hardwood forest in the upper Polletts Cove valley, and a new plant species for Nova Scotia, the native sub-Arctic Altai Fescue (*Festuca altaica*) from a plateau barren near the Blair River (Mazerolle *et al.* 2014). Other notable rare species include Meadow Barley (*Hordeum brachyantherum*), Spiked Woodrush (*Luzula spicata*), Alpine Bistort (*Polygonum* viviparum), Purple Mountain Saxifrage (*Saxifraga oppositifolia)* and Field Wormwood (*Artemisia campestris*), each with only two known occurrences in Nova Scotia, all on Cape Breton Island.

Nova Scotia is unique in northeastern North America for the number and extent of sites having gypsum bedrock at or near the soil surface (Blaney & Mazerolle 2013). Gypsum-associated natural communities are globally uncommon and very rare in northeastern North America. The presence of karst topography and gypsum outcrops throughout the bioregion has resulted in the presence of rare calciphilous vascular plants, with areas with surficial deposits supporting distinct upland and wetland plant communities, some of which are of conservation concern (Blaney & Mazerolle 2013; Mazerolle *et al.* 2015). In two studies of gypsum and other calcareous exposures in Nova Scotia, Blaney & Mazerolle (2013) and Mazerolle *et al.* (2015) documented a high number of rare vascular plant occurrences in the bioregion, identifying many high-priority sites for land conservation. Rare and uncommon plant species associated with gypsum in the bioregion include Bublet Fern (*Cystopteris bulbifera*), Balsam Ragwort (*Packera paupercula)*, Soapberry (*Shepherdia canadensis*), and Ivory Sedge (*Carex eburnea*). Because the rugged sinkhole topography of severe karst occurrences can preclude any significant human activity, these areas often contain old forests and likely act as refuges for species dependent on these habitats (Blaney & Mazerolle 2013).

Areas of gypsum bedrock in the province are almost exclusively found on private land, and are thus not well represented within the provincial protected areas system; less than 1% presently lies within federal, provincial, or privately-owned protected areas (Mazerolle *et al.* 2015). Gypsum mining has a long history in the province and large open pit mines have already removed many of the most significant examples of gypsum landscapes (Mazerolle *et al.* 2015). Gypsum mining companies currently own large portions of undeveloped gypsum land, or the gypsum rights beneath other private lands; therefore the expansion of gypsum mining in the province represents a major ongoing threat to gypsum-associated ecological

communities. Although areas of karst are sometimes protected from forestry activities by their rugged sinkhole topography, wood harvesting is also a significant threat to all forested karst areas of gentler topography.

Lichens

A rare and threatened endemic aquatic lichen, known as Eastern Waterfan, is known to occur in two streams on Cape Breton Island. It grows at or below water level in cool, clear, partially shaded streams and is known from only seven locations in Canada. It is threatened by activities which disturb or alter the watercourse (e.g., level, flow), water quality (e.g., siltation, pollution) or protective vegetation surrounding its preferred habitat (COSEWIC 2013a).

Boreal Felt Lichen (Endangered) occurs in Nova Scotia within 25 km of the Atlantic Coast where annual precipitation exceeds 1400 mm (COSEWIC 2014). Intensive monitoring efforts over the past 10 years indicate that both the number of occurrences and number of individuals of this species are declining, mainly as a result of habitat loss and deterioration as a result of forest harvesting, air pollution, climate change, and predation by introduced slugs (COSEWIC 2014). Boreal Felt lichen is an 'umbrella species' for a community of rare coastal forest lichens, mosses, and invertebrates found in Nova Scotia and Newfoundland, including Blue Felt lichen, also known to occur in the bioregion (Special Concern; COSEWIC 2014).

Frosted Glass-whiskers (Special Concern) is a rare lichen known in Canada from only one occurrence in British Columbia, and two occurrences on Cape Breton Island (COSEWIC 2005). This species is an indicator of old-growth forest habitats, where it occurs on the exposed heartwood of mature red maple trees in Nova Scotia. Although this species may be sensitive to air pollution, the two Cape Breton occurrences appear healthy and are situated within large protected areas (Environment Canada 2011).

Much like the calciphilous (preference for calcareous soils) vascular plants above, the presence of karst topography and gypsum and limestone outcrops throughout the bioregion has resulted in the presence of rare calciphilous lichens. Some have recently been discovered that were previously not known to exist in the province, such as Tattered Jellyskin Lichen (*Leptogium lichenoides*) and Woodland Owl Lichen (*Solorina saccata*) (Anderson & Neily 2010).

iii. Protected Areas and Conservation Lands

According to the International Union for Conservation of Nature (IUCN), a protected area is "a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (Dudley 2008). The Cape Breton bioregion is well represented by an existing network of protected areas and conservation lands that are managed primarily for biodiversity, with nearly 20% of the bioregion currently under some form of conservation designation (Table 4). This is partly attributed to opportunities presented by the increased proportion of crown land (federal and provincial) on Cape Breton Island at 46%, compared to 30% for the entire province.

Federal Protected Areas

Federally protected lands in the bioregion include Sea Wolf Island National Wildlife Area, Big Glace Bay Migratory Bird Sanctuary, and Cape Breton Highlands National Park. National Wildlife Areas and Migratory Bird Sanctuaries, managed by Environment and Climate Change Canada, are established under the authority of the *Canadian Wildlife Act* and the *Migratory Birds Convention Act* respectively. These areas provide safe refuge within suitable habitat for migratory birds and other wildlife in the

terrestrial and marine environment. Cape Breton Highlands National Park, located in northern Cape Breton, was established in 1936 as the first national park in Atlantic Canada. It remains the largest national park in the Maritimes, protecting 950 km^2 of the Maritime Acadian Highlands Natural Region (Parks Canada 2010a). The Park is characterized by a rolling, hilly plateau cut by deep valleys and cascading rivers. Cape Breton Highland National Park promotes a natural range of plants and animals, with an emphasis on boreal forest reestablishment and restoration of the ecological integrity of the Park's forests (Parks Canada 2010a). St Anns Bank was declared a Federal Marine Protected Area in June of 2017. With an area of 4,364 km^2, at the time of writing is the third largest MPA in Canada.

Provincial Protected Areas

There are 19 Wilderness Areas (WA) and 22 Nature Reserves in the bioregion, which are provincially-significant protected areas designated under *Nova Scotia's Wilderness Areas Protection Act* (1998). These areas, managed by Nova Scotia Environment, provide protection for representative examples of Nova Scotia's natural landscapes, native biodiversity, and outstanding natural features (NSE 2016). A large proportion of these areas were added with the provincial "12% protected areas by 2015" initiative committed to in the *Environmental Goals and Sustainable Prosperity Act* (2007). There are 21 provincial parks and 55 protected beaches in the bioregion that are managed by the Nova Scotia Department of Natural Resources. While biodiversity conservation is generally not the primary objective of Nova Scotia provincial parks and protected beaches, these areas do offer legal protection from resource extraction and contribute to overall conservation within the bioregion.

Private Land Trusts

Land trusts such as the Nature Conservancy of Canada (NCC), Nova Scotia Nature Trust, and the Bras d'Or Preservation Nature Trust are non-profit charitable organizations that work to directly conserve important areas of natural diversity through property securement and long-term management. A total of 1067 ha have been protected by trusts in the bioregion, although this area is expected to grow as NCC has recently announced plans for its first large-scale conservation project in Cape Breton (NCC 2017). Their goal is to protect 2000 ha of ecologically significant land, such as rare gypsum-based ecosystem, riverside floodplains and wetlands, and old Acadian forest, around the Bras d'Or Lakes and in the Margaree Valley over the next 10 years.

Joint Ventures

In Nova Scotia, the Eastern Habitat Joint Venture (EHJV) secures, conserves, manages, and supports sustainable use of wetlands and associated uplands that benefit wildlife and their habitats. The EHJV currently manages 716 ha within the bioregion.

Table 4. Conservation Lands within the Cape Breton bioregion.

Site Name (Agency)	Area (ha)	% of Bioregion
Parks Canada		
Cape Breton Highlands National Park	94,870	8.90
Canadian Wildlife Service, Environment and Climate Change Canada		
Sea Wolf Island National Wildlife Areas	77	0.01
Big Glace Bay Migratory Bird Sanctuary	240	0.02
Nova Scotia Environment		
Wilderness Areas (19)	107,185	10.10

Site Name (Agency)	Area (ha)	% of Bioregion
Nature Reserves (22)	6,802	0.64
Department of Natural Resources		
Provincial Parks	1725	<0.01
Protected Beaches	511	<0.01
Total for Provincial Parks and Protected Beaches	2236	0.2
Lands held primarily for conservation by Municipalities and Private Trusts		
Nature Conservancy of Canada	523	<0.01
Nova Scotia Nature Trust	526	<0.01
Bras d'Or Preservation Nature Trust	18	<0.01
Eastern Habitat Joint Venture	716	<0.01
Total for Trusts and EHJV	1,783	0.01
Total Existing Conservation Lands in the Bioregion	**213,193**	**20.0***

*Percent of Bioregion Terrestrial area only – not including area of Bras d'Or Lakes

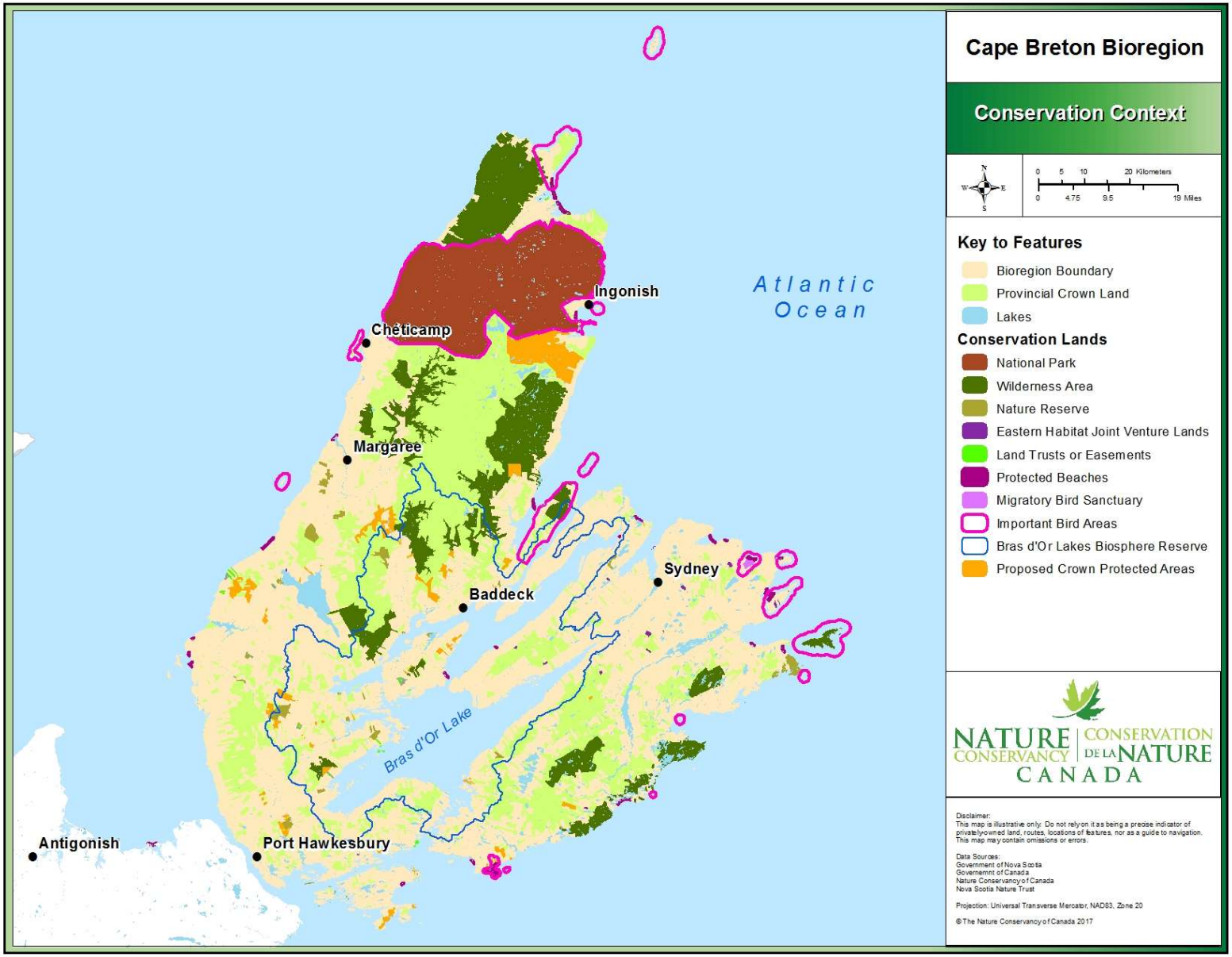

Figure 5. Protected areas, other conservation lands and ecologically significant areas in the Cape Breton bioregion.

iv. Social and Economic Considerations

The Cape Breton bioregion has an incredibly rich and vibrant human history. Beginning with the Paleo-Indians and Maritime Archaic peoples, aboriginal peoples have lived on the island for 10,000 years (BLBRA 2010; Parks Canada 2010a). There is a long history of Mi'kmaq First Nations presence on the island prior to European settlement, particularly on the Bras d'Or Lakes, which provided a source of transportation that linked Mi'kmaq communities living on its shores, as well as an important food source with abundant mussels, crab, trout, eels, salmon and other fish. The bioregion is currently home to five First Nations communities: Eskasoni - Canada's largest Mi'kmaq community – Membertou, Potlotek, Wagmatcook, We'koqma'q, all located on the Bras d'Or Lakes, with the exception of Membertou, near Sydney. Many place names on Cape Breton Island, such as Baddeck, Whycocomagh, and Mabou, are of Mi'kmaq origin (BLBRA 2010).

European settlement on Cape Breton Island is among the earliest in Canada, beginning with coastal fishing colonies established by the Portuguese in the 1500's. The French settled in Cape Breton in the 1700's with the establishment of colonies at Louisbourg and Chéticamp, and a number of trading posts for the exchange of goods and services with the aboriginal peoples (BLBRA 2010). Today, the Chéticamp area retains its distinct Acadian culture and, French is still the language of daily life (Parks Canada 2010a). Louisbourg fell to the British in 1758, and with the 1763 Treaty of Paris, Cape Breton Island came under British rule (BLBRA 2010). The first Scottish settlement on Cape Breton was at Judique in 1775, followed by a large influx of Highland Scots in the first half of the 1800's (BLBRA 2010), which had a strong influence on the culture of the island that remains to this day. The influence of the Gaelic language can still be heard in the speech of their descendants (Parks Canada 2010a).

The mining of coal has been a major factor in the industrial and social development of Cape Breton for over 250 years (Calder *et al.* 1993; Cape Breton Miners Museum 2017). The first commercial coal mine in Canada was opened at Port Morien in 1720 to supply the fortress at Louisbourg. In 1785, the first mine was established at Sydney Mines, setting off the virtually unbroken sequence of coal development in the Sydney coalfield until industrial coal mining in the region ceased in 2001 (Calder *et al.* 1993; Cape Breton Miners Museum 2017). With the development of the coal mining industry and the building of the first steel mill in Sydney in 1889, the population of the Sydney area grew from 10,000 to 75,000 by 1920, primarily immigrants from northern and eastern Europe and Italy, making Cape Breton the most cosmopolitan area of the Maritimes for many years.

Peak coal production in Cape Breton was reached in the early 1940s, however the post-war period brought a steady decline in the industry as inexpensive imported oil replaced coal in many of its traditional industrial and domestic markets (Calder *et al.*1993). In 1966, the formation of a federal Crown agency, the Cape Breton Development Corporation (DEVCO), and the ensuing global oil crisis of the early 1970s led to a revitalization of the coal-mining industry and by the early 1990s as much as 80% of Nova Scotia's electrical power was fueled by the DEVCO mines in the Sydney coalfield. Production problems and increasing production costs led to the decommissioning of the last DEVCO coal mine on Cape Breton in 2001; there are currently no industrial coal mines in operation on Cape Breton Island. Although the bioregion contains commercially-viable levels of gypsum, it has not been as extensively mined as in other parts of Nova Scotia, which at their peak in 2006 exported approximately 80% of Canada's gypsum (NSDNR, n.d.). The slowdown in the American housing industry resulted in the stagnating of Nova Scotia's mainland gypsum mines in 2011, and more recently of the largest mine on Cape Breton Island. It's not clear if and when the market for gypsum will improve.

In addition to coal mining, other natural resources have played, and continue to play, an important role in the rural economy on Cape Breton Island. Fisheries, forestry, and small-scale farming were also important early natural resource industries that influenced the pattern of settlement on the island and helped to develop the region's economy. With the decline of coal mining and the steel industry, fishing and forestry remain dominant economic drivers in the region, with large areas of wilderness managed primarily for forest products. The Point Tupper paper mill in Port Hawkesbury is the largest in Nova Scotia and provides 700 direct and indirect jobs in an area of high unemployment. Its importance to the regional economy was highlighted in 2012, when it was threatened with closure, and the government of the day offered a $124 million bailout, as well as a long-term energy subsidy through a wood-burning biomass plant. The combination of the Point Tupper mill and its biomass plant keeps the demand for wood high in Cape Breton.

Tourism in general, and increasingly eco-tourism, is a valuable part of the economy in the bioregion. The cultural diversity and spirit of the region, in combination with the diversity of the natural environment, coastal scenery, hiking trails, and an extensive network of parks and protected areas, contribute valuable assets to the tourism industry of Cape Breton and pose great potential for conservation and attitudes towards environmental protection. In northern Cape Breton in particular, the local economy is closely tied to the biological diversity and wild beauty of the landscape (Parks Canada 2010a). Island attractions include the Bras d'Or Lakes, salmon and trout fishing on the Margaree River, and the world-renowned Cabot Trail and Cape Breton Highlands National Park. Golfing, recreational angling and hunting remain popular, as well as other recreational activities, including canoeing, hiking, bird-watching, whale-watching, and camping. For these and other attractions, Travel+Leisure Magazine named Cape Breton Island the 3rd best island destination in the world, after Bali and the Galapagos. There is a strong emphasis on conserving the region's cultural and natural heritage as a basis for enjoyable living and as a magnet for tourism (BLBRA 2010).

Approximately 14% (132,000 people) of Nova Scotia's population of 923,600, lives on Cape Breton Island, with approximately 75% living in industrialized Cape Breton County (Statistics Canada 2016). Sydney is the industrial, commercial, and administrative centre for the island, and is surrounded by a number of declining coal-mining towns, the largest of which is Glace Bay. The majority of Cape Breton remains relatively rural, with small communities found along the coasts and on the Bras d'Or Lakes (BLBRA 2010). Although the total population of Nova Scotia has remained relatively stable over the last ten years, there has been a general outmigration from rural areas of the province to central Nova Scotia, and Cape Breton is one of the regions of Nova Scotia which has seen some of the highest rates of depopulation and outmigration in recent years. As a consequence of these and other economic challenges, there has been a serious decline in the number of young, working age people in Cape Breton, and a parallel decline in the Island's political power. Mean average incomes are below provincial averages and the rate of child poverty is one of the highest in the country (Frank 2014). Concurrent with the closure of the steel and coal industries on Cape Breton Island, a number of government-driven regional economic development programs were put in place through federal agencies, such as the Atlantic Canada Opportunities Agency (ACOA), Enterprise Cape Breton Corporation (ECBC) and the province's Regional Development Agencies (RDAs). These programs promote and assist the development of high technology and export-oriented growth, in part through value-added enterprises in the resource industry sectors, as well as through local small businesses (BLBRA 2010). Relatively recently, there has been a surge of urbanization in the southeast corner of the bioregion, where a substantial oil-refining and pulp and paper industry has emerged at Port Hawkesbury.

2. HABITATS, THREATS AND SPATIAL PRIORITIZATIONS

A. Conservation Priority Habitat Types

Central to the Habitat Conservation Strategy is the identification of priority habitat types that host the conservation priority species identified within the bioregion. Priority habitats are the native biological entities (i.e., ecological systems or communities[1]) that the HCS is aiming to conserve. Identifying conservation priority habitat types for the Cape Breton bioregion began with summarizing priorities identified in the Northern Appalachian-Acadian Ecoregional Plan (NAAP) for this area. Using best available ecological, biological, and geophysical data obtained from partners and expert local and regional knowledge, the NAAP is a comprehensive analysis of the ecology and conservation status of the Northern Appalachian-Acadian Ecoregion (Anderson *et al.* 2006). Based on evaluation of the size, condition, and landscape context of representative ecosystem occurrences, the NAAP identified a high concentration of, what they termed, ecoregionally critical occurrences of ecosystems within the Cape Breton bioregion. Ecosystem occurrences that were identified as critical in the bioregion include 1,277 ha of beach and dune and cliff habitat, 1,106 ha of tidal marsh habitat, 16,977 ha of tidal flats, 78,551 ha of freshwater wetlands, 306 ha of riparian and floodplain forest, and nine Tier 1 matrix forest blocks.

Guided by the priorities identified in the NAAP, the process used to identify priority habitat types in the Cape Breton bioregion involved further literature review, consultation with experts, and iterative review with partners to identify habitat associations of priority species of conservation concern. The planning team strived to select priority habitat types at a coarse scale to encompass the most significant elements of conservation concern, including priority species (see Conservation Priority Species – Appendix C), and are representative of the biodiversity of the bioregion.

The final suite of priority habitat types for the Cape Breton bioregion includes nine ecological systems:

1) Barachois ponds
2) Beaches, dunes, rocky shores, and cliffs
3) Coastal islands
4) Estuaries (tidal marsh/estuarine flats)
5) Aquatic and riparian systems
6) Freshwater wetlands
7) Acadian and boreal forest
8) Barrens
9) Grasslands/agro-ecosystems

Descriptions and status assessments of each of the priority habitat types are presented in this section. For each of the priority habitat types efforts were made to assess their ecological integrity using 'key ecological attributes' (KEA) and indicators within the framework of the Open Standards for the Practice of Conservation (CMP 2013) using background information and data collected from the Cape Breton

[1] ***Ecological systems****: Assemblages of ecological communities that occur together on the landscape and share common ecological processes (e.g., flooding), environmental features (e.g., soils and geology) or environmental gradients (e.g., temperature).*

Communities*: Groupings of co-occurring species, including natural vegetation associations and alliances.*
-Major groupings of targeted species that share common natural processes or have similar conservation requirements (e.g., forest-interior birds, freshwater mussels);
-Globally significant examples of species aggregations (e.g., migratory shorebird stopover area).

bioregion, a review of literature, and expert opinion (Appendix F). For the purpose of this Habitat Conservation Strategy, the *Canada National Parks Act* (2000) definition of ecological integrity was adopted, which states that ecological integrity is "…a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes". Ecosystems with the greatest ecological integrity can better withstand or recover from natural and anthropogenic disturbances, and have the highest likelihood of retaining their integrity over time. These habitats may also serve as refuges for rare or at risk species which are absent or less abundant in 'lower quality' examples of the same ecosystem type. The KEAs are important for both assessing the current state of the priority habitat types, and monitoring changes in their ecological integrity over time. Identifying appropriate KEAs and determining the range of acceptable variation for their indicators of ecological integrity was designed to be adaptable as information changes and improves over time.

The ecological integrity of each of the priority habitat types was assessed, where possible, on *landscape context*, *condition*, and *size.* Landscape context includes consideration of two factors: the ecological processes that maintain the priority habitat types and their landscape connectivity. Condition involves an assessment of the composition, structure, and biotic interactions that characterize the priority habitat, and size is a measure of the area or abundance of the priority habitat type. Priority habitat types were ranked for landscape context, condition, size, and overall as 'Poor', 'Fair', 'Good' or 'Very Good', as described in Table 5 (adapted from The Nature Conservancy; Low 2003). A summary of the number of priority species associated with each priority habitat type is provided in Table 6, whereas the full list of significant species nested within priority habitat types is provided in Appendix C. The locations of priority habitat types are mapped in Figure 6 to Figure 15.

Table 5. Description of the assessment ranks of ecological integrity of the conservation priority habitat types for the Cape Breton bioregion.

Rank	Description
Very Good	**Ecological Integrity Optimal**: The structure, species composition, and key ecological processes and functions of the conservation priority habitat are intact and unimpaired by anthropogenic stresses. Ecosystems are functioning at a level comparable with the natural or historic range of variation for that ecosystem, and its capacity for self-renewal is maintained. The conservation priority habitat requires little or no management.
Good	**Ecological Integrity is Good**: The structure, species composition, and key ecological processes and functions of the conservation priority habitat are somewhat impaired by anthropogenic stresses. Ecosystems are functioning within a range of acceptable variation compared with the natural or historic range of variation for that ecosystem, and may require some management.
Fair	**Ecological Integrity is Degraded**: The structure, species composition, and key ecological processes and functions of the conservation priority habitat are impaired by anthropogenic stresses. Ecosystems are functioning below the range of acceptable variation compared with the natural or historic range of variation for that ecosystem, and require management, without which the conservation priority habitat will be vulnerable to serious degradation.

Poor	**Imminent Loss of Ecological Integrity**: The structure, species composition, and key ecological processes and functions of the conservation priority habitat are seriously degraded by anthropogenic stresses. Ecosystems are functioning well below the range of acceptable variation compared with the natural or historic range of variation for that ecosystem, and require significant management and/or restoration. Allowing the conservation priority habitat to remain in this condition for an extended period will make successful restoration highly improbable.
Unknown	**Research Need**: The conservation priority habitat is known to occur, but information on this assessment criterion is currently unknown.
N/A	**Not Applicable**: This criterion is not significant for assessing the ecological integrity of the conservation priority habitat.

Table 6. Priority species associated with each conservation priority habitat type in the Cape Breton bioregion (see Appendix C for the complete list of priority species with coarse-filter habitat associations).

Habitat Type	BCR 14/ MBU 11/12 Priority Bird Species	Rare Bird Species	Rare Terrestrial Invertebrate Species	Rare Reptile Species	Rare Mammal Species	Rare Plant Species	Total Rare Species	Total Species at Risk	Total Priority species
Barachois ponds	8	2	1	0	0	10	13	0	19
Beaches, dunes, rocky shores and cliffs	22	17	2	0	0	12	31	5	39
Coastal islands *	-	-	-	-	-	-	-	-	-
Estuaries	30	18	2	0	0	18	41	9	58
Aquatic and riparian systems	23	23	16	2	0	98	139	19	151
Freshwater wetlands	32	21	16	1	1	66	105	12	122
Acadian and boreal forest	34	28	12	0	11	70	121	21	137
Barrens	1	1	6	0	0	48	55	3	71
Grasslands/agro-ecosystems	4	6	7	1	0	23	37	5	38

*Coastal Islands can be made up of combinations of other priority habitat types and may or may not support species as a result.

i. Barachois Ponds

'Barachois' is a term used in Atlantic Canada that refers to coastal fresh or brackish ponds and lagoons that are either fully or partially separated from the open sea by a barrier beach (Nixon 2014). Barachois ponds are located throughout the bioregion's coastal zone however the large majority are located along the shores of the Bras d'Or Lakes. Approximately 12% of the Bras d'Or Lakes shoreline is formed by barachois (Taylor & Shaw 2002; Figure 6. They are recognized as nutrient-rich, productive ecosystems that serve important ecological functions, such as breeding habitat for waterfowl, shellfish, and fish species. While salinity, oxygen and nutrients affect the diversity of plants and animals that inhabit barachois ponds, they provide habitat for a number of species which are an important food source for many animals from Muskrats to Brook Trout. At the time of this report, a comprehensive species list does not exist for barachois ponds of the Bras d'Or Lakes (Parker *et al.* 2007), though their importance as habitat is widely accepted. They are vulnerable to breakdown or collapse from waves, long shore currents, sea ice and rising sea levels and/or submerging coastlines. Barachois ponds were spatially delineated by using a barachois points layer obtained from NS DNR to select open water features within the provincial open water dataset.

Although no comprehensive species list for Cape Breton barachois ponds exists, conservation of barachois ponds could contribute to the conservation of at least 19 priority species.

Landscape context assessment: Good
The landscape context for barachois ponds was assessed within a GIS by determining the percent natural cover[1] (intactness) within 100m of mapped barachois ponds. According to the 2015 provincial forest inventory 72.8% of the 100m buffer around barachois ponds was considered to be intact, falling within the threshold for a rating of "Good".

Condition assessment: Unknown
Little is known on the condition of barachois in the bioregion. If the level of protection can be considered a surrogate for condition, only 1% of the total area of barachois in the bioregion is protected. More information is required to better understand the condition of barachois in the bioregion. Determining the percent of ponds that are open or closed to salt water from a disturbed barrier beach has been suggested as a way to help determine the condition of these ponds.

Size assessment: Good
There are a total of 2,324 hectares of barachois ponds within the bioregion. There is no historical area measurement from which to compare the current area. It is therefore unknown if area is being lost or gained. With the increased frequency and intensity of storms and sea level rise expected from climate change, barrier beaches that now protect barachois may be displaced or lost which could cause a significant decrease in the number and area of barachois in the bioregion. Do to the lack of historical data a cautionary rating of "Good" was assigned.

[1] *Natural cover includes all forest stands over 6m, and other natural cover such as wetlands, beaches and dunes, barrens, salt march etc.*

Threats:

- 1.1 Housing and urban area development (Low)
- 2.1/2.3 Crop and Livestock Agriculture (Low)
- 2.4 Aquaculture (Low)
- 4.1 Road fragmentation (Low)
- 8.1 Invasive non-native species (Low)
- 9.1 Domestic and urban wastewater (Low)
- 11.1/11.4 Climate change and habitat shifting/Storms and flooding (High)

Overall assessment of barachois ponds in the bioregion: GOOD

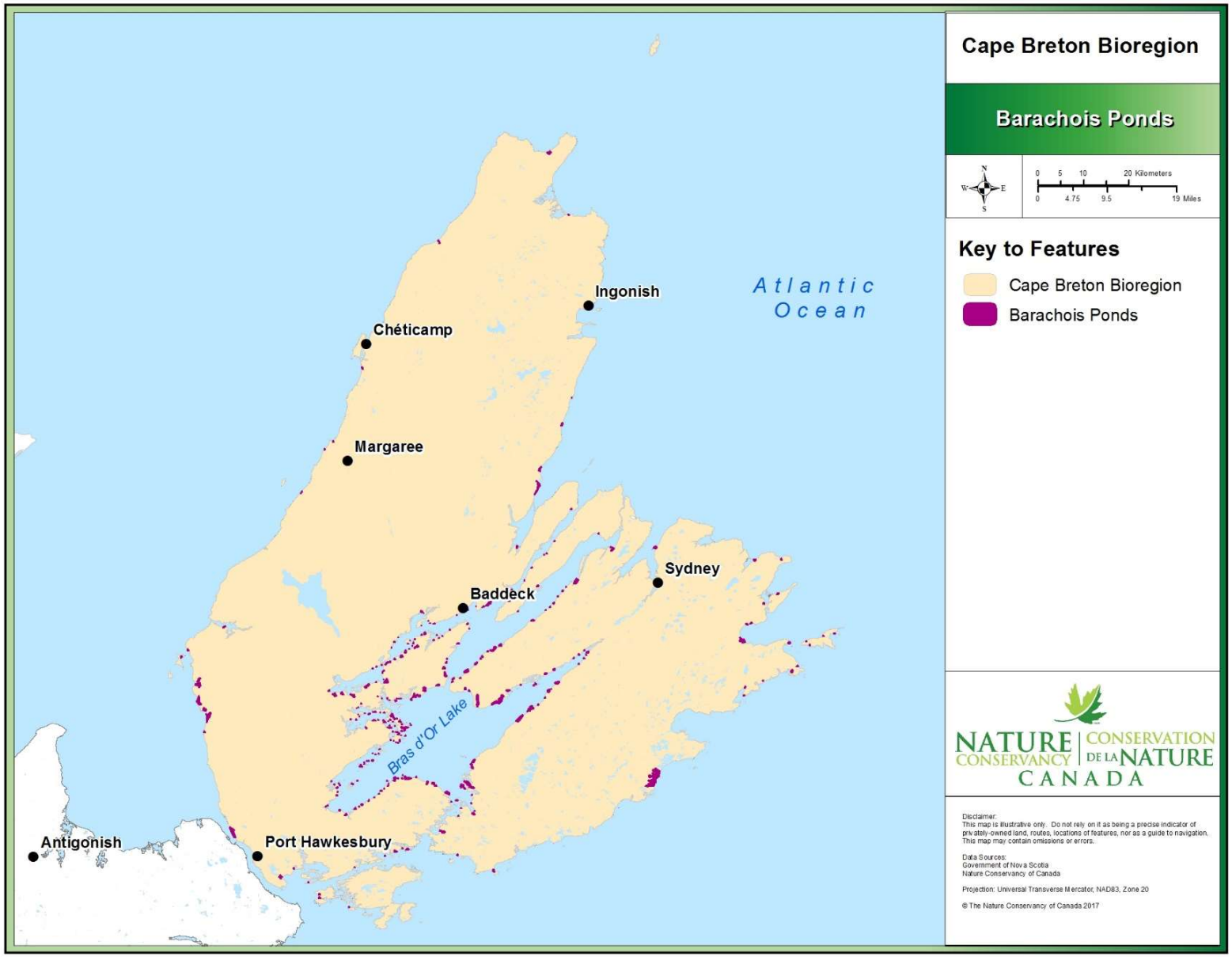

Figure 6. Barachois ponds within the Cape Breton bioregion (features size exaggerated for display purposes).

ii. Beaches, dunes, rocky shores, and cliffs

Beaches are accumulations of unconsolidated marine deposited, well-sorted sand, cobble, or stone deposited on a shore, or in active transit along it, whereas dunes are transient mounds of loose, windblown sand, sometimes stabilized by vegetation (Anderson *et al.* 2006). A barrier beach is a narrow strip of beach and dunes separated from the mainland by marsh, bay, river, or any other body of water. They provide important physical barriers and shoreline stability, protecting delicate ecosystems such as barachois ponds, though they are similarly vulnerable to climate change and sea level rise. Beaches and dunes are ecologically significant ecosystems as they host a number of rare and at risk species. They provide critical nesting habitat for a number of bird species, including Piping Plovers and terns, which lay eggs in shallow scrapes on exposed sand and cobble and rely on isolation to reduce the likelihood of predation by mammals and other birds. They are also particularly important for a number of congregatory shorebirds, including the Semipalmated Sandpiper, Black-bellied Plover, Killdeer, Sanderling, and Dunlin. As a group, shorebirds have been exhibiting major declines across North America (NABCI 2012). Many of these species are in decline, partly due to loss or degradation of breeding habitat and anthropogenic disturbances.

Rocky shores are defined as “rockbound coast... subject to salt spray and wave pounding” and cliffs are defined as “precipitous rock faces which slough off rock fragments and shed water, while accumulating soil and nutrients at their bases” (Anderson *et al.* 2006). Both cliffs and cobble beaches are ecologically significant ecosystems as they support a number of rare and at risk species (Parker *et al.* 2007). Certain vascular plants, lichens, and mosses thrive in cliff environments, and cliffs support several species of swallow, many of which are becoming increasingly rare. Within the bioregion, coastal cliffs also provide habitat for nesting colonies of gulls, cormorants, kittiwakes, black guillemots, and other seabirds. The extensive rocky shorelines and cobble beaches in the bioregion also support a high diversity of waterfowl and shorebirds. Weathering and erosion of cliffs also provide sediment for coastal beaches.

These four habitats are ecologically linked within coastal areas, but they are distinct in that they are affected differently by inundation rates and associated vegetation (Anderson *et al.* 2006). Anthropogenic activities can further compromise the integrity of beaches, dunes, and rocky shores and reduce their ability to withstand the impacts of erosion. Beaches and dunes were spatially delineated using the provincial wetlands layer (Type = B or D). Rocky shores and cliffs were spatially represented in a GIS using the Atlantic Shoreline Character mapping developed by Environment Canada. At the time of this report, the shoreline character of the Bras d’Or was not completed.

Beaches, dunes, rocky shores, and cliffs provide habitat for 39 priority species in the bioregion.

Nested Conservation Priority Species:

- Piping Plover (EN)
- Red Knot (EN)
- ‘Ipswich’ Savannah Sparrow (SC)
- Willet
- Nelson’s Sparrow
- Black-legged Kittiwake

Landscape context assessment: Good
The average Landscape Context Index[1] (LCI) for beaches, dunes, and cliffs in the bioregion is 15.9, 12.2, and 3.8 respectively which is considered to be an indication that, on average, these habitat conservation priorities are surrounded primarily by natural cover and have good landscape context that will contribute toward their long term viability (calculated using NAAP data[2]). Approximately 70% of the 100m area around mapped occurrences of beach, dune, rocky shore and cliffs in the bioregion remains intact according to an assessment completed using the 2015 NS provincial forest resource inventory.

Condition assessment: Good
Beaches, dunes and cliffs are well represented within the protected areas network of the bioregion having 22%, 41%, and 32% respectively under protection. While not all protected areas are created equal with some having a higher level of protection than others, development and resource extraction are prohibited under most regulations.

Size assessment: Good
As a baseline measurement, the total extent of beaches, dunes and cliffs as represented in available GIS data are 1036 ha, 439 ha, and 1175 ha respectively, with an average size of 4.0 ha, 3.2 ha, and 10.5 ha. The average beach size is below the NAAP critical beach size of 8 ha, however throughout the Northern Appalachian-Acadian Ecoregion, contiguous examples of beach and dune complexes are generally small, with 82% of occurrences less than the 8 ha minimum size criteria. The beaches in the bioregion represent 25% of the total beach area in the province; dunes represent just 18%, and cliffs represent 68% of Nova Scotia's cliff habitat. The bioregion contains just 3 % of Nova Scotia's NAAP defined critical beach habitat, 22% of dune habitat, and a significant 84% of critical cliff habitat. For comparison, the Cape Breton coast represents just 26% of Nova Scotia's total shoreline.

Threats:
- 1.1 Housing and urban area development (Medium)
- 1.3 Tourism and recreational areas (Medium)
- 2.4 Aquaculture (Low)
- 4.1 Road fragmentation (Medium)
- 6.1 Recreational activities (Medium)
- 7.3 Ecosystem modification, shoreline armoring (Medium)
- 9.1 Domestic and urban waste water (Low)
- 11.1/11.4 Climate change and habitat shifting/Storms and flooding (Medium)

Overall assessment of beaches and dunes in the bioregion: GOOD

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[1] Landscape Context Index (LCI) is a measure that refers to the relative amount of development, agriculture, quarries, roads, and other fragmenting features directly surrounding ecosystem occurrences. It provides an estimate of isolation of occurrence as well as potential future encroachment on the occurrence. An LCI below 20 (30 for coastal ecosystems) indicates that the habitat conservation priority is surrounded primarily by natural cover with higher LCIs indicating increasing amounts of development directly surrounding ecosystem occurrences. An LCI above 50 is considered to be high, with individual occurrences usually rejected as critical (Anderson et al. 2006).
[2] Rocky shores were not assessed within the NAAP for Nova Scotia.

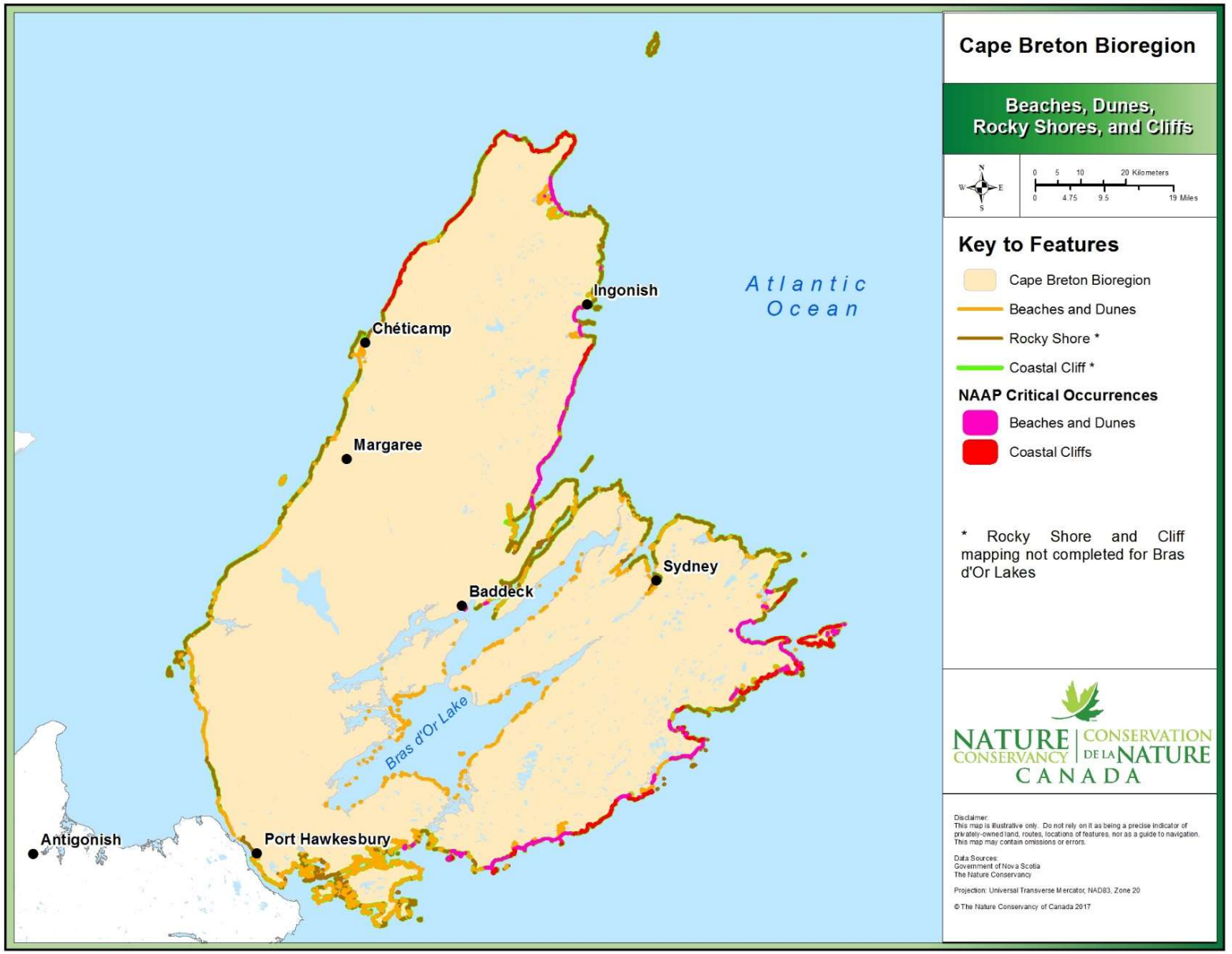

Figure 7. Beaches, dunes, rocky shores, and cliffs within the Cape Breton bioregion (features size exaggerated for display purposes).

iii. Coastal Islands

Coastal islands are abundant in the bioregion, primarily along the south and east-facing shorelines with the Atlantic Ocean, and on the Bras d'Or Lakes. Islands may be composed of bedrock, glacial till, or sand, though bedrock islands are most common in areas of resistant rock, such as the granite and quartzite of the Atlantic Coast (Davis & Browne 1996). The islands of the Bras d'Or are primarily remnants of early drumlin glacial deposits (Taylor & Shaw 2002). Islands provide an important habitat component for many priority species; due to their isolation, islands are often free of predators and other sources of disturbance, providing excellent habitat for colonial breeding seabirds, some of which next exclusively on islands (NS EHJV 2008; Parker et al. 2007). A number of coastal islands in the bioregion have been designated as globally significant Important Bird Areas (ibacanada.ca).

It is difficult to determine the number of priority species that would benefit from the conservation of coastal islands. Islands may contain a number of other habitats described for the bioregion and it is possible that many habitat specialists and generalists would make their way to offshore islands. Islands were represented by including any mapped islands in Nova Scotia's provincial forest resource inventory (FORNON = 97, Offshore Islands).

Nested conservation priority species:

- Bicknell's Thrush (EN NS)
- Leach's Storm Petrel
- Common Tern
- Arctic Tern
- Atlantic Puffin
- Razorbill
- Black-legged Kittiwakes

Landscape context assessment: Unknown

Condition assessment: Very Good

Of the 541 islands located within the bioregion, 508 or 94% appear to be free from disturbance from development, agriculture or roads. They are also well represented within the protected areas network with 37% falling under some form of protection. The average LCI for NAAP identified islands is 1.3 which means that islands in the bioregion are considered to have a very low level of disturbance.

Size assessment: Not Applicable

Islands in the bioregion are considered important regardless of size given their use by a broad suite of priority species. There are 541 coastal islands located within the bioregion, with an average size of 8.6 ha and a total area of 4,659 ha. The largest islands are St Paul's Island off the northern tip of the bioregion and Scatarie Island to the east.

Threats:

- 1.1 Housing and urban area development (Low)
- 2.3 Livestock farming and ranching
- 7.3 Ecosystem modification, shoreline armoring (Low)
- 11.1 Climate change and habitat shifting (Medium)

Overall assessment of coastal islands in the bioregion: VERY GOOD

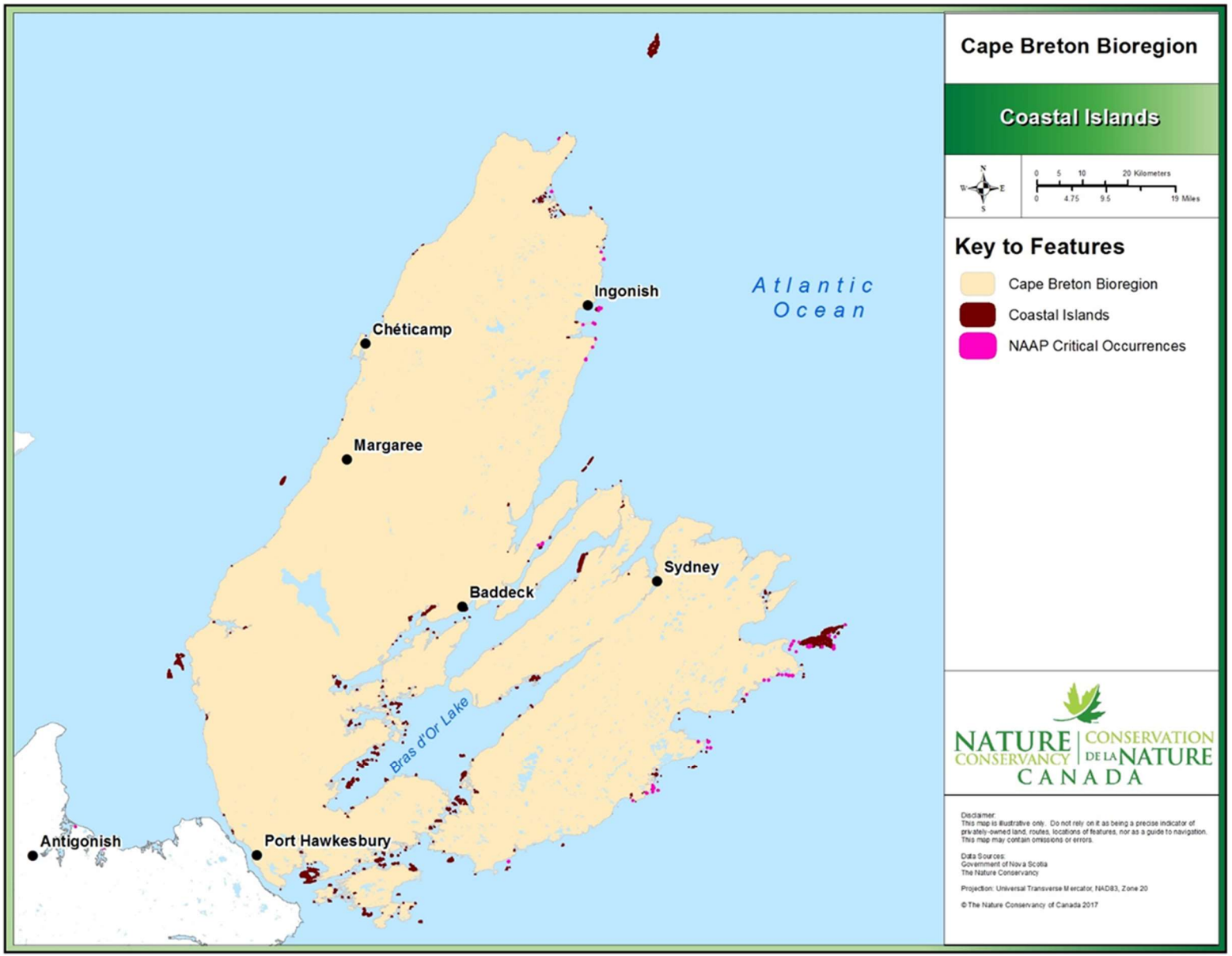

Figure 8. Coastal Islands within the Cape Breton bioregion.

iv. Estuaries (Salt Marsh and Estuarine Flats)

Estuaries, in this context, include wetlands classified as salt marsh and estuarine flats by the Nova Scotia Department of Natural Resources. Tidal salt marshes are poorly-drained, grass-dominated habitats that are subject to regular inundation by salt water (Anderson *et al.* 2006). Generally dominated by *Spartina* grasses, they are strongly influenced by the duration of tidal flooding and the extent of freshwater influx (GMCME 2010; Bowron *et al.* 2012, Porter et al. 2015). Tidal marshes occur along fully exposed coastal areas, at the mouth and along tidal rivers, along the protected side of islands, and behind protective barriers, such as barrier beaches. Salt marshes are among the most productive coastal ecosystems and, along with tidal flats, provide critical breeding and feeding habitat for migratory and breeding waterfowl, shorebirds and seabirds, including rare and at risk species (e.g., Bobolink, Nelson's Sharp-tailed Sparrow, Short-eared Owl, and Willet), and serve as important nursery areas for fish, snails and shellfish. Estuarine wetland habitats also support a number of ecological functions, including flood protection, erosion control, support for coastal and marine food webs, and removal of contaminants, nutrients and suspended sediments from the water column (Gustavson 2010). The magnitude of conversion of salt marsh within Nova Scotia makes them a limited habitat type provincially (Parker *et al.* 2007).

Shallow marine environments with similar substrates can support extensive beds of eelgrass, a highly productive perennial aquatic plant that is a 'keystone species' found on coarse sand to mud bottoms in low intertidal and sub-tidal environments (DFO 2009). Eelgrass has been identified as an ecologically significant species because it creates habitat used preferentially by other species, provides protection for associated communities, and has substantial influence over the ecology of the habitat (DFO 2009).

Tidal flats consist of extensive, horizontal tracts of unconsolidated clays, silts, sands and organic materials that are alternately covered and uncovered by the tide. Tidal flats in the bioregion support large numbers of shorebirds which congregate to feed on abundant burrowing invertebrates, including clams, worms, and amphipods (Anderson *et al.* 2006).

Estuaries provide habitat for at least 58 priority species in the bioregion, including several rare species of rush and the federally listed Harlequin Duck.

Nested Conservation Priority Species:

- Harlequin Duck (EN NS)
- Bobolink (TH)
- 'Ipswich' Savannah Sparrow (SC)
- Willet
- Nelson's Sparrow

Landscape context assessment: Good

The average LCI for salt marsh and tidal flats in the bioregion are 34.9 and 21.7. This represents a Fair rating for salt marsh meaning that the area surrounding Cape Breton salt marsh have a moderate level of disturbance but are less disturbed as seen by the NAAP ecoregional average score of 43. According the 2015 provincial forest resource inventory, approximately 68% of the 100m buffer around salt marsh and estuarine flats remains in an intact state. Tidal flats are rated as good due to the lower LCI score. Tidal flats are therefore less impacted than salt marsh in the bioregion.

Condition assessment: Fair
Traditional ecological knowledge (TEK) states that eelgrass beds within the Bras d'Or lakes estuaries have experienced a significant decline (upwards of 80% loss) from historical distributions (CEPI, 2006). TEK has also indicated that there has been a noticeable recovery in eelgrass beds in recent years. Only 6% of the bioregion's salt marsh is currently protected. Tidal flats and estuaries have virtually no legislated protection in the bioregion.

Size assessment: Good
Only 7% of Nova Scotia's salt marsh and 3% of estuary area occur in the bioregion making them a relatively unique feature worthy of conservation efforts. Tidal flats within the bioregion account for 42% of Nova Scotia's total tidal flats which is significantly more than the proportion of bioregion total area to the area of Nova Scotia at 19%. 6.5 % of the Nova Scotia's NAAP identified critical salt marsh occur in the bioregion while 22% of the critical tidal flats occur there.

Threats:

- 1.1 Housing and urban area development (low)
- 2.1/2.3 Crop and Livestock Agriculture (low)
- 2.4 Aquaculture (Low)
- 4.1 Road fragmentation (low)
- 7.3 Ecosystem modification, shoreline armoring (Medium)
- 8.1 Invasive non-native species (low)
- 9.1 Domestic and urban wastewater (low)
- 11.1/11.4 Climate change and habitat shifting/Storms and flooding (High)

Overall assessment of beaches and dunes in the bioregion: GOOD

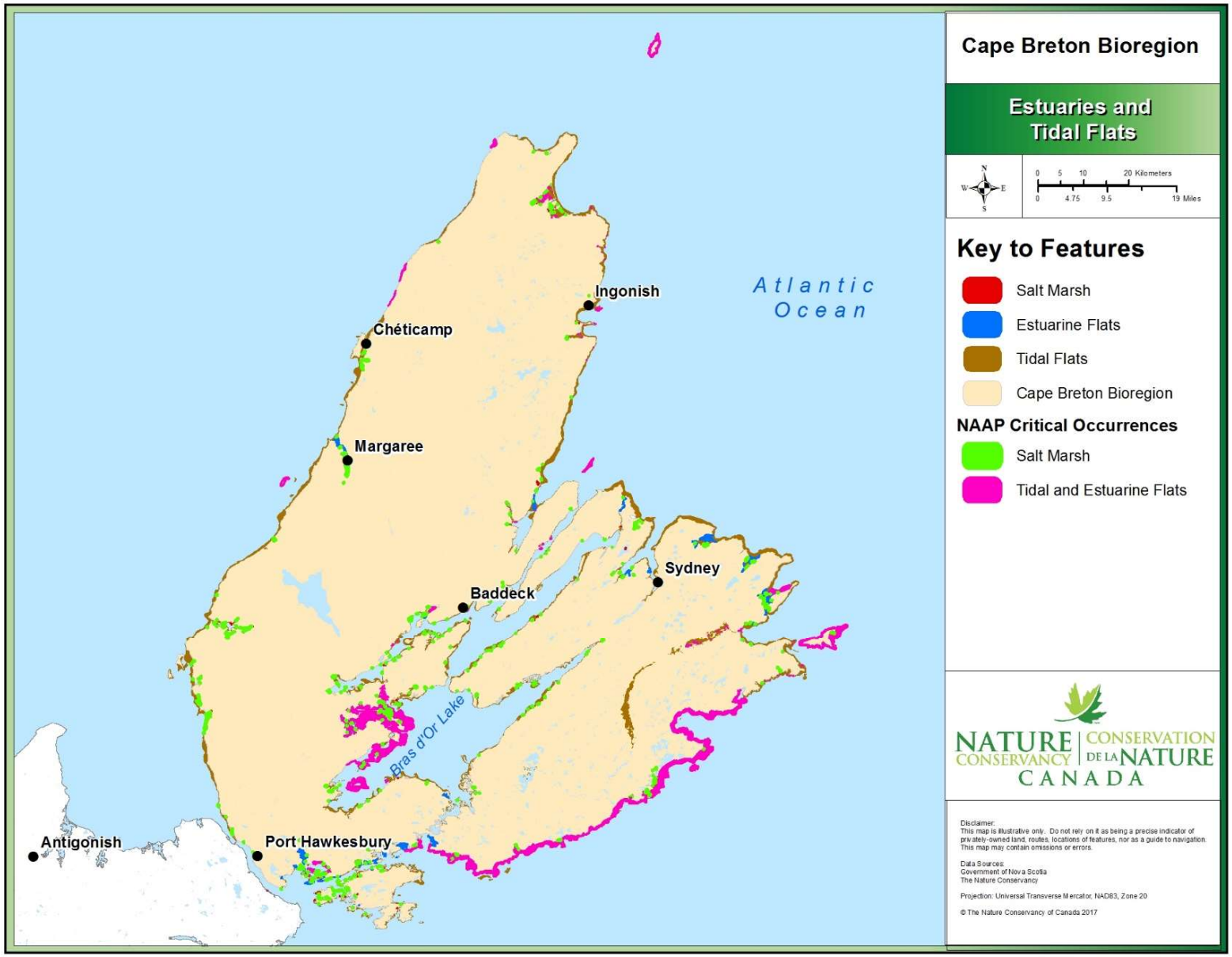

Figure 9. Estuaries and tidal flats within the Cape Breton bioregion.

v. Aquatic and Riparian Systems

Aquatic and riparian systems are characterized as aquatic ecosystems, their adjacent uplands (lakeshores, riversides, and floodplains), and the gradient between the two (Gregory *et al.* 1991). A variety of habitats occur within aquatic and riparian systems, where upland and floodplain forests, herbaceous and woody wetlands, sandbars, and oligotrophic – eutrophic freshwater systems interact to form a complex ecosystem rich in biodiversity. Aquatic and riparian systems are recognized as some of the most biodiverse, complex, and dynamic non-marine ecosystems on the planet due to the large variety of habitats that may occur within them, as well as the diversity of biological, geological, and hydrological processes (Naiman, Decamps & Pollock 1993). They provide spawning grounds for fish and critical areas of rest and foraging for migrating waterfowl and birds (TNC 2016). Floodplains are associated with river valley corridors and provide a terrestrial habitat interface with the hydrological system. Intact floodplains provide a number of important ecological processes including flood protection and improved water quality. Their relatively limited distribution makes its composition sensitive to local disturbances (NS DNR 2015).

A number of rivers in the bioregion are recognized for their clean, cool waters, including the Margaree River and Lake Ainslie system, which was designated as a Canadian Heritage River in 1998. With its cool temperatures and high pH, the Margaree River supports the largest, most consistent Atlantic Salmon population on Nova Scotia. The icy clear waters of the upper reaches of the river system provide excellent spawning areas for Atlantic salmon, Gaspereau (*Alosa pseudoharengus*), and trout. Draining in to the Bras d'Or Lakes, the Middle River, Baddeck River, and River Denys also support significant Atlantic Salmon numbers with excellent water quality and no significant impediments to fish migration (Robichaud-Leblanc and Amiro 2004). Thermal classification studies of streams across Nova Scotia, revealed that almost all sites on these rivers were classified as cool or intermediate streams (89% of 33 sites compared with a Provincial average of 61%; MacMillan *et al.* 2005).

Aquatic and riparian systems provide habitat for 151 significant species in the bioregion, the most of any of the nine priority habitats. They were spatially delineated using the provincial hydrography layer and also selecting all SM (smooth terrain) ecosections from the NS Ecological Land Classification layer (Neily *et al.* 2015) within 100m of a river or stream. Fluvial soil types classified in the Agriculture and Agri-food Canada national soil database were also included if in close proximity to a river or stream. An additional 100 m buffer (ELI 2003) was added to watercourses and lakes to represent the riparian zone. A 100 m buffer is the recommended threshold within 75% of the literature reviewed by the US based Environmental Law Institute on the topic of buffer importance for water quality and wildlife use (ELI 2003).

Nested conservation priority species:

- Atlantic Salmon (EN)
- American Eel (TH)
- Wood Turtle (TH)
- Snapping Turtle (SC)
- Black Ash (TH NS)
- Eastern Waterfan (TH)

Landscape context assessment: Good

According to the 2015 provincial forest resource inventory, 77% of the 100m buffer on rivers, streams and lakes is considered to be in a natural state resulting in a rank of "Very Good". However, when isolating potential floodplain area for the same analysis, only 71% remains intact. It has been suggested

that ELC mapped floodplains go beyond the extent of actual floodplain area and may be including intact upland forest, artificially inflating the intact percentage. It is therefore suspected that floodplains are less intact then the data would suggest which results in a "Fair" landscape context rating when considering floodplains on their own.

Condition assessment: Good
A province-wide watershed health assessment was completed in 2014. The watershed assessment considered multiple threats to watershed health and assigned a relative risk to each secondary watershed across the province. Metrics from watershed assessment include: Road Density, stream length intactness, dams, agriculture, forest age along stream length, stream crossings per km stream length, erodible soils, etc (Sterling et al. 2014). Of the 10,400 km^2 of combined watershed area in the bioregion, 5,512 km^2 were ranked as risk level 1 or 2 on a scale of 1 to 5, 1 meaning lowest risk. This accounts for 53% of the bioregion's watershed area resulting in a "Good" condition rating.

Size assessment: Fair
Just 0.5 % of the NAAP identified critical floodplain exists in the bioregion, the large majority of which is located on the Margaree River. Floodplains may be restricted in size due the steep topography along many rivers in the bioregion. While the Eastern Cape Breton (SFA 19) salmon population is among the most stable in the province, egg counts consistently fall below conservation requirements for species recovery. From 2011-2015, the average percent of conservation requirements for egg counts (2.4 million eggs/m^2) for a sustainable salmon population in the Middle, Baddeck, and North rivers are 56%, 52%, and 83% respectively (DFO 2015). In 2014, all index populations in Eastern Cape Breton were assessed to be below conservation requirements (DFO 2015).

Threats:

- 1.1 Housing and urban area development (Low)
- 2.1/2.3 Crop and Livestock Agriculture (Medium)
- 3.2 Mining and quarrying (Low)
- 4.1 Road fragmentation (Medium)
- 5.3 Logging and wood harvesting (Medium)
- 6.1 Recreational activities (Low)
- 7.2 Dams and water management (High)
- 8.1 Invasive non-native species (Medium)
- 9.1 Domestic and urban wastewater (Low)
- 11.1 Climate change and habitat shifting (High)

Overall assessment of aquatic and riparian systems in the bioregion: GOOD

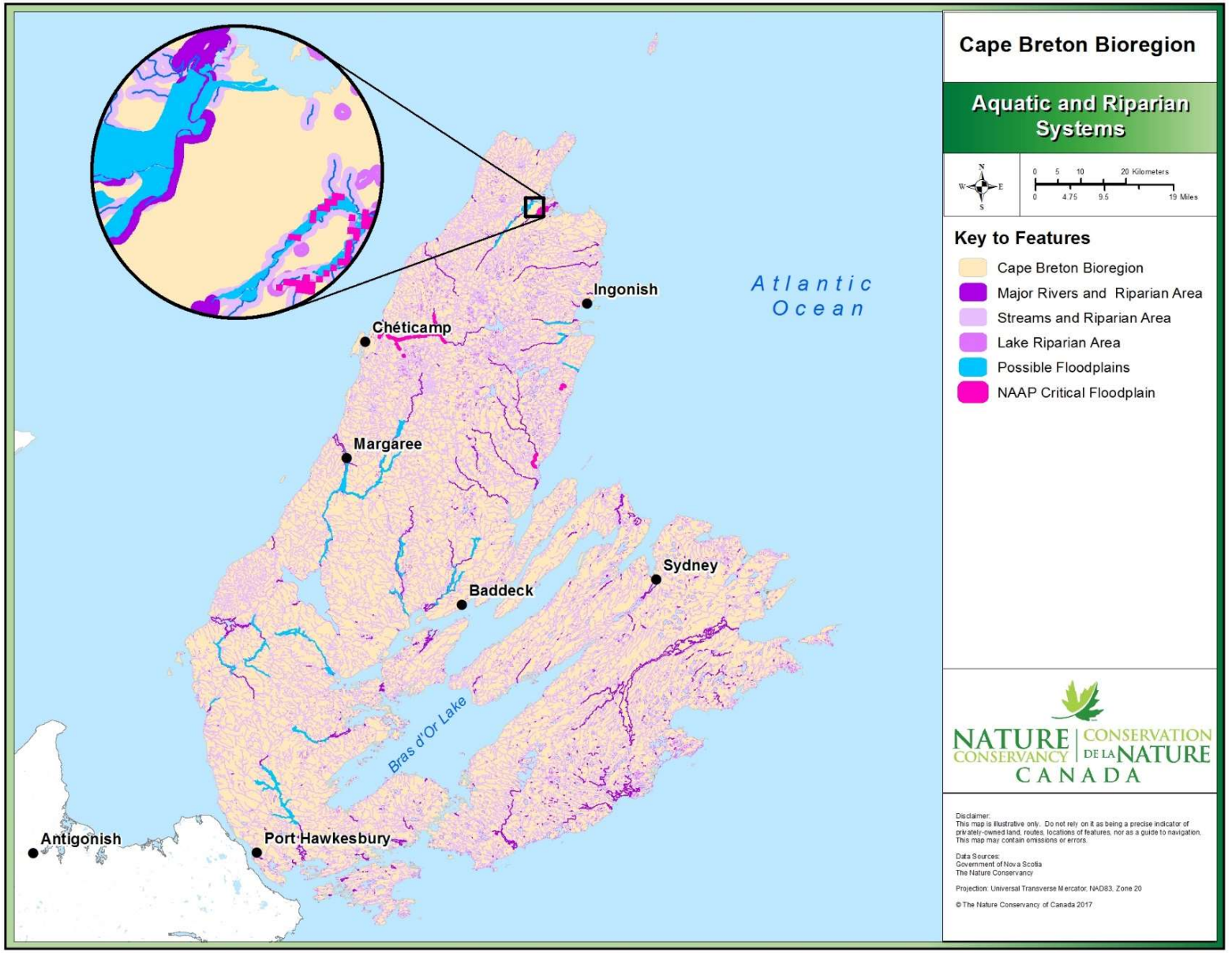

Figure 10. Aquatic and riparian systems within the Cape Breton bioregion (possible floodplains as delineated by NS ELC 2015).

vi. Freshwater Wetlands

Freshwater wetlands are dynamic ecosystems that occur in areas containing a high water table or where surface water flow becomes obstructed. The extent and type of freshwater wetlands that occur in a given watershed are functions of climate, surface configuration of the land, type of bedrock and soil (mineral or organic), degree of inundation or flooding, and nutrient status of the water supply (Davis & Brown 1996a). The majority of wetlands in Nova Scotia are peatlands—wetlands characterized by an accumulation of peat (e.g., bogs and fens). Freshwater wetlands are ecologically important as they typically support more diverse biota, may support regional species at risk, and serve as a filter for runoff entering various lentic and lotic systems (Parker et al. 2007). Peatlands dominate lowland areas of Cape Breton; mineral soil wetlands, including swamps and marshes, also occur. A significant proportion of the bioregion wetlands occur in the highland barrens and are the source water for many Cape Breton rivers and streams. Calcareous wetlands found in the bioregion are of particular ecological significance due to their rarity within the province, as well as their ability to support assemblages of uncommon calciphillic plant species.

Three types of freshwater wetlands were selected as habitat sub-targets within the bioregion and were spatially delineated from the Nova Scotia provincial wetlands inventory (2011): peatlands (bogs and fens), marshes, and swamps. Critical occurrences were identified in the NAAP: size >= 20 hectares; LCI < 20 acres (Anderson et al. 2006). A 100 metre buffer was considered around all freshwater wetlands to protect the ecological functions and integrity of these freshwater ecosystems and maintain nesting areas for various wildlife species (ELI 2003). A 100 m buffer is the recommended threshold within 75% of the literature reviewed by the US based Environmental Law Institute on the topic of buffer importance for water quality and wildlife use (ELI 2003).

Freshwater wetlands provide habitat for 122 significant species in the bioregion.

Nested conservation priority species:

- Hoary Willow (EN NS)

Landscape context assessment: Good

The average Landscape Context Index (LCI) for freshwater wetlands in the bioregion is 13.8, which is considered to be an indication that, on average, the habitat conservation priority is surrounded primarily by natural cover and has good landscape context that will contribute toward the long term viability of the ecosystem type (calculated using NAAP data). According to the 2015 NS provincial forest resource inventory, 70% of the 100m buffer on freshwater wetlands is considered intact. This measure could be aided by the required special management zone buffer protection of 100m afforded to wetlands within Canada Lynx management zones under the provincial species recovery program (NSLRT, 2006).

Condition assessment: Good

In total 85,600 ha (34%) of freshwater wetlands in the bioregion are currently under protected or conservation status, the majority of which are found within the Cape Breton Highlands National Park. Under NS forest policy, a 20m special management buffer is required on all wetlands identified in the inventory though partial harvesting without machinery is permitted. Many forested wetlands however, are not identified by current delineation methods and do not receive the same level of protection as more easily delineated wetlands would.

Size assessment: Good

There are 84,118 hectares of mapped wetlands in the bioregion which represents 8% of the bioregion total area. The average size of wetland complexes in the bioregion is 7 ha. This is well below the NAAP critical threshold of 20 ha. However, several wetland complexes greater than 1000 ha in size exist in the highlands region. Approximately 23% of Nova Scotia's mapped wetlands occur in bioregion, which is comparable to the land base of 19% of the province. NAAP critical wetland occurrences are slightly more represented in the bioregion at 26% of the provincial total NAAP wetland area. The total area and average size of each of the dominant types of wetlands found in the bioregion is presented in Table 7.

Table 7. Total area and average size of occurrences of dominant freshwater wetland types in the Cape Breton bioregion.

Wetland Type	Total Area (ha)	Average Size (ha)	Percent of Total
Peatlands (bog/fen)	40,367	12.6	48
Marsh	21,839	3.6	26
Swamp	21,912	4.9	26
All Freshwater Wetlands	**84,118**	**7.0**	**100**

Threats:

- 1.1 Housing and urban area development (Low)
- 2.1/2.3 Crop and Livestock Agriculture (Low)
- 3.2 Mining and quarrying (Low)
- 4.1 Road fragmentation (Low)
- 5.3 Logging and wood harvesting (Medium)
- 6.1 Recreational activities (Low)
- 8.1 Invasive non-native species (Low)
- 11.1 Climate change and habitat shifting (High)

Overall assessment of freshwater wetlands in the bioregion: Good

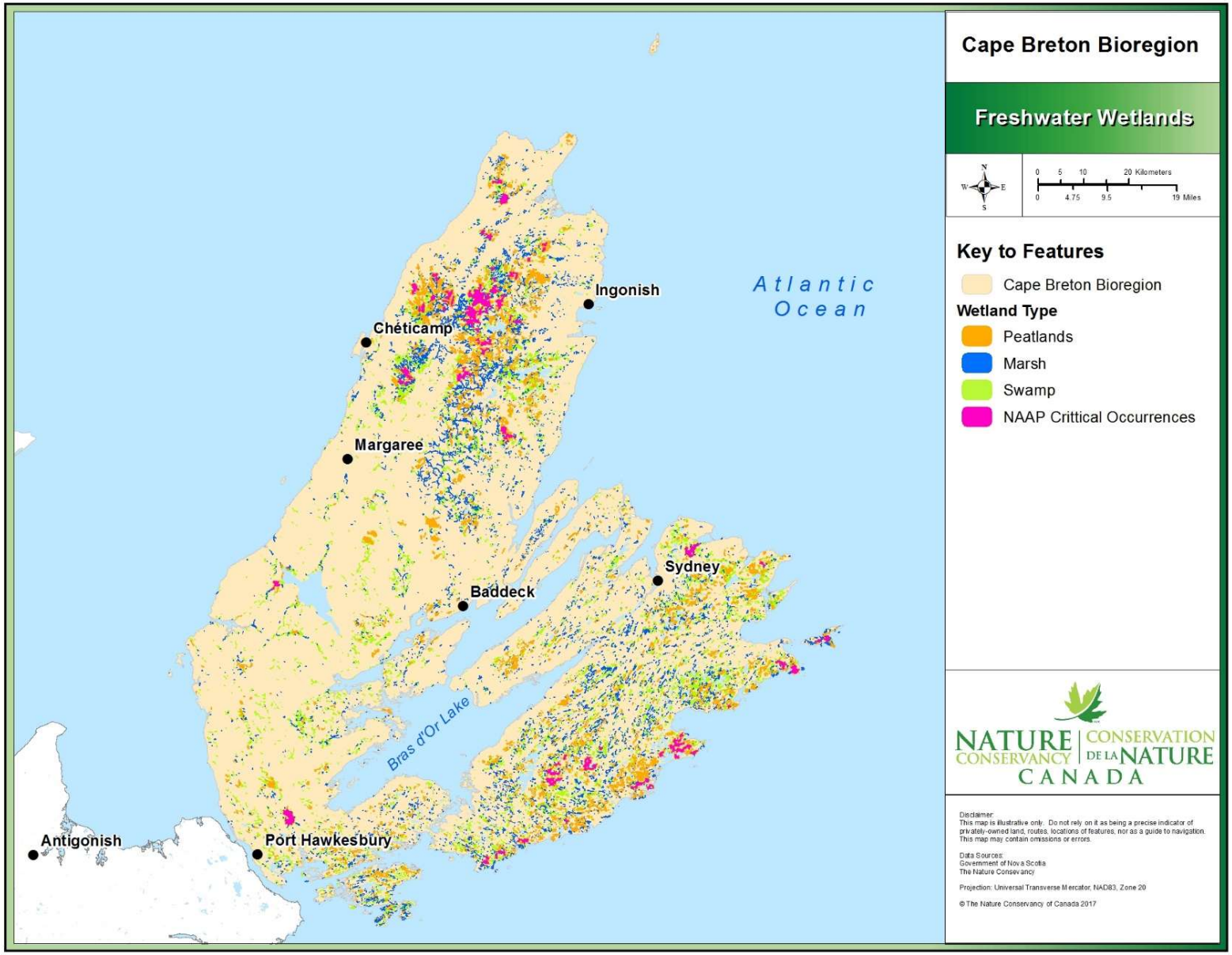

Figure 11. Freshwater wetlands within the Cape Breton bioregion (features size exaggerated for display purposes).

vii. Acadian and Boreal Forest

The bioregion is within the Acadian Forest Region, but also contains areas of boreal forest at high elevations within the Cape Breton Highlands and Northern Plateau Ecodistricts (Figure 12). The Acadian forest is a transitional zone of mixed forest between the deciduous forests of the Northeast United States and the coniferous boreal forests of the Canadian North. The climax condition of Acadian forest consists of mature stands dominated by shade-tolerant, long-lived tree species such as Red Spruce (*Picea rubens*), Eastern Hemlock (*Tsuga canadensis*), Sugar Maple (*Acer saccharum*), and American Beech (*Fagus grandifolia*). Other long-lived although less shade-tolerant species also fare well, such as Yellow Birch (*Betula alleghaniensis*), Eastern White Pine (*Pinus strobus*), Northern Red Oak (*Quercus rubra*), and White Ash (*Fraxinus americana*). The composition of individual stands varies considerably, ranging from pure hardwood valleys to various mixtures of hardwood and softwood species. Intermediate species such as Balsam Fir (*Abies balsamea*), Red Maple (*Acer rubrum*), and Black Spruce (*Picea mariana*) may also be considered edaphic climax species in some environments, such as bogs, fens, and coastal areas (Mosseler *et al.* 2003). Boreal forests in the highlands are primarily dominated by Balsam Fir, Black Spruce, and White Spruce, interspersed with barrens and wetlands. Though less diverse, with shorter-lived tree species than Acadian forest, large intact patches of boreal forest are important to maintain connectivity for wide-ranging mammals, such as Canadian Lynx and Moose. These two forest types, as well as areas of tundra-like vegetation consisting of scrub forest, extensive heath-lichen barrens and sphagnum bogs on the plateau, co-exist within a relatively small area due to a wide range in elevation and maritime climate (Parks Canada 2010a).

The bioregion contains possibly the highest density of intact, unprotected forested landscapes in Nova Scotia. There are nine Tier One matrix forest blocks within the bioregion identified in the NAAP (Anderson *et al.* 2006; Figure 13). These large forested areas greater than 10,000 ha with few roads and mostly intact interior habitat are important for the conservation of a wide range of plant and animal species, from soil invertebrates and fungi to forest interior birds, large herbivores, and wide ranging predators. The interior forests of the bioregion provide key habitat for several mammals including Moose (*Alces alces andersoni*), Canada Lynx (Parker *et al.* 1983), and American Marten.

The greatest influence on Maritime forests has been commercial tree harvesting and the silviculture practices of the forestry industry. Of particular note it the use of plantation and thinning silvicultural practices in the regenerating forest, which impact the stand-structure and tree-species composition and usually result in fewer species and simpler structure compared to areas regenerating naturally (Fraver *et al.* 2009). As is the case with forests across Nova Scotia, the forests of the bioregion have experienced a shift from late-successional shade-tolerant species to a less diverse forest of early-successional species, such as Balsam Fir and Aspen (Populus spp.; Thurston 2011; Anderson *et al.* 2006). Mature Acadian forests have undergone significant decline since European settlement with less than 1% of remaining forests older than 100 years and true old growth forests (>150 years old) existing as small isolated stands of uncertain ecological integrity (Lynds & LeDuc 1995). Yet, less than 100 years ago it was estimated that over 40% of Cape Breton forests were in a virgin undisturbed state (Fernow 1912). The declining area of older forest has been identified as probably the largest single problem facing forest bird conservation, because many birds require attributes of older forest (Stewart *et al.* 2015).

Within Cape Breton Highlands National Park, old growth forests in excess of 350 years old can be found on steep, inaccessible slopes and in deep ravines, making them some of the oldest forest stands in the province (Parks Canada 2010a). Also of significance are the intact stands of mature and old growth Acadian forest occurring on the tolerant hardwood drumlins and hummocks of the Bras d'Or lowlands. One of the larger provincially protected mature old growth forest stands in the province is found in the

Bornish Hills Nature Reserve in the River Denys watershed. There are a number of other examples of forest stands representative of old-growth, climax conditions in the bioregion, located primarily within provincial wilderness areas and nature reserves (NSE 2016).

Another significant element of biodiversity within the forests of the bioregion is the presence of rare gypsum, limestone, and marble derived ecosystems. The dissolution of gypsum, limestone and marble bedrock results in the creation of regionally and nationally rare ecosystems, including karst, calcareous forests and wetlands, and exposed gypsum outcrops. Karst topography is a rugged and irregular type of topography with distinctive hydrological and geomorphic processes, and unique landforms arising from a combination of high rock solubility and porosity (Ford & Williams 2007). The particular conditions of calcareous soils, along with their occurrence as isolated islands within a non-calcareous matrix, have resulted in the evolution of narrow endemic plant species in many calcareous regions (Blaney & Mazerolle 2013), and consequently they support nationally significant ecosystems and rare species (Basquill 2014). The ground flora and fauna associated with calcareous forests are characterized by calcium-loving plants and various species of land snail. Within the bioregion, gypsum, limestone, and marble bedrock is predominately found on private land and is under-represented in the Nova Scotia protected areas network. Nonetheless, calcareous forests on private land contain some impressive examples of old growth forest due to the hazardous terrain on which they occur and the difficulty of accessing them with forestry equipment.

Areas of karst forest may also contain caves; approximately 40 caves have been documented in Nova Scotia, the majority of which occur on mainland Nova Scotia, though the largest known cave, Arch Cave, is located in the Baddeck area of Cape Breton. Caves and abandoned mines provide habitat for a number of obligate and facultative cave insects and other invertebrates, porcupines, deer mice, and occasionally amphibians and fishes (Moseley 1998). Two species of endangered forest bats in the bioregion depend on gypsum caves and abandoned mines for over-wintering, roosting, and swarming habitat (Moseley 2007; H. Broders, pers. comm. 2014). Although there have been no major bat hibernacula sites identified in the bioregion, given the distribution of karst topography in the province, the presence of critical hibernation sites in the bioregion is suspected. Given the rapid decline of bat populations due to White Nose Syndrome, protection of cave and karst forest habitats is especially important to reduce disturbance to already stressed populations and increase the chances of survival of those bats that may be resistant to the disease.

Nested conservation priority species:

- Canada Warbler (TH)
- Olive-sided Flycatcher (TH)
- Bicknell's Thrush (EN NS)
- Boreal Felt Lichen (EN)
- Canada Lynx (EN NS)
- American Marten (EN NS)
- Northern Myotis Bat (EN)

Landscape context assessment: Good

A landscape connectivity analysis completed by The Nature Conservancy (US) in 2012 revealed that the forests of Cape Breton are more connected on average then are the forests of the Northern Appalachian-Acadian Ecoregion by nearly one standard deviation (TNC 2012). This means that there are fewer barriers to species movement through forested ecosystems. This analysis did not account for the variability in forest condition and age and as a result may over-estimate the connectivity for various

forest habitat specialist species, in particular those that prefer older forest such as the provincially endangered American Marten.

Condition assessment: Poor
Since early European settlement the majority of Nova Scotia's forests have been logged extensively several times, simplifying the forest structure, composition, and age class. Recent industrial forestry practices, including widespread clear-cut harvesting, combined with a long history of human habitation and forest use, have resulted in an increase in relatively young, even-aged, early-successional forest types, while the abundance and age of shade-tolerant, late-successional forest types has declined (Loo & Ives 2003; Mosseler et al., 2003). In 2000, it was estimated that 91% of Nova Scotia's forests consisted of even-aged stands less than 100 years old (NSDNR 2000; Stewart et al. 2003), though Lynds & LeDuc (1995) estimated that the percentage of Acadian Forest greater than 100 years old was less than 1%.

An analysis was completed for this report to determine the extent and percent cover of older forests in the bioregion. Acadian and boreal type forests were analyzed separately due to their respective potential for older forests based on the natural disturbance regime (NDR). Within Cape Breton ecosections (NSDNR ELC 2015) with a Gap or Infrequent NDR (large disturbances are temporally less frequent then the maximum age of tree species), mature forests (>80 years) were found to cover only 25% of the forested landscape of the expected 65% (NSDNR ELC 2015). Frequently disturbed ecosections, such as those of the boreal forest were composed of 21% mature (> 40 years) forest of an expected 40% (NSDNR ELC 2015). This resulted in a condition rating of "Poor" for Acadian forests and "Fair" for boreal forests.

Forests in the bioregion provide habitat for 137 priority species and 23% of late successional older forest (>80 years) and un-even aged forest stands are protected in the bioregion.

Size assessment: Fair
According to the 2015 forest resource inventory, 76% of the bioregion remains forested. Nine NAAP tier one matrix blocks are found in the bioregion representing 26% of NS tier 1 matrix total area. Though there are large tracks of remaining intact forests in the bioregion, stands of late-successional forest types are imbedded among a matrix of relatively young, even-aged, early-successional forest types. Patch sizes for these late successional forest types also fall well below the critical patch sizes identified in the literature (NB DNR Old forest – source). Only six percent of mature spruce/fir stands meet the critical patch size of 375 ha. Approximately 61% of mature tolerant hardwood patches meet the critical size of 40 ha; 44% of mature intolerant hardwood patches meet critical size of 30 ha, and 0% of mature pine stands meet the critical size of 10 ha. Overall just 17% of forests by area exist as patches greater or equal to the recommended patch size.

Current threats:
- 1.1 Housing and urban area development (Low)
- 1.3 Tourism and recreational areas (Low)
- 2.1/2.3 Crop and Livestock Agriculture (Low)
- 2.2 Wood and pulp plantations (Low)
- 3.2 Mining and quarrying (Low)
- 4.1 Road fragmentation (Medium)
- 5.3 Logging and wood harvesting (High)
- 6.1 Recreational activities (Low)
- 8.1 Invasive non-native species (Low)
- 8.2 Problematic native species (Medium)

- 11.1 Climate change and habitat shifting (High)

Overall assessment of Acadian and Boreal forest in the bioregion: Fair

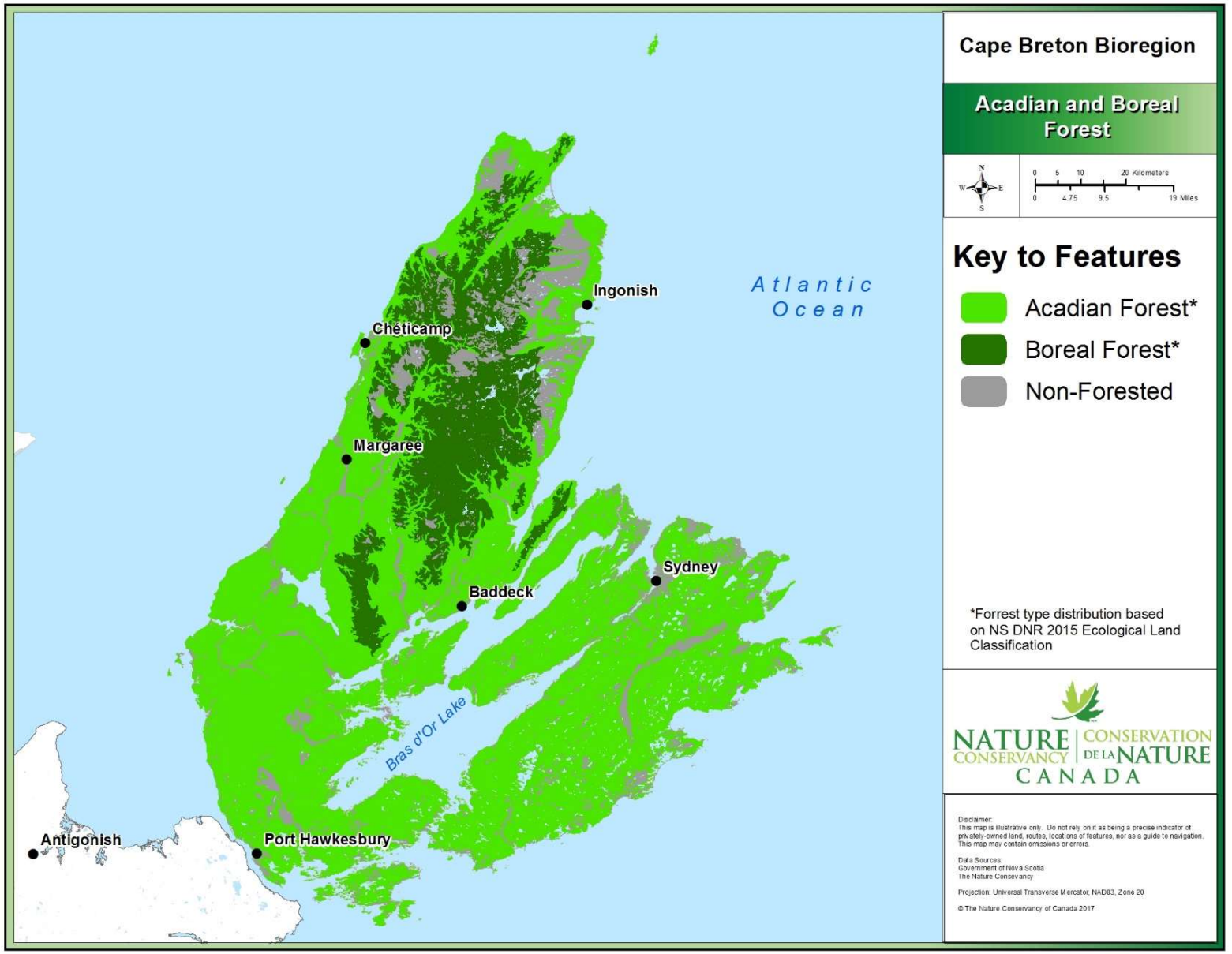

Figure 12. Acadian and Boreal forest distribution in the Cape Breton bioregion.

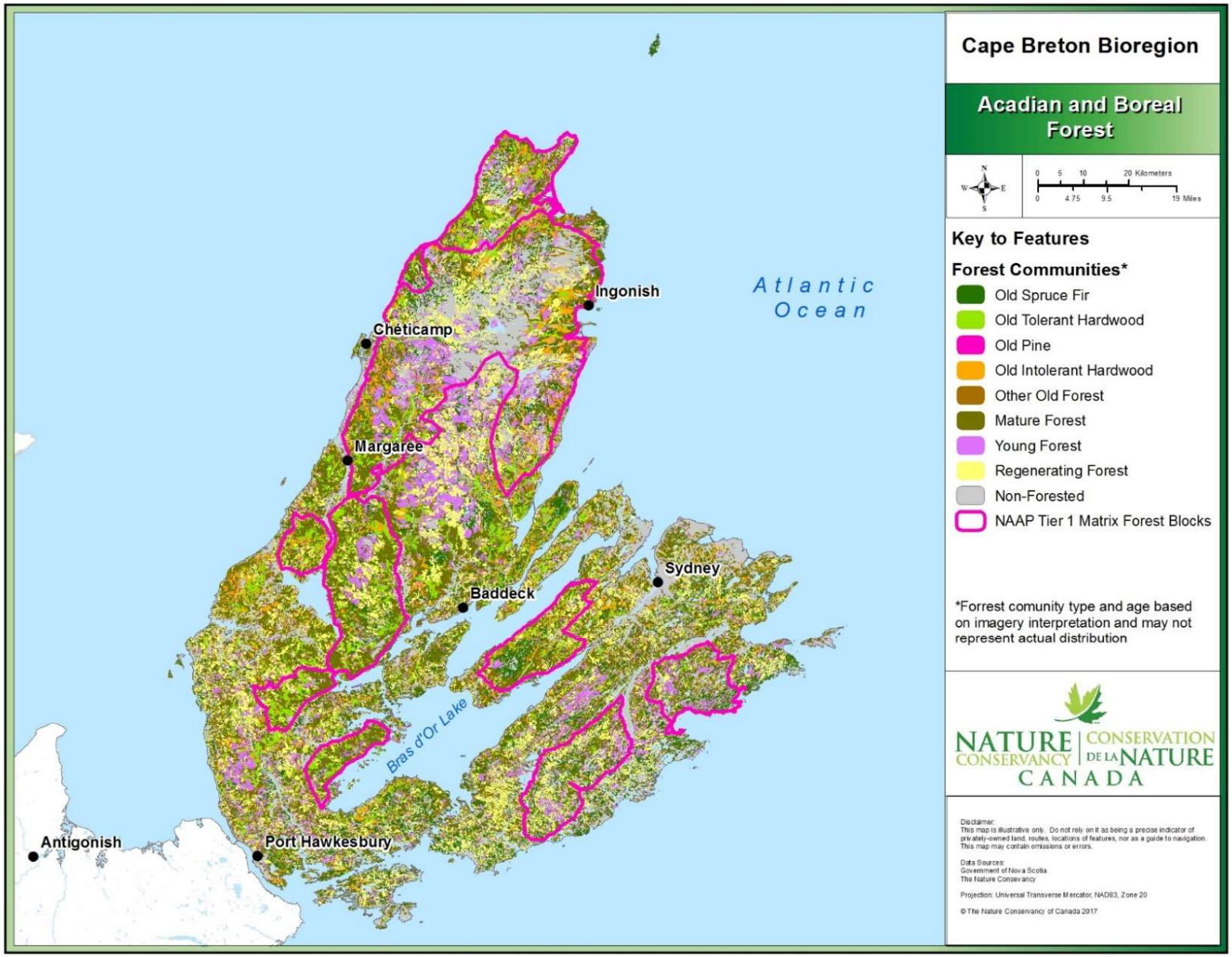

Figure 13. Acadian and boreal forest communities within the Cape Breton bioregion.

viii. Barrens

Barrens are acidic, nutrient-poor habitat types dominated by ericaceous (heath) vegetation and further characterized by sparse tree cover (Davis & Browne 1996; Oberndorfer & Lundholm 2009). Heathlands soils in Nova Scotia generally consist of rapidly drained, shallow humus over exposed bedrock or a thin veneer of sandy glacial till, excessively stony sandy loams (sometimes with cemented horizons), or poorly drained peatlands (Porter 2013). These shrub-dominated habitats often occur where prevailing conditions are too stressful for tree growth (Latham 2003) and frequently in association with bog wetlands (Oberndorfer & Lundholm 2009; Porter 2013). Where sparse and stunted tree cover occurs, it is typically dominated by Black Spruce, Eastern Larch, and in the Cape Breton highlands, Balsam Fir (Neily *et al.* 2003). Many of the common shrub species, including blueberry, cranberry, crowberry, and huckleberry, are prolific berry producers, providing an abundant food source for foraging birds and mammals in the late summer and early fall. Barrens in Cape Breton are of significant importance in providing nesting habitat in Nova Scotia for shorebirds like Greater Yellowlegs, colonial waterbirds such as Leach's Storm Petrel, and foraging habitat for several species of migratory shorebird such as Whimbrel.

There is a large area of tundra-like landscape, consisting of several barren habitats including: subalpine krumholtz woodland forest, extensive heath-lichen barrens, and sphagnum bogs located largely within the Cape Breton Highlands National Park and Jim Campbells Barren Wilderness Area (Parks Canada 2010a). Small wave forests also occur in this area. Specially adapted plants and animal species in this region can withstand extreme conditions – heat and drought conditions on rocky exposures with shallow soil, high humidity relating to persistent fog, acidity and an oligotrophic nutrient regime, cold, snowfall that comes earlier in fall and persists later in spring than elsewhere in the Maritimes, and extreme winds. Along the coast, plant communities also contend with salt spray. Typical plants of the barrens include Reindeer Lichens, Blueberry, Sheep Laurel (Parks Canada 2010a), Rhodora, Black and Pink Crowberry and dwarfed Black Spruce. On Cape Breton Island, species abundant on mainland NS within more sheltered and frequently burned sites are less common. Black Huckleberry has a scattered distribution, most common on interior sites and sites that were burned. Broom Crowberry is known from only one location in Cape Breton.

Persistent barrens are thought to be regulated by climatic and edaphic conditions (Burley 2009). Four factors may be involved in their development: 1) the effects of ice action during glaciation scraping over hard rocks and leaving only a thin layer of coarse till; 2) the formation of a hardpan layer (ortstein) that is impenetrable to plant roots; 3) the effects of fire, stripping humus from the soils; and 4) harsh climatic conditions (Davis & Browne 1996). In a study of coastal barrens in Nova Scotia, Porter (2013) found evidence of charcoal in only four out of greater than 60 soil pits, and the most common humus form encountered was Humimor, which does not develop well in conditions where frequent fires occur (Klinka *et al*. 1981). These results support previous findings that many coastal barrens in Nova Scotia persist in the absence of fire disturbance (Burley 2009; Porter 2013).

Though barrens support relatively low productivity and biomass, they are biodiverse and support numerous rare species of vascular plants, lichens, and bryophytes (Oberndorfer & Lundholm 2009, Porter 2013, Cameron and Bondrup-Neilsen 2013). The majority of rare species on coastal barrens are classified as arctic, alpine and boreal species (Porter 2013). This reflects habitat conditions in Cape Breton that are absent most elsewhere in the Canadian Maritime Provinces. Although the greatest elevation in Cape Breton is only 535m at White Hill, Cape Breton Highlands National Park, Les *suêtes*, an extreme southeasterly wind pattern present on the west coast of Cape Breton, is among a number of climatic drivers responsible for the persistence of alpine and subalpine conditions at these relatively

low elevations. Regionally rare vascular plant species like Diapensia (*Diapensia lapponica)* and Lapland Rosebay (*Rhododendron lapponicum)* occur on these wind exposed barrens in the Cape Breton Highlands. Even at such low elevations, locally uncommon species like the Alpine Bilberry (*Vaccinium uliginosum)*, Northern Blueberry (*Vaccinium boreale)*, Northern Comandra (*Geocaulon lividum),* Highland Rush (*Juncus trifidus),* and others are present in an abundance not found on the mainland Nova Scotia. Reindeer lichens (*Cladonia* spp.) are common. *Cladonia stellaris* and *Cladonia stygia* are especially common on Cape Breton highland heaths in comparison with mainland Nova Scotia. Icelandmoss Lichen (*Cetraria* spp.) are also more common and speciose on the barrens in Cape Breton than elsewhere in Nova Scotia, including rarities on Cape Breton such as Pin-striped Icelandmoss Lichen (*Cetraria laevigata)*.

Even lowland coastal barrens in eastern Cape Breton, such as those of the Baleine Nature Reserve and Scatarie Island Wilderness Area, while they do not support true alpine habitat, do support numerous species with more northern affinities, such as Michaux's Dwarf Birch (Betula michauxii) or Loose-flowered Alpine Sedge (Carex rariflora). Wooly Fringemoss, (*Racomitrium lanuginosum)*, previously thought to be rare in Nova Scotia has been more recently identified at sufficient locations that its provincial conservation status has been updated to secure (S4). These sites are some of the most undisturbed and ecologically important coastal barrens in Nova Scotia.

Recent surveys have revealed a host of lichens and plants not previously known from Nova Scotia, suggesting that there is considerable biodiversity in coastal barrens, and in particular lichens, that have yet to be documented and described (J. Lundholm, per. comm.) For example, a recent survey of a single coastal barren site detected six species of lichens undocumented in Nova Scotia, including the first North American record of the lichen *Rhizocarpon suomiense* (MacDonald *et al.* 2011). Darbyshire *et al*. (2017) describe the recent discovery of Altai Fescue (*Festuca altaica)* in Nova Scotia on an alpine barren on Cape Breton Island. Reindeer lichen species such *Cladonia oricola,* were recently discovered here, representing only the second occurrence of this species in North America (Teuvo Ahti & Frances Anderson, unpublished data, Frances Anderson, per. comm.).

Conservation of barren habitats within the bioregion will contribute to the conservation of at least 71 priority species.

Nested Conservation Priority Species:

- Short-eared Owl (SC)[1]
- Common Nighthawk (TH)
- Willet
- Hudsonian Whimbrel
- Greater Yellowlegs
- Leach's Storm-Petrel

Landscape context assessment: Very Good
Approximately 63% of barrens are protected in the bioregion, a large majority of those within the Cape Breton Highlands National Park and therefore provides a very good landscape context as much of the barren area within the bioregion is contiguous and free from major anthropogenic disturbance. The

[1] Observed on Newfoundland barrens but yet to be observed on barrens in NS. Could be due to lack of targeted survey effort.

Polletts Cove – Aspy Fault Wilderness Area also protects a large area of barrens including undisturbed areas of alpine and subalpine habitat.

Condition assessment: Good
Coastal erosion of exposed headlands also poses a threat to coastal barrens. Off highway vehicle use is one of the most well documented threats to barrens in some areas, where it has been shown to severely degrade habitat, damage sensitive vegetation, destroy soil characteristics, and alter hydrology. Hiking trails have caused significant damage in areas where foot traffic is heavy, especially along the coast and at sites supporting fragile alpine habitat (Oberndorfer & Lundholm 2009; Simon 2012; Porter 2013).

Size assessment: Not Applicable
Size is not likely a limiting factor of the ecological value of this habitat type and thus has not been used to assess the integrity of this habitat. For example, Alpine area barrens are very small and restricted, but should be among the greatest conservation priorities for barrens (K. Porter, pers. comm. 2013). There are currently just over 26,000 ha of barrens in the bioregion, although this is a catch all classification. Little work has been completed to date on the spatial delineation of specific barren types in Nova Scotia. More work is needed to delineate high value habitat for comparison in future habitat assessments.

Threats:

- 1.1 Housing and urban area development (Low)
- 1.3 Tourism and recreational areas (Low)
- 2.1/2.3 Crop and Livestock Agriculture (Low)
- 4.1 Road fragmentation (Low)
- 6.1 Recreational activities (Medium)
- 8.1 Invasive non-native species (Low)
- 11.1 Climate change and habitat shifting (High)
- 3.3 Wind farm development (Medium)

Overall assessment of barrens in the bioregion: Very Good

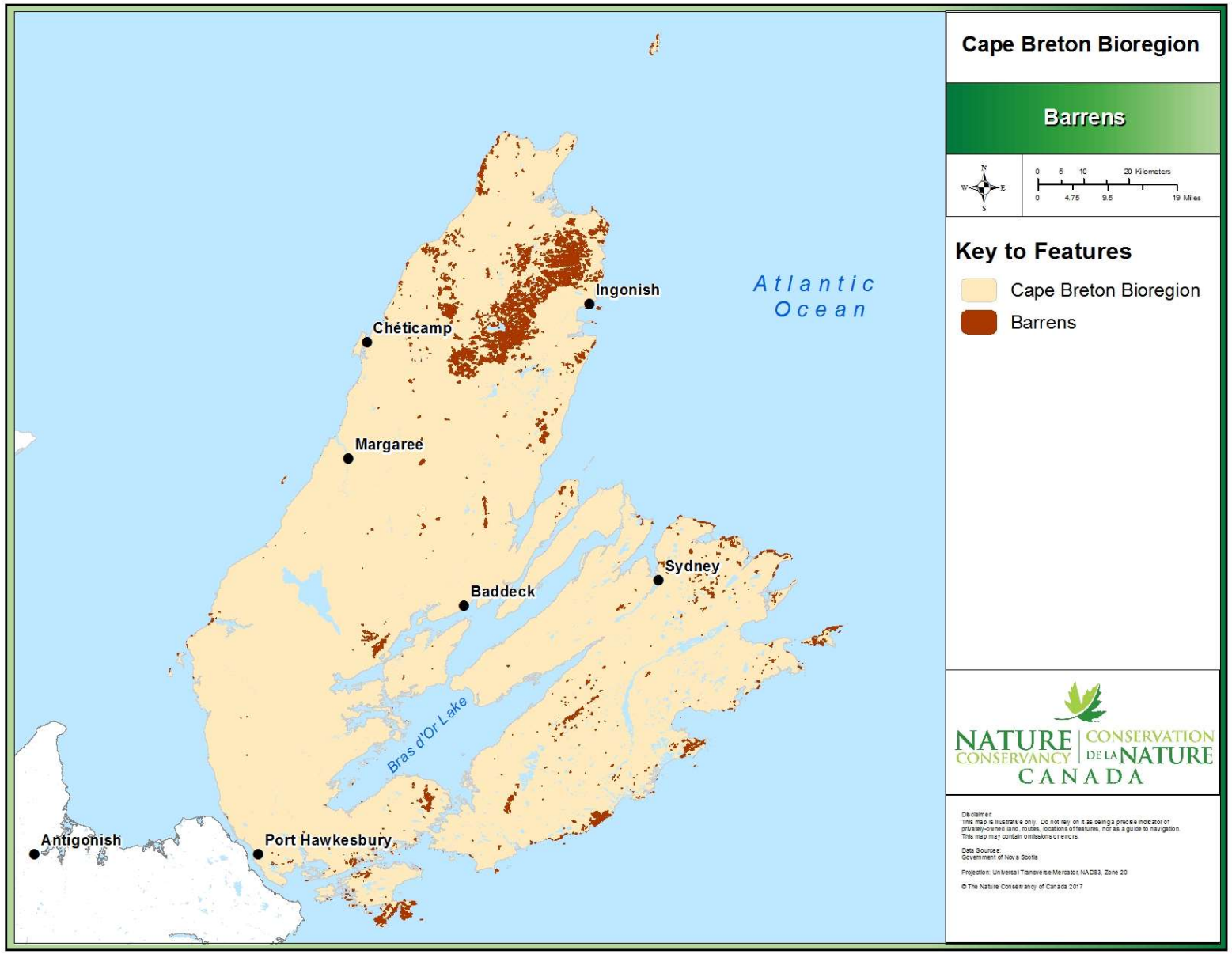

Figure 14. Barrens within the Cape Breton bioregion (features size exaggerated for display purposes).

ix. Grasslands/Agro-ecosystems

Grasslands are open, herbaceous habitats dominated by assemblages of grasses and forbs. Prior to European settlement, natural grasslands were likely uncommon within the bioregion and historically have been associated with various types of agricultural lands (e.g., hayfields, pasture lands), which may serve as habitat for grassland-associated wildlife. These cultivated and managed areas, particularly those near water, are used by a broad variety of species and can be areas of high biological diversity (Environment Canada 2013). There are a number of federally listed and BCR 14 priority bird species within the bioregion that are strongly associated with this habitat type and require grasslands for nesting and foraging habitat, especially agricultural hayfields in eastern North America (Environment Canada 2013). Several of these grassland-associated species are exhibiting major continent-wide declines, including the Bobolink, 'Ipswich' Savannah Sparrow, Short-eared Owl, Rusty Blackbird, Barn Swallow, and Common Nighthawk (Environment Canada 2013; NABCI 2012). A variety of non-grassland dependent species also use this habitat type for foraging and nesting, including waterfowl and Wood Turtle. Threats to grassland-associated species include incompatible farming practices such as mowing during the breeding season, the loss of pasture lands to cropland and old field succession, and contamination of food sources, declines in prey availability, or direct mortality as a result of pesticide use (Environment Canada 2013). Within the bioregion, grasslands occur within the network of agricultural lands or as a result of over-abundant moose foraging in the highlands creating "moose meadows" as post-spruce budworm damaged re-generating vegetation is prevented from maturing.

Conservation of grassland and agro-ecosystem habitats within the bioregion will contribute to the conservation of 60 priority species.

Nested conservation priority species:

- Wood Turtle (TH)
- Bobolink (TH)
- Short-eared Owl (SC)
- Rusty Blackbird (SC)
- Barn Swallow (TH)
- Common Nighthawk (TH)
- Eastern Meadowlark (TH)

Landscape context assessment: Unknown

It is difficult to determine the landscape context for grasslands and agro-ecosystems in the bioregion. Natural grasslands are extremely rare in Nova Scotia as they are not permanent natural landscape features, often used as a part of a crop rotation system.

Condition assessment: Fair

Grasslands within the bioregion are both dependent upon and threatened by human land-use practices. In addition to habitat loss as a result of changes in agricultural land-use practices (i.e., the loss of hayfields and pasture lands to cropland or old field succession), threats to grassland-associated species include incompatible farming practises such as mowing during the breeding season, and pesticide application (Environment Canada 2013). Early and more frequent (i.e., more than once a season) hay harvests do not allow for sufficient time for breeding birds to complete their nesting cycle.

Size assessment: Fair

Agricultural areas in Cape Breton account for just 3.8% of the total agricultural area of NS. Of the total 34,704 ha of farmland in the bioregion, 8,970 ha (26%) are thought to be used for pasture. Pasture type agriculture may provide the most suitable habitat for grassland birds and other species outside of naturally occurring grasslands. The average farm size in the bioregion in 200 acres while only 5.5% of arable land is thought to be in use, which falls below the NS provincial average of 13% (Statistics Canada, 2011). Between 2006 and 2011 total farm area decreased in 3 of the 4 Cape Breton counties. Inverness County saw a decrease of 17%, Cape Breton County – decrease of 7.2%; Victoria County – decrease of 48% and Richmond the only increase at 17.2 %. Grassland habitat is increasing in the highlands due to the abundant moose population. These moose meadows are created by the browsing of regenerating trees in disturbed areas. As the trees are not able to grow, grasses have taken over large areas of the Cape Breton Highlands. While this is seen as threat to naturally occurring ecosystems, it may provide additional grassland habitat to the benefit of declining grassland bird populations.

Population sizes of grassland dependent birds in Cape Breton have seen significant declines over the last 30 to 40 years. Breeding bird surveys reveal that grassland bird populations in Canada are currently 75% below 1970s values and as a group are in faster decline then other groups of birds. As a result the size assessment for grassland birds is Poor.

Threats:

- 2.1/2.3 Crop and livestock agriculture (Medium)
- 9.3 Agricultural and forestry effluents (Medium)
- 11.1 Climate change and habitat shifting (Medium)

Overall assessment of grasslands in the bioregion: Fair

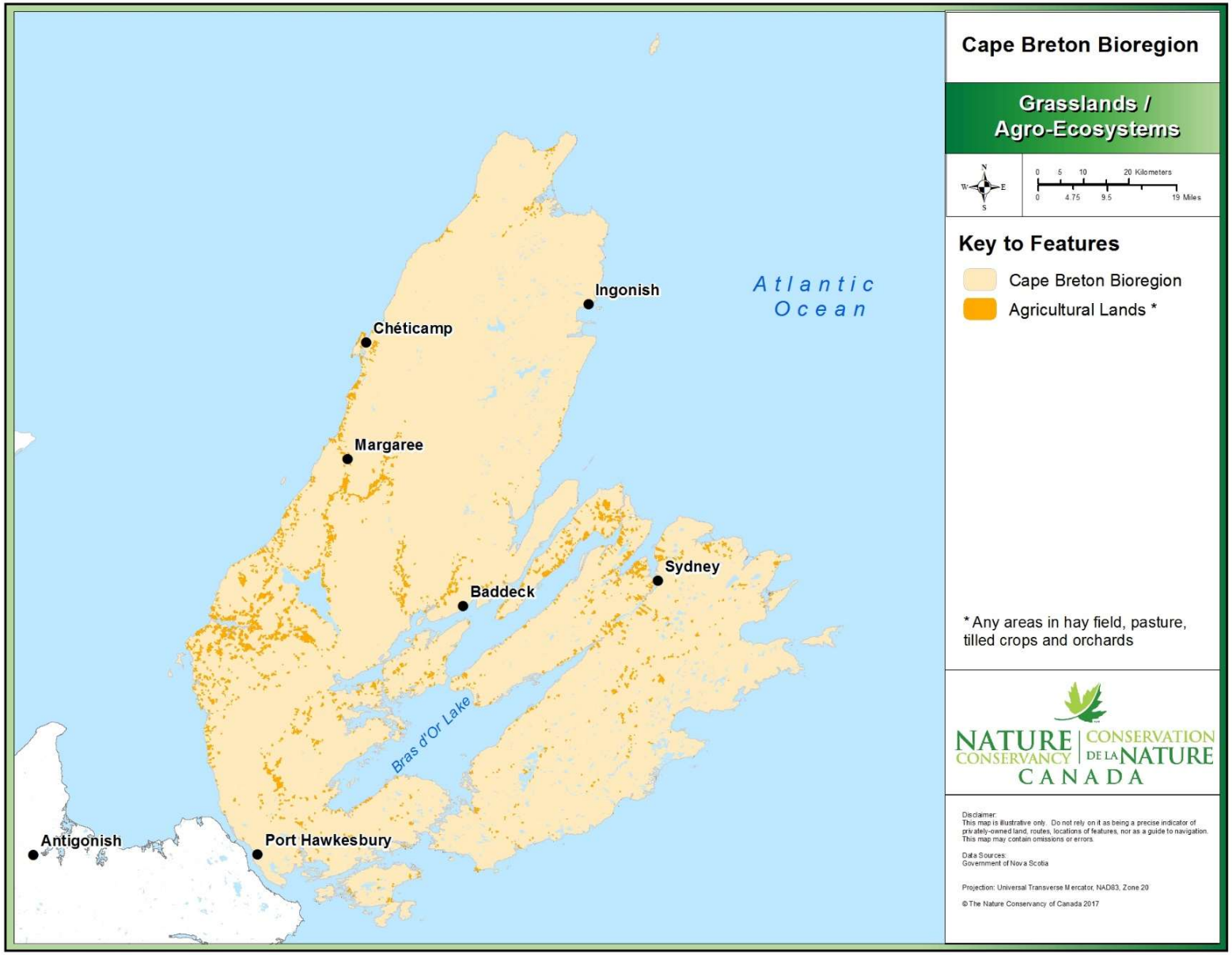

Figure 15. Possible grasslands and agro/ecosystems within the Cape Breton bioregion (features size exaggerated for display purposes).

x. Summary of conservation priority habitat assessments

The overall assessment of the conservation priority habitat types in the Cape Breton bioregion is 'Good' (Table 8). Two out of the nine habitat conservation priorities received 'Very Good' ranks, meaning that according to the best available information, their structure, species composition, and key ecological processes and functions are intact and unimpaired by anthropogenic stresses and are functioning at a level comparable with the natural or historic range of variation for that ecosystem. Five out of the nine habitat conservation priorities received 'Good' ranks, meaning their structure, species composition, and key ecological processes and functions are somewhat impaired by anthropogenic stresses, that they are functioning within a range of acceptable variation compared with the natural or historic range of variation for that ecosystem, but may require some management. One of the nine habitat conservation priorities received a 'Fair' assessment rank, meaning that their structure, species composition, and key ecological processes and functions are impaired by anthropogenic stresses, are functioning below the range of acceptable variation compared with the natural or historic range of variation for that ecosystem, and require management, without which the habitat conservation priority will be vulnerable to serious degradation. None of the priorities received a rank of 'Poor', which would suggest they are seriously degraded by anthropogenic stresses and require significant management and/or restoration.

Table 8. Assessment ranks of ecological integrity for the conservation priority habitats in the

Priority Habitat	Landscape Context	Condition	Size	Assessment Rank
Barachois ponds	Good	Unknown	Good	Good
Beaches, dunes, rocky shores, and cliffs	Good	Good	Good	Good
Coastal Islands	Unknown	Very Good	N/A	Very Good
Estuaries	Good	Fair	Good	Good
Aquatic and riparian systems	Good	Good	Fair	Good
Freshwater wetlands	Good	Good	Good	Good
Acadian and boreal forest	Good	Poor	Fair	Fair
Barrens	Very Good	Good	N/A	Very Good
Grasslands/agroecosystem	Unknown	Fair	Fair	Fair
Overall assessment of conservation priority habitats in the Cape Breton bioregion				**Good**

B. Threats

Threats are the proximate activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of one or more of the identified conservation priority habitat types. Threats impact the habitat's ecological integrity and/or key ecological attributes, and were identified by the Cape Breton bioregion project team using past studies, local expert knowledge, and a review of the literature. Threats identified for BCR 14 and MBU 11 and 12 (Environment Canada 2013) were also examined for specific relevancy to the bioregion and are listed in Table 10**.**

The threats identified within this Habitat Conservation Strategy are thought to be comprehensive for the bioregion's priority habitats, though other threats may be revealed through research or may emerge over time. Threats were ranked based on their scope, severity, and irreversibility of damage to priority habitats that can reasonably be expected within 10 years given the continuation of current circumstances and management using the Open Standards for the Practice of Conservation (CMP 2013), and were categorized using established international taxonomy (Salafsky *et al.* 2008, IUCN-CMP 2012; Appendix G). Full details of the threats analysis can been seen in Appendix H.

Table 9 provides a summary of the threats identified within the CB bioregion. The overall threat status for the CB bioregion is 'Medium'. The geographic extent of identified threat is mapped, where known, in Figure 16 to Figure 26.

Table 9. Summary of threats to the Cape Breton bioregion conservation priority habitats (continued on next page).

Very High	The threat is likely to *destroy or eliminate* the habitat conservation priority
High	The threat is likely to *seriously degrade* the habitat conservation priority
Medium	The threat is likely to *moderately degrade* the habitat conservation priority
Low	The threat is likely to *only slightly impair* the habitat conservation priority
-	The threat's impact on the habitat conservation priority is *negligible*
Unknown	The threat's impact on the habitat conservation priority is *unknown*

Threats	Barachois	Beaches	Coastal islands	Estuaries	Aquatic /riparian systems	Freshwater wetlands	Acadian /boreal forest	Barrens	Grasslands	Summary Threat Rating
1.1 Housing & urban areas	Low	Medium	Low	Low	Low	Low	Low	Low		Medium
1.3 Tourism & recreation areas		Medium					Low	Low		Low
2.1 Annual & perennial non-timber crops	Low			Low	Medium	Low	Low	Low	Medium	Medium
2.2 Wood & pulp plantations							Low			Low
2.3 Livestock farming and ranching	Low		Low	Low	Medium	Low	Low	Low	Medium	Medium
2.4 Marine & freshwater aquaculture	Low	Low		Low						Low
3.2 Mining & quarrying					Low	Low	Low			Low
3.3 Renewable energy - wind								Medium		Low
4.1 Roads & railroads	Low	Medium		Medium	Medium	Low	Medium	Low		Medium
5.3 Logging & wood harvesting					Medium	Medium	High			Medium
6.1 Recreational activities		Medium			Low	Low	Low	Medium		Medium
7.2 Dams & water management/use					High					Medium

Threats	Barachois	Beaches	Coastal islands	Estuaries	Aquatic /riparian systems	Freshwater wetlands	Acadian /boreal forest	Barrens	Grasslands	Summary Threat Rating
7.3 Other ecosystem modifications – shoreline armouring		Medium	Low	Low						Low
8.1 Invasive non-native species	Low	Low		Low	Medium	Low	Low	Low		Medium
8.2 Problematic native species							Medium			Low
9.1 Domestic & urban waste water	Low	Low		Low	Low					Low
11.1 Climate change – habitat shifting	High	Medium	Medium	Medium	High	High	High	High	Medium	High
Overall threat status for priority habitats	Medium	Medium	Low	Medium	High	Medium	High	Medium	Medium	High

Table 10. Relative magnitude of identified threats to priority species within BCR 14 and MBU 11 NS by threat category and broad habitat class. Overall ranks were generated through a roll-up procedure described in (Kennedy et al. 2012). L = Low magnitude threats; M = Medium; H = High. Blank cells indicate that no priority bird species had threats identified in the threat category/habitat combination. Reproduced with permission from Environment Canada 2013.

Threat Category	BCR 14 Habitat Classes													MBU 11/12 Habitat Classes			
	Coniferous forest	Deciduous forest	Mixedwood forest	Shrub/Early Successional	Herbaceous	Cultivated and Managed - Urban		Wetlands	Inland Waterbodies	Coastal (Above High Tide)	Riparian	Widespread	Overall	Marine Waters	Coastal (Intertidal)	Widespread	Overall
Overall	**M**	**H**	**H**	**L**	**L**	**M**	**M**	**M**	**L**	**M**	**M**	**M**		**M**	**H**	**L**	
1. Residential & commercial development	L	L	L	L	L	L	H	M	L	M	M	L	**M**	L	L		**L**
2. Agriculture & aquaculture	M	M	M	L		H		M		L	L		**M**	M	L		**L**
3. Energy production & mining	L	L	L		L							L	**L**		L	L	**L**
4. Transportation & service corridors	M	L	L	L	L			L		L	L	L	**L**		L		**L**
5. Biological resource use	H	H	H		L			H	L	L	M		**H**	M	L		**L**
6. Human intrusions & disturbance					L		L	L	L	M	L		**L**	L	H		**M**
7. Natural system modifications	L	L	L	L		L		L		M	L		**L**		M		**L**
8. Invasive species & other problematic species and genes	L	L	L	L	L	L	L	L	L	M	L		**L**	L	M	L	**L**
9. Pollution	M	H	H	L	L	M	M	M	M	M	M		**H**	H	H		**H**
11. Climate change & severe weather												H				M	

Current Threats

1.1 Housing and urban areas (Threat rating: Medium)

Although the total population of Nova Scotia has remained relatively stable over the last ten years, there has been a general outmigration from rural areas of the province to central Nova Scotia, particularly the Halifax Regional Municipality. Cape Breton Island is one of the regions of Nova Scotia which has seen some of the highest rates of depopulation and outmigration in recent years. Only 3.7% of the bioregion is classified as developed, and this is mostly concentrated around the Bras d'Or Lakes, Cape Breton Regional Municipality, Port Hawkesbury, Ingonish and Cheticamp (Figure 16). There is very little new residential development anticipated on the island over the next ten years.

Most development in Nova Scotia is concentrated along the coastlines, with 70% of the province's population living in the coastal zone (CBCL Ltd. 2009). Development along much of Nova Scotia's scenic coastline for luxury homes has been steadily increasing, and scenic coastal properties with development potential are in relatively high demand on Cape Breton Island (CBCL Ltd. 2009). Coastal barrens may be targeted for their scenic vistas and lack of tree cover to be cleared; for example, coastal housing developments have destroyed a large portion of coastal barrens along the Northeastern Seaboard of the United States (Dunwiddie 1989). Similar development pressure on coastal headlands in Nova Scotia is foreseeable, where a large portion of lands are privately owned.

In Cape Breton, coastal development around beaches on the Bras d'Or Lakes and in northern Cape Breton is also common. Coastal islands, on the other hand, remain primarily in their natural state, with 94% remaining free from development. About 80% of the land adjacent to the coast is classified as undeveloped, with the majority (66%) under natural forest cover (CBCL Ltd. 2009); however, a high percentage of the coastline is under private ownership, so there is potential for increased coastal development in the bioregion. Specific activities associated with housing, cottage, and rural development that threaten the region's biodiversity include infilling, removal of natural vegetation cover, creation of lawns and gardens, and shorefront alterations (e.g., creation of artificial beaches, construction of docks, wharves, breakwaters, and seawalls).

The Human Footprint index, developed by the Wildlife Conservation Society (Woolmer *et al.* 2008), is a measure of the extent and relative intensity of human influence on terrestrial ecosystems at a resolution of 90 m using best available data sets on human settlement (i.e., population density, dwelling density, urban areas), access (e.g., roads, rail lines), landscape transformation (e.g., landuse/landcover, dams, mines, watersheds), and electrical power infrastructure (i.e., utility corridors). Each 90m grid cell is attributed with a Human Footprint score between 0 and 100, where 0 represents no human influence and 100 represents maximum human influence at that location. The areas around the Cape Breton Regional Municipality and Port Hawkesbury are heavily impacted by human disturbance (Figure 17). The northern half of Cape Breton Island is less impacted by human disturbance, with relatively large areas in the Cape Breton Highlands remaining very lightly disturbed.

1.3 Tourism and recreation areas (Threat rating: Low)

Tourism and outdoor recreational activities are popular in Cape Breton and major contributors to the local economy. Tourist infrastructure, from small scale look-offs (parking, interpretive signage), to hotels and resorts, have historically become established along scenic areas of coastal Cape Breton. In particular, tourism and related infrastructure are concentrated on the Bras d'Or Lakes and the Cabot Trail through the Cape Breton Highlands, especially in close proximity to beaches, which are highly

sought after destinations. The development of golf course in the bioregion is an emerging threat to coastal forests; however the affected area is relatively small.

Coastal headlands dominated by barrens are often considered ideal sites for development since it is not necessary to clear tree and scenic vistas are intrinsic. In Nova Scotia, new resort developments are not common, but coastal barrens have high development value because of their scenic quality. Some examples of development on coastal barrens on Cape Breton Island include a seasonal luxury housing development on Isle Madame, Keltic Lodge at Middle Head, and the proposed Mother Canada at Green Cove. At the same time, the likelihood of development is lessened to some extent on sites that have complex topography and boggy or rocky terrain. Coastal barrens also typically occur on windy sites with relatively high rates of precipitation, high frequency of fog, and cooler temperatures, which may make them less desirable for some types of development (e.g., camp grounds).

2.1 Annual and perennial non-timber crops (Threat rating: Medium)

Agriculture in Cape Breton is characterized by a diversity of farm production activities including livestock, horticultural crop, and vegetable crop farms (NSFA 2016). There are 20,098 ha of agricultural land in the bioregion accounting for 1.2% of the bioregion (Figure 18). While the scope is low within the greater context of land usage, the concentration of agricultural activities on floodplains creates a higher risk and impact to these specific habitat types. Floodplains, which are areas of high biodiversity that provide habitat for a wide range of plants and animals, are targeted for agricultural conversion due to the high quality of soil that exists within floodplains as a result of natural flooding and deposition of nutrients. Over 18% of the delineated floodplain area in the bioregion has been converted to agriculture, although in actuality this percentage may be significantly higher (Sean Blaney, per. comm.). It is common practice to completely remove natural vegetation from floodplains, often with little to no buffering on watercourses. Runoff from agricultural fields can result in increased sediment and nutrient inputs, as well as pesticides, into adjacent freshwater ecosystems, which can contribute to siltation, eutrophication, and contamination of the region's freshwaters. Restoration of floodplains, while feasible, would be a long-term process and could take up to 100 years to restore mature forest conditions that existed prior to settlement. For these reasons the threat rating for agriculture on aquatic and riparian systems is high.

Grasslands in the bioregion are primarily anthropogenic features (e.g., hayfields, pasture lands) that occur within the network of existing agricultural lands (Figure 18). Habitat for grassland-associated species can be lost as a result of changes in agricultural land use practices (e.g., conversion of hayfields and pasture lands to tilled cropland). Additional threats to grassland-associated species related to agricultural practices include mowing hayfields during the breeding season for grassland-associated species, and pesticide application (Environment Canada 2013). Timing the harvest of grasses and legumes in the late vegetative or early reproductive stage (before the plant goes to seed) attains high energy and protein content in the resulting hay product (Province of Nova Scotia 2012). Early and more frequent (i.e., more than once a season) hay harvests however, do not allow for sufficient time for breeding birds and reptiles to complete their nesting cycle. Wood Turtle are further vulnerable to injury and mortality from farm machinery. Studies in Nova Scotia have shown that delaying the timing of hay harvesting beyond the breeding season (June to early July) and raising the height of mowers in riparian fields may reduce farm machinery related mortality of Wood Turtles. In addition, Wood Turtle activity is usually restricted to within 300 meters of the water's edge, thus maintaining a seasonal equipment free zone would significantly decrease mortality as well (Tingley *et al.* 2009).

The Environmental Farm Plan (EFP) is a voluntary program that is delivered by the Nova Scotia Federation of Agriculture and funded by Agriculture and Agri-Food Canada, which promotes environmental stewardship on farms by educating farmers about management practices that reduce their impact on the environment (Province of Nova Scotia 2012). Such practices may include maintenance of a well vegetated riparian zone between agricultural lands and freshwater ecosystems, contributing to water temperature control and stabilization of stream banks, thereby reducing flooding impact and stream bank erosion, and protecting the habitat of many aquatic communities. Riparian buffers also provide an area where contaminants may be filtered from water runoff before reaching a watercourse, thus improving water quality and reducing the impacts of pesticides and eutrophication on the region's freshwater resources and sensitive species at risk. The Nova Scotia Eastern Habitat Joint Venture (NS EHJV) Wetland Stewardship Program is also engaged in partnerships with agricultural producers and practitioners to improve the conservation and restoration of wetland habitat in the agricultural landscape, primarily through the promotion and delivery of Agricultural Biodiversity Conservation (ABC) Plans, which allow farmers to clearly identify existing and potential Beneficial Management Practices (BMP's) that will promote the maintenance or enhancement of biodiversity on their farms (NS EHJV 2008).

2.2 Wood and pulp plantations (Threat rating: Low)

Natural forest conversion to wood and pulp plantations is a common forestry practice in Nova Scotia, and approximately 4% (40 000 ha) of the bioregion is classified as forest planation according to the forest resource inventory (Figure 19). Forest plantations generally consist of even-aged monocultures of shade-intolerant, fast-growing softwood species for use in the pulp and paper industry. Native tree species used include Red Pine, Red Spruce, Black Spruce, and White Spruce, as well as Balsam Fir for the Christmas tree industry. The use of non-native Norway Spruce (*Picea abies*) is also widespread in Nova Scotia, due to its exceptional growth, which can be superior to that of native spruce species on comparable sites. Black and White Spruce account for 80-90% of plantation species in the bioregion (Figure 19). Norway Spruce plantations account for just 3% of the total plantation area. Forest plantations severely reduce the species and structural diversity of forest stands, and can result in changes to the hydrology and soil characteristics of the site. They generally lack biodiversity, and have a reduced capacity to provide suitable habitat for native wildlife compared to natural forests (Hartley 2002). As monocultures, they are more vulnerable to damage by insects, disease, and wind, and consequently there is often an associated increase in the use of biocides, such as herbicides and pesticides. Though sometimes publicized as beneficial given the potential for plantations to help alleviate pressure for commercial products on natural forests, it is unclear if this is a realized benefit in the bioregion.

2.3 Livestock farming and ranching (Threat rating: Medium)

Heathlands, or barrens, are often used for pasture for horses or sheep in the bioregion, the latter of which was once more widespread. Many coastal islands and some inland sites with relatively flat topography at the edge of steep relief were considered to be ideal seasonal pasture lands because natural barriers meant fencing was not necessary. The extent to which pasturing historically occurred on Nova Scotia's heathlands is unknown. Pasturing on heathlands has been observed to lead to a higher incidence of weedy exotic and pasture grass species, likely a result of nutrient deposition (scat) and disturbance to native vegetation by browsing and trampling (Katie Porter, per. comm.)

Although pasturing can be considered a disturbance to heathlands, there is also evidence that historical pasturing was a contributing factor to the establishment of heathlands where they did not previously occur. Browsing and trampling may suppress tree growth, and in coastal areas with poor, shallows soils,

this could encourage shrub establishment within an old field site. Such sites or community types are likely to be dynamic in nature and may eventually undergo natural succession back into forest. The extent of this is unknown in Nova Scotia, but well documented in other regions. Collantes *et al.* (1989) found historical sheep pasture more than 1,000 years previously to be a contributing factor in the establishment of Empetrum spp. dominated heathlands in Argentina.

2.4 Marine and freshwater aquaculture (Threat rating: Low)

Aquaculture is recognized globally as the primary means to meet increasing demands for seafood, given that global commercial fisheries are close to their production limits, and is the fastest growing animal food production system in the world (NSAF 2005). Marine shellfish and finfish aquaculture is an expanding industry along the coastlines of the Nova Scotia. The provincial Government has invested significant resources into attracting aquaculture operations to the province, and there will likely be continued growth of the industry in the coming years (Morrison & Hines-Clark 2009).

The large majority of aquaculture in the Bras d'Or Lakes is suspended shellfish (Figure 20). This type of aquaculture can result in impacts to aquatic vegetation such as seagrass and seaweeds through waste, decreased light penetration, eutrophication and physical damage from bags or boats. Studies in Atlantic Canadian bays have seen eelgrass declines as high as 80% in lease areas compared to reference sites (Skinner *et al.* 2013). There are seven fin fish leases in the bioregion however it appears that only one is currently active. Open-pen fin fish aquaculture farms in Nova Scotia pose a potential threat to surrounding coastal ecosystems. Often situated in protected bays, diseases, parasites, pesticides (used for the control of crustacean parasites such as sea lice), and excess food and pharmaceutical waste from finfish aquaculture operations flow freely from open pens into the surrounding marine environment (Atlantic Coalition for Aquaculture Reform 2012). This can pose risks to a wide range of native species through a decline in benthic ecosystem quality, and through the transmission of diseases and parasites; a decline in the health of remnant wild populations of endangered Atlantic Salmon is also a significant threat. The threat from expanded fin fish aquaculture on the Bras d'Or Lakes may be considerable given the low flushing capacity of the lakes, although at the time of this report the threat is considered low because of the low number of active farms.

Of lesser significance is the potential for expanding finfish and shellfish aquaculture operations located in close proximity to important breeding, migratory, or over-wintering habitats to have negative impacts on waterfowl and other migratory birds through the disruption of their natural behaviour. Competition for resources with the aquaculture industry is considered to be a highly ranked threat for BCR 14 NS and MBU 11/12 NS priority bird species (Environment Canada 2013). Further, aquaculture practices can attract gulls, which may then depredate on sensitive species (e.g., Piping Plover and Common Eider) in the vicinity of aquaculture operations (Nocera 2000).

3.2 Mining and quarrying (Threat rating: Low)

Cape Breton has a long history of mining beginning over 250 years ago with the first coal mine. Peak coal production in Cape Breton was reached in the early 1940s, however the post-war period brought a steady decline in the industry as inexpensive imported oil replaced coal in many of its traditional industrial and domestic markets (Calder *et al.*1993). In 1966, the formation of a federal Crown agency, the Cape Breton Development Corporation (DEVCO), and the ensuing global oil crisis of the early 1970s led to a revitalization of the coal-mining industry and by the early 1990s as much as 80% of Nova Scotia's electrical power was fueled by the DEVCO mines in the Sydney coalfield. Production problems and increasing production costs led to the decommissioning of the last DEVCO coal mine on Cape Breton in 2001; there are currently no industrial coal mines in operation on Cape Breton Island, however, there

have been efforts to reopen the coal mine in Donkin for a number of years. The Swiss mining consortium Xstrata purchased the rights to develop the abandoned mine site in 2001 but nothing came of this. The mine was sold to the Cline Group in 2014 and there are plans to resume production in 2017.

Gypsum and limestone mines continue to operate. Nova Scotia is unique in northeastern North America for the number and extent of sites having gypsum bedrock at or near the soil surface (Blaney & Mazerolle 2013). Areas of gypsum bedrock in the province are almost completely on private land, and are thus not well represented within the provincial protected areas system; less than 1% presently lies within federal, provincial, or privately-owned protected areas (Mazerolle *et al.* 2015). Gypsum mining has a long history in the province and large open pit mines have already removed many of the most significant examples of gypsum landscapes (Mazerolle *et al.* 2015). In 2007, Nova Scotia accounted for 81% of Canada's production of natural gypsum and almost all of its exports (Parker *et al.* 2007), with a significant proportion originating from within the bioregion (31% in 2004). Although the footprint of mining in the bioregion is small, the threat to gypsum and limestone systems is high due to the limited distribution of these systems coupled with their targeted extraction. Gypsum mining companies currently own large portions of undeveloped gypsum land; therefore the expansion of gypsum mining in the province represents a major ongoing threat to gypsum-associated ecological communities. Synthetic products and cheaper Chinese exports have resulted in a recent decline in gypsum and limestone mining in the bioregion, with most gypsum mines in the bioregion having either been closed permanently or remaining idle while markets stabilize. Consequently, the threat from mining operations is currently low, although it is possible for efforts to intensify if demand increases. Figure 21 shows existing mining licenses and leases in the bioregion.

3.3 Renewable energy – Wind energy production (Threat rating: Low)

Industrial wind energy production is among the fastest growing sectors of the global energy industry, as the demand for renewable energy sources continues to increase (Nelson 2009). Wind energy is plentiful, renewable, produces no greenhouse gases emissions, and, for onshore sites, is relatively cheap, particularly compared to other renewable energy sources. It also leads to local investment through land leases, municipal taxes, and labor related to construction, maintenance, and operation of wind turbines. In the province's *Renewable Electricity Plan*, the Government of Nova Scotia set an aggressive target of 40% renewable energy by the year 2020 (Province of Nova Scotia 2010). By March 2015, there were 350 MW of installed wind energy capacity in Nova Scotia. There are currently 33 wind turbines in operation within the Cape Breton bioregion, with the most significant installation of 10 turbines at Point Tupper.

Despite the many environmental benefits of wind energy, the rapid growth of the wind energy sector around the globe has raised concerns regarding the impacts of these developments on both resident and migratory populations of wildlife (Arnett *et al.* 2008). Wildlife may be impacted by wind energy developments through direct mortality, changes to habitat availability, and disruption of movement patterns (e.g., foraging, mating, and migration). Wind turbines are thought to have a negligible effect on bird populations compared to other man made impacts (Environment Canada 2013), and compared to other groups of wildlife. Documentation of large numbers of bat fatalities at wind energy facilities across North America has raised the profile of this issue as a primary environmental concern associated with their installation (Johnson 2005). In North America, the species most affected are the long-distance migratory bats, including the Hoary Bat (*Lasiurus cinereus*), the Eastern Red Bat (*L. borealis*), and the Silver-haired Bat (*Lasionycteris noctivagans*), which make up about 75-80% of the documented fatalities at wind energy developments, with the Hoary Bat alone comprising about half of all fatalities (Arnett *et al.* 2008; Kunz *et al.* 2007). In Nova Scotia, overall data suggests that there are no significant populations or migratory movements of these species in or through the province, but they do occur regularly and are

especially vulnerable to wind facilities (H. Broders, per. comm.). Bat fatalities have also been reported in smaller numbers for resident hibernating bat species, including the Little Brown Myotis, the Northern Myotis, and the Tri-colored Bat (Arnett *et al.* 2008; Johnson 2005).

The majority of efforts to minimize conflicts between wildlife and wind energy developments have focused primarily on risk avoidance through pre-construction surveys of wildlife and careful site selection to avoid areas with high levels of wildlife usage (Weller & Baldwin 2012). The assumption of this approach is that low indices of activity prior to construction should translate into low fatality rates post-construction (Baerwald & Barclay 2009), assuming that there is no source of attraction to turbines for wildlife (e.g., lights to alert navigation). Given the anticipated proliferation of wind turbines, we should continue to ensure that turbines are sited to avoid important wildlife habitats and migration corridors whenever possible.

4.1 Roads and railroads (Threat rating: Medium)

Road construction has long been linked to habitat fragmentation and associated with negative impacts on many wildlife species (Beazley *et al.* 2004), both directly and indirectly. The ecological impacts of roads can be hard to quantify, but a growing body of research makes a compelling link between roads and ecological degradation in terrestrial and aquatic ecosystems (Trombulak & Frissell 2000). Roads fragment landscapes and may act as physical barriers between interior patches of habitat for some species. They have negative effects on biodiversity through direct mortality from road construction and vehicle collisions, behavioral modifications (i.e., avoidance), and increased access to once inaccessible places for invasive species and human use, including off-highway vehicle use, poaching, and illegal harvesting of wildlife (Trombulak & Frissell 2000). Vehicle mortality is a recognized threat for Wood Turtle, particularly adult females and hatchlings, given the tendency of females to use roadsides as nest sites. Given the longevity and late maturation of this species, their populations are particularly vulnerable to even small increases in adult mortality (COSEWIC 2007). Road construction can also have negative impacts on freshwater wetlands, tidal marshes, and estuaries as a result of changes to hydrology, direct loss of habitat, and increased erosion and sedimentation downstream (Forman & Alexander 1998; Environment Canada & Parks Canada Agency 2010).

A road density threshold of 0.6 km/km^2 has been shown to be correlated with a decline in some large vertebrate populations (Foreman *et al.* 1997 in Beazley *et al.* 2004). The road density of the bioregion outside of urban areas is 1.4 km/km^2, more than double the 0.6 km/km^2 threshold (Figure 22). According to the provincial ecological landscape analysis for ecoregions within the bioregion, roads have the greatest impact on floodplains, beaches, and estuaries (NSDNR 2015, unpublished).

5.3 Logging and wood harvesting (Threat Rating: Medium)

The Acadian Forest is considered to be at significant risk, with forest harvesting and related activities identified as the primary cause of forest habitat loss (Davis *et al.* 2013; Environment Canada 2013). The majority of Nova Scotia's forests have been logged extensively several times, simplifying the forest structure, composition, and age class. More recent industrial forestry practices (i.e., extensive clear cutting and monoculture plantations) fail to mimic the region's natural forest disturbance regime of primarily gap dynamics, and consequently the current conditions of Nova Scotia's forests no longer reflect the processes and structures produced by natural disturbance regimes (Neily *et al.* 2008). There has been a significant increase in relatively young, even-aged, early-successional forest types, while the abundance and age of shade-tolerant, late-successional forest types has declined (Loo & Ives 2003; Mosseler *et al.* 2003). Only 26% of the 60-70% mature (80 years+) forest historically thought to exist on gap and infrequent disturbance regime ecosections in the bioregion remains (Neily *et al.* 2008). Of

particular concern is the emerging threat from hardwood harvesting for the biomass power generating station in Port Hawkesbury. Approximately 670,000 green tonnes of wood fibre are needed annually to produce 60 megawatts of electricity, half coming from waste wood from sawmills and other wood operations, and the other half coming from cut trees (The Chronicle Herald 2015). It is estimated that 2,790 ha of forest must be harvested annually to meet the boiler's demand; a number thought by many to be unsustainable.

Modern industrial forestry practices not only threaten the overall diversity and state of the bioregion's forests, but they can also have significant consequences for adjacent freshwater ecosystems. Complete removal of tree cover (i.e., clearcutting) in close proximity to watercourses and wetlands can result in increased rates of erosion and water runoff, potentially leading to increased siltation and flooding of adjacent waters. Removal of tree cover directly adjacent to waterbodies reduces the ability of riparian areas to retain and filter water, can lead to bank destabilization further increasing erosion, and can reduce or eliminate tree shade and resulting temperature control benefits, leading to increases in water temperatures (McEachern 2003). This can negatively impact aquatic communities and species, particularly salmonids, which require deep pockets of oxygen-rich cold-water habitat which they use as summer refugia (Brylinsky 2002). Riparian area harvesting also reduces the input of organic material to waterbodies, such as litter-fall and coarse woody debris, which constitute an important source of nutrients and structural complexity (McEachern 2003). Although areas of karst are sometimes protected from forestry activities by their rugged sinkhole topography, wood harvesting is also a significant threat to all forested karst areas of gentler topography. See Figure 23 for mapped harvesting and silviculture areas.

6.1 Recreational activities - Off-highway vehicle use (Medium)

Use of OHVs in sensitive ecosystems can lead to significant habitat degradation, and is a recognized threat to a number of sensitive ecosystems and species at risk. Beaches and sand dunes are particularly sensitive to OHV use, which may result in damage to dune systems and disturbance of the associated species that use them. This occurs through the degradation of dune structure, destruction of stabilizing dune vegetation, disturbance and destruction of the nests of breeding shorebirds (e.g., Piping Plover), and compaction of substrate resulting in reduced invertebrate abundance and therefore local prey availability (Environment Canada 2012).

The use of OHVs in other sensitive ecosystems, such as riparian areas (e.g., lakeshores), bogs/fens, and barrens can severely damage these habitat types, leading to soil compaction, destruction of existing plants, and changes to drainage patterns and hydrology. This can result in long-term habitat loss for sensitive species, such as species of ACPF, as well as damage to seed banks for these sensitive plants (Environment Canada & Parks Canada Agency 2010; Wisheu & Keddy 1991). Off-highway vehicle use is generally regarded as a widespread and significant threat to a number of the bioregion's priority habitats. The Nova Scotia *Off-Highway Vehicles Act* (1989) prohibits the operation of off-highway vehicles in or on a wetland, swamp, marsh, watercourse, sand dune, or coastal or highland barren, with fines for infractions ranging from $500 to $2,000. The regulations are enforced by the Nova Scotia Department of Natural Resources, however, they are difficult to enforce, particularly in remote areas.

In the Margaree watershed, Nova Scotia Environment, working in partnership with local watershed groups, were successful in relocating a Snowmobile Association of Nova Scotia trail to reduce the potential damage of snowmobile and OHV use in sensitive bogs and barrens in the Jim Campbells Barren Wilderness Area (NSE 2008). Bird Studies Canada and its partners collect data on OHV activity in beach

and dune habitat during surveys for Piping Plover and report violations to NS Environment and Natural Resources.

7.2 Dams and water management/use (Threat Rating: Medium)

Aquatic connectivity refers to the accessibility of habitat within a network of freshwater streams, rivers, and lakes to aquatic species that migrate through the system, the quality of which has been identified as critically important to the success of a number of aquatic species, such as Atlantic Salmon and Brook Trout. Increasingly, the ecological integrity of these networks is being compromised by barriers to fish passage, which potentially restrict or eliminate the movement of fish and other aquatic species up and down streams and limit accessibility to suitable spawning, feeding, overwintering, and summer habitats (Fielding 2011; MTRI 2007). Aquatic fragmentation caused by improperly or poorly installed culverts occurs at numerous sites throughout the bioregion.

There are 38 mapped dams in the bioregion (Figure 24). According to Sterling *et al.* (2014), the average percent of stream length within the bioregion watersheds behind dams is only 0.5 percent. Culverts are therefore considered the main threat to aquatic connectivity for native fish species within the bioregion (A. Weston, Adopt a Stream, pers. comm.). A 2013 comprehensive culvert assessment of 27 stream crossings in the East Bay area of the Bras d'Or Lakes completed by Clean Annapolis River Project (CARP) as part of the Atlantic Coastal Action Program (ACAP) Cape Breton revealed a high degree of impassibility related to improper culvert installation. They found that of the 27 fish-bearing stream crossing assessed, 17 culverts were full barriers to fish passage, and 7 were partial barriers, meaning 89% of the culverts assessed constituted a barrier to fish passage (Oliver *et al.* 2013). In northern Cape Breton, aquatic fragmentation has been caused by the installation of culverts along coastal roads and the channelization of the Clyburn and Chéticamp Rivers. These actions have reduced access to and caused the destruction of spawning and rearing habitat for trout, salmon, and eels (Parks Canada 2010b).

7.3 Other ecosystem modifications – shoreline armoring (Threat rating: Low)

The coastlines of Nova Scotia are gradually receding inland over time as a result of post-glacial sea level rise and regional subsistence (CBCL Ltd. 2009), and the rate of sea level rise is expected to increase substantially in response to anthropogenic-caused global climate warming (US CCSP 2009). Sea level rise generally results in eroding coastlines, and over the last century, humans have responded to coastal erosion and flooding by using engineering measures to protect threatened property, such as infilling and the installation of seawalls and rip rap (US CCSP 2009). These measures lead to a phenomenon referred to as coastal or shoreline armoring. Coastal ecosystems, such as beaches, tidal marshes, and tidal flats, respond to gradual sea-level rise by growing vertically and migrating inland, provided that there is sufficient sediment supply. Shoreline armoring effectively prevents their inland migration and may result in the loss of these coastal ecosystems over time. In the case of tidal marshes, aside from the obvious impacts of infilling, which results in complete degradation of the habitat, tidal marshes may also be impacted by coastal development that results in tidal flow restrictions, such as undersized or poorly constructed bridges and culverts. Tidal flow restrictions can result in substantial impacts to hydrology, decreased soil accretion, and changes in vegetation structure, which can severely impact the health and integrity of tidal marsh habitat (Roman *et al.* 1984).

8.1 Invasive non-native species (Threat Rating: Medium)

Non-native species can disrupt ecosystems by displacing native species through competition or predation, or by introducing disease. There are a number of invasive non-native species having negative impacts on ecosystems within the bioregion.

The European Green Crab (*Carcinus maenas*) is a highly invasive species that is common in shallow waters along the coastline of Nova Scotia, having arrived in Nova Scotia marine waters in the 1950's (MTRI 2012) and specifically to the Bras d'Or Lakes between 1992 and 1995 (Trembley 2002). A national risk assessment flagged the European Green Crab as an ecologically and economically high risk species on both coasts of Canada (Theriault *et al.* 2008). It is a voracious consumer of both plants and animals, and can have significant predation impacts on local native species, such as soft-shell clams, Blue Mussels, and juvenile and trapped adult lobster. This species is also recognized as an 'ecosystem engineer', causing significant physical destruction to Eelgrass beds and disrupting the fine sediments on tidal flats as they forage for soft-shelled clams, which is thought to be a contributing factor in the decline in Eelgrass within some estuaries in Nova Scotia (Garbary *et al.* in Hanson 2004). Eelgrass has been identified as an ecologically significant species that provides nursery habitat for juvenile stages of fish and invertebrates, and important feeding habitat for migrating waterfowl (DFO 2009; Hanson 2004). The highest densities of green crab are in West Bay and field surveys in the Deny's Basin have shown eelgrass beds to be significantly smaller than previously indicated (Parker *et al.* 2007). Traditional ecological knowledge confirms that green crabs are damaging eelgrass in the Bras d'Or Lakes and that the loss of eelgrass has likely played a role in the decline of herring and oysters (CEPI 2006).

Another marine invasive species is thought to have entered the Bras d'Or Lakes through ballast water discharge from ships, the protozoan *Haplosporidium nelson,* which began to parasitize Oysters in 2002 (Stephensen *et al* 2003). This protozoan MSX (multinucleated spherical X) infection has resulted in epidemic morbidity and mortality in the oyster beds of the Bras d'Or Lakes estuary, essentially destroying the capture fishery and aquaculture industry (Stephensen & Petrie 2005; Beresford & Hatcher 2007). In 2008, another disease of unknown origin (the Malpeque disease) was discovered in a few oyster populations in a small region of the estuary.

Invasive vascular plant species are also abundant within the bioregion. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, though it is unclear if these introduced species are displacing the native biodiversity (S. Blaney, per. comm.). Field work completed at 21 sites in Cape Breton to determine the ecological significance of gypsum and other calcareous exposures, showed that on average 20% of the species observed were exotic (Mazerolle *et al.* 2015) . A proportion of these would be considered invasive.

Within Cape Breton Highlands National Park, two non-native invasive species have been identified, Japanese Knotweed, an invasive plant that can destabilize riverbanks resulting in siltation of fish habitat, and Spiny-cheeked Crayfish, a voracious predator discovered in one of the Park's lakes (Parks Canada 2010). The Park is making efforts to reduce their numbers.

8.2 Problematic native species (Threat Rating: Bioregion – Low / Highlands region - Medium)

The Spruce Budworm is a native insect that has the capacity to destroy entire forest stands, especially where their target species make up a high percentage of the stand (i.e., low species diversity). Spruce budworm outbreaks are a natural cycle within coniferous forests in the region, however a history of intensive forestry in the region has resulted in a wide distribution of even-aged forests with reduced resilience and increase susceptibility to outbreaks. The Spruce Budworm is widely distributed

throughout Canada, and has caused more damage to Nova Scotia's softwood forests than any other insect (NSDNR 2013a). This pest species can have a significant influence on the successional stage and composition of spruce-fir forests in Nova Scotia, with mature and over-mature Balsam Fir and White Spruce the most susceptible to defoliation (Neily *et al.* 2008). Outbreaks of Spruce Budworm occur approximately every 30 to 40 years in Nova Scotia, with the last major outbreak in Atlantic Canada occurring in the 1970's, peaking in Nova Scotia in the early 1980's (NSDNR 2013a). During this outbreak, large patches of Balsam Fir forest in Cape Breton Highlands National Park were heavily impacted. Then, since the late 1990s, extensive moose browse has halted second growth succession, converting large areas to grassland (Figure 25), and further fragmenting the Boreal forest region. Boreal forest condition in the park is considered to be poor and declining (Parks Canada 2010b).

9.1 Domestic and urban waste water (Threat Rating: Low)

Human sewage management has been an issue on the Bras d'Or Lakes (BLBRA 2010). Direct discharges into the Bras d'Or Lakes occur from onshore sources, commercial ships and recreational boats, as well as issues with faulty residential and light industrial septic tank systems, and inadequate municipal waste treatment facilities. The main impact is bacterial contamination of shellfish and aquaculture sites, with some 3.5% of the tested area of the estuary closed to shellfish harvesting at present (up from <0.01% in 1974; UINR 2007). Direct impacts on human health from these sources have yet to be reported, and in general, the water quality in the Bras d'Or Lakes estuary is very good by national and international standards (Parker *et al.* 2007; UINR 2007; BLBRA 2010). In addition to the Bras d'Or Lakes estuary, some development occurs along major rivers where septic seeping may introduce pollutants into water courses, though the scope is low.

Concerted efforts have been underway, beginning in 1997 with the Bras d'Or Stewardship Society, and strengthened with the formation of the Pitu'paq Partnership in 2001, to implement pollution control, remediation and prevention for the Bras d'Or Lakes. The prime focus for this work has been human sewage management. A number of projects to upgrade sewage treatment facilities, or to install new ones, have been undertaken under the authority of the Provincial Department of Environment, Municipal Councils and First Nation's Band Councils (these entities make up the Pitu'paq Partnership).

On the Cabot Trail in northern Cape Breton, intensive winter road maintenance is required to ensure public safety, and large volumes of salt are used to maintain passable road conditions. Road salt application has been linked to impacts in some wetlands and lakes adjacent to highways; Parks Canada strives to use road salt in the most environmentally responsible manner and it exploring opportunities and options to further reduce the environmental impacts of road salt, while maintaining road safety (Parks Canada 2010).

9.5 Air pollution and acid precipitation (Threat Ranking: Low)

Due to prevailing westerly winds, Nova Scotia receives inputs of acids and other contaminants from the long-range transport of air pollution originating from densely populated, highly industrialized regions of the continent (i.e., coal-burning electricity generating stations in the Midwest and large cities in Central Canada and the Northeast United States). In addition, Cape Breton Island lies downwind of industrialized areas of Nova Scotia and therefore receives additional emissions. Acid precipitation and the acidification of surface waters can have major implications for the health of terrestrial and aquatic ecosystems. Atlantic Salmon populations in Nova Scotia are in serious decline, with populations extirpated from a number of rivers and greatly reduced in all other rivers where they occur on mainland Nova Scotia (DFO 2000; Watt *et al.* 2000). Acidification of their spawning rivers is thought to be one of the principle factors contributing to their declining numbers and poor reproductive success, with highly

acidified rivers no longer supporting naturally reproducing populations. Fortunately, unlike some areas of Nova Scotia that lack natural buffering capacity (e.g., Southwest Nova Scotia), the bedrock and surficial geology underlying most of Cape Breton Island lessens the impact of acidic precipitation. Additionally, legislation and initiatives introduced to limit emissions since the early 1980's have significantly reduced sulphate deposition levels (Clair & Hindar 2005); nonetheless, within the Cape Breton Highlands National Park management plan (2010), sources of pollution are identified as a result of heavy automobile activity on the Cabot Trail. It is recognized that the old growth hardwood forest in the Grande Anse Valley may be suffering from air pollution caused by traffic passing through the valley; currently the Park is monitoring levels of ozone in the area (Parks Canada 2010a).

xi. Emerging Threats

11.1 Climate Change and Habitat Shifting (Threat Rating: High)

In the Atlantic Provinces, mean temperature and summer rainfall are expected to increase by 3°C and 0% to 10% respectively by 2040 as a result of climate change (Bourque & Hassan 2008). Bourque & Hassan (2008) modeled anticipated tree species habitat redistribution in the Acadian Forest of eastern Canada as a result of climate change, and their preliminary projections suggest that boreal species such as Black Spruce and Balsam Fir will be limited to the cooler areas of the province, and temperate hardwood species such as Yellow Birch and Red Oak, as well as White Pine, will benefit from climate change. The resulting impacts of this anticipated habitat shifting on native wildlife is currently unknown. For wildlife species, anticipated range shifts to the north and from coastal to inland sites could lead to the introduction of new predators and increased competition with native wildlife (Environment Canada 2013). Climate change that increases water temperatures can be expected to have a detrimental effect on native trout and salmon (MacMillan & Crandlemere 2005). In freshwater lakes and rivers, climate change will likely lead to a further reduction in the availability of summer thermal refugia habitat for cold water fish species such as Brook Trout and Atlantic Salmon, and an increase in habitat availability for species more tolerant of temperature fluctuations, such as Yellow Perch (*Perca flavescens*) and the invasive Smallmouth Bass (*Micropterus dolomieu*) and Chain Pickerel (*Esox niger*), recently seen in the bioregion. Currently, almost 89% of the 33 sites assessed on the Denys, Middle and Baddeck River systems are cold to intermediate water sites in summer, compared with a Provincial average of only 61% (Parker *et al.* 2007).

Sea-level rise and an increase in the frequency and intensity of storms

Two associated effects of climate change that are expected to have dramatic impacts on the bioregion's coastal ecosystems are global sea-level rise and an increase in the frequency and intensity of storms, and consequently coastal erosion (US CCSP 2009). Global sea levels have risen approximately 120 m due to natural processes (post-glacial sea-level rise, regional subsistence) since the height of the most recent glacial period (i.e., the Wisconsin Glaciation; US CCSP 2009). More recently, the rate of sea-level rise has increased as a result of global climate change. As the oceans warm and expand and polar ice caps melt, estimates of relative sea-level rise in the region range from 45 to 80 cm by 2055, and 1.2 m to 1.73 m by 2100 (CBCL Ltd. 2009; Greenburg et al. 2012; Richards & Daigle 2011). This will have profound effects on the bioregion's coastal ecosystems through increased coastal erosion, inundation, and frequency of flooding (US CCSP 2009). At highest risk are the barrier beaches and barachois ponds and the potential for loss of low lying coastal islands and associated biodiversity, in particular seabird colonies.

Coastal ecosystems, such as beaches, tidal marshes, and tidal flats, respond to sea-level rise by growing vertically and migrating inland over time. Only those coastal features that accumulate sediment at a rate that maintains their elevation relative to sea-level will persist; thus, having space available with a low

gradient slope for inland migration is critical for the maintenance of coastal ecosystems in the face of increased sea-level rise as a result of climate change (US CCSP 2009).

Traditional Ecological Knowledge (TEK) in the Bras D'or Lakes region reveal there are fewer jellyfish because of warmer water. Warmer winters have resulted in less snow pack and lake ice resulting in less spring runoff, impacting fish populations and raising bacteria levels in streams. Insect populations have increased and algae have become more abundant in inlets (CEPI 2006).

Though the threat from climate change is predicted to be high, Cape Breton has been shown to contain a high degree of resilience to climate change by work completed by the Nature Conservancy in the United States (Anderson *et al.* 2012). The term resilience refers to the capacity of a site to adapt to climate changes while still maintaining diversity without the assumption that the suite of species will remain the same (Anderson *et al.* 2012; Figure 26).

Figure 16. Development within the Cape Breton bioregion (features size exaggerated for display purposes).

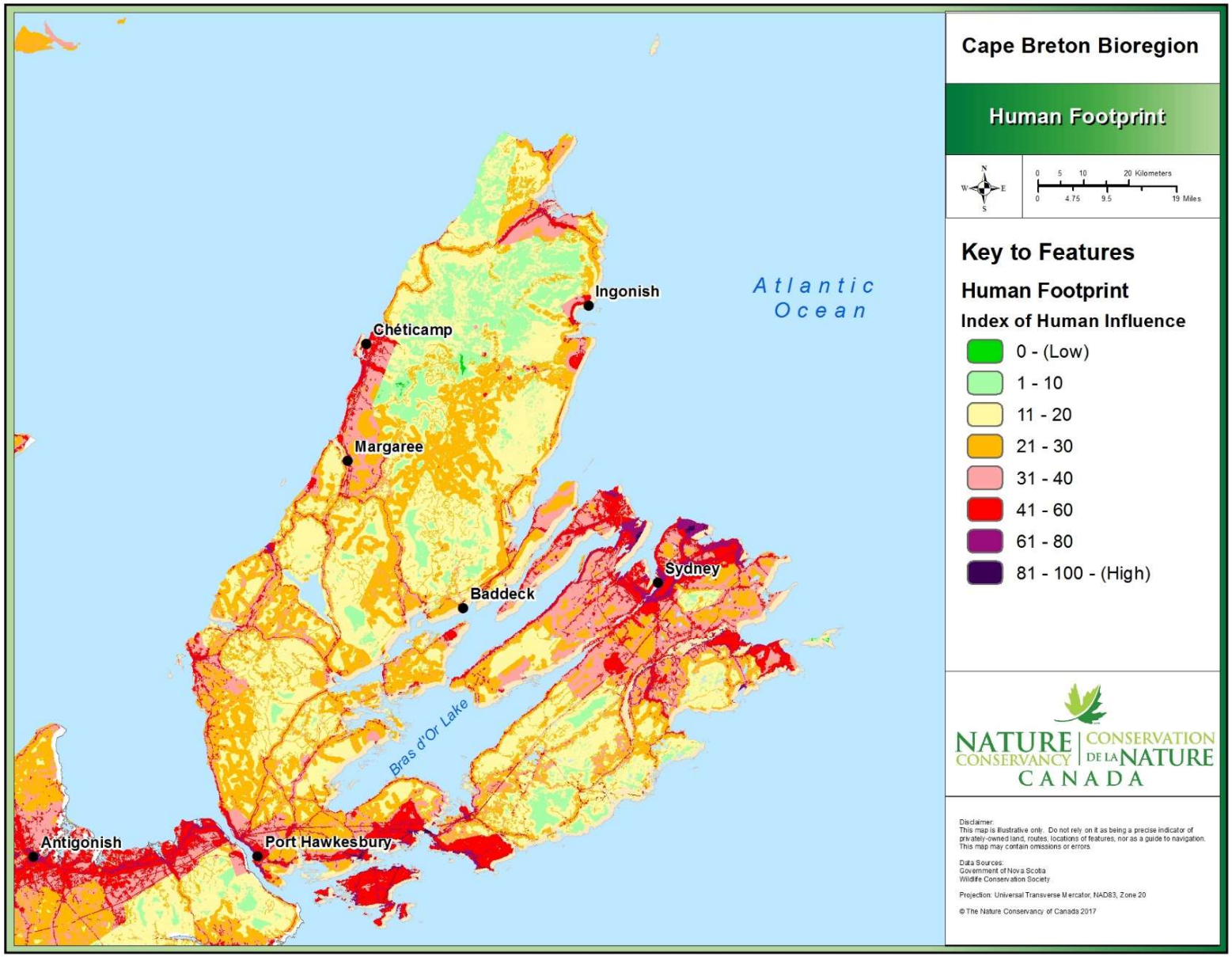

Figure 17. Human Footprint Index for the Cape Breton bioregion.

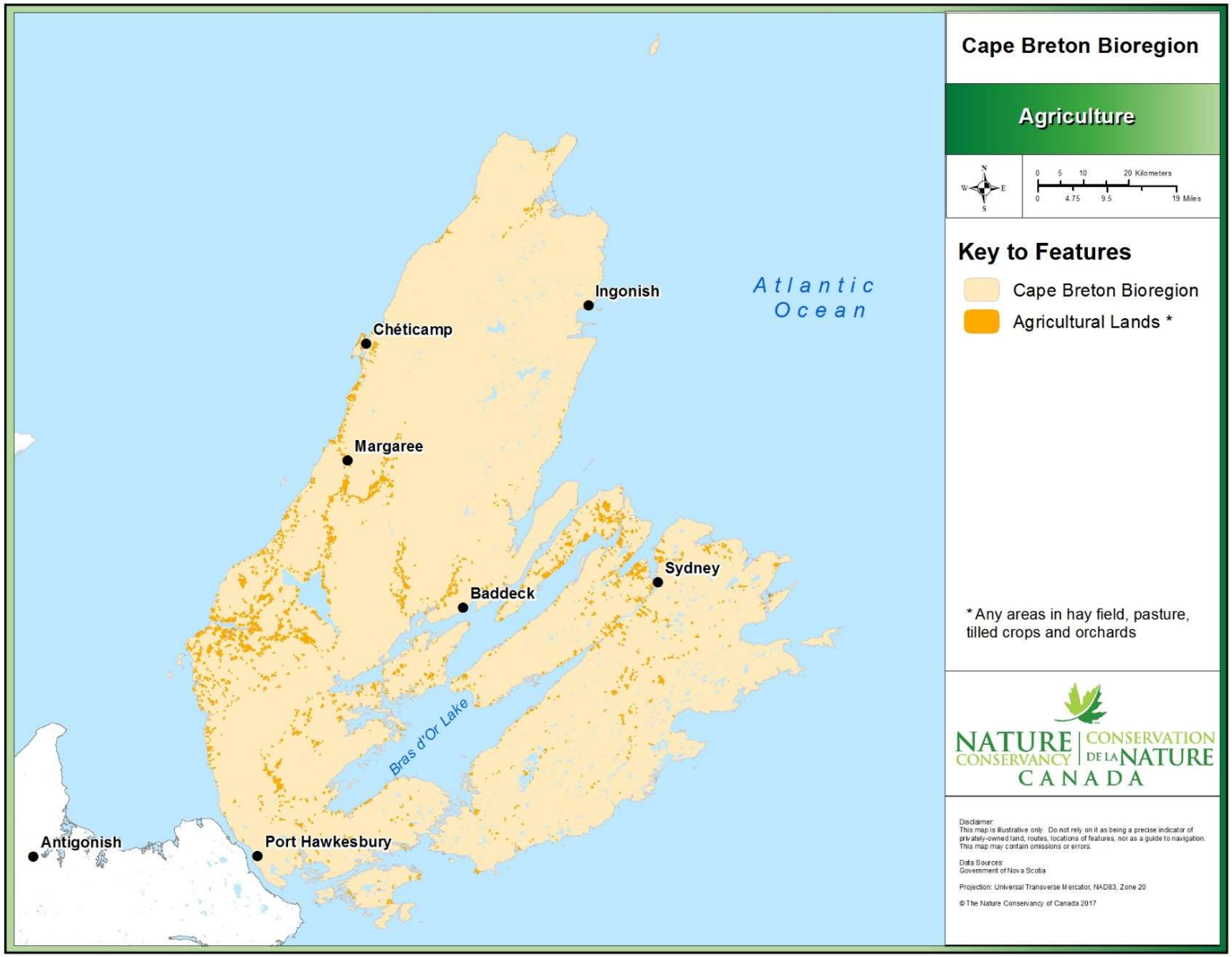

Figure 18. Agriculture within the Cape Breton bioregion. (features size exaggerated for display purposes)

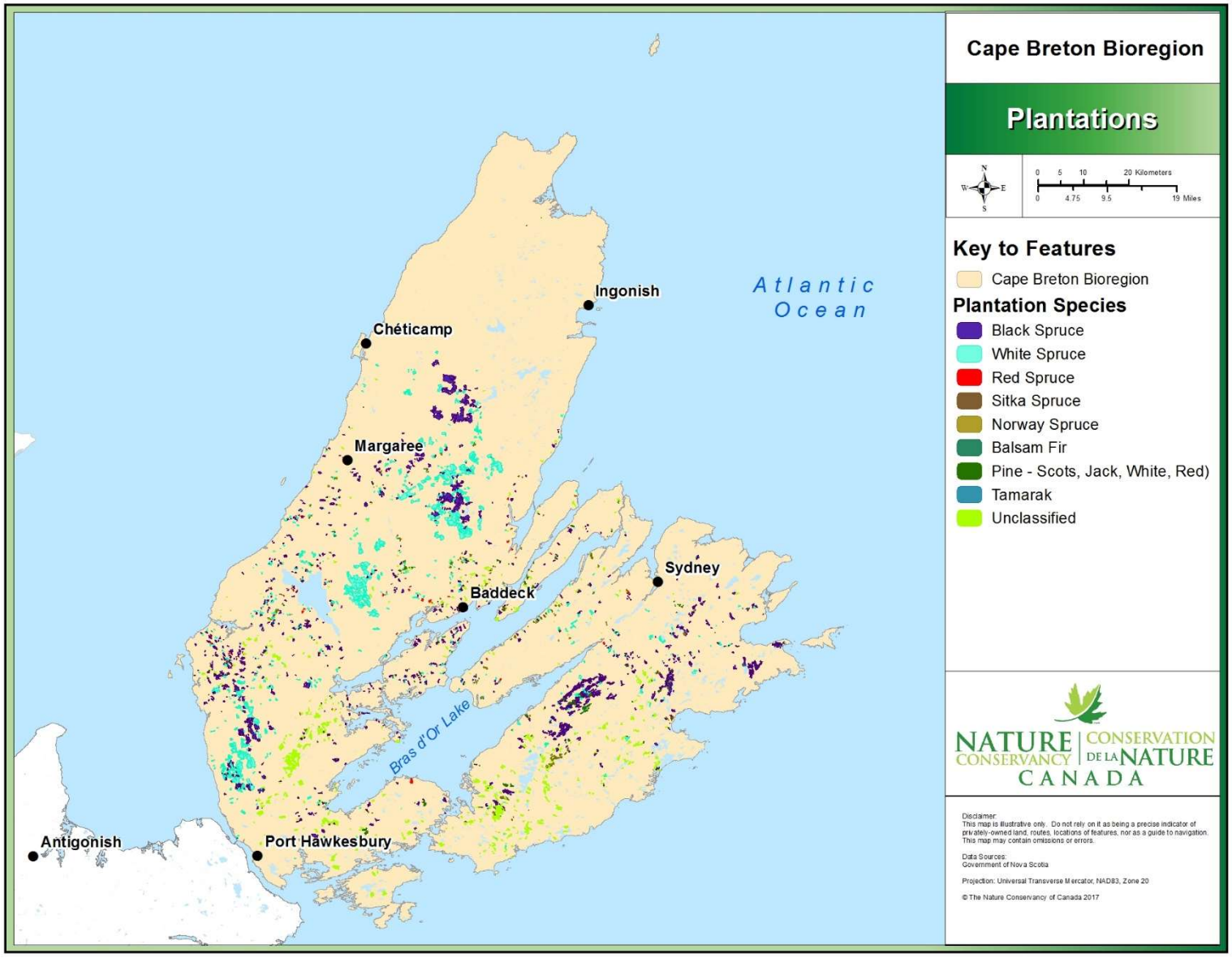

Figure 19. Plantations within the Cape Breton bioregion. (features size exaggerated for display purposes)

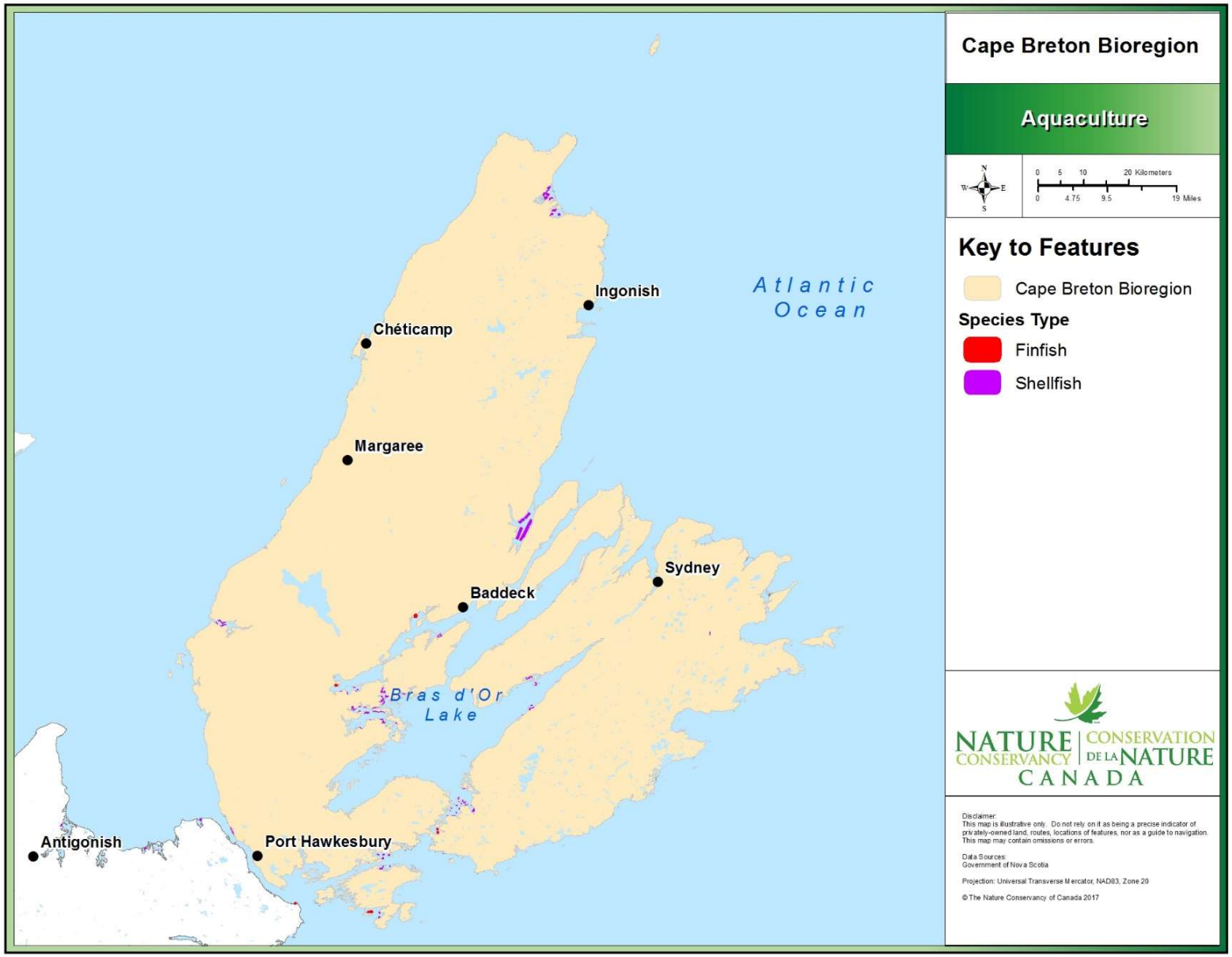

Figure 20. Aquaculture within the Cape Breton bioregion. (features size exaggerated for display purposes)

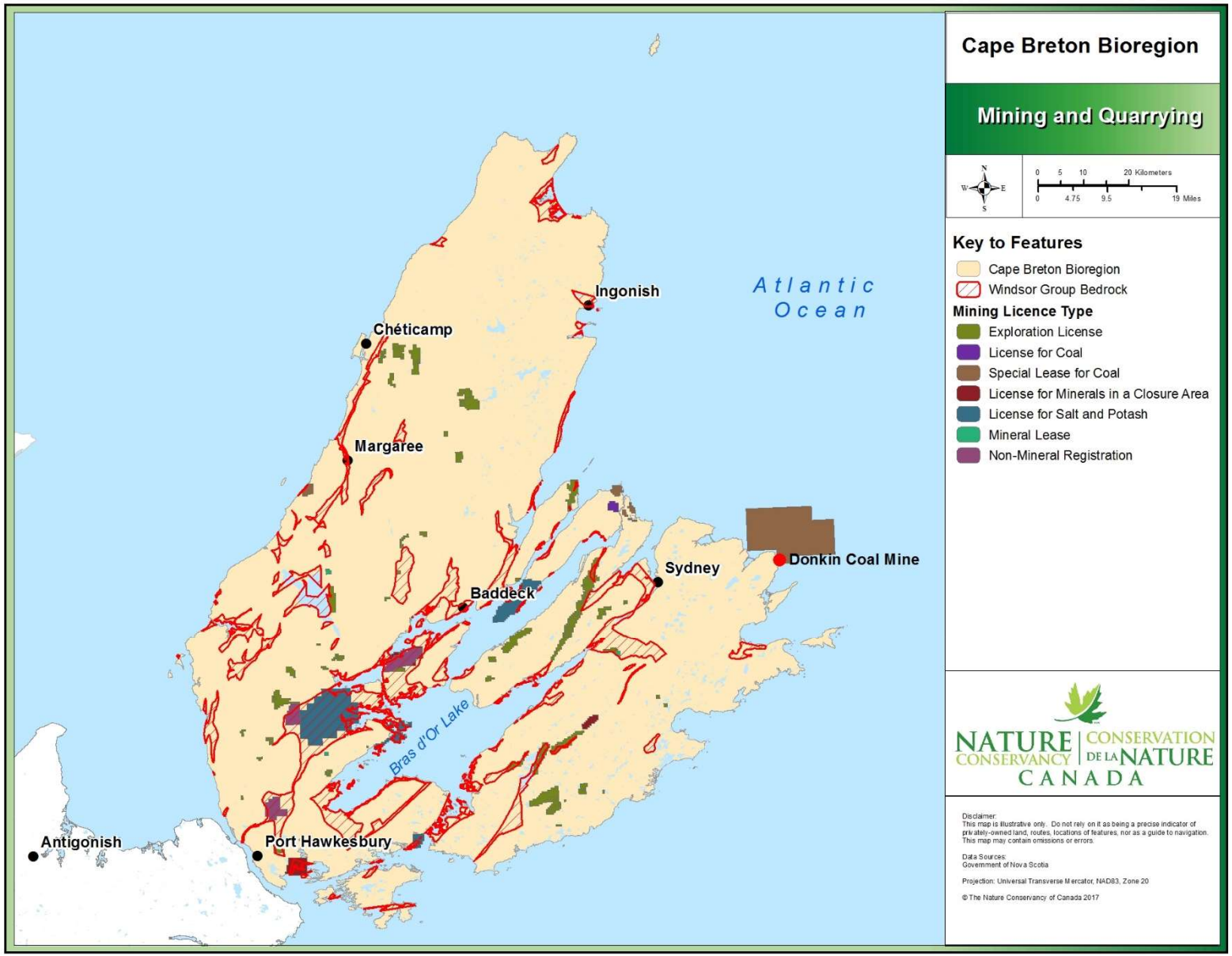

Figure 21. Mining licenses and leases within the Cape Breton bioregion.

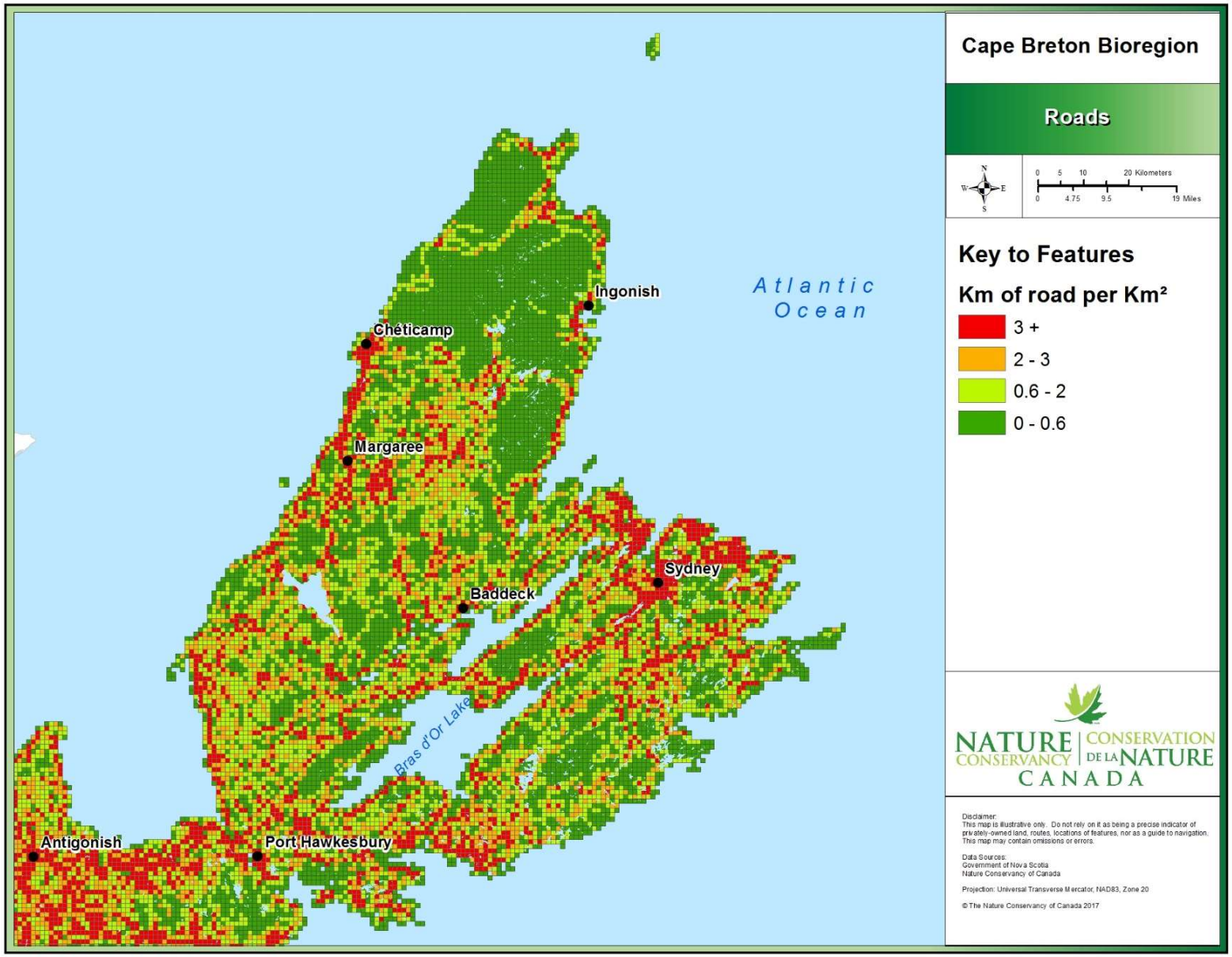

Figure 22. Road density within the Cape Breton bioregion.

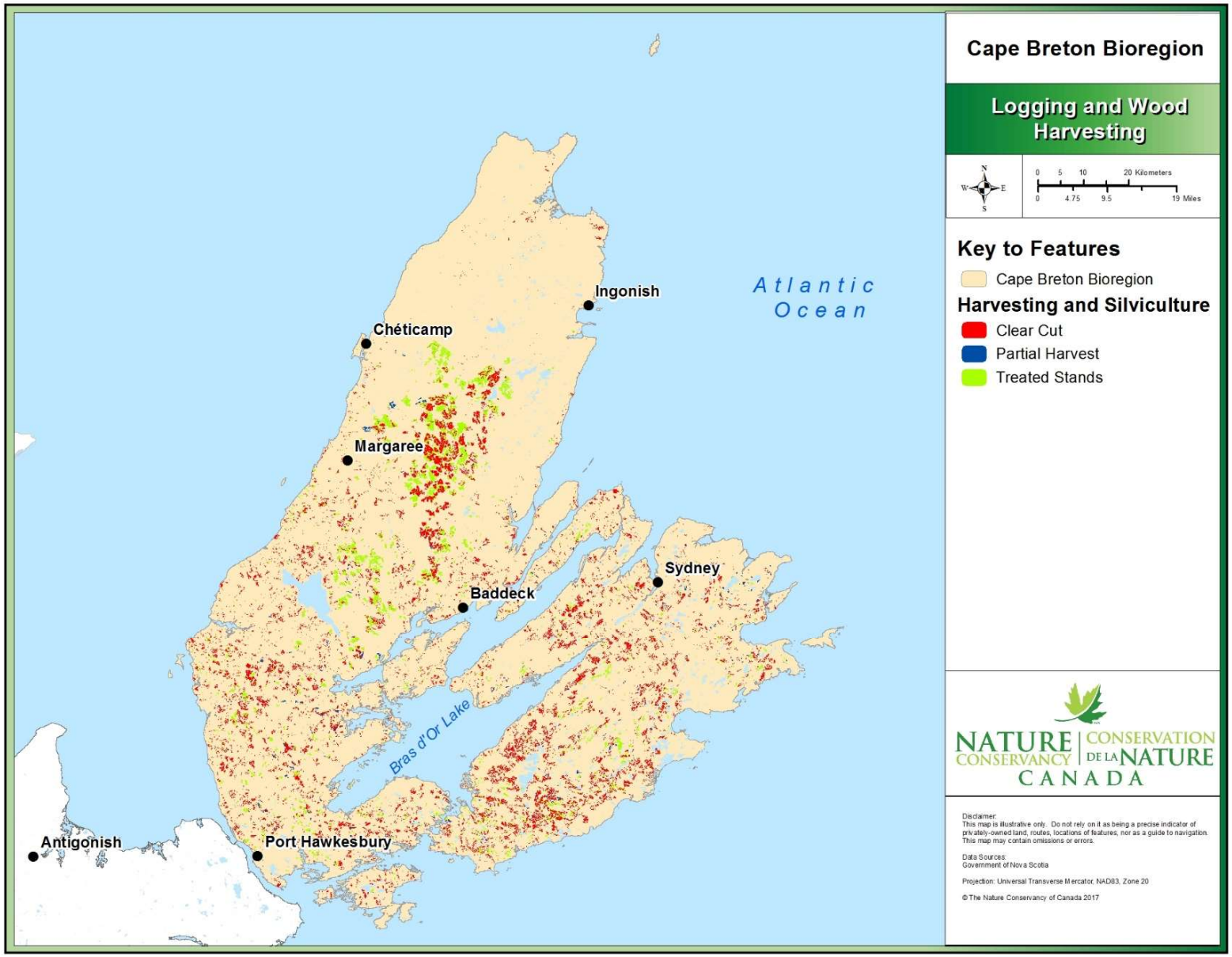

Figure 23. Logging and wood harvesting within the Cape Breton bioregion (clear cutting since 2001).

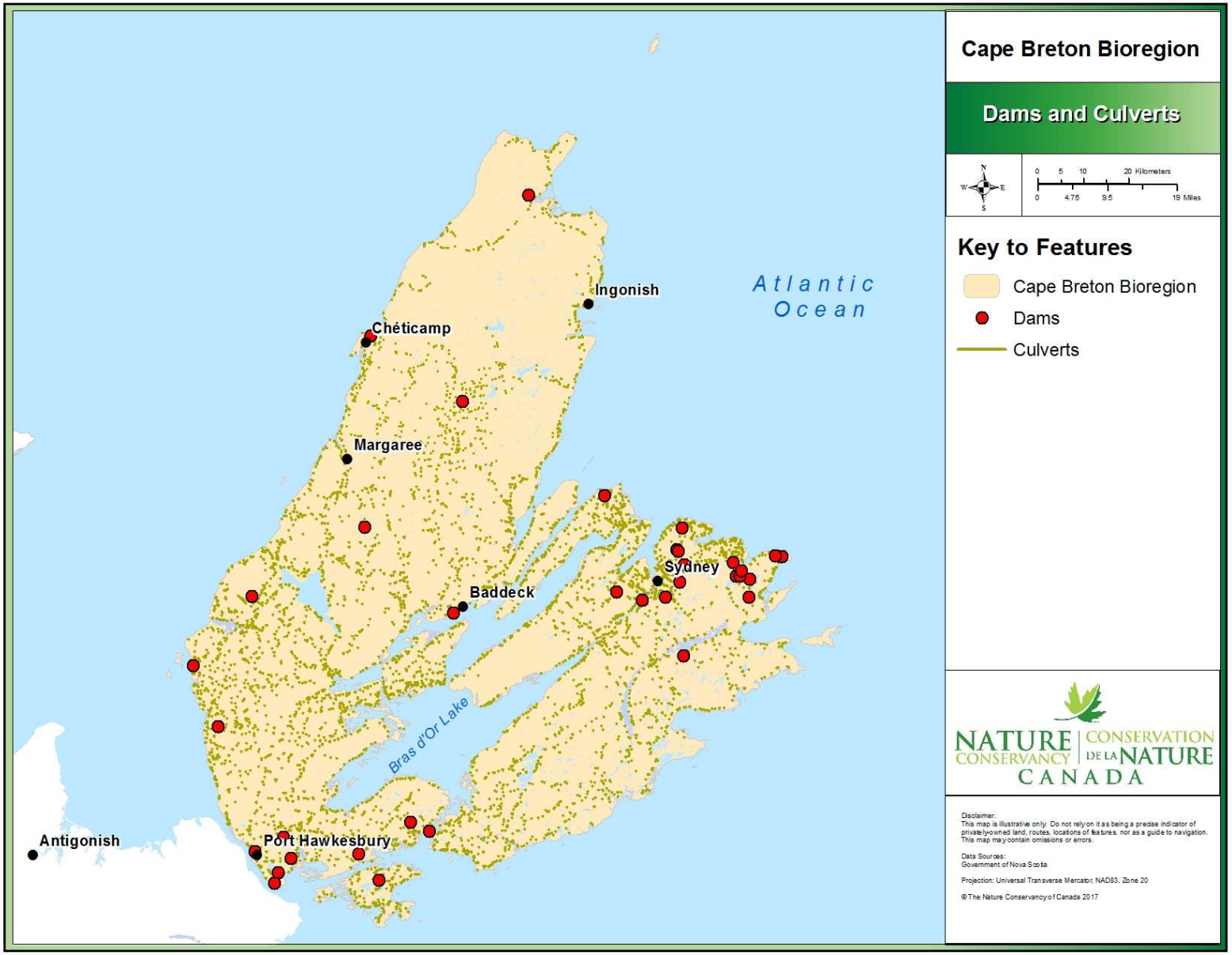

Figure 24. Potential aquatic barriers within the Cape Breton bioregion.

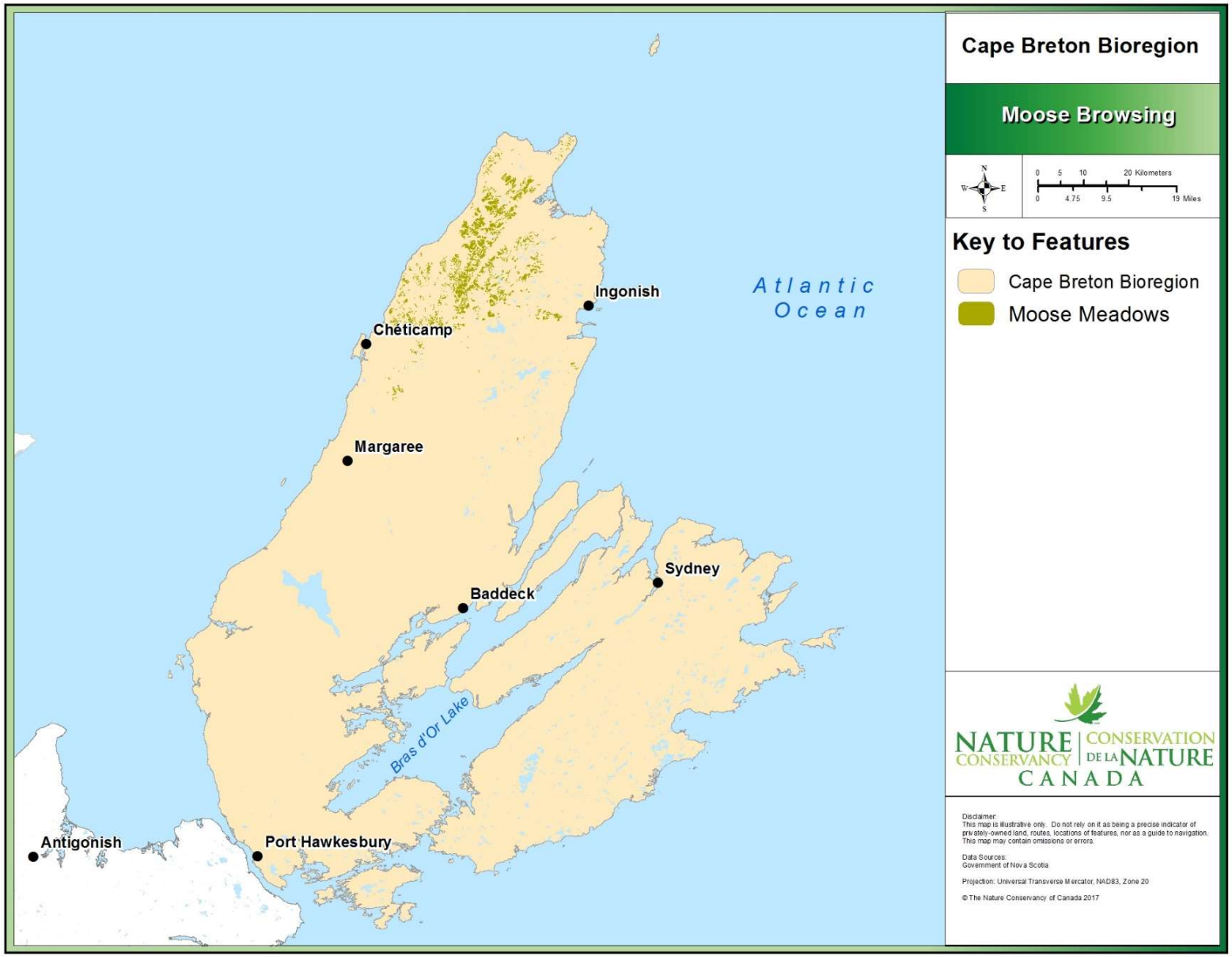

Figure 25. Areas heavily browsed by moose within the Cape Breton highlands.

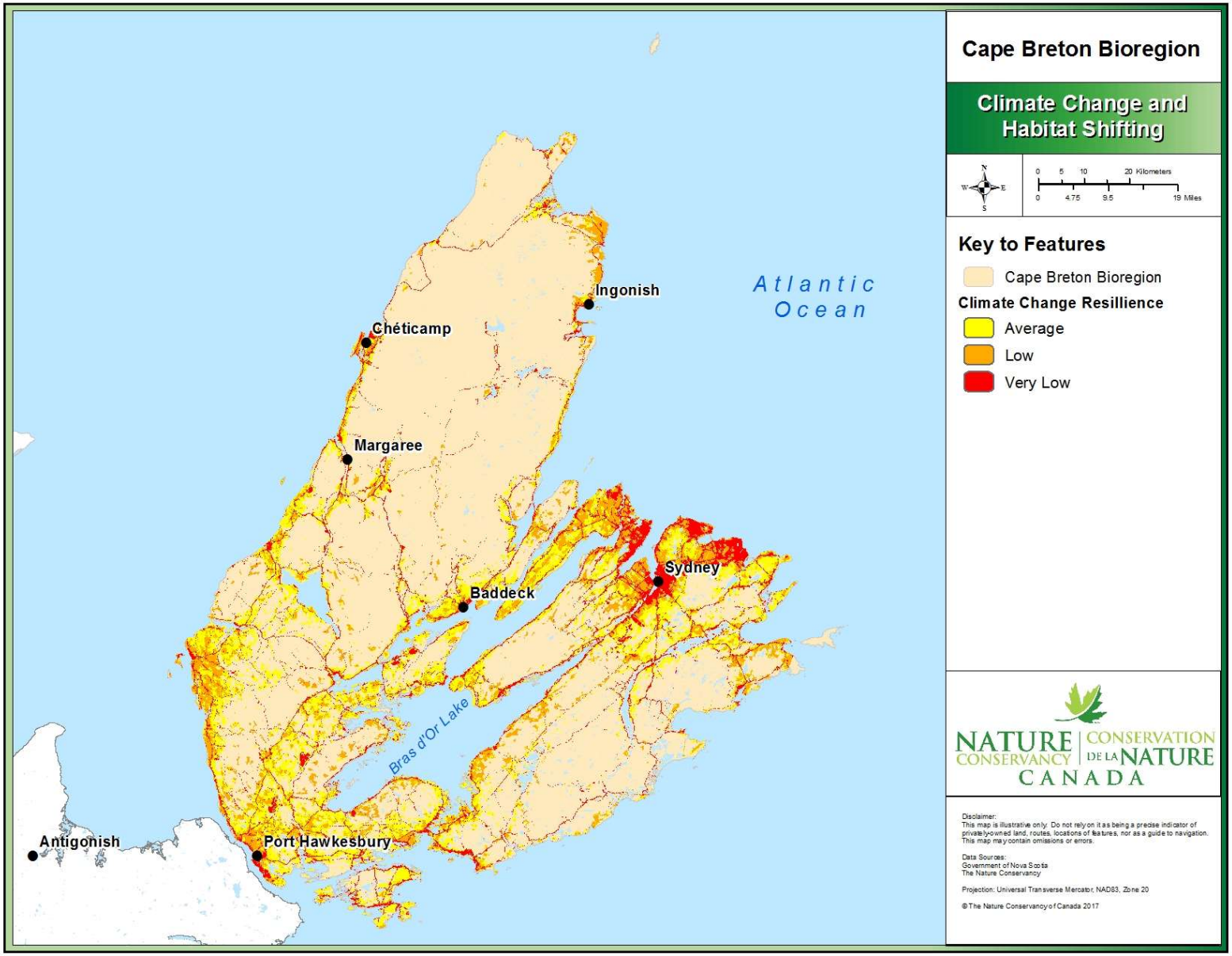

Figure 26. Climate change vulnerability within the Cape Breton bioregion (TNC 2016).

C. Spatial Analyses

As part of the Habitat Conservation Strategy, methodologies were developed with partners to define and combine a series of priority habitats with priority species occurrence composites to identify areas within the CB bioregion that have high conservation value. The goal is to achieve the best possible impact of collective conservation actions in the bioregion in those areas that are the most important for conservation priority habitats and species. Three sets of maps were produced in the analyses which should be used together as decision-support tools: the priority habitat composite, priority species composite maps, and the conservation value index (CVI). No single map is intended to answer all questions regarding conservation needs and these maps are not designed as stand-alone products; the narrative of this report, as well as the threat maps are important elements to be examined. For various reasons, including introduced bias, the CVI map, priority habitat map, and various species composite maps can present contrasting perspectives on spatial priorities. This is expected and also reflects the reality that different approaches to conservation may be required for the conservation of different species and the habitats that host them (i.e., land acquisition versus stewardship). Though the CVI map can be consulted, other maps provided in this document may provide decision-support that is better suited to the mandate of a given conservation group or agency.

i. Habitat Spatial Prioritization

The purpose of the habitat spatial prioritization was to identify areas within the bioregion that have conservation value based on attributes of individual habitat patches independent of species occurrence data.

Habitat classification and data pre-processing

Prior to assigning conservation priority scores to habitat patches, spatial data for each priority habitat type was “pre-processed” in order to identify and isolate those habitat patches with the highest potential to have conservation value. For rare habitat types (e.g., beaches) all habitats found to be present were considered to have potential, thus no occurrences of these habitats were eliminated from the analysis. More widespread and complex habitats (e.g., forest or non-forested areas) also include patches of land unsuitable for conservation action, such as clear cuts or plantation forest blocks, very young forest, or urban and industrial land. Prior to habitat scoring, these patches of land were eliminated from the analysis by methods developed by the conservation partners. For a detailed description of the datasets used and the habitat classification methods employed in this step please refer to Appendix E.

Habitat patch weighting

The process for assigning priority ranks to habitats within the CB bioregion involved weighting (scoring) certain characteristics of the priority habitats higher than others. Freshwater wetland and Acadian and Boreal Forest mosaic habitat occurrences were scored using a three-tiered equation that equally divides the scoring by size (minimum patch size), representation in protected areas (by ecodistrict), and uniqueness (rarity within each ecodistrict and within the bioregion). All other habitat types were weighted according to size or presence/absence of certain characteristics. For a detailed explanation of the habitat weighting process, please refer to Appendix E. The methodology was deliberately designed to emphasize parcels of land that contain larger patches of priority habitats, were not adequately represented within protected areas (by ecodistrict), and/or contain rare habitat occurrences. The more high quality priority habitats that an area contained, the higher the priority rank it received, and higher scores were given to areas with larger patches of ecosystems selected as priority habitats. Area

measurements for the minimum patch size required to support biodiversity in each habitat type were used to comparatively rank habitats in order to avoid over-weighting small habitat patches. For each priority habitat type, final scores between 0 and 1 were assigned to each patch represented in the spatial dataset, with 1 representing high conservation value for priority species for that habitat type and 0 representing unsuitable habitat.

Priority habitat composite

The first map produced presents a composite of the priority habitat types. In order to create a decision support tool free from any bias inherent in the species data, species spatial information was excluded from this analysis. This map was produced by using an additive function that layered each habitat dataset and compiled the scores for each habitat patch. Scores making up the priority habitat composite include consideration of the uniqueness, representation, and size of individual patches of priority habitat types as described above. Figure 27 presents the priority habitat composite for all priority habitat types; a detailed description of the methodology and specific scoring criteria used can be found in Appendix E.

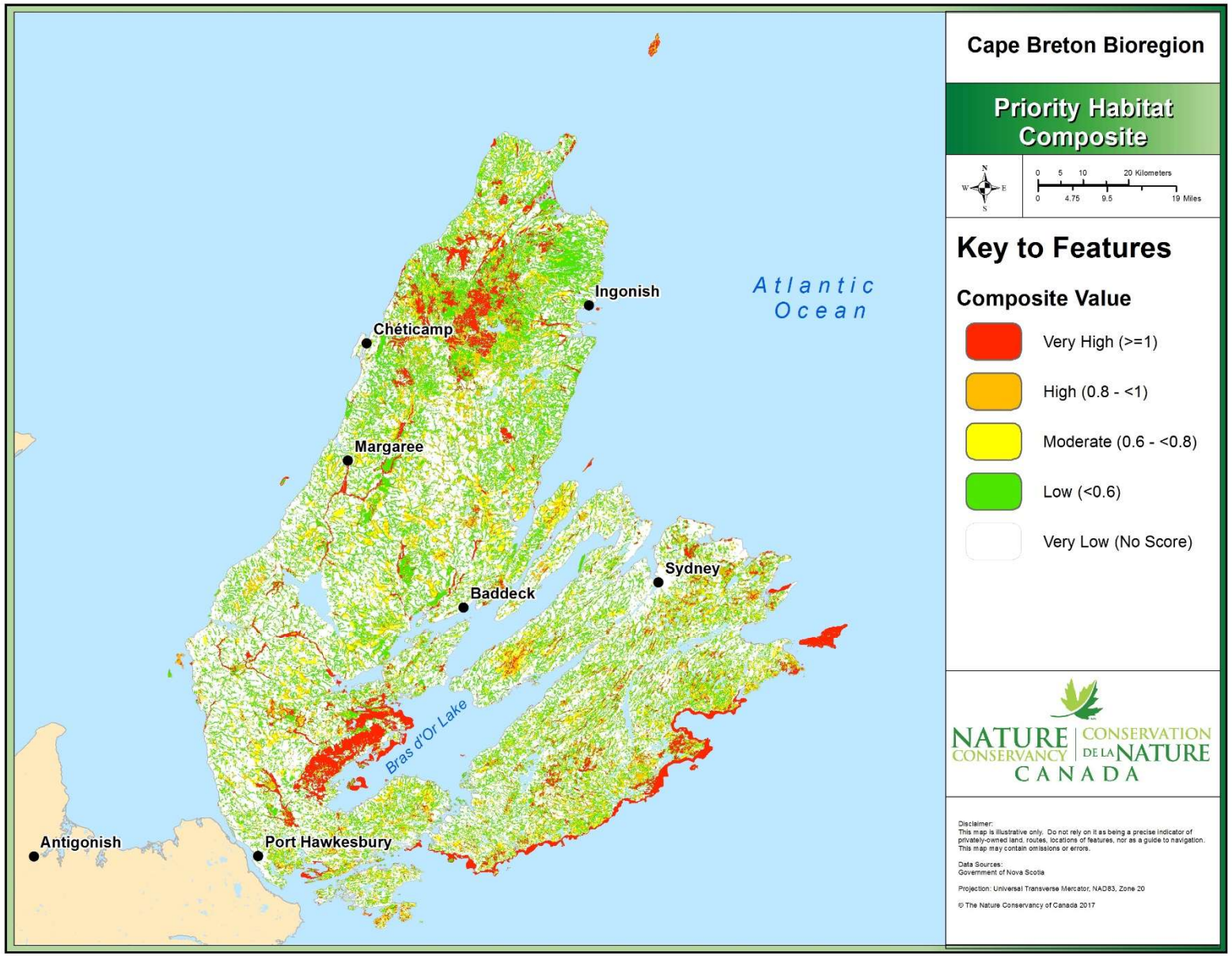

Figure 27. Priority habitat composite for the Cape Breton bioregion.

ii. Species Spatial Prioritization

Methodologies were also developed to map the likelihood of occurrence of priority species within the bioregion. These species composites consist of kernel density estimations of the likelihood of occurrence of priority species based on existing species occurrence data.

Species occurrence data

Spatial data were gathered for each priority species from various sources. For some species, multiple sources of spatial data exist, so the most complete or appropriate dataset was chosen. A single layer of information was derived for each species based on the most appropriate data available, and used to generate a spatial representation of relative occurrence across the province. A detailed description of the methodology and the data used to create the individual species layers can be found in Appendix E. The reader is cautioned that species occurrence data are for the most part temporally and/or spatially incomplete; as such, maps that rely on species occurrence data can be expected to reflect bias due to uneven effort intensity and should be interpreted as presenting relative available evidence of occurrence rather than true relative abundance. Such effort bias expectedly is pronounced in maps of species for which detections are rare (e.g., difficult to detect species, rare species) or that require intensive or survey approach. In order to improve future iterations of species maps, we encourage all those with any additional rare and priority species occurrence data to contribute their records to the Atlantic Canada Conservation Data Centre.

Species composites

Individual species datasets for the full suite of priority species were combined in this analysis to produce an overall biodiversity composite with all species receiving equal weighting. However, given important expected differences among the broad range of priority species included in this Habitat Conservation Strategy with respect to taxonomic groups, conservation status, habitat dependency, and survey bias, a series of species composites were developed for a number of sub-suites of the priority species. Sub-suites of priority species include taxonomic affiliation (i.e., birds, plants, mammals), COSEWIC status (species at risk), habitat dependency (habitat-limited species include those species that are considered to be long-term obligate species of a particular habitat type that have predictable, repetitive use of a relatively limited area over time), and, in the case of birds, survey type (i.e., breeding evidence data, point count data). A detailed description of the methodology used and species data sources can be found in Appendix E. The list of priority species, including their conservation status, habitat associations, and occurrence data sources is provided in Appendix C.

Consideration of the various species composites provides the reader with a better sense of the species and data sources driving certain map outputs, and better enables the reader to consult the underlying data that are most appropriate to their question of interest and hopefully make more accurate conservation decisions. It was felt that this approach and the materials produced would better reflect the ecological complexity of the bioregion and would provide more complete decision support for the broad range of users expected to make use of this Habitat Conservation Strategy.

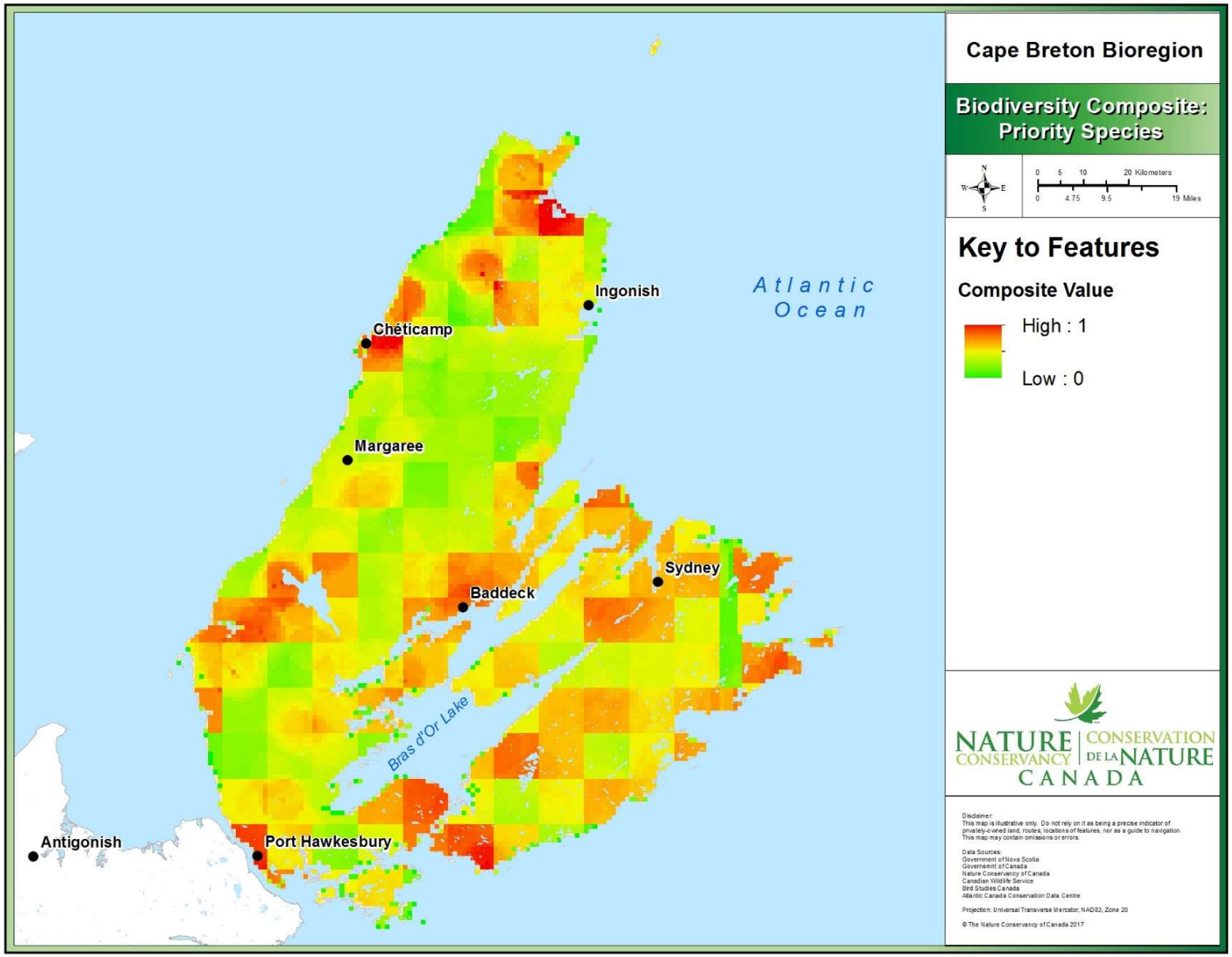

Figure 28. Species composite for all priority species in the Cape Breton bioregion.

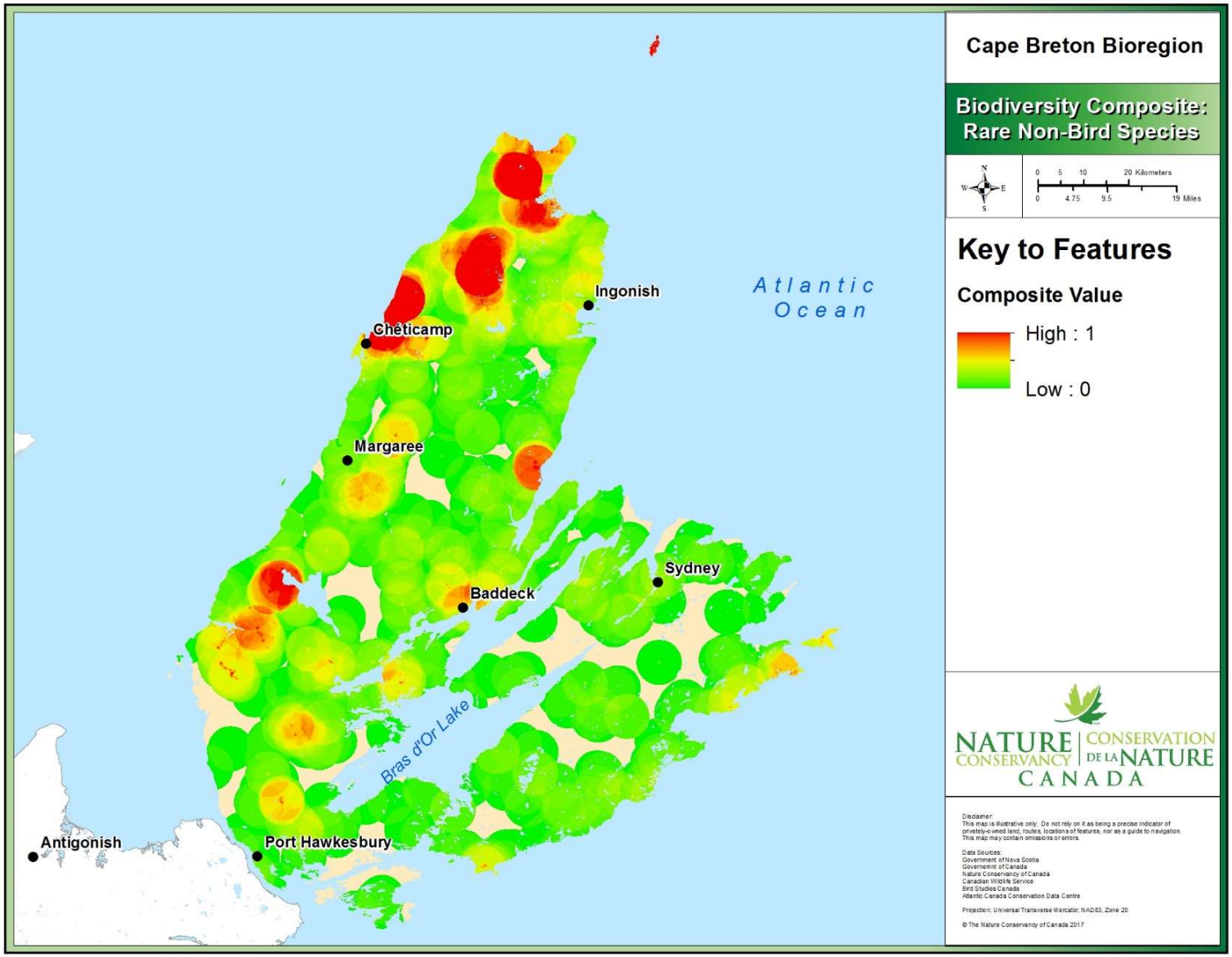

Figure 29. Species composite for species at risk (COSEWIC assessed and NS ESA listed) and rare non-bird priority species in the Cape Breton bioregion.

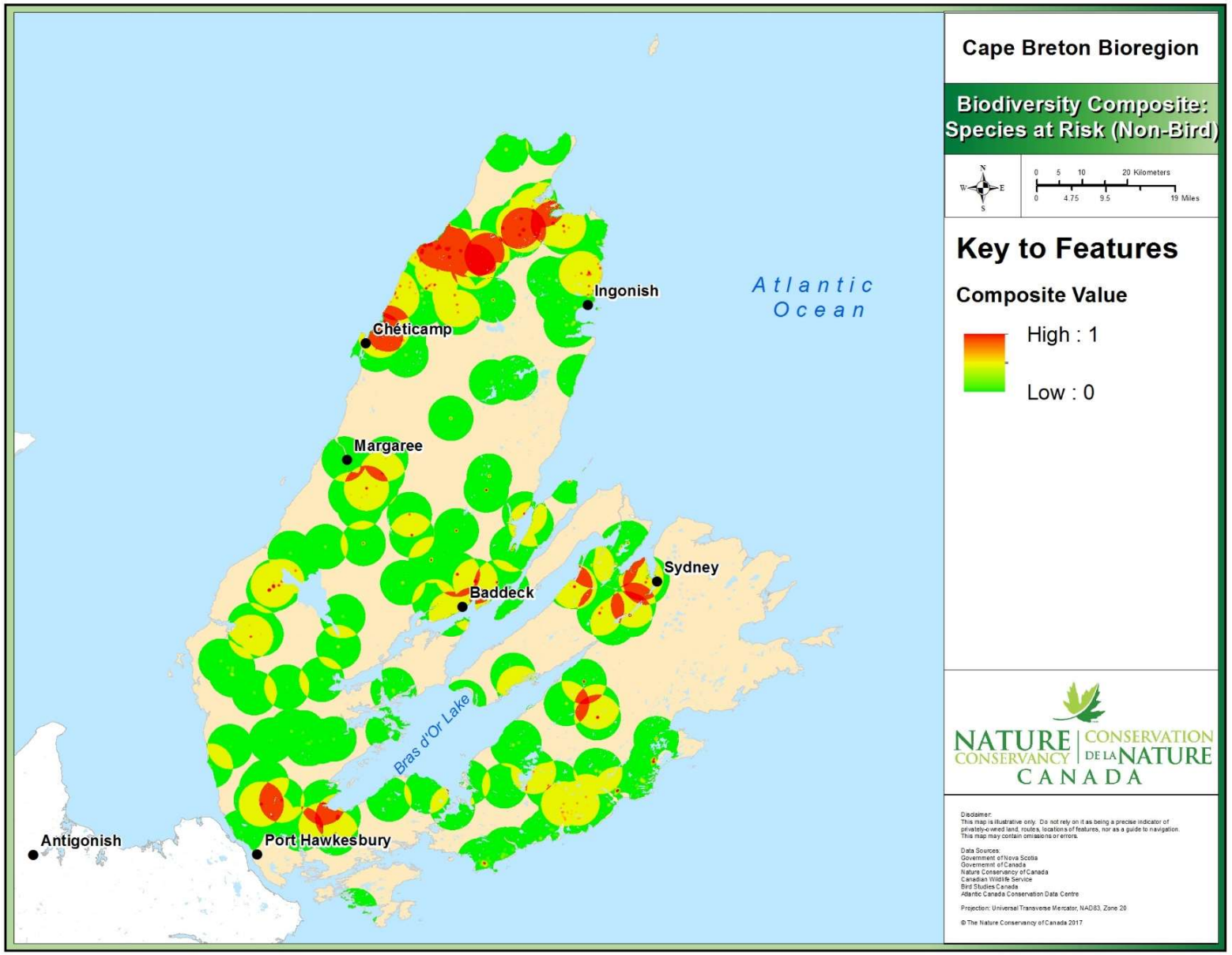

Figure 30. Species composite for non-bird species at risk (COSEWIC assessed and NS ESA listed) in the Cape Breton bioregion.

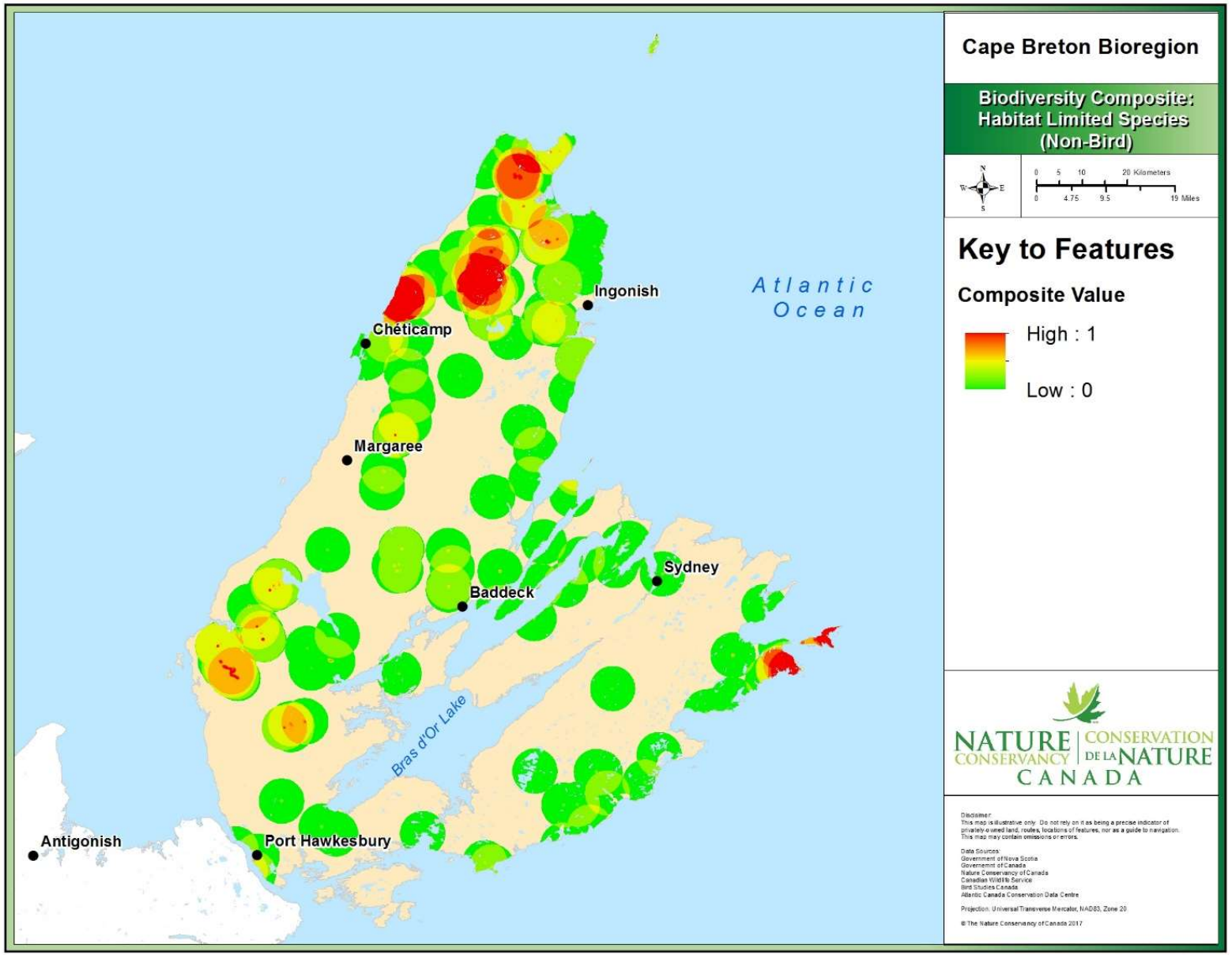

Figure 31. Species composite for rare and at risk non-bird habitat limited priority species in the Cape Breton bioregion.

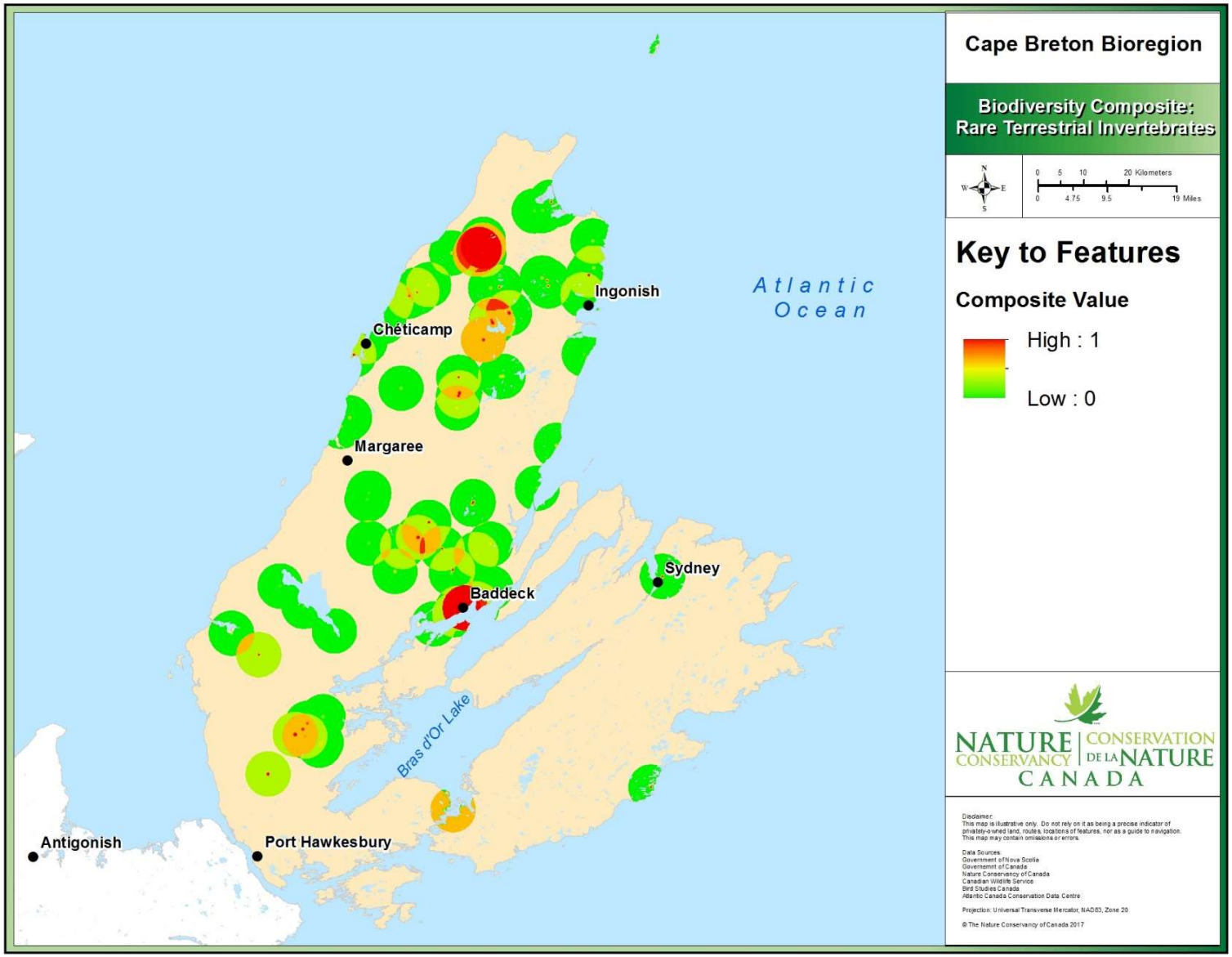

Figure 32. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) terrestrial invertebrate priority species in the Cape Breton bioregion.

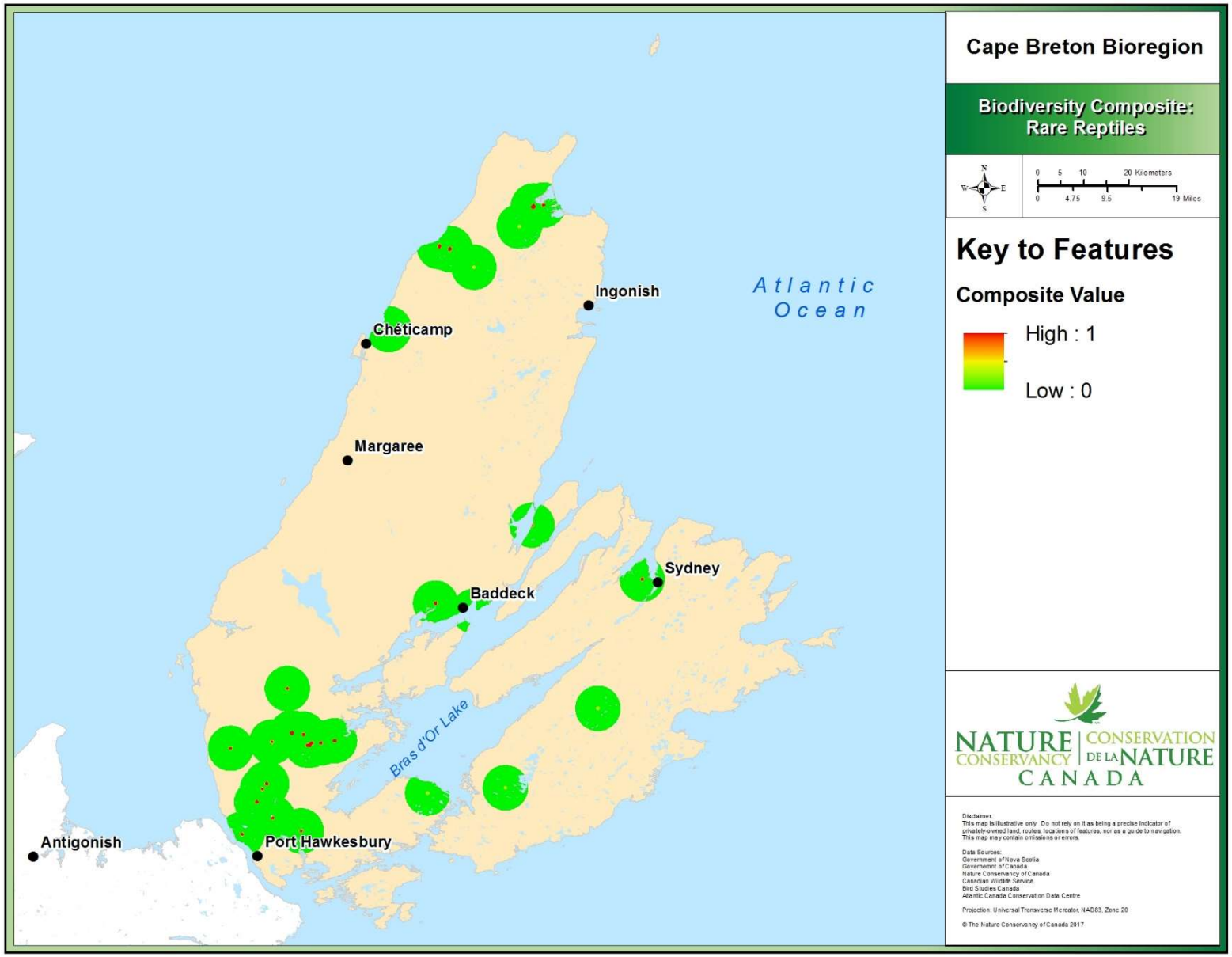

Figure 33. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) reptiles in the Cape Breton bioregion.

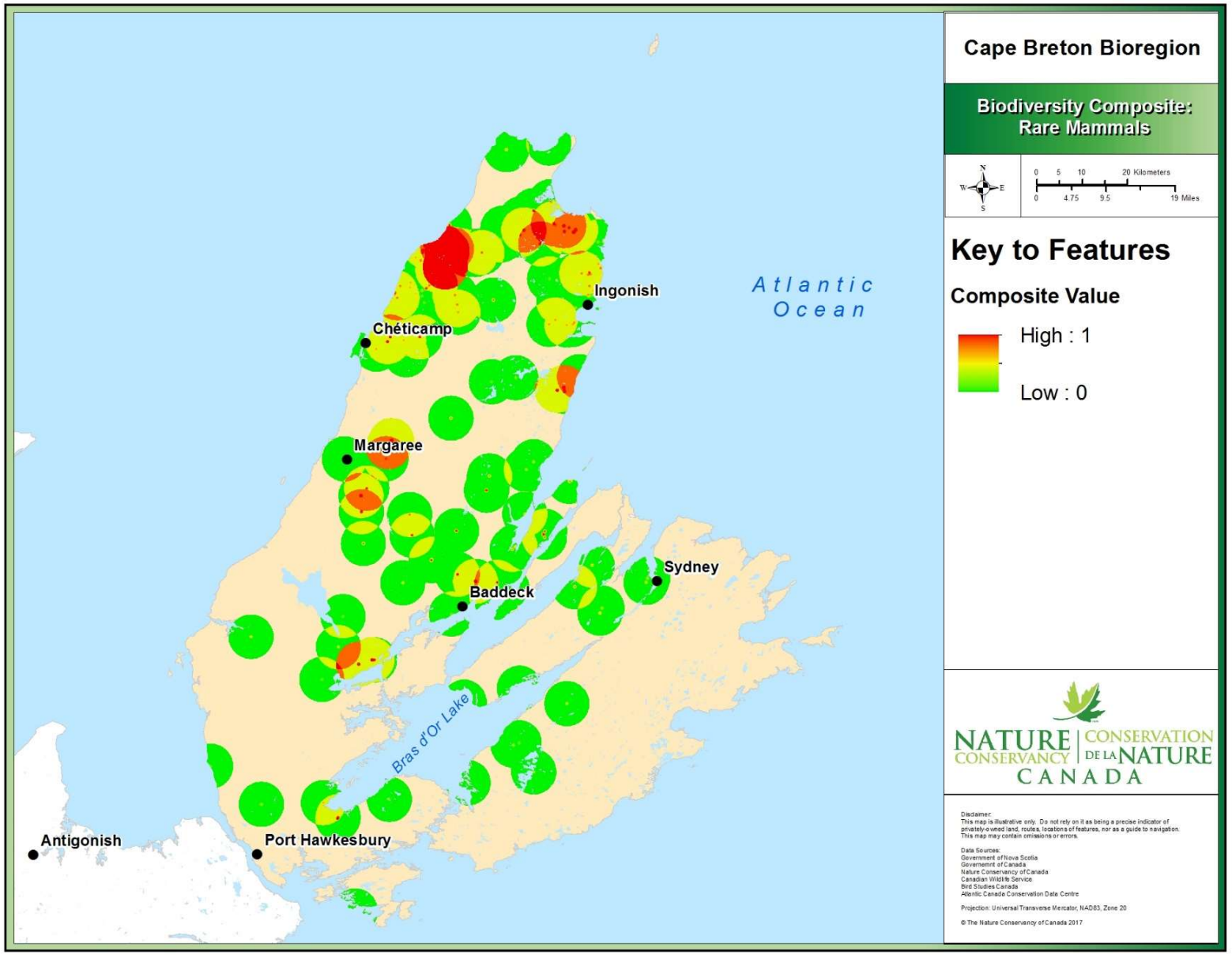

Figure 34. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) mammals in the Cape Breton bioregion.

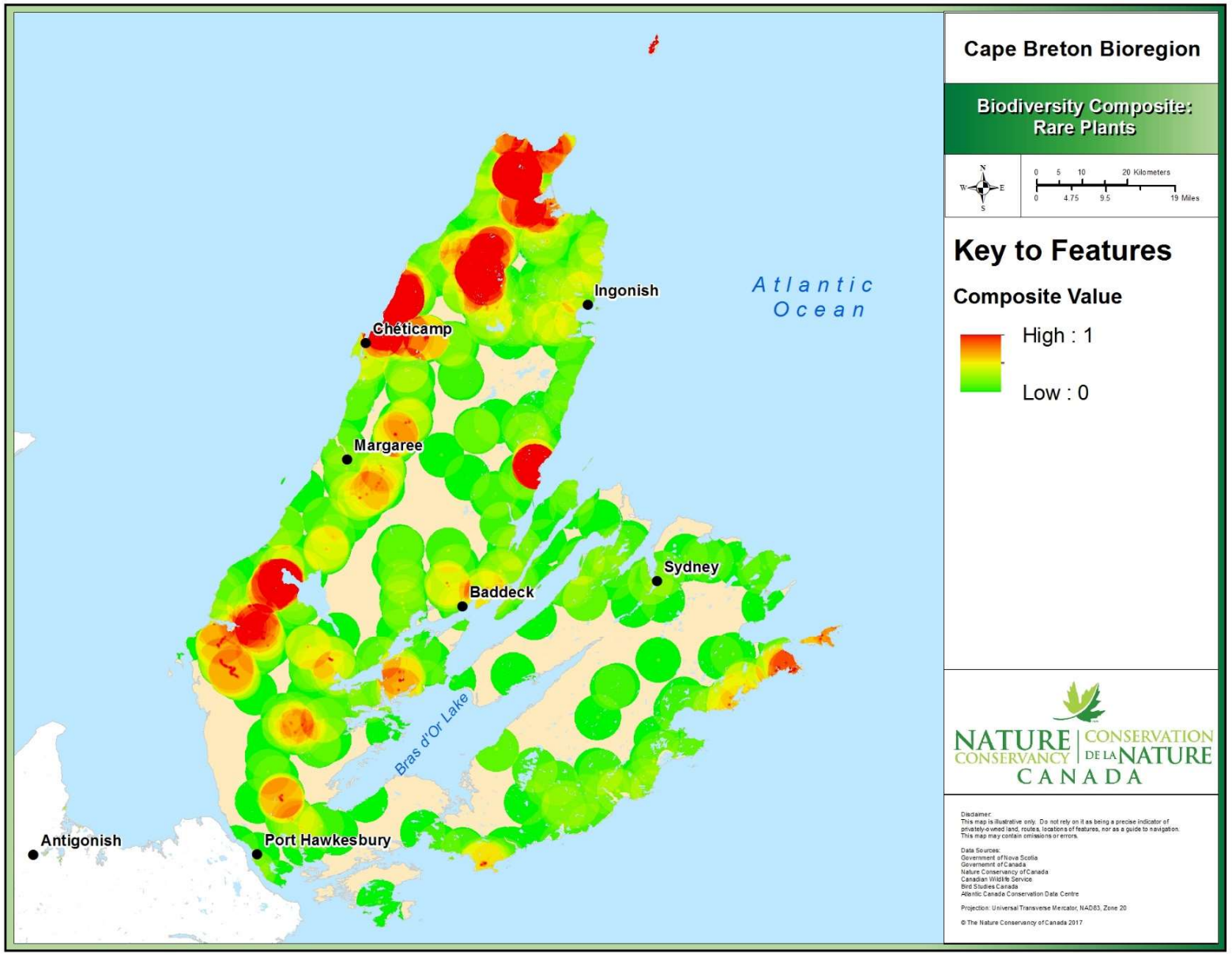

Figure 35. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) plant and lichen species in the Cape Breton bioregion.

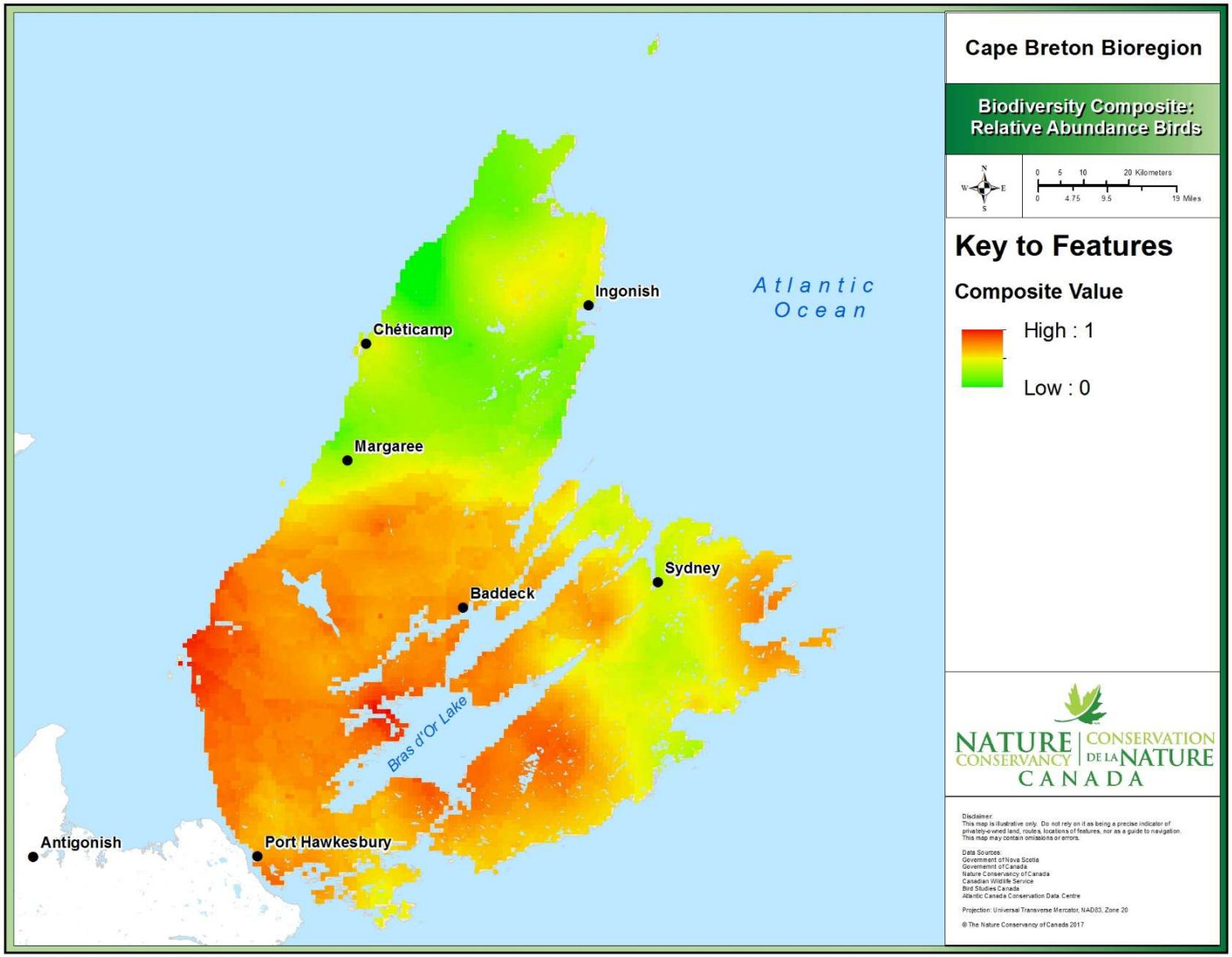

Figure 36. Relative abundance species composite for rare, at risk (COSEWIC assessed and NS ESA listed), and priority bird species in the Cape Breton bioregion.

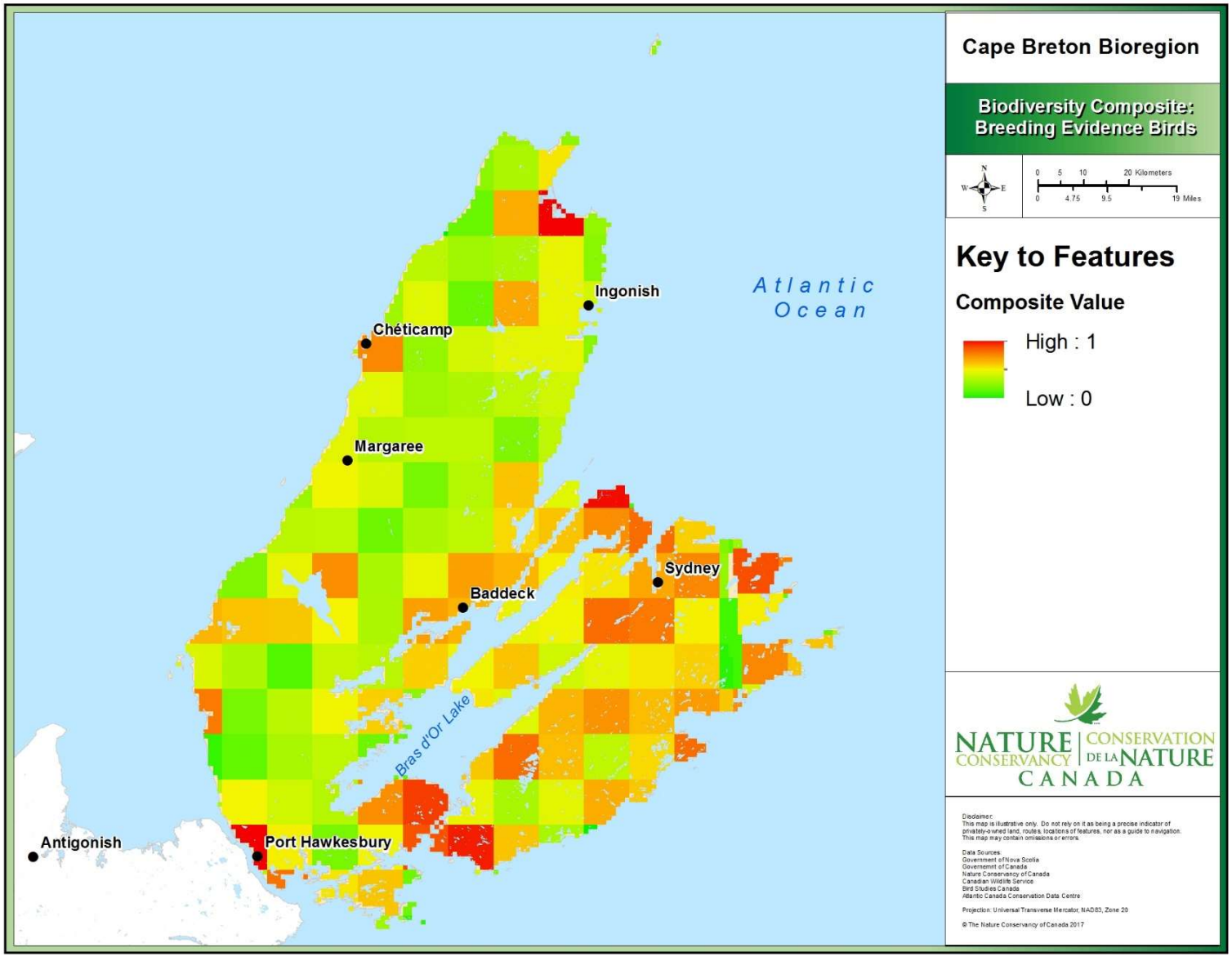

Figure 37. Breeding evidence species composite for rare, at risk (COSEWIC assessed and NS ESA listed), and priority bird species in the Cape Breton bioregion.

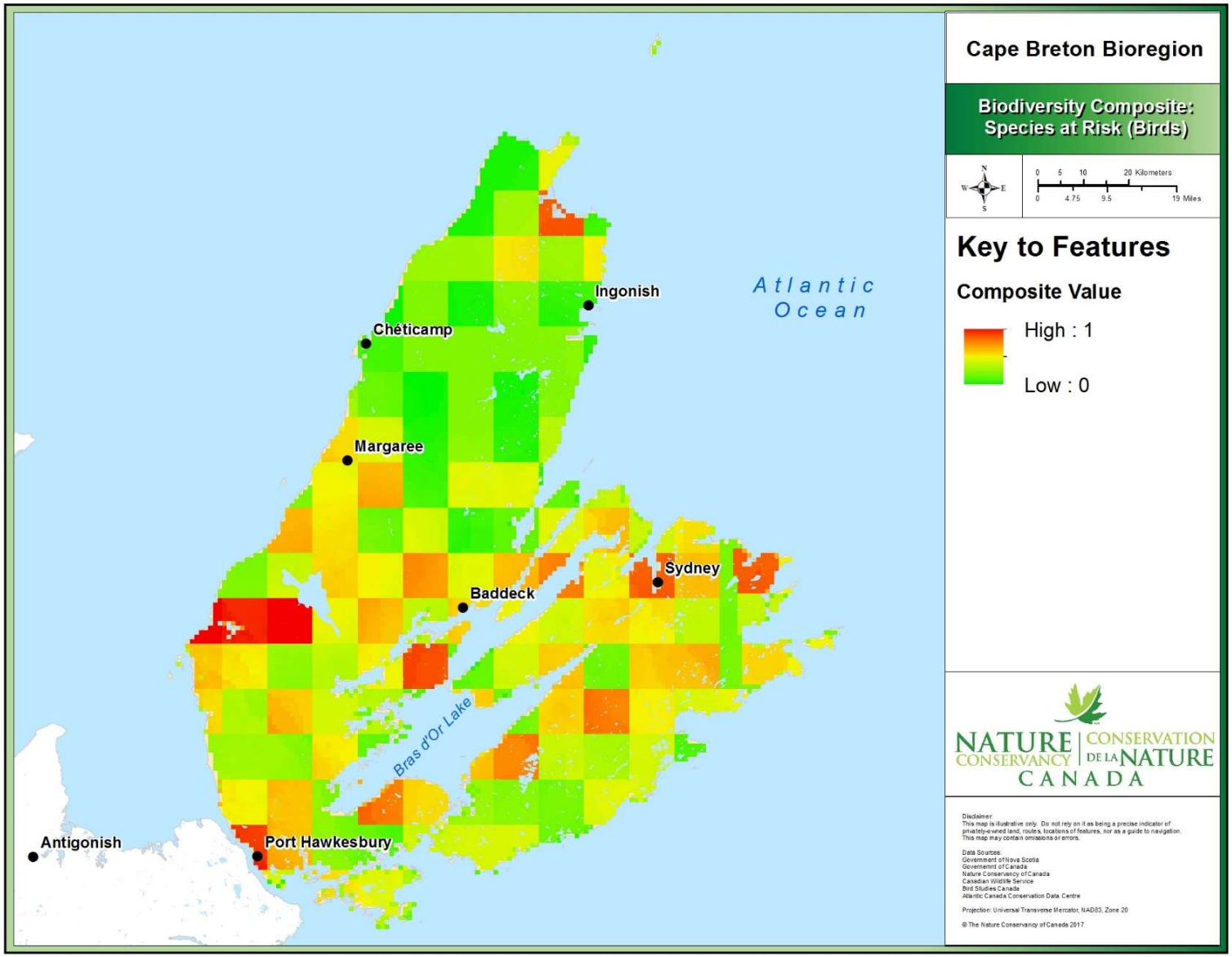

Figure 38. Species composite for bird species at risk (COSEWIC assessed and NS ESA listed) in the Cape Breton bioregion (based on breeding evidence and relative abundance).

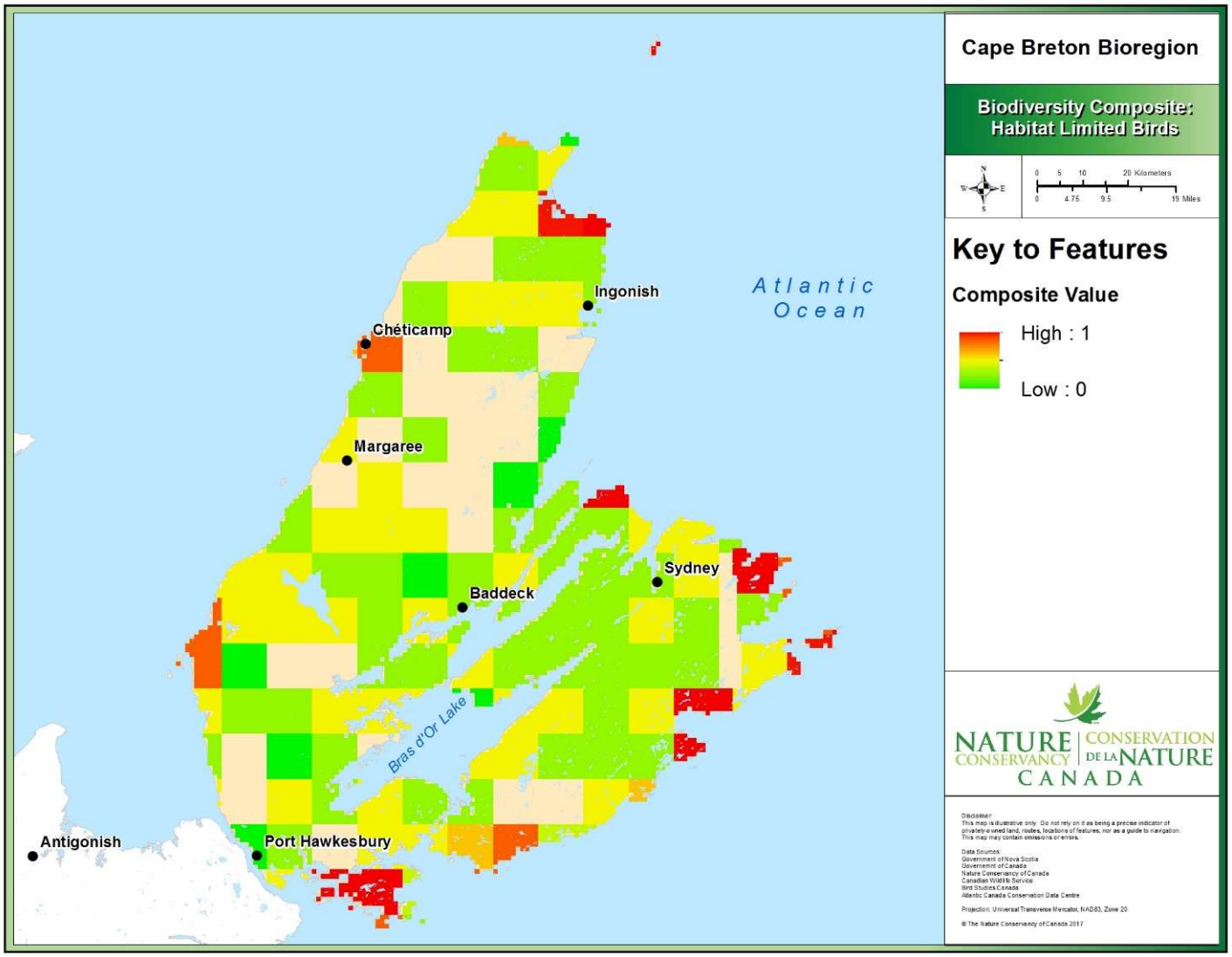

Figure 39. Breeding evidence composite for species at risk, rare and priority habitat limited bird species[1] in the Cape Breton bioregion.

[1] This subset, developed through expert review, includes those species that are considered to be long-term obligate species of a particular habitat type that have predictable, repetitive use of a relatively limited area over time. Species that met the criteria are identified in Appendix C

3. CONSERVATION STRATEGY

A. Vision

The Cape Breton bioregion is a renowned biodiversity hotspot. From the barrier beaches and barachois ponds of the Bras d'Or Lakes, to the plateaus and headwaters of the Cape Breton Highlands, a broad diversity of ecosystems continues to support and provide habitat for a wide range of plant and animal species. The Acadian and Boreal forests are intact and varied in structure, and connectivity is maintained across the landscape. Calcareous ecosystems are adequately protected and support viable populations of rare, calcium-loving plant species. Atlantic Salmon and Brook Trout populations thrive and American Marten and Lynx are distributed throughout significant portions of the landscape. The bioregion successfully integrates the ecology of the region with sustainable economic activity, including recreational and tourism activities that provide significant economic benefits to the region while minimizing impacts to biological communities and ecological services.

B. Goals

The conservation goals that were identified to guide the development of this HCS are:

1) Identify areas that are important for conservation priority habitats and species.
2) Establish, support, and enhance conservation partnerships to facilitate decision-making and focus collective conservation efforts.
3) Maintain healthy, intact, and fully functioning ecosystems by building on existing conservation work by the partnership and informing efforts to acquire land for conservation.
4) Support the management of and protect corridors between existing protected areas and other conservation lands through land securement, partnerships, and community outreach.
5) Support the recovery of populations of species at risk through collective conservation actions by the partnership, further informed by federal and provincial resources on species at risk.
6) Support the advancement of collaborative ecosystem and species research to inform decision-making and planning.
7) Support the advancement of community support and understanding of biodiversity values, and inform local stewardship initiatives.

C. Conservation Partners

Within the Cape Breton bioregion federal, provincial and Mi'kmaq agencies, along with various non-governmental organizations work together in regional conservation planning and research initiatives.

i. National and Provincial Partners

Government of Nova Scotia

The Government of Nova Scotia plays a major role in the conservation of habitats throughout the bioregion. The Department of Environment has the responsibility of enforcing laws and regulations related to the potential destruction of habitat. The province has committed to protecting 13% of the provincial landbase, with a further 6,300 Ha to be designated in the Cape Breton Bioregion. The department of Natural Resources has adopted the Old Forest Policy to locate and conserve 8% of publicly owned forest within each ecodistrict.

The Nature Conservancy of Canada

The Nature Conservancy of Canada (NCC) is the nation's leading land conservation organization, working to protect Canada's most important natural areas and the species they sustain. Since 1962 NCC and its

partners have helped to protect more than 1 million ha across Canada. NCC has been protecting land in Nova Scotia since 1971 and has worked with individuals and communities to protect more than 10,000 ha in 123 projects across the province. At the time of publication, the NCC has secured approximately 523 ha of coastal and inland wilderness in the Cape Breton bioregion.

Parks Canada
On behalf of the people of Canada, Parks Canada protects and presents nationally significant examples of Canada's natural and cultural heritage, and foster public understanding, appreciation and enjoyment in ways that ensure the ecological and commemorative integrity of these places for present and future generations. Parks Canada operates the Cape Breton Highlands National Park.

Environment and Climate Change Canada – Canadian Wildlife Service
The Canadian Wildlife Service (CWS) has a mandate which focuses on migratory birds, species at risk, and their habitats, and is centered on the implementation of the *Migratory Bird Convention Act*, *Canada Wildlife Act*, *Species at Risk Act*, *Canadian Environmental Protection Act*, and the Federal Policy on Wetland Conservation. CWS identifies, designates and protects important habitats such as National Wildlife Areas under the *Canada Wildlife Act* and Migratory Bird Sanctuaries under the *Migratory Bird Convention Act*. In addition to conducting migratory bird surveys, CWS provides support for activities that benefit species at risk through its main funding programs, the Habitat Stewardship Program (HSP) and the Aboriginal Fund for Species at Risk (AFSAR). Additional funding resources include the HSP and AFSAR Prevention Stream (for species other than species at risk), and the National Conservation Plan – National Wetland Conservation Fund, the Gulf of Maine Initiative, and the Ecological Gifts Program. Environment Canada also funds the EcoAction Community Funding Program, the Atlantic Ecosystem Initiatives, and Environmental Damages Fund. CWS works closely with its partners in the development of recovery documents for species at risk and supports activities described within recovery documents for the completion of the schedule of studies for the identification of critical habitat. CWS supports the EHJV, and provides science guidance to conservation partners on conservation actions and priorities for migratory birds, species at risk, and their habitats, including involvement in the development, refinement, and implementation of HCSs, and the NS Bird Conservation Region 14 Strategy. CWS shares its migratory bird survey data and expertise to inform biodiversity and habitat conservation initiatives that contribute to meeting not only the CWS mandate, but also the broader mandates and objectives of its conservation partners. CWS is supportive of the Habitat Conservation Strategy approach as it represents how species and habitat data can be compiled and assessed in ways that benefit a broader suite of conservation-oriented user-groups.

Bird Studies Canada
Bird Studies Canada (BSC) is Canada's national charitable organization dedicated to bird science, conservation, and education. Since 1967, the mission of BSC has been to advance the understanding, appreciation, and conservation of wild birds and their habitats in Canada and elsewhere, through studies that engage the skills, enthusiasm, and support of members, volunteers, and the interested public. In addition to engaging roughly 30,000 volunteer "Citizen Scientists" per year, BSC's works in collaborative partnerships with federal, provincial, industry, and other NGOs. In the Atlantic region, BSC's programs use outreach, stewardship, and research approaches to focus on bird population monitoring, species at risk, and their associated habitats. In Nova Scotia, BSC coordinates with citizens and other conservation organizations to monitor annual population trends of Piping Plover through its NS Piping Plover Conservation Program (2006-present) monitors and promotes stewardship of roost and nest sites of Chimney Swifts (Maritimes Swiftwatch, 2010-present); monitors distribution and abundance of Bicknell's Thrush and other high elevation songbirds (High Elevation Landbird Program,

2001 – present); and tracks distribution and abundance of owls throughout the region (Atlantic Nocturnal Owl Program, 2001- present).Bird Studies Canada also led the production of the Second Maritimes Breeding Bird Atlas (Stewart et al. 2015), which describes changes in distribution and trends of breeding birds in the Atlantic region over a 20-year period, and supports management and conservation planning efforts in the region.

The Atlantic Canada Conservation Data Centre (AC CDC)
The ACCDC enhances data management and information on biodiversity in the region through the maintenance of the most comprehensive and current database on the distribution of biodiversity in Atlantic Canada. The ACCDC database includes more than 1,030,000 geo-located records of species occurrences, over 186,000 of which represent species of conservation concern, and represents the single most comprehensive and current source of information regarding the distribution of Atlantic Canada's biodiversity. They also conduct biological surveys in areas of high biodiversity significance to further understanding of rare species' status and distribution.

Ducks Unlimited Canada (DUC) is the leader in wetland conservation. DUC partners with government, industry, non-profit organizations and landowners to conserve, restore, and manage wetlands and grasslands that are critical for waterfowl, wildlife and the environment. DUC protects land through several means, including acquisitions, conservation easements, and revolving lands strategies. They aim to develop initiatives to conserve coastal habitat for waterfowl to protect molting, staging, and wintering habitat; to maintain diverse habitat quality and quantity needed to sustain current breeding waterfowl numbers; to develop new initiatives that address problems of survival and recruitment of sea ducks; and to acquire wetland inventories and more complete waterfowl surveys to focus conservation programs. There are two wetlands in the Cape Breton bioregion that are maintained by DUC.

ii. Cape Breton Regional Conservation Partners

Atlantic Coastal Action Program (ACAP) Cape Breton is a non-profit charitable community organization serving Cape Breton Island. Established in 1992, the original mission was to develop a comprehensive ecosystem management plan for the watershed area of industrial Cape Breton County. ACAP CB has grown into a dynamic group that integrates environmental, social and economic factors into projects focusing on action, education, and ecosystem planning. The organization is built upon five pillars: 1) environmental education; 2) science, monitoring and research; 3) community engagement; 4) service delivery; and 5) advocacy and influencing policy. Their vision is for a community in which local people are actively engaged, working, and learning together to build healthy and sustainable communities. Current and past projects include bat monitoring, living shorelines, rain gardens, climate change adaptation, and stream restoration. ACAP-CB also collaborates with BSC on beach and Piping Plover monitoring and stewardship initiatives.

Bras d'Or Institute for Ecosystem Research, Cape Breton University, established in 1974 (inactive from 1995 to 2005) has a mandate to "apply the resources of the university to the problems of the community". The research activities of the Bras d'Or Institute focus on how best to operationalize ecosystem-based management of human activities within the maritime communities of Cape Breton. The Institute partners widely with all levels of government, NGOs and the private sector, and was instrumental in the designation of the Bras d'Or Lakes Biosphere Reserve.

Bras d'Or Lake Biosphere Reserve Association, incorporated in 2005, is made up of volunteers that worked to have the Bras d'Or Lakes and its watershed designated as a UNESCO Biosphere Reserve, and who now oversee the activities of the Biosphere Reserve. Membership includes representatives of eight organizations with programs attending directly to concerns relating to the Bras d'Or Lakes and their

watersheds, as well as industry reps from forestry and mining, the area's community college, and private citizens. A UNESCO biosphere reserves is an "areas of terrestrial and coastal ecosystems promoting solutions to reconcile the conservation of biodiversity with its sustainable use. They are internationally recognized, nominated by national governments and remain under sovereign jurisdiction of the states where they are located." They are intended to achieve three basic functions: conservation, sustainable development, and logistic support for research and education.

Bras d'Or Preservation Nature Trust (previously the Bras d'Or Lakes Preservation Foundation) was established in 1993 as the first land trust under the *Nova Scotia Conservation Easements Act*. Its two main objectives are protecting environmentally important private land in the Bras d'Or watershed on Cape Breton Island and educating residents of Cape Breton communities on the importance of the unique Bras d'Or ecology.

Bras d'Or Stewardship Society, established in 1997 is an advocacy group promoting effective stewardship of the Bras d'Or Lakes. The Society promotes accountable and responsible stewardship of the Bras d'Or Lakes, including protect, conservation and restoration activities. They provide a forum to discuss and highlight issues such as sewage contamination, closure of shellfish beds, poorly designed shorefront developments (which also close off public access), lack of effective water quality monitoring, and insufficient environmental assessments.

Margaree Salmon Association

The Margaree Salmon Association, established in 1982, is a volunteer, non-profit organization, dedicated to the conservation, protection and enhancement of Atlantic salmon, trout and their habitat. Since its founding, the Margaree Salmon Association has established itself as the voice for the salmon resource and salmon conservation on the Margaree River, including being a lobbying force on behalf of the Margaree Fish Hatchery. An affiliate of the Atlantic Salmon Federation and the Nova Scotia Salmon Association, the MSA has been an active participant in the Regional Fisheries Advisory Committee, the Zonal Management Advisory Committee the Cape Breton Sports Fishing Advisory Committee, and was involved in the nomination and eventual designation of the Margaree River- Lake Ainslie System as a Canadian Heritage River. Much of the Association's efforts have centered around habitat restoration and repair, through armour rock bank stabilization programs and the construction of flow diverters and tree revetments, and has been carried out in partnership with a variety of government agencies and the NS Adopt-A-Stream Program, administered by the NS Salmon Association.

Inverness South Anglers Association

ISAA's mandate is to further in all ways possible the conservation, propagation, and sustainment of salmon, trout, striped bass and other recreational fisheries in the watersheds that we that we steward on behalf of the contiguous communities of Judique, Port Hood, Mabou and Inverness, aka Inverness (County) South. Since its inception thirteen years ago, ISAA's methods and work products have proven environmentally durable, economically sustainable and worthy of emulation. ISAA is now a recognized leader in community driven watershed stewardship affairs. What we have achieved to date and what we might achieve in future is wholly dependent upon the cash resources provided by our funding partners and the energy and commitment of our volunteers.

Cape Breton Island Wildlife Association

The CBIWA are a volunteer community organization established in the 1980s to promote sustainable hunting and fishing practices, while educating on the benefits of enjoying nature. Its members consist of

anglers, hunters, trappers from across Cape Breton. The CBIWA is a member of the Nova Scotia Federation of Anglers and Hunters. The Association supports conservation, education and protection of our natural resources, including our brooks and streams. Programs include stream restoration and delivering the Fish Friends program in classrooms across Cape Breton.

Nova Scotia Landowners and Forest Fibre Producers Association

NSLFFPA is an independent association which provides forest management, certification and extension services for private woodlot owners in Eastern Nova Scotia. They advocate for sustainable management of our private land forest resource, and believe appropriate forest management can contribute to both the ecology and economy of our region.

iii. First Nations

There are five First Nations bands on Cape Breton Island: Eskasoni, Membertou, Potlotek, Wagmatcook, and We'koqma'q. These six bands are also co-owners of Malagawatch, an area that is set aside for seasonal residence and sustainable recreational use by these First Nations communities. Over the past decade especially, the First Nations have negotiated co-management agreements with non-Aboriginal governments and corporations for resource and environmental management in the proposed biosphere reserve. See EFWC, CEPI and UINR for more information.

Eskasoni Fish and Wildlife Commission (EFWC) was established in 1991 to deal with environmental issues of concern to Aboriginal people in the Bras d'Or Lakes watershed. It was established to acquire and manage communal fishing licenses for Eskasoni First Nation. EFWC is also devoted to conducting marine research in the Bras d'Or Lakes.

Unama'ki Institute of Natural Resources (UINR) is Cape Breton's Mi'kmaq voice on natural resources, the environment, and sustainability. Established in 1998 by the EFWC, the UINR represents First Nations communities on issues pertaining to management and stewardship of natural resources in the traditional territory of Unama'ki (Cape Breton). The goals of the UINR are to provide resources for Mi'kmaq equal participation in natural resource management in Unama'ki and its traditional territory; to strengthen Mi'kmaq research and natural resource management while maintaining traditions and world views; and to partner with other groups sharing the same desire to protect and preserve our resources for future generations. Long-term core funding for the UINR was provided by Fisheries and Oceans Canada through the Aboriginal Aquatic Resource and Ocean Management Program (AAROM). Cape Breton Highlands National Park and UINR have also developed a close relationship through collaboration on research, planning, and training opportunities, including the moose management initiative, reintroduction of endangered American Marten to Cape Breton, and American Eel research and communications (Parks Canada 2010b).

Pitu'paq Partnership Society ("Flowing Into Oneness") was created in 2001 by leaders of Cape Breton's five First Nations and five Cape Breton municipalities (four counties and the Town of Port Hawkesbury). Its purpose is to work together to remediate the Bras d'Or Lakes' sewage contamination from on-site septic systems, boating, and inadequate sewage treatment plants and to create public awareness and understanding of the issues. The vision is to restore the Lake to its original state and manage the waters and lands around the Lake to support aquaculture, wild fisheries and tourism. The Society sponsored a series of public meetings to discuss designation of the Bras d'Or Lake as a non-discharge zone for boating sewage under the federal Shipping Act; this designation was received in July 2006.

Bras d'Or Lakes Collaborative Environmental Planning Initiative (CEPI) arose from a request from First Nations Chiefs in 2003 to lead and develop an overall management plan that incorporates both traditional Mi'kmaq and western perspectives for a healthy and productive Bras d'Or Lakes Watershed ecosystem, and to facilitate its implementation by governments and other relevant stakeholders. The collaborative partnership is among five First Nations, four counties, three provincial government departments, three federal government departments, and several non-governmental organizations. The Unama'ki Institute of Natural Resources provides secretariat and facilitation services.

At the 2004 CEPI Workshop in Wagmatcook, six issues were identified as priorities to be addressed by collaborative planning and management. These issues are as follows: water quality; fisheries; forestry; land use and development; invasive species; climate change.

The Bras d'Or Lakes CEPI, with funding and the in-kind support from its partners, is currently conducting three research projects in the watershed:

- An inventory and assessment of barachois ponds started in 2013 continues, with nearly 150 ponds having been visited so far.
- Water quality and sediment quality samples are being analyzed from each of the six oyster sanctuaries in the Bras d'Or, to examine what land practices might be affecting the oysters.
- The CEPI also supports UINR's Joint Enforcement Patrol program which educates pleasure craft operators on public safety and environmental stewardship of the Lakes (e.g. proper sewage disposal).

A CEPI-lead conference in 2016 brought together the people of Cape Breton Island and others from across the country to discuss and determine best sustainable practices, focusing on six pillars: Forestry; Agriculture; Aquaculture; Mining; Tourism and Alternative Energy.

D. Actions

i. Identified Knowledge and Action Gaps

While this plan strives to address and discuss the full range of habitat conservation priorities and threats to biodiversity in the Cape Breton bioregion, it is not within the scope of the strategy to identify or in any way assign all potential conservation actions required to address all problems, questions, information gaps, or other activities associated with each habitat priority or threat. This section will briefly discuss some of the identified gaps in knowledge, available information, and actions regarding the conservation priority habitat assessment and their threats. Identified knowledge gaps are summarized in Table 11.

Table 11. Identified knowledge gaps for conservation priority habitats in the Cape Breton bioregion.

Conservation Priority Habitat, Species Or Threat	Description
Coastal Islands	Determine the importance of Scaterie Island for breeding Leach's Storm Petrels.
Estuaries	Mapping of the extent of eelgrass beds in the Bras D'Or Lakes is incomplete (completed for some areas but should be completed for all estuaries in the bioregion as a baseline for monitoring and recovery).

Conservation Priority Habitat, Species Or Threat	Description
Barachois Ponds, Barrier Beaches	The current extent of barachois ponds is known only through coarse-scale delineation using satellite imagery; need exists for finer scale mapping of barachois ponds and barrier beaches, possibly using remote sensing.
Freshwater Wetlands	Mapping of the location and extent of forested and calcareous wetlands is incomplete; further inventory and mapping needed to supplement work that has been completed to identify sites.
Aquatic and Riparian Systems	The true extent of floodplains in the bioregion is unclear. Coarse scale mapping was created for the bioregion, however finer scale mapping to delineate the actual extent of floodplains is needed.
Barachois Ponds, Aquatic and Riparian Systems	Currently no comprehensive list of freshwater species found in barachois ponds and major river systems in the bioregion. Filling this gap would provide a record for future comparison and help describe freshwater habitats in the bioregion*.
Acadian and Boreal Forests	Location and extent of old forest in the bioregion is unclear. Current measures are based off estimates from forest inventory and are most likely over estimating the extent. Mapping of actual old forest stands needed.
Acadian and Boreal Forests	Location and extent of karst forest is incomplete. Further inventory and mapping needed to supplement work that has been completed to identify sites.
Acadian and Boreal Forests	Need to improve/update the NSDNR Natural Disturbance Regime GIS layer. The current layer may be overestimating the distribution of frequent disturbance forests, leading to an underestimate of the historical extent of low disturbance, gap-replacement old forest.
Grasslands	More accurate classification of agricultural types is needed with a focus on identifying suitable and potential habitat for grassland bird species.
Barrens	Incomplete baseline species inventory, especially for lichen species. Lack of understanding of ecological requirements for barren persistence and origin on the landscape (role of fire, climatic, anthropogenic factors). The spatial extent and relative area of different habitat types (e.g. dwarf heath, shrubland, alpine and subalpine habitats) encompassed within “barrens” is undefined.
All Habitat Priorities	It would be beneficial to update the A list database of private parcels with high ecological value (DOE).
Land-use Patterns	Need to assess land use practices (forestry, agriculture, road densities) on erodible soils; may indicate higher environmental risk*.
Bats, karst landscapes	The locations of bat hibernacula in the bioregion are currently largely unknown. Work is ongoing, but a complete inventory is lacking.
Bras d’Or Lakes	There has been no sustained monitoring of the impacts of fishing, invasive species, landuse patterns (e.g., land clearing, road building, forest harvesting, mining, agriculture) on sedimentation, pollution, and contamination of the Bras d’Or Lakes. An effort is currently underway to identify robust indicators of estuarine ecosystem health to monitor and report on the state of the Bras d’Or ecosystem annually.

* Identified in *Ecosystem Overview and Assessment Report for the Bras d’Or Lakes* (DFO 2007)

ii. Conservation Actions

The remainder of this section identifies the planned conservation actions by conservation partners in the Cape Breton bioregion for the next five-year period. Table 12 identifies which organizations and government agencies are working to conserve priority habitats and species in the bioregion and lists those actions that are being and will be taken to target specific habitats, species, and threats. Note that some actions, though important, may not directly address identified threats; instead, they may advance important objectives, including monitoring, education and outreach, and partnerships. Readers are advised that this section is particularly important for planning purposes as this table presents opportunities to identify gaps in conservation actions and build partnerships strategically. Note that action categories are based on IUCN – CMP Unified Classification of Conservation Actions Needed (Version 2.0) and are not listed in order of importance.

Table 12. Conservation actions and associated information for conservation partners in the Cape Breton bioregion.

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
1. Land/Water Protection				
1.1 Site/Area Protection Contribute to Marine Protected Area Network planning within the Scotian Shelf marine bioregion, and to the identification and description of Ecologically and Biologically Significant Areas and other habitat classification schemes that contribute towards the goal of protecting 10% of coastal and marine areas by 2020.	DFO, ECCC, Parks Canada	2020	Beaches and Dunes, Estuaries, Coastal Islands	All coastal threats
1.1 Site/Area Protection Secure 1500 ha of high priority sites containing exposed gypsum and/or calcareous ecosystem occurrences to protect them from mining and development.	NCC	2026	Acadian and Boreal Forest, Freshwater Wetlands, Calcareous Sites	3.2 Mining and quarrying
1.1 Site/Area Protection Secure 250 ha of priority 1 and 2 sites containing intact floodplain ecosystems to protect them from development.	NCC	2026	Aquatic and Riparian Systems, Freshwater Wetlands, Acadian and Boreal Forest	1.1 Housing and Urban Area Development 2.1, 2.3 Agriculture

[1] Categories based on IUCN – CMP Unified Classification of Conservation Actions Needed (Version 2.0). Actions are meant to be specific and measureable if possible, and are not listed in order of importance.

[2] Priority Habitats: Beaches and Dunes, Barachois Ponds, Estuaries, Coastal Islands, Freshwater Wetlands, Acadian and Boreal Forest, Riparian and Floodplain Systems, Grasslands/Agro-ecosystems, Barrens.

[3] See section B. Threats for current and emerging threat classification according to IUCN – CMP categories with regional descriptions.

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
1.1 Site/Area Protection Secure 500 ha of P1 and P2 sites containing intact, late-successional Acadian forest to protect them from logging and wood harvesting.	NCC	2026	Acadian and Boreal Forest	5.3 Logging and Wood Harvesting
1.1 Site/Area Protection Assist local land trusts in acquisition of 100 ha of P1 and P2 sites containing coastal ecosystems to protect them from development	NCC, Bras d'Or Lakes Preservation Trust	2026	Estuaries	1.1 Housing and Urban Area Development
1.1 Site/Area Protection Province of Nova Scotia to protect an additional 21,800 ha under the Parks and Protected Areas Plan	Government of Nova Scotia, DOE	2020	Acadian and Boreal Forest	5.3 Logging and Wood Harvesting
1.1 Site/Area Protection Designate NCC lands protected in the bioregion under provincial legislation to protect them from mining, and acquire severed gypsum rights to any property NCC secures.	NCC	2020	Calcareous Sites	3.2 Mining and quarrying
1.1 Site/Area Protection Conduct outreach and build relationships with key industrial gypsum companies to identify potential large scale securement opportunities	NCC	2018	Calcareous Sites	3.2 Mining and quarrying
1.1 Site/Area Protection Provide results of NACP analyses to Crown Share Land Legacy Trust to facilitate the refinement of their 'A-list' of priority lands for acquisition.	NCC	2017		
1.1 Site/Area Protection Acquire properties for wetland conservation through purchase, and owners unknown process (unknown ownership, transfer to the Crown)	NS DNR/ EHJV	Ongoing	Freshwater Wetlands	All wetland threats
1.1 Site/Area Protection Continue to manage properties and conservation easements and seek out new opportunities for easements and land acquisitions.	Bras d'Or Preservation Nature Trust	Ongoing	All Habitats	1.1 Housing and Urban Area Development; 5.3 Logging and Wood Harvesting

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
2. Land/Water Management				
2.1 Site/Area Management Inform and implement the North American Waterfowl Management Plan (NAWMP) and conduct waterfowl surveys as required by the plan.	ECCC, EHJV, USFWS, USGS	Ongoing	Coastal Islands, Estuaries, Freshwater Wetlands, Aquatic and Riparian Systems, Grasslands	
2.1 Site/Area Management Implement management plans for Sea Wolfe (Margaree) Island National Wildlife Area and Big Glace Bay Lake Migratory Bird Sanctuary.	ECCC	Ongoing	Coastal Island, Rocky Shores and Cliffs, Estuary, Barachois Pond	
2.1 Site/Area Management Complete ecological risk assessments of threats to species and ecosystems within existing and proposed protected areas. Create a spatial layer of sensitive habitats and ecosystems to aid in planning and an action plan for protected area managers.	DOE		All habitats	All threats
2.1 Site/Area Management Work collaboratively with partners and neighbours to adaptively manage NCC conservation lands in the bioregion, including the development of management plans and baseline inventories, and undertake priority site management activities. Monitor key threats on NCC properties, and where possible, take direct action to mitigate threats posing an imminent impact to conservation priority habitats.	NCC	Ongoing	All habitats	All threats
2.1 Site/Area Management Create baseline reports and management plans for all properties formally protected by NSNT in the bioregion. Manage protected sites for biodiversity conservation through regular monitoring and stewardship activities.	NSNT	Ongoing		

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
2.1 Site/Area Management Continue ecological integrity monitoring to assess the state of forest, aquatic, wetland, barren, and coastal ecosystem health in Cape Breton Highlands National Park through the monitoring, analysis, and reporting of ecological integrity indicators of ecosystem health (e.g., owls, salamanders, lichens, water quality, freshwater mussels, , Atlantic Salmon) and by summarizing these finding in the *State of the Park Report*.	Parks Canada through collaborative efforts with many partners	Ongoing		
2.1 Site/Area Management Collaboratively manage moose populations in the highlands. Collaborate with Newfoundland Parks Canada Field Units on moose issues.	Parks Canada, Unama'ki Institute of Natural Resources	Ongoing	Acadian and Boreal Forest	Moose
2.1 Site/Area Management Engage the public in active park resource management activities including the establishment of a Citizen Science program for monitoring, restoration, and invasive species control.	Parks Canada	Ongoing		8.1 Invasive non-native/alien species/diseases
2.1 Site/Area Management Complete the development of a monitoring program that measures aquatic connectivity using a GIS tool to assess the connectivity impacts of all road and trail stream crossing structures, and develop a prioritized list of structures requiring remediation. Ensure all new culvert installations meet PC requirements for fish passage.	Parks Canada	Ongoing	Aquatic and Riparian Systems	7.2 Culverts and Dams
2.1 Site/Area Management Examine current road salt application practices which impact adjacent sensitive wetlands; identify and implement mitigation measures such as application reductions in these zones and alternatives to current salt application.	Parks Canada	Ongoing	Aquatic and Riparian Systems, Freshwater Wetlands	4.1 Roads and railroads

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
2.1 Site/Area Management Research, document and map industrial mining ownership in the bioregion, as well as the extent of gypsum/limestone subsurface title rights within key areas for conservation.	NCC	2018	Calcareous Sites	3.2 Mining and quarrying
2.1 Site/Area Management Continue to locate, map, and assess potential old growth stands on private and public lands using adaptations of the NSDNR's old forest scoring methods to refine parcel prioritization, inform conservation efforts, and help maintain old forests and associated biodiversity for landscape connectivity according to Nova Scotia's *Old Forest Policy*.	MTRI, NSDNR, NCC	2018	Acadian and Boreal Forest	5.3 Logging and Wood Harvesting
2.1 Site/Area Management Assess air quality and climate change using lichens within permanent sample plots.	DOE	Ongoing	Acadian and Boreal Forest	9.5 Air pollution and acid precipitation 11 Climate Change
2.1 Site/Area Management Conduct botanical surveys of rare and uncommon cyanolichens to refine parcel prioritization.	ACCDC, NCC	Ongoing	Acadian and Boreal Forest, Aquatic and Riparian Systems	5.3 Logging and Wood Harvesting
2.1 Site/Area Management Explore options for improving mapping of calcareous ecosystem occurrences.	NCC, ACCDC, NS DNR	2018	Calcareous Ecosystems	3.2 Mining and quarrying
2.1 Site/Area Management Delineate the 'Active River Area' of major rivers in the bioregion to identify and map floodplain habitats.	NCC	2020	Aquatic and Riparian Systems, Freshwater Wetlands	2.1, 2.3 Agriculture
2.1 Site/Area Management Conduct a spatial analysis of agricultural proximity to priority Aquatic and Riparian Systems and determine current scope, severity.	NCC	2018	Aquatic and Riparian Systems	2.1, 2.3 Agriculture
2.1 Site/Area Management Continue working with farmers in the development of Agriculture Biodiversity Conservation Plans	Government of NS	Ongoing	Aquatic and Riparian Systems	2.1, 2.3 Agriculture

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
2.1 Site/Area Management Develop a pilot project exploring multiple values on the landscape/framework to assess tradeoffs of various needs/interests (mainly for crown land)	NS DNR	Unknown	All habitats	
2.1 Site/Area Management Conduct 3 years of calcareous plant species surveys to better understand the distribution of calcareous ecosystems in Atlantic Canada with a focus on Cape Breton	ACCDC, NCC	2018	Calcareous Ecosystems (nested target)	
2.1 Site/Area Management Continue to lead the collaborative effort to incorporate Mi'kmaq and western perspectives in the development and delivery of an overall management plan for Bras d'Or Lakes Watershed ecosystems.	CEPI	Ongoing	All habitats	
2.2 Invasive/Problematic Species Control Establish a structure to facilitate collaboration and strategic decision making regarding invasive species control techniques (e.g., Invasive Species Alliance).	NCC	2020	All habitats	8.1 Invasive non-native/alien species/diseases
2.2 Invasive/Problematic Species Control Mitigate the impacts of invasive species. Educate and promote stewardship in order to prevent incidental species invasions.	Parks Canada	Ongoing	All habitats	8.1 Invasive non-native/alien species/diseases
2.2 Invasive/Problematic Species Control Continue the current removal program to reduce the invasive Spiny-cheeked Crayfish population in Freshwater Lake to restore aquatic ecosystem health of the lake and to prevent the spread to other waterbodies. Re-establish elements of native biodiversity where feasible, such as white perch. Continue to enhance visitor and general public awareness of crayfish to help lessen the spread to other waterbodies. Work with external agencies to collaborate on education and mitigation strategies.	Parks Canada	Ongoing	Aquatic and Riparian Systems	8.1 Invasive non-native/alien species/diseases

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
2.2 Invasive/Problematic Species Control Continue to address the invasive beech weevil within Eskasoni community	EFWC	Ongoing	Acadian and Boreal Forest	8.1 Invasive non-native species
2.3 Habitat and Natural Process Restoration The Malagawatch living shoreline project - erosion mitigation and shoreline stabilization.	ACAP	Ongoing	Coastal Habitats	11.4 Storms and Flooding
2.3 Habitat and Natural Process Restoration Continue stream restoration projects – culvert modification to improve fish passage; bank stabilization; salmon pool creation; water-flow re-direction; erosion reduction.	ACAP; Inverness South Anglers Association; Cape Breton Wildlife Association; EFWC; Margaree Salmon Association	Ongoing	Aquatic and Riparian Systems	7.2 Culverts and Dams;
3. Species Management				
3.1 Species Management Identify important areas for marine birds.	ECCC (HCS)	Ongoing	Coastal targets (nested species)	
3.2 Species Recovery American Marten and Canada Lynx – testing efficacy of program, distribution of predators and prey on the highlands (monitoring tracks), compiling information gathered over the years since the introduction of marten.	NS DNR	Ongoing	Acadian and Boreal Forest (nested species)	
3.2 Species Recovery Using trail cameras to locate marten populations to inform harvesting plans	NS DNR	Ongoing	Acadian and Boreal Forest (nested species)	5.3 Logging and Wood Harvesting

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
3.2 Species Recovery Monitor bat populations and the impacts of White Nose Syndrome.	NS DNR, MTRI, ACAP CB	Ongoing	Acadian and Boreal Forest (nested species)	8.1 Invasive non-native species
3.2 Species Recovery Support partners in development of SAR recovery plans and support the activities described within species at risk recovery documents for the completion of schedule of studies for the identification of critical habitat.	ECCC	Ongoing	All targets (nested species)	All threats
3.2 Species Recovery Piping Plover Guardian program: promoting stewardship and conservation of breeding habitat for Piping Plover in Cape Breton and throughout Nova Scotia. Conducting Piping Plover surveys	BSC, ACAP	Ongoing	Beaches and Dunes (nested species)	
3.2 Species Recovery Fin clipping/capture and tag and release programs at the Margaree fish hatchery/Margaree River. Atlantic Salmon stock enhancement on the Mabou, Middle, Margaree, Graham, Baddeck Rivers.	Margaree Salmon Association; Inverness South Anglers Association	Ongoing	Aquatic and Riparian Systems (nested species)	
3.2 Species Recovery Maritime Swiftwatch Program/Aerial Insectivores Program – promoting stewardship and conservation of chimney swift roost and nesting habitat as well as other insectivores through education, outreach, monitoring, citizen science, and collaboration with private landowners and provincial partners.	BSC	Ongoing	Nested species targets.	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
3.2 Species Recovery High Elevation Landbird Program – monitoring abundance and distribution of Bicknell's Thrush (BITH) in high elevation habitats (especially Cape Breton Highlands); education and outreach with local communities on Bicknell's Thrush in Cape Breton; and working with forest companies, regulatory agencies, and other partners to implement BMPs for BITH in industrial forest habitats.	BSC	Ongoing	Nested species targets	
4. Education and Awareness				
4.3 Awareness and Communications Develop public education materials describing the natural history and ecological significance of the bioregion, with a focus on calcareous ecosystems. Produce mapping products that demonstrate the distribution of known calcareous ecosystems located within central Cape Breton Island.	NCC	2020	Calcareous Ecosystems	3.2 Mining and quarrying 5.3 Logging and Wood Harvesting
4.3 Awareness and Communications Develop relationships/partnerships with Port Hawkesbury Paper, Bras d'Or Biosphere Reserve, Margaree Salmon Association, Bras d'Or Preservation Trust and other conservation partners to communicate key conservation messages, with a focus on significance of calcareous ecosystems.	NCC	2018	Calcareous Ecosystems	
4.3 Awareness and Communications Identify a NCC-owned site in the bioregion suitable for public access and interpretation and develop a facilitated interpretive experience.	NCC	2020		
4.3 Awareness and Communications Continue to maintain the Nova Scotia Bat Conservation website www.batconservation.ca and engage the public on bat conservation issues. Increase public awareness of White Nose Syndrome in Nova Scotia bats and promote the proper use of bat houses through the Backyard Biodiversity project.	MTRI, NSDNR, Canadian Cooperative Wildlife Health Centre	Ongoing	Acadian and Boreal Forest (nested species)	8.1 Invasive non-native species

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
4.3 Awareness and Communications Provide input into Important Bird Areas.	Bird Studies Canada	Ongoing		
4.3 Awareness and Communications Developing education programs focussed on ecological monitoring and habitat restoration.	ACAP	Ongoing	All habitats	
4.3 Awareness and Communications Conduct educational outreach targeting beach visitors towards reducing impacts on beach/ dune ecosystems and sensitive wildlife, including Piping Plover.	Bird Studies Canada, ACAP	Ongoing		Human intrusion and disturbance
4.3 Awareness and Communications Conduct educational outreach targeting private landowners towards reducing impacts and disturbance for roost and nest sites of Chimney Swifts and swallows	Bird Studies Canada	Ongoing		1.1 Housing and urban areas
4.3 Awareness and Communications Education and promotion of biodiversity conservation and sustainable economic development within the UNESCO biosphere reserve.	Bras d'Or Lakes Biosphere Reserve Association	Ongoing	All habitats	
4.3 Awareness and Communications Working to complete a walking trail around the biosphere reserve.	Bras d'Or Lakes Biosphere Reserve Association	Unknown		
4.3 Awareness and Communications Bras d'Or Watch Program – an annual day of citizen science in the biosphere reserve	Bras d'Or Lakes Biosphere Reserve Association	Ongoing		

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
4.3 Awareness and Communications Advocate for an appropriate strategy for conservation, restoration and protection of the Bras d'Or lakes through public meetings, newsletters, educational activities and bringing environmental issues to the attention of the general public	Bras d'Or Stewardship Society	Ongoing		
4.3 Awareness and Communications Working to prevent illegal dumping	Cape Breton Wildlife Association	Ongoing	All habitats	9.4 Garbage and solid waste
4.3 Awareness and Communications Continue to produce and circulate educational materials on the work undertaken at UINR.	UINR	Ongoing		
4.3 Awareness and Communications Continue to promote the use of "Two Eyed Seeing" in the approach taken to natural resource use and sustainable economic development.	CEPI	Ongoing		1.1 Housing and Urban Area Development
5. Law and Policy				
5.1.2 Legislation (National level) Implement the *Migratory Bird Convention Act* (MBCA), *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* (WAPPRIITA), *Species at Risk Act* (SARA), *Canadian Environmental Protection Act* (CEPA), *Canada Wildlife Act* (CWA), *Environmental Enforcement Act* (EEA), *Canadian Environmental Assessment Act* (CEAA), *Fisheries Act* (water pollution).	ECCC, DFO	Ongoing	All habitats	All threats
5.1.3 Legislation (Sub-national level) Work with NSDNR and NSE to identify structured mechanism for protection of land trust lands from mining.	NCC	2026	All habitats	3.2 Mining and quarrying

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
5.2 Policies and Regulations Implement the federal policy on wetland conservation.	ECCC	Ongoing	Tidal Marshes, Tidal Flats, Freshwater Wetlands, Riparian and Floodplain Systems	
5.2 Policies and Regulations Research and promotion into taking an ecosystems based approach to coastal management planning (Barachois ponds, nutrient budget modelling).	Bras 'Or Institute for Ecosystem Research	Ongoing	Coastal habitats	All threats
5.4 Compliance and Enforcement Undertake wildlife and environmental enforcement activities (EC Wildlife Enforcement, Environmental Enforcement); address illegal hunting and disturbance, illegal activities and habitat destruction	ECCC, Province of NS	Ongoing	All habitats	Anthropogenic threats
5.4 Compliance and Enforcement Provide data on OHV use to enforcement agencies to identify locations of and trends in violations and to assist in prioritizing enforcement activities	Bird Studies Canada	Ongoing	Beaches and dunes	Anthropogenic threats
6. Livelihood, Economic, and Other Incentives				
6.2 Substitution Provide management planning, silviculture and contractor information for private woodlot owners in Cape Breton	NSLFFPA	Ongoing	Acadian and Boreal Forests	5.3 Logging and wood harvesting
6.3 Market Forces Administrate the group FSC certification program for NS private woodlot owners. Complete a High Value Conservation Framework for FSC certified woodlot owners.	NSLFFPA	Ongoing	Acadian and Boreal Forests	5.3 Logging and wood harvesting
6.3 Market Forces Explore opportunities for private woodlot participation in the carbon market	NSLFFPA	Ongoing	Acadian and Boreal Forests	5.3 Logging and wood harvesting
6.4 Conservation Payments	ECCC, NCC, NSNT	Ongoing		

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
Implement and encourage the use of EC Ecological Gifts (Ecogifts) program.				
6.5 Non-monetary Values Explore the opportunity to develop an incentive program that provides recognition for woodlot owners that promotes sustainable harvesting and protection of biodiversity on woodlots.	NCC	2018	Acadian Forest Mosaic	5.3 Forest harvesting practices
7. External Capacity Building				
7.1 Institutional and Civil Society Development Provide ECCC-CWS support and input into the development of Habitat Conservation Strategies.	ECCC, NCC, PC, MTRI, NSNT, DUC, NSDNR, BSC, NSDOE, ACCDC, watershed groups, municipalities	Ongoing		
7.2 Alliance and Partnership Development Assess the feasibility of establishing a consortium of conservation interests operating in Nova Scotia to provide a platform for collaboration and communication, information exchange, and high level strategy and planning on key issues.	ECCC, Province of NS, NCC, MTRI, NSNT	2016	All habitats	
7.2 Alliance and Partnership Development Continue to work with Unama'ki Institute of Natural Resources to collaboratively manage common interests (e.g., moose population monitoring, American Eel research, American Marten). Establish a Collaborative Management Committee through terms of reference between Parks Canada and local Mi'kmaq communities on Cape Breton to act as a forum for discussing shared management objectives and broader interests in both natural and cultural resource management.	Parks Canada, Unama'ki Institute of Natural Resources, Mi'kmaq communities	Ongoing	All habitats	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
7.2 Alliance and Partnership Development Provide input into Important Bird Areas.	ECCC, NCC, MTRI, NSNT, DUC, NSDNR, BSC, ACCDC, International ENGOs, other government agencies, watershed groups, municipalities	Ongoing	All habitats	
7.2 Alliance and Partnership Development Working with forestry companies to reduce impacts of forestry within the Margaree watershed.	Margaree Salmon Association	Ongoing	Acadian and Boreal Forest; Aquatic and Riparian Systems; Freshwater Wetlands	5.3 Forest Harvesting Practices
7.2 Alliance and Partnership Development Continue to liaise the Guardian Program with Federal and Provincial governments – a coordinated and collaborative effort to protect natural resources within Cape Breton.	UINR	Ongoing		
7.2 Alliance and Partnership Development Continue to partner with Parks Canada, Fisheries and Oceans Canada, Cape Breton University, Port Hawkesbury Paper, the province of Nova Scotia, Cape Breton municipalities, and a host of other government departments and organizations, to ensure that Mi'kmaq perspective and knowledge are an integral part of Cape Breton projects.	UINR	Ongoing		

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Expected Date for Completion	Priority Habitat(s)[2]	Primary Related Threat(s)[3]
7.3 Conservation Finance Communicate, inform, and increase awareness related to funding opportunities for conservation: North American Wetland Conservation Act (NAWCA)/Eastern Habitat Joint Venture (EHJV), North Atlantic Landscape Conservation Cooperative (NALCC); National Conservation Plan (NCP): Atlantic Ecosystems Initiative (AEI), Habitat Stewardship Program (HSP), Aboriginal Fund for Species at Risk (AFSAR), National Wetland Conservation Fund (NWCF), Science Horizons Youth Internship Program and the International Environmental Youth Corps. EcoAction Community Funding Program, Environmental Damages Fund, Gulf of Maine Initiative	ECCC, US Federal and State partners	Ongoing	All habitats	

References

Aboriginal Canada Portal. 2009. "All Aboriginal Communities in Nova Scotia - Aboriginal Communities." <http://www.aboriginalcanada.gc.ca/acp/community/site.nsf/en/ns-all-b.html>. Viewed October 2009.

Anderson, F. & T. Neily. 2010. A Reconnaissance level survey of calciphilous lichens in selected karst topography in Nova Scotia with notes on incidental bryophytes. A Mersey Tobeatic Research Institute report prepared for the Nova Scotia Department of Natural Resources.

Anderson, M. G., M. Clark, & A. Olivero Sheldon. 2012. Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region. The Nature Conservancy, Eastern Conservation Science.

Anderson, M. G., B. Vickery, M. Gorman, L. Gratton, M. Morrison, J. Maillet, A. Olivero, C. Ferree, D. Morse, G. Kehm, K. Rosalska, S. Khanna, & S. Bernstein. 2006. The Northern Appalachian / Acadian Ecoregion: Ecoregional Assessment, Conservation Status and Resource CD. The Nature Conservancy, Eastern Conservation Science, and the Nature Conservancy of Canada, Atlantic and Quebec Regions.

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, & R. D. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. *Journal of Wildlife Management* 72: 61-78.

Atlantic Canada Conservation Data Centre (ACCDC). 2013. Digital database of rare species locations for Nova Scotia. Atlantic Canada Conservation Data Centre, Sackville, NB.

Atlantic Coalition for Aquaculture Reform. 2012. Open letter and briefing regarding open net pen aquaculture concerns. Appendix III: Science Briefing. http://www.ecologyaction.ca/files/images/Letter%20on%20Open%20Pen%20Aquaculture_Unaddressed.pdf.

Baerwald, E. F. & R. M. R. Barclay. 2009. Geographic variation in activity and fatality of migratory bats at wind energy facilities. *Journal of Mammalogy* 90: 1341-1349.

Basquill, S. 2014. Karst Processes, Landforms, and Management Implications in Nova Scotia.

Beazley, K., T. Snaith, F. MacKinnon, & D. Colville. (2004). Road density and potential impacts on wildlife species such as American Moose in mainland Nova Scotia. Proceedings of the Nova Scotia Institute of Science 42: 339-357.

Beresford, R., and Hatcher, B.G., 2007. Cape Breton Oyster Futures. Bras d'Or Institute for Ecosystem Research, Cape Breton University, Sydney, N.S.

Blancher, P. 2013. Estimated number of birds killed by house cats (*Felis catus*) in Canada. *Avian Conservation and Ecology* 8: 3.

Blaney, C. S. & D. M. Mazerolle. 2013. Vascular Plant Surveys of Gypsum Bedrock Sites in Nova Scotia. Report to the Nova Scotia Department of Environment and Labor, Protected Areas and Ecosystems Branch. Atlantic Canada Conservation Data Centre, Sackville NB.

Blehert, D. S. 2012. Fungal disease and the developing story of bat White-nose Syndrome. *Plos Pathogens* 8.

Bourque, C. P. -A., & Q. K. Hassan. 2008. Projected impacts of climate change on species distribution in the Acadian Forest region of eastern Nova Scotia. *The Forestry Chronicle* 84: 553-557.

Bowron, T., N. Neatt, D. van Proosdij, & J. Lundholm. 2012. Chapter 14: Tidal marsh Restoration in Atlantic Canada, Pp. 191-210 In *Restoring Tidal Flow to Tidal marshes: A Synthesis of Science and Management*. C. T. Roman & D. M. Burdick (eds). Island Press.

Bras d'Or Lake Biosphere Reserve Association. 2010. Nomination Submission from Canada for the Bras d'Or Lake Biosphere Reserve. UNESCO submission document.

Brylinsky M. (2002). Nova Scotia Hypolimnion Project. Wolfville, Nova Scotia: Publication No. 67 of the Acadia Centre for Estuarine Research.

Burley, S. 2009. Forest Expansion into Coastal Barrens in Nova Scotia, Canada. M.Sc. Thesis, Saint Mary's University, Halifax.

Calder, J. H., K. S. Gillis, D. J. MacNeil, R. D. Naylor, & N. W. Campbell. 1993. One of the Greatest Treasures: The Geology & History of Coal in Nova Scotia. Information Circular No. 25, Nova Scotia Department of Natural Resources.

Cameron, Robert P. and Soren Bondrup-Nielsen. 2013. Plant Communities within Atlantic Coastal Heathlands in Nova Scotia. Eagle Hill Institute Stable.

Cameron, R. P. 2002. Habitat associations of epiphytic lichens in managed and unmanaged forest stands in Nova Scotia. *Northeastern Naturalist* 9: 27-46.

Canadian Heritage Rivers System (CHRS). 2017. Margaree River. Canadian Heritage Rivers System: Canada's National River Conservation Program. http://chrs.ca/the-rivers/margaree/.

Cape Breton Miners Museum. 2017. History of Mining in the Region. Cape Breton Miners Museum, Glace Bay, Nova Scotia. http://www.minersmuseum.com/history-of-mining/.

CBCL Limited. (2009). The State of Nova Scotia's Coast Technical Report. A report prepared for the Province of Nova Scotia, Halifax.

Clair, T. A. & A. Hindar. 2005. Liming for the mitigation of acid rain effects: A review of recent results. Environmental Review 13: 91-128.

CMP (The Conservation Measures Partnership) 2013. Open Standards for the Practice of Conservation Version 3.0. http://cmp-openstandards.org/wp-content/uploads/2017/06/CMP-OS-V3.0-Final-minor-update-May-2107.pdf

Collaborative Environmental Planning Initiative (CEPI). 2006. Bras d'Or Lakes Traditional Ecological Knowledge Workshop Proceedings, May 3-4, 2006.

Collantes, M. B.; Anchorena, J. & Koremblit, G. 1989. A soil nutrient gradient in Magellanic Empetrum heathlands. Vegetatio 80: 183-193

COSEWIC. 2004. COSEWIC assessment and status report on the Yellow Lampmussel *Lampsilis cariosa* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC 2005. COSEWIC assessment and status report on the Frosted Glass-whiskers *Sclerophora peronella* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007. COSEWIC assessment and update status report on the Wood Turtle *Glyptemys insculpta* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2008. COSEWIC assessment and status report on the Snapping Turtle *Chelydra serpentina* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.

COSEWIC. 2009. COSEWIC assessment and status report on the Bicknell's Thrush *Catharus bicknelli* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010a. COSEWIC assessment and status report on the Atlantic Salmon *Salmo salar* (Nunavik population, Labrador population, Northeast Newfoundland population, South Newfoundland population, Southwest Newfoundland population, Northwest Newfoundland population, Quebec Eastern North Shore population, Quebec Western North Shore population, Anticosti Island population, Inner St. Lawrence population, Lake Ontario population, Gaspé-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010b. COSEWIC assessment and status report on the Monarch *Danaus plexippus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2012. Technical summary and supporting information for an emergency assessment of the little brown myotis *Myotis lucifugus.* Committee on the Status of Endangered Wildlife in Canada, Ottawa.

COSEWIC. 2013a. COSEWIC assessment and status report on the Eastern Waterfan *Peltigera hydrothyria* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2013b. COSEWIC assessment and status report on the Piping Plover *circumcinctus* subspecies (*Charadrius melodus circumcinctus*) and the *melodus* subspecies (*Charadrius melodus melodus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2014. COSEWIC assessment and status report on the Boreal Felt Lichen *Erioderma pedicellatum*, Boreal population and Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2015. COSEWIC assessment and status report on the Yellow-banded Bumble Bee *Bombus terricola* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Chronicle Herald (The). 2015. Nova Scotia Power biomass project in Cape Breton raising green concerns. Retrieved September 19, 2016. http://thechronicleherald.ca/novascotia/1261832-nova-scotia-power-biomass-project-in-cape-breton-raising-green-concerns.

Darbyshire, S., S. Blaney, S. Basquill. 2017. The first record of Altai Fescue, *Festuca altaica (Poaceae*), in Nova Scotia, from an Eastern Alpine Site on Cape Breton Island. *Canadian Field Naturalist*, 131(2): 164.

Davis, D. S. & S. Browne. 1996a. The Natural History of Nova Scotia, Volume I: Topics and Habitats. Nova Scotia Museum, Government of Nova Scotia, Nimbus Publishing, Halifax.

Davis, D. S. & S. Browne. 1996b. The Natural History of Nova Scotia, Volume II: Theme Regions. Nova Scotia Museum, Government of Nova Scotia, Nimbus Publishing, Halifax.

Davis, M., L. Gratton, J. Adams, J. Goltz, C. Stewart, S. Buttrick, N. Zinger, K. Kavanagh, M. Sims, & G. Mann. 2013. New England-Acadian forests. World Wildlife Fund. Accessed September 18, 2014. http://worldwildlife.org/ecoregions/na0410.

Department of Fisheries and Oceans (DFO). 2000. The effects of acid rain on Atlantic Salmon of the Southern Upland of Nova Scotia. Maritime Regional Habitat Status Report 2000/2E.

Department of Fisheries and Oceans (DFO). (2009). Does eelgrass (*Zostera marina*) meet the criteria as an ecologically significant species? Canadian Science Advisory Secretariat Science Advisory Report 2009/018.

Dudley, N. (ed.). 2008. Guidelines for applying protected areas management categories. International Union for Conservation of Nature, Gland, Switzerland.

Dunwiddie, W. P. 1989. Forest and heath: the shaping of the vegetation on Nantucket Island. Journal of Forest History 33, 126-133.

Ecological Stratification Working Group. 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa.

ELI (Environmental Law Institute). (2003). Conservation Thresholds for Land Use Planners. Washington D.C.

Environment Canada. 2011. Management Plan for the Frosted Glass-whiskers (*Sclerophora peronella*), Nova Scotia Population, in Canada. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa.

Environment Canada. 2012. Recovery Strategy for the Piping Plover (*Charadrius melodus melodus*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa.

Environment Canada. 2013. Bird Conservation Strategy for Bird Conservation Region 14 and Marine Biogeographic Units 11 and 12 in Nova Scotia: Atlantic Northern Forest, Scotian Shelf and Bay of Fundy, and Gulf of St. Lawrence. Canadian Wildlife Service, Environment Canada, Sackville, NB.

Environment Canada & Parks Canada Agency. 2010. Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada. *Species at Risk Act* Recovery Strategy Series, Ottawa.

Environmental Law Institute (ELI). 2003. Conservation Thresholds for Land Use Planners. Washington DC.

Erskine, A. J. 1992. Atlas of breeding birds of the Maritimes Provinces. Nimbus Publ. and Nova Scotia Mus., Halifax.

Fernow, B. E. (1912). Forest conditions of Nova Scotia. Canada Commission of Conservation, Ottawa.

Fisheries and Oceans Canada. 2009. Development of a framework and principles for the biogeographic classification of Canadian marine areas. Canadian Science Advisory Secretariat Science Advisory Report 2009/056.

Fisheries and Oceans Canada. 2014. Status of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. Canadian Science Advisory Secretariat Science Advisory Response 2015/021.

Fielding, G. 2011. Barriers to Fish Passage in Nova Scotia: The Evolution of Water Control in Nova Scotia's Watersheds. Environmental Science Honours Thesis, Dalhousie University, Halifax.

Ford, D. C. & P. W. Williams. 2007. Karst Geomorphology and Hydrology, 2nd ed. John Wiley & Sons: Chichester, U.K.

Forman, R. T. T. & L. E. Alexander. 1998. Roads and their major ecological effects. *Annual Reviews of Ecological Systems* 29: 207-231.

Frank, L. 2014. Report Card on Child and Family Poverty in Nova Scotia. Canadian Centre for Policy Alternatives, Halifax.

Fraver, S., A. S. White, R. S. Seymour. 2009. Natural disturbance in an old-growth landscape of northern Maine, USA. *Journal of Ecology* 97: 289-298.

Frick, W. F., J. F. Pollock, A. C. Hicks, K. E. Langwig, D. S. Reynolds, G. G. Turner, C. M. Butchkoski, & T. H. Kunz. 2010. An emerging disease causes regional population collapse of a common North American bat species. *Science* 329: 679-682.

Greenburg, D. A., W. Blanchard, B. Smith & E. Barrow. 2012. Climate change, mean sea level and high tides in the Bay of Fundy. *Atmosphere-Ocean* 50: 261-276.

Gregory, S. V., F. J. Swanson, W. A. McKee & K. W. Cummins. 1991. An Ecosystem Perspective of Riparian Zones: Focus on links between land and water. *Bioscience* 41: 540-551.

Gulf of Maine Council (GOMC) on the Marine Environment. 2010. Coastal Ecosystems and Habitats. State of the Gulf of Maine Report. www.gulfofmaine.org/stateofthegulf.

Gustavson, K. 2010. Coastal Ecosystems and Habitats: State of the Gulf of Maine Report. Gulf of Maine Council on the Marine Environment.

Hanson, A. R. (ed.). 2004. Status and conservation of eelgrass (*Zostera marina*) in Eastern Canada. Technical Report Series No. 412. Canadian Wildlife Service, Atlantic Region.

Hartley, M. J. 2002. Rationale and methods for conserving biodiversity in plantation forests. Forest Ecology and Management 155: 81–95.

IBA Canada. 2012. Important Bird Areas in Canada. Bird Studies Canada and Nature Canada, Ottawa. Accessed June 10, 2013. http://www.ibacanada.ca.

IBTCG. 2010. *A Conservation Action Plan for Bicknell's Thrush (Catharus bicknelli)*. J. A. Hart, C. C. Rimmer, R. Dettmers, R. M. Whittam, E. A. McKinnon, and K. P. McFarland, Eds. International Bicknell's Thrush Conservation Group. Available at www.bicknellsthrush.org

International Union for Conservation of Nature (IUCN-CMP). 2012. IUCN-CMP Unified Classification of Direct Threats, Version: 3.2. http://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme.

Johnson, G. D. 2005. A review of bat mortality at wind-energy developments in the United States. *Bat Research News* 46: 45-50.

Klinka, R., R. N. Green, R. L. Trowbridge, & L. E. Lowe. 1981. Taxonomic Classification of Humus Forms in Ecosystems of British Columbia. Province of British Columbia Ministry of Forests.

Kennedy, J.A., E.A. Krebs and A.F. Camfield. 2012. A Manual for Completing All-bird Conservation Plans in Canada, April 2012 version. Canadian Wildlife Service, Environment and Climate Change Canada. Ottawa, ONLatham, R. E. 2003. Shrubland longevity and rare plant species in the northeastern United States. *Forest Ecology and Management* 185: 21–39.

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R. P. Larkin, M. D. Strickland, R. W. Thresher, & M. D. Tuttle. 2007. Ecological impacts of wind energy development on bats: Questions, research needs, and hypotheses. Frontiers of Ecology and the Environment 5: 315-324

Lindenmayer, D.B., Franklin, J.F., (2002). Conserving Forest Biodiversity: A Comprehensive Multi-scaled Approach. Island Press: Washington.

Loo, J., & N. Ives. 2003. The Acadian Forest: Historical condition and human impacts. *The Forestry Chronicle* 79: 462-474.

Lorch, J. M., C. U. Meteyer, M. J. Behr, J. G. Boyles, P. M. Cryan, A. C. Hicks, A. E. Ballmann, J. T. H. Coleman, D. N. Redell, D. M. Reeder, & D. S. Blehert. 2011. Experimental infection of bats with *Geomyces destructans* causes white-nose syndrome. *Nature* 480: 376-U129.

Lynds, A. & J. Leduc. 1995. Old forests of Nova Scotia. Nova Scotia Dept. of Natural Resources, Parksand Recreation Div., Occasional Papers No.1, 18p

MacDonald, A. M., J. T. Lundholm, & S. R. Clayden. 2011. Saxicolous lichens on a Nova Scotia coastal barren. *Northeastern Naturalist* 18: 475-488.

MacDonald, P. R. N. & P. J. Austin-Smith. 1989. Bald eagle, *Haliaeetus leucocephalus*, nest distribution on Cape Breton Island, Nova Scotia. *Canadian Field Naturalist* 103:293-296.

MacMillan, J. L., D. Caissie, J. E. LeBlanc & T. J. Crandlemere. 2005. Characterization of summer water temperatures for 312 selected sites in Nova Scotia. Canadian Journal of Fisheries and Aquatic Sciences Technical Report 2582.

MacMillan, J. & T. J. Crandlemere. 2005. Trout population parameters and habitat characteristics in Nova Scotia lakes. Interim data report. Research reports. Nova Scotia Department of Fisheries and Aquaculture.

Mazerolle, D., S. Blaney, A. Belliveau. 2014. Rare vascular plant surveys in the Polletts Cove and LaHave River areas of Nova Scotia. An Atlantic Canada Conservation Data Centre report to the Nova Scotia Department of Natural Resources Species at Risk Conservation Fund.

Mazerolle, D., S. Blaney, A. Belliveau. 2015. Evaluation of the Ecological Significance of Gypsum and Other Calcareous Exposures in Nova Scotia. An Atlantic Canada Conservation Data Centre report to the Nova Scotia Crown Share Land Legacy Trust.

McAlpine, D. F. & I. M. Smith. 2010. Assessment of Species Diversity in the Atlantic Maritime Ecozone. NRC Research Press Canada.

McEachern G. 2003. Where Land and Waters Meet: Understanding and protecting riparian areas in Canada's forests. J. D. Gysbers & P. Lee (eds.), M. Carver (contributor). Global Forest Watch Canada: Edmonton, Alberta

Meller, C. 2013. Bats among animals added to Nova Scotia protected list. *The Chronicle Herald*, Halifax, July 11, 2013, p. A1.

Mersey Tobeatic Research Institute (MTRI). 2007. State of aquatic health and landscape connectivity in the Upper Mersey and Medway watersheds in the Southwest Nova Biosphere Reserve. Mersey Tobeatic Research Institute, Kempt, Nova Scotia.

Mersey Tobeatic Research Institute (MTRI). 2008. Species at Risk in Nova Scotia: Identification and Information Guide. Mersey Tobeatic Research Institute, Kempt, Nova Scotia. http://www.speciesatrisk.ca/SARGuide/.

Mersey Tobeatic Research Institute (MTRI). 2012. Invasive Alien Species in Nova Scotia: Identification and Information Guide. Kempt, Nova Scotia.

Mosseler, A., J. A. Lynds, & J. E. Major. 2003. Old-growth forests of the Acadian Forest Region. *Environmental Review* 11: 47-77.

Morrison, M. & S. Hines-Clark. 2009. Scotian South Shore Natural Area Conservation Plan (NACP). Nature Conservancy of Canada, Atlantic Region.

Naiman, R. J., H. Decamps, & H. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 10: 958-970.

Nature Conservancy of Canada (NCC). 2017. Nature Conservancy of Canada Launches First Large-Scale Project in Cape Breton. January 12, 2017 Media Release, Baddeck, Nova Scotia.

Neily, P. D., E. Quigley, L. Benjamin, B. Stewart, & T. Duke. 2005. Ecological Land Classification for Nova Scotia: Volume 1 - Mapping Nova Scotia's Terrestrial Ecosystems, Revised Edition. Nova Scotia Department of Natural Resources, Renewable Resources Branch, Report 2005.

Neily, P. D., E. Quigley, & B. Stewart. 2008. Mapping Nova Scotia's Natural Disturbance Regimes. Nova Scotia Department of Natural Resources, Renewable Resources Branch, Report 2008-5.

Nelson, V. 2009. Wind Energy: Renewable Energy and the Environment. CRC Press, Taylor & Francis Group, Boca Raton.

Nixon, F. C. 2014. Barachois evolution in the Bras d'Or Lakes under past, present and future sea-level rise: Progress to date. Mineral Resources Branch, Report of Activities 2014, Nova Scotia Department of Natural Resources Report ME 2014-001: 113-119.

Nocera, J. J. 2000. Baseline Information Reports on 12 Coastal Areas of Significance to Wildlife. A project to facilitate the Eastern Habitat Joint Venture Property Securement Strategy in Nova Scotia.

North American Bird Conservation Initiative (NABCI). 2016. The State of North America's Birds 2016. Environment and Climate Change Canada, Ottawa, Ontario. www.stateofthebirds.org.

Nova Scotia Agriculture and Fisheries (NSAF). 2005. Growing Our Future: Long-Term Planning for Aquatic Farming in Nova Scotia: A Discussion Document. http://novascotia.ca/fish/documents/Growing-our-future.pdf.

Nova Scotia Department of Environment and Labour (NSDEL). 2002a. Natural Landscapes of Nova Scotia: Summary Descriptions. Protected Areas Branch, Halifax.

Nova Scotia Department of Environment and Labour (NSDEL). 2002b. Natural Landscapes of Nova Scotia (1:10,000 Map). Protected Areas Branch, Halifax. http://novascotia.ca/nse/protectedareas/docs/landscapes_map.pdf.

Nova Scotia Department of Natural Resources (NSDNR). 2013. Species at Risk Overview: NS Endangered Species Act –Legally Listed Species. Wildlife Division. Last Updated July 23, 2013. http://novascotia.ca/natr/wildlife/biodiversity/species-list.asp.

Nova Scotia Eastern Habitat Joint Venture (NS EHJV). 2008. Eastern Habitat Joint Venture Five Year (2007-2012) Plan for the Implementation of the North American Waterfowl Management Plan in Nova Scotia. Nova Scotia Department of Natural Resources.

Nova Scotia Environment (NSE). 2008. Margaree-Lake Ainslie Canadian Heritage River 10-year Monitoring Report, 1998-2008. Prepared for the Canadian Heritage Rivers Board, Nova Scotia Environment.

Nova Scotia Environment (NSE). 2011. Primary 1:10,000 Watersheds of Nova Scotia. Water and Wastewater Branch, ESPM Division, Nova Scotia Environment.

Nova Scotia Environment (NSE). 2016. Protected Areas. http://novascotia.ca/nse/protectedareas/.

Nova Scotia Federation of Agriculture (NSFA). 2016. Statistical Profile of Cape Breton. Retrieved June 21, 2016. http://nsfa-fane.ca/wp-content/uploads/2011/06/CapeBreton.pdf.

Nova Scotia Lynx Recovery Team (NSLRT). 2006. Provincial Recovery Plan for the Canada Lynx (Lynx canadensis), Nova Scotia. 32 pp.

Oberndorfer, E. C. & J. T. Lundholm. 2009. Species richness, abundance, rarity and environmental gradients in coastal barren vegetation. *Biodiversity and Conservation* 18: 1523–1553.

Oliver, N. L. Freeman, & L. Cliche. 2013. Aquatic Connectivity, Cape Breton, Nova Scotia. Atlantic Coastal Action Program Cape Breton. NSLC Adopt-A-Stream and Clean Annapolis River Project Initiative.

Parker, G. R., J.W. Maxwell, L. D. Morton, & G. E. Smith. 1983. The ecology of the lynx (*Lynx canadensis*) on Cape Breton Island. *Canadian Journal of Zoology* 61:770-786.

Parker, M., M. Westhead, P. Doherty, & J. Naug. 2007. Ecosystem Overview and Assessment Report for the Bras d'Or Lakes, Nova Scotia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2789.

Parks Canada. 2010a. Cape Breton Highlands National Park of Canada – Management Plan. Parks Canada, Ingonish Beach, Nova Scotia.

Parks Canada. 2010b. Cape Breton Highlands National Park of Canada – State of the Park Report 2010. Parks Canada, Ingonish Beach, Nova Scotia.

Porter, C., Lundholm, J., Bowron, T., Lemieux, B., van Proosdij, D., Neatt, N., & Graham, J. 2015. Classification and environmental correlates of tidal wetland vegetation in Nova Scotia, Canada. *Botany*, *93*(12), 825-841.

Porter, C. 2013. Classification of dwarf heath plant communities on the coastal barrens of Nova Scotia. M.Sc. Thesis, Saint Mary's University, Halifax.

Province of Nova Scotia. 2010. Renewable Electricity Plan: A path to good jobs, stable prices, and a cleaner environment. Nova Scotia Department of Energy, Halifax. http://www.gov.ns.ca/energy/resources/EM/renewable/renewable-electricity-plan.pdf.

Province of Nova Scotia. 2012. On Nova Scotia Farms: A Teacher's Guide to Nova Scotia Agriculture. Agricultural Education Office of the Nova Scotia Department of Agriculture.

Richards, W. & R. Daigle. 2011. Scenarios and Guidelines for Adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities. Climate Change Dictorate, Nova Scotia Department of Environment.

Robichaud-Leblanc, K. A. & P. G. Amiro. 2004. Assessments of Atlantic Salmon stocks in selected rivers of Eastern Cape Breton, SFA 19, to 2003. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Research Document 2004/017.

Rodenhouse, N. L., S. N. Mathews, K. P. McFarland, J. D. Lambert, N. R. Iverson, A. Prassad, T. S. Sillett, and R. T. Holmes. 2008. Potential effects of climate change on birds of the Northeast. Mitig Adapt Strat Glob Change 13:517-540.

Roman, C. T., W. A. Niering, & R. S. Warren. 1984. Tidal marsh vegetation change in response to tidal restriction. *Environmental Management* 8: 141-150.

Salafsky, N, D. Salzer, J. Ervin, T. Boucher, & W. Ostlie. 2003. Conventions for Defining, Naming, Measuring, Combining, and Mapping Threats in Conservation: An Initial Proposal for a Standard System. Conservation Measures Partnership, Washington, DC.

Salafsky, N., Salzer, D., Stattersfield, A. J., Hilton-Taylor, C., Neugarten, R., Butchart, S. H. M., Collen, B., Cox, N., Master, L. L., O'Connor, S. and Wilkie, D. 2008. A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions. Conservation Biology, 22: 897–911Shaw, j. D. J. W. Piper, & R. B. Taylor. 2002. The Geology of the Bras d'Or Lakes, Nova Scotia. Proceedings of the Nova Scotia Institute of Science 42: 127-147.

Skinner, M.A., S. Courtney, & C. McKindsey. 2013. Reductions in distributions, photosynthensis, and productivity of eelgrass Zostera marina associated with oyster *Crassostrea virginica* aquaculture. *Marine Ecology Progress Series*. 486: 105-119.

Statistics Canada. 2016. Focus on Geography Series, 2015 Census. Statistics Canada Catalogue no. 98-310-XWE2011004, Ottawa, Ontario.

Sterling, S., Garroway, K., Guan, Y., Ambrose, S., Horne, P., Kennedy, G., (2014) A new watershed assessment framework for Nova Scotia: A high-level, integrated approach for regions without a dense network of monitoring stations. *Journal of Hydrology* 519:2596-2612.

Stephenson M.F., McGladdery S.E., Maillet M., Veniot A., Meyer G., 2003, First reported occurrence of MSX in Canada. J. Shellfish Res. 22, 355.

Stephenson, M. and B. Petrie. 2005. Oceanographic influences on the management of MSX disease of American oysters (Crassostrea virginica) in Atlantic Canada. Bulletin of the Aquaculture Association of Canada 105-1: 67-78.

Stewart, R. L. M., K. A. Bredin, A. R. Couturier, A. G. Horn, D. Lepage, S. Makepeace, P. D. Taylor, M.-A. Villard, & R. M. Whittam (ed.). 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Birds Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, NB.

Taylor, R. B. & J. Shaw. 2002. Coastal character and coastal barrier evolution in the Bras d'Or Lakes, Nova Scotia: Proceedings of the Nova Scotia Institute of Science 42(1): 149-181.

The Chronicle Herald. 2015. Nova Scotia Power biomass project in Cape Breton raising green concerns. Published January 9, 2015, Halifax, Nova Scotia.

The Nature Conservancy (TNC). 2016. Benefits of Healthy Floodplains. Retrieved June 13, 2016. http://www.nature.org/ourinitiatives/habitats/riverslakes/benefits-of-healthy-floodplains.xml

Therriault, T.W.; Herborg, L.M.; Locke, A.; McKindsey, C.W. (2008). Risk assessment for European green crab (*Carcinus maenas*) in Canadian waters. Can. Sci. Advis. Sec. Res. Doc. 2008/042.

Thurston, H. 2011. The Atlantic Coast: A Natural History. Greystone Books, co-published with David Suzuki Foundation, 77- 84, 206-229.

Tingley R., D. G. McCurdy, M. D. Pulsifer, & T. B. Herman. 2009. Spatio-temporal differences in the use of agricultural fields by male and female wood turtles (Glyptemys insculpta) inhabiting an agri-forest mosaic. Herpetological Conservation and Biology 4: 185-190.

Tremblay, M. J. 2002. Large epibenthic invertebrates in the Bras d'Or Lakes. Proceedings of the Nova Scotia Institute of Science 42: 101-126.

Trombulak, S. C. & C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14: 18-30.

Unama'ki Institute of Natural Resources. 2007. State of the Bras d'Or Lakes Marine Environmental Water Quality Background Report. 2007-03-01

United States Fish and Wildlife Service. 2017. White Nose Syndrome: North America's Response to the Devastating Bat Disease. http://www.whitenosesyndrome.org.

United States Climate Change Science Program (US CCSP). 2009. Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region. J. G. Titus (coordinating lead author). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research.

Vercaemer B., J. Ouellette-Plante, J. T. Johnson, & A. McIsaac. 2011. Assessment of Green Crab (*Carcinus maenas*) abundance in the Bras d'Or Lake of Cape Breton, Nova Scotia. Canadian Technical Report of Fisheries and Aquatic Sciences 2965.

Watt, W. D., C. D. Scott, P. J. Zamora, & W. J. White. 2000. Acid toxicity levels in Nova Scotian rivers have not declined in synchrony with the decline in sulfate levels. Water, Air, and Soil Pollution 118: 203-229.

Weller, T. J. & J. A. Baldwin. 2012. Using echolocation monitoring to model bat occupancy and inform mitigations at wind energy facilities. Journal of Wildlife Management 76: 619-631.

Wisheu, I. C. & P. A. Keddy. 1991. Seed banks of a rare wetland plant community: Distribution patterns and the effects of human-induced disturbance. Journal of Vegetation Science 2: 181-188

Woolmer, G., S. C. Trombulak, J. C. Ray, P. J. Doran, M. G. Anderson, R. F. Baldwin, A. Morgan, & E. W. Sanderson. 2008. Rescaling the Human Footprint: A tool for conservation planning at an ecoregional scale. *Landscape and Urban Planning*. 87: 42-53.

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Appendices

Appendix A. List of Abbreviations

Acronyms	Title
ACCDC	Atlantic Canada Conservation Data Centre
ACAP	Atlantic Coastal Action Program
ACPF	Atlantic Coastal Plain Flora
AOI	Area of Interest
BCR	Bird Conservation Region
BSC	Bird Studies Canada
CEPI	Bras d'Or Lakes Collaborative Environmental Planning Initiative
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DFO	Department of Fisheries and Oceans
DUC	Ducks Unlimited Canada
ECCC	Environment and Climate Change Canada
EFWC	Eskasoni Fish and Wildlife Commission
EHJV	Eastern Habitat Joint Venture
IBA	Important Bird Area
UINR	Unama'ki Institute of Natural Resources
IUCN	International Union for Conservation of Nature
MBBA	Maritime Breeding Bird Atlas
MBS	Migratory Bird Sanctuary
MBU	Marine Biogeographic Unit
MTRI	Mersey Tobeatic Research Institute
NAAP	Northern Appalachian - Acadian Ecoregional Plan
NAWCA	North American Waterfowl Conservation Act
NAWMP	North American Waterfowl Management Plan
NCC	Nature Conservancy of Canada
NS	Nova Scotia
NSDNR	Nova Scotia Department of Natural Resources
NSE/DOE	Nova Scotia Environment
NS ESA	Nova Scotia Endangered Species Act
NSLFFPA	Nova Scotia Landowners and Forest Fibre Producers Association
NSNT	Nova Scotia Nature Trust
NWA	National Wildlife Area
OHV	Off-Highway Vehicle
PC	Parks Canada
SAR	Species at Risk
UNESCO	United Nations Educational, Scientific, and Cultural Organization

Appendix B: Glossary of Biodiversity and Conservation Ranks

Species at Risk (SAR): those species that have been designated as Endangered, Threatened or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or listed through provincial endangered species legislation.

***Species at Risk Act* (SARA):** proclaimed in 2003, the federal legislation that is designed to prevent wildlife species, subspecies, and distinct populations from becoming extirpated or extinct, provide for the recovery of extirpated, endangered or threatened species, and ensure that species of special concern do not become endangered or threatened. Once a species is listed, the provisions under SARA apply to protect and recover the species.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): a national committee of experts that assesses the national status of wild species, subspecies, varieties, or other designable units that are considered to be at risk in Canada. COSEWIC assigns the following status to species:

Status Category	Definition
Extinct (EXT)	A wildlife species that no longer exists.
Extirpated (EXP)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere in the wild.
Endangered (EN)	A wildlife species facing imminent extirpation in Canada, or extinction.
Threatened (TH)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)	A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Not At Risk (NAR)	A wildlife species that has been evaluated and found to be not at risk given the current circumstances.
Data Deficient (DD)	A species for which there is insufficient information to resolve a species' eligibility for assessment or to permit an assessment of the species' risk of extinction.

***Nova Scotia Endangered Species Act* (NS ESA):** The provincial legislation that protects species in Nova Scotia that have been assessed and determined to be at risk of extinction. The Act was proclaimed in 1999 and was one of the first provincial endangered species acts in Canada. There are 71 species that are legally listed under the act. The NS ESA assigns the following status to species:

Status Category	Definition
Endangered (EN)	A species facing imminent extirpation or extinction.
Threatened (TH)	A species likely to become endangered if limiting factors are not reversed.
Vulnerable (VU)	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Extirpated (EXP)	A species that no longer existing in the wild in the Province but exists in the wild outside of the Province.
Extinct (EXT)	A species that no longer exists.

Global Rank (G-RANK): the overall status of a species or ecological community is regarded as its "global" status; this range-wide assessment of condition is referred to as its global conservation status rank.

Global conservation status assessments are generally carried out by NatureServe scientists with input from relevant natural heritage member programs (e.g., CDCs and NHICs) and experts on particular taxonomic groups, and are based on a combination of quantitative and qualitative information. The factors considered in assessing conservation status include the total number and condition of occurrences; population size; range extent and area of occupancy; short- and long-term trends in these previous factors; scope, severity, and immediacy of threats, number of protected and managed occurrences, intrinsic vulnerability and environmental specificity.

Global Ranks

Rank	Definition
GX	**Presumed Extinct** (species)—Not located despite intensive searches and virtually no likelihood of rediscovery. **Eliminated** (ecological communities)—Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
GH	**Possibly Extinct** (species)—Missing; known from only historical occurrences but still some hope of rediscovery. **Presumed Eliminated** (historic ecological communities)—Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut Forest.
G1	**Critically Imperilled**—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	**Imperilled**—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	**Vulnerable**—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	**Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	**Secure**—Common; widespread and abundant.

Variant Ranks

Rank	Definition
G#G#	**Range Rank**—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. A G2G3 rank would indicate that there is a roughly equal chance of G2 or G3 and other ranks are much less likely. Ranges cannot skip more than one rank (e.g., GU should be
GU	**Unrankable**—Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Whenever possible, the most likely rank is assigned and a question mark qualifier may be added (e.g., G2?) to express minor uncertainty, or a range rank (e.g., G2G3) may be used to delineate the limits (range) of uncertainty.
GNR	**Unranked**—Global rank not yet assessed.
GNA	**Not Applicable**—A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

Sub-national (Provincial) Rank (S-RANK): provincial ranks are used by natural heritage member programs to set conservation priorities for rare species and vegetation communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of a province. Comparison of global and provincial ranks, gives an indication of the status and rarity of an element in that province in relation to its overall conservation status, therefore providing insight into the urgency of conservation action for it in the province.

Subnational Conservation Status Ranks

Status	Definition
SX	**Presumed Extirpated**—Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
SH	**Possibly Extirpated** (Historical)—Species or community occurred historically in the province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or community could become SH without such a 20-40 year delay if the only known occurrences in a nation or state/province were destroyed or if it had been extensively and unsuccessfully looked for. The SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.
S1	**Critically Imperilled**—Critically imperilled in the province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the province.
S2	**Imperilled**—Imperilled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S3	**Vulnerable**—Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	**Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	**Secure**—Common, widespread, and abundant in the province.
SNR	**Unranked**—Province conservation status not yet assessed.
SU	**Unrankable**—Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	**Not Applicable**—A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#S# S#B S#N	**Range Rank**—A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4). **Breeding** (Migratory species) **Non-breeding** (Migratory species)

Nova Scotia Department of Natural Resources General Status Ranks: Since 1995, the Province of Nova Scotia has been an active member of a National General Status Working Group comprised of provincial, territorial and federal representatives. The General Status Assessment process is a "first alert" system that provides the Province with an overall indication of how well species are doing in Nova Scotia, and helps to identify which species or populations are secure, which are sensitive, and which are at risk.

General Status Ranks

Rank	Description
0.2	**Extinct**—Species that are extirpated worldwide (i.e., they no longer exist anywhere).
0.1	**Extirpated**—Species that are no longer present in a given geographic area, but occur in other areas.
1	**At Risk**—Species for which a formal, detailed risk assessment (COSEWIC status assessment or provincial or territorial equivalent) has been completed and that have been determined to be at risk of extirpation or extinction (i.e., Endangered or Threatened). A COSEWIC designation of Endangered or Threatened automatically results in a Canada General Status Rank (Canada rank) of At Risk. Where a provincial or territorial formal risk assessment finds a species to be Endangered or Threatened in that particular region, then, under the general status program, the species automatically receives a provincial or territorial general status rank of At Risk.
2	**May Be At Risk**—Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC, or provincial or territorial equivalents.
3	**Sensitive**—Species that are not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk.
4	**Secure**—Species that are not believed to belong in the categories Extinct, Extirpated, At Risk, May Be At Risk, Sensitive, Accidental or Exotic. This category includes some species that show a trend of decline in numbers in Canada but remain relatively widespread or abundant.
5	**Undetermined**—Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status.
6	**Not Assessed**—Species that are known or believed to be present regularly in the geographic area in Canada to which the rank applies, but have not yet been assessed by the general status program.
7	**Exotic**—Species that have been moved beyond their natural range as a result of human activity. In this report, Exotic species have been purposefully excluded from all other categories.
8	**Accidental**—Species occurring infrequently and unpredictably, outside their usual range.

Appendix C. Conservation Priority Species

Conservation priority species for the Cape Breton bioregion, including all federally COSEWIC assessed and SARA listed species at risk, all provincially listed species at risk, a subset of the Atlantic Canada Data Centre (ACCDC) rare species database (S1, S2, and S3 ranked species with a global rank of G1, G2, or G3), and all Bird Conservation Region (BCR) 14 or Marine Biogeographic Unit (MBU) 11 or 12 priority bird species that occur with regularity in the bioregion (Environment Canada 2013). For each species, their conservation status, source of occurrence data, and course-filter habitat associations are provided. See the ACCDC for a complete glossary of biodiversity and conservation ranks (www.accdc.com).

		Conservation Status							Priority Habitat Affiliation								
Common name	*Scientific name*	COSEWIC status	SARA Status	Provincial status	G-rank	S-rank	BCR 14 Priority Species	MBU 11/12 Priority	Barachois Ponds	Beaches, Dunes, Rocky	Coastal Islands	Estuaries	Aquatic and Riparian	Freshwater Wetlands	Acadian and Boreal	Barrens	Grasslands
Invertebrates																	
Arctic Fritillary	*Boloria chariclea*				G5	S2									x	x	
Baltimore Checkerspot	*Euphydryas phaeton*				G4	S2S3								x			
Brook Snaketail	*Ophiogomphus aspersus*				G4	S1							x				
Canada Whiteface	*Leucorrhinia patricia*				G4	S1								x			
Compton Tortoiseshell	*Nymphalis l-album*				G5	S1S2									x		
Dorcas Copper	*Lycaena dorcas*				G5	S1							x	x			
Eastern Lampmussel	*Lampsilis radiata*				G5	S2							x				
Eastern Pearlshell	*Margaritifera margaritifera*				G4	S2							x				
Forcipate Emerald	*Somatochlor a farcipata*				G5	S2S3							x	x	x		
Grey Hairstreak	*Strymon melinus*				G5	S1S2										x	x
Harpoon Clubtail	*Gomphus descriptus*				G4	S2S3							x		x		
Hoary Comma	*Polygonia gracilis*				G5	S1							x		x		

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	SARA Status	Provincial status	G-rank	S-rank	BCR 14 Priority Species	MBU 11/12 Priority	Barachois Ponds	Beaches, Dunes, Rocky	Coastal Islands	Estuaries	Aquatic and Riparian	Freshwater Wetlands	Acadian and Boreal	Barrens	Grasslands
Jutta Arctic	*Oeneis jutta*				G5	S1								x	x		
Milbert's Tortoishell	*Aglais milberti*				G5	S2									x		x
Monarch	*Danaus plexippus*	SC	SC	EN	G5	S2B				x			x	x	x	x	x
Muskeg Emerald	*Somatochlora septentrionalis*				G5	S2								x			
Mustard White	*Pieris oleracea*				G4G5	S2								x	x		
Northern Cloudywing	*Thorybes pylades*				G5	S2								x	x		x
Quebec Emerald	*Somatochlora brevicincta*				G4	S1								x			
Ringed Emerald	*Somatochlora albicincta*				G5	S1							x	x			
Salt Marsh Copper	*Lycaena dospassosi*				G2G4	S2						x					
Satyr Comma	*Polygonia satyrus*				G5	S1?							x	x		x	x
Short-Tailed Swallowtail	*Papilio brevicauda*				G3G4	S1S2				x					x	x	x
Spot-Winged Glider	*Pantala hymenaea*				G5	S2B			x			x		x			
Subarctic Bluet	*Coenagrion interrogatum*				G5	S1							x	x			
Tidewater Mucket	*Leptodea ochracea*				G3G4	S1							x				
Triangle Floater	*Alasmidonta undulata*				G4	S2S3							x				
Williamson's Emerald	*Somatochlora williamsoni*				G5	S2							x	x			
Yellow Banded Bumble Bee	*Bombus terricola*	SC			G2G4	S3							x	x	x	x	x
Yellow Lampmussel	*Lampsilis cariosa*	SC	SC	TH	G3G4	S1							x				

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Fish																	
American Eel	*Anguilla Rostrata*	TH			G4	S5						x	x				
Atlantic Salmon (Eastern Cape Breton **Population**)	*Salmo salar*	EN			G5	S2						x	x				
Atlantic Sturgeon	*Acipenser oxyrinchus*	T			G3	S2						x	x				
Striped Bass	*Morone saxatilis*	EN			G5	S1						x	x				
Birds																	
American Bittern	*Botaurus lentiginosus*				G4	S3S4B	x		x			x	x	x			
American Black Duck	*Anas rubripes*				G5	S5	x	x	x			x	x	x			
American Golden Plover	*Pluvialis dominica*				G5	S1S2M	x			x			x				x
American Redstart	*Setophaga ruticilla*				G5	S5B	x								x		
American Three-toed Woodpecker	*Picoides dorsalis*				G5	S1S2									x		
American Woodcock	*Scolopax minor*				G5	S4S5B	x							x	x		
Bald Eagle	*Haliaeetus leucocephalus*				G5	S4	x				x	x	x				
Baltimore Oriole	*Icterus galbula*				G5	S2S3B							x		x		
Bank Swallow	*Riparia riparia*	TH		EN	G5	S3B	x			x			x			x	
Barn Swallow	*Hirundo rustica*	TH		EN	G5	S3B	x						x				x

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Barrow's Goldeneye - Eastern Pop	*Bucephala islandica (Eastern pop.)*	SC	SC	VU	G5	S1N	x	x				x					
Bay-Breasted Warbler	*Setophaga castanea*				G5	S3S4B	x								x		
Belted Kingfisher	*Megaceryle alcyon*				G5	S5B	x		x			x	x	x			
Bicknell's Thrush	*Catharus bicknelli*	TH	SC	EN	G4	S1S2B	x								x		
Black and White Warbler	*Mniotilta varia*				G5	S4S5B	x						x		x		
Black-bellied Plover	*Pluvialis squatarola*				G5	S4M		x		x	x	x					
Black-billed Cuckoo	*Coccyzus erythropthalmus*				G5	S3?B	x								x		
Blackburnian Warbler	*Setophaga fusca*				G5	S4B	x								x		
Black-legged Kittiwake	*Rissa tridactyla*				G5	S2B		x		x							
Black Scoter	*Melanitta americana*				G5	S5M		x	x	x		x		x			
Black-throated Green Warbler	*Dendroica virens*				G5	S4S5B	x								x		
Blue-headed Vireo	*Vireo solitarius*				G5	S5B	x								x		
Bobolink*	*Dolichonyx ory*	TH		VU	G5	S3S4B	x										x
Boreal Chickadee	*Poecile hudsonica*				G5	S3	x								x		
Boreal Owl	*Aegolius funereus*				G5	S1B									x		
Brown-headed Cowbird*	*Molothrus ater*				G5	S2S3B											x
Buff-breasted Sandpiper	*Tryngites subruficollis*	SC			G4	SNA				x		x					

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Canada Goose (North Atlantic)	*Branta canadensis*				G5	S4B	x	x	x			x		x			
Canada Warbler	*Wilsonia canadensis*	TH	TH	EN	G5	S3B	x								x		
Cape May Warbler	*Dendroica tigrina*				G5	S2B	x						x	x	x		
Chimney Swift	*Chaetura pelagica*	TH	TH	EN	G5	S2S3B	x								x		
Cliff Swallow	*Petrochelidon pyrrhonota*				G5	S2S3B				x			x	x			
Common Eider	*Somateria mollissima*				G5	S4		x			x						
Common Goldeneye	*Bucephala clangula*				G5	S2B,S5N		x					x	x	x		
Common Loon	*Gavia immer*				G5	S3B	x	x					x				
Common Murre	*Uria aalge*				G5	S1?B, S5N		x		x	x						
Common Nighthawk	*Chordeiles minor*	TH	TH	TH	G5	S3B	x								x	x	
Common Tern	*Sterna hirundo*				G5	S3B	x	x		x		x					
Cooper's Hawk	*Accipiter cooperii*				G5	S1?B							x		x		
Dunlin	*Calidris alpina*				G5	S4M		x		x		x	x	x			
Eastern Kingbird	*Tyrannus tyrannus*				G5	S3S4B	x						x	x	x		
Eastern Wood-Pewee	*Contopus virens*	SC		VU	G5	S3S4B	x								x		
Evening Grosbeak	*Coccothraustes vespertinus*			VU	G5	S4B	x								x		
Gadwall	*Anas strepera*				G5	S2B						x	x	x			

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Great Cormorant	*Phalacrocorax carbo*				G5	S2S3B		x		x	x	x	x				
Gray Catbird	*Dumetella carolinensis*				G5	S3B	x								x		
Gray Jay	*Perisoreus canadensis*				G5	S3S4	x								x		
Green-winged Teal	*Anas crecca*				G5	S4S5B	x		x			x		x			
Harlequin Duck - Eastern Pop	*Histrionicus histrionicus Pop 1*	SC	SC	EN	G4T4	S2N		x			x	x					
Hudsonian Godwit	*Limosa haemastica*				G4	S1S2M		x				x	x	x			
Hudsonian Whimbrel	*Numenius phaeopus hudsonicus*				G5TNR	S2S3M						x				x	
Killdeer	*Charadrius vociferus*				G5	S3S4B	x			x		x	x				
Leach's Storm-Petrel	*Oceanodroma leucorhoa*				G5	S4S5B		x		x		x		x		x	
Least Sandpiper	*Calidris minutilla*				G5	S1B,S3M		x		x		x		x			
Lesser Yellowlegs	*Tringa flavipes*				G5	S5M	x	x		x		x		x			
Long-eared Owl	*Asio otus*				G5	S2S3									x		
Long-tailed Duck	*Clangula hyemalis*				G5	S4N		x				x	x				
Magnolia Warbler	*Setophaga magnolia*				G5	S5B	x								x		
Mallard	*Anas platyrhynchos*				G5	S5	x						x	x			
Mourning Warbler	*Geothlypis philadelphia*				G5	S4B	x							x	x		
Nelson's Sparrow	*Ammodramus nelsoni*				G4	S4B	x					x					x
Northern Mockingbird	*Mimus polyglottos*				G5	S1B											

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Northern Parula	*Setophaga americana*				G5	S5B	x							x	x		
Northern Pintail	*Anas acuta*				G5	S1B								x			
Northern Shoveler	*Anas clypeata*				G5	S2B								x			
Olive-sided Flycatcher	*Contopus cooperi*	TH	TH	TH	G4	S3B	x								x		
Perigrin Falcon	*Falco peregrinus pop. 1*	SC	SC	VU	G4T4	S1B	x							x			
Philadelphia Vireo	*Vireo philadelphicus*				G5	S2?B									x		
Pied-billed Grebe	*Podilymbus podiceps*				G5	S3B	x							x			
Pine Grosbeak	*Pinicola enucleator*				G5	S2S3B	x								x		
Pine Siskin	*Carduelis pinus*				G5	S2S3							x		x		
Piping Plover	*Charadrius melodus melodus*	EN	EN	EN	G3TNR	S1B	x	x		x							
Purple Finch	*Haemorhous purpureus*				G5	S4S5B	x								x		
Purple Sandpiper	*Calidris maritima*				G5	S3N		x									
Razorbill	*Alca torda*				G5	S2B,S4N		x				x					
Red Knot rufa spp	*Calidris canutus rufa*	EN	EN	EN	G4T2	S2M		x		x	x						
Red-necked Grebe	*Podiceps grisegena*				G5	S4N		x		x		x					
Red Necked Phalarope	*Phalaropus lobatus*	SC			G4G5	S2S3M		x				x	x	x			
Red Phalarope	*Phalaropus fulicarius*				G5	S2S3M		x		x	x						
Ring-necked Duck	*Aythya collaris*				G5	S5B	x							x			
Rose Breasted Grosbeak	*Pheucticus ludovicianus*				G5	S2S3B							x		x		
Ruffed Grouse	*Bonasa umbellus*				G5	S4S5	x								x		

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Rusty Blackbird	*Euphagus carolinus*	SC	SC	EN	G4	S2S3B	x						x	x	x		
Sanderling	*Calidris alba*				G5	S4M, S2N		x	x			x					
'Ipswich' Savannah Sparrow (princeps)	*Passerculus sandwichensis*	SC			G5	S4B	x			x		x		x		x	
Scarlet Tanager	*Piranga olivacea*				G5	S2B								x			x
Semipalmated Plover	*Charadrius semipalmatus*				G5	S1B				x		x	x	x			
Semipalmated Sandpiper	*Calidris pusilla*				G5	S3M		x		x	x	x					
Short-eared Owl	*Asio flammeus*	SC	SC		G5	S1S2B	x					x		x	x	?	
Solitary Sandpiper	*Tringa solitaria*				G5	S1?B,S 4S5M	x	x	x	x		x		x	x		
Sora	*Porzana carolina*				G5	S4S5B	x							x			
Spotted Sandpiper	*Actitis macularius*				G5	S3S4B	x			x		x	x	x			
Spruce Grouse	*Falcipennis canadensis*				G5	S5	x							x	x		
Tree Swallow	*Tachycineta bicolor*				G5	S4B	x						x	x	x		
Veery	*Catharus fuscescens*				G5	S4B	x								x		
Vesper Sparrow*	*Pooecetes gramineus*				G5	S2S3B											x
Virginia Rail	*Rallus limicola*				G5	S2B	x							x			
Warbling Vireo	*Vireo gilvus*				G5	S1B									x		
White-throated Sparrow	*Zonotrichia albicollis*				G5	S5B	x								x		

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Willet	*Tringa semipalmata*				G5	S2S3B		x		x	x	x	x			x	
Willow Flycatcher	*Empidonax traillii*				G5	S2B							x		x		
Wilson's Snipe	*Gallinago delicata*				G5	S3S4B	x							x			
Reptiles																	
Snapping Turtle	*Chelydra serpentina*	SC	SC	VU	G5	S5							x	x			
Wood Turtle	*Glyptemys insculpta*	TH	TH	TH	G4	S1							x				x
Mammals																	
American Marten	*Martes americana*			EN	G5	S1									x		
Canada Lynx	*Lynx canadensis*			EN	G5	S1									x		
Eastern Red Bat	*Lasiurus borealis*				G5	S1									x		
Fisher	*Martes pennanti*				G5	S2									x		
Hoary Bat	*Lasiurus cinereus*				G5	S1									x		
Little Brown Myotis	*Myotis lucifugus*	EN	EN	EN	G3	S1									x		
Long Tailed Shrew	*Sorex dispar*		SC		G4	S1									x		
Northern Long-eared Bat	*Myotis septentrionalis*	EN	EN	EN	G1G3	S1									x		
Rock Vole	*Microtus chrotorrhinus*				G4	S2									x		
Silver-haired Bat	*Lasionycteris noctivagans*				G5	S1									x		
Lichen																	
Appressed Jellyskin Lichen	*Leptogium subtile*				GNR	S1S3									x		

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Arctic Kidney Lichen	*Nephroma arcticum*				G5?	S1S2									x		
Bloody Beard Lichen	*Usnea mutabilis*				G5	S2S3					x				x		
Blue Felt Lichen	*Degelia plumbea*	SC	SC	VU	GNR	S2							x	x	x		
Boreal Felt Lichen	*Erioderma pedicellatum (Atlantic pop.)*	EN	E	EN	G1G2Q	S1S2									x		
Crinkled Snow Lichen	*Flavocetraria nivalis*				G4	S2S3										x	
Eastern Waterfan	*Peltigera hydrothyria*	T			G4	S1							x				
Frosted Glass Wiskers Lichen	*Sclerophora peronella*	SC	SC		GNR	S1?									x		
Gray Witch's Beard Lichen	*Gowardia nigricans*				G5	S1										x	
Peppered Moon Lichen	*Sticta fuliginosa*				G3G5	S3									x		
Powdered Honeycomb Lichen	*Cavernularia hultenii*				G3	S1									x		
Rockhair Lichen	*Racodium rupestre*				GNR	S2S3										x	
Scaly Pelt Lichen	*Peltigera lepidophora*				G4	S1S2											
Spiny Heath Lichen	*Cetraria muricata*				GNR	S2S3										x	
Tattered Jellyskin Lichen	*Leptogium lichenoides*				G5	S1S2									x		
Tree Pelt Lichen	*Peltigera collina*				G3G4	S2?									x		
Woodland Owl Lichen	*Solorina saccata*				G3G5	S1									x		
Moss																	

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a Feather Moss	*Hylocomiastrum pyrenaicum*				G4G5	S2S3							x		x		
a Moss	*Anomodon viticulosus*				G5	S2?									x		
a Moss	*Bryum uliginosum*				G3G5	S2?											
a Moss	*Fontinalis sullivantii*				G3G5	S2?							x		x		
a Moss	*Leucodon andrewsianus*				G5T5	S2S3									x		
a Moss	*Limprichtia revolvens*				G4G5	S2S3											
a Moss	*Platydictya confervoides*				G4G5	S2?							x		x		
False Willow Moss	*Platydictya jungermannioides*				G5	S2?									x		
Fragile Twisted Moss	*Tortella fragilis*				G5	S2S3										x	
Giant Spear Moss	*Calliergon giganteum*				G5	S2S3							x	x			
Hooked Scorpion Moss	*Scorpidium scorpioides*				G4G5	S2?							x	x			
Yew-leaved Pocket Moss	*Fissidens taxifolius*				G5	S2?									x		
Warnstorf's Peat Moss	*Sphagnum warnstorfii*				G5	S2S3								x			
Vascular Plants																	
Acadian Quillwort	*Isoetes acadiensis*				G3Q	S3							x				
Alpine Bistort	*Polygonum viviparum*				G5	S1										x	
Alpine Azalea	*Loiseleuria procumbens*				G5	S1										x	
Alpine Cliff Fern	*Woodsia alpina*				G4	S1S2										x	
Alpine Timothy	*Phleum alpinum*				G5	S1					x		x			x	

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American False Pennyroyal	*Hedeoma pulegioides*				G5	S2S3										x	x
American Yellow Rocket	*Barbarea orthoceras*				G5	S1							x				
Bastard's Toadflax	*Comandra umbellata*				G5	S2S3								x			
Bearberry Willow	*Salix uva-ursi*				G5	S1										x	
Bearded Sedge	*Carex comosa*				G5	S2							x	x			
Bebbs Sedge	*Carex bebbii*				G5	S2							x		x		
Big-leaved Marsh-elder	*Iva frutescens ssp. oraria*				G5T5	S2S3			x			x					
Black Ash	*Fraxinus nigra*			TH	G5	S1S2							x	x	*x*		
Blue Cohosh	*Caulophyllum thalictroides*				G4G5	S2							x	x			
Blue Mountain Heather	*Phyllodoce caerulea*				G5	S1										x	
Blunt Sweet Cicely	*Osmorhiza depauperata*				G5	S1									*x*		
Bog Birch	*Betula pumila*				G5	S2S3								x			
Bog Willow	*Salix pedicellaris*				G5	S2							x	x			
Boreal Aster	*Symphyotrichum boreale*				G5	S2?							x	x			
Broad-Glumed Brome	*Bromus latiglumis*				G5	S1							x	x	*x*		
Brook Lobelia	*Lobelia kalmii*				G5	S2								x	x		
Bulbous Rush	*Juncus bulbosus*				G5?	S1S2							x	x			
Canada Anemone	*Anemone canadensis*				G5	S2							x				x
Canada Cinquefoil	*Potentilla canadensis*				G5	S2S3										x	x
Canada Lily	*Lilium canadense*				G5	S2S3							x				

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Canada Rice Grass	*Piptatherum canadense*				G5	S2									*x*	x	x
Canada Waterweed	*Elodea canadensis*				G5	S2S3							x	x			
Chestnut Sedge	*Carex castanea*				G5	S2							x		x		
Chinese Hemlock-parsley	*Conioselinum chinense*				G5	S2							x	x	*x*		
Clustered Sanicle	*Sanicula odorata*				G5	S1							x	x	x		x
Common Bedstraw	*Galium aparine*				G5	S2S3								x	*x*		x
Common Butterwort	*Pinguicula vulgaris*				G5	S1										x	
Common Moonwort	*Botrychium lunaria*				G5	S1								x			x
Cucko Flower	*Cardamine pratensis var. angustifolia*				G5T5	S1				x		x					
Cursed Buttercup	*Ranunculus sceleratus*				G5	S1S2							x	x			
Cut-leaved Anemone	*Anemone multifida*				G5	S1							x				
Diapensia	*Diapensia lapponica*				G5	S1										x	
Disguised St John's-wort	*Hypericum dissimulatum*				G5	S2S3						x					
Drummond's Rockcress	*Arabis drummondii*				G5	S2											
Dwarf White Birch	*Betula minor*				G4Q	S1S2										x	
Estuarine Sedge	*Carex vacillans*				GNR	S1S3			x			x					
Estuary Beggarticks	*Bidens hyperborea*				G4	S1			x			x					
False Mermaidweed	*Floerkea proserpinacoides*				G5	S2										x	

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Fernald's Serviceberry	*Amelanchier fernaldii*				G2G4Q	S2?							x	x			
Few-flowered Spikerush	*Eleocharis quinqueflora*				G5	S2							x				
Flat-stemmed Pondweed	*Potamogeton zosteriformis*				G5	S2S3			x			x					
Field Locoweed	*Oxytropis campestris var. johannensis*				G5T4	S2							x				
Field Wormwood	*Artemisia campestris var. borealis*				G5T5?	S1				x						x	
Fleshy Stitchwort	*Stellaria crassifolia*				G5	S1							x				
Fragrant Green Orchid	*Platanthera huronensis*				G5T5?	S1S2							x	x			
Fragrant Wood Fern	*Dryopteris fragrans var. remotiuscula*				G5T3T5	S2				x						x	
Frankton's Saltbush	*Atriplex franktonii*				G2G4	S3S4				x		x					
Fries' Pondweed	*Potamogeton friesii*				G4	S2									x		x
Fringed Blue Aster	*Symphyotrichum ciliolatum*				G5	S2S3							x				
Glandular Birch	*Betula glandulosa*				G5	S1										x	
Glaucous Blue Grass	*Poa glauca*				G5	S2S3							x				
Glaucous Rattlesnakeroot	*Prenanthes racemosa*				G5	S1							x				
Gray Willow	*Salix glauca ssp. Callicarpaea*				G5T3T5	S1							x			x	

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Greenish Sedge	*Carex viridula var. elatior*				G5TNR	S1									x		
Green Spleenwart	*Asplenium trichomanes-ramosum*				G4	S2											
Hairlike Sedge	*Carex capillaris*				G5	S2							x				
Hairy Willow	*Salix vestita*				G5	S1										x	
Hayden's Sedge	*Carex haydenii*				G5	S1							x	x			x
Highland Rush	*Juncus trifidus*				G5	S2S3								x		x	
Inverted Bladderwort	*Utricularia resupinata*				G4	S2							x	x			
Labrador Bedstraw	*Galium labradoricum*				G5	S2									x		x
Lance Leaved Figwart*	*Scrophularia lanceolata*				G5	S1							x				x
Large Round-Leaved Orchid	*Platanthera macrophylla*				G5T4	S2								x	*x*		
Large St John's-wort	*Hypericum majus*				G5	S2								x			
Lance Leaved Grape Fern	*Botrychium lanceolatum var. angustisegmentum*				G5T4	S2S3									x	x	
Laurentian Bladder Fern	*Cystopteris laurentiana*				G3	S1							x				x
Least Moonwort	*Botrychium simplex*				G5	S2S3								x			
Limestone Meadow Sedge	*Carex granularis*				G5	S1							x	x			x
Little Curlygrass Fern	*Schizaea pusilla*				G3G4	S3S4									*x*	x	

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Little Yellow Rattle	*Rhinanthus minor ssp. Groenlandicus*				G5T5?	S1										x	x
Livid Sedge	*Carex livida var. radicaulis*				G5T5	S1S2								x			
Long-bracted Frog Orchid	*Coeloglossum viride var. virescens*				G5T5	S2S3								x	*x*		
Long-leaved Starwort	*Stellaria longifolia*				G5	S2							x	x			
Loose-flowered Alpine Sedge	*Carex rariflora*				G5	S1								x		x	
Low Spikemoss	*Selaginella selaginoides*				G5	S1S2							x	x	*x*		
Marsh Grass-of-Parnassus	*Parnassia palustris var. parviflora*				G5T4	S2							x	x			
Marsh Horsetail	*Equisetum palustre*				G5	S1										x	x
Marsh Lousewort	*Pedicularis palustris*				G4G5	S1								x			
Meadow Barley*	*Hordeum brachyantherum*				G5	S1						x	x	x			x
Michaux's Dwarf Birch	*Betula michauxii*				G4G5	S2S3								x		x	
Mistassini Primrose	*Primula mistassinica*				G5	S2							x				
Moor Rush	*Juncus stygius ssp. Americanus*				G5T5	S2								x			
Moss Campion	*Silene acaulis var. exscapa*				G5T5	S1										x	
Mountain Sorrel	*Oxyria digyna*				G5	S1										x	
Multi-rayed Goldenrod	*Solidago multiradiata*				G5	S2									*x*	x	

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Narrow-leaved Beaked Sedge	*Carex rostrata*				G5	S1?							x	x			
Narrow-leaved Evening Primrose	*Oenothera fruticosa ssp. Glauca*				G5	S2								x			x
New Jersey Rush	*Juncus caesariensis*	SC	SC	VU	G2G3	S2							x	x			
Northern Adder's-tongue	*Ophioglossum pusillum*				G5	S2S3									x	x	
Northern Arnica	*Arnica lonchophylla*				G5	S1									*x*	x	
Northern Birch	*Betula borealis*				G4G5	S2								x	x		
Northern Bog Sedge	*Carex gynocrates*				G5	S1							x	x			
Northern Bog Violet	*Viola nephrophylla*				G5	S2							x				
Northern Burreed	*Sparganium hyperboreum*				G5	S1S2									x		
Northern Firmoss	*Huperzia selago*				G5	S1?							x		*x*		
Northern Gentian	*Gentianella amarella ssp. Acuta*				G5T5	S1							x				
Northern Holly Fern	*Polystichum lonchitis*				G5	S2							x		x		
Northern Maidenhair Fern	*Adiantum pedatum*				G5	S1									*x*	x	
Northern Meadowsweet	*Spiraea septentrionalis*				G2G3Q	S1?										x	
Northern Rough Fescue	*Festuca altaica*				G5	S1										x	

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Norwegian Whitlow Grass	*Draba norvegica var. clivicola*				G5TNR	S1									x		
Orange-fruited Tinker's Weed	*Triosteum aurantiacum*				G5	S2?							x		x		
Oval-leaved Bilberry	*Vaccinium ovalifolium*				G5	S1									*x*	x	
Ovate Spikerush	*Eleocharis ovata*				G5	S2?							x				
Pale False Manna Grass	*Torreyochloa pallida var. pallida*				G5T5?	S1							x	x			
Pale Jewelweed	*Impatiens pallida*				G5	S2							x				x
Peach-leaved Dock	*Rumex maritimus var. persicarioides*				G5T3?Q	S2?			x	x		x					
Pennsylvania Cinquefoil	*Potentilla pensylvanica var. litoralis*				G5T4T5	S1				x							
Philadelphia Fleabane	*Erigeron philadelphicus*				G5	S2							x	x			
Pinebarren Golden Heather	*Hudsonia ericoides*				G4	S2							x		*x*	x	x
Pink Crowberry	*Empetrum eamesii ssp. Atropurpureum*				G5T5	S2S3										x	
Porcupine Sedge	*Carex hystericina*				G5	S2							x		x		
Proliferous Fescue	*Festuca prolifera*				GU	S1S2										x	
Prototype Quillwort	*Isoetes prototypus*	SC	SC	VU	G2G3	S2							x				
Pubescent Sedge	*Carex hirtifolia*				G5	S2S3							x				

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	SARA Status	Provincial status	G-rank	S-rank	BCR 14 Priority Species	MBU 11/12 Priority	Barachois Ponds	Beaches, Dunes, Rocky	Coastal Islands	Estuaries	Aquatic and Riparian	Freshwater Wetlands	Acadian and Boreal	Barrens	Grasslands
Purple False Oats	*Trisetum melicoides*				G4	S1							x	x			
Purple Mountain Saxifrage	*Saxifraga oppositifolia*				G4G5	S1										x	
Quebec Hawthorn	*Crataegus submollis*				G5	S2?									*x*		
Red Bulrush	*Blysmus rufus*				G5	S1				x		x					
Red Pigweed	*Chenopodium rubrum*				G5	S2						x					
Red Stemmed Spikerush	*Eleocharis erythropoda*				G5	S1							x				
Richardson's Pondweed	*Potamogeton richardsonii*				G5	S2			x			x	x	x			
Richardson's Rush	*Juncus alpinoarticulatus ssp. nodulosus*				G5T5?	S1S2							x				
Robinson's Hawkweed	*Hieracium robinsonii*				G2G3	S2											
Rock Whitlow Grass	*Draba arabisans*				G4	S2								x			
Russet Sedge	*Carex saxatilis*				G5	S1							x			x	
Sage Willow	*Salix candida*			EN	G5	S1							x	x			
Saltmarsh Starwort	*Stellaria humifusa*				G5?	S2			x			x					
Satiny Willow	*Salix pellita*				G5	S2S3							x			x	
Scabrous Black Sedge	*Carex atratiformis*				G5	S2										x	
Scirpuslike Sedge	*Carex scirpoidea*				G5	S2				x							
Seabeach Ragwort	*Senecio pseudoarnica*				G5	S2				x							
Seaside Spurge	*Chamaesyce polygonifolia*				G5?	S2S3				x							

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Sharp-fruited Knotweed	*Polygonum raii*				G3G5Q	S2S3							x				x
Shining Ladies'-Tresses	*Spiranthes lucida*				G5	S2								x			
Showy Lady's-Slipper	*Cypripedium reginae*				G4	S2							x	x			
Silver Maple	*Acer saccharinum*				G5	S1							x		*x*		
Slender Beakrush	*Rhynchospora capillacea*				G4	S1			x			x	x	x			
Slender Blue Flag	*Iris prismatica*				G4G5	S1							x		x	x	
Slender Cottongrass	*Eriophorum gracile*				G5	S2S3								x			
Slender Rice Grass	*Piptatherum pungens*				G5	S2									*x*	x	
Slim-stemmed Reed Grass	*Calamagrostis stricta*				G5T5	S1S2									x		
Small Flowered Bittercress	*Cardamine parviflora var. arenicola*				G5T5	S2							x	x	x		
Small Yellow Lady's Slipper	*Cypripedium parviflorum var. makasin*				G5T4T5	S2											
Small-flowered Bittercress	*Cardamine parviflora var. arenicola*				G5T5	S2									*x*	x	
Small's Knotweed	*Polygonum buxiforme*				G5	S2S3				x		x					
Smooth Cliff Fern	*Woodsia glabella*				G5	S2							x		x		
Smooth Sweet Cicely	*Osmorhiza longistylis*				G5	S2							x				
Soapberry	*Sheperdia canadenses*				G5	S2S3									x	x	

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Sparse-Flowered Sedge	*Carex tenuiflora*				G5	S1								x			
Spiked Woodrush	*Luzula spicata*				G5	S1							x			x	
Spreading Wild Rye	*Elymus hystrix var. bigeloviana*				G5T5?	S1							x		*x*		
Spurred Gentian	*Halenia deflexa*				G5	S2S3										x	x
Stalked Bulrush	*Scirpus pedicellatus*				G4	S2?							x	x			
Steller's Rockbrake	*Cryptogramma stelleri*				G5	S1S2			x			x	x	x			
Sticky False-Asphodel	*Triantha glutinosa*				G5	S1							x	x			
Sturdy Bulrush	*Schoenoplectus robustus*				G5	S1?							x				
Swedish Bunchberry	*Cornus suecica*				G5	S1S2									*x*	x	
Sweet Wood Reed Grass	*Cinna arundinacea*				G5	S1S2							x	x	*x*		
Thread-Leaved Pondweed	*Stuckenia filiformis*				G5T5	S2S3							x		x		x
Thyme-Leaved Speedwell	*Veronica serpyllifolia ssp. humifusa*				G5T5?	S2S3											x
Triangular-valve Dock*	*Rumex salicifolius var. mexicanus*				G5T5	S2							x	x			
Tuckerman's Sedge	*Carex tuckermanii*				G4	S1							x		x	x	
Virginia Anemone	*Anemone virginiana*				G5	S2							x		x		
Water Blinks	*Montia fontana*				G5	S1							x	x	*x*		
Water Pygmyweed	*Crassula aquatica*				G5	S2			x			x	x				

Common name	*Scientific name*	Conservation Status							Priority Habitat Affiliation								
		COSEWIC status	**SARA Status**	**Provincial status**	**G-rank**	**S-rank**	**BCR 14 Priority Species**	**MBU 11/12 Priority**	**Barachois Ponds**	**Beaches, Dunes, Rocky**	**Coastal Islands**	**Estuaries**	**Aquatic and Riparian**	**Freshwater Wetlands**	**Acadian and Boreal**	**Barrens**	**Grasslands**
Weigand's Wild Rye	*Elymus wiegandii*				G4G5	S1									x	x	
Western Hairy Rockress	*Arabis hirsuta var. pycnocarpa*				G5T5	S1S2										x	
White Mountain Saxifrage	*Saxifraga paniculata ssp. neogaea*				G5T5	S2							x				
White Sea-blite	*Suaeda maritima ssp. Richii*				G5T3	S1				x		x					
White-flowered Willowherb	*Epilobium lactiflorum*				G5	S1?							x				
Whorled Water Milfoil	*Myriophyllum verticillatum*				G5	S2							x		x		
Wild Celery	*Vallisneria americana*				G5	S2							x				
Wild Chives	*Allium schoenoprasum*				G5	S2							x				
Wood Anemone	*Anemone quinquefolia*				G5	S2							x	x	x		
Yellow Lady's-slipper	*Cypripedium parviflorum*				G5T5	S2							x	x	x		
Yellow Marsh Marigold	*Caltha palustris*				G5	S2							x	x			
Yellow Mountain Saxifrage	*Saxifraga aizoides*				G5	S1										x	
Yellowish-white Bladderwort	*Utricularia ochroleuca*				G4?	S1											

Appendix D. BCR 14 NS and MBU 11/12 NS Priority Birds

Priority bird species in Bird Conservation Region 14, and Marine Biogeographic Unit 11/12 in Nova Scotia and justification for their priority status (Environment Canada 2013). Species are listed alphabetically by common name within their respective pillar group. Species indicated with an (*) are not represented in the occurrence data used in the spatial analyses in this Habitat Conservation Strategy, though at least some of these species are known to occur in the bioregion in low numbers.

Common Name	*Scientific Name*	COSEWIC	SARA	NS ESA	BCR 14	MBU 11	MBU 12	Population Objective
Landbirds								
American Redstart	*Setophaga ruticilla*				y			Maintain current
Bald Eagle	*Haliaeetus leucocephalus*				y			Maintain current
Bank Swallow	*Riparia riparia*	TH			y			Increase 100%
Barn Swallow	*Hirundo rustica*	TH		EN	y			Increase 100%
Bay-breasted Warbler	*Dendroica castanea*				y			Increase 50%
Belted Kingfisher	*Megaceryle alcyon*				y			Increase 50%
Bicknell's Thrush	*Catharus bicknelli*	TH		EN	y			Increase 50%
Black-and-white Warbler	*Mniotilta varia*				y			Maintain current
Black-billed Cuckoo	*Coccyzus erythropthalmus*				y			Assess/Maintain
Blackburnian Warbler	*Dendroica fusca*				y			Maintain current
Black-throated Green Warbler	*Dendroica virens*				y			Maintain current
Blue-headed Vireo	*Vireo solitaries*				y			Maintain current
Bobolink	*Dolichonyx oryzivorus*	TH		VU	y			Increase 100%
Boreal Chickadee	*Poecile hudsonica*				y			Increase 100%
Canada Warbler	*Cardellina Canadensis*	TH	TH	EN	y			Increase 50%
Cape May Warbler	*Dendroica tigrina*				y			Increase 50%
Chimney Swift	*Chaetura pelagica*	TH	TH	EN	y			Increase 100%
Common Nighthawk	*Chordeiles minor*	TH	TH	TH	y			Increase 100%
Eastern Kingbird	*Tyrannus tyrannus*				y			Increase 100%
Eastern Whip-poor-will*	*Antrostomus vociferous*	TH	TH	TH	y			Assess/Maintain
Eastern Wood-Pewee	*Contopus virens*	SC		VU	y			Increase 50%
Evening Grosbeak	*Coccothraustes vespertinus*				y			Maintain current

Common Name	*Scientific Name*	COSEWIC	SARA	NS ESA	BCR 14	MBU 11	MBU 12	Population Objective
Gray Catbird	*Dumetella carolinensis*				y			Increase 100%
Gray Jay	*Perisoreus canadensis*				y			Assess/Maintain
Magnolia Warbler	*Dendroica magnolia*				y			Maintain current
Mourning Warbler	*Oporornis philadelphia*				y			Maintain current
Nelson's Sparrow	*Ammodramus nelsoni*				y			Assess/Maintain
Northern Parula	*Parula americana*				y			Maintain current
Olive-sided Flycatcher	*Contopus cooperi*	TH	TH	TH	y			Assess/Maintain
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	SC	SC	VU	y			Assess/Maintain
Pine Grosbeak	*Pinicola enucleator*				y			Increase 50%
Purple Finch	*Carpodacus purpureus*				y			Maintain current
Ruffed Grouse	*Bonasa umbellus*				y			Increase 50%
Rusty Blackbird	*Euphagus carolinus*	SC	SC	EN	y			Increase 100%
'Ipswich' Savannah Sparrow	*Passerculus sandwichensis princeps*	SC	SC		y			Recovery objective
Short-eared Owl	*Asio flammeus*	SC	SC		y			Increase 50%
Spruce Grouse	*Falcipennis canadensis*				y			Increase 50%
Tree Swallow	*Tachycineta bicolor*				y			Maintain current
Veery	*Catharus fuscescens*				y			Maintain current
White-throated Sparrow	*Zonotrichia albicollis*				y			Maintain current
Shorebirds								
American Golden-Plover	*Pluvialis dominica*				y			Assess/Maintain
American Woodcock	*Scolopax minor*				y			Increase 50%
Black-bellied Plover	*Pluvialis squatarola*					y	y	Assess/Maintain
Dunlin	*Calidris alpina*					y	y	Assess/Maintain
Hudsonian Godwit	*Limosa haemastica*					y	y	Assess/Maintain
Killdeer	*Charadrius vociferus*				y			Maintain current
Least Sandpiper	*Calidris minutilla*					y	y	Assess/Maintain
Lesser Yellowlegs	*Tringa flavipes*				y	y	y	Assess/Maintain

Common Name	*Scientific Name*	COSEWIC	SARA	NS ESA	BCR 14	MBU 11	MBU 12	Population Objective
Piping Plover	*Charadrius melodus melodus*	EN	EN	EN	y	y	y	Recovery objective
Purple Sandpiper	*Calidris maritima*					y	y	Assess/Maintain
Red Knot (rufa)	*Calidris canutus rufa*	EN	EN	EN		y	y	Assess/Maintain
Red Phalarope	*Phalaropus fulicarius*					y		Assess/Maintain
Red-necked Phalarope	*Phalaropus lobatus*	SC				y		Assess/Maintain
Sanderling	*Calidris alba*					y	y	Assess/Maintain
Semipalmated Sandpiper	*Calidris pusilla*					y	y	Assess/Maintain
Solitary Sandpiper	*Tringa solitaria*				y	y	y	Assess/Maintain
Spotted Sandpiper	*Actitis macularius*				y			Increase 100%
Whimbrel*	*Numenius phaeopus*				y	y	y	Assess/Maintain
Willet	*Tringa semipalmata*					y	y	Increase 50%
Wilson's Snipe	*Gallinago delicata*				y			Increase 100%
Waterbirds								
American Bittern	*Botaurus lentiginosus*				y			Increase 50%
Black-legged Kittiwake	*Rissa tridactyla*					y		Maintain current
Bonaparte's Gull*	*Chroicocephalus philadelphia*					y	y	Assess/Maintain
Common Loon	*Gavia immer*				y	y	y	Maintain current (BCR 14); Assess/Maintain (MBU 11)
Common Murre	*Uria aalge*					y		Assess/Maintain
Common Tern	*Sterna hirundo*				y	y	y	Assess/Maintain
Cory's Shearwater*	*Calonectris diomedea*					y		Assess/Maintain
Dovekie*	*Alle alle*					y	y	Assess/Maintain
Great Cormorant	*Phalacrocorax carbo*					y	y	Assess/Maintain
Great Shearwater*	*Puffinus gravis*					y	y	Assess/Maintain
Great Skua*	*Stercorarius skua*					y		Assess/Maintain
Horned Grebe (Western)*	*Podiceps auritus*	SC				y	y	Assess/Maintain
Ivory Gull*	*Pagophila eburnea*	EN	EN			y	y	Assess/Maintain
Leach's Storm-Petrel	*Oceanodroma leucorhoa*					y	y	Assess/Maintain
Manx Shearwater	*Puffinus puffinus*					y		Assess/Maintain

Common Name	*Scientific Name*	COSEWIC	SARA	NS ESA	BCR 14	MBU 11	MBU 12	Population Objective
Pied-billed Grebe	*Podilymbus podiceps*				y			Maintain current
Razorbill	*Alca torda*					y	y	Assess/Maintain
Red-necked Grebe	*Podiceps grisegena*					y	y	Assess/Maintain
Red-throated Loon*	*Gavia stellata*					y	y	Assess/Maintain
Roseate Tern*	*Sterna dougallii*	EN	EN	EN		y		Recovery objective
Sooty Shearwater*	*Puffinus griseus*					y	y	Assess/Maintain
Sora	*Porzana carolina*				y			Maintain current
South Polar Skua*	*Stercorarius maccormicki*					y		Assess/Maintain
Thick-billed Murre*	*Uria lomvia*					y		Assess/Maintain
Virginia Rail	*Rallus limicola*				y			Assess/Maintain
Waterfowl								
American Black Duck	*Anas rubripes*				y	y	y	Maintain current
Barrow's Goldeneye (Eastern)	*Bucephala islandica*	SC	SC		y	y	y	Assess/Maintain
Black Scoter	*Melanitta americana*						y	Assess/Maintain
Canada Goose (North Atlantic)	*Branta canadensis*				y	y	y	Maintain current
Canada Goose (Temperate-breeding in Easter)	*Branta canadensis*				y	y	y	Decrease
Common Eider	*Somateria mollissima*					y	y	Maintain current
Common Goldeneye	*Bucephala clangula*					y	y	Assess/Maintain
Green-winged Teal	*Anas crecca*				y			Increase 50%
Harlequin Duck (Eastern)	*Histrionicus histrionicus*	SC	SC	EN		y		Recovery objective
Long-tailed Duck	*Clangula hyemalis*					y	y	Assess/Maintain
Mallard	*Anas platyrhynchos*				y			Maintain current
Ring-necked Duck	*Aythya collaris*				y			Increase 50%
Surf Scoter	*Melanitta perspicillata*					y	y	Assess/Maintain
White-winged Scoter	*Melanitta fusca*					y		Assess/Maintain

Appendix E. Methodology – Conservation Value Index

1. Purpose of Analysis

The prioritization methodology presented in this report was used to identify areas within the Cape Breton Bioregion where conservation efforts should be concentrated. The goal is to achieve the best possible impact in the areas that are the most critical for the defined habitat conservation priorities and significant species, while minimizing their associated threats.

The methods used for the GIS analyses were established in a collaborative, iterative manner, through close communication with the Canadian Wildlife Services (CWS) and the Nature Conservancy of Canada (NCC), with input from and consultation with relevant experts from the ACCDC, Bird Studies Canada (BSC), and the New Brunswick provincial government.

2. Conservation value index

This is a map layer created by combining a priority habitat ranking analysis and a priority species analysis. The process for assigning priority habitat ranks involved weighting (scoring) certain characteristics of the conservation priority habitats higher than others. Wherever possible, weighting criteria included consideration of the uniqueness (rarity within each Ecodistrict and within the bioregion), representation within protected areas (by Ecodistrict), and size (compared to minimum patch size). The more high quality priority habitat that an area contained, the higher the priority habitat rank it received. Promoting small extents of multiple priority habitats was avoided by selecting minimum size criteria for habitat-based conservation priorities. In most cases, higher scores were given to areas with larger patches of ecosystems selected as priority habitat types.

The priority species analysis consisted of a density analysis of known species occurrences for priority species (see below) which identifies areas where observations of species are more concentrated on the landscape. These biodiversity hotspots should help identify and drive conservation efforts on the ground.

For as much of the data as possible, the layers were gathered or generated for the full extent of Nova Scotia, and then clipped to the bioregion, in order to avoid repeating effort for other bioregions in the province.

Priority species list

Determination of the priority habitat types to be considered began with the compilation of the list of priority species for the bioregion, established by consensus according to objective selection criteria. Initially, only species at risk were chosen as targets for the analyses, however concerns were raised early in the planning of the project by partners that this would result in a final product too limited in scope to be relevant to a wide group of stakeholders. Additionally, it was felt that focusing only on species at risk would mean that important species might be missed, resulting in a conservation plan that didn't capture the true diversity of habitats and species in the bioregion. The ACCDC species database was used to compile the list of conservation priority species for the strategy. The list was limited to species that adhered to the following criteria:

- Ranked as S1 or S2, or as S3 with a G1, G2 or G3 ranking
- Identified as a BCR priority species (14 for Nova Scotia)
- Identified by COSEWIC as Endangered, Threatened or Special Concern

Aquatic species and species occurring accidentally were removed from the analyses.
Habitat associations for each priority species were determined (where possible) in either specific or general terms, based on information within existing species databases, literature review, and expert knowledge. Habitat associations were then summarized in to broad habitat types to identify priority habitat types for conservation that would encompass important habitat for the majority of the species making up the priority species list (Appendix C).

Priority Habitat Ranking Analysis

Based on habitat affinities of the priority species, but independent of their spatial patterns of occurrence, the following nine habitat types were determined to be conservation priority habitats for the Cape Breton bioregion:

1) Barachois ponds
2) Beaches, dunes, rocky shores, and cliffs
3) Coastal islands
4) Estuaries (tidal marsh/estuarine flats)
5) Aquatic and riparian systems
6) Freshwater wetlands
7) Acadian and boreal forest
8) Barrens
9) Grasslands/agro-ecosystems

Priority habitat data

Data pre-processing
All habitat priorities except grasslands were directly included in the prioritization analysis. Due to the lack of spatial data separating agriculture types in NS, it was agreed that grasslands could not be accurately prioritized. Whereas habitat priority data came from a number of sources, source layers were overlaid and the union and dissolve functions were used in ArcGIS to give the highest probability of actual habitat type occurrence without field verification.

Priority habitats and Data Sources:

- **Acadian and Boreal Forest** – For the purpose of prioritization, only older and uneven aged forests were considered. The Nova Scotia Department of Natural Resources Forests Division "Forest Themes" layer was used to select older and uneven aged forest types based on community type, stand maturity, and seral stage. Table 1 describes the forest types included in the prioritization analysis. For more information on how forest classes were qualified, refer to the "Nova Scotia Procedural Guide for Ecological Landscape Analysis" found here (appendix 8 and 9). According to DNR NS Forestry Division, Mature 1 equates to forest stands older than 40 years and Mature 2, over 80 years.

While Balsam Fir dominant stands are not generally targeted due to being an early successional community type established after disturbance, Balsam Fir stands are a natural component the boreal Ecodistricts in the bioregion. For the purpose of prioritization only Balsam Fir dominant stands within the boreal-like Cape Breton Highlands and Northern Plateau Ecodistricts were included. Mature 1 stands

were included due to the shorter lifespan of Balsam Fir trees compared to other types included in the analysis.

Only White Spruce stands not identified as Old Field (FORNON = 5) were included.

Table 1: Priority Forest Classes used in the prioritization analysis

Priority Forest Class	DNR Forest Theme Community	Development Class	Seral Stage
Old Tolerant Hardwood	Tolerant Hardwood	Mature 2 / Multi Age	Late and Mid
	Tolerant/Intolerant Hardwood	Mature 2 / Multi Age	Late and Mid
	Tolerant Hardwood / Mixedwood	Mature 2 / Multi Age	Late and Mid
Old Pine `	Pine Dominant	Mature 2 / Multi Age	Late and Mid
Old Spruce / Fir	Balsam Fir Dominant	Mature 1 and 2 / Multi Age	Late and Mid
	Red / Black Spruce Dominant	Mature 2 / Multi Age	Late and Mid
	Spruce / Fir Dominant	Mature 2 / Multi Age	Late and Mid
	Spruce / Pine / Hemlock Mix	Mature 2 / Multi Age	Late and Mid
	White Spruce Dominant	Mature 2 / Multi Age	Late and Mid

The resulting priority forest class selections were dissolved based on the three Community Types to ensure the largest patch size was used in the equation.

- **Aquatic and Riparian Systems** – Intact riparian areas were delineated by creating a 100m buffer (ELI 2003) on all rivers, streams, lakes, salt marsh, estuaries, freshwater wetlands, and barachois ponds. Floodplains as identified by NS DNR within the Ecological Landscape Classification 2015 were also included. For prioritization purposes only, riparian and floodplain area that was free of development, agriculture and had trees more than 6m in height were included.

- **Barachois Ponds** - Barachois ponds were spatially delineated by intersecting a barachois points layer obtained from the Department of Natural Resources with a NS hydrographical layer to represent the ponds in two dimensional space for analysis.

- **Beaches and Dunes** - Beaches and Dunes were selected from the 2006 Nova Scotia Provincial Wetlands Inventory (WTY1 = B and D)

- **Coastal Islands** – Coastal islands were selected from the Nova Scotia Forest Resource Inventory "Landclass = 97 (offshore islands).

- **Freshwater Wetlands** – Three types of freshwater wetlands were selected as habitat targets with the bioregion. They were selected from the 2015 Nova Scotia wetlands inventory and included: Peatlands (Bogs or Fens), Marsh and Swamp.

- **Estuaries (Salt Marsh and Estuarine Flats)** - Salt marsh were selected from the 2015 Nova Scotia wetlands inventory (WETLAND = Tidal marsh). Estuaries were selected from the 2006 Nova Scotia Wetlands inventory (WTY1= EF – Estuarine Flat) where eelgrass (*Zostera marina*) was the dominant vegetation type.

- **Barrens –** Barrens were selected from the 2015 provincial forest resource inventory (FORNON = 84, 85). Coastal and inland barrens were spatially identified by creating a 500m buffer along the coast. Barrens which fell inside this buffer were classed as coastal, and those outside the buffer were classed as inland.

Cleaning the Data

The first step prior to the prioritization analysis was to clean the GIS data before assignment of weights were calculated. In order to avoid weighting polygons based on topographic errors, all polygons of the same habitat type were dissolved in ArcGIS to eliminate any insignificant boundaries between contiguous patch occurrences. This also means that specific habitat types nested under priority habitat types were dissolved to calculate the largest extent of each nested habitat into the analysis. For example, the Acadian and Boreal Forest priority has three forest types nested within it: Spruce/Fir, Pine, and Tolerant Hardwood. The nested target types were dissolved so the adjacent patches of the same community type were rolled up together as one contiguous patch. The area of each nested priority habitat patch was recalculated using "Calculate Geometry" and the three tiered equation (see below) scores were then assigned based on the new area of the dissolved polygons. The exception was the Freshwater Wetlands nested habitat size calculation. Wetlands of all three nested types (Peatlands, Marsh, and Swamp) were dissolved together to identify the size extent of wetland complexes, regardless of type.

Stage 1: The 3 Tiered Equation

The following equation was used to assign a score between 0 and 1 to each habitat polygon. The score is the average of three equally weighted factors that have each been assigned a score between 0 and 1 according to the descriptions below.

$$Score = \frac{(Uniqueness + Representation + Size)}{3}$$

Factor 1: Uniqueness

This is a measure of rarity of a priority habitats within the Ecodistricts of the bioregion. It is the assumption that enduring features across the landscape (climate, topography, geography, soils) can impact the ecological attributes of a particular habitat type. As a result, it is suspected that the differences in habitats between Ecodistricts could support different assemblages of specialist species. The Uniqueness calculation was created to place value on ecosystems that are rare or unique across

Ecodistricts. Habitat patches that receive high uniqueness scores will receive a higher conservation priority.

The uniqueness score is determined by the average of two area-based assessments:

$$U_1 = 1 - \left(\frac{Habitat_{Ecodistrict}}{Habitat_{NA-Ecodistricts}} \right)$$

$$U_2 = 1 - \left(\frac{Habitat_{NA-Total}}{Ecosystem_{NA-Total}} \right)$$

Habitat refers to the type of habitat (e.g., marsh) that is nested within a target type (e.g., freshwater wetlands) or in other cases, a non-nested target type (e.g. Beach and Dune). U_1 calculates the amount of habitat within each Ecodistrict in the bioregion compared to the area of that habitat within all Ecodistricts of the bioregion. U_2 calculates the amount of nested habitat within the bioregion compared to the total parent target within the bioregion. The final uniqueness score is an average of the two:

$$Uniqueness = \frac{(U_1 + U_2)}{2}$$

Coastal habitat targets (salt marsh and barachois ponds) are unique geographically within the NA and are generally considered to be ecologically valuable for a number of reasons related to wildlife habitat, coastal protection, climate change resilience etc, and were automatically assigned a uniqueness score of 1.

Factor 2: Representation

Based on the assumptions of Ecodistricts mentioned above, Representation within protected areas was calculated using the following area based assessment:

$$Representation = 1 - \left(\frac{Habitat\ Protected_{\ Ecodistrict}}{Total\ Habitat_{\ Ecodistrict}} \right)$$

This equation determines the proportion of each habitat type protected within each of the bioregion's Ecodistricts (See protected areas table for qualifying lands). The purpose of the equation is to determine which habitat types are under-represented in the protected areas network at the scale of the Ecodistrict. Parcels that contain habitats that are under-represented in the protected areas network will receive a higher score and thus a higher conservation priority.

Factor 3: Size

$$Size = \frac{Habitat_{\ \text{Patch Size}}}{Habitat_{\ \text{Critical Patch Size}}}$$

Size is a patch occurrence based metric. The area of each patch for each habitat type is divided into a critical patch size[1] specific to each habitat type (see table 1 for minimum patch sizes). If a patch is the same size or larger than its respective critical patch size, that patch is given a size score of 1. Other patches are scored on a sliding scale from 0 to 0.99 based on its proportion of the critical patch size. See table below for a summary of the size criteria used within the analysis. Barachois ponds and barrens are important and productive habitats. There is no known measured critical patch size at the time of this report. These priority habitats were not included in the size calculation and scores were based on the remaining two factors.

Table 2. Minimum size criteria for each habitat type:

Habitat Conservation Priority	Minimum Size (Ha)
Beaches and Dunes	8.1
Salt marsh	24
Freshwater Wetlands (complex)	20.2
Barachois Ponds	No minimum
Barrens	No minimum
Acadian Forest Mosaic[2]	
Old and Uneven Aged Tolerant Hardwood	100
Old and Uneven Aged Spruce/Fir	375
Old and Uneven Aged Pine	15

Stage 1 GIS Analysis Steps

1. Using a GIS, Uniqueness and Representation scores were determined for all priority habitats other than Coastal Islands, Aquatic and Riparian Systems, and Grasslands. Size scores were determined for each patch of Acadian and Boreal Forest, Beaches and Dunes, Freshwater Wetlands, and Salt Marsh in the bioregion. Where appropriate, the three tiered equation was completed for each priority habitat polygon, giving a score to each.

2. Using the Field Calculator the initial parcel score for stage 1 was calculated into a field called "InitVal" using the scores described above.

$$InitVal = (Unq + Rep + Size) / 3$$

Stage 2: Buffer Score Multiplication and Initial Priority

Aquatic target occurrences including: Rivers Streams and Lakes, Salt marsh and Estuaries, Freshwater Wetlands, and barachois ponds, were given a 100m buffer (ELI 2003). Floodplains were included as an additional layer contributing to the overall buffer scores. A score of 0.2 was assigned to buffers of each target. Areas of permanent land conversion (urban areas, paved roads, agriculture etc.) and forests less than 6m in height (recent harvesting) were removed from the buffer layers as to not prioritize highly

[1] Developed as part of The Nature Conservancy's NAAP report 2006 (Anderson etal 2006) and the NB Department of Natural Resources Old Forest Community and Old forest Wildlife Habitat Definitions 2012.

[2] For forest communities, patch sizes were adapted from the NB Provincial Old Forest Community and Wildlife Definitions 2012 (NBDNR 2012). In all cases, the largest patch size for each community was used to capture all species that were identified for each community type.

impacted areas. Each of the 5 buffer layers with scores of 0.2 are summed to produce a buffer layer that has scores between 0 and 1. The buffer score layer was multiplied, as a percentage, to the score calculated from the 3 tier equation. This places considerable weight on the presence of multiple overlapping buffers. Therefore, the maximum increase to a stage 1 polygon score will be 100% over the original value. The buffer addition ensures that a higher priority is given to those areas where buffers for multiple habitat target types. This helps to confirm habitat diversity as well as ensures the protection of multiple ecosystem functions and services should that area be protected. Note that this method may result in a bias for coastal areas where more opportunity exists for multiple buffer types.

Stage 3: Coastal Islands Parcels Prioritization:

Because Coastal Islands may not adhere to the enduring features which describe Ecodistricts, a different scoring method was applied. Islands were scored based on 3 criteria:

1. Habitat (the number of habitat types present)[1] – More than 3 types = 0.3 / less than 3 types = 0
2. Development, roads or presents of buildings)[2] – No development, roads or buildings = 0.2
3. Rare colonial bird species presence (within 200m of the island)[3]. – Colonial birds present = 0.5

Islands with known rare colonial bird colonies were given a score of 1. Scores for remaining islands were determined by summing the individual criteria scores above for a maximum score of 1. Table 3 describes the value breaks for each priority ranking.

Stage 4: Additional Ecological Value Adjustments

1. Polygons that contained all or a portion of a NAAP identified Critical habitat occurrences (Anderson et al 2006) for Coastal Features, Freshwater Wetlands, steep slopes, coves, and ravines, received an increase of one priority rank. Riparian Areas were excluded due the scale at which the NAAP floodplains layer was created (Ecoregional). Tier 1 forest matrix blocks were also excluded due to the scale and coarseness at which it was created.
2. Forest polygons received a score increase of 0.2 if the coincided with a vernal pool and an automatic score of 1 if identified as field verified old growth forest (ACCDC 2016).
3. Wetland polygons identified as field verified calcareous fens received an automatic score of 1.
4. All salt marsh and barachois ponds received a score of 1 due to their uniqueness as a habitat type and their role in climate change mitigation.
5. Barrens identified as Alpine Tundra in the Nature Conservancy NAAP land classification layer received an automatic score of 1 due to their uniqueness in Nova Scotia and the high level of threat from climate change.
6. NAAP identified critical tidal flats were included and given a score of 1.

[1] Habitat types were identified from the Nova Scotia Forest Resource Inventory and included: Natural Forest Stand; Wetland; Cliff Dune, Rocky Shore and beach; Barrens, Salt Marsh; Tidal Flat. If 3 or more habitat types found on island, habitat score is 0.3, otherwise it is 0.

[2] A 2013 buildings point layer from the Department of Environment was used. If development, roads (DNR FRI) or a building was found on the island, the score was 0. If no building development or roads found, Development score is 0.2.

[3] If data point from Bird Studies Canada/CWS rare/colonial bird species data within 200 m of island, score is 0.5.

7. The final habitat raster layer was corrected by subtracting the area identified as Moose Meadows in the Provincial Forest Inventory in a response to comments received on the methodology.

Priority habitat composite

The resulting priority habitat composite map for the Cape Breton bioregion can be found in Summary Figure 2, pg. xiii.

Species Composite Analysis and Subsets

Analyses rely on significant species lists established by consensus according to objective selection criteria, recognising that important data gaps exist for several taxa. Specifically, species within these lists include ACCDC ranked S1, S2, or S3 with a G1, G2, or G3 ranking; BCR 14 'priority bird species' by province; COSEWIC assessed Endangered, Threatened, and Special Concern species. Species for which occurrence is considered accidental, specifically birds, were excluded from lists. Priority species habitat associations (where this information is available) can be considered for the purpose of more objective identification of priority habitats. In other words, tallies based on occurrence of priority species within certain habitat types can help inform the selection of habitat priorities if none are identified otherwise (see section on habitat data, below).

SPECIES DATA SOURCES

Table E.1: Data layers, data sources and data types used to describe species spatial distribution.

Data layers	Data source	Source data type
Occurrence of mammals, reptiles, amphibians, vascular plants, non-vascular plants, lichens, etc.	ACCDC	Points
Relative abundance of birds	MBBA point count	Points, counts
Breeding evidence of birds	MBBA breeding evidence	Polygons (10X10 km squares), breeding evidence categories
Occurrence of SAR critical habitat	CWS Atlantic Region Critical Habitat Mapping Database	Polygons (irregular)

Atlantic Canada Conservation Data Centre (ACCDC) data

Species Occurrence Data

The ACCDC dataset contains point data records for a large number of species occurring in Atlantic Canada (mostly Maritimes). Points within the ACCDC database with low geographic certainty, and species that were not appropriate for the analyses were excluded from the dataset. All records with higher geographic certainty (according to the ACCDC data) were retained and then classified into broad groups consisting of: Aquatic, Mammal, Bird, Reptile/Amphibian, Insect, or Plant. Next, G and S ranks for these species were assessed. Only species with a ranking of S1 or S2, or S3 with a global ranking of G1, G2 or G3, were retained. All species listed by COSEWIC were retained, regardless of their S or G rankings.

Species listed as BCR priority species were retained, regardless of S or G rankings. Those not already listed in the ACCDC were added to the list. However, information from the ACCDC dataset for BCR priority species was retained for analyses only if information could not be obtained via the original data sources (i.e., MBBA, CWS).

Habitat associations were determined (where possible) for each species, based on information within datasets, specific studies, or expert advice.

Maritimes Breeding Bird Atlas (MBBA) data

Point Count Data
During development of the Maritimes Breeding Bird Atlas, species relative abundance maps were derived from point data records originating primarily from priority squares (approximately ¼ of all squares in the Maritimes). These point count data were used by Bird Studies Canada to derive species relative abundance maps for the Maritimes on behalf of the Maritimes Breeding Bird Atlas. Methodologies for creating these relative abundance maps since have changed and this set will not be used within the publication.

Breeding Evidence Data

Confirmed = 0.5 (for each Atlas; max value of 1)
Probable = 0.3 (for each Atlas; max value of 0.6)
Possible = 0.1 (for each Atlas; max value of 0.2)

Rare/Colonial Species Data

Colonial buffer = 500 m

Atlantic Region Species at Risk Critical Habitat Mapping
Mapping of Critical Habitat for Species at Risk in the Atlantic Region has involved identifying the unique aspects of each species' habitat and illustrating those elements through a GIS model. Through field work data and GIS applications, spatial reference that reflects the sensitivity of species and their respective habitats was created for 23 species. The model for the identification of Critical Habitat for Species at Risk will continue to be used to identify habitat for new species, as well as to refine the data available for existing Species at Risk.

SPECIES DATA STEPS

ACCDC data

1) Generate point process layers (shapefiles) for each species within the dataset. All records must have a CDC Precision Code value of 3.7 or less (Table F.1).
2) Generate 'Primary Buffers' by conducting kernel density analysis for each species, using a 500 m radius, a 10m output cell size and the appropriate 'POPULATION' parameter value (Figure F.1). This approach attributes more value to pixels closest to the centroid with more precise observations.
3) Conduct buffer analysis to derive 'Secondary buffers' for each species, using a 5000 m radius. Use a fixed value of 0.2 for pixels within the secondary buffer.
4) Combine Primary and Secondary buffers for each species (at the provincial geographic scale) to create species rasters with pixel values ranging from 0 to 1 (Maritimes scale).
5) Overlay rasters from the suite of species to derive 'Species Composites'.

Table E.2: ACCDC precision code, definitions, spatial context, unit size and range of values within the dataset.

prec	*common speech*	*example*	*unit size*	*literal range (m)*
6.0	within province	province	1000.0km	562.3 - 1778.3
5.7	in part of province	'NW NB'	500.0km	281.2 - 889.1
5.0	within in county	county	100.0km	56.2 - 177.8
4.7	within 50s of kilometers		50.0km	28.1 - 88.9
4.0	within 10s of kilometers	BBA grid	10.0km	5.6 - 17.8
3.7	within 5s of kilometers		5.0km	2.8 - 8.9
3.0	within kilometers	topo grid	1.0km	0.6 - 1.8
2.7	within 500s of meters		500.0m	281.2 - 889.1
2.0	within 100s of meters	ball field	100.0m	56.2 - 177.8
1.7	within 50s of meters		50.0m	28.1 - 88.9
1.0	within 10s of meters	boxcar	10.0m	5.6 - 17.8
0.7	within 5s of meters		5.0m	2.8 - 8.9
0.0	within meters ***NOT USED***	pace	1.0m	0.6 - 1.8
-1.0	within 10s of centimeters	fingernail	0.1m	0.1 - 0.2

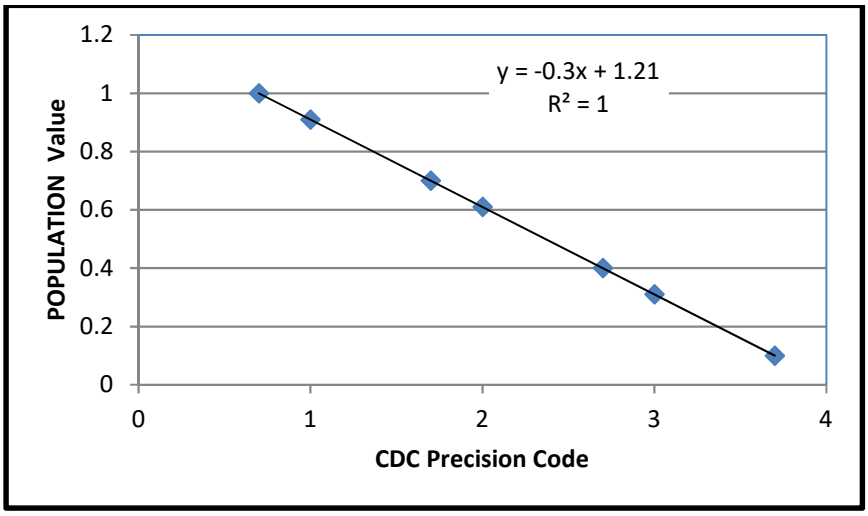

Figure E.1: Population values derived for the purpose of informing the kernel density point process using precision code values found within the ACCDC dataset. Linear equation can be used to populate a new attribute field with POPULATION value information.

MBBA point count

1) These data can be used to represent the relative abundance of breeding priority bird species detected during the course of point count surveys.
2) Relative abundance rasters were derived from point count information by Bird Studies Canada.
3) Final decisions on quality and appropriateness of individual rasters were made 'a priori' by MBBA and BSC staff.
4) All rasters were reclassified such that values range between 0 and 1.

MBBA breeding evidence

1) These data can only be used to represent evidence of breeding of priority bird species as determined during the course of breeding evidence surveys. These data specifically were used for species not captured adequately during the course of point count surveys.

2) The highest level of breeding evidence was determined, by species, for each square, for the Atlas period 2006-2011.
3) Raster values were derived using this breeding evidence data according to following rules: Confirmed = 0.5; Probable = 0.3; Possible = 0.1.
4) Raster Values were doubled such that values range between 0.2 and 1.

AR SAR CH mapping data

1) To represent Atlantic Region Species at Risk for which Critical Habitat (CH) mapping has been initiated.
2) Map CH polygons, for Endangered and Threatened priority species, instead of using layers for species derived using other datasets.
3) Buffer CH polygons by 5 km
4) CH polygons given value of 0.8, surrounding buffer given value of 0.2, for a total ranking of 1 for CH polygons.

SPECIES DATA COMPOSITES

Results:

Overlaying the rasters for the suite of priority species creates a species composite. These species composites can be adapted to illustrate biodiversity hotspots, hotspots for particular suites of species, hotspots for species associated with priority habitats (based on species-habitat matrices), etc.

NOTE: A batch processing tool was developed by NCC to automate steps 1) through 5), with the exception of establishing the target list of species considered.

Data Transformation:

In order to combine rasters from the 3 data sources, all species must be represented by an equal range of values. The values for the MBBA Atlas 2 were doubled to increase the maximum value to 1. The relative abundance bird species rasters were run through a model which first replaced negative raster values with 0 and then normalized the remaining values between 0 and 1. The ACCDC Non-bird kernel density rasters did not require additional transformation as they were previously calculated to be between 0 and 1.

Species were selected from 1 of the 3 data sets and placed into groups based on the desired composite Groups of species rasters were then input into the Cell Statistics Tool in Arc GIS 10.1 and a raster sum was calculated. The output composite raster was normalized between 0 and 1 for display, so that all composites could be visualized at the same numerical scale.

The overall species composite is the sum of the un-normalized composites created for the MBBA 2 birds, the Relative Abundance birds as well as the All Rare-Non Bird Species. While combining these data sets may present some bias do to the differing methods in creating the individual species rasters, it can still present a general indication of areas with the highest concentrations of priority species.

List of Species Composite Subsets

a. Rare Mammals (ACCDC)
b. Rare Reptiles (ACCDC)
c. Rare Terrestrial Invertebrates (ACCDC)
d. Rare Plants (ACCDC)
e. All Rare Non-Bird Species (ACCDC)

f. Listed Non-Bird Species at Risk (ACCDC)
g. Habitat Limited Non-Bird Species (ACCCDC)
h. Maritime Breeding Bird Atlas 2 Significant Species
i. Relative Abundance Significant Bird Species
j. Listed Bird Species at Risk (MBBA and Relative Abundance)
k. Habitat Limited Bird Species (MBBA and Relative Abundance)
l. Overall Species Composite (All Non-Birds -ACCDC, MBBA and Relative Abundance Birds – **Used in combination with Priority Habiatat ranking analysis to create Conservation Index**)

Appendix F. Priority Habitats Assessment Results

Version: 2017-10-17

Target Viability – Details and Results

Target 1	Acadian and Boreal Forests

KEA 1	Forest Structure and Succession
Type	Condition
Comments	A measure of the landscape potential for mature and multi aged forest distribution against the current distribution based on the Natural Disturbance Regime Ecosections.

Indicator 1	Existing mature/multi age forest of total ecosection potential based on Gap and Infrequent disturbance regime
Details	Using the natural disturbance regime (NDR) attribute in the Ecological Land Classification (Neily et al 2003) we can select eco-sections identified as Gap or Infrequent NDR which theoretically would support old forest conditions. Within a GIS, using the forest theme data layer from DNR NS, stands classified as Mature 2 (>80 years) and Multi Age are selected and clipped to the Gap and Infrequent ecosections. Non-forest natural habitat is removed - FORNON 70, 71, 72, 73, 75, 77, 84, 85) to isolate forested and historically forested areas. Must also remove from the forest layer, forest loss 2000 - 2014 from Global Forest Watch dataset that may not be accounted for in the provincial inventory. Using a GIS, calculate the total area of Mature, Multi age forest within Gap and infrequent NDR ecosections and calculate percent cover of remaining ecosection area after non-forested natural habitat removed.
Comments	While DNR uses both Mature 1 and Mature 2 in their calculations, only Mature 2 was included here. Mature 1 translates to stands with trees 40 years and over, which is, in most ecologists' opinion, too young to be considered mature from an ecological view. Mature 2 is meant to refer to stands with trees over 80 years.

Thresholds 1:

Poor	**Value Range 0 - 35% Measurement (25.4%)**
Fair	Value Range 35% - 50%
Good	Value Range 50% - 65%
Very Good	Value Range >65%
Rating Source	External Research
Comments	65 is the middle point of the expected percent of late successional mature and multi age forest on ecosections with gap (70%) and infrequent (60%) disturbance regimes. (Ecological Land Assessments - NS DNR.) Other thresholds are best guess interpretations for the remaining viability rankings.

Indicator 2	Existing mature/uneven age forest of total ecosection potential based on Frequent disturbance regime
Details	Using the natural disturbance regime (NDR) attribute in the Ecological Land Classification (Neily et al 2003) we can select eco-sections identified as Frequent NDR. Within a GIS, using the forest theme data layer from DNR NS, stands classified as Mature 2 (>80 years), Multi Age are selected and clipped to the Frequent ecosections. Non-forest natural habitat is removed - FORNON 70, 71, 72, 73, 75,76, 77, 84, 85) to isolate forested and historically forested area. Must also remove from the forest layer, forest loss 2000 - 2014 from Global Forest Watch dataset that may not be accounted for in the provincial inventory. Using a GIS, calculate the total area of Mature, Multi age within Frequent NDR ecosections and calculate percent cover of remaining ecosection area after non-forested natural habitat removed.
Comments	While DNR uses both Mature 1 and Mature 2 in their calculations, only Mature 2 was included here. Mature 1 translates to stands with trees 40 years and over, which is, in most ecologists' opinion, too young to be considered mature. Mature 2 is meant to refer to stands with trees over 80 years. Boreal ecosections, however included both Mature 1 and Mature 2 forest as trees here are naturally shorter lived.

Thresholds 2:

Poor	Value Range 0%- 15%
Fair	**Value Range 15% - 30% Measurement (21.7%)**
Good	Value Range 30%-40%
Very Good	Value Range > 40%
Rating Source	External Research
Comments	According to NS Ecological Landscape Analyses for frequent disturbance ecosections, 40% of forested area should be covered in mature and multi age forest types. Other thresholds are best guess interpretations for the remaining viability rankings.

KEA 2	Connectivity among communities and ecosystems
Details	Maintaining connectivity between and among ecosystems is a key factor in preserving biodiversity.
Type	Landscape Context
Comments	

Indicator	TNC Connectivity Index
Details	The TNC Local Connectivity dataset (TNC 2012) was used to measure forest connectivity. The dataset provides an index (0-100) of habitat connectedness across the landscape. The current value was calculated by clipping the dataset to the forested area and disturbed forest areas within the Bioregion boundary. An average index value for the Bioregion forested/potentially forested area was calculated. Forested area includes landclass 99. Wetlands, Lakes, and Barrens were removed as to focus on the connectivity of the forest, including areas where forest would have been. Including wetlands and lakes (seen as intact in the connectivity layer) would artificially increase the overall connectivity average for forests. This layer does not account for condition of forest and simply considers forested vs non forested cover. For more information on this layer, see: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/e

	dc/reportsdata/terrestrial/resilience/permeability/Pages/default.aspx
Comments	definition query for forested and converted forest land: "LNDCLASS" = 99 OR "FORNON" = 86 OR "FORNON" = 87 OR "FORNON" = 91 OR "FORNON" = 92 OR "FORNON" = 93 OR "FORNON" = 95 OR "FORNON" = 97 OR "FORNON" = 98 OR "FORNON" = 99

Thresholds:

Poor	Value Range >-1 SD
Fair	Value Range -0.5 to 0.5 SD
Good	**Value Range 0.5 to 2 SD Measurement (0.7 SD)**
Very Good	Value Range > 2 SD
Rating Source	Rough Guess
Comments	TNC local connectedness layer was clipped with extract by mask too to the boundary of the Bioregion. The "Get raster properties tool" was used to calculate the mean index Standard Deviation value for the Bioregion. SD refers to the standard deviation from the mean for the Northern Acadian-Appalachian Ecoregion.

KEA 3	Intact forest cover
Details	Intact forests are relatively free from the influence of development, agriculture and recent (2000-2016) forestry activities.
Type	Size
Comments	

Indicator	Percent intact forest
Details	Using the provincial resource inventory 2015 for the area where forests are and may have been in the past is calculated, This includes all lands currently covered in forest (FORNON 0-62) as well as urban area, agriculture, and blueberry farms. This area was calculated to be 905,846.7 Ha. Next, the area of intact forest was calculated by selected only FORNON = 0 (natural stand)

	from the inventory and erasing the global forest watch Canada forest loss 2001-2014 layer. This results in 676,633.5 Ha for a percent intact of 74.6%. Transportation and other resource corridors were not included in the calculation due to their uncertainly of historically being only forest cover.
Comments	

Thresholds:

Poor	Value Range 0 – 30%
Fair	Value Range 30 – 50%
Good	**Value Range 50 – 75% Measurement (74.6)**
Very Good	Value Range 75 – 100%
Rating Source	External Research
Comments	Thresholds adapted from "How much habitat is enough" forest habitat thresholds p.14. “30% forest cover at the watershed scale is the minimum forest cover threshold. This equates to a high-risk approach that may only support less than one half of the potential species richness, and marginally healthy aquatic systems” “40% forest cover at the watershed scale equates to a medium-risk approach that is likely to support more than one half of the potential species richness, and moderately healthy aquatic systems” “50% forest cover or more at the watershed scale equates to a low-risk approach that is likely to support most of the potential species, and healthy aquatic systems.” Document Link **Top value for each threshold range belongs to the higher rank.**

Target 2	Aquatic and Riparian Systems

KEA 1	Overall watershed health
Details	An assessment at the scale of the watershed can indicate the overall viability of connected aquatic systems.
Type	Condition
Comments	

Indicator	Proportion of Natural Area watersheds area with risk rating 1 or 2 (2014 Shannon Sterling Provincial Watershed Assessment Report)
Details	2014 nova scotia watershed assessment considers multiple threats to watershed health and assigns a relative risk to each secondary watershed across the province. Metrics from watershed assessment include: Road Density, stream length intactness, dams, agriculture, forest age along stream length, stream crossings per KM stream length, erodible soils. etc
Comments	Assessment completed at secondary watershed scale

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	**Value Range 50 - 75% Measurement (53%)**
Very Good	Value Range 75 - 100%
Rating Source	Rough Guess
Comments	Equal intervals between 0 and 100. Arbitrary division not based on any ecological threshold. **Top value for each threshold range belongs to the higher rank.**

KEA 2	Floodplain Intactness
Details	Floodplains can provide habitat for a host of rare plants and plant assemblages. They are also important for regulating the seasonal variation in water flow.
Type	Condition
Comments	

Indicator	Floodplain Natural Cover
Details	There is currently no existing complete floodplain GIS layer for the Province. For this indicator, floodplains were delineated using a combination of soils data as well as the ELC Ecosections for NS. Select out the smooth ecosections (SM) from the ELC that intersect a watercourse and combine that with the Dept of Ag soils layer for alluvial soil types (types: Avenport, Bridgeville, Cumberland, and Stewiack). While there is bound to be some error with this floodplain delineation, it may be the best available method at this time. Using a GIS calculate the percent of the delineated floodplain that is in natural cover. Natural cover includes forest > 6m, wetlands, open water)
Comments	Some floodplains may be naturally covered in forest less than 6 m such as meadows etc. More detailed landcover data would enhance this analysis. **Extent of floodplains are most likely over-estimated thus increasing the percent of natural cover by including upland forest**. Research gap.

Thresholds:

Poor	Value Range < 70%
Fair	**Value Range 70 - 80% Measurement (71%)**
Good	Value Range 80 - 90%
Very Good	Value Range 90 - 100%
Rating Source	Rough Guess
Comments	Floodplains are unique areas that should remain entirely intact in order to reduce impacts to species and habitats but also to reduce impacts to settlement and other development.

KEA 3	Riparian Area Intactness
Details	Maintaining connectivity between and among ecosystems is a key factor in preserving biodiversity.
Type	Landscape Context
Comments	

Indicator	Intact Habitat within River/Lake Riparian area (100m buffer on rivers, lakes and streams)
Details	To provide water quality and wildlife protection buffers of at least 100 meters are recommended (Conservation thresholds for land use planners 2003). A 100m buffer was created on all rivers, streams, and lakeshores in the bioregion. Open water ecosections (XXWA) were erased from the buffer as to not count buffer area inside lakes and rivers. Intact natural cover (all forested over 6m with GFW forest loss 2001-2014 removed, wetlands and other natural cover, was clipped to the 100m buffer shape and calculated for percent intact habitat cover against total buffer area.
Comments	To ensure that buffers function adequately, all major sources of disturbance and contamination should be excluded from the buffer zone, including dams, stream channelization, water diversions and extraction, heavy construction, impervious surfaces, logging roads, forest clear cutting, mining, septic tank drain fields, agriculture and livestock, waste disposal sites, and application of pesticides and fertilizers (Wenger 1999,Pringle 2001).

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	Value Range 50 - 75%
Very Good	**Value Range 75 - 100% Measurement (77%)**
Rating Source	External Research
Comments	"How much habitat is enough" doc says 75% of stream length should be naturally vegetated. This represents the very good threshold. The remaining values are distributed evenly.

KEA 4	SFA 19 Atlantic Salmon Spawning Success
Details	Atlantic Salmon populations are declining in NS though CB populations fair better on average.
Type	Size
Comments	

Indicator	5 Year Average percent of conservation (egg) requirements
Details	2011 - 2015 average percent of conservation requirements (2.4 million eggs/m2) for sustainable salmon population on Middle, Baddeck, and North Rivers Middle - 56% Baddeck - 52% North - 83%
Comments	Salmon population monitoring by DFO in ECB is currently focused on three river systems: Middle, Baddeck, and North rivers. In 2014, all index populations in eastern Cape Breton were assessed to be below conservation (egg) requirements

Thresholds:

Poor	Value Range 0 - 50%
Fair	**Value Range 50 - 75% Measurement (64%)**
Good	Value Range 75 - 99%
Very Good	Value Range 100% and above
Rating Source	External Research

Comments	The conservation requirement must be met to ensure a sustainable population of salmon. The divisions are therefore reflective of this. In reality anything less than the conservation requirement could result in declining population of salmon, a ranting of 75% or above would be an improvement over current status and so it was ranked as good.

Target 3	**Barachois Ponds**

KEA 1	Connectivity to surrounding ecosystems and buffer influence
Details	
Type	Landscape Context
Comments	

Indicator	Proportion of intact natural habitat within 100 m of pond
Details	Barachois ponds were delineated by intersecting the NS open water ecosections with the aerial photo interpreted barachois point data created by DNR NS as well as the WTY1= P from the DNR wetlands salt layer. A 100m buffer was created around the pond polygons and the percent natural cover was assessed using a GIS using methods outlined in previous indicators.
Comments	

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	**Value Range 50 - 75% Measurement (72.8%)**
Very Good	Value Range 75 - 100%
Rating Source	Rough Guess

Comments	Equal intervals between 0 and 100. Not based on any ecological threshold. **Top value for each threshold range belongs to the higher rank.**

KEA 2	Total Barachois Pond Area
Details	As sea level rises, barachois ponds may be inundated if sea levels rise faster than they can adapt or migrate. This is meant to be a baseline area for future comparison.
Type	Size
Comments	

Indicator	Total Cape Breton Barachois pond area
Details	Barachois ponds were delineated by intersecting the NS open water ecosections with the aerial photo interpreted barachois point data created by DNR NS. This is an initial attempt to map the complete distribution of barachois and future delineations may differ to initial error as well as any potential loss or gain in barachois area. Caution should be exercised when comparing current measure with future ones.
Comments	

Thresholds:

Poor	Value Range ->15% current
Fair	Value Range - 10% to -15% current
Good	**Value Range Current extent Measurement (2323.7 ha)**
Very Good	Value Range +> 10% current
Rating Source	Rough Guess

Comments	Using the current extent as a ""good" baseline is used because there is no easily accessible data on the historical extent of Barachois. Without a previous baseline we do not know whether we are in a decline or increase in barachois area when compared to the past. **Top value for each threshold range belongs to the higher rank.**

Target 4	**Beaches, Dunes, Rocky Shores and Cliffs**

KEA 1	Beach/Dune Area
Details	While not providing an accurate assessment of viability, we can use this KEA to measure the change in beach/dune area over time.
Type	Size
Comments	

Indicator	Total area of beach and dune complexes
Details	Total area of beach and dunes calculated using 2010 NS DOE Small Patch Ecosystems layer. This can serve as a baseline for future viability analyses.
Comments	

Thresholds:

Poor	Value Range > 10% under current
Fair	Value Range 10% under current
Good	**Value Range current size Measurement (1478 Ha)**
Very Good	Value Range 10% over current
Rating Source	Not Specified
Comments	Future viability will be measured against the current extent. +- <10% from current is allowed for data errors.

KEA 2	Inland Migration Potential and disturbance
Details	To allow for the inland and shoreline migration of beaches and dunes in response to climate change and natural migration processes, it is important that the area around beaches and dunes remains free of disturbance from development and other ecosystem modifications.
Type	Landscape Context
Comments	

Indicator	Proportion of intact natural habitat within 100m of beach/dune complexes.
Details	The FRI was limited to FORNON = 0 with height>=6m, 70, 71,72, 73, 74, 75, 76, 77, 83, 84, 85, 94. GFW forest loss 2001-2014 was then erased. Beaches and Dunes shp was given a 100m buffer then clipped to the Bioregion to remove buffer portion in the offshore zone. The "intact" FRI was clipped to the buffer shape. Areas of shoreline hardening within 100m of a beach or dune were also considered a barrier to movement. Area of intact buffer divided into total buffer area and multiplied by 100 to get percent intact.
Comments	

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	**Value Range 50 - 75% Measurement (69.8%)**
Very Good	Value Range 75 - 100%
Rating Source	Rough Guess
Comments	Thresholds divided into quartiles, not based on any ecological reasoning. Of the total buffer area of 4363 ha, only 3048 intact according to intact classification. 69.8%

Target 5	**Coastal Islands**

KEA 1	Natural Integrity
Details	Islands free of disturbance.
Type	Condition
Comments	

Indicator	Islands free of building structures / disturbance (proportion of islands)
Details	Using the provincial buildings layer combined with the anthropogenic features of the resource inventory, the percent of islands free from any disturbance was calculated using a GIS.
Comments	Forest inventory and buildings layer used to assess disturbance on islands. Island considered disturbance-free if no buildings or anthropogenic cover from inventory found. Used select by location tool to select islands that intersected with any of the following: Buildings layer, roads and transportation corridors, urban development, agriculture. Of the 541 coastal islands, 30 co-occur with the layers above. Therefor 511 islands are free from human influence (94 %).

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	Value Range 50 - 75%
Very Good	**Value Range 75 - 100% Measurement (94%)**
Rating Source	Rough Guess
Comments	If we consider recent recommendation that 50% of global habitat be conserved for biodiversity, 50 % is the threshold between fair and good and the remaining breaks represent quartiles.

Target 6	**Estuaries (Tidal Marsh and Estuarine Flats)**

KEA 1	Eelgrass Coverage
Details	Eelgrass is an estuary keystone species which provides habitat for fish development and also provides habitat for organisms a several trophic levels.
Type	Condition
Comments	

Indicator	Present Eelgrass cover compared to Historical cover
Details	Measure the extent of eelgrass coverage in key estuaries of the Bras d'Or using existing data. Compare with historical distribution if data is available.
Comments	Comparative datasets are not available at this time. Baseline data was collected by UINR in 2009 but it does not appear that more recent comparative measures exist. Viability is an estimate based on observed trends in the Bras d'Or. While eelgrass has seen some recovery, its extent remains below what it once was. UINR personal comm.

Thresholds:

Poor	Value Range	Critical decline
Fair	Value Range	Decreasing distribution
Good	**Value Range**	**Increasing distribution**
Very Good	Value Range	Historical extent
Rating Source	Rough Guess	
Comments		

KEA 2	Connectivity to surrounding ecosystems and buffer influence
Details	Maintaining connectivity between and among ecosystems is a key factor in preserving biodiversity.
Type	Landscape Context
Comments	

Indicator	Proportion of intact habitat within 100m of salt marsh or coast of estuarine system
Details	A 100m buffer was created around salt marsh (provincial wetlands inventory 2015) and 10k hydrography coast river water polygons. Open water ecosections (XXWA) were erased as to not count buffer area inside target area. Intact FRI (all forested over 6m, and other natural cover with GFW forest loss 2001-2014 removed) (used as a proxy for condition of the forest and not considered complete loss) clipped to buffer shape and calculated for percent intact against total buffer area.
Comments	intact query from forest inventory = ("FORNON" =0 AND "HEIGHT" >=6) OR "FORNON" IN (6, 7, 8, 9, 13, 14, 15, 33, 38, 39, 70, 71, 72, 73, 75, 76, 77, 84, 85, 94)

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	**Value Range 50 - 75% Measurement (68.8%)**
Very Good	Value Range 75 - 100%
Rating Source	Rough Guess
Comments	Equal intervals between 0 and 100. Not based on any ecological threshold. 3357 Ha of 4879 Ha intact within 100m buffer.

Target 7	**Freshwater Wetlands**

KEA 1	Wetland Area
Details	Total wetland area will serve as a baseline measurement against which to measure wetland loss or gain over time.
Type	Size
Comments	

Indicator	Total Wetland Area
Details	Total wetland area will serve as a baseline measurement against which to measure wetland loss or gain over time. DNR 2015 provincial wetland data was used to calculate total wetland area within the bioregion.
Comments	

Thresholds:

Poor	Value Range > 10% Under Current Area
Fair	Value Range 10% Under Current Area
Good	**Value Range Current Area Measurement (85,600.8 Ha)**
Very Good	Value Range 10% Over Current
Rating Source	Rough Guess
Comments	Future viability will be measured against current extent.

KEA 2	Connectivity to surrounding ecosystems and buffer influence
Details	Maintaining connectivity between and among ecosystems is a key factor in preserving biodiversity.
Type	Landscape Context
Comments	

Indicator	Proportion of intact natural habitat within 100 m of freshwater wetlands
Details	NS wetland assessment protocol considers an intact 100m buffer around wetlands to be classed as high for water quality, flood control and wildlife habitat. Also echoes the 100m riparian buffer suggested along lotic systems to provide benefits to water quality and wildlife habitat in the conservation thresholds document 2003. 100m buffers are also required in highland wetlands within Lynx management zones as part of the recovery strategy. The intact percent of the wetland buffer was calculated using the GIS methods described in previous buffer-based indicators.
Comments	

Thresholds:

Poor	Value Range 0 - 25%
Fair	Value Range 25 - 50%
Good	**Value Range 50 - 75% Measurement (70.3%)**
Very Good	Value Range 75 - 100%
Rating Source	External Research
Comments	How much habitat is enough (EC 2010) recommends 75% of stream buffers remain vegetated. This has been expanded to wetland buffers.

Target 8	**Grasslands and Agro-Ecosystems**

KEA 1	Grassland bird populations
Details	Can be used as an indicator of grasslands condition for support of grassland bird populations.
Type	Size
Comments	

Indicator	Grassland bird index rating
Details	Breeding bird surveys calculate this rating. Currently 75% below 1970s value.
Comments	This is a general rating for grasslands birds in the Bird Conservation Region 14. Data specific to Cape Breton is unavailable at this time.

Thresholds:

Poor	Value Range current index
Fair	Value Range 20% above current
Good	Value Range 40% above current
Very Good	Value Range 60% above current
Rating Source	Rough Guess
Comments	Grassland bird pop decline by 75% since 1970s in Atlantic Canada. Abundance index for grassland birds calculated as part of Breeding bird surveys. Current condition is poor considering the decline in the last 30 - 40 years. Incremental increases in the index will show a potential increase in grassland condition. .

Target 9	Barrens

KEA 1	ID Name Barrens area
Details	Used as a baseline measure for future measurements for comparison.
Type	Size
Comments	

Indicator	ID Name Total barren area
Details	Used as a baseline measure for future measurements for comparison.
Comments	Fornon 84, 85 from 2015 forest inventory.

Thresholds:

Poor	Value Range > 10% Under Current Area
Fair	Value Range 10% Under Current Area
Good	**Value Range current area (26,068.8 Ha)**
Very Good	Value Range 10% Over Current
Rating Source	Rough Guess
Comments	

KEA 2	ID Name Protected Barrens
Details	Used as a baseline measure for future measurements for comparison.
Type	Size
Comments	

Indicator	ID Name Percent barrens protected
Details	In the absence of available metrics and data to develop alternative KEAs, the amount protected will act as a proxy for the condition and landscape context of barrens.
Comments	Fornon 84, 85 from 2015 forest inventory.

Thresholds:

Poor	Value Range < 10 %
Fair	Value Range 10% – 17%
Good	Value Range 17%- 50%
Very Good	**Value Range 50% + (63%)**
Rating Source	Rough Guess
Comments	Aichi target of 17% is threshold for good. Of the 26,068.8 Ha of barrens, 16603.6 are protected. 63%

Appendix G. IUCN Threats Classification

World Conservation Union-Conservation Measures Partnership (IUCN-CMP) classification of direct threats to biodiversity (version 2.0).

Threats Classification	Definitions
1. Residential and commercial development	**Human settlements of other non-agricultural land uses with a substantial footprint**
1.1 Housing and urban areas	Human cities, towns and settlements including non-housing development typically integrated with housing
1.2 Commercial and industrial areas	Factories and other commercial centers
1.3 Tourism and recreation areas	Tourism and recreation sites with a substantial footprint
2. Agriculture and aquaculture	**Threats from farming and ranching as a result of agricultural expansion, intensification or practices; includes silviculture, mariculture and aquaculture**
2.1 Annual and perennial non-timber crops	Crops planted for food, fodder, fiber, fuel or other uses
2.2 Wood and pulp plantations	Stands of trees planted for timber or fiber outside of natural forests, often with non-native species
2.3 Livestock farming and ranching	Domestic terrestrial animals raised in one location on farmed or nonlocal resources (farming); also domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats (ranching)
2.4 Marine and freshwater aquaculture	Aquatic animals raised in one location on farmed or nonlocal resources; also hatchery fish allowed to roam in the wild
3. Energy production and mining	**Threats from production of non-biological resources**
3.1 Oil and gas drilling	Exploring for, developing, and producing petroleum and other liquid hydrocarbons
3.2 Mining and quarrying	Exploring for, developing, and producing minerals and rocks
3.3 Renewable energy	Exploring, developing and producing renewable energy
4. Transportation and service corridors	**Threats from long, narrow transport corridors and the vehicles that use them including associated wildlife mortality**
4.1 Roads and railroads	Surface transport on roadways and dedicated tracks
4.2 Utility and service lines	Transport of energy and resources
4.3 Shipping lanes	Transport on and in freshwater and ocean waterways
4.4 Flight paths	Air and space transport
5. Biological resource use	**Threats from consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species**
5.1 Hunting and collecting terrestrial animals	Killing or trapping terrestrial wild animals or animal products for commercial, recreation, subsidence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch

Threats Classification	Definitions
5.2 Gathering terrestrial plants	Harvesting plants, fungi, and other non-timber/non-animal products for commercial, recreation, subsidence, research or cultural purposes, or for control purposes
5.3 Logging and wood harvesting	Harvesting trees and other woody vegetation for timber, fiber, or fuel
5.4 Fishing and harvesting aquatic resources	Harvesting aquatic wild animals or plants for commercial, recreation, subsidence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch
6. Human intrusions and disturbance	**Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources**
6.1 Recreational activities	People spending time in nature or travelling in vehicles outside of established transport corridors, usually for recreational reasons
6.2 War, civil unrest and military exercises	Actions by formal or paramilitary forces without a permanent footprint
6.3 Work and other activities	People spending time in or travelling in natural environments for reasons other than recreation or military activities
7. Natural system modifications	**Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare**
7.1 Fire and fire suppression	Suppression or increase in fire frequency and/or intensity outside of its natural range of variation
7.2 Dams and water management/use	Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities
7.3 Other ecosystem modifications	Other actions that convert or degrade habitat in the service of "managing" natural systems to improve human welfare
7.4 Removing/reducing human maintenance	Absence or reduction of current or historical maintenance regimes important for key ecological attributes, including regimes historically maintained by protected area staff, farmers and ranchers, indigenous peoples, private landowners, or any other resource manager
8. Invasive and other problematic species, pathogens and genes	**Threats from non-native and native plants, animals, pathogens/microbes, or genetic material that have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance or virulence**
8.1 Invasive non-native/alien plants and animals	Harmful plants and animals not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities
8.2 Problematic native plants and animals	Harmful plants and animals that are originally found within the ecosystem(s) in question, but have become "out of balance" or "released" directly or indirectly due to human activities
8.3 Introduced genetic material	Human-altered or transported organisms or genes

Threats Classification	Definitions
8.4 Pathogens and microbes	Harmful native and non-native agents that cause disease or illness to a host, including bacteria, viruses, prions, fungi, and other microorganisms
9. Pollution	**Threats from introduction of exotic and/or excess materials or energy from point and non-point sources**
9.1 Household sewage and urban waste water	Water-borne sewage and non-point runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments
9.2 Industrial and military effluents	Water-borne pollutants from industrial and military sources including mining, energy production, and other resource extraction industries that include nutrients, toxic chemicals and/or sediments
9.3 Agricultural and forestry effluents	Water-borne pollutants from agricultural, silvicultural, and aquaculture systems that include nutrients, toxic chemicals and/or sediments including the effects of these pollutants on the site where they are applied
9.4 Garbage and solid waste	Rubbish and other solid materials including those that entangle wildlife
9.5 Air-borne pollutants	Atmospheric pollutants from point and non-point sources
9.6 Excess energy	Inputs of heat, sound or light that disturb wildlife or ecosystems
10. Geological events	**Threats from catastrophic geological events**
10.1 Volcanoes	Volcanic events
10.2 Earthquakes/tsunamis	Earthquakes and associated events
10.3 Avalanches/landslides	Avalanches or landslides
11. Climate change	**Change in climate patterns (e.g., those resulting from increased atmospheric greenhouse gases like CO_2) and/or events outside the natural range of variation that could wipe out a vulnerable species or ecosystem**
11.1 Ecosystem encroachment	Large-scale effects of ecosystems shifting and impinging on other species and ecosystems
11.2 Changes in geochemical regimes	Broad-scale changes in the geochemical conditions of ecosystems including ocean acidification
11.3 Changes in temperature regimes	Broad-scale changes in temperature mean, variability, seasonality, and extremes, including changes in temperature extremes, increased average summer temperature, and decreased minimum winter/spring temperature
11.4 Changes in precipitation and broad-scale hydrological regimes	Broad-scale changes in precipitation mean, variability, seasonality, and extremes, including decreased or increased precipitation, changes in timing of precipitation, changes in form of precipitation (e.g., snow vs rain; snowcover and snowpack where applicable), changes in evapotranspiration rates and hydrological cycles, and droughts and floods
11.5 Severe/extreme weather events	Changes in frequency, timing and/or intensity of storms as well as severe weather events that threaten targets that have lost resilience

Appendix H. Threats Analysis Detailed Results

Acadian and Boreal Forests

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Logging and wood harvesting	High	High	High	High	Scope: Intensive forest harvesting throughout the Bioregion. Addition of biomass boiler at point Tupper has resulted in large increase in hardwood harvests in addition to softwood pulp harvests. According to the provincial resource inventory and GFW Canada Forest loss data, 8% of forest has been lost temporarily to clear cut from 2001-2014. This does not include partial harvests and information for harvesting on private land is often unavailable. Forest harvesting impacts are also not limited to only the area cut. Edge effects extend beyond the limit of the harvested area. Taking this into consideration and the increase in hardwood harvesting in CB we can realistically expect between 11 and 30% of the forest to be harvested in the next 10 years. Compounding the current state of the forest. Severity: Clear cutting accounts for 95% of harvesting in NS. Irreversibility: With management assistance, forest could theoretically return to previous state within 100 years if forest was younger than 100 yrs. before cut.
Invasive non-native species	Low	Low	High	Low	Ratings determined by Sean Blaney: "I would rate all vascular plant invasive as high irreversibility. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, so they rate a bit higher. I'm not sure exactly how ecologically significant many of these fairly visibly striking invasions are. They may not be displacing that much native biodiversity in many cases."
Housing and Urban Area Development	Low	High	High	Low	Scope: Only 3.7% of NA is Developed (FORNON - 87, 92, 93, 95) - FRI 2015 - and most is concentrated around the Bras D'or, Sydney area, Port Hawkesbury, Ingonish, and Cheticamp. Little development exists

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					elsewhere and very little new development expected over next 10 years. Severity: where it does occur generally results in majority loss of target. Irreversibility: Return of target to developed areas not likely but possible within 100yrs with restoration efforts.
Wood and Pulp Plantations	Low	Medium	High	Low	Scope: Approx. 5% of the NA forested area is classified as plantation according to the resource inventory 2014. Severity: Depending if planting species mimic natural forest type. Most do not. Irreversibility: Restoration of plantation to encourage natural forest stand succession is costly and not likely over a large area.
Tourism and Recreational Areas	Low	Medium	Medium	Low	Scope: Tourism and recreation is popular in Cape Breton and a major contributor to the local economy. Most tourism centred around bras d'Or and highlands and Cabot trail. With Golf becoming an emerging threat, potential for forest loss is there albeit over a relatively small area. Severity: impacts to forest are minimal though could result in loss of function and area. Irreversibility: Impacts likely reversible within 20 yrs. if target not completely degraded in an area.
Problematic Native Species	Medium	High	High	Medium	Since their introduction and in concert with the spruce budworm outbreak of the 1970s and 80s, moose populations have exploded and are having a large impact on the highland forest ecosystems by preventing the regeneration of trees due to browsing. 15,473 Ha of "moose meadows" according to NS forest inventory. Nearly 20% of the forested area of the highlands plateau ecodistrict has been converted to moose meadow from typical spruce/fir boreal forest type.
Mining and Quarrying	Low	Very High	High	Low	Scope: Gypsum, Dolomite and coal primary mine types. Current mining footprint relatively small so overall impact to forests on the whole are low. Mining slowing in CB and little activity expected over next 10 years. Severity: Though where mines occur they are mostly open pit and so

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					the forest cover is completely removed. Irreversibility: Restoration of mine site is possible but costly and not likely to happen in much less than 100 yrs.
Agriculture	Low	High	High	Low	Scope: 20,098 Ha of Agriculture from FRI 2015. Only 1.2% of CB area. Severity: Near complete removal of target where land is cleared for agriculture Irreversibility: IF allowed to regenerate naturally or with assistance from silviculture, forest could re-establish within 21-100 yrs.
Climate Change and Habitat Shifting	Medium	Medium	Very High	High	Scope/Severity: Projected annual average temperature increase of 3 degrees by the end of the century could have significant impacts on forest species composition as boreal species decline and temperate species thrive. Boreal forest ecosystems in the highlands of Cape Breton are most under threat. Irreversibility: impacts from climate change not likely reversibly within 100 years.
Road Fragmentation	Medium	Medium	High	Medium	Scope: Roads are prevalent in most areas of cape Breton minus the highlands. Severity: Provincial road index (ELA 2008) gives average road index score around 10/100 for forested area. The GIS based “Road Index” program calculates and maps the spatial influence of the transportation network. It is the relative influence of man-made linear features within landscapes (Procedural Guide for ELA 2008) The GIS based “Road Index” program calculates and maps the spatial influence of the transportation network. It is the relative influence of man-made linear features within landscapes (Procedural Guide for ELA 2008)
Recreational activities	High	Low	Medium	Low	Scope: There are 2088 km of ATV and Snowmobile trails on Cape Breton. This may be an underestimate as only reported trails are

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					included. Severity: These trails in combination with forestry roads, permits access to vast majority of CB outside protected areas. Impacts may be minimal on forests though disturbance to wildlife would be significant/.Also could act as a vehicle for the introduction and propagation of alien invasive species. Irreversibility: impacts most likely reversible within 20 years with removal of threat.

Aquatic and Riparian Systems

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Domestic and Urban Wastewater	Low	Medium	Medium	Low	Scope: Some cottages and homes exist along rivers and around lakes that may have outdated septic resulting in leaching of waste into aquatic systems. Severity: Pharmaceuticals are not removed at wastewater treatment plants and are finding their way into aquatic systems. Water quality in the NA is thought to be relatively good though potential for increased impacts possible as tanks age and cottage density increases. Irreversibility: Repairs to old tanks and regulations for newer installs could reduce the impacts within 20 yrs.
Invasive non-native species	Medium	Medium	High	Medium	Ratings determined by Sean Blaney: "I would rate all vascular plant invasive as high irreversibility. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, so they rate a bit higher. I'm not sure exactly how ecologically significant many of these fairly visibly striking invasions are. They may not be displacing that much native

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					biodiversity in many cases."
Logging and wood harvesting	Medium	Medium	High	Medium	Scope: Harvesting prevalent on large proportion of Bioregion land base, though regulations prevent total loss of riparian habitat. Severity: NS regulations require 20m buffer on streams and lakes though 50 Basal area can be removed. Cape Breton has a 100m buffer requirement within special management zones for lynx so the impact on rivers within those zones wold be significantly less than outside those zones. Irreversibility: With management assistance, buffer could return to previous state within 100 years if forest was younger than 100 yrs. before cut.
Housing and Urban Area Development	Low	Medium	Low	Low	Some development occurs along major rivers where septic seeping may introduce pollutants into the water courses though the scope is low.
Mining and Quarrying	Low	Low	Medium	Low	Scope: Footprint from active mines relatively low. Severity: Not located on major rivers though some smaller rivers and streams may experience some effects from tailings run-off. Irreversibility: Effects could technically be reversed but would be costly and take a long time
Climate Change and Habitat Shifting	High	Medium	Very High	High	Scope: Total coverage Severity: Average annual Temperature increase of 3 degrees by century's end could have significant impacts on Atlantic salmon populations as river temperatures increase. Increased winter temperatures will result in reduced snow pack which feeds rivers in spring. Headwaters may begin to dry up. Irreversibility: Impacts from climate change not likely reversible.
Agriculture	Medium	High	Medium	Medium	Scope: 18 % of ELC/soil based mapped floodplains converted to agriculture. While on the whole riparian areas are less affected, floodplains are biodiversity hotspots that provide habitat for a wide range of plant and animal species if left intact.

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					Severity: Loose regulations allow for agriculture to water edge so potential for complete removal of riparian area is possible. Irreversibility: If allowed to regenerate naturally or with silviculture, riparian area could be restored within 100 years.
Road Fragmentation	Medium	Medium	High	Medium	Scope / Severity: Floodplain road index scores (ELA 2008) are average 35/100. Much higher than forests. This service is comprised of an integer raster generated from the weighted density of all transportation features surrounding a cell (pixel) and the distance to the closest transportation feature. Values range between 1-100, with higher values representing urbanized landscapes and lower values representing remote undeveloped landscapes. The density and distance measures are calculated using a 1X1 kilometer analysis window and assigned to a 1 hectare cell. Transportation features are derived from the Nova Scotia Topographic Database augmented with road features visually delineated from Landsat satellite imagery. Irreversibility: Compaction of soil on roads makes restoration challenging and costly.
Recreational activities	Medium	Low	High	Low	Scope: Fishing is popular in CB due to its relatively pristine salmon rivers. Severity: Impacts could include erosion from foot traffic and other access methods. Margaree and Skye rivers in particular. Irreversibility: effects reversible likely within 20 yrs.
Dams and water management	High	High	Medium	High	Scope: 4.5% of stream length behind dams on average. 0.002 dams per km of stream length on average. Source: 2014 watershed assessment report. CARP culvert assessment found twenty-seven of the thirty culverts assessed were on fish bearing streams. Of the 27 fish barring stream culverts visited, seventeen were full barriers and seven were partial barriers (88%); only three were not barriers to fish passage. Severity: Dams alone not a significant threat but culverts leading cause of lost aquatic connectivity.

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					Irreversibility: Costs would be significant however with a commitment of resources, culverts could be repaired/replaced to provide improved passage of fish.

Barachois Ponds

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Domestic and Urban Wastewater	Low	Low	Low	Low	The Bras d'Or Lakes are relatively clean. Bacterial contamination from sewage is the primary source of pollution. Six of the eleven sub- watersheds have experienced declining water quality in recent years (UINR) - State of the Bras d'Or Marine Environmental Water Quality Background Report Report # S0701Water quality in the tested areas of the Bras d'Or Lakes is very good compared to other shellfish harvesting areas in Atlantic Canada: 97% of the areas tested are classified as Approved, for shellfish harvesting; 0.4% are classified as Conditional, and 2.6% are Closed to shellfish harvesting (CSSP)
Invasive non-native species	Low	Low	High	Low	Ratings determined by Sean Blaney: "I would rate all vascular plant invasive as high irreversibility. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, so they rate a bit higher. I'm not sure exactly how ecologically significant many of these fairly visibly striking invasions are. They may not be displacing that much native biodiversity in many cases."
Housing and Urban Area	Medium	Low	Low	Low	Coastal development within the barachois watersheds may introduce siltation and pollutants into the system.

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Development					
Aquaculture	Low	Low	Low	Low	The large majority of aquaculture in the Bras d'Or is suspended shellfish. This type of aquaculture has minimal impacts and has been shown to actually increase water clarity and habitat. There are currently 7 fin fish leases however it appears that only 1 is currently active. The threat from expanded fin fish aquaculture is real due to the low flushing capability of the lakes, though at the time of this report, because of the low number of active farms, the threat is low.
Climate Change and Habitat Shifting	High	High	High	High	Sea level rise projected at 86cm by end of century. Current barrier beaches will be inundated and barachois will be displaced though could reform as sediments shift in response.
Agriculture	Medium	Low	High	Low	Scope: 60 of the 388 ponds identified in the bioregion are within 100m of agricultural land.15.4%. 43 are within 30m (11%). Potential for impacts based on proximity but no field verified evidence. Severity: Due to low proximity of agriculture to ponds, impacts are most likely minimal Irreversibility: Where agriculture impacts ponds, re-generation of Ag land could be within 100 yrs.
Road Fragmentation	Low	Low	High	Low	Roads pass over 55 of 388 ponds in the Bioregion (13%). It is unclear if this would contribute sediment loading in all if any cases, so scope is low and severity is low. Knowledge gap exists here.

Grasslands/ Agro-Ecosystems

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Agriculture	Medium	Medium	Medium	Medium	Incompatible farming practices such as mowing during the breeding season has been identified as a major threat to declining grassland nesting species such as bobolink and wood turtle. There has not been any direct study on the scope or severity of impact in CB. Threat could be reversed with educating on harvesting times.
Climate Change and Habitat Shifting	Low	Medium	Very High	Medium	Climate change with respect to warming temperatures may have little negative impact to grasslands and may in fact create additional treeless areas in response to increased fire disturbance. Grassland species are predicted to move further north as a result.
Wind Farms	Not Specified	Not Specified	Not Specified	Not Specified	

Freshwater Wetlands

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Logging and wood harvesting	Medium	Medium	High	Medium	Scope: wetlands not generally merchantable though forested wetlands can be targeted for harvesting in winter. Severity: Cape Breton has a 100m buffer requirement on freshwater wetlands within special management zones for lynx so the impact on freshwater wetlands within those zones wold be significantly less than outside those zones. Irreversibility: variable depending on state of target prior to harvest.
Invasive non-	Medium	Low	High	Low	Ratings determined by Sean Blaney: "I would rate all vascular plant

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
native species					invasive as high irreversibility. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, so they rate a bit higher. I'm not sure exactly how ecologically significant many of these fairly visibly striking invasions are. They may not be displacing that much native biodiversity in many cases."
Housing and Urban Area Development	Low	Medium	High	Low	Infilling for development may occur however the scope would be relatively low. Severity: Though the impacts have not been measured, proximity is being used as an estimate to the level of potential impact. Irreversibility: wetlands lost to development not likely to return.
Mining and Quarrying	Low	Low	Medium	Low	Scope: Footprint from active mines relatively low. Severity: Not located near wetlands though some downstream wetlands may experience some effects from tailings run-off. Irreversibility: Effects could technically be reversed but would be costly and take a long time
Climate Change and Habitat Shifting	High	Medium	Very High	High	Scope / Severity: it is expected that climate change will have a pronounced effect on wetlands through alterations in hydrological regimes with great global variability (Erwin 2008) -"Wetlands and global climate change: the role of wetland restoration in a changing world". Irreversibility: Impacts from climate change not likely reversible.
Agriculture	Low	Medium	Medium	Low	659 of 14283 wetlands within 30m of agricultural land. 4.6% 978 within 100m. 6.9%Severity: wetlands are generally not suitable for agriculture though runoff may pose some impacts in wetlands in close proximity to agriculture. Irreversibility: Effects can be reversed by removal of threat as wetlands could recover within 20 yrs.
Road Fragmentation	Medium	Low	High	Low	Scope/ Severity: Road index (ELA 2008) scores wetland ecosections with average of 11/100.

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					This service is comprised of an integer raster generated from the weighted density of all transportation features surrounding a cell (pixel) and the distance to the closest transportation feature. Values range between 1-100, with higher values representing urbanized landscapes and lower values representing remote undeveloped landscapes. The density and distance measures are calculated using a 1X1 kilometer analysis window and assigned to a 1 hectare cell. Transportation features are derived from the Nova Scotia Topographic Database augmented with road features visually delineated from Landsat satellite imagery. Irreversibility: Roads are not easily removed.
Recreational activities	Low	High	Medium	Low	ATV use in wetlands, though illegal is common. It can have sever impacts on the hydrology and overall function of the ecosystem. Irreversibility: Wetlands could recover with removal of threat.

Beaches, Dunes, Rocky Shores and Cliffs

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Domestic and Urban Wastewater	Low	Low	Low	Low	The Bras d'Or Lakes are relatively clean. Bacterial contamination from sewage is the primary source of pollution. Six of the eleven sub- watersheds have experienced declining water quality in recent years (UINR) - State of the Bras d'Or Marine Environmental Water Quality Background Report # S0701Water quality in the tested areas of the Bras d'Or Lakes is very good compared to other shellfish harvesting areas in Atlantic Canada: 97% of the areas tested are classified as Approved, for shellfish

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					harvesting; 0.4% are classified as Conditional, and 2.6% are Closed to shellfish harvesting (CSSP)
Invasive non-native species	Low	Low	High	Low	Ratings determined by Sean Blaney: "I would rate all vascular plant invasive as high irreversibility. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, so they rate a bit higher. I'm not sure exactly how ecologically significant many of these fairly visibly striking invasions are. They may not be displacing that much native biodiversity in many cases."
Housing and Urban Area Development	Medium	Medium	High	Medium	Coastal development and in particular around beaches is common.
Aquaculture	Low	Low	Low	Low	The large majority of aquaculture in the Bras d'Or is suspended shellfish. This type of aquaculture has minimal impacts and has been shown to actually increase water clarity and habitat. There are currently 7 fin fish leases however it appears that only 1 is currently active. The threat from expanded fin fish aquaculture is real due to the low flushing capability of the lakes, though at the time of this report, because of the low number of active farms, the threat is low.
Tourism and Recreational Areas	High	Medium	Medium	Medium	Tourism and tourism infrastructure is concentrated around bras d'Or, though the scope is limited overall, they are concentrated where beaches exist as these are highly sought after destinations.
Climate Change and Habitat Shifting	Very High	Medium	High	Medium	Scope / Severity: Sea level rise projected at 86cm by end of century. Current barrier beaches will be inundated or eroded. Beach sustainability will be determined by ability to migrate landward or along the coast. Sea level rise could outpace ability of beach dune system to migrate. Irreversibility: impacts form climate change not likely reversible within 100 yrs.
Ecosystem Modification -	Medium	High	Medium	Medium	Shoreline mapping of the Bras d'Or by DNR underway. Results will better inform level of impact from armoring. Partners have indicated

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Shoreline Armouring					that this is causing costal erosion around the Bras d'Or.
Road Fragmentation	Medium	Medium	High	Medium	Road index for beach ecosections is average 27/100 This service is comprised of an integer raster generated from the weighted density of all transportation features surrounding a cell (pixel) and the distance to the closest transportation feature. Values range between 1-100, with higher values representing urbanized landscapes and lower values representing remote undeveloped landscapes. The density and distance measures are calculated using a 1X1 kilometer analysis window and assigned to a 1 hectare cell. Transportation features are derived from the Nova Scotia Topographic Database augmented with road features visually delineated from Landsat satellite imagery. Irreversibility: Roads not easily removed.
Recreational activities	Medium	High	High	Medium	Scope: ATV use on beaches and dunes is common Severity: Use on dunes, though not common in the NA could have significant impacts in loss of stabilizing vegetation leading to erosion of beach and dune. Irreversibility: Restoration of damaged dunes feasible with proper management within 20 yrs.

Coastal Islands

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Housing and Urban Area Development	Low	Medium	Low	Low	94% coastal islands are free from development.

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Ecosystem Modification - Shoreline Armouring	Low	Low	Low	Low	Shoreline mapping of the Bras d'Or by DNR underway. Results will better inform level of impact from armoring. Partners have indicated that this is causing costal erosion around the Bras d'Or.
Climate Change and Habitat Shifting	High	Medium	Medium	Medium	Scope / Severity: Impacts from climate change dependant on complexity of habitats on an island. Sea level rise may erode shorelines if substrate is unstable, reducing the size of islands. Overall impacts would be relatively unknown and would need to be assessed on a case by case basis. Irreversibility: Impacts from CC not likely reversible.

Barrens (Information for threats to Barrens collected from Katie Porter)

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Invasive non-native species	Low	Medium	Medium	Low	Scope: low Invasive species are present at a limited number of sites in Nova Scotia, most extensively on sand barrens and coastal barrens. Severity: Medium A number of invasive plant species may represent a threat to heathland plant community structure (and thus ecosystem functioning) in Nova Scotia: Rosa rugosa has recently been shown to displace a fragile native coastal sand dune community in Cape Breton, Nova Scotia (Hill et al. 2010). We have observed this species displacing native dune vegetation and at the edge of cobble beaches and disturbed grassy shoreline at many additional sites across Nova Scotia, though we have not yet observed it becoming established in shrub-dominated communities or in wetlands. However, Garbary et al. (2011), found this garden escapee to spread

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					rapidly and displace native coastal plant communities on upland coastal barren habitat at Briar Island. Other than wetlands and areas where Green Alder or coniferous woodland occurs, R. rugosa is able to colonize the majority of coastal habitats that occur in the province (Garbary et al. 2013). Garbary et al. (2013) further conclude that "R. rugosa represents a serious threat to native plant communities on windswept coastal headlands and offshore islands of the region". These works suggest the species may in the future prove to threaten heathlands by displacing native coastal plant communities. Heathlands disturbed by development are often fragmented, isolated, and vulnerable to further anthropogenic disturbance and to invasion (Clarkson et al. 2010). It is possible the threat of invasive species will become more of a concern as development pressures increase. Irreversibility: low It is likely the species can feasibly be removed from a site, although moderate effort may be required.
Housing and Urban Area Development	Low	Medium	High	Low	Coastal housing developments have destroyed a large portion of barrens along the Northeastern Seaboard of the United States (Dunwiddie 1989). Similar development pressure is foreseeable in areas of Nova Scotia, where a large portion of lands are privately owned. Despite a smaller and declining overall population size, development along much of Nova Scotia's scenic coastline for luxury homes has been increasing steadily (CBCL 2009). Residential developments on Cape Breton: Population size and economic stability is declining in many of Cape Bretons largest communities, meaning that a rate or extent of urban sprawl similar to Halifax is highly unlikely to occur in Cape Breton. However, scenic properties with development potential for tourist infrastructure or expensive seasonal homes are in relatively higher demand. Unlike mainland Nova Scotia, the largest area of heathland in Cape Breton occurs at high elevation. The remote nature of these sites reduces property values, and residential

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					development is less common. Lower elevation heathlands near the coast on privately owned lands are at greatest risk for residential development.
Tourism and Recreational Areas	Medium	Low	High	Low	Tourism Industry: Tourist infrastructure, from small scale look-off sites (parking, interpretive signage) to hotels and resorts, have historically become established along scenic areas of coastal heathland. Coastal headlands dominated by heaths are often considered ideal sites for such developments since clearing of trees is not needed and scenic vistas are intrinsic. Resort developments are uncommon, but coastal heathland sites have high development value because of their scenic quality. At the same time, the likelihood of development is lessened to some extent on sites that have complex topography and boggy or rocky terrain, due to challenging architectural specifications. Heathlands are most often not suitable for the establishment of campgrounds because heathlands often occur on windy sites with relatively high rates of precipitation, high frequency of fog, relatively cooler temperatures, uneven and rocky terrain, and frequently feature a substantial area of wetlands. Development of any type results in land use conversion. Associated impacts include habitat fragmentation and destruction in the footprint of the developments, introduction of exotic and invasive species and road construction. Noise, air and soil pollution are likely to occur. Land use conversion may be permanent. Historic fishing and agricultural settlements in Nova Scotia appear to have naturally recovered some cases. In other cases, it seems unlikely that many residential or urban developments could be restored given ecological complexities of many sites. Blasting activities and leveling of complex topography, or in-filling of wetlands are often required to develop heathland sites. Restoration activities should account for microhabitat heterogeneity characteristic of heathland sites, which is linked to high species diversity. Examples from Cape Breton: • Loss of habitat on Isle Madame relating to seasonal luxury housing developments (previous Lundholm lab study site)

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					• Keltic Lodge at Middle Head • Mother Canada development proposal, Green Cove
Climate Change and Habitat Shifting	High	Medium	Very High	High	CB HIGHLAND SITES: Impacts of climate change may be the most severe at sites that provide milder arctic conditions and lower elevation alpine habitat. Climate change is highly likely to lead to the decline of lichens in such habitats (Cornelissen et al 2001). Shallow-rooted plants, e.g. in the Cape Breton Highlands are susceptible to blowdown from hurricanes (Neily et al. 2008). Changes to vascular plant community structure could also be anticipated. Nova Scotia's coastal and highland heaths share many species and ecological commonalities with habitat found in other regions where climate change impacts have been better studied (e.g., Northern Europe and Icelandic heathlands, boreal and sub-alpine plant community types in other parts of northeastern North America). In these other regions where these conditions have been studied (e.g. within sub-arctic dwarf shrublands), researchers have observed changes in plants' bud production, phenology, and reproductive success, leading to a deterioration of ecosystem functioning. It has been suggested these effects impact the overall biodiversity and productivity of their respective habitats (Björn et al. 1997). Several lichens species associated with northern alpine sites have recently been discovered in the Cape Breton highlands (Porter, Basquill, Lundholm unpublished data). Impacts to these species are unknown, but they should be considered relatively vulnerable given their restricted habitat and known environmental associations. COASTAL SITES: Coastal heathlands throughout Nova Scotia frequently occur well under 10m elevation (unpublished data Porter 2011) and sea level rise will flood at least some area of these habitats. The ability for heaths to migrate into forested systems has not been documented before although the converse is true. In general, more research is needed to better understand vegetation dynamics at heath-forest margins in NS (Burley et al 2010). Some low-lying heathlands, grassy islands, and pinnacles are likely to submerge. This is of particular concern with respect to sites of importance to nesting seabirds. In other cases, sites such as Sea

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					Wolf Island, are expected to be more resistant to the effect of storms and sea level rise due to their high elevation and hard bedrock type. However, responses of vegetation communities on such islands to effects of climate change are not known (Environment Canada 2013). Increased storm intensity near the coast is one factor anticipated to result in increased erosion. Coastal erosion will occur to a lesser extent on sites with hard bedrock types relative to those with sedimentary exposures. Although it is possible that increased storm intensity may also expand or create new heathland habitat along the coast, this would not mitigate loss of habitat due to submergence or erosion and it seems doubtful that disturbed blow-downs would exhibit equal habitat complexity and diversity to long established heaths. Plant community types that are restricted to the coastline of coastal barrens may also be especially vulnerable to storms and to sea level rise. In the salt spray and upper intertidal zone, Rhodiola rosea and other vascular plant and bryophyte species are restricted to a narrow habitat band. We have casually observed small-scale losses of this zone and/or individual plants within it in response to recent hurricanes. Although Plantago maritima and Festuca rubra often colonize the edge of barrens, there is as of yet no evidence that other species with more specific habitat requirements have the ability to migrate landward fast enough to respond to increased sea level and storm intensity. A number of other, rarer species inhabit this zone. Scurvy grass (Cochlearia tridactylites) is one such plant that is exclusive to this habitat type in Nova Scotia. The zone is relatively narrow and low plant densities reduce the number of propagules available to colonize newly available habitat further up slope/inland.
Agriculture	Medium	Low	Medium	Low	Scope: Medium The economic potential of heathlands for agricultural use is considered to be low (Hall and Alders 1968). Habitat conversion for crop production is rare because heathlands are typically located in areas of high environmental exposure and are underlain by shallow, acidic and nutrient poor soils (Oberndorfer and Lundholm

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					2008). Heathlands soils in Nova Scotia often consist of rapidly drained, shallow humus over exposed bedrock or a thin veneer of sandy glacial till, excessively stony sandy loams (sometimes with cemented horizons), or poorly drained peatlands (Porter 2013). Heathlands are, however, often used for pasture horses or sheep, the latter of which was once more widespread. Many coastal islands and some inland sites with relatively flat topography at the edge of steep relief have been considered to be ideal seasonal pasture lands because natural barriers meant fencing was not necessary. The extent to which pasturing historically occurred on Nova Scotia's heathlands is unknown. Severity: low The role of pasturing in either the establishment or degradation of heaths relating to historic or ongoing agricultural use have not been well studied in Nova Scotia. In other regions, ecologists have demonstrated deleterious changes in plant community composition and nutrient profile of heathlands in response to pasturing of grazing animals (e.g., Bokdam and Gleichman 2000, Wahren et al 1994). Although such effects of pasturing have not been studied on Nova Scotia's heathlands, we have casually observed higher incidence of weedy exotic and pasture grass species in areas that are or were previously used for pasture. Naturalists have reported similar disturbance of heaths and the maintenance of open habitat on heaths/tree suppression by pasture animals on mainland and coastal island sites throughout Nova Scotia (e.g. HFN 1980). We suspect that changes in vegetation on Nova Scotia's heathlands resulting from pasturing may relate to nutrient deposition (scats), and disturbance to native vegetation by browsing and trampling. Although pasturing can be considered a disturbance to heathlands, there is also evidence that historical pasturing is one contributing factor to the establishment of

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					heathlands where they did not previously occur. Browsing and trampling could suppress tree growth, and in coastal areas with poor, shallows soils this could encourage shrub establishment within an old field site. Such sites or community types are likely to be dynamic in nature and may eventually undergo natural succession back into forest. The extent of this is unknown in Nova Scotia but well documented in other regions e.g., Collantes et al. (1989) found historical (more than 1,000 years ago) sheep pasture to be a contributing factor in establishment of Empetrum spp. dominated heathlands in Argentina. Irreversibility: medium Although restoration hasn't been undertaken in Nova Scotia yet, active restoration of heathlands converted to agricultural lands is feasible and actively practiced in other regions (e.g. Pywell et al 1995). It is also possible that at some sites, harsh environmental conditions may competitively exclude exotic plant species over time. At some historically pastured sites, natural regeneration seems to be leading to recovery (e.g. Hemeons Head, Stuarts Point, etc. on the Mainland – & those sites were also burned and had residential and/or fishing structures). There remain significant gaps in scientific knowledge of the natural and anthropogenic history of heathlands in Nova Scotia. Many sites have complex histories of human use and disturbance (fire, agriculture, settlement, fishing infrastructure, military structures, colonial encampment, light houses etc.) and also natural disturbance (wind, salt spray, elevation, coastal humidity and precipitation, wetlands or shallow soils, seabird colonies, potentially fire etc.). Better historical contextualization is needed to resolve these issues and inform restoration activities. Available knowledge of successional trajectories or capacity for natural recovery is also limited. These factors will complicate restoration planning. This applies to the "irreversibility" ranking related to other threats as well Cape Breton examples: Money Point (current horse pasture), Gabarus (evidence of historic pasture lands – old rock walls and old field areas), Polletts Cove area

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					privately owned lands (historic and current pastures).
Road Fragmentation	Low	Medium	Medium	Low	Scope: low Primary roads sometimes bisect heathlands in areas with dense coastal-rural settlement. More often, access roads are built through heathlands in association with coastal housing developments, to access coastal infrastructure, e.g. lighthouses or for natural resource extraction activities, e.g. extensive forestry, mining and hydroelectric access roads in the Cape Breton highlands. Severity: medium Road fragmentation most notably displaces habitat in the immediate footprint of the road, introduces exotic species, alters hydrology, and limits the dispersal and movement patterns of many plant and animal species. Road mortalities of mammals and herpetiles also increase with the establishment of roads. Winter road maintenance can also introduce hazardous salts into heathland ecosystems. Salts are commonly used across Nova Scotia and are transported from roadsides into wetland and upland habitat in runoff and as snowmelt. Amphibians are particularly vulnerable to these substances because of their permeable skin. Salts accumulate over time in wetlands but even when concentrations are below established acute toxicity thresholds, significant mortality of amphibian larvae has been documented (Copan 2016). Although it has not been studied in Nova Scotia, pollutants and exhaust associated with roads are known to change plant species composition on heathlands in other regions (Angold 1997). Road salts are also known to degrade soils by altering pH and nutrient cycling. Salts alter Cation Exchange Capacity of soils, displacing trace metals making them less available for absorption and consumption by plants (Copan 2016). At sites far from the coast, we have on occasion observed an abundance of salt-tolerant species such as Plantago maritima where they could otherwise be expected to be absent. Irreversibility: medium

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					Restoration of roads on heathlands has not been attempted but it may be feasible, especially in upland habitat. Restoration of altered wetland hydrology is more complex and logistically challenging. Salt? Examples: • Extensive gravel roads were built across our study site at Little Anse on Isle Madame (2010-2012) in association with the construction of expensive coastal housing development. • Industrial access roads and quarries used to maintain these roads in Cheticamp Flowage fragment wide tracts of boreal forest, heaths and wetlands.
Wind Farms	High	Medium	High	Medium	According to the Nova Scotia Wind Atlas, almost all coastal and highland heathlands are located on sites with the greatest wind speed categories.
Recreational activities	Very High	Medium	Medium	Medium	Scope: Very High ATV: Off-road ATV use on heathlands is very common despite formal legal protection prohibiting ATV use on heathlands and also the wide availability of extensive networks of actively-managed, legal recreational trails. Few heathland sites in Nova Scotia have no evidence of ATV use. Only the steepest, rocky sites at high elevations in Cape Breton are inaccessible to wheeled vehicles and snowmobiles. Fishing, Hunting, Berry Harvesting: Duck hunting is common on heathlands, especially around coastal islands and at larger inland sites with significant habitat features such as sheltered coastal inlets and open fresh water bodies (lakes, ponds etc). A small number of coastal sites are also frequented by recreational mackerel fishers. Many sites are also commonly used for berry harvesting. Crops that are commonly harvested from heathlands include Cloudberry (Bakeapple), Blueberry, Huckleberry, Cranberries and on occasion Crowberries and Lingonberries. There is no evidence to suggest that and of these harvesting activities represent a threat to heathlands.

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					Hiking: A large number of heathland sites feature hiking trails of various levels of organization from formally established and maintained recreational trails within provincial parks to informal footpaths on privately owned sites. Boat traffic (motorized and non-motorized) A number of coastal sites are frequented by kayakers, sailors and motorized boats for recreational activities. Ecotourism related boat traffic is primarily of (growing) concern for islands that provide habitat for colonial seabirds eg., by Dietz and Chiasson (2000). Severity: Medium ATV: The impacts of ATV damage and hiking trails on heathland habitat include soil erosion and compaction, alteration of hydrology, and the introduction of non-native exotic or invasive species. One of the largest impacts that ATV tracks have on barrens microhabitats is soil alteration: soil temperature is increased by two to three degrees, and soils are compacted and eroded relative to hiking trails or undisturbed barrens soils. ATV tracks have been shown to reduce lichen abundance (cover) and crush vegetation. Native seedlings are able to geminate on ATV trails, but survival rates are low and species composition of seedlings is altered, i.e. the species that successfully germinate on ATV trails are significantly different than surrounding vegetation (Simon 2012). Heaths on sand dunes (e.g. Point Michaud), in wetlands, and across thick, upland humus forms and peaty deposits (e.g. Baleine) are likely to be impacted by soil erosion. However, rock exposures are also among the most sensitive habitats to ATV disturbance on heathlands. On the coastal heathlands, bogs, low shrub plant communities, and rock crack microhabitats are more vulnerable to ATV disturbance than tall shrub heaths (Simon 2012). These naturally occurring barren habitat types are often persistent and regulated by environmental extremes, whereas tall shrub zones may represent dynamic heaths associated with other disturbance types (e.g. fire) (Burley and Lundholm 2010).

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					On wet and steep sites trail braiding is likely to occur, which increases the area impacted. The most impactful ATV use is associated with braided trails and also "mud bogging". On upland sites, "doing doughnuts" widens the footprint of tracks. These activities are more commonly observed on the mainland in southwest Nova Scotia and Halifax County. In Cape Breton, it appears that illegal ATV use is more frequently associated with access to remote sites for berry picking or hunting. Hiking trails: Hiking trails are a frequent occurrence on many of Nova Scotia's heathlands. Although many formal hiking trails are actively maintained and represent limited extent of impact, others become extensive braided networks of informal footpaths distributed widely across a site. Like ATV use, soils erosion, loss of vegetation and habitat fragmentation associated with these braided footpaths are visually apparent from air photos. The impacts of hiking trails to vegetation communities have long been documented in other regions, e.g. since Bates (1935) etc. Hiking trails have impacts similar to ATV use (e.g. loss of biomass and soil compaction; Keddy et al., 1979; Hannaford and Resh, 1999; Cole, 2004) but usually within an initially narrower footprint. This footprint widens with time and intensity of use (Dale, 1974). Simon (2012) showed that hiking trails negatively affect coastal barrens in Nova Scotia by increasing soil erosion and by introducing exotic weedy species. Some of the most accessible hiking trails on Nova Scotias heathlands are visited by thousands of hikers and tourists each year, and these sites appear to be highly invaded by weedy exotic species in the area around the trails. In wet areas, well-traveled braided trails appear to have an impact on wetland hydrology. Like ATV trails, hiking paths become braided, especially across wet peat or when soils are so badly disturbed that they are completely eroded and water pools on exposed bedrock. Similar scarification is visible in upland habitat, where

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					footpaths contribute to the erosion of shallow, sensitive soils. Because vegetation stabilizes shorelines and prevents erosion, footpaths along cliffs and at the edge of shorelines could accelerate coastal erosion. Shoreline slumping and soil erosion are extensive at some sites where scenic footpaths occur at the coastal edge. ATV or hiking trail – impacts to bird nesting sites: Nesting birds can be disturbed by the presence of humans associated with hiking trails and ATV use. Increased presence of humans, trampling and noise can cause stress to birds, nest abandonment, accidental crushing of nest sites. The Common Nighthawk is one vulnerable ground-nesting species that seeks out rocky terrain, often associated with inland heaths to nest. Many shoreline nesting species such as Willet are also vulnerable to activities in coastal areas. Some species such as Leach's Storm Petrel nest in burrows in dwarf heath on islands and are sensitive to the presence of humans. Boat traffic – impacts to bird nesting sites: Ecotourism related boat traffic (kayaks, and motorized boats) represents a notable and increasing disturbance to breeding and colonial seabirds on islands in particular (eg., Dietz and Chiasson 2000, Environment Canada 2013). Boat traffic in general represents a stressor and impacts nesting seabirds, even though in some cases bird colonies can become habituated to regular noise associated with a small number of vessels, e.g. for lobster fishing (Dietz and Chiasson 2000). Recreational boat activity around nesting shorebirds and around islands that provide habitat for colonial seabirds, can have deleterious effects on reproductive and migratory success. Willets, Cliff Swallows, Black Guillemot, Storm Petrels, Terns, Eider Duck, Puffin, and a number of other species are vulnerable to such activities. Irreversibility: Medium Resilience and natural regeneration following trail abandonment have not been quantitatively studied in Nova Scotia, though the use of historical air photos

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					allowed us to observe the footprint of ATV tracks (exotic species, soil erosion, and compaction in the tracks), persisting more than 50 years post abandonment at one site (mainland NS). It is difficult to prevent ATV use of heathlands because they consist of open treeless expanses where access cannot be prevent using traditional management techniques (e.g. placement of boulders or other barricades). ATV trails often cover wide expanses in remote locations where regular monitoring is not feasible. In similar habitats farther south of the border (e.g. Maine), some parks are monitored with video cameras, and access prevention using fencing has been effective, but these activities are highly unlikely to be well received by Nova Scotians. Stewardship action in other parts of the province that employs a community-focused approach seems to have been more successful. To date, there has been no formal attempt to restore ATV trails on heathlands in Nova Scotia. Restoration of heathlands soils may be challenging at remote sites that are difficult to access. Community-initiated efforts have been made to reduce the impact of hiking trails and bouldering trails in Nova Scotia by installing boardwalks, for example: • Boardwalk installation at the "Land of Confusion" bouldering trail, Pollys Cove NS: http://www.climbnovascotia.ca/2016/04/erosion-prevention-in-the-loc/ • Boardwalk in wetland habitat at Port Bickerton Also, landscape architects have recently begun planning a pilot restoration project on a disturbed hiking trail on privately owned lands near Duncan's Cove, NS. (ref: https://asla.org/uploadedFiles/CMS/Meetings_and_Events/2015_Annual_Meeting_Handouts/SAT-A03_Plant%20What%20You%20See%20-%20Fragile%20Arctic%20Ecosystems.pdf)

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					With respect to boat traffic, limiting or managing ecotourism activities can mitigate or prevent harmful disturbance. Example sites: ATV trails – Baliene, Hemeons Head, Pollys Cove, Pennant & Terence Bay areas, Rouges Roost, Canso Coastal Barrens, etc. Formally maintained hiking trails –Taylor Head, Cape Breton Highlands National Park (Skyline Trail, Middle Head, Green Cove, Mica Hill, etc), Gaff Point, Port Bickerton Lighthouse trails, Bluff Wilderness loops, Royal Canadian air Force Radar Unit #5 trails at Bonnett Lake Barrens, etc. New proposed trails: Cape Breton Highlands "Seawall Trail" is an extensive trails network proposed for the Cape Breton Highlands Informal Hiking trails: Duncans Cove Nature Reserve, Prospect High Head, Herring Cove Provincial park, Pennant Point (Crystal Crescent Beach Provincial Park), Terence Bay & Penant Area heathlands (e.g., Sandy Cove & Terence Bay Lighthouse, Western Head (Queens County), White Point (Victoria County) Bouldering trails – Rogues Roost, Pollys Cove "LOC; Lands of Confusion" Popular kayak and recreational boat routes – Eastern Shore Islands, Hertford and Ciboux "Bird Islands", others (see Kayak Routes of NS book) Hertford and Ciboux "Bird Islands" are examples of ecological importance offered formal conservation protection, but where ecotourism nonetheless represents a significant management concern (Dietz and Chiasson 2000).

Estuaries and Tidal Flats

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
Domestic and Urban Wastewater	Medium	Low	Low	Low	The Bras d'Or Lakes are relatively clean. Bacterial contamination from sewage is the primary source of pollution. Six of the eleven sub- watersheds have experienced declining water quality in recent years (UINR) - State of the Bras d'Or Marine Environmental Water Quality Background Report # S0701Water quality in the tested areas of the Bras d'Or Lakes is very good compared to other shellfish harvesting areas in Atlantic Canada: 97% of the areas tested are classified as Approved, for shellfish harvesting; 0.4% are classified as Conditional, and 2.6% are Closed to shellfish harvesting (CSSP)Closures are generally in and around estuaries where currents can cause an increased concentration of coliform bacteria.
Invasive non-native species	High	Low	High	Low	Ratings determined by Sean Blaney: "I would rate all vascular plant invasive as high irreversibility. Calcareous stream beds and open gypsum slopes are often heavily invaded by a variety of species, even in seemingly low disturbance areas, so they rate a bit higher. I'm not sure exactly how ecologically significant many of these fairly visibly striking invasions are. They may not be displacing that much native biodiversity in many cases."
Housing and Urban Area Development	Medium	Low	Medium	Low	Coastal development within near proximity to salt marsh and estuaries may introduce siltation and pollutants into the system.
Aquaculture	Low	Low	Low	Low	The large majority of aquaculture in the Bras d'or is suspended shellfish. This type of aquaculture has minimal impacts and has been shown to actually increase water clarity and habitat. There are currently 7 fin fish leases however it appears that only 1 is currently active. The threat from expanded fin fish aquaculture is real due to the low flushing capability of the lakes, though at the time of this report,

Threat	Scope	Severity	Irreversibility	Summary Threat Rating	Comments
					because of the low number of active farms, the threat is low.
Climate Change and Habitat Shifting	Very High	Medium	High	Medium	Scope / Severity: sea level rise projected at 86cm by end of century. Current extent of saltmarsh could be affected and sea level rise could outpace the ability of this target to migrate landward. Irreversibility: Impacts from CC not likely reversible within 100 yrs.
Ecosystem Modification - Shoreline Armouring	Low	Low	Low	Low	Shoreline mapping of the Bras d'Or by DNR underway. Results will better inform level of impact from armoring. Partners have indicated that this is causing costal erosion around the Bras d'Or.
Agriculture	Low	Low	Medium	Low	Scope: Agriculture not often in proximity to salt marsh and estuaries Severity: may have some impact from runoff but not common in the NA. Irreversibility: Threat not having much impact to begin with.
Road Fragmentation	Medium	High	High	Medium	Average road index score (ELA 2008) for salt marsh ecosections is 36. The highest of all habitat types. This service is comprised of an integer raster generated from the weighted density of all transportation features surrounding a cell (pixel) and the distance to the closest transportation feature. Values range between 1-100, with higher values representing urbanized landscapes and lower values representing remote undeveloped landscapes. The density and distance measures are calculated using a 1X1 kilometer analysis window and assigned to a 1 hectare cell. Transportation features are derived from the Nova Scotia Topographic Database augmented with road features visually delineated from Landsat satellite imagery. Irreversibility: Roads not easily or cheaply removed.