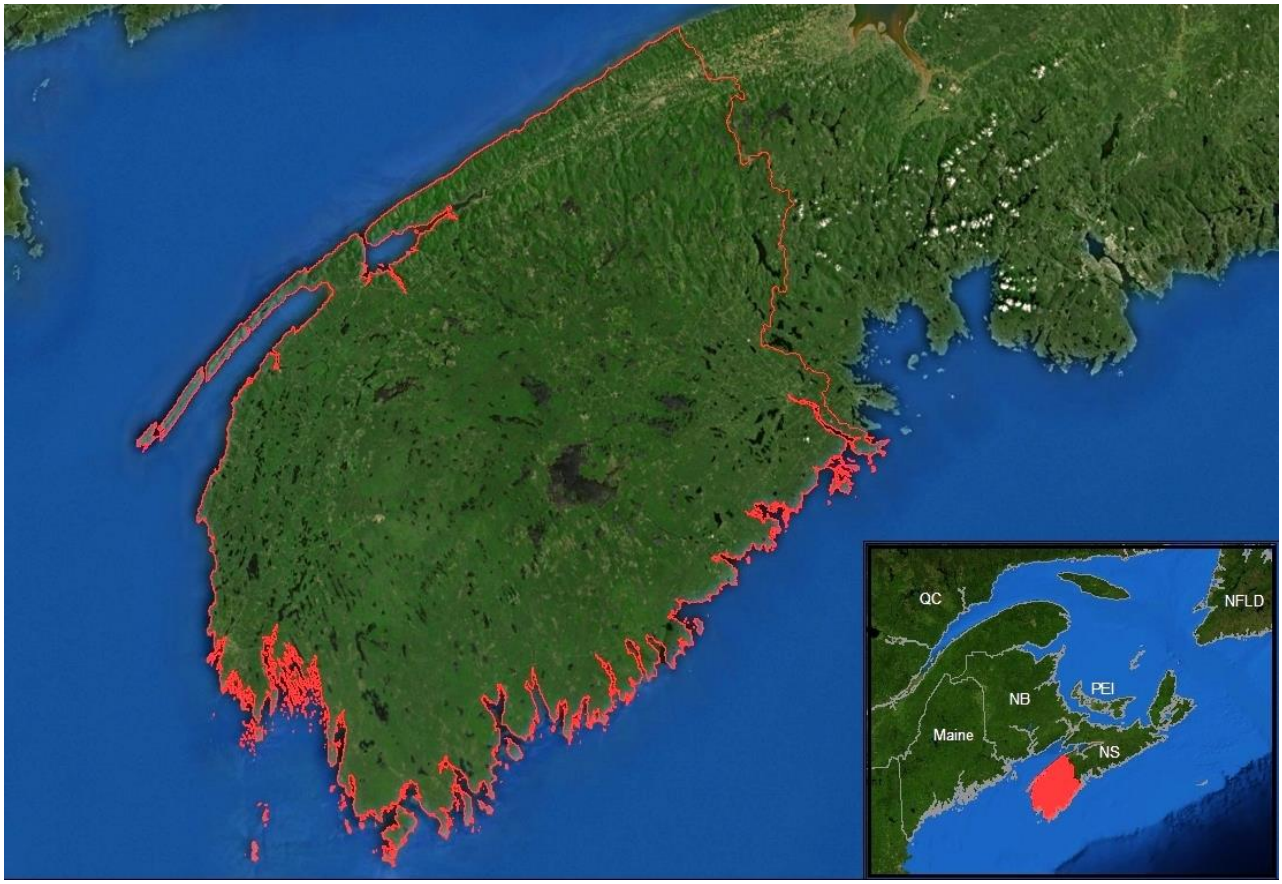
Southwest Nova Scotia Habitat Conservation Strategy

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EXECUTIVE SUMMARY

This Habitat Conservation Strategy (HCS) was developed through collaboration among member organizations of the Eastern Habitat Joint Venture (EHJV) Nova Scotia Steering Committee and partner conservation groups. It is intended to be the first of a series of HCS with contiguous boundaries that will consider all areas of the province. 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 Southwest Nova Scotia (SWNS) 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 within the bioregion 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

HCSs 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. Also discussed are existing protected areas and conservation lands in the bioregion, and social and economic considerations relevant to regional conservation work. The approach taken in the development of the narrative is meant to be thorough but not exhaustive, emphasizing references 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.

Ecological context

Situated in the southwest of peninsular Nova Scotia, the 1,618,299 ha SWNS bioregion is one of the most biologically diverse areas of the province, containing an outstanding assemblage of significant biodiversity features (Summary—Figure 1). Due to its unique geological and climatic history, and its southerly position in the province, the bioregion hosts a number of peripheral and disjunct populations of temperate flora and fauna, including a number of Nova Scotia's rarest terrestrial species. Consequently, the region contains a high concentration of federally and provincially listed species at risk, including 37 species listed on Schedule 1 of the *Species at Risk Act*, an additional 15 species assessed as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and 46 species listed in the *Nova Scotia Endangered Species Act,* six of which have not been assessed as at risk by COSEWIC.

The coastline of the SWNS bioregion is 2,813 km long and is irregular and indented with numerous bays and inlets, salt and brackish marshes, beach and dune complexes, extensive tidal flats, and abundant and remote coastal islands. These rich coastal ecosystems represent important habitat in the region for biodiversity, and contain sites of global significance to breeding, staging, and over-wintering shorebirds, marsh birds, and waterfowl. The bioregion contains nine provincially delineated primary watersheds, encompassing a large network of freshwater lakes, rivers, and streams, including some of the longest rivers and largest freshwater lakes in the province, and a high concentration of critical occurrences of freshwater wetland and riparian ecosystems. Many of these sites host rare and endangered species of Atlantic Coastal Plain Flora.

The bioregion contains Nova Scotia's largest remaining intact Acadian Forests, which serve as habitat for the conservation of a wide range of rare and endangered, as well as common, forest-associated species, from soil invertebrates and little known fungi, to forest interior birds, large herbivores, and wide ranging predators. Numerous studies have identified the forests occurring in southwest Nova Scotia as important for core ecosystem protection and connectivity within the province and the greater Northern Appalachian-Acadian Ecoregion. There is an existing network of protected lands that are managed primarily for biodiversity, including Nova Scotia's largest protected area, the Tobeatic Wilderness Area, and Kejimkujik National Park and National Historic Site, one of the province's three national parks and national park reserves (Summary—Figure 1). Together these federally and provincially protected lands make up the core area of the UNESCO designated Southwest Nova Biosphere Reserve.

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 rare species, species at risk, and bird species identified as conservation priorities, but independently of spatial patterns of species occurrence, the following nine habitat types were determined to be conservation priorities for the SWNS bioregion.

1) Beaches and dunes
2) Tidal marshes
3) Tidal flats
4) Coastal islands
5) Freshwater wetlands
6) Acadian Forest mosaic
7) Riparian and floodplain systems
8) Grasslands/agro-ecosystems
9) Barrens

A map was generated depicting the spatial location of overall conservation priority habitats based on habitat uniqueness, representivity, and patch size (Summary—Figure 2). This overall conservation priority habitat composite does not incorporate information on occurrence records of rare and endangered species, or conservation priority birds. Different perspectives on species-based prioritizations are presented in the priority species composite maps in Figures 25 to 36 (p. 107 to 118) which illustrate the distribution of 11 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 SWNS 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. To supplement these figures Appendix D presents a summary of the species presented in each map, and the dataset used to represent these species.

Threats

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

1.1.1 Cottage and residential development (Threat status: Medium)
2.1.1 Incompatible agricultural practices (Threat status: Medium)
2.4.1 Marine and shellfish aquaculture (Threat status: Medium)
5.3.1 Forest harvesting practices (Threat status: Medium)
6.1.1 Recreational beach use (Threat status: Medium)
4.1.1 Road fragmentation (Threat status: Medium)
8.1.1 Invasive European green crab (Threat status: Medium)
8.2.1 Problematic native species (Threat status: Medium)
9.3.1 Agricultural and forestry effluents (Threat status: Medium)
9.5.1 Air pollution and acid precipitation (Threat status: Medium)
11.1.1 Sea-level rise and coastal erosion (Threat status: Medium)
11.4.1 Storm-induced coastal erosion (Threat status: Medium)

Conservation actions

The following summary presents the conservation actions undertaken by organizations working in the SWNS 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 17, p. 128.

<u>Government of Canada – Environment 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.
- Contribute to Marine Protected Area Network planning within the Scotian Shelf marine bioregion, and to the identification 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 (in partnership with the DFO, PC).
- Offer support to ENGOs, communities, aboriginal organizations, and academia via 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 and Aboriginal Fund for Species at Risk.
- Engage and consult with all partners in the development of SAR recovery documents, and support activities described within recovery documents for the schedule of studies for SAR and

the identification of their critical habitat within the SWNS bioregion (in partnership with EC, NSDNR, Academic Institutions, NSNT, NCC, MTRI).
- Support the EHJV and provide science guidance to conservation partners on actions and priorities for migratory birds and SAR including development, refinement, and implementation of this HCS and of the NS Bird Conservation Region 14 Strategy.
- Continue management activities associated with Sand Pond NWA and Sable River, Port Joli, Haley Lake, and Port Hebert Migratory Bird Sanctuaries.
- Inform and implement the North American Waterfowl Management Plan (NAWMP) and conduct waterfowl surveys as required by the plan (in partnership with the EHJV).
- Continue to strengthen the partnership with the Atlantic Canada Conservation Data Center through the exchange of monitoring and inventory data from conservation areas.

Province of Nova Scotia
- Designate 68 000 ha of new protected areas under the 14% Protected Areas Initiative.
- Assess air quality and climate change using lichens within permanent sample plots.
- Complete a gap analysis for the province's system of protected areas.
- Complete ecological risk assessments to assess 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.
- Undertake wildlife and environmental enforcement activities (EC Wildlife Enforcement, Environmental Enforcement); address illegal hunting and disturbance, illegal activities and habitat destruction (in partnership with EC).

Eastern Habitat Joint Venture
- Inform and implement the North American Waterfowl Management Plan (NAWMP) and conduct waterfowl surveys as required by the plan (in partnership with the EC).
- Engage 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 and identification of Beneficial Management Practices (BMP's) that promote the maintenance or enhancement of biodiversity on farms.

Nature Conservancy of Canada
- Secure 2500 ha of priority 1 and priority 2 forested habitat to protect them from harvesting.
- Secure 500 ha of priority 1 and priority 2 habitat for species at risk to protect them from development.
- Secure 500 ha of priority 1 and priority 2 coastal habitat to protect them from development.
- Work collaboratively with partners and neighbours to manage NCC conservation lands in the region, including the development of management plans and baseline inventories, and undertake priority site management activities. Monitor key threats, and where possible, take direct action to mitigate threats posing an imminent impact to conservation priority habitats.
- Continue to work to refine knowledge regarding the location of NCC key biodiversity targets to inform parcel prioritizations.
- Develop a detailed assessment of land tenure within critical habitat areas for ACPF.

- Conduct wildlife connectivity analyses to identify optimal connectivity corridors between core protected areas/natural habitats.
- Map the 'active river area' (i.e., 100-year floodplain) to define floodplains for primary rivers in Southwest Nova Scotia.
- Establish a structure to facilitate collaboration and strategic decision making regarding invasive species control techniques (e.g., Invasive Species Alliance; in partnership with MTRI).
- Participate in the review and update of the Nova Scotia Mineral Resources Act and seek appropriate mechanisms for resolution of conflicts between private conservation lands and sub-surface rights (in partnership with NSNT).

Nova Scotia Nature Trust

- Acquire priority coastal habitat and priority habitat for Blanding's Turtle, Eastern Ribbonsnake, ACPF, and Piping Plover as opportunities arise.
- 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.
- Address habitat threats through the education and engagement of stakeholders, landowners, and landusers.
- Participate in the review and update of the Nova Scotia Mineral Resources Act and seek appropriate mechanisms for resolution of conflicts between private conservation lands and sub-surface rights.

Parks Canada

- Continue ecological integrity monitoring to assess the state of forest, freshwater, wetland, and coastal ecosystem health in Kejimkujik National Park and summarize findings in the State of the Park Report.
- Raise awareness of invasive species in Nova Scotia and the role they play in ecosystems through the Backyard Biodiversity project (in partnership with MTRI).
- Continue research to investigate population dynamics of invasive Green Crab, assess their ecological impacts on coastal ecosystems, and determine if physical removal (e.g., trapping) can effectively and sustainably control invasive Green Crab in Kejimkujik National Park Seaside Adjunct estuaries. Continue to work with local interests and other government departments to develop a positive use for removed crabs, including lobster bait, fertilizer, and compost.
- Continue to monitor and eradicate all mature, seed-producing Glossy Buckthorn plants within Kejimkujik National Park and National Historic Site as locations become known, and educate and engage the public on the ecological impacts of this species, its identification, and how to employ the most effective means of control (in partnership with MTRI).
- Continue to monitor temporal trends in eelgrass extent and condition within the Kejimkujik Seaside Adjunct, and assess whether management responses (e.g., invasive European Green Crab reduction, eelgrass transplanting) have been effective in reversing eelgrass loss.
- Continue annual Water-pennywort surveys on Kejimkujik and George Lakes.
- Continue to facilitate opportunities for volunteers to engage in regional SAR and environmental conservation programs in the Southwest Nova Biosphere Reserve through the Kejimkujik Southwest Nova Volunteer Program (in partnerhip with Friends of Keji, MTRI, BSC, Acadia University).

Bird Studies Canada

- Continue to work together through the coordination of volunteers and partners in Piping Plover monitoring (e.g., breeding success, threats), breeding habitat protection (e.g., on-beach signage, fencing), and stewardship on beaches in Southwest Nova Scotia, including joint monitoring collaborations, outreach, and volunteer celebration events (in partnership with Parks Canada, Environment Canada).
- Engage with international (U.S. and Caribbean) partners in Piping Plover conservation to improve information sharing.
- Continue to systematically monitor population levels of Chimney Swift at known roost sites through a citizen-science monitoring and conservation program to advance knowledge of nesting ecology, and to increase awareness of this species at risk in the Maritimes. Continue to solicit the public for sightings of Chimney Swift and nest locations (in partnership with MTRI, EC).

Mersey Tobeatic Research Institute

- Continue to locate, map and assess potential old growth stands on private and public lands 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 (in partnership with NSDNR and NCC).
- Conduct botanical surveys of rare and uncommon cyanolichens to refine parcel prioritization (in partnership with NCC).
- Conduct a full inventory, with habitat mapping and photo inventory of lakes identified in the ACPF Recovery Strategy.
- Continue the volunteer-based Kejimkujik and Mersey LoonWatch Programs to monitor loon abundance and breeding success on lakes in the Southwest Nova Biosphere Reserve, with a focus on the Mersey and Medway watersheds. Continue to work with partners on studies of reproduction, survivorship, and the role of mercury in the Kejimkujik ecosystem (in partnership with PC, EC, Biodiversity Institute, Acadia University).
- Continue to systematically monitor population levels of Chimney Swift at known roost sites through a citizen-science monitoring and conservation program to advance knowledge of nesting ecology, and to increase awareness of this species at risk in the Maritimes. Continue to solicit the public for sightings of Chimney Swift and nest locations (in partnership with BSC, EC).
- Continue the long-standing volunteer program to protect Blanding's Turtle nests from predation, flooding, and other risks and work with landowners to protect turtles on their properties. Develop a long term monitoring plan and continue to monitor the three known populations in the SWNS bioregion to collect long term data on survivorship, clutch size, headstarting, hatchling success, habitat use, and site fidelity. Search for new populations by soliciting and following up on public sighting reports, and provide information on high priority sites to land trusts (in partnership with PC, EC, Acadia University, Friends of Keji, Blanding's Turtle Recovery Team).
- Continue to conduct systematic surveys and solicit public sightings of Eastern Ribbonsnake to determine their range and abundance in the bioregion. Continue to monitor the one known Eastern Ribbonsnake overwintering site to document site use, snake abundance, and site fidelity, and conduct field surveys around known concentration sites in spring and fall to locate additional overwintering sites (in partnership with PC, Dalhousie University, Eastern Ribbon Snake Recovery Team)
- Continue research to increase knowledge of Boreal Felt Lichen habitat requirements and contributing factors to their survivorship, and improve the predictive ability of a GIS habitat algorithm to locate Boreal Felt Lichen occurrences. Monitor known occurrences and protect

newly found occurrences of Boreal Felt Lichen and other at risk lichens through work with forestry companies. Search for occurrences in potential habitat prior to planned harvests. Maintain a database of lichen occurrences and habitat data (in partnership with NSDNR, NSDOE, Port Hawkesbury Paper, and Northern Pulp).

- Continue to map populations of endangered, threatened, and special concern species of ACPF on the 36 high priority lakes identified in the ACPF recovery strategy and engage landowners in stewardship actions. Monitor ACPF populations at key sites to document lake-level population changes, and continue to sample water quality on a sub-set of the 36 high priority lakes. Continue to engage volunteers in the monitoring of ACPF species and the identification of threats along lakeshores in southwest Nova Scotia (in partnership with NSNT, PC).
- Continue to engage local citizens through outreach and social media to create habitat for the Monarch Butterfly by joining the Butterfly Club and planting butterfly gardens at their homes, businesses, community centers, and schools (in partnership with PC).
- 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 (in partnership with NSDNR, Saint Mary's University, and CCWHC).
- Conduct door-to-door outreach and education for lakefront property owners with occurrences of ACPF and their habitat to communicate the significance of shoreline communities and potential threats associated with cottage development.
- Collaborate with the Province of Nova Scotia and other stakeholders regarding changes to the Code of Forest Practice for Crown Land.
- Continue to assist small woodland owners in Southwest Nova Scotia to certify their woodlands under one collective Forest Stewardship Council (FSC) group certification and provide training and education opportunities as a tool for woodlot owner engagement and support for sustainable woodland management. Continue current research to explore awareness and attitudes of forest product consumers, and investigate marketing strategies to support locally produced certified forest products (in partnership with FNSWO).

<u>Atlantic Canada Conservation Data Centre (ACCDC)</u>

- 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.
- Conduct biological surveys in areas of high biodiversity significance throughout the bioregion to further understanding of rare species' status and distribution. Particular priorities include:
    - Botanical surveys of potential ACPF habitat between Tusket watershed and Queen's County.
    - Botanical surveys of open bedrock barrens near Shelburne-Yarmouth county line to refine parcel prioritization and to document plant communities.
    - Insect biodiversity surveys in southwestern Nova Scotia, focusing on the discovery of disjunct species associated with the Atlantic Coastal Plain, including targeted efforts to find species dependent on rare ACPF such as Sweet Pepperbush and Eastern Baccharis.

<u>Saint Mary's University</u>

- Synthesize existing data to produce a comprehensive classification of Acadian heathland ecosystem diversity.

Fernhill Institute for Plant Conservation

- Continue to monitor the Eastern Mountain Avens on Brier Island and Digby Neck as needed and continue studies of reproduction and growth with partners. Assist with baseline studies of conditions in Big Meadow Bog and other critical habitat sites and monitor gull populations and vegetation threats in Big Meadow Bog. Work with partners to engage the community through public meetings, the Gulf of Maine Institute youth group, and the community stewardship committee (in partnership with MTRI, NCC, EC, NSDNR, Acadian University, NSMNH).

Medway Community Forest Cooperative

- Demonstrate strong environmental stewardship and woodland management through the development of the Medway Community Forest Cooperative, a locally governed, long-term, ecologically-based stewardship plan that allows multiple uses of a working community forest, while nurturing new and innovative forest-based businesses that support the local economy.

SOMMAIRE

La présente stratégie de conservation des habitats a été élaborée en collaboration avec des partenaires et des collaborateurs du comité directeur chargé du Plan conjoint des habitats de l'est de la Nouvelle-Écosse; elle constitue une première de plusieurs stratégies de conservation des habitats accompagnées de frontières contiguës qui tiendront compte de toutes les régions de la province. Ces stratégies visent à mieux coordonner et orienter les mesures prises par les organismes de conservation régionaux; elles visent également à repérer les possibles initiatives de conservation conjointes et à cerner les lacunes relatives aux mesures prises sur le terrain. L'objectif de la présente stratégie de conservation des habitats consiste à déterminer et à évaluer l'état actuel des espèces et des communautés écologiques dont la conservation est prioritaire à l'échelle de la biorégion du sud-ouest de la Nouvelle-Écosse (ci-après, la « biorégion »), à présenter une série d'approches cartographiques qui permettront de repérer l'emplacement des espèces au sein de la biorégion, ainsi qu'à déterminer les mesures de conservation et d'intendance prévues au sein de la biorégion pour améliorer les partenariats, réduire les redondances et faciliter la prise de décisions. Chaque organisme est orienté par sa propre mission, sa propre vision et ses propres principes directeurs; à ce titre, les renseignements fournis dans ce document se veulent un outil transparent d'aide à la décision qui permettra d'établir les priorités organisationnelles et de mener des analyses normatives de manière plus détaillée.

Le document comprend des descriptions, en termes généraux, de la portée, de la justification et de la pertinence écologique de la biorégion, une description des systèmes écologiques dominants qui se trouvent dans la biorégion et des processus écologiques qui forment ces systèmes, de même qu'une description de la pertinence de ces systèmes à titre d'habitats importants pour des espèces désignées dont la conservation est importante; en outre, le document porte une attention particulière aux espèces en péril, aux espèces d'oiseaux prioritaires et aux espèces rares. Les menaces pesant sur la conservation des espèces prioritaires et de leurs habitats sont indiquées et évaluées, et les mesures de conservation et d'intendance que comptent prendre les organismes pour atténuer les menaces et contribuer à la conservation d'espèces prioritaires et de leurs habitats au cours de la période de planification s'étendant sur les cinq prochaines années sont également présentées. L'approche visant l'élaboration de cette stratégie de conservation des habitats devait être détaillée, sans être complète, puisqu'il a été déterminé que des renseignements approfondis et plus détaillés étaient plus appropriés dans leur forme de publication initiale.

Une approche partagée

Les SCH et leurs frontières biorégionales sont fondées sur des unités écologiques significatives et les limites d'importants bassins hydrographiques. Les biorégions des SCH sont établies en tenant compte du contexte, des priorités, des menaces et des mesures de conservation propres aux régions. Elles sont aussi établies de manière à faciliter la mise en œuvre des mesures de conservation, allant de la protection à l'intendance de l'habitat.

Dans la première partie, chacune des SCH présente les descriptions, en termes généraux, de l'étendue spatiale et de la signification écologique de la biorégion. Les espèces prioritaires se trouvant à l'intérieur de la biorégion sont traitées, en mettant l'accent sur les espèces en péril et autres taxons rares, notamment les espèces aviaires prioritaires de la Région de conservation des oiseaux 14 (ainsi que les espèces d'oiseaux qui se servent des Unités biogéographiques marines adjacentes, le cas échéant). Aussi, les aires protégées et aires de conservation, en plus de considérations sociales et économiques liées aux efforts de conservation sont aussi traitées. L'approche adoptée dans l'élaboration du texte se

veut rigoureuse, mais non exhaustive, et met l'accent sur des références pertinentes vers des travaux plus détaillés et des études approfondies.

La deuxième partie présente le rôle significatif d'importants habitats pour les espèces identifiées et dont la conservation est jugée importante. La deuxième partie présente également les menaces à la conservation des habitats et des espèces prioritaires. Celles-ci sont identifiées, évaluées et, lorsque possible, cartographiées à l'échelle biorégionale. Un éventail de perspectives cartographiques pouvant servir à identifier des aires prioritaires pour la biorégion est présenté, incluant cartes composites d'habitats et d'espèces dérivées des meilleures données disponibles. Ultimement, la carte des habitats prioritaires (composite de tous les habitats) et la carte des espèces prioritaires (composite de toutes les espèces) sont combinées pour produire une carte de l'Index de la valeur de conservation (IVC) de la biorégion. Pour différentes raisons, incluant le biais évoqué, la carte de l'IVC, les cartes d'habitats prioritaires et les différentes cartes composites multi-espèces peuvent présenter des perspectives contrastantes quant aux priorités spatiales. C'est une situation à laquelle on peut s'attendre, et cela témoigne de la réalité que des approches contrastantes en matière de conservation peuvent être requises pour la protection de différentes espèces et des habitats qui les accueillent (c.-à-d. l'acquisition de terres par opposition à l'intendance). Il n'existe aucune carte unique pouvant fournir tout le soutien à la prise de décision qui soit entièrement harmonisée avec toutes les priorités de tous les partenaires en conservation. Ainsi, on incite fortement les utilisateurs de cette SCH et de toutes les autres SCH à considérer sérieusement l'usage de la série complète de cartes et de l'information présentées pour obtenir le soutien à la prise de décision qui répond le mieux à leurs besoins.

Dans la troisième partie, chaque SCH présente les mesures de conservation et d'intendance que les organisations prévoient entreprendre pour atténuer les menaces cernées et pour contribuer à la conservation des habitats (et des espèces qu'ils accueillent) au cours d'une période de planification de cinq ans. En plus de présenter des pistes de collaboration pour la mise en œuvre des mesures, cette matrice illustre les lacunes qui peuvent être interprétées comme des possibilités pour l'élaboration de nouvelles mesures de conservation complémentaires. Il faut remarquer que les groupes voués à la conservation sollicitant du financement gouvernemental afin de réaliser leurs mesures de conservation à l'intérieur d'une biorégion (p. ex. le Fonds autochtone pour les espèces en péril, le Programme d'intendance de l'habitat pour les espèces en péril, le Plan de conservation national – Le Fonds national de conservation des milieux humides, le Fonds en fiducie pour l'environnement du Nouveau-Brunswick et le Fonds de fiducie de la faune du Nouveau-Brunswick) sont fortement encouragés à se référer spécifiquement à l'information pertinente incluse dans la SCH appropriée.

Contexte écologique

Situées dans le sud-ouest de la péninsule de la Nouvelle-Écosse, les 1 618 299 ha qui composent la biorégion du sud-ouest de la Nouvelle-Écosse représentent l'une des régions les plus biologiquement diversifiées de la province; la biorégion comprend un assemblage exceptionnel d'importantes caractéristiques relatives à la biodiversité (carte 1 – Contexte en matière de conservation). Étant donné son histoire géologique et climatique unique et sa position dans le sud de la province, la biorégion renferme un certain nombre de populations périphériques et isolées de flore et de faune tempérées, y compris certaines des espèces terrestres les plus rares de la Nouvelle-Écosse. Par conséquent, la région comprend une forte concentration d'espèces en péril inscrites à l'échelle provinciale et à l'échelle fédérale, y compris 37 espèces inscrites à l'annexe 1 de la Loi sur les espèces en péril, 15 autres espèces évaluées comme étant à risque par le Comité sur la situation des espèces en péril au Canada (COSEPAC) et 46 espèces inscrites dans le Endangered Species Act de la Nouvelle-Écosse, dont six n'ont pas été évaluées comme étant à risque par le COSEPAC.

Le littoral de la biorégion fait 2 813 km; il est irrégulier et présente une multitude de baies et de ruisseaux, de marais salés et saumâtres, de plages et de dunes complexes, de larges bas fonds intertidaux et d'îles côtières abondantes et éloignées. Ces riches écosystèmes côtiers constituent des habitats importants de la région en ce qui concerne la biodiversité dans la mesure où ils abritent des espèces rares ainsi que des sites d'importance mondiale pour la reproduction, les haltes migratoires et l'hivernage d'oiseaux de rivage, d'oiseaux de marais et de sauvagine. La biorégion comprend neuf principaux bassins versants délimités à l'échelle provinciale qui englobent un vaste réseau de lacs, de rivières et de ruisseaux d'eau douce, y compris certaines des plus longues rivières et certains des plus grands lacs d'eau douce de la province ainsi qu'une forte concentration d'occurrences essentielles d'écosystèmes de terres humides d'eau douce et d'écosystèmes riverains. Bon nombre de ces sites renferment des espèces rares et menacées de flore de la plaine côtière de l'Atlantique.

La biorégion comprend certaines des plus grandes forêts acadiennes intactes restantes de la Nouvelle-Écosse; en plus de servir d'habitats, ces forêts assurent la conservation d'une vaste gamme d'espèces rares et menacées et d'espèces communément associées aux forêts, notamment des invertébrés terricoles, des champignons peu connus, des oiseaux forestiers, de grands herbivores et divers prédateurs. De nombreuses études ont désigné les forêts du sud-ouest de la Nouvelle-Écosse comme étant importantes à la protection des écosystèmes fondamentaux et à la connectivité au sein de la province et de la grande écorégion des Appalaches nordiques et de l'Acadie. Il existe un réseau de terres protégées qui est géré principalement pour en assurer la biodiversité; ce réseau comprend la plus grande aire protégée de la Nouvelle-Écosse, la zone de nature protégée Tobeatic et le lieu historique national et parc national du Canada Kejimkujik, soit l'un des trois parcs nationaux et réserves de parcs nationaux de la province (carte 1). Ensemble, ces terres protégées à l'échelle fédérale et provinciale constituent l'aire principale de la réserve de la biosphère du sud-ouest de la Nouvelle-Écosse désignée par l'Organisation des Nations Unies pour l'éducation, la science et la culture (UNESCO).

Objectifs

Voici les objectifs de conservation qui ont été relevés pour orienter l'élaboration de la stratégie de conservation des habitats du sud-ouest de la Nouvelle-Écosse:

1) Déterminer les aires de conservation clés qui sont essentielles aux espèces et aux habitats dont la conservation est jugée prioritaire.
2) Établir, soutenir et améliorer les partenariats en matière de conservation pour faciliter la prise de décisions et insister sur les efforts de conservation collectifs.
3) Maintenir des écosystèmes sains, intacts et entièrement fonctionnels en s'appuyant sur des travaux de conservation existants effectués par le partenariat, et contribuer aux efforts pour acquérir des terres aux fins de conservation.
4) Protéger et appuyer la gestion de corridors situés entre des aires protégées existantes et d'autres terres protégées moyennant l'acquisition de terres, la création de partenariats et la sensibilisation communautaire.
5) Soutenir le rétablissement de populations d'espèces en péril grâce à l'adoption collective de mesures de conservation dans le cadre du partenariat.
6) Soutenir l'avancement des recherches collaboratives menées sur des écosystèmes et des espèces pour éclairer la prise de décisions et la planification.
7) Appuyer l'avancement du soutien communautaire, comprendre les valeurs de la biodiversité et contribuer aux initiatives de gouvernance locale.

Conservation – Habitats prioritaires

Selon les affinités en matière d'habitat des espèces rares, des espèces en péril et des espèces d'oiseaux jugées prioritaires sur le plan de la conservation, les neuf types d'habitat ci-après ont été déterminés comme des priorités en matière de conservation à l'échelle de la biorégion du sud-ouest de la Nouvelle-Écosse.

1) Plages et dunes
2) Marais à marée
3) Bas fonds intertidaux
4) Îles côtières
5) Terres humides d'eau douce
6) Mosaïque de forêts acadiennes
7) Systèmes riverains et de plaines d'inondation
8) Terres herbeuses et agroécosystèmes
9) Terrains dénudés

Une carte a été produite montrant l'emplacement de parcelles d'habitat à haute priorité, en tenant compte de leur unicité, représentativité, et de la taille des parcelles en question (sommaire – Figure 2). Ce composite d'habitats n'incorpore aucune information dérivée d'observations d'espèces rares ou menacées, ni d'espèces d'oiseaux prioritaires. Par contre, différentes perspectives de priorisation fondées sur les observations d'espèces sont présentées en forme de composites dans les figures 25 à 36 (p. 107 à 118). Celles-ci présentent 11 regroupements d'espèces prioritaires dérivées des meilleures données disponibles pour chaque espèce. Le lecteur doit considérer que les données d'occurrence pour la majorité des espèces sont incomplètes, et que leur disponibilité varie selon la date et l'intensité de l'inventaire, ce qui mène à certains biais qui apparaissent dans certaines cartes. Alors, les composites d'espèces et toute carte dérivée à partir de données d'espèces sont vulnérables à ces biais.

L'intégration de données sur les habitats prioritaires (composite d'habitats prioritaires) et de données sur les espèces prioritaires (composite d'espèces prioritaires) mène à la carte montrant l'indice de valeur de conservation pour la biorégion (sommaire – Figure 3). Cette carte a été produite afin d'identifier les aires dans la biorégion ayant la plus grande valeur de conservation, considérant les données sur l'habitat et sur les espèces, selon les données disponibles. Étant donné qu'aucune carte unique ne peut offrir la « meilleure » réponse, le lecteur est encouragé de comparer la carte d'indice de valeur de conservation avec la carte composite des habitats et de considérer les nuances, avant toute prise de décision. L'annexe D présente les listes d'espèces ayant servi à produire chaque carte en plus des sources de données pour chaque espèce.

Menaces

Les menaces suivantes ont été désignées comme modérées à élevées pour les habitats susmentionnés :

1.1.1 Aménagements résidentiels et de chalets (menace modérée)
2.1.1 Pratiques agricoles incompatibles (menace modérée)
2.4.1 Aquaculture marine, de mollusques et de crustacés (menace modérée)
5.3.1 Pratiques de récolte incompatibles (menace modérée)
6.1.1 Utilisation de plages à des fins récréatives (menace modérée)
4.1.1 Fragmentation des routes (menace modérée)
8.1.1 Crabe européen envahissant (menace modérée)
8.2.1 Espèces indigènes problématiques (menace modérée)

9.3.1 Effluents agricoles et de la foresterie (menace modérée)
9.5.1 Pollution atmosphérique et précipitations acides (menace modérée)
11.1.1 Élévation du niveau de la mer et érosion côtière (menace modérée) Southwest Nova Scotia Bioregion Habitat Conservation Strategy xiv
11.4.1 Érosion côtière attribuable aux tempêtes (menace modérée)

En général, la biorégion est confrontée à des menaces modérées.

Mesures de conservation

Le sommaire suivant présente les mesures de conservation entreprises par les organisations œuvrant dans la biorégion pour adresser les menaces et alors contribuer à la conservation d'habitats prioritaires et les espèces qui s'y trouvent, sur une période de 5 ans. Quoique celles-ci ne doivent pas être considérées comme étant complètes, des mesures sont présentées pour chaque organisation partenaire. Une liste plus détaillée de mesures de conservation établie selon les catégories de l'UICN, incluant les liens entre les menaces et les différents habitats prioritaires, est présentée dans le tableau 17, p. 128.

<u>Gouvernement du Canada – Environnement et Changement climatique Canada (ECCC)</u>

- Mettre en œuvre et mettre en application la *Loi sur la convention concernant les oiseaux migrateurs*, la *Loi sur les espèces sauvages du Canada*, la *Loi sur les espèces en péril*, la *Loi canadienne sur la protection de l'environnement*; et promouvoir la Politique fédérale sur la conservation des milieux humides.
- Identifier les lieux importants pour les oiseaux marins. Contribuer à l'élaboration d'un réseau d'aires marines protégées pour la biorégion du plateau néoécossais, incluant des sites hauturiers et côtiers identifiés en tant que zones importantes écologiques et biologiques (ZIEB) (en partenariat avec le MPO et PC).
- Offrir un soutien aux organisations environnementales non-gouvernementales (OENG), aux organisations autochtones et aux milieux universitaires par l'entremise de programmes d'emploi d'Environnement Canada, notamment le programme de stages pour les jeunes Horizons-Sciences et le Service écojeunesse international.
- Offrir un soutien aux organisations environnementales non-gouvernementales (OENG), aux organisations autochtones et aux institutions académiques par l'entremise du Programme d'action communautaire pour l'environnement, notamment le travail sur l'habitat et sur la conservation et intendance des systèmes écologiques grâce à un soutien direct et en nature (p. ex. le Programme de financement communautaire ÉcoAction, le Fonds pour dommages à l'environnement, le Plan de conservation national - le Fonds national de conservation des milieux humides, le Plan de conservation national – Initiative du Golfe du Maine, les Initiatives de l'écosystème de l'Atlantique, le Programme des dons écologiques du Canada, le Programme d'intendance de l'habitat – Volet prévention, le Fonds autochtone pour les espèces en péril – Volet prévention).
- Offrir un soutien aux organisations environnementales non-gouvernementales (OENG) et aux organisations autochtones pour le travail spécifique sur les espèces en péril dans le cadre du Programme d'intendance sur les habitats et le Fonds autochtone pour les espèces en péril.
- Soutenir les activités décrites dans les documents de rétablissement des espèces en péril en vue de l'achèvement de la série d'études sur la détermination des habitats critiques. Engager et consulter tous les partenaires dans l'élaboration de documents sur le rétablissement des espèces en péril (en partenariat avec NSDNR, institutions académiques, NSNT, CNC, MTRI).

- Coordonner le Plan conjoint des habitats de l'Est (PCHE) et fournir une orientation scientifique aux partenaires sur les mesures de conservation et sur les priorités concernant les oiseaux migrateurs, les espèces en péril et leurs habitats, notamment par l'élaboration, le peaufinement et la mise en application de cette SCH et de la Stratégie de la Nouvelle-Écosse pour la conservation des oiseaux dans la Région 14.
- Poursuivre les activités de gestion associées à la Réserve nationale de la faune de Sand Pond et aux Refuges d'oiseaux migrateurs de Port l'Hébert, Port Joli, rivière du Sable et du lac Haley.
- Coordonner et mener des enquêtes sur les oiseaux migrateurs (p. ex. inventaires de haltes migratoires de limicoles, inventaires des sites de nidification du pluvier siffleur, inventaires des parcelles de surveillance de l'Inventaire de la sauvagine de l'est, Relevé hivernal triennal du canard noir, Relevé hivernal triennal d'eiders, inventaires de colonies d'oiseaux, parcours actifs du Relevé des oiseaux nicheurs).
- Continuer de renforcer le partenariat avec le Centre de données sur la conservation du Canada atlantique via l'échange de données de monitorage et d'inventaire provenant des aires de conservation.

<u>Gouvernement de la Nouvelle-Écosse</u>

- Établir 68000 ha de nouvelles aires protégées via l'initiative 14% en aires protégées (14% Protected Areas Initiative).
- Évaluer la qualité de l'air et les changements climatiques en se servant de lichens se trouvant à l'intérieur d'aires d'échantillonnage permanentes.
- Effectuer une analyse de l'écart du système d'aires protégées de la province.
- Effectuer de l'évaluation du risque écologique afin de mieux définir les menaces aux espèces à l'intérieur d'aires protégées existantes et proposées. Créer une couche de données montrant les habitats et écosystèmes sensibles afin d'informer la planification et l'élaboration de plans d'actions pour les gestionnaires d'aires protégées.
- Continuer l'évaluation du potentiel de peuplements de vielles forêts sur terres privées et publiques suivant une version adaptée de la grille d'évaluation des vielles forêts du Nova Scotia Department of Natural Resources afin d'informer les efforts de conservation, d'acquisition de propriétés, et aussi afin d'assurer le maintien de communautés écologiques des vielles forêts et leur connectivité selon la politique sur les vielles forêts de la Nouvelle-Écosse.
- Effectuer les activités entourant l'application de la loi sur la faune (application de la loi sur la faune et autres lois environnementales par ECCC); adresser le braconnage, autres perturbations de la faune, activités illégales et la destruction de l'habitat (en partenariat avec ECCC).

<u>Plan conjoint de l'habitat de l'Est (PCHE)</u>

- Informer et mettre en œuvre le Plan nord-américain de gestion de la sauvagine (North American Waterfowl Management Plan (NAWMP)) et entreprendre des inventaires de sauvagine tels que stipulés dans le plan (en partenariat avec ECCC).
- S'engager dans des partenariats avec des producteurs agricoles et praticiens en agriculture afin d'améliorer la conservation et la restauration de l'habitat sur le paysage agricole, surtout par la promotion et la mise en œuvre de plans de conservation de la biodiversité en milieu agricole (Agricultural Biodiversity Conservation (ABC) Plans) et l'identification de pratiques exemplaires de gestion (Beneficial Management Practices (BMPs)) qui contribuent au maintien et à l'amélioration de la biodiversité en milieu agricole.

Conservation de la nature Canada (CNC)

- Sécuriser 2500 ha de parcelles d'habitat évaluées au niveau prioritaire 1 et de parcelles d'habitat forestier évaluées au niveau prioritaire 2 afin de les protéger contre la coupe.
- Sécuriser 500 ha de parcelles d'habitat évaluées au niveau prioritaire 1 et 2 pour les espèces en péril afin de les protéger contre le développement.
- Sécuriser 500 ha de parcelles d'habitat côtier évaluées au niveau prioritaire 1 et 2 afin de les protéger contre le développement.
- Travailler en collaboration avec organisations partenaires et voisins afin de gérer les aires de conservation d Conservation de la nature Canada dans la biorégion, incluant le développement de plans de gestion et d'inventaires de base, et d'y entreprendre des mesures de gestion prioritaires. Assurer le monitorage de menaces importantes, et lorsque possible entreprendre des mesures directes pour adresser les menaces ayant un effet néfaste sur les habitats prioritaires.
- Continuer à améliorer nos connaissances sur l'emplacement de cibles de biodiversité (habitats et espèces) pouvant informer la priorisation de parcelles d'habitat.
- Développer un outil précis servant à identifier les détenteurs de parcelles où se trouve l'habitat essentiel pour la flore de la plaine côtière de l'Atlantique au Canada.
- Entreprendre l'analyse de connectivité pour la faune afin d'identifier les corridors pouvant lier aires protégées et habitats naturels intacts.
- Cartographier la zone riveraine active (plaine inondable sur 100 ans) afin de mieux définir les plaines inondables pour les rivières primaires de la biorégion.
- Établir un mécanisme pouvant faciliter la collaboration et la prise de décision concernant le contrôle d'espèces envahissantes (p. ex., Invasive Species Alliance; en partenariat avec MTRI).
- Participer à la révision et à la mise à jour de la Nova Scotia Mineral Resources Act et développer des mécanismes pouvant réduire les conflits entre détenteurs d'aires de conservation et les droits miniers (en partenariat avec NSNT).

Nova Scotia Nature Trust (NSNT)

- Sécuriser des aires d'habitat côtier et des aires d'habitat prioritaires pour la tortue mouchetée, couleuvre mince, flore de la plaine côtière Atlantique du Canada, et pour le pluvier siffleur, selon les opportunités.
- Établir des plans d'inventaire et de gestion pour toutes les parcelles protégées par NSNT dans la biorégion. Gérer ces aires de conservation pour le bénéfice de la biodiversité via le monitorage régulier et l'intendance active.
- Adresser les menaces aux habitats via l'éducation des parties prenantes, des détenteurs et utilisateurs de terrain.
- Participer à la révision et à la mise à jour de la Nova Scotia Mineral Resources Act et développer des mécanismes pouvant réduire les conflits entre détenteurs d'aires de conservation et les droits miniers (en partenariat avec CNC).

Gouvernement du Canada – Parcs Canada (PC)

- Continuer l'évaluation de la santé des écosystèmes forestiers, d'eau douce, et côtiers du parc via le monitorage et l'analyse d'environ 30 mesures (p. ex. oiseaux forestiers, salamandres, qualité de l'eau, myes, zostère marine, omble de fontaine), tout en rendant disponibles ces résultats dans le rapport sur l'état actuel du parc.
- Augmenter le profil des espèces envahissantes et de leurs impacts sur les écosystèmes auprès du public en Nouvelle-Écosse via le « Backyard Biodiversity project »(en partenariat avec MTRI).

- Continuer les recherches sur la dynamique des populations de crabe vert afin d'évaluer leur impact sur les écosystèmes côtiers et de vérifier si les méthodes de suppression physiques (p. ex. piégeage) peuvent permettre le contrôle efficace de l'espèce dans le parc Kejimkujik et dans les estuaires voisins. Assurer le suivi des tendances au niveau de la répartition et de la condition des zostèraies du parc et évaluer l'efficacité des mesures de gestion utilisées servant à contrer la perte de zostère marine (p. ex. suppression du crabe vert, transplantation de zostère). Continuer à travailler avec les partenaires locaux, départements et paliers gouvernementaux afin d'identifier des avenues pour les prises de crabe vert (p. ex. appât pour le homard, engrais, compost).
- Continuer le suivi et l'éradication du nerprun bourdaine dans le parc Kejimkujik et éduquer et sensibiliser le grand public sur les impacts écologiques négatifs liés à cette plante, son identification, et comment appliquer les meilleures mesures de contrôle permettant à limiter sa dispersion. Hausser le profil des espèces envahissantes en Nouvelle-Écosse et de leur impact sur les écosystèmes via le Backyard Biodiversity Project (en partenariat avec MTRI).
- Continuer le monitorage de tendances au niveau de l'étendue et de la condition des zostéraies à l'intérieur du Parc Kejimkujik et évaluer l'efficacité des mesures de gestion servant à réduire les pertes de zostère (p. ex. réduction du crabe vert, culture de zostère).
- Continuer les inventaires d'hydrocotyle à ombrelle sur le lac Kejimkujik et sur le lac George.
- Continuer à fournir des opportunités afin que les bénévoles s'engagent aux programmes de conservation des espèces en péril de la biorégion et dans la Réserve de la biosphère Southwest Nova à travers le programme de bénévolat Kejimkujik Southwest Nova (en partenariat avec Friends of Keji, MTRI, ÉOC, Acadia University).

<u>Étude d'oiseaux Canada (ÉOC)</u>

- Continuer à travailler en collaboration au niveau de la coordination des bénévoles et partenaires contribuant au suivi du Pluvier siffleur, à la protection de son habitat et à l'intendance sur les plages du sud-ouest de la Nouvelle-Écosse, incluant des activités conjointes de monitorage, de conscientisation, et de de reconnaissance des bénévoles (en partenariat avec PC, ECCC).
- Collaborer avec certains partenaires internationaux (É.-U. et caraïbes) afin d'améliorer le partage d'information au sujet de la conservation du Pluvier siffleur.
- Continuer le monitorage systématique des populations de martinet ramoneur aux sites de repos connus via une initiative de science citoyenne de monitorage et de conservation. Ce programme rassemble les bénévoles et les groupes communautaires agissant comme intendants pour l'espèce et son habitat, tout en améliorant les connaissances sur la reproduction et la conscientisation générale liée à cette espèce en péril des Maritimes. Continuer à solliciter les mentions d'observation et de sites de reproduction de l'espèce provenant du grand publique (en partenariat avec MTRI, ECCC).

<u>Mersey Tobeatic Research Institute (MTRI)</u>

- Continuer l'évaluation du potentiel de peuplements de vielles forêts sur terres privées et publiques suivant une version adaptée de la grille d'évaluation des vielles forêts du Nova Scotia Department of Natural Resources afin d'informer les efforts de conservation, d'acquisition de propriétés, et aussi afin d'assurer le maintien de communautés écologiques des vielles forêts et leur connectivité selon la politique sur les vielles forêts de la Nouvelle-Écosse (en partenariat avec NSDNR and CNC).
- Entreprendre des inventaires botaniques de cyanolichens afin d'améliorer la priorisation de parcelles de terrain (en partenariat avec CNC).

- Effectuer un inventaire complet, avec carte des habitat et inventaire de photos aériennes pour les identifiés dans le programme de rétablissement pour la flore de la plaine côtière de l'Atlantique au Canada.
- Continuer le programme de bénévolat Kejimkujik and Mersey LoonWatch afin d'assurer le suivi de la population et du succès reproducteur du Plongeon huard sur les lacs de la réserve de la biosphère Southwest Nova en se concentrant sur les bassins versants des rivières Mersey et Medway. Continuer en partenariat les travaux de recherche sur la reproduction et le survi du plongeon huard, et l'effet du mercure (Hg) sur l'écosystème du parc Kejimkujik (en partenariat avec PC, ECCC, Biodiversity Institute, Acadia University).
- Continuer le monitorage systématique des populations de martinet ramoneur aux sites de repos connus via une initiative de science citoyenne de monitorage et de conservation. Ce programme rassemble les bénévoles et les groupes communautaires agissant comme intendants pour l'espèce et son habitat, tout en améliorant les connaissances sur la reproduction et la conscientisation générale liée à cette espèce en péril des Maritimes. Continuer à solliciter les mentions d'observation et de sites de reproduction de l'espèce provenant du grand publique (en partenariat avec ÉOC, ECCC).
- Continuer les initiatives de bénévolat de longue date servant à protéger les nids de tortue mouchetée des prédateurs, des inondations et d'autres risques. Travailler avec les propriétaires de terrains privés afin d'encourager la protection de l'espèce sur ces terrains. Développer un plan de monitorage à long-terme et continuer le monitorage des trois populations connues de cette espèce dans le sud-ouest de la Nouvelle-Écosse, et récolter des données sur la survie des jeunes et des adultes, la taille des couvées, l'usage de l'habitat et la fidélité au site. Entreprendre des recherches visant l'identification de nouvelles populations en sollicitant de l'information sur les observations par les particuliers. Fournir de l'information sur les sites prioritaires aux organismes de conservation de l'habitat (en partenariat avec PC, ECCC, Acadia University, Friends of Keji, Équipe de rétablissement de la tortue mouchetée).
- Continuer le travail servant à identifier la répartition géographique de la couleuvre mince en Nouvelle-Écosse. Déterminer l'abondance de l'espèce et identifier les aires de concentration à l'intérieur de l'aire de répartition en effectuant des inventaires systématiques et en sollicitant l'information sur les observations par les particuliers. Continuer le monitorage du seul et unique site d'hivernage connu pour l'espèce, et documenter son usage, l'abondance des couleuvres minces s'y trouvant, leur fidélité au site, et effectuer des inventaires dans les zones entourant les aires de concentration du printemps et de l'automne afin d'identifier de nouveaux sites d'hivernage (en partenariat avec PC, Dalhousie University, Équipe de rétablissement de la couleuvre mince).
- Continuer la recherche visant à améliorer la puissance des modèles de SIG afin d'augmenter la possibilité de découvrir de nouveaux sites pour l'érioderme boréal. Chercher à améliorer les connaissances sur ses besoins en habitat et les facteurs contribuant à sa survi. Assurer le suivi et la protection des sites en travaillant avec les compagnies forestières. Faire la vérification de sites potentiels destinés à la coupe avant que la coupe ait lieu. Maintenir une banque de données sur les sites et les habitats (en partenariat avec NSDNR, NSDOE, Port Hawkesbury Paper, Northern Pulp).
- Continuer l'identification d'aires de répartition d'espèces en voie de disparition, menacées et préoccupantes sur les 36 lacs à priorité élevée identifiés dans la stratégie de rétablissement pour la flore de la plaine côtière de l'Atlantique au Canada. Solliciter l'engagement de propriétaires de terrains aux activités d'intendance. Continuer l'échantillonnage et l'évaluation de la qualité de l'eau sur les 36 lacs à priorité élevée et solliciter l'engagement de bénévoles sur

tous les aspects du projet. Dans le parc national et lieu historique national Kejimkujik, continuer les inventaires sur les lacs Kejimkujik et George. Continuer à solliciter la participation de bénévoles au suivi de la flore de la plaine côtière de l'Atlantique au Canada et à l'identification de menaces sur les rives des lacs du sud-ouest de la Nouvelle-Écosse (en partenariat avec NSNT, PC).

- Continuer l'engagement de citoyens locaux via les activités de rayonnement et les médias sociaux afin de créer de l'habitat pour le monarque, incluant la culture de plantes favorables à l'espèce à domicile, sur le site d'entreprises, de centres communautaires et écoles (en partenariat avec PC).
- Continuer à travailler avec le Nova Scotia Department of Natural Resources afin d'assurer la mise-à-jour et le maintien du site Web Nova Scotia Bat Conservation (www. Batconservation.ca) et solliciter l'engagement du grand public en matière de conservation pour les chauves-souris. Sensibiliser le publique sur le syndrome du nez blanc (SNB) et son effet sur les chauves-souris de la Nouvelle-Écosse, et assurer l'usage approprié de maisons de chauves-souris via le projet Backyard Biodiversity (en partenariat avec NSDNR, Saint Mary's University, CCWHC).
- Effectuer des activités éducatives et de promotion de relations communautaires avec les propriétaires de terrains adjacents aux lacs où se trouve la flore de la plaine côtière de l'Atlantique au Canada. Faire valoir l'importance de la flore riveraine et des menaces associées au développement.
- Collaborer avec la province de la Nouvelle-Écosse et d'autres intervenants en ce qui concerne les modifications au code des pratiques forestières sur les terres de la couronne (Code of Forest Practice for Crown Land).
- Continuer à appuyer les propriétaires de petits lots boisés du sud-ouest de la Nouvelle-Écosse, en partenariat, afin d'obtenir une certification de groupe du Forest Stewardship Council (FSC) pour ces propriétaires de lots boisés. Fournir de la formation et des programmes éducatifs afin d'encourager la participation des propriétaires de petits lots boisés et appuyer la gestion durable de ces lots boisés. Continuer les recherches servant à identifier les valeurs et le niveau de sensibilisation des consommateurs de produits forestiers, et étudier les stratégies de mise en marché pouvant encourager l'usage de produits forestiers certifiés (en partenariat avec FNSWO).

<u>Centre de données sur la conservation du Canada atlantique (CDCCA)</u>

- Améliorer la gestion des données et de l'information sur la biodiversité se trouvant dans la biorégion atlantique par le maintien de la banque de données la plus complète traitant la répartition de la biodiversité en Atlantique.
- Effectuer des inventaires écologiques dans les zones importantes pour la biodiversité dans toute al biorégion afin de mieux comprendre l'état et la répartition des espèces rares, en particulier, pour les priorités suivantes :
    - Inventaires botaniques d'habitat pour la flore de la plaine côtière de l'Atlantique au Canada entre le bassin versant Tusket et le comté de Queens.
    - Inventaires botaniques de landes rocheuses près de la frontière des comptés de Shelburne et de Yarmouth afin de mieux prioriser les parcelles et de mieux documenter la flore en général.
    - Inventaires d'insectes dans le sud-ouest de la Nouvelle-Écosse, misant sur la découverte de populations isolées associées à la flore de la plaine côtière de l'Atlantique au Canada, incluant des efforts ciblés sur la découverte d'espèces d'insectes dépendantes sur la flore de la plaine côtière de l'Atlantique au Canada rares, incluant le clèthre à feuilles d'aulne (Sweet Pepperbush) et le baccharis à feuilles d'arroche (Eastern Baccharis).

Saint Mary's University

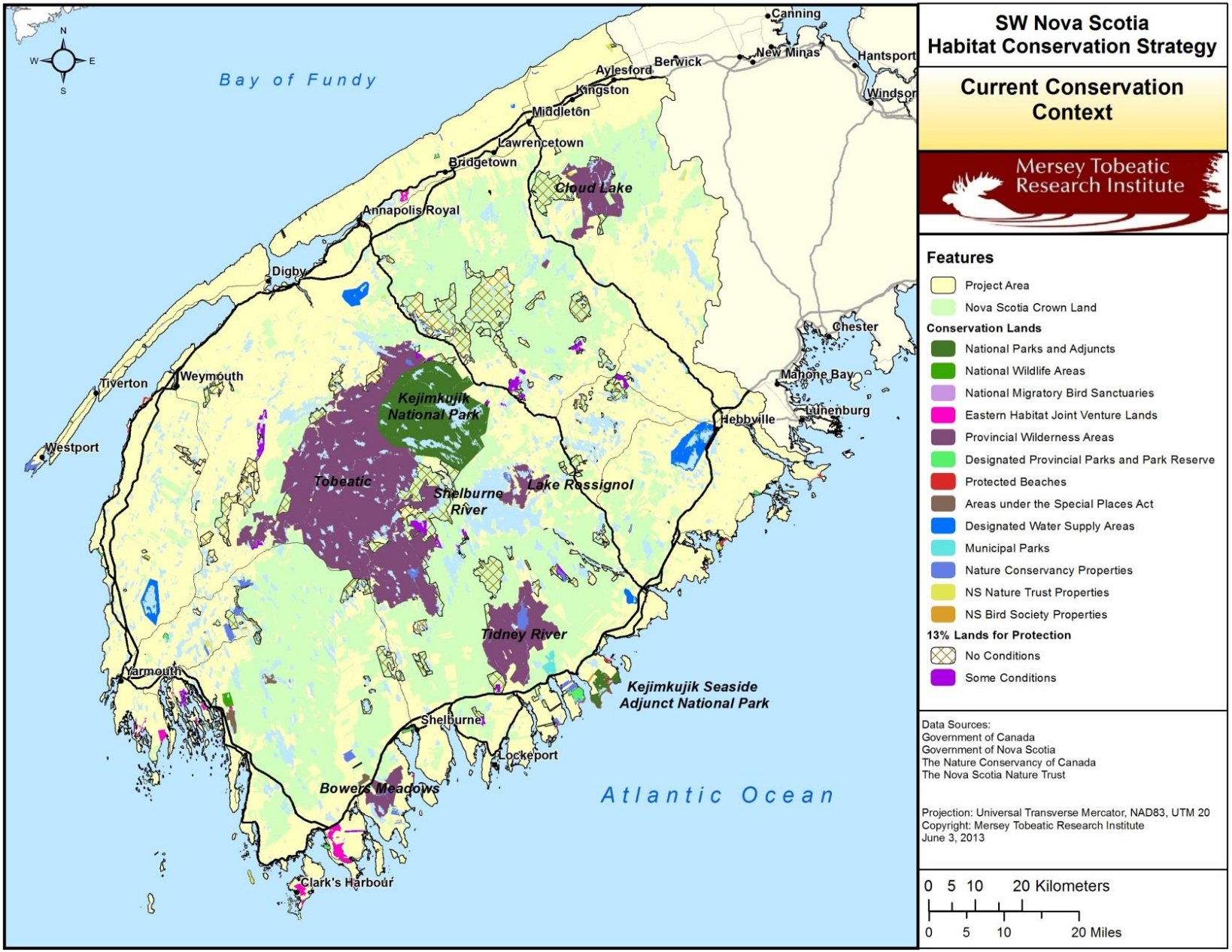
- Faire la synthèse des données existantes afin de produire une classification plus complète de la diversité des écosystèmes des landes Acadiennes

Fernhill Institute for Plant Conservation

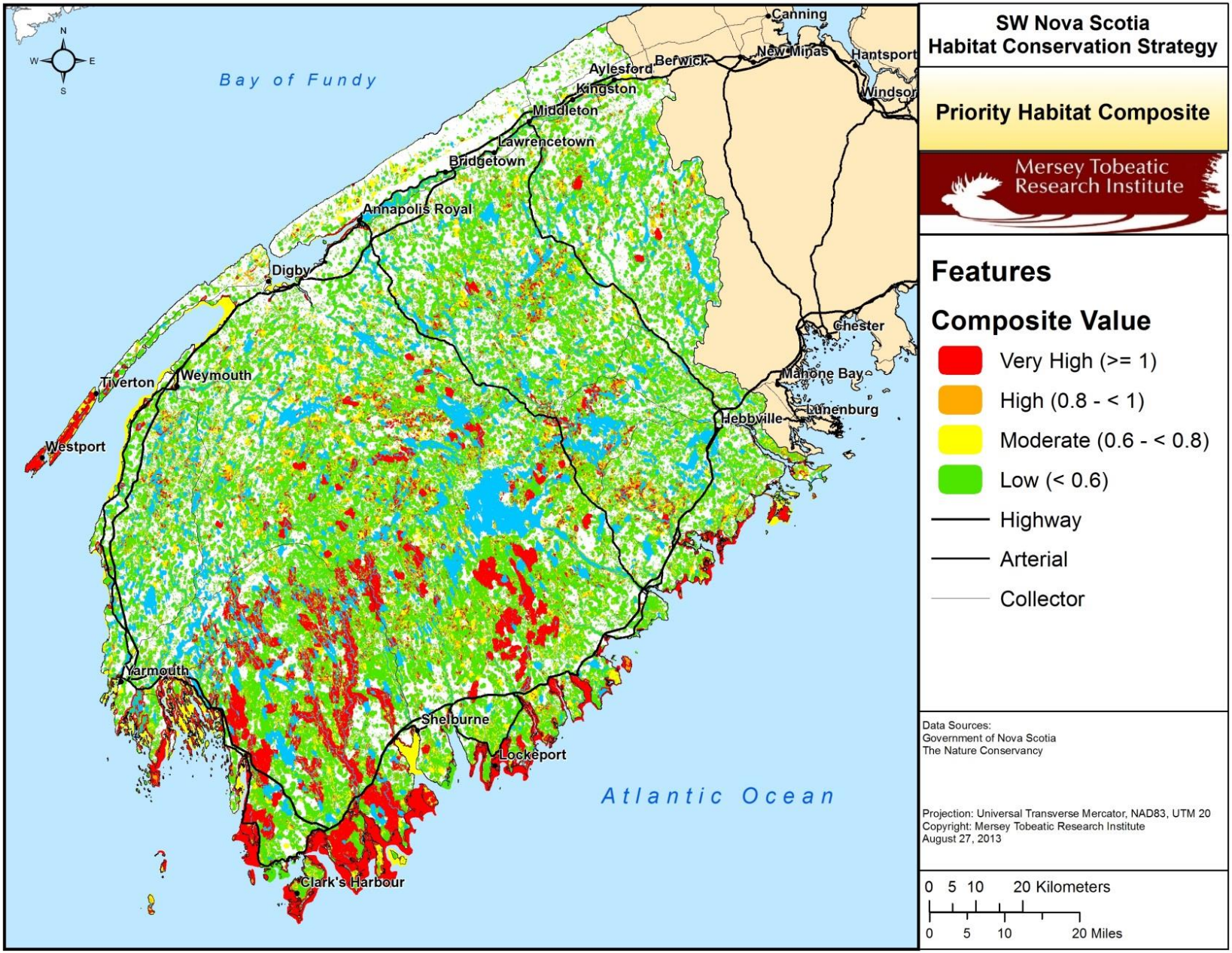
- Continuer, au besoin, le monitorage de la benoîte de Peck sur l'Île Brier et sur le Digby Neck et continuer les recherches sur la reproduction et la croissance de l'espèce avec des partenaires. Assister aux recherches de base sur les conditions dans la tourbière Big Meadow et dans les autres habitats essentiels de l'espèce. Effectuer le suivi des populations de goélands et des menaces provenant de la végétation dans la tourbière Big Meadow. Travailler avec des partenaires afin de solliciter l'engagement de la communauté via des rencontres publiques, le Gulf of Maine Institute Youth Group et le comité d'intendance de la communauté (en partenariat avec MTRI, CNC, ECCC, NSDNR, Acadia University, NSMNH).

Medway Community Forest Cooperative

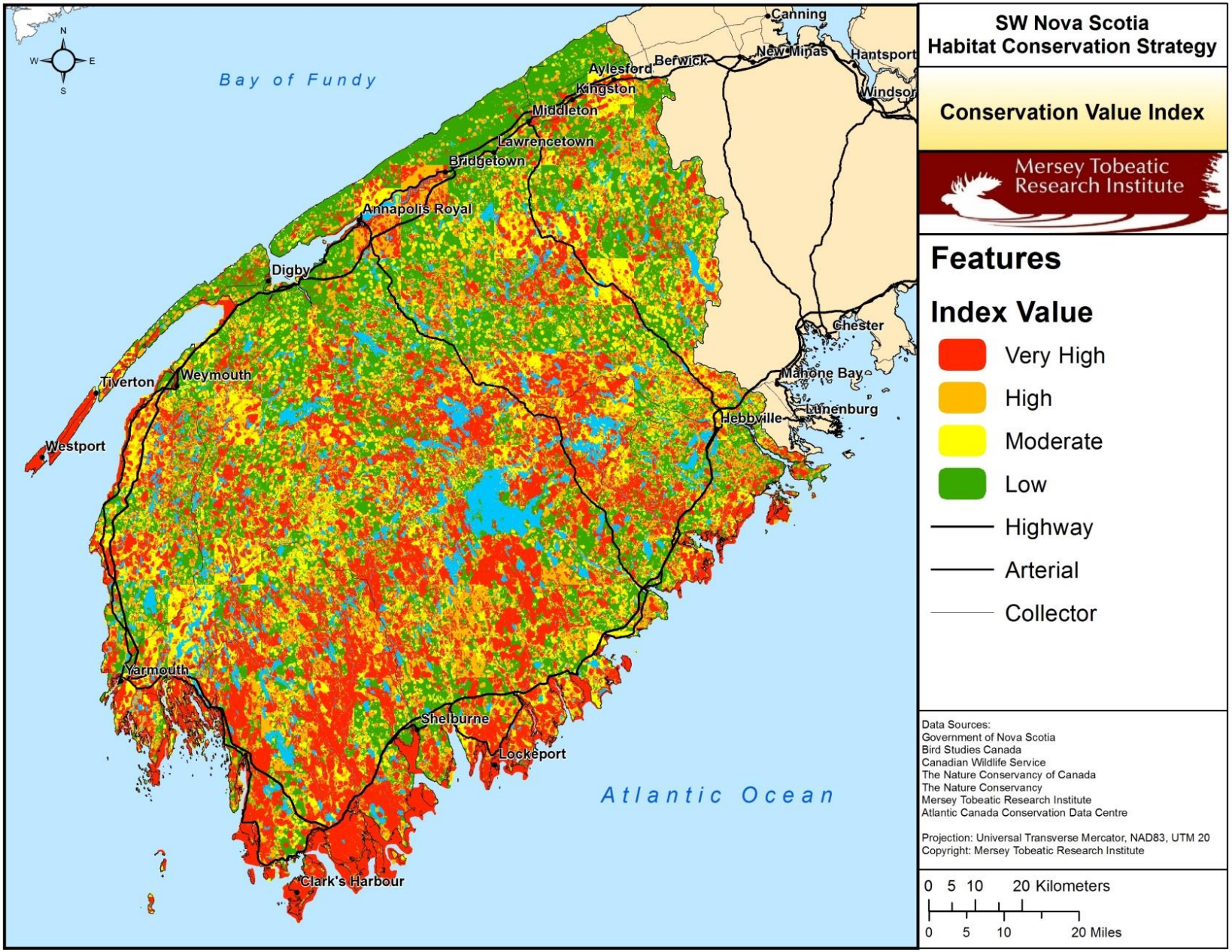
- Démontrer une intendance environnementale forte vis-à-vis la gestion des forêts, via le développement de modèles de gestion locaux durables, fondés sur les écosystèmes, permettant diverses avenues pour les produits provenant des forêts communautaires, tout en encourageant de nouvelles entreprises forestières qui appuient l'économie locale.



Summary—Figure 1. Protected areas, conservation lands, and overall land tenure in the Southwest Nova Scotia bioregion. Permanently protected land includes federal, provincial, and land trust holdings.



Summary—Figure 2. Priority habitat composite for the Southwest Nova Scotia bioregion.



Summary—Figure 3. Conservation Value Index (CVI) for the Southwest Nova Scotia bioregion.

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A. Bioregion Scope

i. Location and Size

The Southwest Nova Scotia (SWNS) bioregion is a diverse and extensive complex of rugged coastline, protected bays and estuaries, coastal islands, a network of freshwater lakes, rivers, streams and wetlands, fertile valleys, extensive coastal and inland barrens, and vast stretches of Acadian Forest (Figure 1). Bioregions are geographic areas defined by natural boundaries (i.e., physical and environmental features), including watershed boundaries and soil and terrain characteristics. The SWNS bioregion was defined (see Boundary Justification) for the purpose of this habitat conservation strategy and is not otherwise a recognized ecological or management area. The total area of the SWNS bioregion is 1,618,299 ha, which represents approximately 29.3% of the Nova Scotia land base. The coastline of the bioregion is 2,813 km long and is irregular and indented with numerous bays and inlets, and abundantly scattered with coastal islands, particularly on the south-facing shoreline with the Atlantic Ocean and Gulf of Maine.

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 very similar boundaries within Canada. The SWNS bioregion includes all or portions of four provincial 'ecoregions', including 11 nested 'ecodistricts', as delineated within the Nova Scotia Department of Natural Resources' Ecological Land Classification (Neily *et al.* 2003), and 16 'Natural Landscapes', as defined by the Nova Scotia Department of Environment and Labour (2002; Table 1). All of the terrestrial portions of Maritime Canada fall within the Atlantic Northern Forest (Bird Conservation Planning Region 14) and the North Atlantic Landscape Conservation Cooperative (LCC), while the offshore areas of Nova Scotia belong to the Scotian Shelf and Gulf Marine Bioregions (DFO 2009a). The SWNS bioregion is made up of 606,340 ha of Crown-owned land (37.5%), a further 41,982 ha of federally-owned lands managed by Parks Canada Agency and Environment Canada (2.6%), and the remaining 59.9% made up of a small proportion of municipal and Aboriginal lands, with the majority privately owned.

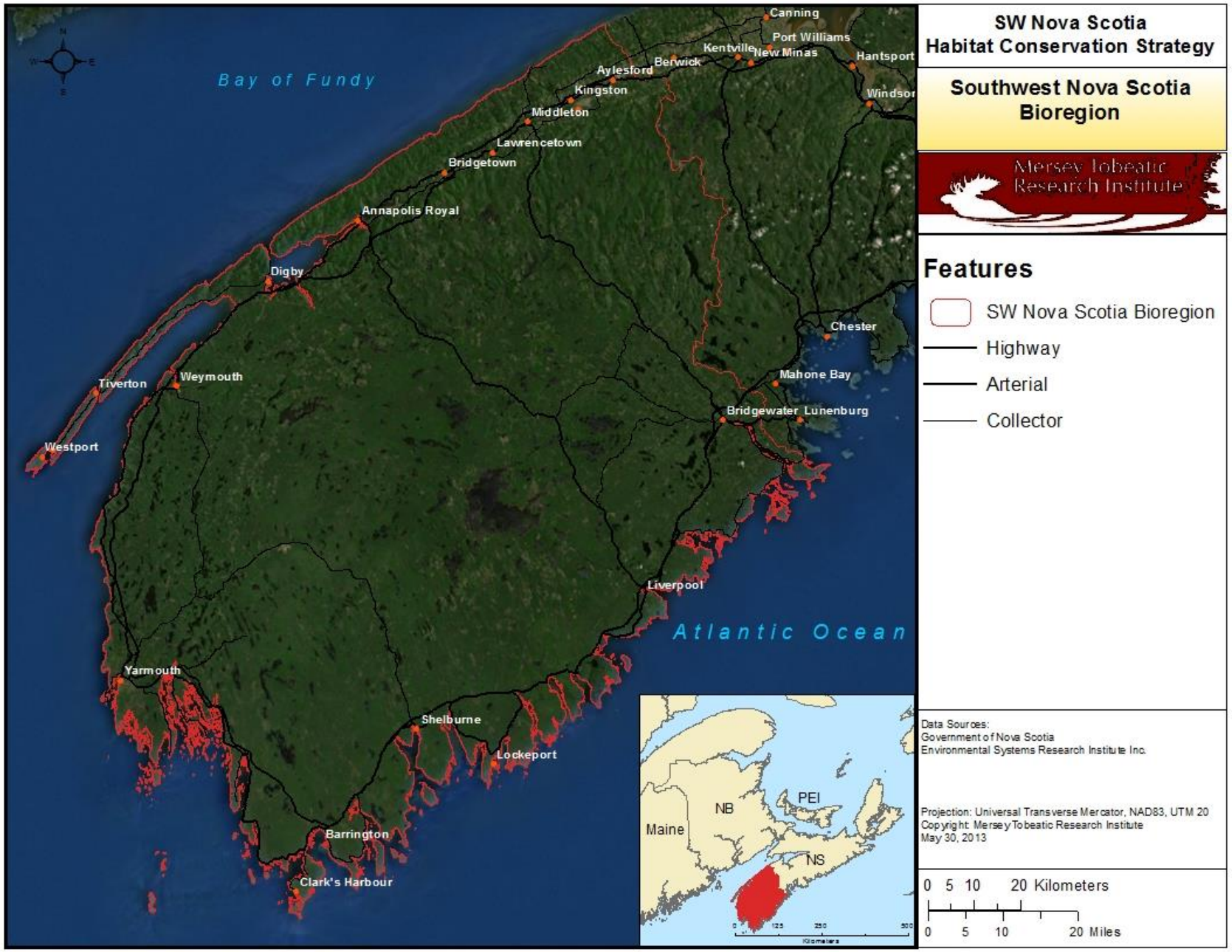

Figure 1. Boundaries of the Southwest Nova Scotia bioregion.

Table 1. Ecological land classification for the Southwest Nova Scotia bioregion.

NAAP Subregion[1]	NS DNR Ecoregion[2]	Ecodistrict[2]	NS Natural Landscape[3] *
Gulf of Maine, Bay of Fundy, Minas Basin	Fundy Shore	North Mountain	North Mountain Ridge
	Valley and Central Lowlands	Annapolis Valley	Annapolis Valley
NS Hills and Drumlins	Western	Valley Slope	South Mountain Foothills
		South Mountain	South Mountain Rolling Plain
			Fisher Lake Drumlins
		Clare	St. Mary's Bay Cliffs and Beaches
			Sissiboo Low Hills
			Tusket River Drumlins
		LaHave Drumlins	LaHave Drumlins
		Rossignol	Lake Rossignol Hills
		Sable	Roseway River Glacial Plain
			Sable River Basin
		Western Barrens	Shelburne River Plain
Atlantic Coast	Atlantic Coast	South Shore	Mahone Bay Islands
			Shelburne Headlands
		Tusket Islands	Tusket Islands

[1] *Northern Appalachians-Acadian Plan (NAAP; Anderson et al. 2006)*
[2] *Nova Scotia Department of Natural Resources Ecological Land Classification (Neily et al. 2003)*
[3] *Nova Scotia Department of Environment and Labour Natural Landscape (NSDEL 2002)*
** NS DNR Ecodistricts and NS Natural Landscapes are similar, but not 100% congruent. Both are used by provincial agencies, and therefore, presented here.*

ii. Boundary Justification

The principal element guiding delineation of the SWNS bioregion was the United Nations Educational, Scientific and Cultural Organization (UNESCO) designation of the Southwest Nova Biosphere Reserve (SNBR), which is bounded by the political boundaries of the five western counties of Nova Scotia (Figure 2). However, it was determined that boundary delineation of the bioregion should be more ecologically relevant. 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). They are also recognized as an important ecological unit for the management and recovery of a number of regional species at risk (i.e., Atlantic Coastal Plain Flora, reptiles; Hill & Keddy 1992; Hill *et al.* 2000; COSEWIC 2005). Watershed management is common practice in other jurisdictions, and an attractive landscape unit for local watershed and stewardship groups. Therefore, the boundary of the bioregion was designed to encompass the entire area of the SNBR, yet be congruent with nine provincially-defined primary watersheds (Nova Scotia Environment 2011). This includes all watersheds and estuaries west of the eastern boundaries of the LaHave River and the Annapolis River watersheds (Figure 2).

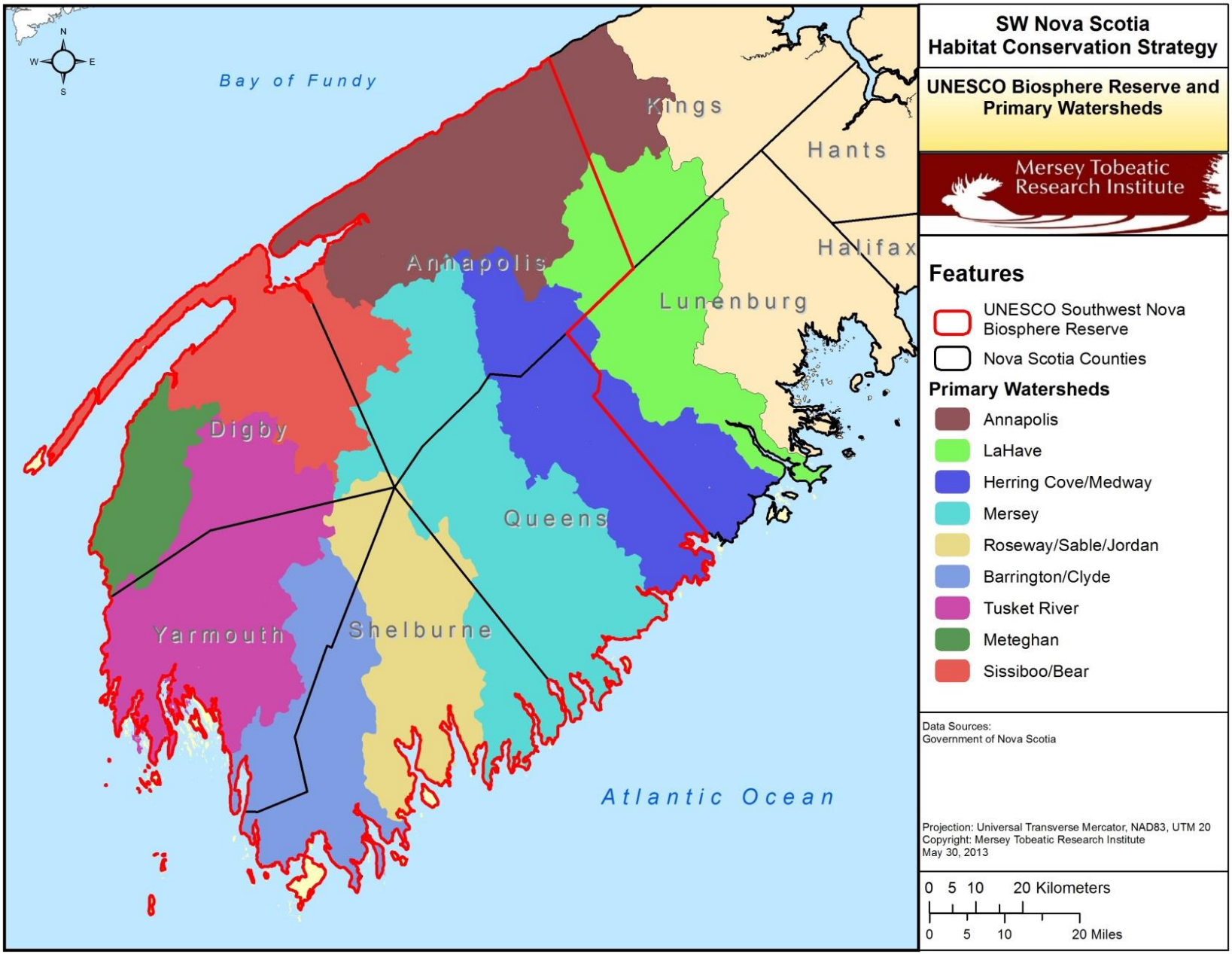

Figure 2. The UNESCO designated Southwest Nova Biosphere Reserve and the nine provincially-delineated primary watersheds encompassed by the Southwest Nova Scotia bioregion.

iii. Ecological Significance

The southwest region of Nova Scotia is one of the most biologically diverse areas of the province, containing an outstanding assemblage of significant biodiversity features, including extensive coastal ecosystems, a large network of freshwater lakes, rivers, and wetlands, fertile valleys, and vast stretches of Acadian forest. Nova Scotia's largest remaining intact forests are found in the SWNS bioregion; these large areas of contiguous forest with few permanent roads and mostly intact interior forest 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 (Anderson *et al.* 2006). Numerous studies (Anderson *et al.* 2006; Beazley *et al.* 2005; Reining *et al.* 2006; Trombulak *et al.* 2008) have identified the forests occurring in Southwest Nova Scotia as important for core ecosystem protection and connectivity within the province and greater ecoregion. While significant temporary landscape conversion has occurred, there are large tracts of forest with minimal permanent conversion to non-forest land-use, posing tremendous opportunity for ongoing conservation efforts. The bioregion also encompasses an extensive network of freshwater lakes, rivers, streams, and wetlands, including a high concentration of critical occurrences of freshwater wetland and riparian ecosystems (Anderson *et al.* 2006). Many of these sites support high biological diversity, including rare and endangered species of Atlantic Coastal Plain Flora.

The SWNS bioregion has a high concentration of critical coastal complexes (Anderson *et al.* 2006), including tidal marshes, beach and dune complexes, extensive tidal flats, and remote coastal islands. These coastal complexes represent important habitat in the region for biodiversity, including rare taxa. There are four federal Migratory Bird Sanctuaries in the bioregion, as well as eight Important Bird Areas, some of which are of global significance as breeding, staging, and over-wintering areas for a variety of shorebirds, marsh birds, and waterfowl (IBA Canada 2012). In a study to identify ecologically and biologically significant areas on the Scotian Shelf based on scientific expert opinion, Fisheries and Oceans Canada identified Lobster Bay and the Cape Sable area as two of the most ecologically and biologically significant areas along the Atlantic coast of Nova Scotia (Doherty & Horsman 2007). These coastal locations have also been highlighted in more data-driven exercises (Greenlaw *et al.* 2011; Greenlaw *et al.* 2013; Gromack *et al*. 2010).

Nova Scotia is a peninsular land mass connected to the remainder of the North American continent by a 24 km wide isthmus (Figure 1 inset). The unique southerly position of the SWNS bioregion in the province combined with the glacial history of the region have led to conditions that favour the occurrence of peripheral and disjunct populations of more temperate flora and fauna, which colonized Nova Scotia from the vast Atlantic Coastal Plain exposed during the Wisconsin Glaciation 16,000 to 12,000 years ago when sea levels were as much as 120 metres below their current levels and the shoreline was far seaward of its present location (McAlpine & Smith 2010; US CCSP 2009). Many of these Atlantic Coastal Plain species are found primarily along the mid-Atlantic seaboard of North America, with disjunct populations in southwest Nova Scotia. Consequently, the region contains a high concentration of federally and provincially listed species at risk. Isolated populations may be significant, particularly if they occur at the edge of the species' range, as they may have diverged genetically from populations in the main range and may display local adaptations (Lesica & Allendorf 1995).

B. Ecological Context

i. Climate and Geology

Nova Scotia has a modified continental climate, with proximity to the coast and elevation determining local climatic variation (Davis & Browne 1996). The SWNS bioregion is almost completely surrounded by the cold waters of the Atlantic Ocean (to the south), the Gulf of Maine (to the southwest), and the Bay of Fundy (to the north). Given its extensive geographic area, and since no part of the bioregion is greater than 60 km from the coast, significant temperature and precipitation variation occurs. Mean annual temperature ranges from 5 to 7°C for most of Nova Scotia, with January and February being the coldest months, and July and August the warmest (Davis & Browne 1996). The Fundy Shore is characterized by cooler summers and somewhat milder winters than the interior of the bioregion. The cold waters of the Bay of Fundy tend to prolong the arrival of spring and fog is frequent along the coast. Sheltered between the North and South Mountains, the lowlands of the Annapolis Valley record some of the hottest summer temperatures, mildest winters, and lowest precipitation within the province. These climatic features, as well as the fertile soils, make the Annapolis Valley one of Nova Scotia's most prominent agricultural areas.

The interior climate of the bioregion is characterized by milder weather conditions than the eastern portion of mainland Nova Scotia, including warm summers and mild winters (average -3.5°C; Davis & Browne 1996; Neily *et al.* 2003). Along the Atlantic Coast the climate is significantly influenced by the Atlantic Ocean, contributing to mild winters and the longest frost-free period in the Maritimes, but also to a slow spring warm-up and the lowest number of growing degree days in Nova Scotia (Neily *et al.* 2003). Annual precipitation in the SWNS bioregion ranges from 1100 - 1300 mm in the Annapolis Valley, to 1400-1500 mm along the Atlantic Coast (Neily *et al.* 2003). Precipitation is highest in the fall and winter months and usually lowest in June and July (Davis & Browne 1996).

The present landscape of the SWNS bioregion is diverse, reflecting its variable bedrock material and extensive glacial history, which includes repeated glaciation events until approximately 12 000 years before present (Davis & Browne 1996). A significant geological feature of the bioregion is the North Mountain, a continuous ridge of columnar basalt that stretches for approximately 200 km along the Fundy Shore from Brier Island to Cape Blomidon, rising to more than 225 m above sea level at its highest elevation. In stark contrast, the elevation of the adjacent Annapolis Valley lowland seldom exceeds 50 m above sea level. Triassic sandstones underlie the Annapolis Valley, which provide the parent material for the very coarse to moderately coarse sandy soils (Neily *et al.* 2003). The remainder of the bioregion is underlain by Meguma slate and quartzite, as well as the extensive South Mountain batholith, a massive intrusion of granite (Davis & Browne 1996; Keppie 2000). The interior surface of the SWNS bioregion comprises part of the Appalachian peneplain, which slopes gently to the southeast towards the Atlantic Ocean, with some of Nova Scotia's longest rivers flowing across its surface. Glacial deposits, primarily from the Wisconsin Glaciation, have contributed to a variety of landforms, including glacial till deposits, drumlins, eskers, kames, and outwash deposits (Davis & Browne 1996). Most of the region's lakes have been created by glacial scouring on the relatively flat surface of the southwest region.

ii. Conservation Priority Species

Conservation Priority species are objectively defined as:

- Any species with a federal assessment (COSEWIC) of Special Concern, Threatened or Endangered (including all species on Schedule 1 of the *Species at Risk Act*)
- Any species at risk with a provincial listing (*Nova Scotia Endangered Species Act*) 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 priority bird species that occurs with regularity in the bioregion

Due to its unique geological and climatic history, and its southerly position in peninsular Nova Scotia, the SWNS bioregion hosts a number of peripheral and disjunct populations of temperate flora and fauna (McAlpine and Smith 2010), including a number of Nova Scotia's rarest species. Consequently, the region contains a high concentration of federally assessed and provincially listed species at risk, including 39 species listed on Schedule 1 of the SARA, an additional 16 species assessed as at risk by COSEWIC, and 46 species listed in the NS ESA, six of which are not assessed or listed as species at risk nationally (Table 2). Appendix B provides a complete glossary of biodiversity and conservation ranks. Appendices C and D each provide the complete list of priority species found within the SWNS bioregion with their conservation status and source of occurrence data, and coarse filter habitat associations respectively. 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 Southwest Nova Scotia bioregion, listed alphabetically by common name within their respective taxonomic group.

Common Name	*Scientific Name*	COSEWIC	SARA[2]	NS ESA[3]
Invertebrates				
Brook Floater	*Alasmidonta varicosa*	Special Concern	Special Concern	Threatened
Macropis Cuckoo Bee	*Epeoloides pilosulus*	Endangered		Endangered
Monarch	*Danaus plexippus*	Special Concern	Special Concern	
Yellow Banded Bumble Bee	*Bombus terricola*	Special Concern		
Fishes				
American Eel	*Anguilla rostrata*	Threatened		
Atlantic Salmon	*Salmo salar*	Endangered	Endangered	
Atlantic Sturgeon	*Acipenser oxyrinchus*	Threatened		
Atlantic Whitefish	*Coregonus huntsmani*	Endangered	Endangered	Endangered
Striped Bass	*Morone saxatilis*	Endangered		
Birds				
Bank Swallow	*Riparia riparia*	Threatened		
Barn Swallow	*Hirundo rustica*	Threatened		Endangered
Barrow's Goldeneye (E.)	*Bucephala islandica*	Special Concern	Special Concern	
Bobolink	*Dolichonyx oryzivorus*	Threatened		Vulnerable
Buff-breasted Sandpiper	*Tryngites subruficollis*	Special Concern		
Canada Warbler	*Cardellina canadensis*	Threatened	Threatened	Endangered

Common Name	*Scientific Name*	COSEWIC	SARA[2]	NS ESA[3]
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Threatened
Eastern Meadowlark	*Sturnella magna*	Threatened		
Eastern Whip-poor-will	*Antrostomus vociferus*	Threatened	Threatened	Threatened
Eastern Wood-pewee	*Contopus virens*	Special Concern		Vulnerable
Harlequin Duck (East.)	*Histrionicus histrionicus*	Special Concern	Special Concern	Endangered
Horned Grebe (West.)	*Podiceps auritus*	Special Concern		
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	Threatened
Peregrine Falcon (anatum/tundrius ssp.)	*Falco peregrinus anatum/tundrius*	Special Concern	Special Concern	Vulnerable
Piping Plover (melodus ssp.)	*Charadrius melodus melodus*	Endangered	Endangered	Endangered
Red Knot (rufa ssp.)	*Calidris canutus rufa*	Endangered	Endangered	Endangered
Red Necked Phalarope	*Phalaropus lobatus*	Special Concern		
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern	Endangered
Savannah Sparrow (princeps ssp.)	*Passerculus sandwichensis princeps*	Special Concern	Special Concern	
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern	
Wood Thrush	*Hylocichla mustelina*	Threatened		
Reptiles				
Blanding's Turtle	*Emydoidea blandingii*	Endangered	Endangered	Endangered
Eastern Ribbonsnake	*Thamnophis sauritus*	Threatened	Threatened	Threatened
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable
Wood Turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened
Mammals				
American Marten	*Martes americana*			Endangered
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered
Moose (Mainland NS)	*Alces alces americana*			Endangered
Northern Myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered
Tri-colored Bat	*Perimyotis subflavus*	Endangered	Endangered	Endangered
Lichens				
Blue Felt Lichen	*Degelia plumbea*	Special Concern		Vulnerable
Boreal Felt Lichen	*Erioderma pedicellatum*	Endangered	Endangered	Endangered
Vole Ears Lichen	*Erioderma mollissimum*	Endangered	Endangered	Endangered
Vascular Plants				
Black Ash	*Fraxinus nigra*			Threatened
Eastern Mountain Avens	*Geum peckii*	Endangered	Endangered	Endangered
Eastern White Cedar	*Thuja occidentalis*			Vulnerable
Prototype Quillwort	*Isoetes prototypus*	Special Concern	Special Concern	Vulnerable
Rockrose	*Helianthemum canadense*			Endangered
Vascular Plants – Atlantic Coastal Plain Flora				
Eastern Baccharis	*Baccharis halimifolia*	Threatened		Threatened
Eastern Lilaeopsis	*Lilaeopsis chinensis*	Special Concern	Special Concern	Vulnerable
Goldencrest	*Lophiola aurea*	Special Concern	Threatened	Vulnerable

Common Name	*Scientific Name*	COSEWIC	SARA[2]	NS ESA[3]
Long's Bulrush	*Scirpus longii*	Special Concern	Special Concern	Vulnerable
Pink Coreopsis	*Coreopsis rosea*	Endangered	Endangered	Endangered
Plymouth Gentian	*Sabatia kennedyana*	Endangered	Threatened	Endangered
Redroot	*Lachnanthes caroliniana*	Special Concern	Special Concern	Vulnerable
Spotted Pondweed	*Potamogeton pulcher*			Vulnerable
Sweet Pepperbush	*Clethra alnifolia*	Special Concern	Special Concern	Vulnerable
Thread-leaved Sundew	*Drosera filiformis*	Endangered	Endangered	Endangered
Tubercled Spike-rush	*Eleocharis tuberculosa*	Special Concern	Special Concern	Vulnerable
Water-pennywort	*Hydrocotyle umbellata*	Threatened	Threatened	Endangered

Fishes

Freshwaters within the bioregion host fish species such as Brook Trout (*Salvelinus fontinalis*), White Perch (*Morone americana*), Yellow Perch (*Perca flavescens*), Brown Bullhead (*Ameiurus nebulosus*), White Sucker (*Catostomus commersonii*), American Eel (*Anguilla rostrata*), and Golden Shiner (*Notemigonus crysoleucas*) (NSDFA 2006). Rare and at-risk fish species that depend on the bioregion's freshwater aquatic habitats to complete their lifecycle include the anadromous[1] Striped Bass, Atlantic Salmon, Atlantic Sturgeon, and Atlantic Whitefish, and the catadromous[2] American Eel.

Atlantic Salmon in the bioregion are part of the Nova Scotia Southern Upland population, which extends from rivers in northeastern mainland Nova Scotia, along the Atlantic coast and into the Bay of Fundy as far as Cape Split, which has been designated as Endangered by COSEWIC since 2010. The population has suffered extensive declines over at least the past century, historically impacted by dams that have impeded spawning migrations and flooded spawning and rearing habitats, and other human influences, such as pollution and logging, that have reduced or degraded freshwater habitats (COSEWIC 2010a). Acidification of freshwater habitats brought about by acidic precipitation is another major, ongoing threat, as is poor marine survival related to substantial but incompletely understood changes in marine ecosystems (COSEWIC 2010a). 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 coldwater habitat, important as summer refugia for Atlantic Salmon and other salmonids (e.g., Brook Trout) are limited in the region because of the naturally shallow lakes. Climate change and land use patterns may be contributing to further degradation of cold water habitat (Brylinsky 2002).

The Atlantic Whitefish, a small salmonid species, is a Canadian endemic that only occurs in two watersheds in Southwest Nova Scotia. The Tusket River watershed population is thought to be extirpated. Atlantic Whitefish are known to occur in three connected lakes in the Petite Riviere watershed in Lunenburg County. Typically, an anadromous fish species, this population of Atlantic Whitefish is landlocked above a hydroelectric dam. Estimates suggest there are fewer than 1000 individuals left in the wild, with threats to their survival including hydroelectric dams, habitat acidification, competition with invasive fish species (Smallmouth Bass and Chain Pickerel), poor land use practices, and recreational fishing.

Threats to freshwater fish species include climate change, overfishing, habitat loss and degradation, dams and other migration barriers, contaminants (agricultural and/or industrial pollutants), aquaculture,

[1] *spawn in freshwater but migrate to the ocean to feed*
[2] *those that spawn in saltwater but migrate to freshwater to feed*

invasive species, and changes to ocean systems that may affect some anadromous species (e.g., Atlantic Salmon, Striped Bass).

Birds

In 2013, Environment Canada completed a strategy for the Nova Scotia portion of BCR 14, incorporating consideration of MBU 11 and 12. This strategy, one of a suite for each bird conservation region across Canada, is designed to serve as a framework for implementing conservation for the province's priority bird species (Environment Canada 2013). The strategy identifies 'priority species', which include those species that regularly occur in the region that are vulnerable due to population size, distribution, population trend, abundance, and threats. Some widely distributed and abundant 'stewardship' species are also included because they typify the national or regional avifauna and/or because they have a large proportion of their range and/or continental population in the region. Species of management concern are included as priority species 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 (Environment Canada 2013).

The BCR 14 Strategy (Environment Canada 2013) identified 99 priority species for Nova Scotia, primarily for conservation, but also management action; 97 of these occur in the SWNS bioregion with regularity. These species are grouped into four pillar groups based on their characteristics and the habitats they occupy (Table 3). Wetlands are used by the greatest number of species (45%), followed by forests (35%), and cultivated and managed areas (i.e., grasslands; 34%). Of the 97 priority bird species occurring in the bioregion, 20 have been assessed as at risk by COSEWIC (Table 2). The complete list of Nova Scotia BCR 14 and MBU 11/12 priority species is provided in Table 5.

Table 3. Summary of BCR 14 and MBU 11 priority bird species that occur with regularity in the Southwest Nova Scotia bioregion.

Bird Group	Total	BCR 14	MBU 11	Federally Assessed (COSEWIC)	Provincially Listed (NS ESA)
Landbirds	39 (42%)	39	-	13	10
Shorebirds	19 (20%)	8	14	2	2
Waterbirds	22 (24%)	6	18	2	1
Waterfowl	13 (14%)	7	10	2	1
Total	**93**	**61**	**42**	**19**	**14**

The SWNS bioregion's extensive forests host a diversity of forest-dependent landbirds. There are 22 priority bird species that are associated with coniferous forest in the region, half of which are found primarily in mature or old-growth stands, and six of which are found only in coniferous forest (Environment Canada 2013). There are 13 priority bird species associated with deciduous forest, and 22 priority species associated with mixedwood forest types, a number of which are found primarily in mature or old-growth stands. Despite the fact that Nova Scotia's largest remaining intact forests are found within the bioregion, past and current forestry practices have reduced the amount of mature and old growth, late-successional forest on the landscape, and increased the amount of relatively young, early-successional forest types. As a result, a number of forest-dependent landbirds have exhibited declines (NABCI 2012). Examples include the Canada Warbler, Olive-sided Flycatcher, Rusty Blackbird, Chimney Swift, and Eastern Whip-poor-will. The highest ranked threat identified for priority birds that use each of these forest types continues to be the alteration of forest composition and structure through timber harvest, but also a reduction in prey availability and contamination from pesticides and

herbicides, and habitat fragmentation as a result of road construction, wind energy developments, and other changes to land-use practices (Environment Canada 2013).

The rich coastal ecosystems of the SWNS bioregion offer excellent breeding, staging, and wintering habitat for several congregatory bird species, uncommon species, and species with restricted ranges. Within the coastal zone of the bioregion there are eight nationally designated Important Bird Areas (IBAs; Table 4), some of which are of global significance to birds. 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, and 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.

Table 4. Important Bird Areas located within the Southwest Nova Scotia bioregion (IBA Canada 2012).

IBA	Site	IBA Criteria	Size (ha)
NS003	The Brothers	Globally Significant: Congregatory Species, Nationally Significant: Threatened Species	451
NS004	South Shore - Port Joli	Continentally Significant: Congregatory Species; Nationally Significant: Threatened Species	43,561
NS015	Bon Portage Island	Globally Significant: Congregatory Species, Colonial Waterbirds/Seabird Concentrations	300
NS016	Eastern Cape Sable Island	Globally Significant: Congregatory Species, Shorebird Concentrations; Nationally Significant: Threatened Species, Congregatory Species	3,362
NS017	South Shore - Roseway to Baccaro	Nationally Significant: Threatened Species, Congregatory Species	15,655
NS018	South Shore - Barrington Bay	Nationally Significant: Threatened Species, Congregatory Species	4,206
NS021	Brier Island and Offshore Waters	Globally Significant: Congregatory Species, Colonial Waterbirds/Seabird Concentrations, Shorebird Concentrations; Continentally Significant: Congregatory Species	92,450
NS024	South Shore - East Queens County	Globally Significant: Congregatory Species, Nationally Significant: Threatened Species, Congregatory Species	4,901

Table 5. 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.

Common Name	*Scientific Name*	COSEWIC[1]	SARA[2]	NS ESA[3]	BCR 14	MBU 11	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

[1] *Committee on the Status of Endangered Wildlife in Canada; EN = Endangered, TH = Threatened, SC = Special Concern.*
[2] Species at Risk Act *(2003); EN = Endangered, TH = Threatened, SC = Special Concern.*
[3] Nova Scotia Endangered Species Act *(1999); EN = Endangered, TH = Threatened, VU = Vulnerable.*

Common Name	*Scientific Name*	COSEWIC[1]	SARA[2]	NS ESA[3]	BCR 14	MBU 11	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%
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	Assess/Maintain
Dunlin	*Calidris alpina*					y	Assess/Maintain
Hudsonian Godwit	*Limosa haemastica*					y	Assess/Maintain
Killdeer	*Charadrius vociferus*				y		Maintain current
Least Sandpiper	*Calidris minutilla*					y	Assess/Maintain
Lesser Yellowlegs	*Tringa flavipes*				y	y	Assess/Maintain
Piping Plover	*Charadrius melodus melodus*	EN	EN	EN	y	y	Recovery objective
Purple Sandpiper	*Calidris maritima*					y	Assess/Maintain

Common Name	*Scientific Name*	COSEWIC[1]	SARA[2]	NS ESA[3]	BCR 14	MBU 11	Population Objective
Red Knot	*Calidris canutus rufa*	EN	EN	EN		y	Assess/Maintain
Red Phalarope	*Phalaropus fulicarius*					y	Assess/Maintain
Red-necked Phalarope	*Phalaropus lobatus*	SC				y	Assess/Maintain
Sanderling	*Calidris alba*					y	Assess/Maintain
Semipalmated Sandpiper	*Calidris pusilla*					y	Assess/Maintain
Solitary Sandpiper	*Tringa solitaria*				y	y	Assess/Maintain
Spotted Sandpiper	*Actitis macularius*				y		Increase 100%
Whimbrel	*Numenius phaeopus*				y	y	Assess/Maintain
Willet	*Tringa semipalmata*					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	Assess/Maintain
Common Loon	*Gavia immer*				y	y	Maintain current (BCR 14); Assess/Maintain (MBU 11)
Common Murre	*Uria aalge*					y	Assess/Maintain
Common Tern	*Sterna hirundo*				y	y	Assess/Maintain
Cory's Shearwater	*Calonectris diomedea*					y	Assess/Maintain
Dovekie	*Alle alle*					y	Assess/Maintain
Great Cormorant	*Phalacrocorax carbo*					y	Assess/Maintain
Great Shearwater	*Puffinus gravis*					y	Assess/Maintain
Great Skua	*Stercorarius skua*					y	Assess/Maintain
Horned Grebe (Western)	*Podiceps auritus*	SC				y	Assess/Maintain
Ivory Gull*	*Pagophila eburnea*	EN	EN			y	Assess/Maintain
Leach's Storm-Petrel	*Oceanodroma leucorhoa*					y	Assess/Maintain
Manx Shearwater	*Puffinus puffinus*					y	Assess/Maintain
Pied-billed Grebe	*Podilymbus podiceps*				y		Maintain current
Razorbill	*Alca torda*					y	Assess/Maintain

Common Name	*Scientific Name*	COSEWIC[1]	SARA[2]	NS ESA[3]	BCR 14	MBU 11	Population Objective
Red-necked Grebe	*Podiceps grisegena*					y	Assess/Maintain
Red-throated Loon	*Gavia stellata*					y	Assess/Maintain
Roseate Tern	*Sterna dougallii*	EN	EN	EN		y	Recovery objective
Sooty Shearwater	*Puffinus griseus*					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	Maintain current
Barrow's Goldeneye (Eastern)	*Bucephala islandica*	SC	SC		y	y	Assess/Maintain
Black Scoter	*Melanitta americana*						Assess/Maintain
Canada Goose (North Atlantic)	*Branta canadensis*				y	y	Maintain current
Canada Goose (Temperate-breeding in Eastern Canada)	*Branta canadensis*				y	y	Decrease
Common Eider	*Somateria mollissima*					y	Maintain current
Common Goldeneye	*Bucephala clangula*					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	Assess/Maintain
Mallard	*Anas platyrhynchos*				y		Maintain current
Ring-necked Duck	*Aythya collaris*				y		Increase 50%
Surf Scoter	*Melanitta perspicillata*					y	Assess/Maintain
White-winged Scoter	*Melanitta fusca*					y	Assess/Maintain

* Does not occur with regularity in the Southwest Nova Scotia bioregion.

Reptiles

The Eastern Ribbonsnake is a small, slender, semi-aquatic snake typically found in wetlands with abundant aquatic and terrestrial vegetation (Parks Canada Agency 2012b). It is at the northern limit of its range in Nova Scotia and occurs as a small, disjunct, post-glacial relic population confined to the southwest interior of Nova Scotia in the three watersheds of the LaHave, Medway, and Mersey Rivers. Threats impacting the survival of this species are not well understood but likely include alteration, degradation, or loss of shoreline and wetland habitat, and small population effects (Parks Canada Agency 2012b).

Like the Eastern Ribbonsnake, the Blanding's Turtle occurs in Nova Scotia as a small disjunct population at the northeast periphery of the species' range, likely totaling fewer than 250 mature adults. The Nova Scotia population is genetically distinct and consists of three small, isolated subpopulations found within two watersheds in central southwest Nova Scotia (COSEWIC 2005). This medium-sized freshwater turtle inhabits shallow waters in lakes, permanent and ephemeral ponds, streams, and wetlands. They nest in a variety of loose substrates, including sand, organic soil, gravel, and cobblestone. Nest predation by mammals is the most significant cause of nest failure, which may exceed 50% in Kejimkujik National Park (COSEWIC 2005). Females, attracted to the gravel shoulders of roadways for nesting habitat, are at increased risk of mortality by vehicles. Human alteration of lakeshores used for nesting is also considered a significant contributing factor in the decline of Blanding's Turtle, as well as increasing habitat degradation, and mortality of adults.

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. Like the Blanding's Turtle, nest failure and adult mortality are intensified by females nesting in gravel shoulders along roadways and in quarries (COSEWIC 2008).

The Wood Turtle is a medium-sized turtle that is native to northeastern North America, though their range is discontinuous and populations are often small and isolated (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 Turtle include bogs, marshy pastures, meadows, upland forest, and hayfields (COSEWIC 2007). Threats to Wood Turtle across its range include increased mortality of adults on roadways and off-highway vehicle trails, loss of nesting and riparian habitat, and nest predation (COSEWIC 2007).

Mammals

Two large-ranging mammals, the Eastern Wolf (*Canis lupis*) and the Woodland Caribou (*Rangifer tarandus*) have long been extirpated from the bioregion. Wolves have been extirpated from the province since the mid 1800's, and it is thought that very few ever lived in Nova Scotia (NSDNR 2013b). Prior to European settlement, Woodland Caribou were common throughout Nova Scotia. They have been extirpated from mainland Nova Scotia since the early 1900's, with over-hunting, habitat loss, climate change, and competition and disease associated with an increase in the number of white-tailed deer (*Odocoileus virginianus*) cited as contributing factors to their decline (MTRI 2008; NSDNR 2013b). In much the same way, the mainland Nova Scotia population of the Eastern Moose, the most abundant large mammal in the province when European settlers arrived in the 1600's, has experienced significant declines. Despite hunting restrictions since the early 1900's their numbers have continued to decline, with an estimated 1000-1200 individuals in isolated sub-populations across mainland Nova Scotia,

including several small populations located within the SWNS bioregion, the largest of which is in the Tobeatic Wilderness Area (estimated at 150 individuals; NSDNR 2007). Consequently, the population was formally listed as Endangered under the *Nova Scotia Endangered Species Act* (NS ESA) in 2003. The factors affecting their decline are numerous, complex and not well understood, but may include historical over hunting, poaching, habitat loss, climate change, increased road access to moose habitat, acid precipitation, mineral deficiencies in their diet, and competition, disease and parasites associated with an increase in the number of white-tailed deer in the province (NSDNR 2007).

Canada Lynx (*Lynx canadensis*), which formerly occurred in areas with suitable habitat across Nova Scotia, has been extirpated from the bioregion and currently is 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).

Three species of primarily forest bats, the Little Brown Myotis, the Northern Myotis, and the Tri-colored Bat, were designated as Endangered by COSEWIC in an emergency assessment on February 3, 2012. The Province of Nova Scotia recently followed suit by listing the same three species as Endangered under the NS ESA in July 2013. The COSEWIC assessment and subsequent provincial listing were primarily 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 *Geomyces destructans*, a cold-loving fungus introduced from Europe that thrives in cave conditions and as such, impacts bat population directly during the winter hibernation period (Blehert 2012; Lorch *et al.* 2011). White Nose Syndrome is thought to disrupt patterns of torpor and possibly result in death by starvation or dehydration (Cryan *et al.* 2010; Reeder *et al.* 2012), and is responsible for the death of an estimated 5.7 and 6.7 million hibernating bats in the last 6 years in the northeastern United States and eastern Canada (COSEWIC 2012). The Little Brown Myotis, the most abundant species in the region currently affected by WNS, has experienced the most dramatic population declines, with an average decline of 73% within 2 years of infection at 115 infected sites and 91% at 54 sites with greater than 2 years of exposure to WNS in the northeastern United States (Frick *et al.* 2010). Mortality rates of infected sites in Ontario, Quebec, and New Brunswick are over 80% (COSEWIC 2012). First documented in Nova Scotia in April 2011, WNS decimated five known 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). Researchers believe that WNS could lead to local extinctions of the Little Brown Myotis, as well as other species (Frick *et al.* 2010); therefore, it is prudent to protect any surviving animals which may be genetically predisposed to surviving the infection, as well as the habitats that host them (e.g., known and potential hibernacula).

Flora

Under nearly constant canopy cover, the Acadian Forest supports a unique diversity of trees, flora, lichens, mosses, mammals, birds, amphibians, reptiles, and invertebrates, including a number of the region's threatened and endangered species. Two of Nova Scotia's rarest native tree species, Black Ash and Eastern White Cedar, are listed as Threatened and Vulnerable respectively under the NS ESA. Once relatively common throughout the region, these swamp and floodplain-associated species have experienced considerable declines in the province. Black Ash is currently known from only 35-40 sites in Nova Scotia; however mature individuals are rare with only 12 known to exist in the province (NSDNR 2013b). Eastern White Cedar is reported at 34 sites scattered across Yarmouth, Digby, Kings, Annapolis,

and Cumberland Counties (NSDNR 2013b). The extensive history of agriculture, land development, forestry, road construction, and other land-use practices in the region have influenced the status of these species in Nova Scotia over the past three centuries.

The Atlantic Coastal Plain Flora (ACPF) are a unique group of over 90 taxonomically unrelated herbaceous plants that are generally small and slow growing, and best represented in habitats such as lakeshores, bogs, fens, and tidal marshes (Environment Canada & Parks Canada Agency 2010). In general, ACPF are poor competitors and are adapted to surviving in nutrient poor environments that are subject to natural disturbances that maintain their habitat characteristics and reduce competition (Environment Canada & Parks Canada Agency 2010; Wisheu & Keddy 1989). Atlantic Coastal Plain Flora species are constrained by both biologically limiting factors and anthropogenic threats that are increasingly affecting their habitat. Of the more than 90 species of ACPF that occur in Nova Scotia, 12 species have been assessed as Endangered, Threatened, or Special Concern by COSEWIC, five of which are rare globally, and an additional species has been listed under the NS ESA; 12 of these are represented within the SWNS bioregion (Table 2). Under the provincial general status assessment process, 23 of the 90 species of ACPF in Nova Scotia are considered 'at risk', including the COSEWIC assessed and NS ESA listed species (Appendix C). Globally, the bioregion contains some of the most intact and best remaining habitat for these species.

The southwest region's forests and swamps are host to a diverse and abundant lichen flora. The cool, moist coastal forests of the Atlantic Coast provide suitable habitat for three of the province's rarest cyanolichens, Boreal Felt Lichen, Vole Ears Lichen, and Blue Felt Lichen. Boreal Felt Lichen and Vole Ears Lichen occur in coastal coniferous forest, whereas Blue Felt Lichen is most often associated with mature Red Maple trees in mixedwood stands adjacent to streams, rivers or lakes (e.g., Red Maple swales; COSEWIC 2010). Boreal Felt Lichen and Vole Ears Lichen have experienced significant declines of over 90% and 80% respectively over the past few decades (Environment Canada 2007; COSEWIC 2009). Blue Felt Lichen is currently known from 88 locations in Nova Scotia, representing a considerable portion of its North American distribution (COSEWIC 2010). Cyanolichens are particularly sensitive to atmospheric pollution and acid precipitation, stemming from their reliance on airborne nutrients and water, as well as the lack of a protective cuticle (Cameron *et al.* 2007). As such, these represent significant threats for each of these species. Atmospheric pollution in Nova Scotia is produced both locally and transported from the eastern United States and central Canada. Also considered a significant threat to their persistence in the province is forest harvesting practices that result in direct removal of host trees or disruption of the moist microclimate conditions these species depend on (e.g., partial harvests or harvesting in adjacent stands). In a study of lichen diversity and abundance in harvested and unharvested forest stands in Nova Scotia, Cameron (2002) found lichen communities were more diverse, and lichen abundance was greater in stands that were not subjected to harvesting.

Bryophytes, simplest of the terrestrial plants, are often conspicuous in moist, forested habitats in Nova Scotia (Davis & Browne 1996). They are abundant throughout the province, though at present there is only one priority non-vascular plant species with occurrence records in the bioregion, Wulf's Peat Moss (ACCDC 2013), which is associated with moist, coniferous forests and swamps.

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 SWNS bioregion is well represented by an existing network of protected areas and conservation lands that are managed primarily for biodiversity (Figure 3).

Located within the bioregion is one of Nova Scotia's three National Parks and National Park Reserves – Kejimkujik National Park and National Historic Site, which includes Kejimkujik Seaside, located on the Atlantic Coast. In addition to the National Park, managed by Parks Canada, federally protected lands within the bioregion include one National Wildlife Area, and four Migratory Bird Sanctuaries, established under the authority of the *Canadian Wildlife Act* and the *Migratory Birds Convention Act* respectively, and managed by Environment Canada (Table 6). These areas provide safe refuge within suitable habitat for migratory birds and other wildlife in the terrestrial and marine environment.

There are six Wilderness Areas, 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 2012a). The most prominent of these is the Tobeatic Wilderness Area, which is the largest protected area in Nova Scotia. The Tobeatic Wilderness Area is adjacent to Kejimkujik National Park and National Historic Site; together these federally and provincially protected lands make up the core area of the UNESCO designated Southwest Nova Biosphere Reserve, which encompasses the five western counties of Nova Scotia (Figure 2). Biosphere Reserves are internationally recognized as an area in the world that is deemed to demonstrate a *"balanced relationship between humans and the biosphere"*. Although the designation does not afford the land base any legal protection, collaborative efforts among people in the designated area promote the sustainability of local economies and communities, as well as the conservation of ecosystems.

Six Nature Reserves, also managed by Nova Scotia Environment, can be found in the bioregion. These areas, protected under the *Special Places Protection Act* (1981), are areas selected to preserve and protect, in perpetuity, representative and special natural ecosystems, plant and animal species, features and natural processes (Nova Scotia Environment 2012a). Scientific research and education are the primary uses of nature reserves and recreation is generally restricted.

Within the SWNS bioregion there are 20 provincial parks and five protected beaches – Rissers, Summerville, Sand Hills, Port Maitland, and Mavillette beaches – that are managed by the Nova Scotia Department of Natural Resources. While biodiversity conservation is not the primary objective of Nova Scotia provincial parks and protected beaches, these areas do offer legal protection and contribute to overall conservation within the bioregion.

The Nature Conservancy of Canada (NCC) is a non-profit charitable organization that works to directly conserve Canada's most important areas of natural diversity through property securement and long-term management and restoration. The NCC has secured approximately 8784 ha of coastal and inland wilderness in the SWNS bioregion.

The Nova Scotia Nature Trust (NSNT) is a conservation charity that works with private landowners to conserve ecologically significant habitat within Nova Scotia through securement and conservation easements. The NSNT's Endangered Species Program works to conserve critical habitat for species at

risk in the bioregion, including Blanding's Turtle, Eastern Ribbonsnake, Piping Plover, and endangered species of ACPF and currently protects approximately 1485 ha of coastal wilderness, critical freshwater habitats, old-growth forests, and habitat for species at risk in the bioregion. Partners in the Nova Scotia Eastern Habitat Joint Venture (NS EHJV) have secured and manage approximately 2824 ha of prime coastal and inland wetlands in the SWNS bioregion through the North American Waterfowl Management Plan (NAWMP 1986), providing important nesting, staging, and wintering habitat for resident and migratory birds, and other wetland-dependent species.

Further gains in the area of protected and conservation lands in the bioregion are anticipated as the Government of Nova Scotia passed the *Environmental Goals and Sustainable Prosperity Act* in 2007, committing the Province to protecting 12 percent of Nova Scotia's land base by 2015. Related to this commitment, the Colin Stewart Forest Forum, a protected areas planning process, was initiated by leading environmental non-government organizations (ENGOs) and the four largest forestry companies operating in Nova Scotia in 2005, and was formally endorsed by the Government of Nova Scotia in 2007. Following nearly 5 years of scientific analysis and cooperative planning, the Colin Stewart Forest Forum submitted a final report to the Province in 2009. The report identified Crown and privately-owned commercial forest lands with high conservation value and provided a roadmap towards completing a protected areas network in Nova Scotia (Colin Stewart Forest Forum Steering Committee 2009). Identified candidate '12% lands' within the bioregion included proposed additional and expanded wilderness areas, nature reserves, and provincial parks and reserves totaling 75,518 ha. In August 2013 the Government of Nova Scotia released *Our Parks and Protected Areas: A Plan for Nova Scotia.* The plan identifies approximately 206,000 ha of land to be added to the existing parks and protected areas system by 2015 (Government of Nova Scotia 2013). In total, these lands represent 13.04% of the provincial land base, exceeding the Government's commitment to protect 12% of the provincial land base by 2015, and will significantly expand the existing network of protected areas and conservation lands within the SWNS bioregion (81,602 ha; Table 7). The plan also identifies an additional 10,600 ha to be legally protected by 2020, which would bring the provincial total to approximately 13.9% (Government of Nova Scotia 2013).

Table 6. Existing conservation lands in the Southwest Nova Scotia bioregion.

Site Name (Agency)	Area (ha)	% of Bioregion
National Parks (Parks Canada)		
Kejimkujik National Park and National Historic Site	38,100	2.35
Kejimkujik Seaside Adjunct	2200	0.14
Total for National Parks	40,300	2.49
National Wildlife Areas (Environment Canada)		
Sand Pond	531	0.03
Migratory Bird Sanctuaries (Environment Canada)		
Sable River	397	0.02
Port Joli	346	0.02
Haley Lake	95	0.01
Port Hebert	313	0.02
Total for Migratory Bird Sanctuaries	1151	0.07
Wilderness Areas (Nova Scotia Environment)		
Tobeatic	103,780	6.41
Tidney River	17,800	1.10
Cloud Lake	10,830	0.67
Lake Rossignol	4,120	0.25
Bowers Meadow	4,120	0.25
McGill Lake	180	0.01
Total for Wilderness Areas	140,830	8.70
Nature Reserves (Nova Scotia Environment)		
Spinneys Heath	640	0.04
Great Barren & Quinan Lakes	355	0.02
Quinns Meadow	337	0.02
Ponhook Lake	43	<0.01
Sporting Lake	25	<0.01
Tusket River	22	<0.01
Total for Nature Reserves	1,421	0.09
Provincial Parks and Beaches (Nova Scotia Department of Natural Resources)		
Provincial Parks	1361	0.08
Protected Beaches	751	0.05
Total for Provincial Parks and Protected Beaches	2,112	0.13
Lands Held Primarily for Conservation by Municipalities and Private Trusts		
Nature Conservancy of Canada	8784	0.54
Nova Scotia Nature Trust	1485	0.09
Eastern Habitat Joint Venture	2824	0.17
Nova Scotia Bird Society Lands	83	0.01
Municipal Protected Lands	933	0.06
Total Existing Conservation Lands in the Bioregion	**199,923**	**12.35**

Table 7. Proposed (pending) conservation lands in the Southwest Nova Scotia bioregion, including new conservation lands and expansions to existing conservation lands.

Site Name (Agency)	Status	Area (ha)	% of Bioregon
Wilderness Areas (Nova Scotia Environment)			
Medway Lakes Wilderness Area	New	19,382	1.2
Tobeatic Wilderness Area	Expansion	16,803	1.04
Silver River Wilderness Area	New	6,187	0.38
Cloud Lake Wilderness Area	Expansion	4,894	0.3
Tidney River Wilderness Area	Expansion	2,368	0.15
Scrag Lake Wilderness Area	New	1,838	0.11
Roseway River Wilderness Area	New	1,680	0.1
Tusket River Wilderness Area	New	1,651	0.1
Port La Tour Bogs Wilderness Area	New	1,400	0.09
Sissiboo River Wilderness Area	New	1,205	0.07
Shelburne River Wilderness Area	Expansion	1,144	0.07
Porcupine Lake Wilderness Area	New	951	0.06
Carleton River Wilderness Area	New	871	0.05
Tusket Islands Wilderness Area	New	704	0.04
Bowers Meadows Wilderness Area	Expansion	30	<0.01
Lake Rossignol Wilderness Area	Expansion	23	<0.01
Total for Wilderness Areas		60,405	3.73
Nature Reserves (Nova Scotia Environment)			
Dunraven Bog Nature Reserve	New	3,199	0.2
Shingle Lake Nature Reserve	New	1,722	0.11
McGowan Lake Nature Reserve	New	1,155	0.07
Pleasant River Nature Reserve	New	1,132	0.07
Eighteen Mile Brook Nature Reserve	Expansion	1,046	0.06
Wentworth Lake Nature Reserve	New	1,005	0.06
Lower Mersey Nature Reserve	New	822	0.05
Long Lake Bog Nature Reserve	New	714	0.04
Port L'Hebert Nature Reserve	New	687	0.04
Ten Mile Lake Nature Reserve	New	675	0.04
Smith Lake Nature Reserve	New	620	0.04
Skull Bog Lake Nature Reserve	New	524	0.03
Snowshoe Lakes Nature Reserve	New	414	0.03
Harpers Lake Nature Reserve	New	401	0.02
Northwest Brook Nature Reserve	New	386	0.02
Porcupine Lakes Nature Reserve	New	238	0.01
Sixth & Coades Lake Nature Reserve	Expansion	221	0.01
Ponhook Lake Nature Reserve	Expansion	160	0.01
Tupper Lake Nature Reserve	New	159	0.01
Lambs Lake Nature Reserve	New	158	0.01
Torbrook Nature Reserve	New	152	0.01

Site Name (Agency)	Status	Area (ha)	% of Bioregon
Jordan Lake Nature Reserve	New	141	0.01
Sloans Lake Nature Reserve	New	141	0.01
Hectanooga Cedar Swamp Nature Reserve	New	124	0.01
Carters Beach Nature Reserve	New	95	0.01
Minard Brook Nature Reserve	New	83	0.01
Total for Nature Reserves less than 0.01% of the bioregion (13)		480	0.03
Total for Nature Reserves		16,041	0.99
Provincial Parks (NS Department of Natural Resources)			
Indian Fields Provincial Park	Core Park	1,499	0.09
Thomas Raddall Provincial Park	Core Park	615	0.04
Mersey River Provincial Park	Supporting Park	394	0.02
Fisher Lake Provincial Park	Supporting Park	121	0.01
Ellenwood Provincial Park	Supporting Park	114	0.01
The Islands Provincial Park	Supporting Park	104	0.01
Rissers Beach Provincial Park	Core Park	101	0.01
New France Provincial Park	Supporting Park	86	0.01
Sand Hills Beach Provincial Park	Supporting Park	85	0.01
Total for Provincial Parks less than 0.01% of the bioregion (38)		2,037	0.13
Total for Provincial Parks		5,156	0.32
Total Proposed Conservation Lands in the SWNS bioregion		**81,602**	**5.04**

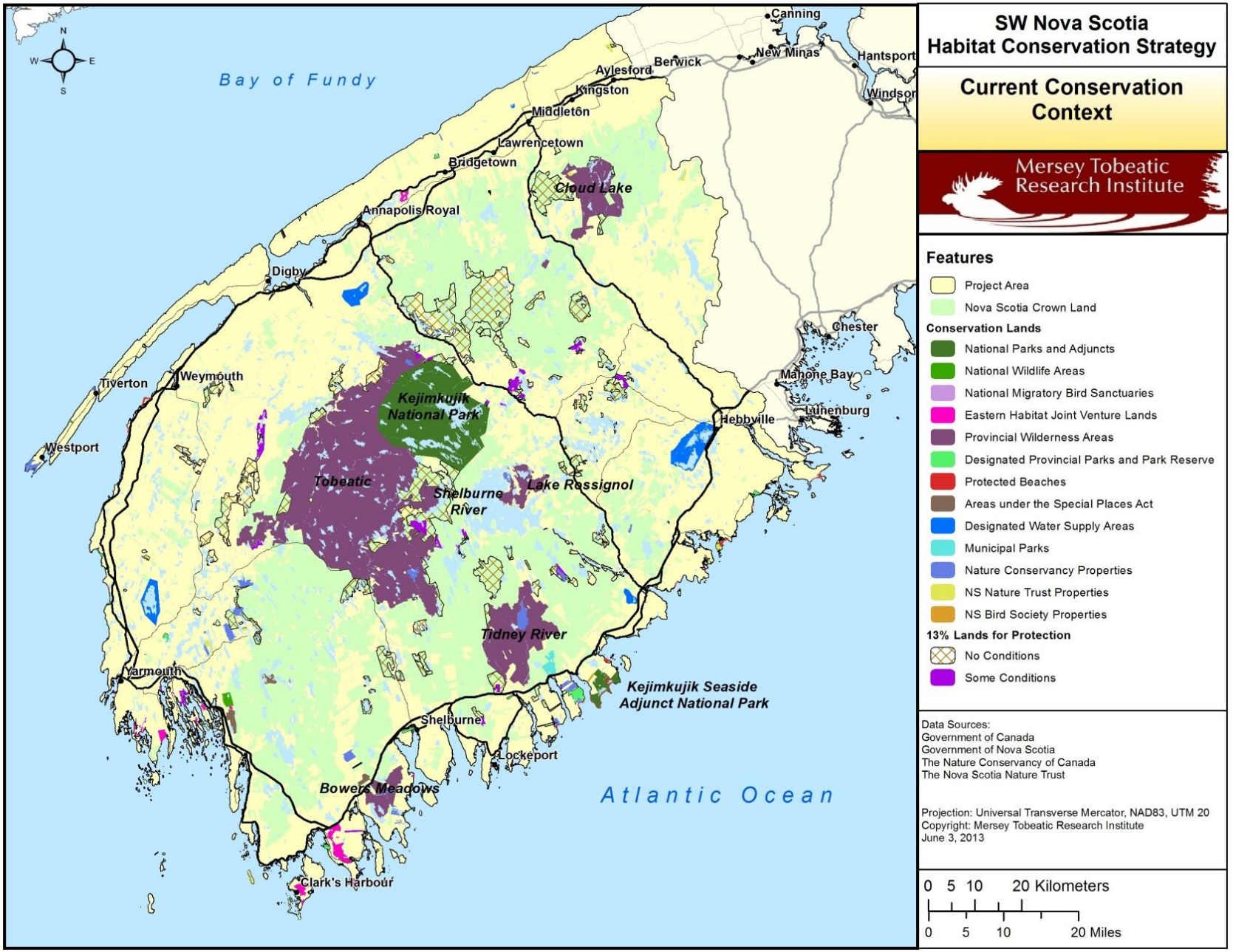

Figure 3. Protected areas and other conservation lands in the Southwest Nova Scotia bioregion.

iv. Social and Economic Considerations

Social Considerations

There is a history of Mi'kmaq habitation and use of the lands and waters of the SWNS bioregion prior to European colonization. The bioregion contains several significant Mi'kmaq archaeological sites, including known encampments, travel routes, village sites, fishing and hunting grounds, burial sites, and petroglyphs, attesting to 4000 years of Mi'kmaq occupancy of the area (Parks Canada Agency 2011). The Mersey River, which flows from the South Mountain in Annapolis County into Kejimkujik Lake, Lake Rossignol, and ultimately into the Atlantic Ocean, was a major transportation route for the Mi'kmaq people (Parks Canada Agency 2011). In recognition of this rich cultural landscape, Kejimkujik National Park received the additional designation as a National Historic Site in 1995, making it the first and only National Park in Canada to also be a National Historic Site. When sport hunting developed in the latter half of the nineteenth century, the Mi'kmaq became renowned in the region for their guiding expertise for international sportsmen (Parks Canada Agency 2011). Thus began the hunting and fishing lodge tradition in the southwest interior of Nova Scotia, where the Tobeatic Game Sanctuary was established. In addition to inland areas of the bioregion, the Mi'kmaq people also used the coastal inlets and abundant resources found along the Atlantic Coast, where ancient shell middens left by the Mi'kmaq can be found. The Mi'kmaq continue to hunt, fish, and gather food plants and traditional medicines in the bioregion and the area is still of great importance to their communities today (Parks Canada Agency 2011). Of the thirteen Mi'kmaq First Nations in Nova Scotia, three are located within the SWNS bioregion: Acadia, Bear River, and Annapolis Valley First Nations.

The Maritime Provinces have the longest history of continuous European settlement in Canada. The Annapolis Valley attracted many of the first European settlers to Nova Scotia, with French colonists arriving in the early 1600's. These early settlers "reclaimed" extensive areas of coastal tidal marsh near Annapolis Royal and created fertile agricultural land through the construction of dykes equipped with aboiteaux, dramatically transforming the coastal landscape of the area. Today, 620 km of dykes exist, protecting 17,400 ha of land, along with approximately 600 residential and commercial buildings, as well as roads and railroads (NSDA 2007). Agricultural activity in the province peaked in the late 1800's, and today the fertile soils and favourable climate of the Annapolis Valley continue to support the most productive farms in Nova Scotia, including a thriving apple industry. Historically, Nova Scotia had as many as 47,000 small farms occupying over 1,900,000 ha of the province. Today, fewer but larger farms employing more intense farming practices still occur on approximately 7% of the provincial land base, with about 4000 farms occupying about 400,000 ha (NSDA 2007; Province of Nova Scotia 2012). The average farm size is just over 100 ha, far smaller than the Canadian average of 315 ha (Province of Nova Scotia 2012). Outside of the Annapolis Valley, small pockets of agricultural land became embedded throughout southwest Nova Scotia, often in association with the region's abundant and fertile drumlins, though many of the marginal farmlands were later abandoned, giving way to old field succession (Neily *et al.* 2003).

The rich cultural heritage of the region hosts founding settlements of the first French and British colonies in the New World at National Historic Sites including Port Royal, Fort Sainte Marie de Grace, Melanson Settlement, Fort Anne, and Fort Edward. The settlement pattern in the SWNS bioregion evolved as transportation and communication networks developed along the coasts, as shown today in the distribution of the region's towns and villages (CBCL Ltd. 2009). Acadians, the descendants of the 17th century French colonists who settled in the Maritime Provinces, celebrate over 400 years of Acadian history in Nova Scotia. Several thriving Acadian communities can be found on the Acadian Shore (i.e., Clare and Argyle municipal districts), in the southwest of the bioregion. Settlement by Black Loyalists in Shelburne County, who came to Nova Scotia to escape the southern slave trade and the American War

of Independence, added to the rich cultural diversity of the southwest region. More recent settlement by northern European immigrants to the Atlantic Coast and inland has shaped land-use practices, and has contributed to the cultural mosaic.

Though the total population of Nova Scotia has remained relatively stable over the last 10 years, there has been a general migration to central Nova Scotia, and particularly the Halifax Regional Municipality. Consequently, the counties that make up the SWNS bioregion have seen some decreases in population. Despite the fact that about 70% of the population of the province lives on the coast, about 80% of the land adjacent to the coast is classified as undeveloped, with the majority (66%) under natural forest cover (CBCL Ltd. 2009). Much of the Atlantic Coast remains undeveloped, with little development in the last 50 years around many of the small residential fishing communities. Nonetheless, 86% of the coastline, including coastal islands, is under private ownership, so there is considerable potential for increased coastal development. Increases in housing and development have occurred around the urban centres, the largest of which is the town of Bridgewater, which is a commercial and industrial centre.

Economic Considerations

Natural resources have played, and continue to play, an important role in the SWNS bioregion's rural economy. Fisheries and forestry were the important early natural resource industries that helped to develop the region's economies, influencing where people settled. Ports and harbours provided the initial nodes for development, and whereas some have developed into substantial urban centres, others have declined in economic importance over time (CBCL Ltd. 2009). Forestry remains a dominant economic driver in the region, with large areas of wilderness managed primarily for forest products. By the late 1800's, forestry in Nova Scotia began to move away from sawmill production and toward a productive and profitable pulp and paper industry. Founded in 1929, the Bowater Mersey Paper Company Ltd. operated a pulp and paper mill in Southwest Nova Scotia for over 80 years, representing a significant source of jobs and economic development for the local economy. In the past decade, however, the Nova Scotia forest industry has seen considerable changes in response to weak demand in key markets such as the United States, appreciation of the Canadian dollar, and insecure global markets, resulting in the closure of small-scale logging and sawmill operations and several large pulp and paper mills. An additional product of the lengthy history of forestry in the region is the vigorous regeneration of Balsam Fir (*Abies balsamea*), which has led to the establishment of a significant Christmas tree industry.

In June 2012 it was announced by parent company Resolute Forest Products that the Bowater Mersey Paper Company would be selling its assets in Nova Scotia, including over 225,000 ha of forested lands in Southwest Nova Scotia. In December 2012 the province of Nova Scotia purchased all of the shares in the Bowater Mersey Paper Company, taking control of the largest block of privately-owned lands in Nova Scotia. Though the closing of the Bowater Mersey Paper Company represented a significant loss to the local economy, purchase of the lands by the Province provides equally significant opportunities for the future of forestry in the region, including improved environmental stewardship, development of innovative forest products and forest certification programs, and proposals by local groups to manage Community Forests to support long-term rural economic development.

Other traditional industries of the region include nearshore coastal fisheries, shipbuilding, professional backcountry guiding for recreational angling and hunting, and mining. A productive lobster fishery in the region, as well as herring, mackerel, crab, scallop, and clams, provide an economic base for many of the coastal areas; however, groundfishing has been reduced substantially in recent years (McCullough *et al.* 2005). Metals and minerals mined include gold, tin, sand, gravel, and crushed rock. New industries have been established, including mink farming, aquaculture, offshore oil and gas, and renewable energy

such as wind, tide (CBCL Ltd. 2009), and biofuel (woody biomass conversion to diesel fuel). Since 2010, American Mink pelts have been Nova Scotia's leading agricultural export. In 2012, 120 Mink farms produced a total of over 1.4 million pelts, generating approximately $140 million (Province of Nova Scotia 2012). The Mink farming industry in Nova Scotia represents 33% of all fur farms in Canada, and 85% of Mink production in the province takes place in Digby and Yarmouth counties within the SWNS bioregion. The total value of aquaculture production and sales in Nova Scotia in 2011 was greater than $43 M, of which over 76% was from Atlantic Salmon and Rainbow Trout aquaculture (NSDFA 2011). 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 cultural diversity and spirit of the region, in combination with the diversity of the natural environment, including impressive coastal scenery, hiking trails, and an extensive network of parks and protected areas, together contribute valuable assets to the tourism industry of Southwest Nova Scotia. Recreational angling and hunting remain popular, as well as other recreational activities including canoeing, hiking, bird-watching, whale-watching, and camping. Coastal development patterns reflect the changing character of many coastal areas from traditional resource-based economies to service-based tourism and recreational economies, with many businesses converting marine structures originally associated with fishing and transportation into service-related commercial buildings (CBCL Ltd. 2009).

2. HABITAT, THREAT, AND SPECIES SPATIAL PRIORITIZATION

A. Conservation Priority Habitat Types

Central to the Habitat Conservation Strategy is the identification of priority habitat types that host the priority species identified within the bioregion. Priority habitats are the native biological entities (i.e., ecological systems, communities and/or species[1]) that the HCS is aiming to conserve. Identifying conservation priority habitat types for the SWNS 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 SWNS bioregion. Ecosystem occurrences that were identified as critical in the SWNS bioregion include 920 ha of beach and dune habitat, 7087 ha of tidal marsh habitat, 29,609 ha of tidal flats, 16,369 ha of freshwater wetlands, 55,547 ha of riparian and floodplain forest, and six Tier 1 matrix forest blocks.

Guided by the priorities identified in the NAAP, the process used to identify priority habitat types in the SWNS 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, p.7; Appendix C), and are representative of the biodiversity of the bioregion.

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

1) Beaches and Dunes
2) Tidal Marshes
3) Tidal Flats
4) Coastal Islands
5) Freshwater Wetlands
6) Riparian Systems
7) Acadian Forest Mosaic
8) Grasslands
9) Barrens

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[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)

Species*: Types of species targets may include:*
-Globally imperilled and endangered native species (e.g., G1 to G3G4)
-Species of concern due to vulnerability, declining trends, disjunct distributions or endemism
-Focal species, including keystone species, wide-ranging regional species and umbrella species

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 Conservation Area Planning workbook (Low 2003) using background information collected from the SWNS bioregion, a review of literature, and expert opinion. 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 based on their *landscape context*, *condition*, and *size* using criteria adapted from the NAAP to assess their ability to maintain regional biodiversity. 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 8 (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 9, whereas the full list of significant species nested within priority habitat types is provided in Appendix D. The locations of priority habitat types are mapped in Figure 4 to Figure 12.

Table 8. Description of the assessment ranks of ecological integrity of the conservation priority habitat types for the Southwest Nova Scotia 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 9. Priority species associated with each conservation priority habitat type in the Southwest Nova Scotia bioregion (see Appendix D for the complete list of priority species with coarse-filter habitat associations).

Habitat Type	BCR 14/ MBU 11 priority bird species	Priority bird species	Priority terrestrial invertebrate species	Priority reptile species	Priority mammal species	Priority plant species	Species at risk	Unique species[1]	Total priority species
Beaches and Dunes	11	10	0	0	0	11	3	1	26
Tidal marshes	25	12	0	0	0	16	5	9	48
Tidal Flats	20	12	0	0	0	1	2	1	23
Coastal Islands	10	6	0	0	0	0	3	0	12
Freshwater Wetlands	31	15	6	3	2	58	23	13	111
Riparian and Floodplain Systems	33	21	10	4	4	78	33	30	149
Acadian Forest Mosaic	34	19	15	0	11	42	20	35	114
Grasslands/Agro-ecosystems	24	12	4	0	0	22	8	5	60
Barrens	16	7	3	0	0	11	6	2	35

[1] *Species that are unique to that particular coarse-filter habitat type and are not associated with any of the other coarse-filter habitat types, based on literature review.*

i. Priority Habitat: *Beaches and Dunes*

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). Beaches and dunes are ecologically linked but form distinct habitats, the former being periodically inundated and the latter dry and distinguished by vegetation adapted to constant sand burial. Nowhere on mainland Nova Scotia are sand dunes exceptionally well developed, compared with other areas of the Maritimes (e.g., P.E.I.), likely attributed to a scarcity of sand on the higher-energy coasts and to lower-energy environments in areas where sediment is abundant (McCann 1990). Beaches and dunes are ecologically significant ecosystems as they host a number of rare and at risk species including Piping Plover, Red Knot, and Savannah Sparrow. They provide critical nesting habitat for a number of bird species, including 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. Many of these species are in decline, partly due to loss or degradation of breeding habitat and anthropogenic disturbances. 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).

The SWNS bioregion's coastal sandy beaches support relatively high concentrations of breeding Piping Plover, a well-known and well-studied 'flagship' species at risk. In Nova Scotia, the Piping Plover nests on fewer than 30 beaches and about two-thirds of the province's Piping Plover breed on the Atlantic Coast in Southwest Nova Scotia, mostly within the boundaries of established IBAs. The Atlantic Coast may be particularly important for this species, as banding studies have shown that individuals breeding in Southwest Nova Scotia demonstrate strong site fidelity for beaches in the region and represent a separate population that is reproductively isolated from the rest of the Eastern Canadian population (Amirault-Langlais 2014). The numbers of breeding pairs for this southern subpopulation have declined by 34% since 1991 and in many years, reproductive success has been low despite intensive conservation effort (S. Abbott, per. comm.). Threats to the persistence of Piping Plover in the region include habitat loss and degradation, predation pressures, and human disturbance during the breeding season. This subpopulation's small size, isolation, limited suitable habitat, and low reproductive success contribute to higher risk of continued decline and possible extirpation from the region.

Conservation of beach and dune habitat within the SWNS bioregion will contribute to the conservation of at least 26 priority species (Table 9).

Nested Conservation Priority Species

- Piping Plover (EN)
- Red Knot (EN)
- Savannah Sparrow (SC)
- Black-bellied Plover
- Killdeer
- Sanderling
- Dunlin
- Semipalmated Plover

Landscape context assessment of beaches and dunes: Good

The majority of beach and dune habitat in the SWNS bioregion, including almost all of the NAAP identified critical occurrences of beaches and dunes, are scattered along the south-facing shorelines with the Atlantic Ocean and Gulf of Maine, making up 0.1% of the total area of the bioregion (Figure 4). Development within the bioregion is concentrated along the coastlines; nonetheless approximately 80% of the land adjacent to the coast is classified as undeveloped (CBCL Ltd. 2009). A high percentage of the coastline is under private ownership however, so there is considerable potential for increased coastal

development. The sensitivity of the coastline of the bioregion to sea-level rise and hence coastal erosion is high to moderate along the Atlantic Coast where the majority of beach and dune systems occur (Shaw *et al.* 1998). Shoreline hardening and associated loss of sediment supply may further compound the impacts of sea-level rise by limiting the landward migration of beaches and dunes. The average Landscape Context Index[1] (LCI) for beaches and dunes in the SWNS bioregion is 12.54, 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). In total 353 ha (14.6%) of beach and dune habitat in the bioregion are currently under protected or conservation status.

Condition assessment of beaches and dunes: Fair

Beaches and dunes face growing pressures from development, recreational activities, and climate change effects. The largest area of protected beaches within the SWNS bioregion is within Kejimkujik National Park Seaside Adjunct, which contains St. Catherine's River Beach and Little Port Joli Beach, both critical sites for nesting Piping Plover (S. Abbott, per. comm.). These two extensive beaches have minimal infrastructure and are partially closed to public access during the April to August nesting period for Piping Plover. Five beaches are located in provincial parks within the bioregion – Rissers, Summerville, Sand Hills, Port Maitland, and Mavillette. Though a provincial park designation provides a measure of protection for these beaches, this may also contribute to their degradation through the development of infrastructure, such as roads, parking lots, and trails established to address increased use. Such infrastructure, accompanied with increased use, can alter the dynamics of beach and dune ecosystems, resulting in semi-permanent to permanent conversion of habitat and associated losses for the species they support.

The anticipated increase in the frequency and intensity of storms in relation to climate change may further impact the condition of beaches and dunes in the bioregion (US CCSP 2009). There are 18 additional beaches designated as protected beaches under the *Nova Scotia Beaches Act*, providing for their protection as significant and sensitive environmental and recreational resources, although the Act is designed primarily to prevent the removal of sand and other aggregate material. The *Nova Scotia Beaches Act* protects non-designated beaches only below the mean high watermark.

Beaches and dunes can be heavily impacted by human activities, particularly off-highway vehicle use and other recreational activities. Off-highway vehicles are damaging to dune systems and the associated species that they host through the degradation of dune structure, destruction of stabilizing dune vegetation, as well as alteration of wildlife activity patterns and destruction of shorebird nests. Recreational beach users may also disturb breeding shorebirds, which can result in changes in normal nesting or feeding behaviour, and ultimately nest failure (Environment Canada 2012). These activities include pedestrian traffic, unleashed dogs, camping and campfires, and the collection of shells or wrack (Environment Canada 2012). Human activities can also result in artificially high predator populations of opportunistic native species (e.g., crows, gulls, racooons) and predation by these species has been identified as one of the most important factors limiting populations of the endangered Piping Plover

[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).*

across their North American breeding range and current predation rates appear to be higher than they were in the past (Goossen *et al.* 2002). Many beaches used traditionally for breeding by Piping Plovers within the bioregion have been lost as breeding habitat due to natural and human-induced changes.

There is little information on the impact of invasive species on beaches and dunes in the SWNS bioregion, however Rugosa Rose (*Rosa rugosa*) is an emerging invasive that has been documented in Digby County and elsewhere in the region (S. Basquill, per. comm.). Once established on sandy coasts, this dense shrub out-competes most native vegetation species (MTRI 2012). Hill *et al.* 2012 surveyed beach and dune systems on Cape Breton Island and northern mainland Nova Scotia and found some dune systems on Cape Breton Island to be heavily colonized by Rugosa Rose with negative impacts on native dune communities, and a further two of nine systems surveyed in northern mainland Nova Scotia had Rugosa Rose.

Size assessment of beaches and dunes: Fair

In total there are 2421 ha of beaches and dunes, making up 0.1% of the total area of the SWNS bioregion. Of this area, 920 ha were identified as critical in the NAAP, representing 44% of the critical occurrences of beaches and dunes in Nova Scotia (note that the bioregion contains 29.3% of the total area of the province). The screening criterion for the minimum size of critical occurrences of beaches and dunes in the NAAP was 8 ha (Anderson *et al.* 2006). The average size of beach and dune complexes in the SWNS bioregion is 6 ha, which is less than the NAAP minimum size criteria for critical occurrences; 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.

Current threats to beaches and dunes in the bioregion

- 1.1 Cottage and residential development
- 1.3 Beach/recreational development
- 2.4 Marine shellfish and finfish aquaculture
- 4.3 Shipping activity oil spills & discharges
- 6.1 Recreational beach use (Threat status: High)
- 6.1 Off-highway vehicle use
- 8.1 Invasive plants
- 8.2 Problematic native species

Emerging threats to beaches and dunes in the bioregion

- 11.1 Sea-level rise and coastal erosion
- 11.5 Storm-induced coastal erosion (Threat status: High)

Overall assessment of beach and dune habitat in the SWNS bioregion: Fair

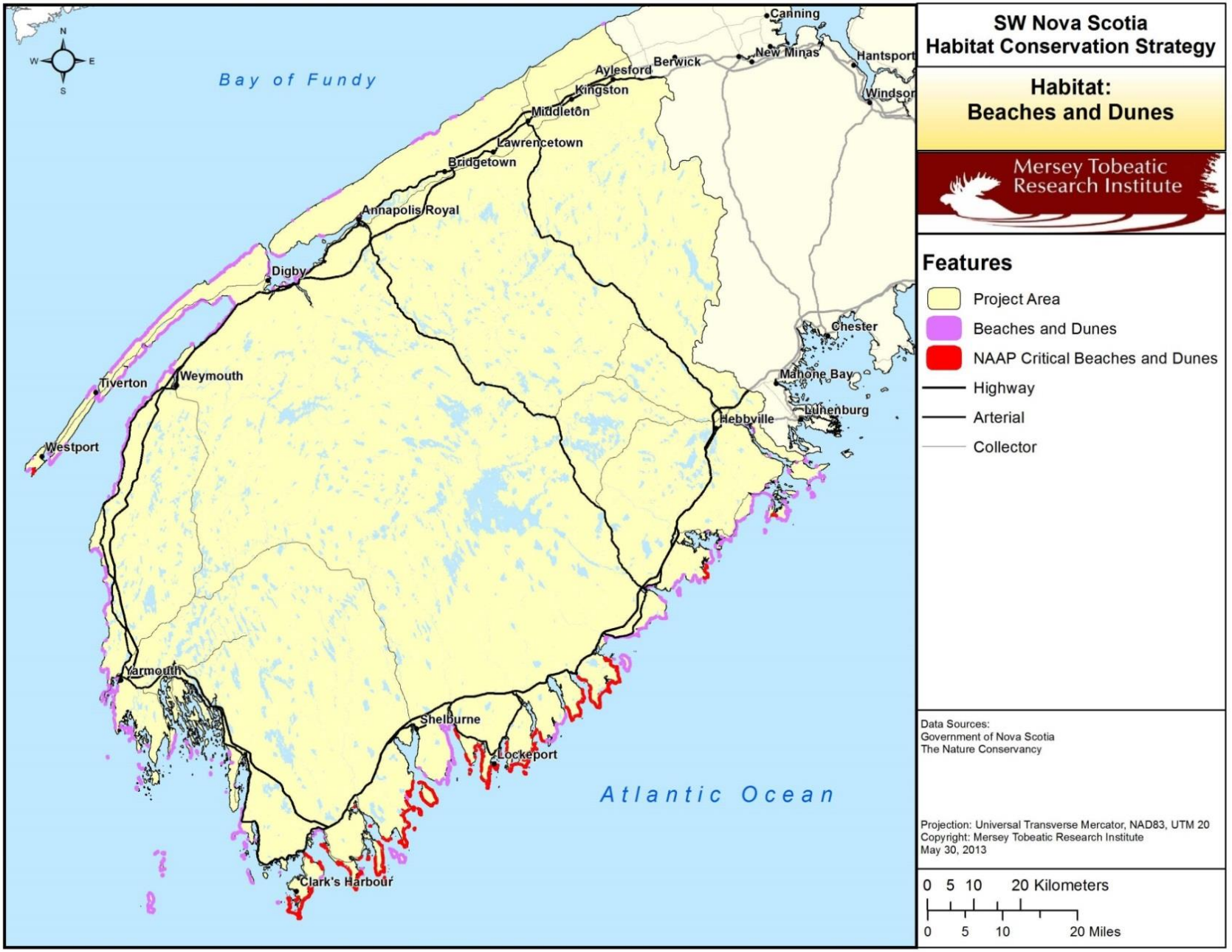

Figure 4. Beach and dune habitat within the Southwest Nova Scotia bioregion.

ii. Priority Habitat: *Tidal Marshes*

Tidal 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 influenced by gradients associated with the duration of tidal flooding and the extent of freshwater influx (GMCME 2010; Bowron *et al.* 2012). Tidal marshes occur along fully exposed coastal areas, at the mouth and along tidal rivers (e.g., Annapolis River), along the protected side of islands, and behind protective barriers, such as barrier beaches (T. Bowron, per. comm.). Brackish marshes occur in areas where there is significant mixing of fresh and salt water, such as the mouth of a large river. Tidal marshes are a common coastal feature in the SWNS bioregion due to ample sediment supply from glacial deposits (McCullough *et al.* 2005) and are among the most biologically productive ecosystems in the world, providing important breeding, staging, and wintering habitat for a wide variety of bird species, including rare and at risk species (e.g., Bobolink, Nelson's Sharp-tailed Sparrow, Short-eared Owl, and Willet), and as important nursery areas for juvenile fish and shellfish. The province's tidal marshes and intertidal flats are believed to support the largest breeding concentration of Willet in Eastern Canada (NS EHJV). Eastern Lilaeopsis is a small, semi-aquatic species of Atlantic Coastal Plain Flora that is found in the intertidal zone of five river estuaries located in the bioregion, usually where *Spartina alterniflora* dominates. Tidal marshes also serve important functions in flood protection, erosion control, supporting coastal and marine food webs, and removal of contaminants, nutrients and suspended sediments from the water column. GPI Atlantic (Genuine Progress Index for Atlantic Canada) estimates that the remaining tidal marshes in Nova Scotia provide over $400 million worth of ecosystem services to Nova Scotia communities each year (Government of Nova Scotia 2011).

Tidal barriers are structures that impact the natural movement of tidal waters and species into low lying coastal areas and waterways, changing the physical, chemical, biological, or ecological characteristics of waterways and include dykes, aboiteaux, causeways, bridges, culverts, dams, and wharves (Wells 1999). Since European settlement in the early 1700's Nova Scotia has seen extensive loss of tidal marsh habitat, particularly along the Annapolis River, which once was host to extensive areas of tidal marsh. Much of this area is now used for agriculture, having been protected from tidal inundation by a system of dykes in the 1600's. Beyond the use of dykes to restrict tidal flow, tidal barriers have been used extensively to serve other anthropogenic needs, such as the creation of head ponds for the generation of hydroelectric or tidal power, road or highway crossings, recreational or urban use areas, flood control, logging, and other industrial activities (Wells 1999). Tidal barriers are a main cause of tidal marsh loss in the region and a wide range and number of barriers exists on rivers that drain into the Bay of Fundy (Bowron *et al.* 2012; Hynes 2005; Wells 1999). Estimates of original tidal marsh loss are as high as 65% province-wide, and 85% along the Bay of Fundy (Bowron *et al.* 2012; NAWCC 2012; Reed & Smith 1972; Singh *et al.* 2007).

Conservation of tidal marsh habitat within the SWNS bioregion will contribute to the conservation of at least 48 priority species (Table 9).

Nested Conservation Priority Species

- Bobolink (TH)
- Short-eared Owl (SC)
- Red Knot (EN)
- Eastern Lilaeopsis (SC)
- Eastern Baccharis (TH)
- Willet
- Nelson's Sparrow

Landscape context assessment of tidal marshes: Fair
Like beaches and dunes in the bioregion, tidal marshes are found primarily along the shorelines with the Atlantic Ocean and the Gulf of Maine, with significant occurrences located in the Yarmouth area and in Lobster Bay, including some of the largest intact tidal marshes in the province (T. Bowron, per. comm.; Figure 5). Historically, extensive tidal marshes were located at the mouth of the Annapolis River; however, these have been heavily impacted by agricultural practices over the past 300 years. Since European settlement of Nova Scotia in the early 1700's Nova Scotia has seen extensive loss of tidal marsh habitat, primarily to dyking for agriculture. Estimates of tidal marsh loss are as high as 65% of original tidal marshes province-wide, and 85% along the Bay of Fundy (Bowron *et al.* 2012; NAWCC 2012; NSE 2012b; Singh *et al.* 2007). Tidal marsh restoration efforts have been ongoing in Southwest Nova Scotia since 2002 (Bowron *et al.* 2012).

Development within the bioregion is concentrated along the coastlines; nonetheless approximately 80% of the land adjacent to the coast is classified as undeveloped (CBCL Ltd. 2009). A high percentage of the coastline is under private ownership however, so there is considerable potential for increased coastal development. The sensitivity of the bioregion to sea-level rise and hence coastal erosion is high to moderate along the Atlantic Coast where the majority of tidal marshes are found (Shaw *et al.* 1998). Shoreline hardening and associated loss of sediment supply may further compound the impacts of sea-level rise by limiting the landward migration of tidal marshes. The additional protection of uplands adjacent to tidal marshes (suggested 275 m buffer; EC, OMNR, & OME 1998) will help to protect the ecological functions and integrity of the habitat priority, maintain nesting areas for wildlife (e.g., waterfowl), and allow for landward migration in the face of sea-level rise due to climate change. In 2011 the Province of Nova Scotia released the Nova Scotia Wetland Conservation Policy, which provides a direction and framework for the conservation and management of wetlands in the province, and identifies specific objectives intended to prevent the net loss of Nova Scotia's wetlands into the future (Government of Nova Scotia 2011). Under the policy, all tidal marshes are considered to be *Wetlands of Special Significance*. This policy should help to restrict any further loss of tidal marsh habitat in the province.

The average Landscape Context Index (LCI) for tidal marshes in the Southwest Nova Scotia bioregion is 27.51**,** 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, although this value is approaching the upper bound of 30 for coastal ecosystems (calculated using NAAP data). In total 602 ha (7.7%) of tidal marshes in the bioregion are currently under protected or conservation status.

Condition assessment of tidal marshes: Fair
Numerous tidal marshes within the bioregion have restricted tidal flow due to the installation of historic infrastructure, such as the extensive areas of dykes and aboiteaux on the Annapolis River, or undersized and poorly constructed culverts, and causeways and roadways. Tidal flow restrictions can result in decreased soil accretion, and changes in vegetation, which can severely impact the health and integrity of tidal marsh habitat (Roman *et al.* 1984; Sullivan 2005). At least three non-indigenous invasive plant species have been documented in tidal wetlands in eastern Canada, the Common Reed (*Phragmites australis ssp. australis*), Purple Loosestrife (*Lythrum salicaria*), and Reed Canary Grass (*Phalaris arundinacea*) (T. Bowron, K. Porter, per. comm.). The Common Reed is an aggressive invasive species that inhabits freshwater or brackish shores and wetlands and is of particular concern in the bioregion, including an extensive colony in Annapolis Royal. It spreads quickly to form large, dense stands that exclude native species and can alter the structure and function of native marsh ecosystems (Mal & Narine 2004; MTRI 2012).

Size assessment of tidal marshes: Good

In total there are 7843 ha of tidal marsh, which makes up 0.5% of the total area of the bioregion. Of this area, 7087 ha were identified as critical in the NAAP, representing 42% of the critical occurrences of tidal marshes in Nova Scotia (note that the bioregion contains 29.3% of the total area of the province). The screening criterion for the minimum size of critical occurrences of tidal marshes in the NAAP was 24 ha or part of a coastal complex (based on physical features that unify marsh, tidal flat, beach, and salt pond habitat) over 40 ha (Anderson *et al.* 2006). A 275 metre buffer was included around tidal marshes to protect the ecological functions and integrity of this priority habitat and allow for landward migration in the face of sea-level rise due to climate change. The average size of tidal marsh occurrences in the bioregion is 9 ha, which is significantly less than the NAAP minimum size criteria for critical occurrences of tidal marshes, however, for tidal marshes there is further criteria that occurrences below the minimum criteria may be considered critical if they are part of a coastal complex of unified marsh, tidal flat, beach, and salt ponds over 40 ha (Anderson *et al.* 2006). Many of the tidal marshes located within the bioregion are associated with extensive areas of tidal flats, and consequently still meet the criteria for critical occurrences.

Current threats to tidal marshes in the bioregion

- 1.1 Cottage and residential development
- 2.1 Agricultural practices – annual and perennial non-timber crops
- 2.3 Livestock farming and ranching
- 2.4 Marine shellfish and finfish aquaculture
- 4.1 Roads and railroads
- 4.3 Shipping activity oil spills and discharges
- 7.2 Dams and other aquatic barriers
- 8.1 Invasive European Green Crab
- 8.1 Invasive plants
- 9.1 Household sewage and urban waste water
- 9.3 Agricultural and forestry effluents

Emerging threats to tidal marshes in the bioregion

- 11.1 Sea-level rise and coastal erosion
- 11.5 Storm-induced coastal erosion

Overall assessment of tidal marsh habitat in the SWNS bioregion: Fair

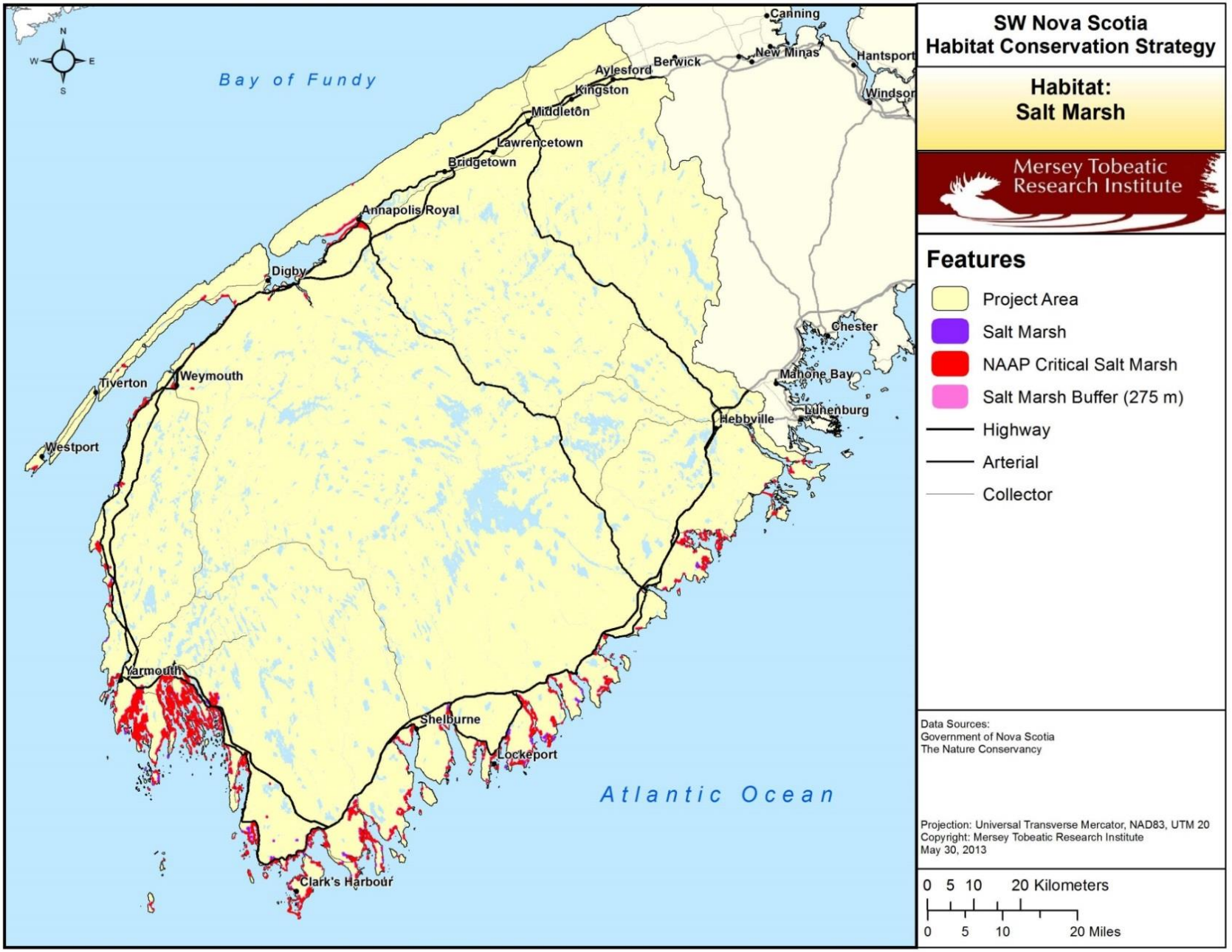

Figure 5. Tidal marsh habitat within the Southwest Nova Scotia bioregion.

iii. Priority Habitat: *Tidal Flats*

Tidal flats are another common coastal feature of the SWNS bioregion, particularly in shallow estuaries and coastal marine environments along the Atlantic Coast. 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 vast numbers of shorebirds which congregate to feed on abundant burrowing invertebrates, including clams, worms, and amphipods (Anderson *et al.* 2006).

Tidal flats also support extensive beds of Eelgrass (*Zostera marina*), a highly productive perennial aquatic plant that is a 'keystone species' found on coarse sand to mud bottoms in low intertidal and subtidal environments (DFO 2009b). Eelgrass has been identified as an ecologically significant species in that it creates habitat used preferentially by other species, provides protection for associated communities, and has substantial influence over the ecology of the habitat (DFO 2009b). Eelgrass beds provide nursery habitat for juvenile stages of fish and invertebrates, and important feeding habitat for migrating waterfowl. The primary productivity of Eelgrass and their associated epiphytic communities exceeds that of many cultivated terrestrial systems, playing an important role as biological filters, sediment stabilizers, and exporters of organic matter and nutrients to subsidize the productivity of other coastal ecosystems (McCarthy & Kehler in MTRI & PC 2013). The extensive mud flats and eelgrass beds that can be found along the Atlantic Coast of the bioregion, particularly in the areas around Port Joli and Cape Sable Island, support significant numbers of migrating and overwintering waterfowl, including Atlantic Brant (*Branta bernicla*), Canada Goose, Common Goldeneye, Barrow's Goldeneye, Common Loon, Common Eider, American Black Duck, and the federally endangered Harlequin Duck (Hanson 2004; NS EHJV 2008). There is also a significant moulting area for Common Eider located between Liverpool and Baccaro.

Eelgrass declines in recent decades have been reported in the southern Gulf of St. Lawrence and on the Atlantic coast of Nova Scotia. Information on coast-wide trends is limited, but in some locations in the Maritime Provinces inter-annual declines of 30% to 95% have been reported (DFO 2009b). Losses of 30% and 44% of Eelgrass cover from 1978-2000 were recorded at two sites in Lobster Bay, Nova Scotia (Sharp & Semple in Hanson 2004), and Eelgrass at Kejimkujik National Park Seaside Adjunct is reported to have declined to less than 2% of its 1987 distribution (McCarthy & Kehler in MTRI & PC 2013). Possible contributing factors to the observed declines in Eelgrass distribution include disease, eutrophication, human activities, environmental changes, and disturbance by invasive European Green Crab (*Carcinus maenas*) (DFO 2009b; Hanson 2004). Associated with these dramatic declines in Eelgrass biomass within estuaries in Maritime Canada, significant changes in the distribution and declines in the abundance of fall-staging waterfowl have been observed (Seymour *et al.* 2002). Historical evidence suggests that if Eelgrass declines were to become widespread, there would be major impacts on waterfowl feeding behaviour, migration patterns, and over-winter survival (Hanson 2004).

Conservation of tidal flats within the SWNS bioregion will contribute to the conservation of at least 23 priority species (Table 9).

Nested Conservation Priority Species

- Barrow's Goldeneye (SC)
- Harlequin Duck (SC)
- Piping Plover (EN)
- Eastern Lilaeopsis (SC)
- Common Goldeneye
- Dunlin
- Semipalmated Plover

Landscape context assessment of tidal flats: Good

The highly indented and irregular coastline of the Atlantic Coast provides the most suitable depositional environments (i.e., shallow estuaries) to support the development of tidal flats within the bioregion; hence, this is where they are primarily found (Figure 6). Development within the bioregion is concentrated along the coastlines; nonetheless approximately 80% of the land adjacent to the coast is classified as undeveloped (CBCL Ltd. 2009). Though a high percentage of the coastline is under private ownership, in Nova Scotia a grant of land typically only extends to the ordinary high water mark of tidal or coastal land; land between the mean high and low water marks of coastal water is considered to be Crown land under management by the Nova Scotia Department of Natural Resources (CBCL Ltd. 2009; NSDNR 2013c). In addition to this, tidal flats do not have a great deal of development potential, however they may be severely impacted by adjacent onshore development if there are resulting changes to sedimentation patterns, or an increase in urban waste water, agricultural, forestry, or industrial effluents. At present, there is very little commercial or industrial activity in the proximity of tidal flats in the bioregion. The sensitivity of the bioregion to sea-level rise and hence coastal erosion is high to moderate along the Atlantic Coast where the majority of tidal flats occur (Shaw *et al.* 1998). Shoreline hardening and associated loss of sediment supply may further compound the impacts of sea-level rise by limiting the landward migration of tidal flats. The average Landscape Context Index (LCI) for tidal flats in the SWNS bioregion is 10.63**,** 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). There are currently no areas of tidal flats in the bioregion that are under protected or conservation status.

Condition assessment of tidal flats: Fair

Eelgrass declines in recent decades have been reported on the Atlantic Coast of the bioregion. Losses of 30% and 44% of eelgrass cover from 1978-2000 were recorded at two sites in Lobster Bay, Nova Scotia (Sharp & Semple in Hanson 2004), and eelgrass at Kejimkujik Seaside is reported to have declined to less than 2% of its 1987 distribution (McCarthy & Kehler in MTRI & PC 2013). Possible contributing factors to the observed declines in eelgrass distribution include disease, eutrophication, human activities, environmental changes, and disturbance by invasive European Green Crab (*Carcinus maenas*) (DFO 2009b; Hanson 2004). Associated with these dramatic declines in eelgrass biomass within estuaries in Maritime Canada, significant changes in the distribution and declines in the abundance of fall-staging waterfowl have been observed (Seymour *et al.* 2002). Historical evidence suggests that if eelgrass declines were to become widespread, there would be major impacts on waterfowl feeding behaviour, migration patterns, and over-wintering survival (Hanson 2004). Without proper regulation, recreational and commercial harvesting of clams and marine worms reduce invertebrate populations, degrading tidal flat habitat. Further, these activities can negatively alter the habitat structure of tidal flats, particularly mud flats, which have reduced resilience to physical disturbance compared to sandflats (GOMC 2005). Such activities can also lead to negative impacts on waterfowl and shorebirds.

Size assessment of tidal flats: Good

Within the SWNS bioregion there are 53,483 ha of tidal flats, accounting for 3.3% of the total area of the bioregion. Of this area, 29,609 ha were identified as critical in the NAAP, representing 39% of the critical occurrences of tidal flats in Nova Scotia (note that the bioregion contains 29.3% of the total area of the province). The screening criterion for the minimum size of critical occurrences of tidal flats in the NAAP was 40 ha (Anderson *et al.* 2006). The average size of occurrences of tidal flats in the bioregion is 180 ha, which is substantially larger than the NAAP minimum size criteria for tidal flats in the region.

Current threats to tidal flats in the bioregion

- 1.1 Cottage and residential development
- 2.4 Marine shellfish and finfish aquaculture
- 4.3 Oil spills and discharges from shipping activity
- 5.4 Clam and baitworm harvesting
- 9.1 Household sewage & urban waste water
- 9.3 Agricultural and forestry effluents
- 8.1 Invasive European Green Crab (Threat status: High)

Emerging threats to tidal flats in the bioregion

- 11.1 Sea-level rise and coastal erosion

Overall assessment of tidal flats in the SWNS bioregion: Good

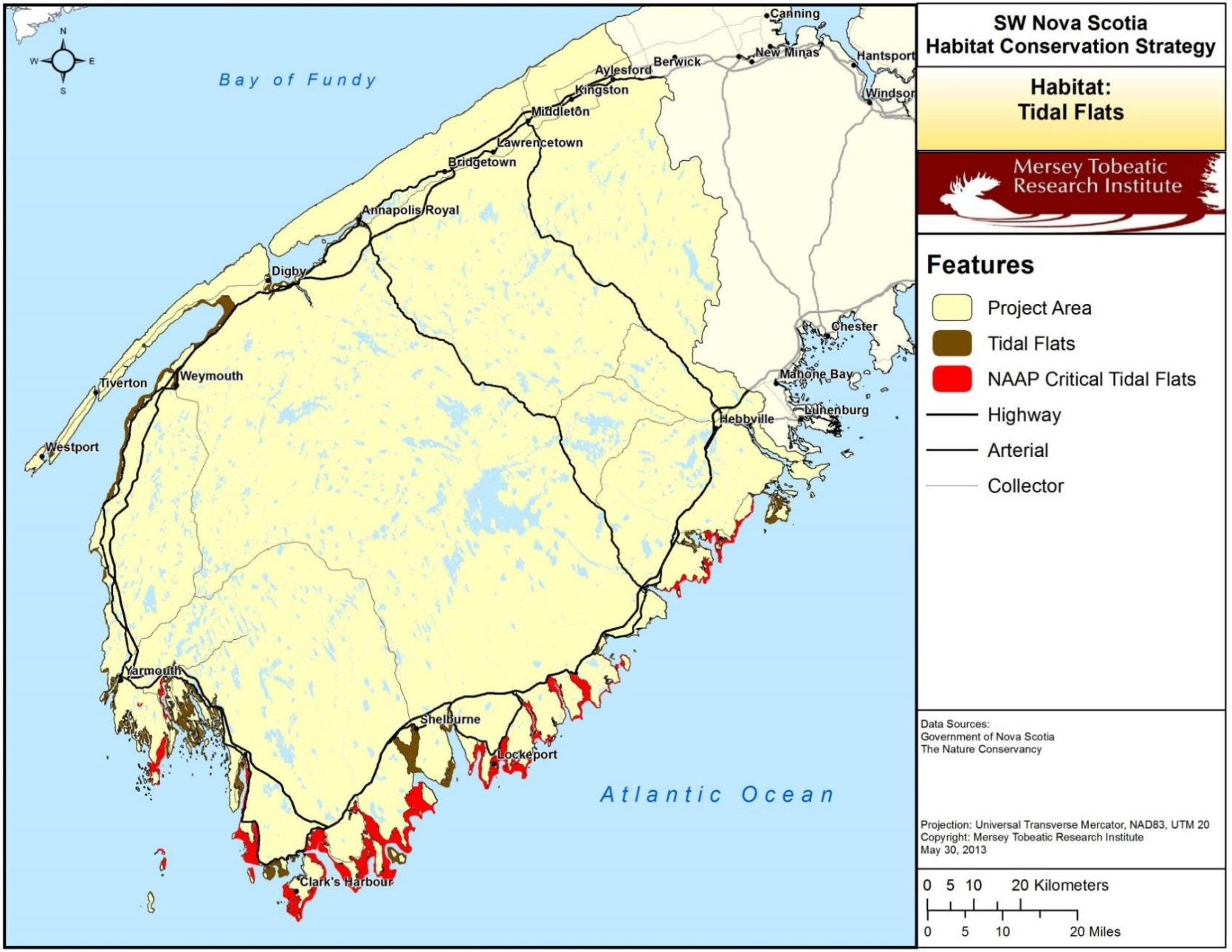

Figure 6. Tidal flats within the Southwest Nova Scotia bioregion.

iv. Priority Habitat: *Coastal Islands*

Coastal islands are abundant along the Atlantic Coast of the SWNS bioregion and are an important habitat component for many species. Islands may be composed of bedrock, glacial till, or sand, though bedrock islands are most common, particularly in areas of resistant rock, such as the granite and quartzite of the Atlantic Coast (Davis and Browne 1996). Many of the large bays located on the Atlantic Coast of the bioregion shelter numerous islands, a number of which host critical breeding sites for seabirds and waterfowl (Environment Canada 2013). Due to their isolation, islands are often free of predators and other sources of disturbance, providing excellent habitat for colonial breeding birds (NS EHJV 2008). These include Common Eider, Razorbill, Roseate Tern, and Leach's Storm Petrel, which nest almost exclusively on islands. Islands in the southern end of the bioregion also provide ideal stopover sites for hundreds of thousands of migrating birds (landbirds and marine birds), and over-wintering sites for the federally and provincially listed Harlequin Duck, which over-winters in five to six known discreet locations in waters adjacent to the bioregion's abundant coastal islands (NS EHJV 2008).

Brier Island, located at the westernmost point of Nova Scotia in the Bay of Fundy, and its surrounding marine waters have long been recognized as a globally significant area for migrating shorebird and waterbird species, including phalaropes, shearwaters, and Black-legged Kittiwake (IBA 2012). Thousands of Razorbill, Thick-billed Murre, and Dovekie overwinter in the waters around Brier Island. North Brothers, one of two islets that make up The Brothers located approximately 700 m from the southwest coast of Nova Scotia, supports the largest population of Roseate Tern in Canada, representing approximately half of the estimated Canadian population, among the 550 to 725 pairs of nesting Arctic and Common Tern found on the island (IBA 2012; J. McKnight, per. comm.). These two islands have been designated as a wildlife management area and activities that threatened the tern colony are being managed. Bon Portage Island, also located on the southwest coast, supports the largest known colony of Leach's Storm-petrel in the Maritimes. Cape Sable Island, located at the southernmost point of Nova Scotia, represents a globally significant stop over for spring and fall shorebird migrant species, including Semipalmated Sandpiper, Black-bellied Plover, Sanderling, Least Sandpiper, Dunlin, and the federally endangered Red Knot (IBA 2012). Other waterbirds that can be found using the abundant coastal islands in the region include loons, herons, cormorants, and seaducks.

Conservation of coastal islands within the bioregion will contribute to the conservation of at least 12 priority species (Table 9).

Nested Conservation Priority Species

- Roseate Tern (EN)
- Leach's Storm Petrel
- Harlequin Duck (SC)
- Common Eider
- Razorbill
- Atlantic Puffin

Landscape context assessment of coastal islands: Good

For the purposes of this HCS, coastal islands include all mapped islands in Nova Scotia's provincial cadastral property database that are located up to 5 kilometres offshore. Coastal islands are abundant in the bioregion, totaling 935, mostly located among the many bays and inlets along the shorelines with the Atlantic Coast and Gulf of Maine (Figure 7). Development within the bioregion is concentrated along the coastlines; nonetheless approximately 80% of the land adjacent to the coast is classified as undeveloped (CBCL Ltd. 2009). A high percentage of the coastline, including coastal islands is under private ownership however, so there is considerable potential for increased coastal development. The numerous drumlin islands of Mahone Bay (just east of the bioregion) for example, are under increasing pressure from human activity and development. The sensitivity of the bioregion to sea-level rise and

hence coastal erosion is high to moderate along the shorelines with the Atlantic Ocean and the Gulf of Maine, where the majority of coastal islands occur (Shaw *et al.* 1998). In total 775 ha (6.4%) of coastal islands in the bioregion are currently under protected or conservation status.

Condition assessment of coastal islands: Good
Islands are isolated by nature, but may be subject to varying levels of disturbance, based on their location and activities in surrounding waters. Predators gain access to near shore islands by swimming (i.e., American Mink) or over the ice during cold winters (i.e., Eastern Coyote). At present, low levels of human habitation and use on most coastal islands in the bioregion have resulted in minimal anthropogenic disturbance. Uncontrolled sheep grazing, however, occurs on a number of coastal islands in Lobster Bay. The impact of this practice is localized; however, grazing sheep can be extremely detrimental to native vegetation and have the potential to introduce invasive plant species (Morrison and Hines-Clark 1999). Their grazing activity may also result in disturbance to migratory birds nesting in tall grasses on coastal islands (Nocera 2000).

Size assessment of coastal islands: Not Applicable
Islands in the bioregion are considered important regardless of size given their use by a broad suite of priority species, though larger islands can host permanent populations of mammalian predators. There are 935 coastal islands located within the bioregion, with an average size of 13.5 ha and a total area of 12,031 ha, or 0.7% of the bioregion.

Current threats to coastal islands in the bioregion
- 1.1 Cottage and residential development
- 2.3 Livestock farming and ranching
- 2.4 Marine shellfish and finfish aquaculture
- 4.3 Shipping activity oil spills and discharges
- 6.1 Recreational beach use
- 8.2 Problematic native species

Emerging threats to coastal islands in the bioregion
- 11.1 Sea-level rise and coastal erosion
- 11.5 Storm-induced coastal erosion

Overall assessment of coastal islands in the SWNS bioregion: Good

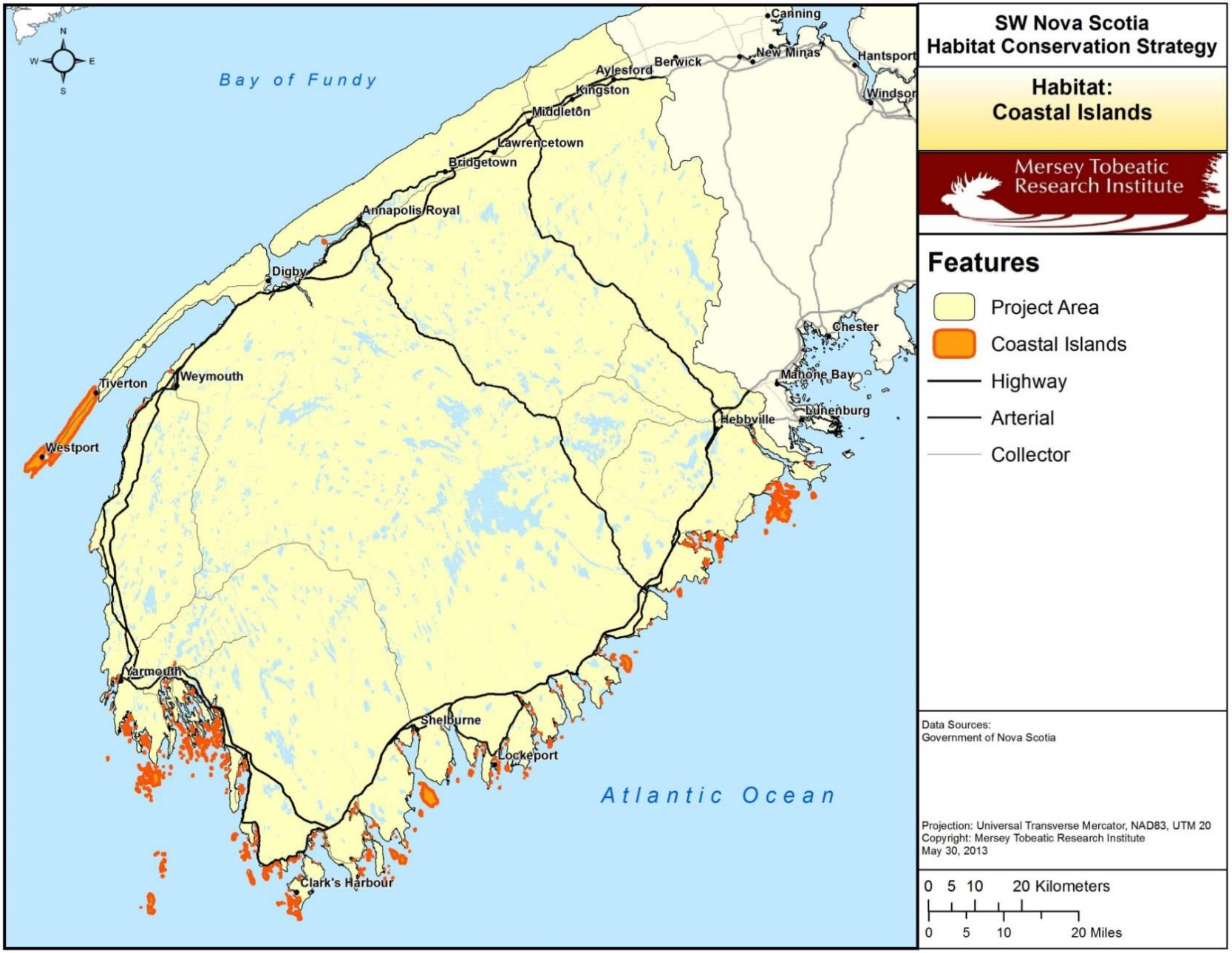

Figure 7. Coastal islands within the Southwest Nova Scotia bioregion.

v. Priority Habitat: *Freshwater Wetlands*

The province of Nova Scotia uses the following definition for wetlands:

> "Land commonly referred to as marsh, swamp, fen or bog that either periodically or permanently has a water table at, near, or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions" –*Nova Scotia Environment Act*, 2011.

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 & Browne 1996).

Freshwater wetlands are a significant habitat type commonly encountered in the SWNS bioregion. Among the most productive and diverse of all ecosystems, the ecological diversity of the bioregion's freshwater wetlands supports a diverse assemblage of wildlife, including a number of Nova Scotia's rare and endangered species (e.g., Blanding's Turtle, Eastern Ribbonsnake, Snapping Turtle, Eastern Mountain Avens, and Thread-leaved Sundew). Globally rare species of Atlantic Coastal Plain Flora can be found in lake-edge wetlands; these wetlands are among the most ecologically significant wetlands in the province. Additionally, many bird species depend on freshwater wetlands throughout the year for nesting, brood rearing, migration, and wintering habitat (NS EHJV 2008). Freshwater wetlands also perform vital ecological and social functions, including carbon storage, water quality improvement through natural filtration, a natural sink for pollutants, and the control or abatement of flooding, drought, and soil erosion (Davis & Browne 1996; Nova Scotia Environment 2012c), providing an estimated $7.9 billion worth of benefits in ecosystem services to Nova Scotians annually, according to a GPI Atlantic study on the province's water resource values (Government of Nova Scotia 2011). Certain human activities, including residential and cottage development, forest harvesting, agricultural practices, road construction, and infilling, have the potential to impact the hydrology of freshwater wetlands, which can lead to changes in the vegetation community and potentially impact habitat for sensitive species (i.e., Atlantic Coastal Plain Flora). Climate change and activities such as forest harvesting and draining can alter nutrient flows and/or the hydrology of wetlands, resulting in changes in the ecological integrity of these sensitive ecosystems.

Peatlands (Bogs and Fens)

The majority of wetlands in Nova Scotia are peatlands, which are wetlands characterized by at least 40 centimetres of accumulated peat (National Wetlands Working Group 1997). Over time lakes, ponds, and freshwater marshes can become slowly infilled with organic and inorganic sediments, eventually becoming invaded by peat-forming vegetation (i.e., *Sphagnum* mosses) and developing into peatlands (Davis & Browne 1996). Bogs are nutrient-poor, acidic peatlands that develop on open terrain with restricted drainage and are dominated by *Sphagnum* mosses (Nova Scotia Environment 2012c). They may be treed (Black Spruce and Eastern Larch can be common), and they often are covered with ericaceous shrubs such as Leatherleaf (*Chamaedaphne calyculata*), Huckleberry (*Gaylussacia* and *Vaccinium spp.*), Lambkill (*Kalmia angustifolium*), and Labrador Tea (*Ledum groenlandicum*) (Nova Scotia Environment 2012c). The 'Atlantic Plateau Bog', an uncommon type of raised bog, is found only in the southern coastal regions of the province, in Yarmouth and Shelburne County. They rise up sharply from the surrounding terrain to heights of about four metres with the top nearly flat like a plateau and often with a number of pools (National Wetlands Working Group 1997). Fens are peatlands fed by nutrient-

rich water moving through mineral soil and dominated by sedges and grasses (Nova Scotia Environment 2012c). They are found primarily along the edges of lakes and rivers, or the perimeter of bogs, and are differentiated from marshes by the accumulation of peat, lower nutrient load, and lower pH. Nutrient rich fens also occur (S. Basquill, per comm.)

Eastern Mountain Avens, a flowering herbaceous perennial plant, is one of the most globally endangered plants in the Canadian Maritimes. The species occurs in Nova Scotia as a highly disjunct population in moist to wet *Sphagnum* peat in sparsely treed coastal peatlands on Digby Neck and Brier Island (COSEWIC 2000). Eastern Mountain Avens is threatened primarily by habitat loss and degradation caused by the draining of peatlands and tree and shrub encroachment of their habitat. Thread-leaved Sundew is an endangered species of Atlantic Coastal Plain Flora that is known to occur in only five peatland sites in Nova Scotia, highly disjunct from the main range of this species (Environment Canada and Parks Canada Agency 2010). Atlantic Coastal Plain Flora species are constrained by biologically limiting factors, including small population sizes, northern range limitations, and reduced reproductive capabilities, as well as anthropogenic threats, including infilling, peat mining, and commercial cranberry production for peatland associated species (Environment Canada and Parks Canada Agency 2010).

Marshes and Swamps

Freshwater marshes are frequently inundated wetlands characterized by grassy or reedy (emergent herbaceous) vegetation adapted to saturated soils (Anderson *et al.* 2006). They receive their water from the surrounding watershed as surface runoff, stream inflow, precipitation, and groundwater discharge (Nova Scotia Environment 2012c). Inland marshes are particularly important for breeding waterfowl such as American Black Duck, Ring-necked Duck, and Green-winged Teal (NS EHJV 2008), and although the Annapolis Valley contains a small percentage of the province's freshwater wetlands, it contains a relatively high proportion of the province's shallow and deep marsh habitat (NS EHJV 2008). Swamps are seasonally flooded wetlands with more woody plants than a marsh and better drainage than a bog (Anderson *et al.* 2006). They are dominated by trees and shrubs with generally over 30% cover in woody species, wood-rich peat or mineral soils, and water tables typically at or below the surface. They may be seasonally or permanently flooded with as much as 30 cm of water (Nova Scotia Environment 2012c). Significant portions of the bioregion are occupied by stunted forests of Black Spruce on bogs (Neily *et al.* 2003), and large tracts of red maple swamps, known as red maple swales, can be found associated with rivers and in basins and lakeside depressions in the west of the bioregion.

With high nutrient levels giving rise to high vascular plant diversity and productivity, freshwater wetlands are also important habitat for a number of regional species at risk including Eastern Ribbonsnake, Blanding's Turtle, and Snapping Turtle. The Eastern Ribbonsnake is a small, slender, semi-aquatic snake typically found in wetlands with abundant aquatic and terrestrial vegetation (Parks Canada Agency 2012b). It is at the northern limit of its range in Nova Scotia and occurs as a small, disjunct, post-glacial relic population confined to the southwest interior of Nova Scotia in the three watersheds of the LaHave, Medway, and Mersey Rivers. Threats impacting the survival of this species are not well understood but likely include alteration, degradation, or loss of shoreline and wetland habitat, and small population effects (Parks Canada Agency 2012b). Like the Eastern Ribbonsnake, the Blanding's Turtle occurs in Nova Scotia as a small disjunct population at the northeast periphery of the species' range, likely totaling fewer than 250 mature adults. The Nova Scotia population is genetically distinct and consists of three small, isolated subpopulations found within two watersheds in central southwest Nova Scotia (COSEWIC 2005). This medium-sized freshwater turtle inhabits shallow waters in lakes, permanent and ephemeral ponds, streams, and wetlands. They nest in a variety of loose substrates, including sand, organic soil, gravel, and cobblestone. Nest predation by mammals is the most significant cause of nest failure, which may exceed 50% in Kejimkujik National Park (COSEWIC

2005). Females, attracted to the gravel shoulders of roadways for nesting habitat, are at increased risk of mortality by vehicles. Human alteration of lakeshores used for nesting is also considered a significant contributing factor in the decline of Blanding's Turtle, as well as increasing habitat degradation, and mortality of adults. 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. Like the Blanding's Turtle, nest failure and adult mortality are intensified by females nesting in gravel shoulders along roadways and in quarries (COSEWIC 2008).

Vernal Pools

Often overlooked, but of comparable ecological significance, are seasonal vernal pools that occur throughout the bioregion, particularly in the Acadian Forest mosaic. Vernal pools are small (typically less than 0.5 ha), isolated, and shallow wetlands that lack permanent inlet or outlet streams and often dry out in the summer (Nova Scotia Environment 2012d). They provide critical breeding habitat for a variety of amphibians, including the Wood Frog (*Lithobates sylvaticus*) and various salamanders (*Ambystoma* spp.), which have adapted to living in these temporary, predator-free pools. They also provide foraging sites and refugia for a variety of wetland and non-wetland dependent herptiles, reptiles, birds, and mammals (Gibbs 2000; Semlitsch & Bodie 1998; Snodgrass *et al.* 2000). At present there is very little known about the overall distribution and types of vernal pools present in Nova Scotia, much less the bioregion. The location of potential vernal pools has been mapped by the Nova Scotia Department of Natural Resources through their wet areas mapping, which predicts where water will naturally flow and/or accumulate in the landscape based on digital elevation data and the known location of surface water (NSDNR 2012). In 2011, Nova Scotia Environment launched a Vernal Pool Mapping and Monitoring Project with the goal of developing a provincial database of vernal pools to improve the conservation and understanding of these fragile and important habitats.

According to the Nova Scotia provincial wetland inventory, 127,071 ha of freshwater wetlands occur within the SWNS bioregion, though note that the area of treed swamp is considered underestimated (S. Basquill, per. comm.). Conservation of freshwater wetlands within the bioregion will contribute to the conservation of 111 priority species (Table 9).

Nested Conservation Priority Species

- Blanding's Turtle (EN)
- Eastern Ribbonsnake (TH)
- Snapping Turtle (SC)
- Eastern Mountain Avens (EN)
- Thread-leaved Sundew (EN)
- Long's Bulrush (SC)

Landscape context assessment of freshwater wetlands: Very Good

Freshwater wetlands within the bioregion include bogs, fens, marshes, shrub- and forest-dominated swamps, and seasonal vernal pools, with bogs being the most commonly encountered wetland type (Figure 8). Information on the amount of freshwater wetlands occurring in Nova Scotia prior to European settlement is limited; however, historic wetland losses appear to have been high for some types. Losses of freshwater wetlands are thought to be highest in the most fertile regions, such as the Annapolis Valley (Government of Nova Scotia 2011). In 2011 the Province of Nova Scotia released the Nova Scotia Wetland Conservation Policy, which provides a direction and framework for the conservation and management of wetlands in Nova Scotia, and identifies specific objectives intended to prevent the net loss of Nova Scotia's wetlands (Government of Nova Scotia 2011). This policy should help limit any further loss of freshwater wetlands in the province. Nova Scotia Environment has the

primary regulatory and enforcement responsibilities for wetlands. In addition, current forest harvesting regulations in Nova Scotia require that all forestry operations leave a minimum 20 m forested buffer along watercourses and wetlands, though some level of harvesting is permitted within these buffers. The average Landscape Context Index (LCI) for freshwater wetlands in the SWNS bioregion is 2.52**,** which is very low and 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). In total 23,310 ha (18.3%) of freshwater wetlands in the bioregion are currently under protected or conservation status.

Condition assessment of freshwater wetlands: Good

The water quality of wetlands may be impacted by a number of factors including inflowing water and runoff, groundwater inflow, precipitation, and vegetation. Surface waters within the bioregion are generally soft with low buffering capacity, which is typical of water draining from igneous rocks (Kerekes & Schwinghamer 1973). In addition, freshwater systems in the bioregion have been heavily impacted by acid precipitation originating from industrialized regions of the continent and have some of the most acidic freshwaters in North America (Clair *et al.* 2001). Acidic precipitation may negatively impact some types of freshwater wetlands, such as nutrient-poor swamps and fens, which do not possess adequate buffering capacity to neutralize acid precipitation (Davis & Browne 1996). The collective impacts of these factors may result in poor water quality for some freshwater wetland dependent species. Certain human activities, including residential and cottage development, forest harvesting, agricultural practices, road construction, infilling, and climate change may impact the hydrology or nutrient flows of freshwater wetlands, which can lead to changes in the vegetation community and potentially impact habitat of sensitive species (i.e., Atlantic Coastal Plain Flora). Bogs and fens face the additional threats of peat mining and cranberry production, which significantly degrade these freshwater wetlands, though these anthropogenic activities are localized and not currently widespread throughout the bioregion.

Size assessment of freshwater wetlands: Good

In total there are 127,071 ha of freshwater wetlands in the bioregion, which make up 7.9% of the bioregion. Of these, 16,369 ha were identified as critical in the NAAP. The screening criterion for the minimum size of critical occurrences of freshwater wetlands was 20 ha (Anderson *et al.* 2006). A 275 metre buffer was included around freshwater wetlands to protect the ecological functions and integrity of this priority habitat (EC, OMNR & OME 1998). The total area and average size of each of the dominant types of wetlands found in the bioregion is presented in Table 10. The average size of freshwater wetland occurrences is 5.6 ha, which is considerably less than the NAAP minimum size criteria for critical occurrences. Nonetheless, the SWNS bioregion, which makes up 29.3% of the total area of the province, contains 51% of the province's critical occurrences of freshwater wetlands.

Table 10. Total area and average size of occurrences of dominant freshwater wetland types in the Southwest Nova Scotia bioregion.

Wetland Type	Total Area (ha)	Average Size (ha)
Peatlands (bog/fen)	69,184	13.4
Marsh	15,886	3.1
Shrub Swamp	3440	2.3
Treed Swamp	38,560	3.5
All Freshwater Wetlands	**127,070**	**5.6**

Current threats to freshwater wetlands in the bioregion

- 1.1 Cottage and residential development
- 2.1 Agricultural practices – annual and perennial non-timber crops
- 2.1 Commercial cranberry production
- 3.2 Peat mining
- 5.3 Forest harvesting practices
- 6.1 Off-highway vehicle use
- 7.2 Dams and other aquatic barriers
- 8.1 Invasive plants
- 8.2 Problematic native species
- 9.1 Household sewage & urban waste water
- 9.3 Agricultural and forestry effluents
- 9.5 Air pollution and acid precipitation

Emerging threats to freshwater wetlands in the bioregion

- 11.1 Habitat shifting and alteration (Climate Change)

Overall assessment of freshwater wetlands in the SWNS bioregion: Good

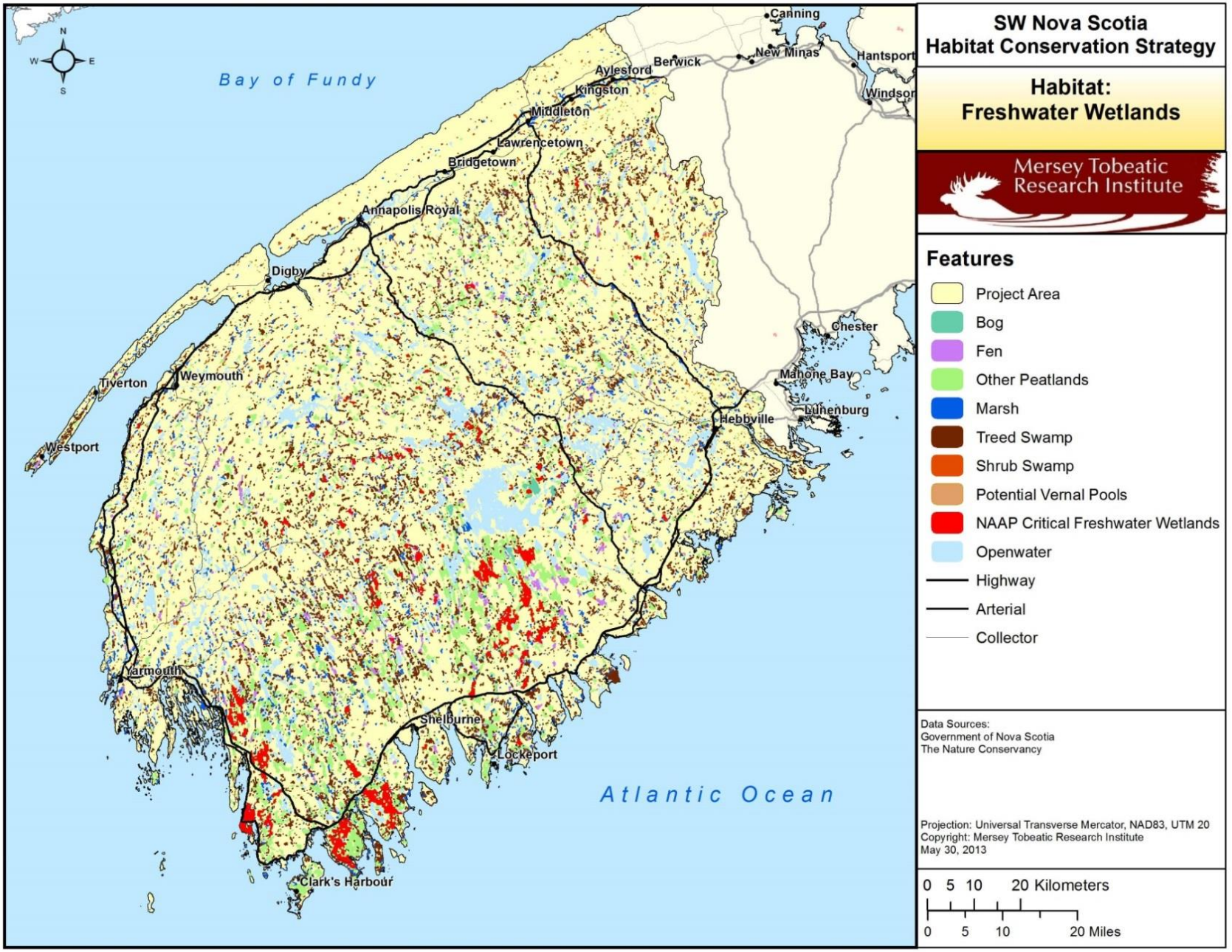

Figure 8. Freshwater wetlands within the Southwest Nova Scotia bioregion.

vi. Priority Habitat: *Riparian and Floodplain Systems*

Riparian systems refer to freshwater aquatic ecosystems (e.g., rivers, streams, wetlands, and lakes), their adjacent terrestrial ecosystems, and the interface, or transition zone between them (Gregory *et al.* 1991). Within terrestrial riparian areas, vegetation is influenced by the presence of water and is distinct from adjacent uplands (Environment Canada 2013). Riversides and floodplains are some of the most dynamic areas of the landscape and within Southwest Nova Scotia there is a high concentration of ecoregionally critical occurrences of these ecosystems (Anderson *et al.* 2006). These terrestrial ecosystems are dependent on the seasonal rise and fall of water levels, with high spring and storm waters submerging floodplains, depositing fresh sediment and nutrients, enriching the soils (Anderson *et al.* 2006). Not easily delineated, terrestrial riparian areas may be treed, shrubby, or herbaceous, depending on site conditions, though in northeastern North America, natural riparian areas are typically forested (Environment Canada 2013). Forested riparian areas are used by a broad range of terrestrial and semi-aquatic taxa, and typically support higher diversity and density of amphibians, reptiles, birds, and mammals than adjacent uplands (McEachern 2003). It has been estimated that 70 percent of terrestrial vertebrates use riparian areas during some part of their life (Naiman *et al.* 1993). Forested riparian areas are particularly important habitat for a number of breeding bird species, given the diversity and abundance of invertebrates available for food, diverse and complex vegetation, and favourable microclimates (Akerman 2007). They may also serve as important dispersal corridors for a range of taxa (Naiman *et al.* 1993), and are important for the conservation of sensitive aquatic species, such as Atlantic Salmon, Brook Trout, and Atlantic Whitefish. Though dynamic in width and extent, these generally linear features also play a vital role in water filtration and freshwater temperature and flood control (Semlitsch & Bodie 2003; Taylor 2002).

The highest concentrations of Atlantic Coastal Plain Flora (ACPF) species can be found along exposed, gently sloping lakeshores composed of sand, cobble, gravel, or peat, mainly in the lower Tusket River valley, and the Medway, and Roseway River watersheds in Southwest Nova Scotia (Blaney & Mazerolle 2009; EC & PCA 2010). Along lakeshores ACPF are dependent upon natural disturbances such as seasonally fluctuating water levels, wave action, and ice scour to maintain their habitat characteristics and reduce competition (EC & PCA 2010; Wisheu & Keddy 1989). Lakeshore species of ACPF face the greatest number of threats, including cottage and residential development, shoreline alterations, off-highway vehicle (OHV) use, infilling, eutrophication from mink farms, and invasive species (e.g., Glossy Buckthorn; S. Eaton, per. comm.; EC & PCA 2010). With over 70% of the province privately owned, the majority of ACPF species and locations occur on private land (EC & PCA 2010).

The Wood Turtle 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. Threats to Wood Turtle across its range include increased mortality of adults on roadways and off-highway vehicle trails, loss of nesting and riparian habitat, and nest predation (COSEWIC 2007). In addition to freshwater wetlands, Blanding's Turtle and Eastern Ribbonsnake are also associated with riparian areas. Conservation of terrestrial riparian systems within the SWNS bioregion will contribute to the conservation of at least 149 priority species (Table 9).

Nested conservation priority species

- Blanding's Turtle (EN)
- Eastern Ribbonsnake (EN)
- Wood Turtle (TH)
- Pink Coreopsis (EN)
- Plymouth Gentian (EN)
- Sweet Pepperbush (TH)
- Water Pennywort (SC)
- Eastern White Cedar (VU NS)
- Black Ash (TH NS)

Landscape context assessment of riparian and floodplain systems: Good
The bioregion contains nine provincially delineated primary watersheds, encompassing a large network of freshwater lakes, rivers, and streams, including some of the longest rivers, and largest and highest concentration of freshwater lakes in the province (Figure 9). Given their proximity to water and related soil characteristics, terrestrial riparian ecosystems are threatened by cottage, residential, and agricultural development, and forestry activities, which in turn makes them vulnerable to contamination from agricultural and forestry effluents (Environment Canada 2013). The rich floodplains of the Annapolis Valley have undergone extensive conversion to agriculture over the past 400 years, and consequently little of the original floodplain forest remains intact (Neily *et al.* 2003). Nonetheless, the SWNS bioregion contains a high concentration of ecoregionally critical occurrences of riparian and floodplain forest (Anderson *et al.* 2006).

Condition assessment of riparian and floodplain systems: Fair
Cottage and residential development, with their associated shoreline alterations (e.g., infilling, wharves, breakwaters, mowing), are considered to be the most significant and widespread threats to some of the most ecologically significant and sensitive riparian systems within the SWNS bioregion, particularly along lakeshores (EC & PCA 2010). The use of off-highway vehicles in sensitive riparian areas is also considered to be a widespread threat to this ecosystem type. Current forest harvesting regulations in Nova Scotia require that all forestry operations leave a minimum 20 m forested buffer along watercourses, though some level of harvesting is permitted within these buffers. At present, riparian buffers are not required on land cleared for agriculture, which is known to impact aquatic systems through direct erosion, increased sedimentation, pesticide runoff, nutrient loading and increased water temperatures due to the removal of riparian natural cover. At the present time, threats associated with the construction and operation of hydroelectric dams, including habitat conversion and the alteration of natural disturbance processes through the stabilization of water levels, are also generally considered to be low within some of the most sensitive riparian habitats in the bioregion (EC & PCA 2010).

Although exotic species are present along watercourses, invasive species are generally not dominant, although a number of invasive species are emerging as major threats within the province, such as Glossy Buckthorn (*Frangula alnus*), Common Reed (*Phragmites australis*), Garlic Mustard (*Alliaria petiolata*) and Purple Loosestrife (*Lythrum salicaria*), all of which can have various degrees of negative impacts on riparian zones. Additionally, aquatic invasive species are of considerable concern, such as Smallmouth Bass (*Micropterus dolomieu*), Muskellunge (*Esox masquinongy*), and Chain Pickerel (*Esox niger*), the latter of which is considered a high threat. These species are voracious predators and both directly prey upon and out-compete native fish species.

Size assessment of riparian and floodplain systems: Very Good
The SWNS bioregion contains a high concentration of ecoregionally critical occurrences of riparian and floodplain forest (Figure 9; Anderson *et al.* 2006). Of the 56,960 ha of ecoregionally critical occurrences of riparian and floodplain forest identified in the NAAP, 55,547 ha are located within the bioregion; therefore, the bioregion, which makes up 29.3% of the total area of Nova Scotia, contains 97.5% of the province's critical occurrences of riparian and floodplain forest.

Current threats to riparian and floodplain systems in the bioregion

- 1.1 Cottage and residential development
- 2.1 Annual and perennial non-timber crops
- 2.3 Mink Farming
- 2.3 Livestock farming and ranching
- 4.1 Roads and railroads

- 5.3 Forest harvesting practices
- 6.1 Off-highway vehicle use
- 7.2 Dams and other aquatic barriers
- 8.1 Invasive predatory fish species
- 8.1 Invasive plants
- 8.2 Problematic native species
- 9.1 Household sewage and urban waste water
- 9.3 Agricultural and forestry effluents
- Air pollution and acid precipitation

Emerging threats to riparian and floodplain systems in the bioregion

- 11.1 Habitat shifting and alteration (Climate Change)

Overall assessment of riparian and floodplain systems in the SWNS bioregion: Good

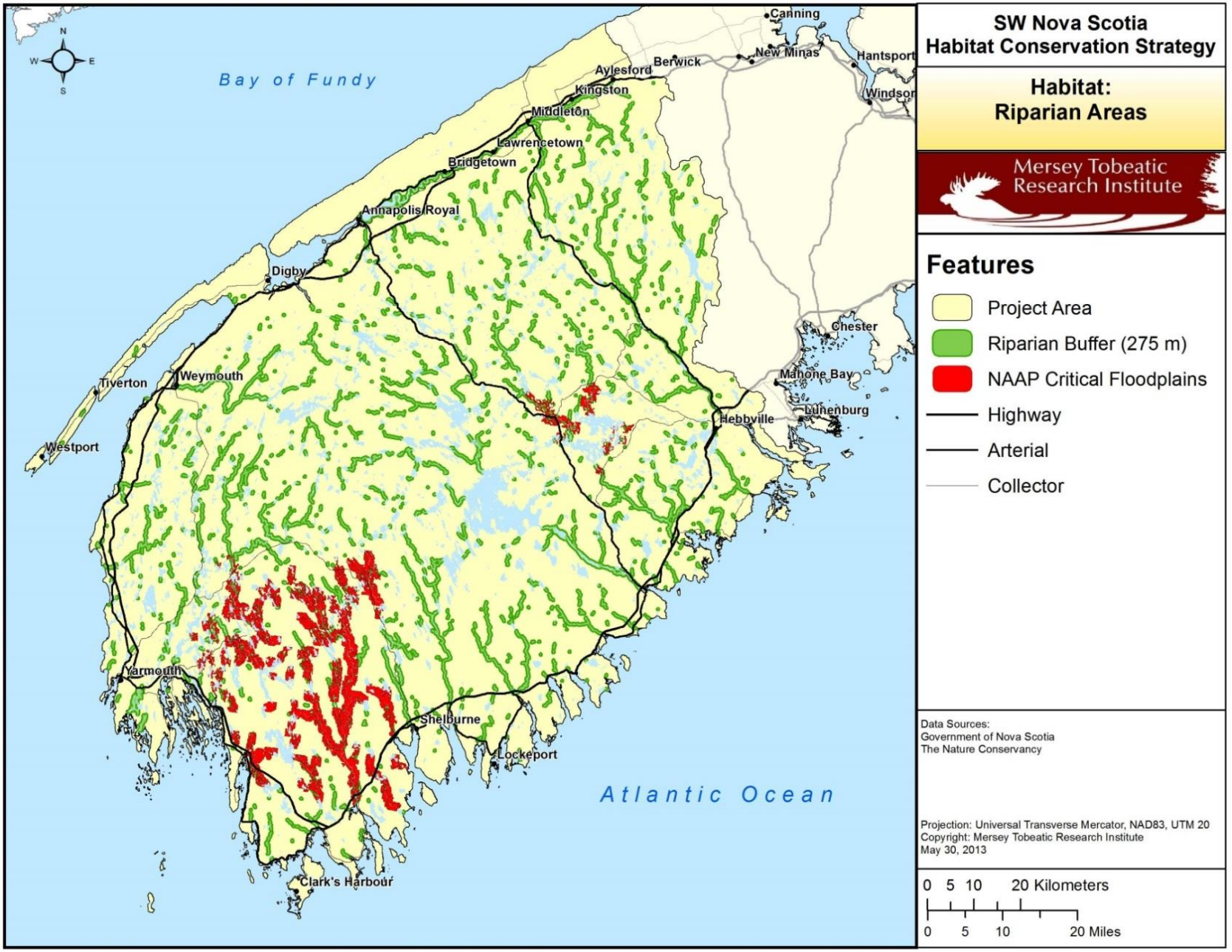

Figure 9. Riparian and floodplain systems within the Southwest Nova Scotia bioregion.

vii. Priority Habitat: *Acadian Forest Mosaic*

Nova Scotia falls within the Acadian Forest Region, which spans the Canadian Maritime provinces (Rowe 1972). The Acadian Forest is a rich and diverse temperate forest with a unique mixture of boreal species from the north and deciduous species from the south, with Red Spruce (*Picea rubens*) often considered the defining species of this forest region (Mosseler *et al.* 2003). The climax condition consists of mature forests dominated by shade-tolerant, long-lived tree species such as Red Spruce, Eastern Hemlock (*Tsuga canadensis*), Sugar Maple (*Acer saccharum*), and American Beech (*Fagus grandifolia*). Other long-lived although less shade-tolerant species can also fare well, such as Yellow Birch (*Betula alleghaniensis*), Eastern White Pine, Northern Red Oak (*Quercus rubra*), and White Ash (*Fraxinus americana*). Intermediate species such as Balsam Fir, Red Maple (*Acer rubrum*), and Black Spruce may also be considered climatic or edaphic climax species in some environments, such as bogs, fens, and coastal areas (Mosseler *et al.* 2003).

On the Fundy Coast, a narrow band of coastal forest dominated by White Spruce (*Picea glauca*) quickly transitions to a mixedwood forest of Balsam Fir, Red Spruce, Red Maple, Yellow Birch, and White Birch (*Betula papyrifera*), with American Beech and Sugar Maple found on upper slopes (Neily *et al.* 2003). One of Nova Scotia's rarest native trees, Eastern White Cedar (*Thuja occidentalis*), grows in a few locations near the southwestern end of the North Mountain (Neily *et al.* 2003) and in the Annapolis Valley (S. Basquill, per. comm.). In the Annapolis Valley, extensive forest clearing for agriculture has left little of the original forest intact (Neily *et al.* 2003). Well-drained sandy soils support pure stands of White Pine, Red Oak, and Red Pine (*Pinus resinosa*), whereas areas near the Annapolis River once supported a riparian hardwood forest with American White Elm (*Ulmus americana*), Black Cherry (*Prunus serotina*), Sugar Maple, and White Ash. Forest stands of Red Spruce, Hemlock, and White Pine are most prominent in the interior of the bioregion where climax forest of tolerant hardwoods can also be found on drumlins and the upper slopes of well-drained hills (Neily *et al.* 2003). On the Atlantic Coast the soils are thin and stony, supporting typical coastal forests dominated by White and Black Spruce, with scattered occurrences of Balsam Fir, which may be stunted on exposed headlands. In the far southwest, the Gulf of Maine has a moderating effect on the climate, allowing the growth of Red Spruce and other tolerant species such as White Pine, Sugar Maple, and Yellow Birch in the coastal forest (Neily *et al.* 2003).

Since early European settlement the majority of Nova Scotia's forests have been logged extensively, simplifying forest structure and composition. Relatively recent industrial forestry practices, 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). Regenerating forest stands lack certain characteristics that are typical of old forest stands, even when they have reached their full height. These include large-diameter trees, large woody debris, and canopy openings with consequent understory regeneration, features that provide the necessary conditions for a variety of plant and animal species, such as cavities for nesting birds, bats, and other small mammals, food for ground beetles, and substrates for lichens and mosses (NBDNR 2013). Old stand types are far less abundant than they were historically found in this region (Mosseler *et al.* 2003), and in Nova Scotia it is estimated that less than 1% of our forests are greater than 100 years old (Lynds & LeDuc 1995). The World Wildlife Fund has designated the Acadian Forest as critically endangered due to the long history of settlement and land clearing that has occurred here, with only approximately 5% of the forest remaining in pre-settlement condition.

According to the Nova Scotia Department of Natural Resources' Forest Resource Inventory 346,478 ha of late successional forest (i.e., development class mature or multi-aged with a seral score of 38-50) occur within the SWNS bioregion. Conservation of forested ecosystems within the bioregion will contribute to the conservation of 113 priority species (Table 9).

Nested conservation priority species

- Canada Warbler (TH)
- Olive-sided Flycatcher (TH)
- Boreal Felt Lichen (EN)
- Vole Ears Lichen (EN)
- Mainland NS Moose (EN NS)
- Northern Myotis Bat (EN)
- Tricoloured Bat (EN)
- Eastern White Cedar (VU NS)
- Black Ash (TH NS)

Landscape context assessment of Acadian Forest Mosaic: Good

Nova Scotia's largest remaining intact forests are found in the SWNS bioregion, forming six Tier 1 matrix forest[1] blocks, as identified in the NAAP (Anderson *et al.* 2006). Through analysis of the historic size ranges of documented natural disturbance events, along with the area requirements of forest-interior breeding species in the region, Anderson *et al.* (2006) determined that a 10,000 ha (25,000 acre) minimum matrix block in the Acadian Forest would be able to withstand any natural disturbance (hurricanes, fire, ice storms) while maintaining all natural ecological processes. These large areas of contiguous forest, with few roads and mostly intact interior forest, allow for the maintenance of ecological processes and viable occurrences of forest communities, and are important as 'coarse filters' for the conservation of a wide range of plant and animal species, from soil invertebrates and little known fungi to forest interior birds, large herbivores, and wide ranging predators (Anderson *et al.* 2006). The goal of the matrix forest selection was to identify viable examples of dominant forest types that, if protected and allowed to regain their natural condition, would serve as critical source areas for associated species requiring interior forest conditions (Anderson *et al.* 2006).

In total 61,845 ha (17.8%) of the SWNS bioregion's late-successional forest types are currently under protected or conservation status. Outside of these protected areas, widespread clearcut harvesting has occurred (see Threats), significantly impacting the region's forests. Forest road density is also high (see Threats), particularly in consideration of the low population density in the interior of the southwest region of Nova Scotia. Nonetheless, while significant temporary landscape conversion has occurred, there are large tracts of forest with minimal permanent conversion to non-forest land-use, posing opportunity for ongoing and continued conservation efforts.

Condition assessment of Acadian Forest Mosaic: Fair

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 clearcut 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%. Regenerating forest stands lack certain characteristics that are typical of old forest stands, even when

[1] *Matrix Forest: a widespread forest community which dominates the landscape and forms the background in which other smaller scale communities occur.*

they have reached their full height. These include large-diameter trees, large woody debris, and canopy openings with consequent understory regeneration, features that provide the necessary conditions for a variety of plant and animal species, such as cavities for nesting owls and colonies of Northern Myotis bats, food for ground beetles, and substrates for lichens and mosses (NBDNR 2013). Recognizing the critical role of old-forest habitat in sustaining biodiversity, the Province introduced an *Interim Old Forest Policy for Crown land* in 1999, with the goal of protecting and restoring old-growth forest on a minimum of 8% of public land. Within the bioregion forest stands that exhibit old growth characteristics are located primarily within the network of protected areas, but small stands also exist on privately-owned and Crown land (Belliveau & Farrow 2010; Pesklevits 2006). Forestry practices remain the dominant threat to the region's forested ecosystems, with outbreaks of both native and invasive insects (e.g., eastern spruce budworm, pale-winger gray moth, jack pine budworm) and disease also posing threats to the region's forests.

Size assessment of Acadian Forest Mosaic: Fair

Though Nova Scotia's largest remaining intact forests are found in the bioregion, stands of late-successional forest types are imbedded among a matrix of relatively young, even-aged, early-successional forest types (Figure 10). According to the Nova Scotia Department of Natural Resources' Forest Resource Inventory 346,478 ha of late successional forest (i.e., development class mature or multi-aged with a seral score of 38-50) occur within the bioregion, making up 21.4% of the total area of the bioregion. For each of the identified late-successional forest community types, minimum patch size criteria were identified to maintain the overall integrity of forest stands and provide sufficient habitat to maintain viable populations of old forest dependent vertebrate species[1] (see Appendix E for methodology and minimum size criteria). The area and average size of each of the dominant late-successional forest types within the bioregion is presented in Table 11, and in all cases the average size of late-successional forest stands is significantly less than the minimum size criteria, which ranged from 15 ha for late-successional stands of White Pine to 60 ha for late-successional mixedwood forest stands.

Table 11. Total area and average size of occurrences of late-successional forest types in the bioregion.

Late-successional Forest Type	Total Area (ha)	Average Size (ha)	Minimum Size (ha)
Tolerant hardwood			
Inland	24,354	6.9	40
Coastal	5,789	13.6	40
Tolerant mixedwood			
Inland	18,969	5.7	60
Coastal	2,275	9.1	60
Tolerant softwood			
Inland	278,677	7.9	50 (15 ha for WP)
Coastal	16,414	8.0	50
All late-successional forest types	**346,478**	**8.6**	

[1] *Adapted from the New Brunswick Department of Natural Resources'* Old Forest Community and Old-Forest Wildlife Habitat Definitions for New Brunswick *(2013) and the Coast Forest Conservation Initiative's* Maintaining the Integrity of Northern Goshawk Nesting and Post-fledging Areas in the Ecosystem Based Management Plan Area of Coastal British Columbia: Guidance for Forest Professionals *(2012).*

Current threats to Acadian Forest mosaic in the bioregion

- 2.2 Wood and pulp plantations
- 3.2 Mining and quarrying
- 4.1 Roads & railroads
- 5.3 Forest harvesting practices (Threat status: High)
- 6.1 Off-highway vehicle use
- 8.1 Invasive plants
- 8.4 Invasive pathogens
- 9.3 Agricultural and forestry effluents
- 9.5 Air pollution and acid precipitation
- 4.1 Roads and railroads

Emerging threats to Acadian Forest mosaic in the bioregion

- 11.1 Habitat shifting and alteration (Climate Change)

Overall Assessment of Acadian Forest mosaic in the Southwest Nova Scotia bioregion: Fair

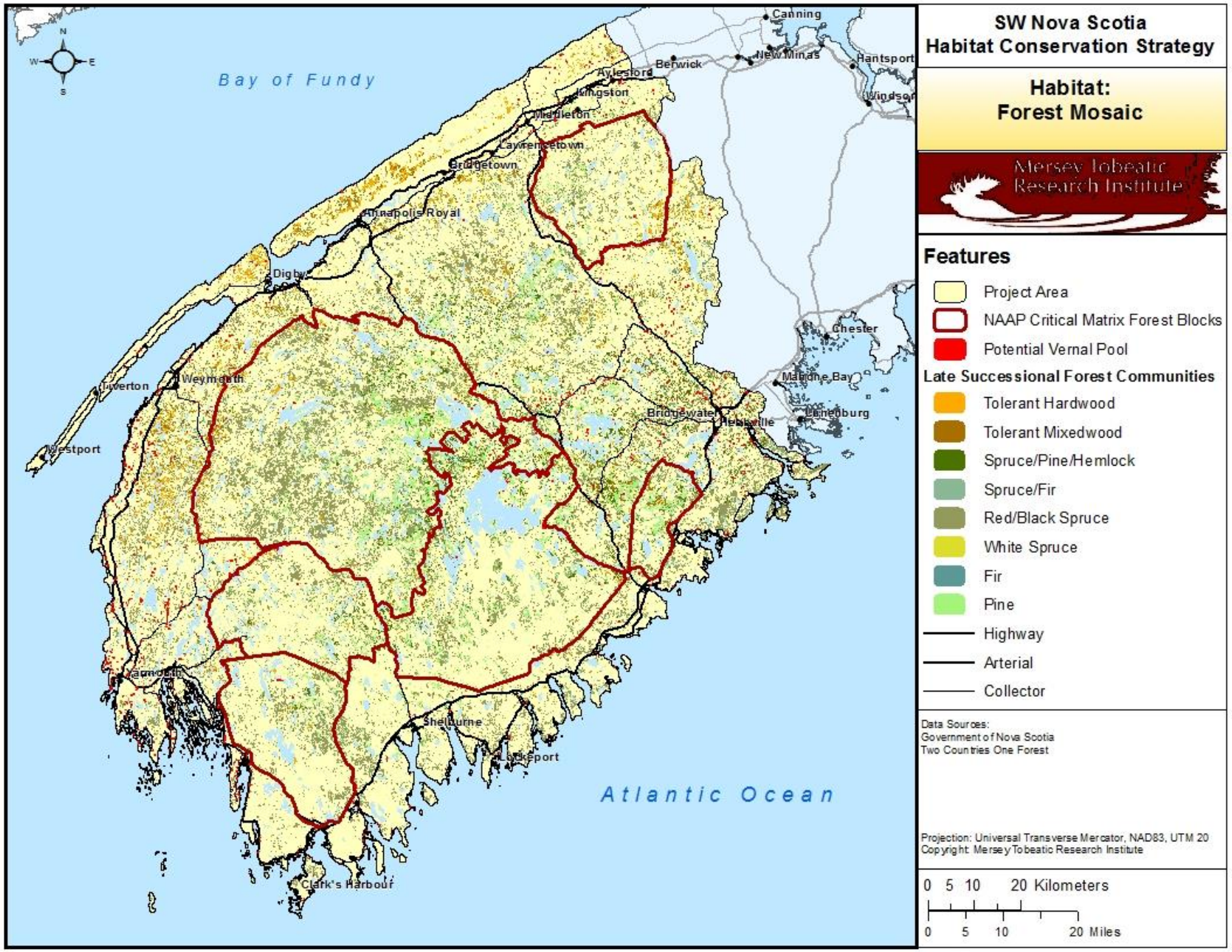

Figure 10. Late-successional Acadian Forest stands within the Southwest Nova Scotia bioregion.

viii. Priority Habitat: *Grasslands and 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, 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, located primarily within the Annapolis Valley. Smaller concentrations of agricultural activity occur in Lunenburg, Digby, and Yarmouth counties, with additional pockets embedded throughout the bioregion, often occupying the region's abundant and fertile drumlins (Neily *et al.* 2003).

Conservation of grassland and agro-ecosystem habitats within the bioregion will contribute to the conservation of 60 priority species (Table 9).

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 of grasslands and agro-ecosystems: Fair

Figure 11 shows the location of all lands used for agriculture, including lands used for tilled crops, pasture, hayfields, and orchards; therefore, only some proportion of these areas represent suitable habitat for grassland-associated species. Compared to historical levels, in Nova Scotia there are fewer but larger farms employing more intense farming practices occurring on approximately 7% (400,000 ha) of the provincial land base with forage (i.e., hay) making up over 170,000 (70,000 ha; Province of Nova Scotia 2012). Many marginal farmlands have been abandoned, giving way to old field forest succession (Neily *et al.* 2003), and further losses of grasslands occur when agricultural lands used for hay and pasture lands are converted to other uses, such as tilled cropland or development.

Condition assessment of grasslands and agro-ecosystems: 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 of grasslands and agro-ecosystems: Unknown

It is difficult to assess the size viability of grasslands within the bioregion as we do not currently have a good understanding of the total area and distribution of this habitat type. Nonetheless, there appears to be a general reversion of abandoned agricultural areas to early successional forest vegetation types in the bioregion, and consequently a reduction in the abundance and availability of grassland habitat. In 2006, active farmland represented only about one-third of that used in 1901 (NSALRC 2010), and agricultural lands continue to decline as a result of urban development (Environment Canada 2013).

Current threats to grasslands/agro-ecosystems in the bioregion

- 2.1 Annual and perennial non-timber crops
- 2.3 Livestock farming and ranching
- 8.1 Invasive plants
- 9.3 Agricultural and forestry effluents

Overall assessment of grasslands in the Southwest Nova Scotia bioregion: Fair

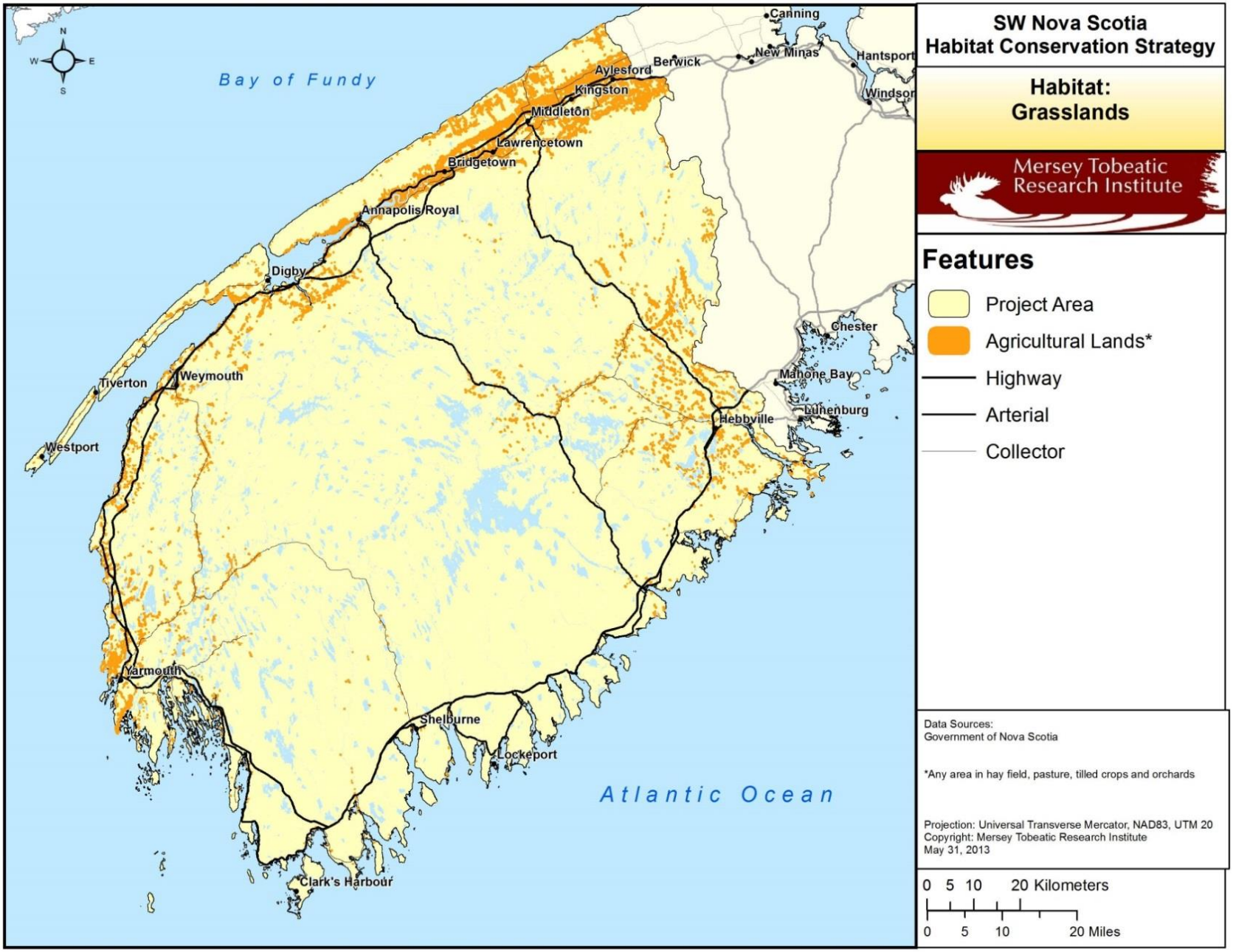

Figure 11. Agricultural lands within the Southwest Nova Scotia bioregion.

ix. Priority Habitat: *Barrens*

Extensive inland barrens located in southwest Nova Scotia, primarily in Yarmouth and Shelburne counties, are a conspicuous feature of the bioregion. Coastal barrens also occur, mainly along the Atlantic Coast, where they are generally isolated by coastal forests and development (Oberndorfer & Lundholm 2009). 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). 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 southwest Nova Scotia relict White and Red Pine (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.

Persistent barrens are thought to be regulated by climatic and edaphic conditions in exposed inland sites and near-coast exposed sites (Burley 2009). Four factors may be involved in the development of barren habitats: 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). The extensive inland barrens of southwest Nova Scotia show evidence of widespread burns in the past, which may have hindered the regeneration of forest and in many areas the presence of hardpan may prevent any natural recolonization by trees (Strang 1972). 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 host to rare species of vascular plants, lichens, and bryophytes in Nova Scotia (Oberndorfer & Lundholm 2009), including Forked Bluecurls (*Trichostema dichotomum*) and Greenland Stitchwort (*Minuartia groenlandica*) (B. Toms, per. comm.). A Cladonia lichen, *Cladonia oricola*, was recently discovered on barrens in Nova Scotia, representing only the second occurrence of this species in North America (unpublished data, Teuvo Ahti & Frances Anderson 2011), and the moss *Dicranum condensatum*, and lichen *Cladonia brevis*, and the shrubs *Vaccinium uliginosum* and *Betula michauxii*, some of the rarist species in Nova Scotia, are found exclusively on barrens (K. Porter, per. comm.). The majority of rare species on coastal barrens are classified as arctic-alpine and boreal species (Porter 2013). A recent survey of one coastal barren site detected several species of lichens undocumented in Nova Scotia, including the first North American record of the lichen *Rhizocarpon suomiense* (MacDonald *et al.* 2011), suggesting that there is considerable biodiversity in coastal barrens, and in particular lichens and bryophytes, that have yet to be documented and described (J. Lundholm, per. comm.).

The dry, *Corema*-dominated sand barrens of the Annapolis Valley a small area of Queens County are a unique and rare type of barren habitat in the province (Newell 2007). They are strongly dominated by the Broom Crowberry (*Corema conradii*; Carbyn *et al.* 2006), a species of Atlantic Coastal Plain Flora that is relatively common in Nova Scotia (S4 – Secure), but is considered to be rare to uncommon in all other parts of its North American range (NatureServe 2013). It is estimated that greater than 97% of the original open sand barrens occurring in the Annapolis Valley have been lost as a result of fire suppression, agricultural and residential development, sand quarrying, and invasion by non-indigenous

species (Catling *et al.* 2004). The provincially endangered Rockrose is most often associated with the Annapolis Valley sand barrens.

Conservation of barren habitats within the bioregion will contribute to the conservation of at least 35 priority species (Table 9).

Nested Conservation Priority Species

- Savannah Sparrow princeps ssp. (SC)
- Rockrose (EN NS)
- Forked Bluecurls
- Greenland Stitchwort
- Newfoundland Dwarf Birch
- Alpine Bilberry

Landscape context assessment of barrens: Good

There are extensive inland barrens located in southwest Nova Scotia, primarily in Yarmouth and Shelburne counties (Figure 12). Coastal barrens also occur, mainly along the Atlantic coast (Oberndorfer & Lundholm 2009). The extensive inland barrens are largely located within the Tobeatic Wilderness Area, although an area known as the Shelburne Barrens remains unprotected. Barrens within the Tobeatic Wilderness Area have been lost to forest encroachment in the lifetime of some users, though this trend has not been assessed using aerial photography (B. Toms, per. comm.). Large coastal barren complexes are protected at Kejimkujik National Park Seaside Adjunct and Bowers Meadows Wilderness Area. In contrast, the *Corema*-dominated sand barrens of the Annapolis Valley region are comparatively rare (Newell 2007). It is estimated that greater than 97% of the original open sand barrens occurring in the Annapolis Valley have been lost as a result of fire suppression, agricultural and residential development, sand quarrying, and invasion by non-indigenous species (Catling *et al.* 2004). In total 12,474 ha (38.0%) of barrens in the bioregion are currently under protected or conservation status.

Condition assessment of barrens: Good

Extensive areas of barrens are protected within the bioregion, representing the greatest protection status (38%) of any of the habitat conservation priorities identified in this Habitat Conservation Strategy. Nonetheless, areas of barrens are threatened by habitat destruction and loss by housing, commercial, and mining development, including the extensive Shelburne Barrens which have been threatened by mining developments. Housing developments are among the greatest threats to coastal barrens across the province (Porter 2013). Coastal erosion of exposed headlands also poses a threat to coastal barrens, with Hill, Vander Kloet, and Garbary (2012) documenting a loss of 85% of the coastal barren habitat on Gaff Point over the last 35 years. 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 (Oberndorfer & Lundholm 2009; Porter 2013; Simon 2012).

At present, invasive non-native species do not appear to pose a significant threat to coastal barren communities (Oberndorfer & Lundholm 2009), though encroachment on coastal barrens by Rugosa Rose has been documented on Brier Island (Garbary 2011). This species is considered an invasive species of coastal barrens in Maine, and should be closely monitored in the bioregion. Scots Pine (*Pinus sylvestris*) has been shown to be an aggressive invader of the *Corema*-dominated sand barrens of the Annapolis Valley, shading out native vascular plants (Catling & Carbyn 2005; Newell 2007). Extensive farming, commercial and housing developments, road construction, and sand extraction are also ongoing and imminent threats to sand barrens in the Annapolis Valley (Newell 2007).

Size assessment of barrens: Not Applicable
In total there are 95,342 ha of barrens, which make up 2.4 % of the total area of the bioregion. The average size of inland barrens is 9.7 ha, coastal barrens is 9.0 ha, and sand barrens is 5.9 ha, though there were no minimum size criteria used for barrens, as it does not appear that size is a limiting factor when determining the ecological value of this habitat type (K. Porter, per. comm.).

Current threats to barrens in the bioregion

- 1.1 Cottage and residential development
- 3.2 Mining and quarrying
- 6.1 Off-highway vehicle use
- 8.1 Invasive plants
- 9.3 Agricultural & forestry effluents
- 9.5 Air pollution & acid precipitation

Emerging threats to barrens in the bioregion

- 11.1 Sea-level rise and coastal erosion
- 11.5 Storm-induced coastal erosion

Overall assessment of barrens in the Southwest Nova Scotia bioregion: Good

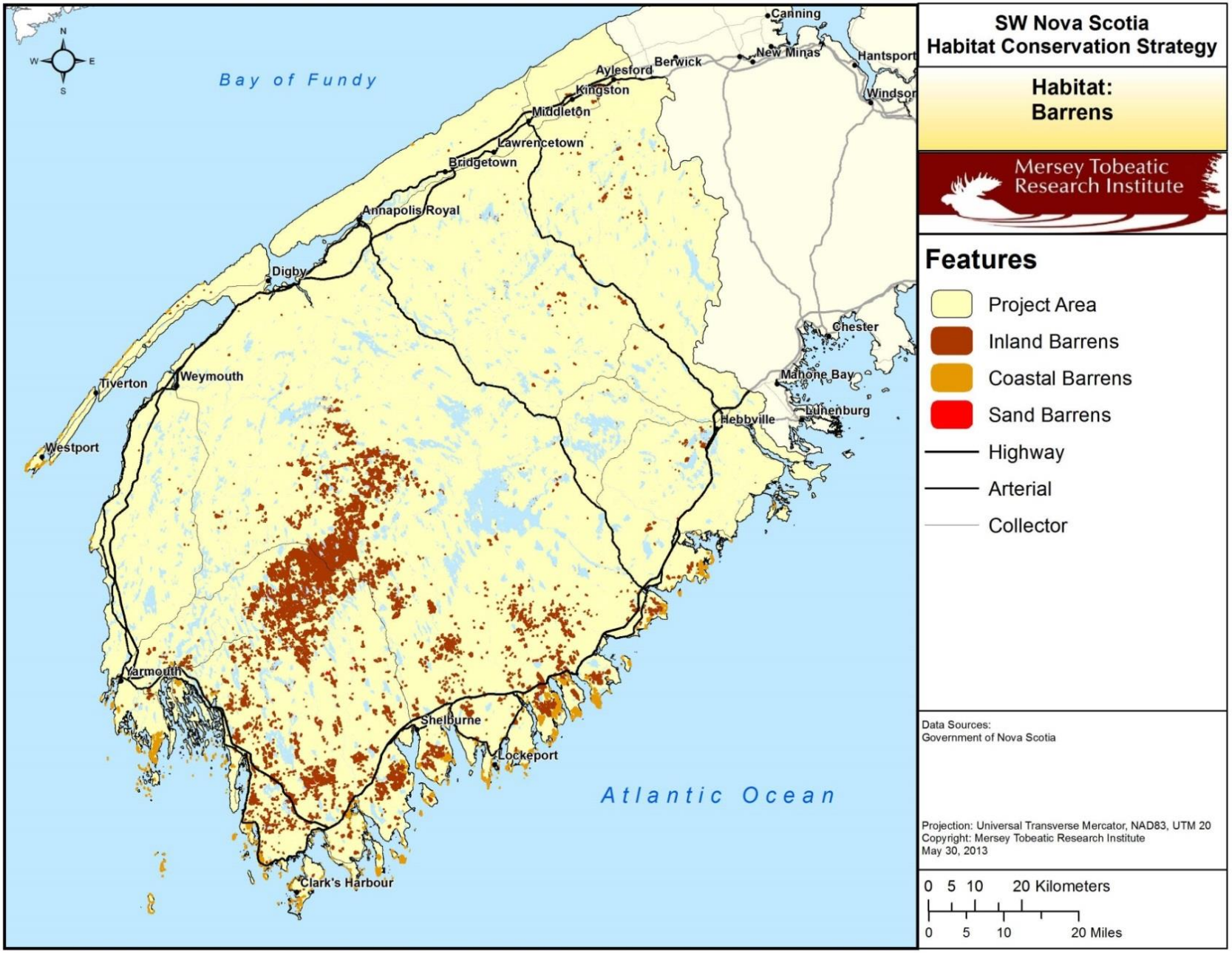

Figure 12. Barrens within the Southwest Nova Scotia bioregion.

x. Summary of conservation priority habitat assessments

The overall assessment of the conservation priority habitat types in the Southwest Nova Scotia bioregion is 'Good' (Table 12). 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. Four out of the nine habitat conservation priorities received 'Fair' assessment ranks, 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 12. Assessment ranks of ecological integrity for the conservation priority habitats in the Southwest Nova Scotia bioregion.

Priority Habitat	Landscape Context	Condition	Size	Assessment Rank
Beaches and dunes	Good	Fair	Fair	**Fair**
Tidal marshes	Fair	Fair	Good	**Fair**
Tidal flats	Good	Fair	Good	**Good**
Coastal islands	Good	Good	N/A	**Good**
Freshwater wetlands	Very Good	Good	Good	**Good**
Riparian and floodplain systems	Good	Fair	Very Good	**Good**
Acadian Forest mosaic	Good	Fair	Fair	**Fair**
Grasslands/agro-ecosystems	Fair	Fair	Unknown	**Fair**
Barrens	Good	Good	N/A	**Good**
Overall assessment of conservation priority habitats in the SWNS 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 SWNS bioregion project team using past studies, local expert knowledge, and a review of the literature. Threats identified for BCR 14 and MBU 11 (Environment Canada 2013) were also examined for specific relevancy to the SWNS bioregion and are listed in Table 14 and in Figure 13 and Figure 14. 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 Conservation Action Planning Workbook (Low 2003), and were categorized using established international taxonomy (Salafsky *et al.* 2008, IUCN-CMP 2012; Appendix H).

Table 13 provides a summary of the threats identified within the SWNS bioregion. The overall threat status for the SWNS bioregion is "medium". The geographic extent of identified threats is mapped, where known, in Figure 15 to Figure 23.

Table 13. Summary of threats to the Southwest Nova Scotia 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*

Table 12 (continued). Summary of threats to the Southwest Nova Scotia bioregion priority habitats.

Threats Across Priorities	Beaches /Dunes	Tidal Marshes	Tidal Flats	Coastal Islands	Fresh-water Wetlands	Riparian/ Floodplain Systems	Acadian Forest Mosaic	Grasslands/ Agro-ecosystems	Barrens	Overall Threat Rank
1.1 Cottage & residential development	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium	**Medium**
1.3 Beach/ recreational development	Medium	-	-	-	-	-	-	-	-	**Low**
2.1 Annual & perennial non-timber crops	-	Medium	-	-	Medium	Low	-	Medium	-	**Medium**
2.1 Commercial cranberry production	-	-	-	-	Low	-	-	-	-	**Low**
2.2 Wood & pulp plantations	-	-	-	-	-	-	Medium	-	-	**Low**
2.3 Mink farming	-	-	-	-	Low	Low	-	-	-	**Low**
2.3 Livestock farming & ranching	-	Medium	-	Low	Low	Low	-	Low	-	**Low**
2.4 Marine shellfish & finfish aquaculture	Medium	Low	Medium	Low	-	-	-	-	-	**Medium**
3.2 Mining & quarrying	-	-	-	-	-	-	Low	-	Low	**Low**
3.2 Peat mining	-	-	-	-	Low	-	-	-	-	**Low**
3.3 Wind energy production	Low	Low	Low	Low	-	-	Low	-	Low	**Low**
4.1 Roads & railroads	Low	Medium	Low	-	Low	Low	Medium	-	Low	**Medium**
4.3 Shipping activity oil spills & discharges	Low	Low	Medium	Low	-	-	-	-	-	**Low**
5.3 Forest harvesting practices	-	-	-	Low	Medium	Medium	High	-	-	**Medium**
5.4 Clam & baitworm harvesting	-	-	Low	-	-	-	-	-	-	**Low**
6.1 Recreational beach use	High	-	-	Low	-	-	-	-	-	**Medium**

Threats Across Priorities	Beaches /Dunes	Tidal Marshes	Tidal Flats	Coastal Islands	Fresh-water Wetlands	Riparian/ Floodplain Systems	Acadian Forest Mosaic	Grasslands/ Agro-ecosystems	Barrens	Overall Threat Rank
6.1 Off-highway vehicle use	Medium	-	-	Low	Low	Low	Low	-	Low	**Low**
7.2 Dams & other aquatic barriers	-	High	-	-	Low	Medium	-	-	-	**Medium**
8.1 Invasive European Green Crab	-	Low	High	-	-	-	-	-	-	**Medium**
8.1 Invasive predatory fish species	-	-	-	-	-	Medium	-	-	-	**Low**
8.1 Invasive plants	Low	Low	-	Low	Low	Low	Low	-	Low	**Low**
8.2 Problematic native species	Medium	-	-	Medium	Medium	Low	Low	Low	-	**Medium**
8.4 Invasive pathogens	-	-	-	-	-	-	Low	-	-	**Low**
9.1 Household sewage & urban waste water	-	Low	Low	-	Low	Low	-	-	-	**Low**
9.3 Agricultural & forestry effluents	-	Low	Low	-	Low	Low	Medium	Medium	Low	**Medium**
9.5 Air pollution & acid precipitation	-	-	-	-	Medium	Medium	Low	-	Low	**Medium**
11.1 Sea-level rise & coastal erosion	Medium	Medium	Medium	Medium	-	-	-	-	Low	**Medium**
11.5 Storm-induced coastal erosion	High	Medium	Low	Low	-	-	-	-	-	**Medium**
Overall threat status for priority habitats	**High**	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**

Table 14. 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 Habitat Classes			
	Coniferous forest	Deciduous forest	Mixedwood forest	Shrub/Early Successional	Herbaceous	Cultivated and Managed Areas	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 & genes	L	L	L	L	L	L	L	L	L	M	L		**L**	L	M		**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	

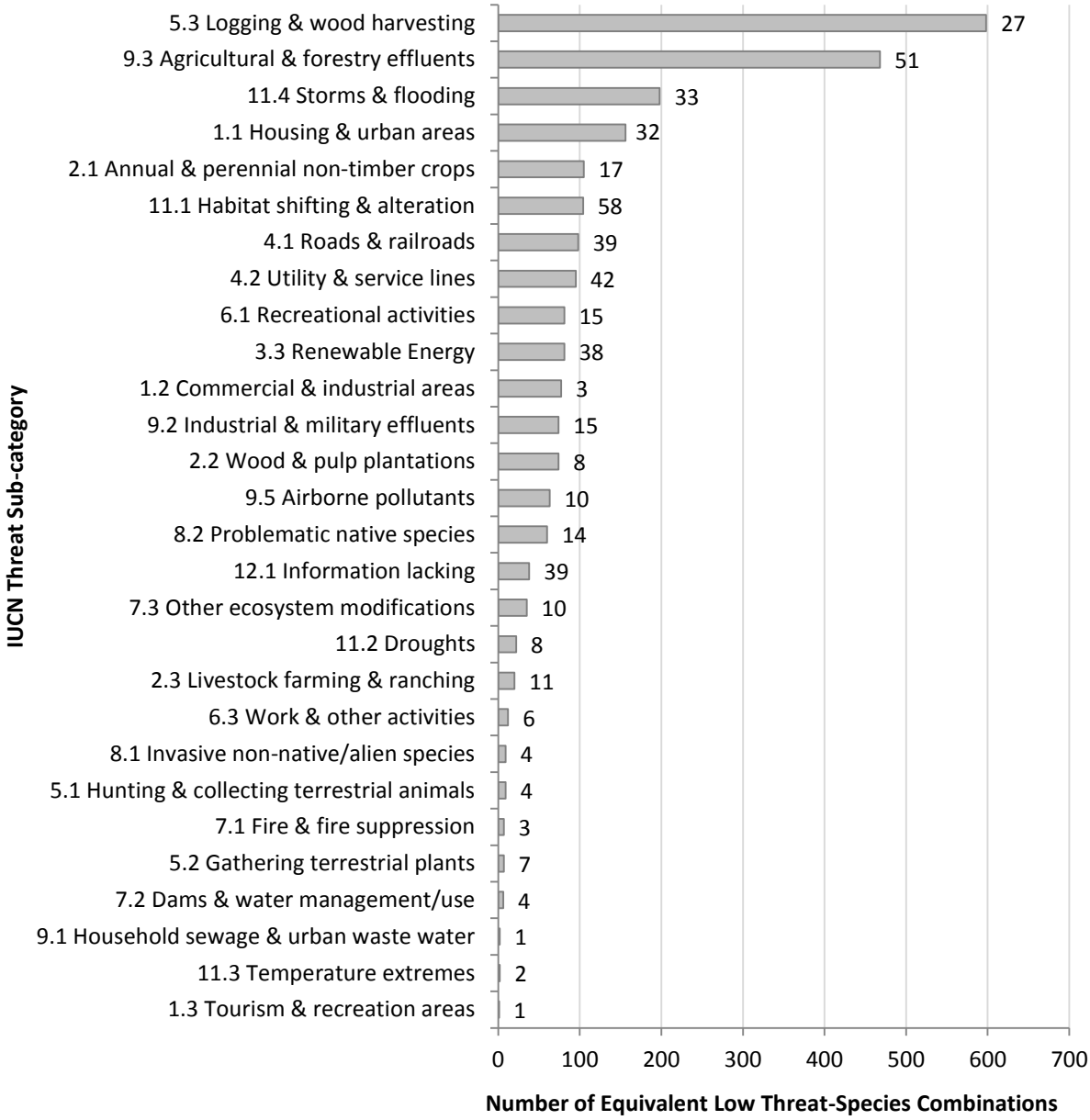

Figure 13. Ranked IUCN sub-categories of threats to priority bird species within BCR 14 NS based on the number of priority bird species affected and the magnitude of the threats (calculated using an inverse of the 3:5:7 rule; Salaksky 2003). The number of priority birds affected by threats within a particular IUCN threat sub-category is provided at the end of each bar. Modified from Environment Canada 2013 by A. R. Benoît.

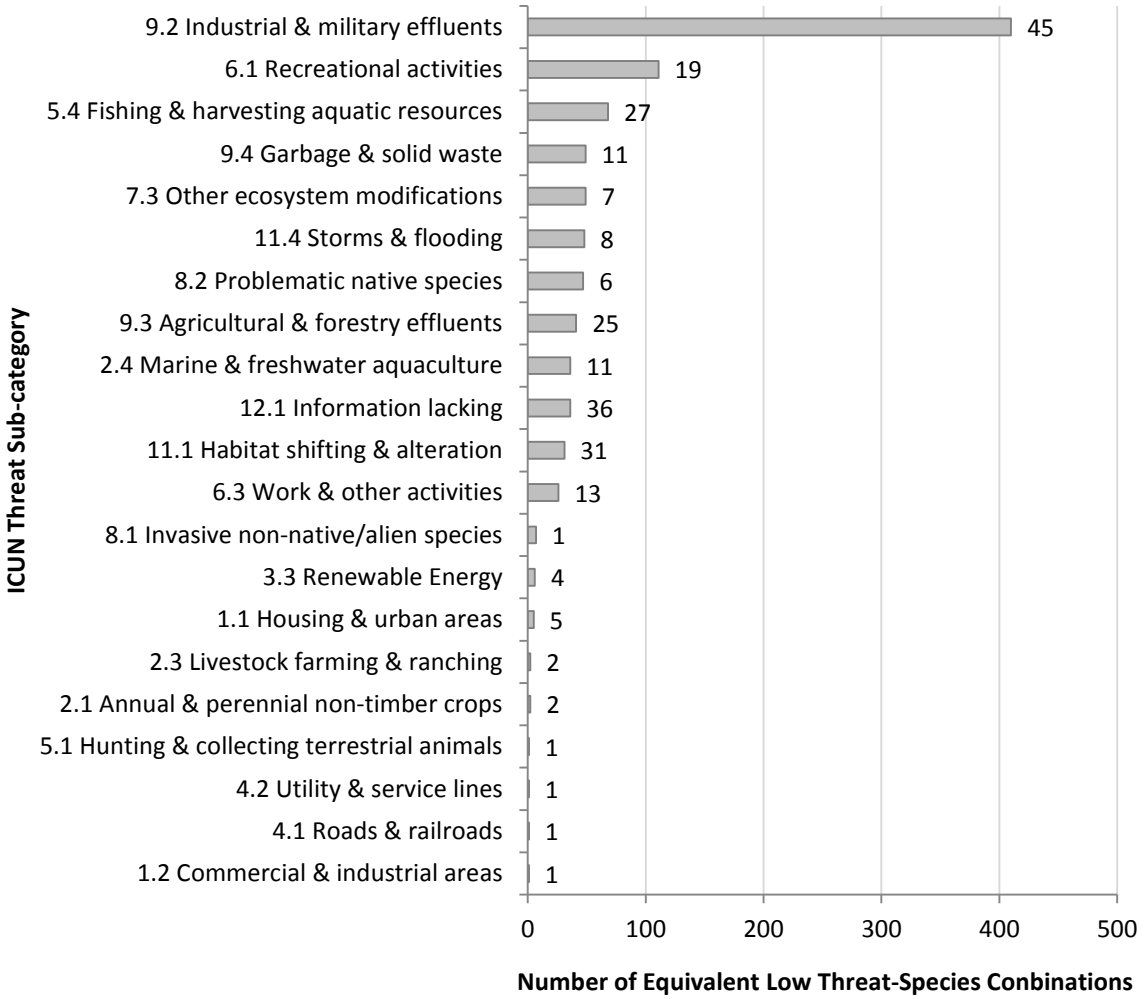

Figure 14. Ranked IUCN sub-categories of threats to priority bird species within MBU 11 NS based on the number of priority bird species affected and the magnitude of the threats (calculated using an inverse of the 3:5:7 rule; Salaksky 2003). The number of priority birds affected by threats within a particular IUCN threat sub-category is provided at the end of each bar. Modified from Environment Canada 2013 by A. R. Benoît.

i. Current Threats

1.1 Cottage and residential development
(Summary Threat Ranking: Medium)

The population of Nova Scotia has remained relatively stable over the last 10 years, however there has been a general migration to central Nova Scotia, particularly the Halifax Regional Municipality; consequently, the majority of the SWNS bioregion has seen some decrease in population. Nonetheless, increasing cottage and residential development is one of the most pervasive and impactful threats to habitat conservation priorities in the bioregion. Increases in residential development are most notable around the urban centres, the largest of which is the town of Bridgewater, and along the bioregion's coastlines (Figure 15). The scope and intensity of this threat varies among priorities, but given the increasing demand for cottage and housing development along the region's coastlines, coastal islands, and inland lakes and rivers, this threat is likely to increase. Development along coastlines and inland waterbodies tends to be linear, extending along the shoreline, which has a high potential for impacting coastal and riparian ecosystems, as it tends to interrupt the natural connections between aquatic and marine environments and their adjacent terrestrial uplands (CBCL Ltd. 2009). 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).

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). Despite this fact, about 80% of the land adjacent to the coast is classified as undeveloped, with the majority (66%) under natural forest cover (CBCL Ltd. 2009). A high percentage of the coastline is under private ownership however, so there is considerable potential for increased coastal development. 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 anthropogenically-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 riprap[1] (US CCSP 2009). These measures lead to a phenomenon referred to as coastal or shoreline hardening. 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 hardening 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; Sullivan 2005).

Within the SWNS bioregion, cottage shoreline development on inland lakes and rivers is also increasing. Cottage development within critical habitat for endangered species of ACPF is steadily increasing, and is directly correlated with an increase in the occurrence of shoreline alterations (Eaton & Boates 2003).

[1] *Riprap is rock or other material used to armor shorelines, streambeds, bridge abutments, pilings, and other shoreline structures against erosion.*

This has the potential to negatively impact species of ACPF in a number of ways, the most obvious of which is the direct loss and degradation of critical habitat. Also associated with shoreline development is the potential for nutrient-rich runoff and the introduction of invasive species, which may negatively impact sensitive shoreline ecosystems.

Additionally, where there is residential development, there will be an increase in the abundance of domestic cats. Blancher (2013) estimates that approximately 204 million birds (range 105-348 million) are killed by domestic and feral cats in Canada each year. The birds most susceptible to cat predation are those that nest or forage on or near the ground, or spend substantial time in human-dominated landscapes where cats are abundant (Environment Canada 2013).

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) (Figure 16). 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. Much of the coast and the larger coastal islands have been significantly impacted by human disturbance, whereas some inland portions of the bioregion remain virtually undisturbed.

1.3 Beach park/recreational development
(Summary Threat Ranking: Low)

Five beaches within the SWNS bioregion are located in provincial parks –Rissers, Summerville, Sand Hills, Port Maitland, and Mavillette –and an additional 18 beaches are designated as protected beaches under the *Nova Scotia Beaches Act*, providing for their protection as significant and sensitive environmental and recreational resources, although the Act is designed primarily to prevent the removal of sand and other aggregate material. Though these designations provide a measure of protection for these beaches in the bioregion, they may also contribute to their degradation through the development of infrastructure, such as roads, parking lots, and trails established to address increased use. Such infrastructure, accompanied with increased use, can alter the dynamics of beach and dune ecosystems and may contribute to blowouts, soil compaction, and shifts in key geomorphic processes, resulting in semi-permanent to permanent conversion of habitat and associated losses for the species they support.

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

Grasslands in the SWNS bioregion are primarily anthropogenic features (e.g., hayfields, pasture lands) that occur within the network of existing agricultural lands, located primarily within the Annapolis Valley, with smaller concentrations in Lunenburg, Digby, and Yarmouth counties (Figure 17). 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 practises 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).

Nova Scotia has a long history of fragmentation and loss of wetland habitat as a result of conversion to agricultural land use by dyking, draining, and infilling, particularly the extensive loss of tidal marsh and freshwater wetlands in the Annapolis Valley. The 2011 *Nova Scotia Wetland Conservation Policy* identifies specific objectives that are intended to prevent the net loss of Nova Scotia's wetlands into the future (Government of Nova Scotia 2011). This should help to restrict any further net loss of wetland habitat in the province; however, agricultural land use practices impact freshwater ecosystems in a number of other ways. 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. These threats are particularly relevant to shoreline habitat critical to ACPF in the bioregion; increased sedimentation, pesticide and fertilizer inputs to the sensitive shoreline and bog habitats they depend on may hinder their survival (Environment Canada & Parks Canada Agency 2010). Under the province's current forest harvesting regulations, all forestry operations are required to leave a minimum 20 m forested buffer along watercourses, including wetlands, however, there are no legislated requirements for riparian buffers on land cleared for agriculture. Many cultural practices, such as providing livestock direct access to streams for a water source and allowing livestock to cross streams, have been widely used in Nova Scotia (Province of Nova Scotia 2012).

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).

2.3 Livestock farming and ranching
(Summary Threat Ranking: Low)

In Nova Scotia, there are currently no legislated requirements for riparian buffers along watercourses and wetlands adjacent to agricultural lands. The cultural practices of providing livestock direct access to streams as a water source and allowing livestock to cross through streams have been widely used in Nova Scotia (Province of Nova Scotia 2012). These practises, though localized, can contribute to bank destabilization, increased erosion, and increased sediment and nutrient inputs into freshwater

ecosystems, which can contribute to increased siltation, eutrophication, and contamination of the region's freshwaters. Uncontrolled sheep grazing is another common historical practice in the region, and still occurs on a number of coastal islands in Lobster Bay within the SWNS bioregion. The impact of this practice is localized; however, grazing sheep can be extremely detrimental to native vegetation and have the potential to introduce invasive plant species (Morrison and Hines-Clark 1999). Their grazing activity may also result in disturbance to migratory birds nesting in tall grasses on coastal islands (Nocera 2000).

2.3 Mink farming
(Summary Threat Ranking: Low)

Until recently, the rapidly-expanding mink farm industry, which is concentrated in Digby and Yarmouth counties (Figure 17), has been largely unregulated, and runoff from manure, carcasses, and waste feed has been allowed to seep untreated into local watercourses for years (David Suzuki Foundation 2011). In 2008, in response to public concerns that the water quality of a number of lakes located within the Carleton, Meteghan, and Sissaboo River watershed was becoming seriously degraded, the Nova Scotia Department of Environment initiated a three-year program designed to evaluate the water quality status of ten lakes located within these watersheds. The results of this evaluation indicated that water quality was impaired in a number of the lakes surveyed, particularly with respect to high nutrient concentrations resulting in the development of high algal concentrations, including species of blue-green algae known to produce toxins that, under certain conditions, may be harmful to humans, livestock, and wildlife (Brylinsky 2011). The lakes exhibiting the most serious symptoms of nutrient over-enrichment were located in close proximity to a high concentration of Mink farms, which were identified to be the major source of nutrients leading to nutrient over-enrichment of the lakes (Brylinsky 2011). Elevated levels of fecal coliform were also detected in a number of the lakes, though they never exceeded the recreational guideline of 200/ml (Brylinsky 2011). Escapes from mink farms may also contribute to elevated levels of predation for many species, including colonial nesting birds in the vicinity of Mink farms, though this has not been well studied or documented (K. Allard, per. comm.).

In January 2013, new Fur Industry Regulations governing the management of fur farms in Nova Scotia were released. These regulations, intended to focus on the environmental management of fur farms, including the storage, treatment, and disposal of manure, waste feed, and carcasses, have received widespread criticism from local, regional, and national community and environmental groups (e.g., Tri-County Watershed Protection Association, Ecology Action Centre, Sierra Club of Canada, David Suzuki Foundation), which feel that the regulations fall short of curbing the harmful impacts of Mink farms on local freshwater ecosystems (CBC News 2013; Ecology Action Centre 2013).

2.1 Commercial cranberry production
(Summary Threat Ranking: Low)

Nova Scotia is recognized as an area of Canada with ideal climatic conditions for growing cranberries, indicated by widely distributed wild, native cranberries across the Province. Cranberries have been grown commercially in Nova Scotia for more than 100 years, and today's cranberry industry consists of 15 growers managing approximately 130 ha of land for cranberry production (Province of Nova Scotia 2012), representing less than 0.1% of the agricultural lands in the province. No current plans exist for commercial cranberry production in the vicinity of sites hosting species of ACPF; however, this continues to be a potential threat for this sensitive group of vascular plants (Environment Canada & Parks Canada Agency 2010).

2.2 Wood and pulp plantations
(Summary Threat Ranking: Low)

Natural forest conversion to wood and pulp plantations is a common forestry practice in the SWNS bioregion (Figure 17). 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, Black, 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. Forest plantations severely reduce the species and structural diversity of forest stands, can result in changes to the hydrology and soil characteristics of the site, 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 region.

2.4 Marine shellfish and finfish aquaculture
(Summary Threat Ranking: Medium)

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 SWNS bioregion, especially in the large, protected bays along the Atlantic Coast and the Annapolis Basin (Figure 18). Numerous shellfish aquaculture leases approved in the bioregion can be found in Lunenburg Bay, Lobster Bay, Yarmouth Harbour, St. Mary's Bay, and the Annapolis Basin, and include leases for Blue Mussels (*Mytelis edulis*), Sea Scallops (*Placopecten magellanicus*), Bay Scallops (*Argopecten irradians*), Soft-shell Clams (*Mya Arenaria*), Bay Quahaug (*Mercenaria mercenaria*), American Oyster (*Crassostrea virginica*), and European Oyster (*Ostrea edulis*). Finfish aquaculture farms are dispersed primarily along the Atlantic Coastline, with a concentration in the bays located near the town of Shelburne, around Digby Neck, and in the Annapolis Basin. Finfish aquaculture leases approved for the bioregion include Atlantic Salmon, Rainbow Trout (*Oncorhynchus mykiss*), Atlantic Cod (*Gadus morhua*), Atlantic Halibut (*Hippoglossus hippoglossus*), and Haddock (*Melanogrammus aeglefinus*), though the great majority are for Atlantic Salmon and Rainbow Trout (NSDFA 2013). 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 growing number of open-pen finfish aquaculture farms in Nova Scotia poses 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 Atlantic Coalition for Aquaculture Reform was formed in the fall of 2010 by a number of groups in New Brunswick and Nova Scotia who share a common concern about the negative environmental and social impacts of the salmon aquaculture industry. In March 2012, 51 organizations,

representing a diverse range of interests including wild salmon conservationists, commercial fisheries groups, environmental organizations, sustainable economic development proponents, and tourism operators supported a letter to Premier Darrell Dexter requesting that a moratorium on further expansion of open net pen salmon aquaculture be declared.

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 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
(Summary Threat Ranking: Low)

The provincial mineral database ranks the majority of Southwest Nova Scotia as having low mineral potential (NSDNR 2004), though aggregate mines can be found in relatively large numbers in some parts of the SWNS bioregion (Figure 19). Gold was mined at a number of sites in Queens and Lunenburg Counties in the late 1800's, and a few locations in Yarmouth County (NSDNR 2004). In recent decades, the bioregion has seen very little industrial mining activity, with the exception of the East Kemptville Tin Mine (operated from 1985-1992), and the White Rock Mine for quartz (in operation since 2004) in Yarmouth County. Atlantic Gold NL, parent company of D.D.V. Gold Ltd., is an Australian-listed gold exploration company that currently has two gold exploration and development projects in Nova Scotia, both outside of the bioregion –Touquoy and Cochrane Hill Gold Projects. In addition to developing these two projects, Atlantic Gold is actively exploring regional positions in the province to build its resource base, and have reported positive results of gold exploration within two areas in the bioregion southwest of Lake Rossignol, West Caledonia and Caduesky Lake (Atlantic Gold NL 2012).

3.2 Peat mining
(Summary Threat Ranking: Low)

Peat is the partially decomposed remains of plants and animals, primarily *Sphagnum* moss, which have accumulated in oxygen poor, water-saturated freshwater environments (Anderson 1993). Peat accumulates at a very slow rate of about a millimetre per year (Keddy 2010). The mining, or removal, of peat from bogs results in complete habitat degradation and impacts to the hydrology of the site. The SWNS bioregion contains over 69,000 ha of peatlands, making up a large percentage of the peatlands found throughout the province (Anderson 1993 estimated that greater than half of the province's peatlands, 86,900 ha, were located in Southwestern Nova Scotia). The current condition of peatlands in the bioregion is generally good and populations of nested species are presumed to be intact and healthy, however the potential for peat mining in the region remains a threat (Morrison and Hines-Clark 2009). Although there are no current plans for commercial peat mining at ACPF locations, this continues to be a potential threat (Environment Canada & Parks Canada Agency 2010).

3.3 Wind energy production
(Summary Threat Ranking: 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). In the province's *Renewable Electricity Plan*, the Government of Nova Scotia set an aggressive target of achieving 40% of

electricity needs met by renewable energy by the year 2020 (Province of Nova Scotia 2010). Of this amount, 25% has been set as coming from made-in-Nova Scotia sources by 2015, and the wind energy sector is expected to be the largest contributor in meeting this goal (Province of Nova Scotia 2010). There are currently 43 wind turbines in operation within the SWNS bioregion. Twenty-four are located on the North Shore of the bioregion, with the most significant installation of 20 turbines situated on Digby Neck adjacent to the Bay of Fundy. A further 17 turbines are located at Pubnico Point in Yarmouth County (Nova Scotia Power 2013a).

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 (*Perimyotis subflavus*) (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 (road fragmentation)
(Summary Threat Ranking: Medium)

Although the SWNS bioregion contains some of Nova Scotia's largest protected areas and areas with some of the lowest road densities in the province (Figure 20), it is criss-crossed by a vast network of tens of thousands of kilometers of roads, largely due to the density of forest roads (Figure 21; Beazley *et al.* 2004). 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. They have negative effects on biodiversity through direct mortality from road construction and vehicle collisions, behavioural modifications (i.e., avoidance), alterations of the physical and chemical environment, and increased access to once inaccessible places for invasive species and human use, including improved access for off-highway vehicle use, poaching, and legal harvesting of

wildlife (Environment Canada & Parks Canada Agency 2010; Trombulak & Frissell 2000). Road construction can have a negative impact on freshwater wetlands, tidal marshes, and estuaries as a result of changes to hydrology and direct loss of habitat (Environment Canada & Parks Canada Agency 2010).

Vehicle mortality is a recognized threat for Blanding's Turtle and 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 these species, their populations are particularly vulnerable to even small increases in adult mortality (COSEWIC 2007; Parks Canada Agency 2012a). In areas with high road densities, mortality of females can lead to male-biased population sex ratios (Steen & Gibbs 2002). There have also been suggestions that mainland Moose in Southwest Nova Scotia are restricted to undisturbed areas with few roads (Snaith & Beazley 2002) and that increasing road development may be a factor in their decline (NSDNR 2007).

4.3 Oil spills and discharges from shipping activities
(Summary Threat Ranking: Low)

Marine ship-source oil spills can have significant impacts on coastal ecosystems and wildlife. Spills can occur as a result of accidents or as chronic intentional discharge of oily wastes from oil tankers, bulk carriers, barges, fishing vessels, and pleasure craft (Transport Canada 2013). On the east coast of Canada, there are 10,000 vessel movements per year with oil tankers accounting for about one third of this traffic (Transport Canada 2013). Over 95 million tonnes of various petroleum and fuel products are moved in and out of 23 ports in Atlantic Canada (Transport Canada 2013). Thus the threat of accidental oil spills exists, which could have devastating consequences on coastal ecosystems and priority species in the SWNS bioregion, though this threat is generally considered to be low. The most significant spill off of Canada's East Coast occurred off the coast of Nova Scotia in 1970 when the tanker *Arrow* spilled over 10,000 tonnes of oil coating 120 kilometers of the shoreline in Chedabucto Bay with oil sludge. Though the threat of a large oil spill may be low, the cumulative impact of oily discharges from shipping activities is considered to be a highly ranked threat to priority bird species in MBU 11 NS (Environment Canada 2013).

5.3 Forest harvesting practices
(Summary Threat Ranking: Medium)

Within the Acadian Forest the dominant natural disturbance regime consists of gap dynamics, with stand-replacing disturbances (e.g., hurricane, fire) occurring only every several hundred to several thousand years (Mosseler *et al.* 2003). Forest associations typical of the Acadian Forest include long-lived, shade-tolerant species such as Red Spruce, Eastern Hemlock, White Pine, Sugar Maple, Beech, and Yellow Birch. In this disturbance mosaic, nearly constant canopy closure is maintained well beyond the life span of individual trees, providing habitat for a range of native species that depend on different forest stages. Following stand-replacing disturbances, forest succession typically begins with early-successional, shade-intolerant species, which require full light, establish themselves quickly, and exhibit rapid growth, though they have relatively short lifespans. In the absence of repeated disturbances, they tend to be replaced over time by more long-lived, shade-tolerant species, which regenerate well under themselves (NBDNR 2013).

Following European arrival in the 17th century, human land use activities have significantly impacted the frequency, intensity, and magnitude of natural forest disturbance processes in Nova Scotia. 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; Figure 22) fail to mimic the region's natural forest disturbance

regime, 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). Regenerating forest stands lack certain characteristics that are typical of old Acadian Forest stands, including large-diameter trees, large woody debris, and canopy openings with consequent understory regeneration, and fail to provide suitable habitat for some old forest dependent wildlife (NBDNR 2013).

Modern industrial forestry practises not only threaten the overall diversity and state of the SWNS bioregion's forests, but they can also have significant consequences for adjacent freshwater and coastal 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. Water runoff from industrial forestry practices can also carry pesticides and other biocides, which can negatively impact water quality and associated aquatic communities and species (see 9.3 Agricultural & Forestry Effluents). 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 litterfall and coarse woody debris, which constitute an important source of nutrients and structural complexity (McEachern 2003).

Riparian buffers around lakes and streams that are protected from forestry activities have been widely used to mitigate the negative impacts of forestry on aquatic ecosystems (McEachern 2003). Current forest harvesting regulations in Nova Scotia require that all forestry operations leave a minimum 20 m forested buffer along watercourses; this should help to alleviate some of these adverse impacts, however, the regulations permit some level of harvesting within these buffers. Further, a study of the conservation value of riparian habitat and riparian buffers for breeding birds in southwest Nova Scotia consistently found higher abundances of species of conservation concern in buffers that were greater than 40 m wide (Akerman 2007). Additional research on salamanders, turtles, and birds suggests much wider buffers are required to maintain habitat for terrestrial species (recommended 75-200 m; see McEachern 2003).

5.4 Clam and baitworm harvesting
(Summary Threat Ranking: Low)

Recreational and low-intensity commercial harvesting of clams and marine worms can have a substantial impact on intertidal flats without proper regulation. These activities can result in physical impacts to the habitat structure of tidal flats, particularly mudflats, which have reduced resilience to physical disturbance compared to sandflats (GOMC 2005). They can also result in negative impacts to benthic community structure by reducing the overall species richness and abundance of non-target infauna (Griffiths *et al.* 2006; GOMC 2005). Localized clam and baitworm harvesting does take place on some tidal mudflats within the bioregion, particularly in the Yarmouth area, however the resulting impacts are thought to be low as harvesting is not extensive (Morrison & Hines-Clark 2009).

6.1 Recreational beach use
(Summary Threat Ranking: Medium)

Beaches and dunes within the SWNS bioregion are heavily impacted by recreational beach use. Recreational beach users may disturb breeding shorebirds, which can result in changes in normal nesting or feeding behaviour, and ultimately nest failure (Environment Canada 2012). These activities include pedestrian traffic, unleashed dogs, camping and campfires, and the collection of shells or wrack (Environment Canada 2012). Many traditional breeding beaches in the bioregion which previously supported Piping Plovers have been lost due to natural and human-induced changes.

6.1 Off-highway vehicle use
(Summary Threat Ranking: Low)

With increased cottage and residential development along the SWNS bioregion's coastlines and inland waters, there has been an associated increase in recreational activities, including the use of off-highway vehicles (OHV). Use of OHVs in sensitive ecosystems can lead to significant habitat degradation, and is a recognized threat to a number of the bioregion's 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.

7.2 Dams and other aquatic barriers
(Summary Threat Ranking: Low)

Aquatic connectivity refers to the network created by freshwater streams, rivers, and lakes as they flow into one another, 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, pressure is being placed on these networks in the form of 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). Nova Scotia has a long history of using small hydro-electric dams on our rivers to generate power (Nova Scotia Power 2013b). In addition to creating barriers for fish passage and reducing aquatic connectivity, the development of hydroelectric dams has the potential to adversely impact a number of the bioregion's most sensitive habitats and species. Dams impact freshwater ecosystems by altering the natural hydrology of river systems, including changes to flow regimes, water temperatures, sediment transport, and nutrient loads (Bednarek *et al.* 2001; Saunders *et al.* 2002). Flow regimes are fundamental in determining the physical characteristics of river and riparian habitat. Biological communities and

species are dependent on the availability of specific habitats, including riffles, pools, and cold water habitat; therefore, alteration of the natural flow regime affects the distribution and abundance of biodiversity within the river system (Bednarek *et al.* 2001).

Nova Scotia Power Inc. currently owns and operates 33 hydroelectric plants on 17 river systems across Nova Scotia, the majority of which are located in Southwest Nova Scotia. There are also numerous small dams located throughout the province; the Nova Scotia Water Control Structure Database, maintained by Nova Scotia Environment, contains 586 dam locations throughout the province, of which only 14% contain associated fish passage technology (Fielding 2011). The Mersey and Annapolis watersheds, located within the SWNS bioregion, contain concentrations of a large number of dams (Fielding 2011). A previous ground-truthing survey found approximately 70 dams in the Upper Mersey and Medway watersheds (McKendry 2007). In the Mersey River, Atlantic Salmon populations have been extirpated and in the Medway River they are in extremely low numbers, likely a result of dams installed for hydroelectric power and historical log driving (Hill *et al.* 1998; MTRI 2007). Dams and dam remnants, however, may currently provide some positive ecological effects for biodiversity by providing a barrier to the introduction of invasive fish species to some river systems (Corbett 2007).

In addition to aquatic ecosystems and species, hydroelectric dams have the potential to adversely impact terrestrial riparian ecosystems and species. Dams negatively impacts species of ACPF through both the loss or degradation of habitat (i.e., flooding), and through changes to the natural processes that maintain habitat characteristics that these sensitive species are dependent upon. In general, species within this unique assemblage of herbaceous plants are poor competitors and require low nutrient substrates that are subject to natural disturbance patterns that reduce competition, including seasonally fluctuating water levels, wave action, and ice scouring (Environment Canada & Parks Canada Agency 2010; Wisheu & Keddy 1989). Hydroelectric dams disrupt and stabilize natural seasonal water levels on lakes and within watersheds, which can negatively impact ACPF habitat, leading to increased interspecific competition and poor reproductive success (Environment Canada & Natural Parks Agency 2010). As an example, hydroelectric dam development in the late 1920's resulted in the extirpation of Pink Coreopsis and Plymouth Gentian from lakes in the Tusket River watershed. Morris *et al.* (2002a) estimate that 50% of the suitable shoreline habitat for rare ACPF in Nova Scotia has been lost due to hydroelectric dam installation.

Tidal barriers are structures that impact the natural movement of tidal waters and species into low lying coastal areas and waterways, changing the physical (e.g. sedimentation, water circulation), chemical (e.g. salinity, oxygen, trace elements), biological (e.g. fish behavior), or ecological (e.g. production) characteristics of waterways and include dykes, aboiteaux, causeways, bridges, culverts, dams, and wharves (Wells 1999). Since European settlement in the early 1700's Nova Scotia has seen extensive loss of tidal marsh habitat, particularly along the Annapolis River, which once was host to extensive areas of tidal marsh. Much of this area is now used for agriculture, having been protected from tidal inundation by a system of dykes in the 1600's. Beyond the use of dykes to restrict tidal flow, tidal barriers have been used extensively to serve other anthropogenic needs, such as the creation of headponds for the generation of hydroelectric or tidal power, road or highway crossings, recreational or urban use areas, flood control, logging, and other industrial activities (Wells 1999). Tidal barriers are a main cause of tidal marsh loss in the region and a wide range and a number of barriers exist on rivers that drain into the Bay of Fundy (Bowron *et al.* 2012; Hynes 2005; Wells 1999). They can lead to a decline in habitat area and ecological integrity, reduced length of tidal rivers, increased erosion, sedimentation, water turbidity, reduced nutrient transfer, changes in channel size and direction, the conversion of tidal marshes into brackish and freshwater wetlands, and interference with the movement

of fish and aquatic invertebrates (Wells 1999). Estimates of original tidal marsh loss are as high as 65% province-wide, and 85% along the Bay of Fundy (NAWCC 2012; Reed & Smith 1972; Singh *et al.* 2007).

Wells (1999) assessed major rivers entering the Bay of Fundy and found that barriers exist on at least 25 of 44 major rivers around the Bay of Fundy, 26 of which are located in Nova Scotia. Of these, only three rivers are located within the SWNS bioregion; however, two of these had partial restriction, and one, the Annapolis River, had complete restriction. Only half of the rivers in Nova Scotia assessed had functional fishways (Wells 1999). In 2001, the Ecology Action Centre initiated a comprehensive audit of tidal barriers in the Bay of Fundy to assess the potential for tidal marsh restoration. As part of this, tidal crossings in Digby and Annapolis Counties were audited in 2004 (Hynes 2005). Of the 58 tidal crossings audited (located primarily in St. Mary's Bay and the Annapolis Basin), approximately 60% had at least partial restriction, and nine of these had complete restriction. Almost all of the culverts assessed restricted tidal flow and represented barriers to fish passage.

Restoration of tidal marsh through the removal of tidal barriers represents an excellent opportunity to restore some of the area of tidal marsh that has been lost from the bioregion. Tidal marshes are valuable ecosystems and their ecosystem function may be restored through planned removal or modification of tidal barriers to restore site hydrology, which has become a common practice in the Gulf of Maine over the past two decades (Konisky et al. 2006), and has been used successfully to restore tidal marsh habitat in Nova Scotia (Bowron *et al.* 2009; Bowron *et al.* 2012).

8.1 Invasive European Green Crab
(Summary Threat Ranking: Medium)

Coastal marine environments world-wide are increasingly threatened by invasive species. The European Green Crab 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). 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 and Blue Mussels. The species is also a recognized 'ecosystem engineer', causing significant physical destruction to Eelgrass beds on tidal flats; as they forage for soft-shelled clams, they disrupt the fine sediments associated with Eelgrass beds, which is thought to be a contributing factor in the decline of 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 2009b; Hanson 2004). Dramatic Eelgrass declines in recent decades have been reported on the Atlantic Coast of the SWNS bioregion. Losses of 30% and 44% of Eelgrass cover from 1978-2000 were recorded at two sites in Lobster Bay, Nova Scotia (Sharp & Semple in Hanson 2004), and Eelgrass at Kejimkujik National Park Seaside Adjunct is reported to have declined to less than 2% of its 1987 distribution (McCarthy & Kehler in MTRI & PC 2013). Green Crabs are also present in the region's tidal marshes, where their impacts are poorly understood, however in New England they have been identified as a major contributor to tidal marsh loss (T. Bowron, per. comm.). The impacts of Green Crabs on tidal marshes should be closely monitored in the bioregion.

8.1 Invasive predatory fish species
(Summary Threat Ranking: Low)

The spread of two invasive fish species, Smallmouth Bass (*Micropterus dolomieu*) and Chain Pickerel (*Esox niger*), threatens native fish populations in lakes and rivers in more than half of the primary watersheds in Nova Scotia. In Nova Scotia Smallmouth Bass primarily inhabit lakes, but also riverine habitat, with rocky bottoms and plenty of shade (LeBlanc 2010; MTRI 2012). They are efficient

predators of fish, mammals, and amphibians. Smallmouth Bass were first introduced into Nova Scotia in 1942 by sanctioned introduction, and since then the number of documented occurrences of the species has increased to 188 waterbodies by 2008, due mainly to illegal transfers and natural dispersal within watersheds, and to a lesser extent, accidental releases (LeBlanc 2010). Smallmouth Bass are present in all but five counties in the province but are most concentrated in Halifax, Lunenburg, and Yarmouth counties; as of May 2009, this species was reported in 122 lakes in the seven counties that overlap with the boundaries of the SWNS bioregion (LeBlanc 2010). Chain Pickerel inhabit shallow, vegetated ponds, lakes, and streams, and are voracious predators of fish, insects, mice, and snakes (MTRI 2012). Once established, they can decimate native Speckled Trout populations in just a few years (MTRI 2012). As of 2010, Chain Pickerel were known to occur in 95 lakes throughout the province (Mitchell 2010). It is illegal to release live fish into the waters of the province without a permit given the potential threat to native fish populations.

8.1 Invasive plants
(Summary Threat Ranking: Low)

There are a number of invasive plant species that are present within the SWNS bioregion with varying impacts on the conservation priority habitats. Rugosa Rose is a dense shrub that inhabits coastal areas, and once established, can outcompete most native species, threatening biodiversity and ecosystem function in beach, dune, and headland habitats (MTRI 2010). This species has heavily colonized four dune systems on Cape Breton Island, with negative impacts on native dune communities (Hill *et al.* 2010), and within the bioregion, has been documented in several counties (S. Basquill, per. comm.). Considered an invasive species of coastal barrens in Maine, encroachment on coastal barrens by Rugosa Rose has been documented on Brier Island (Garbary 2011). Glossy Buckthorn (*Fraggula alnus*), found throughout the bioregion, is an introduced, ornamental shrub that can attain heights of 6 m and inhabits wet to moist fields, thickets, forests, shorelines, and open wetlands (MTRI 2010). This species forms dense stands, replacing native wetland and shoreline plant communities, and dominating forest understories once established. It is tolerant of acidic conditions and is well adapted to invade a wide variety of natural habitats in the SWNS bioregion, potentially representing the greatest threat to native plant communities from an invasive plant in the province (MTRI 2010).

At least three non-indigenous invasive plant species have been documented in tidal wetlands in eastern Canada, and include the Common Reed, Purple Loosestrife, and Reed Canary Grass (T. Bowron, K. Porter, per. comm.). The Common Reed is an aggressive invasive species that inhabits freshwater or brackish shores and wetlands and is of particular concern in the SWNS bioregion, including an extensive colony of Common Reed in Annapolis Royal. It spreads quickly to form large, dense stands that exclude native species and can alter the structure and function of native marsh ecosystems (Mal & Narine 2004; MTRI 2012). Scots Pine (*Pinus sylvestris*) was introduced to Nova Scotia from Europe in the 1920s for reforestation of abandoned agricultural lands, and grows well in a variety of soil and moisture conditions. This species threatens native biodiversity by outcompeting native species and modifying ecosystems, and in particular, has been shown to be an aggressive invader of the *Corema*-dominated sand barrens of the Annapolis Valley, shading out native vascular plants, including the provincially endangered Rockrose (Newell 2007).

8.2 Problematic native species
(Summary Threat Ranking: Medium)

Human activities and land use practices, including urbanization, agricultural practices, and the extirpation of regional apex predators, such as the eastern wolf (i.e., mesopredator release; Ripple *et al.* 2013) can result in artificially high predator populations of opportunistic native species. Such

opportunistic predatory species include American Crow (*Corvus brachyrhynchos*), Red Fox (*Vulpes vulpes*), Common Raven (*Corvus corax*), gulls (*Larus spp.),* Raccoon (*Procyon lotor*), Eastern Coyote (*Canis latrans*), and American Mink (*Neovison vison*). Predation by a number of these species has been identified as one of the most important factors limiting populations of the endangered Piping Plover across their North American breeding range and current predation rates appear to be higher than they were in the past (Goossen *et al.* 2002). Increased predation of Blanding's Turtle and Wood Turtle nests and egg-laying females by opportunistic edge predators due to increased fragmentation of their habitat by forestry, agriculture, and urban expansion is also a recognized threat for these species at risk (COSWIC 2005, 2007).

Several native pests (e.g., Spruce Beetle, White-marked Tussock Moth, Spruce Budworm, and Pale-winged Gray Moth) have the capacity to destroy entire forest stands, especially where their target species makes up a high percentage of the stand (i.e., low species diversity). 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 overmature 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).

8.4 Invasive pathogens
(Summary Threat Ranking: Low)

Invasive insects and diseases have had significant impacts on the bioregion's forests. American Elm was once a significant floodplain forest species in Nova Scotia; however, it has been all but eliminated from natural habitats by Dutch Elm Disease, an introduced fungal pathogen that is spread by both a native and an introduced bark beetle. Beech Bark Disease is another example of a fungal pathogen that was introduced to North America from Europe and is spread by an insect. The fungus, which is introduced to the tree through wounds in the bark caused by the Beech Scale (*Cryptococcus fagisuga*), causes defects (i.e., cankers) and can lead to eventual mortality of beech trees. The disease has all but eliminated large, mature American Beech and has left a legacy of small, cankered trees in the region's forests (Davis & Browne 1996).

9.1 Household sewage & urban waste water
(Summary Threat Ranking: Low)

Associated with increased cottage and residential development along the bioregion's coastlines and inland waters is the potential for nutrient-rich runoff of household and urban sewage and waste water to enter our freshwater and coastal ecosystems. Nutrient-rich runoff from shoreline development can contribute to the input of sediments and nutrients to shoreline environments in the bioregion, potentially altering the species composition of shoreline vegetation and negatively impacting rare species of ACPF (Environment Canada & Parks Canada Agency 2010). Atlantic Coastal Plain Flora are generally located on nutrient-poor, infertile substrates, thus reducing competition from plant species with greater nutrient requirements; therefore, soil enrichment from nutrient runoff may lead to increased interspecific competition by providing suitable growing conditions for more competitive plant species (Wisheu & Keddy 1989). Within coastal environments, mudflats are particularly susceptible to pollution and contamination from coastal development (sewage and stormwater discharge), because they are depositional environments where organic pollutants and metals can accumulate.

9.3 Agricultural and forestry effluents
(Summary Threat Ranking: Medium)

Agricultural and forest harvesting practices also have the potential to contribute to the input of sediments and nutrients to freshwater and coastal shoreline environments in the SWNS bioregion. In addition to increases in the nutrient and sediment load of freshwater and coastal ecosystems, which can lead to eutrophication and increased sedimentation, agricultural and forestry effluents may also contain significant amounts of biocides, such as pesticides, herbicides, or fungicides. Depending on the concentration, exposure to biocides can lead to the direct mortality of priority species, alteration of habitat characteristics, increased interspecific competition, and a decrease in the availability of prey and/or diet quality (Environment Canada 2013; Environment Canada & Parks Canada Agency 2010).

9.5 Air pollution and acid precipitation
(Summary Threat Ranking: Medium)

Southwest Nova Scotia has some of the most acidic freshwaters in North America. Large areas of the SWNS bioregion are underlain by poorly acid buffering bedrock and consequently the soils of the region do not have the buffering capacity to neutralize acidic depositions (Clair *et al.* 2001). In addition, there is an abundance of wetlands in the region that produce natural organic acids, contributing to naturally acidic freshwaters. Although generally free of point source pollution, surface waters of the bioregion have collected additional acid inputs from the long-range transport of air pollution originating from 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), thereby increasing the acidity of many fresh water rivers and lakes (Clair *et al.* 2001). The amount of acid deposition that an area can tolerate, calculated as acid equivalents per ha per year, is known as its critical load. Ouimet *et al.* (2006) estimated critical loads and exceedances of acidity for upland forests in Eastern Canada, and found that some of the greatest exceedances in the region occurred in the southwest of Nova Scotia due to low critical loads and high loads of acid deposition. Legislation and initiatives introduced to limit emissions since the early 1980's have significantly reduced sulphate deposition levels; however, surface waters in the region have been slow to recover (Clair & Hindar 2005). Even with aggressive emission cuts in Europe and North America, large numbers of lakes and rivers in sensitive regions will not recover pH levels suitable for sustaining healthy aquatic communities for decades following emission reductions, given the depletion of base cations from catchment soils (Clair *et al.* 2007).

Acid precipitation and the acidification of surface waters in Southwest Nova Scotia have major implications for the health of terrestrial and aquatic ecosystems. Cyanolichens are sensitive to acid precipitation, which impacts their ecology through the direct uptake of air pollutants (i.e., sulphur dioxide), and further acidifies the naturally acidic substrates on which they thrive, reducing their buffering capacity (Environment Canada 2007). The disappearance of Boreal Felt Lichen from New Brunswick it thought to be attributed to the impacts of acid precipitation. The uptake of mercury by biota, which biomagnifies in aquatic foodwebs and can pose risks to fish-eating wildlife, is enhanced in acidic conditions (Dennis *et al.* 2005). Common Loons are a piscivorous bird and often face high mercury exposure. Mean blood mercury concentrations of adult Common Loons sampled in Kejimkujik National Park are the highest found in breeding populations across North America, which has been linked to impaired reproduction and altered breeding behaviour (Burgess *et al.* 2005; Burgess & Hobson 2006). 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. The natural rate of recovery of acidified waters may not be sufficient to ensure that Atlantic Salmon populations persist in a number of the regions rivers, therefore a number of mitigation options to protect remaining Atlantic Salmon stocks have been proposed, including liming to neutralize river acidity and restore some habitat production capacity (DFO 2000).

The addition of calcite (lime, calcium carbonate, $CaCO_3$) or other buffering substances to aquatic ecosystems or the catchment areas that drain into them is one method that has been used to accelerate the ecosystem recovery of acidified freshwaters (Clair & Hindar 2005). The liming of lakes, streams, and rivers has been studied experimentally in North America and Europe for over 20 years (see review in Clair & Hindar 2005). Catchment liming is an attractive alternative to direct lake or in-stream liming given that it is more effective at buffering smaller streams and tributaries in the upper reaches of watersheds, it requires less intensive maintenance, and the liming material needs to be spread at much lower frequencies, although the costs of application are high (Clair & Hindar 2005). Catchment liming has been shown to improve water quality in small stream catchments for long periods of time (decades in some cases; Clair & Hindar 2005). The recovery of soils, and thus drainage waters, from the effects of acidification can take decades, even under the most optimistic acid reduction scenarios; therefore, it may be necessary to continue catchment liming in the long term (50 to 60 years in some cases) to maintain the modification of water chemistry at the desired state (Clair & Hindar 2005). In 2010, the Bluenose Coastal Action Foundation initiated a project to determine how a typical small catchment in the region (Maria Brook, a tributary to the Gold River, outside of the bioregion) responds to terrestrial catchment liming (Sterling in MTRI & PC 2013). Thirty tons of fine-grained calcium carbonate were applied to soils in May 2012, with plans for a second larger application in May 2013. Initial results from 2012 found an improvement in the pH and conductivity of surface waters following liming (Sterling in MTRI & PC 2013). Though pollution prevention and reduction should be the first priority, terrestrial liming may prevent the extirpation of some sensitive species (e.g., Atlantic salmon) from afflicted rivers so that recolonization by genetically-adapted populations can occur when acidification effects are eventually reversed by pollution reduction efforts, predicted to occur in five or six decades (Clair & Hindar 2005).

ii. Emerging Threats

Climate Change and Severe Weather

11.1 Habitat shifting and alteration
(Summary Threat Ranking: Unknown)

The Earth's climate is warming as a result of anthropogenic emissions of greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, from the burning of fossil fuels and land-use change (i.e., climate change; US CCSP 2009). The rate of global climate change observed over the last two decades is already having significant and wide ranging effects on the Earth's ecosystems and wildlife, and presents increasing challenges for species' adaptation (Nicholls *et al.* 2007). In the Atlantic Provinces mean temperature and summer rainfall are expected to increase by 3^{o}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). 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 Speckled Trout, and an increase in habitat availability for species more tolerant of temperature fluctuations, such as Yellow Perch and the invasive Smallmouth Bass and Chain Pickerel. In the coastal marine environment, climate change will result in changes in ocean temperatures and currents, with unknown impacts on marine productivity and food webs.

11.1 Global sea-level rise
(Summary Threat Ranking: Medium)

Two associated effects of climate change that are expected to have dramatic impacts on the SWNS 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). Since the height of the most recent glacial period (i.e., the Wisconsin Glaciation), global sea levels have risen approximately 120 m due to natural processes (post-glacial sea-level rise, regional subsistence; 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 present, 620 km of dykes protect approximately 17,400 ha of land in Nova Scotia, along with approximately 600 residential and commercial buildings, as well as roads and railroads (NSDA 2007). Van Proosdij *et al.* (2013) estimates that all of the dykes within Nova Scotia are below the predicted rates of sea-level rise by 2055, which will result in more flooding, potential damage to coastal infrastructure and property loss, potential loss of life, coastal erosion, freshwater flooding, and dam failure in the dykelands (van Proosdij & Page 2012).

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). Shoreline hardening (see 1.1 Cottage and Residential Development) effectively prevents the inland migration of these priority coastal ecosystems and may result in their loss as global sea-levels rise. The potential alteration or loss of coastal habitats such as tidal marshes, beaches, and tidal estuaries will have negative impacts on many animal and plant species that depend on them. Post-glacial sea-level rise and natural subsidence, combined with increasing rates of climate change-induced sea-level rise and increasing storm activity, make the Atlantic Coast of Nova Scotia one of the most sensitive in Canada to global sea level rise (Figure 23).

11.5 Storm-induced coastal erosion
(Summary Threat Ranking: Medium)

Also associated with climate change is an anticipated increase in the frequency and intensity of storms and major cyclone activity, and consequently storm-related flooding and coastal erosion (US CCSP 2009). Associated with increased intensity, projections also suggest that tropical storms in the Northern Hemisphere will track further north than ever before as a result of climate change (CBCL Ltd. 2009). Combined with the expected rise in global sea levels, the impact of storm surges on coastal ecosystems will be much greater than previously, particularly low-lying areas, such as the Acadian dykelands, and areas with frequent storm conditions, such as the Atlantic Coast (CBCL Ltd. 2009).

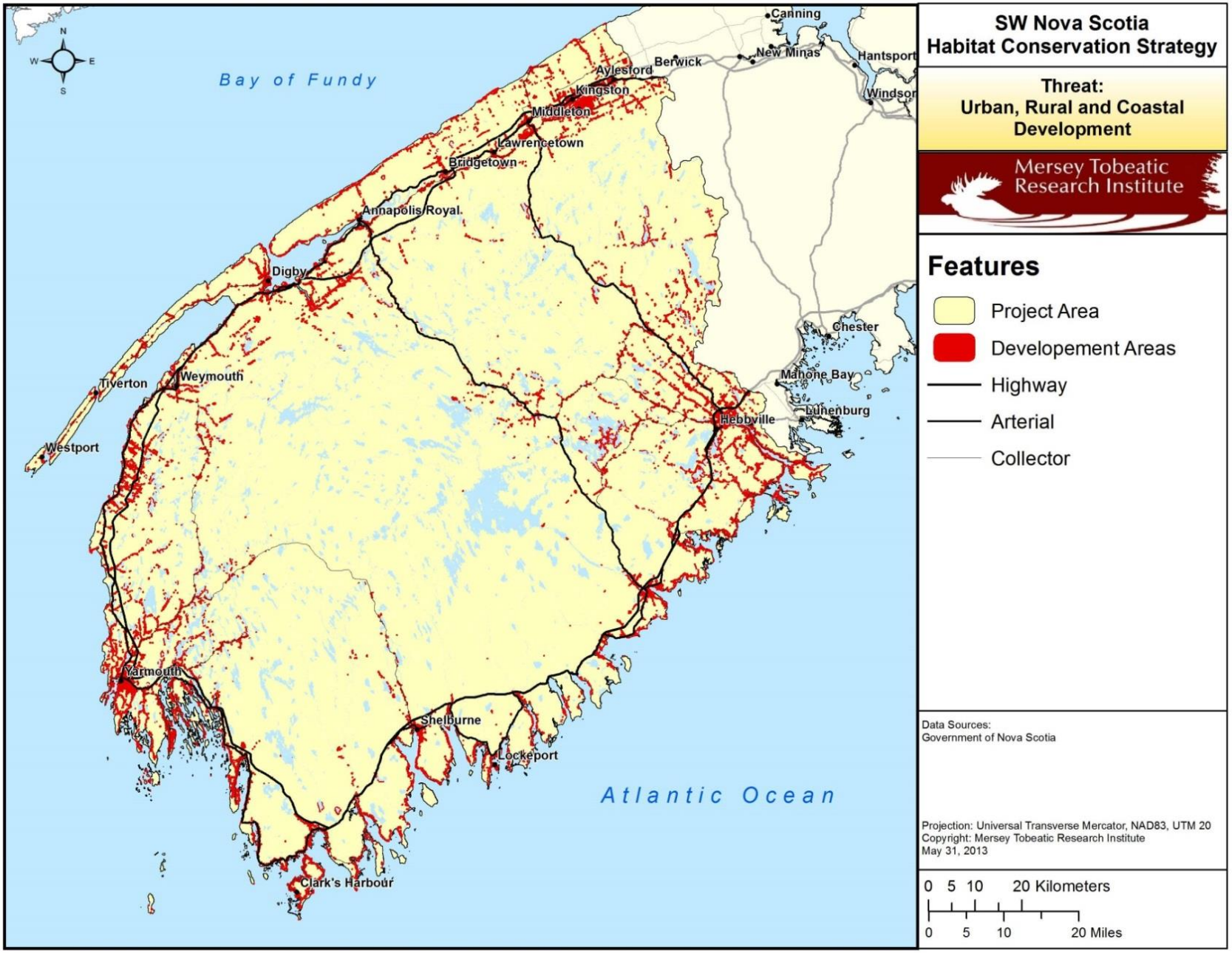

Figure 15. Urban, rural, and coastal development in the Southwest Nova Scotia bioregion.

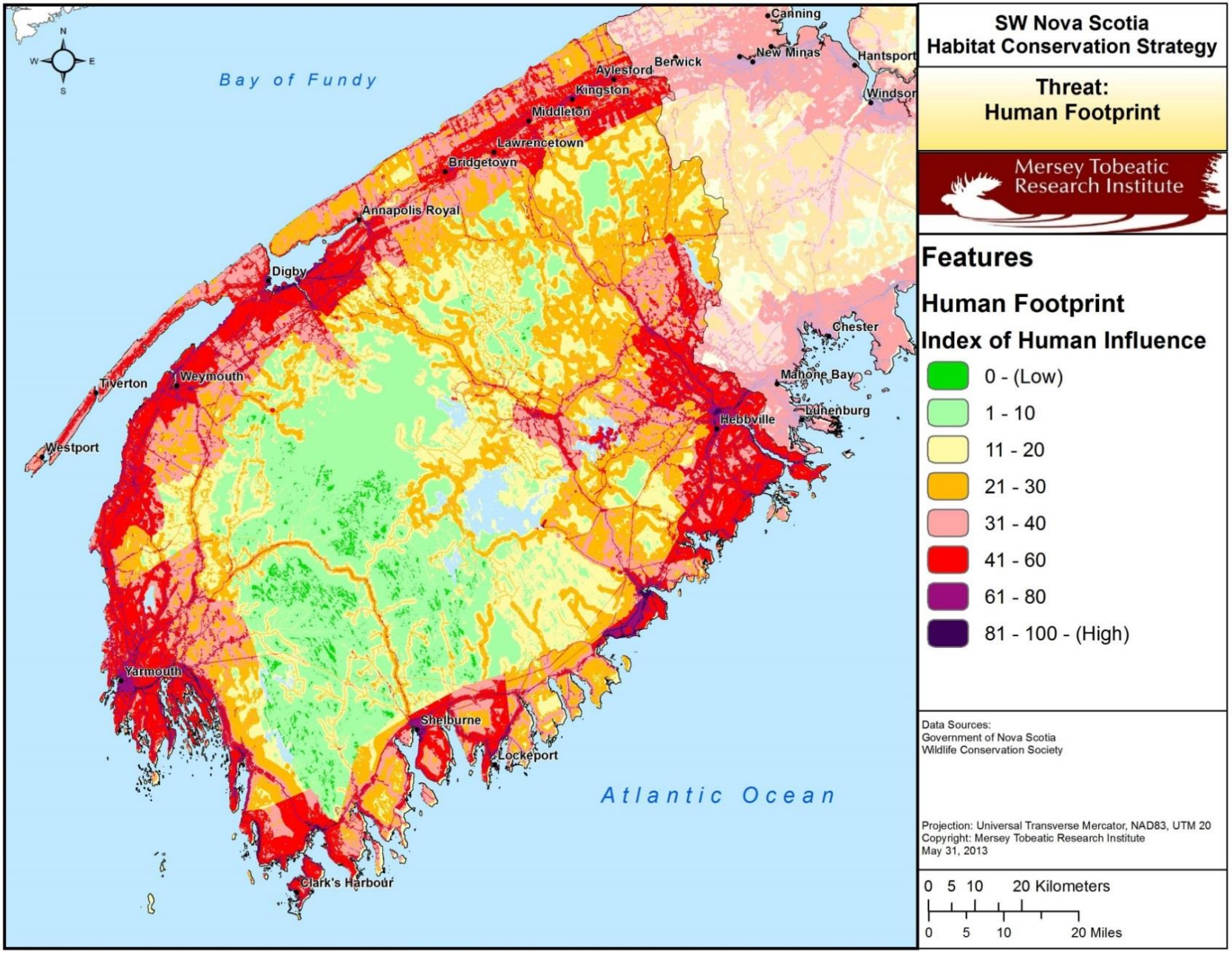

Figure 16. Human Footprint Index in the Southwest Nova Scotia bioregion.

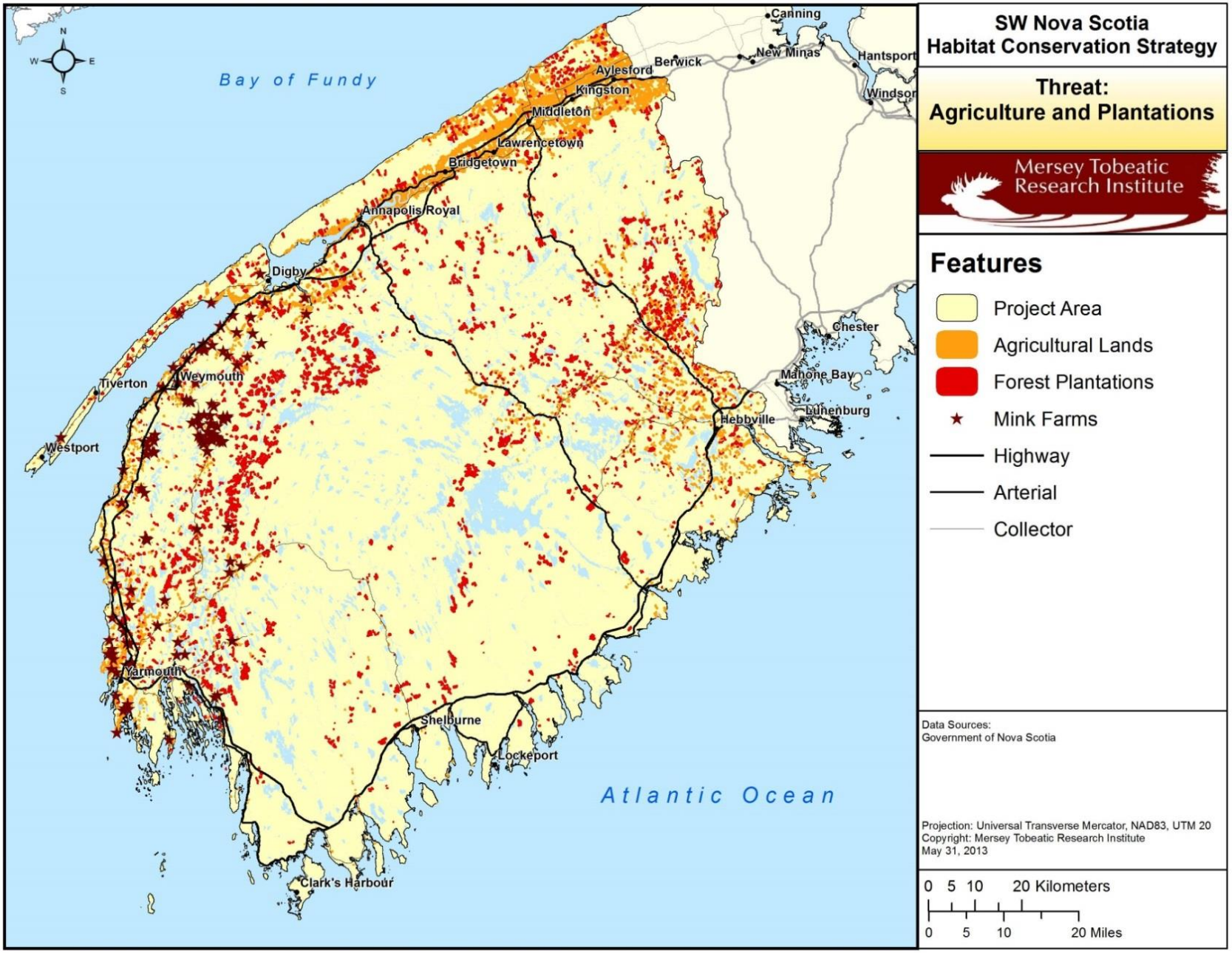

Figure 17. Lands used for agriculture and forest plantations in the Southwest Nova Scotia bioregion.

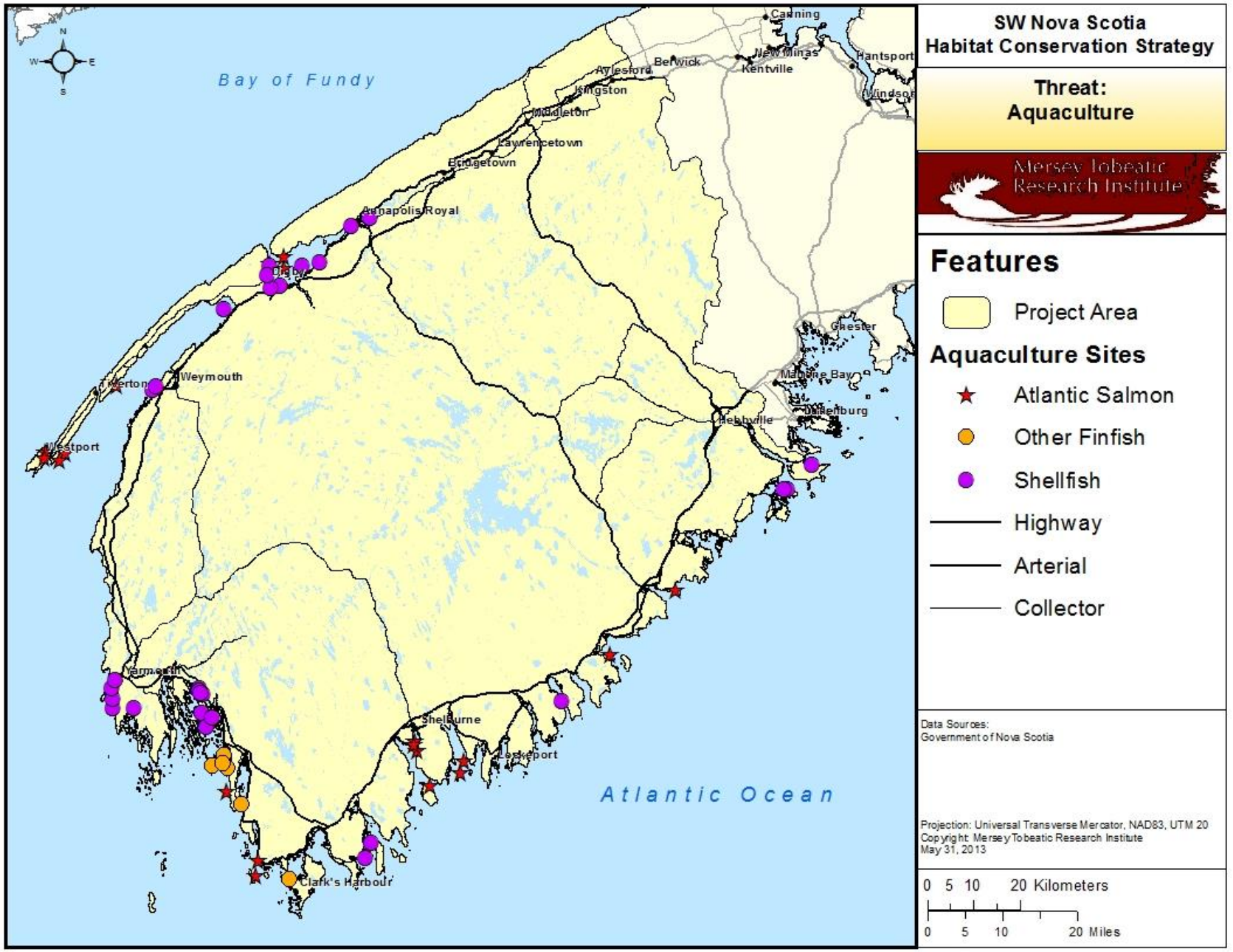

Figure 18. Marine shellfish and finfish aquaculture sites in the Southwest Nova Scotia bioregion.

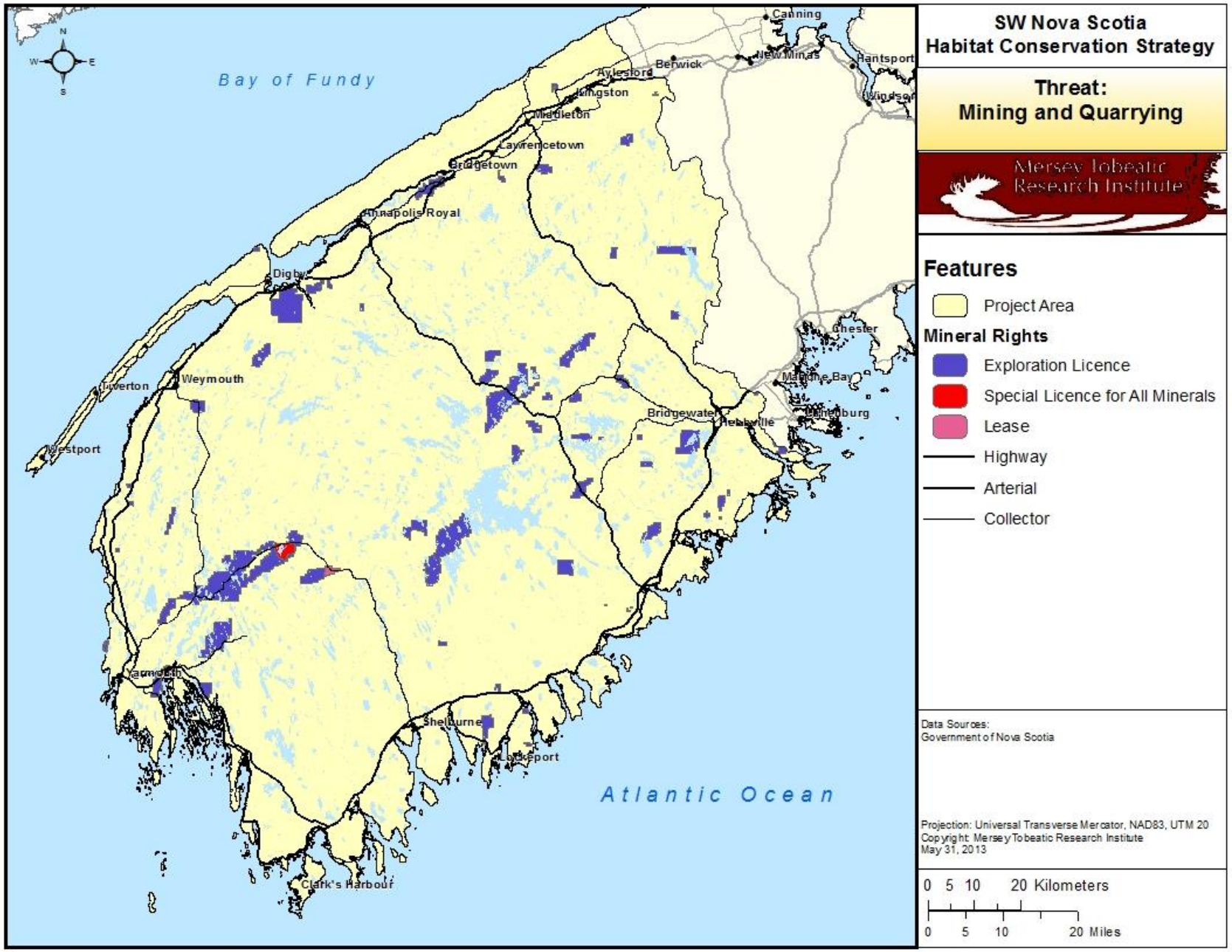

Figure 19. Mine and quarry leases in the Southwest Nova Scotia bioregion.

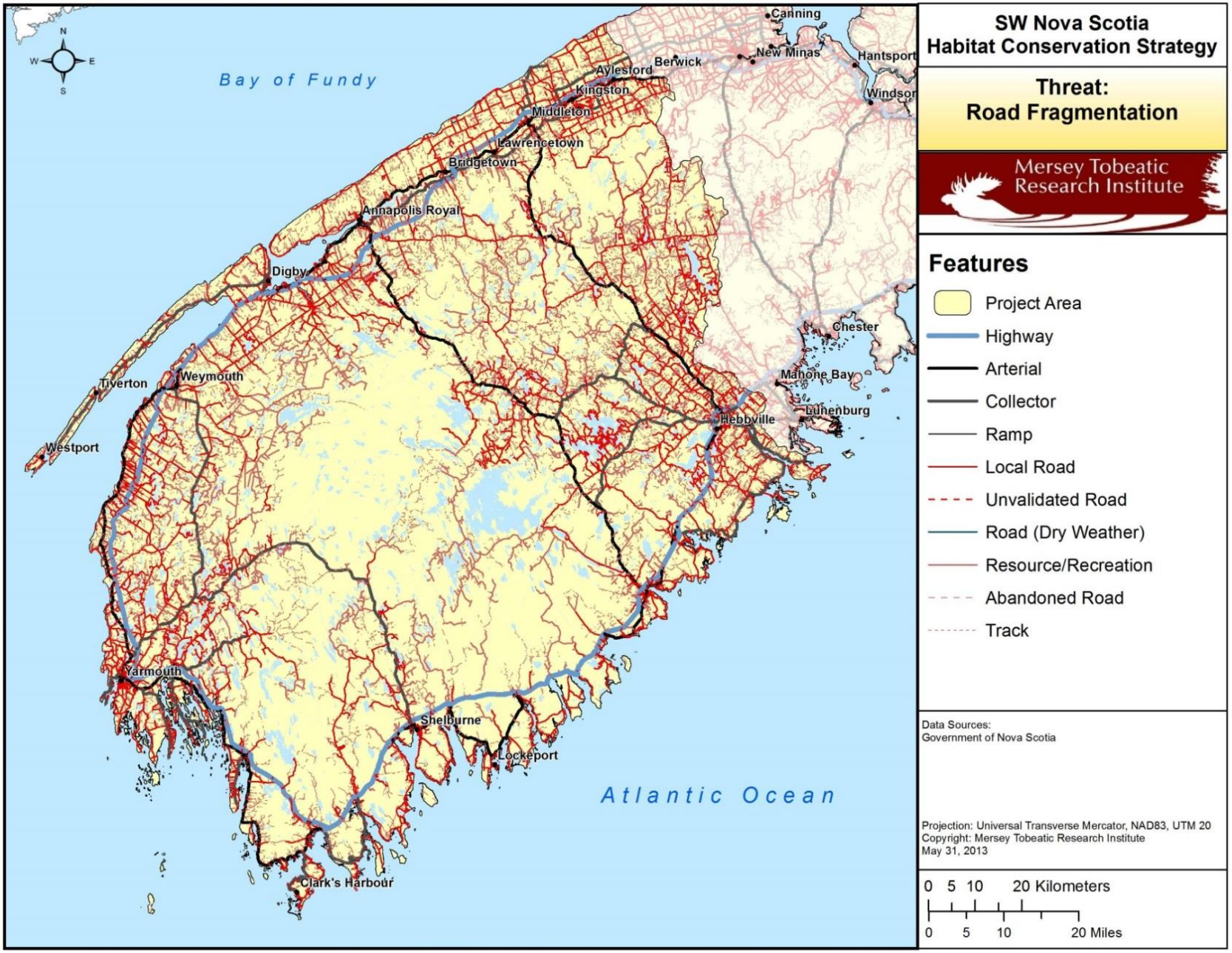

Figure 20. Road fragmentation in the Southwest Nova Scotia bioregion.

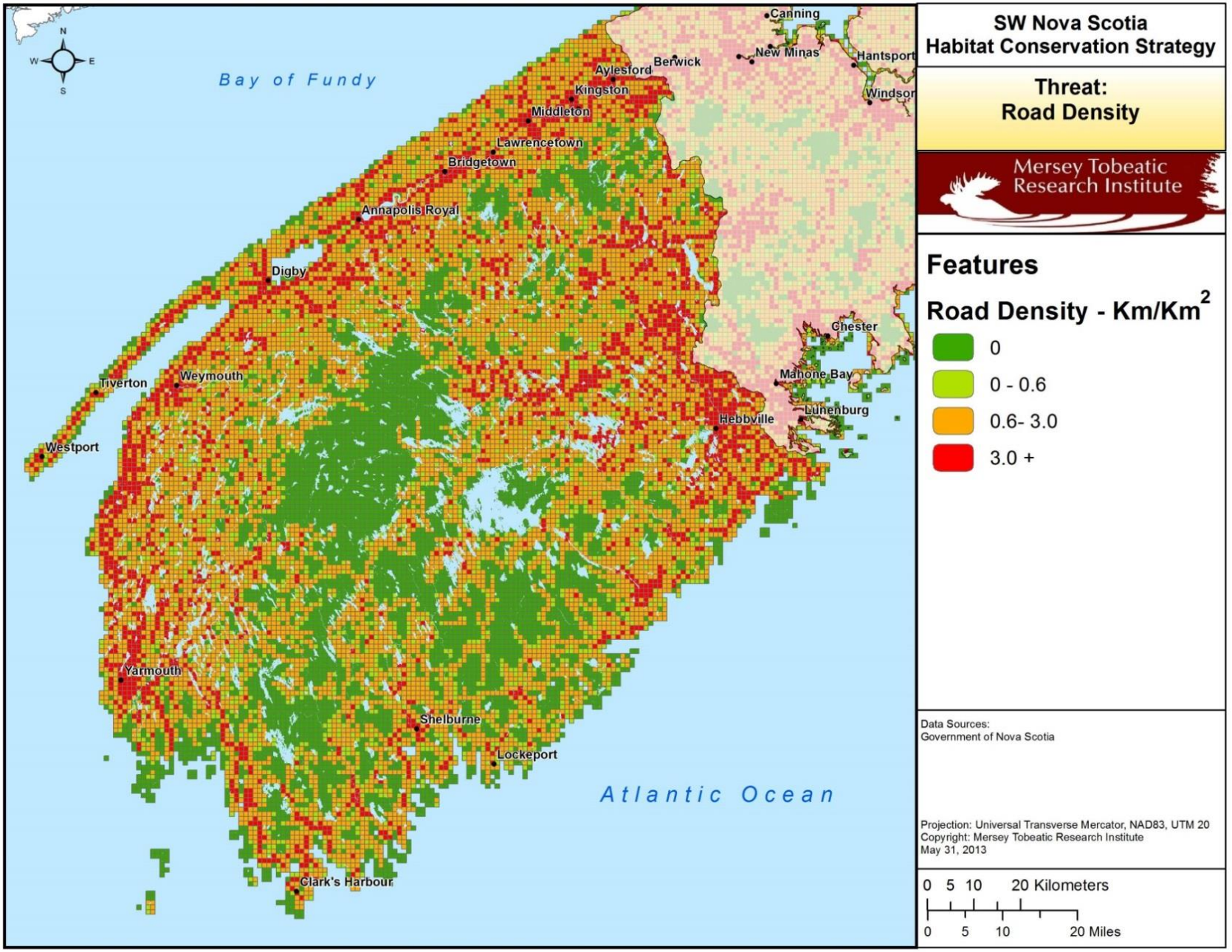

Figure 21. Road density (km/km^2) in the Southwest Nova Scotia bioregion.

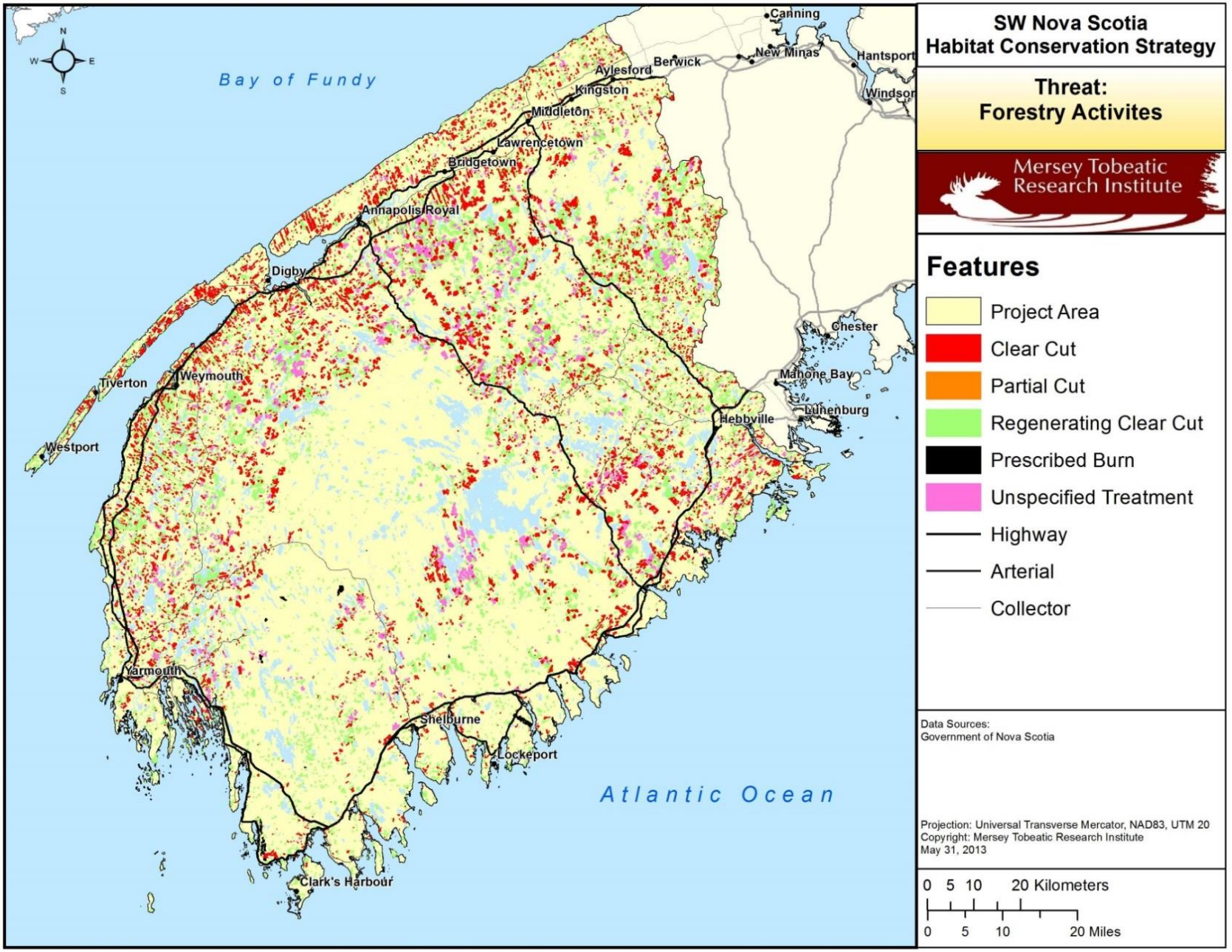

Figure 22. Forest harvesting activities in the Southwest Nova Scotia bioregion.

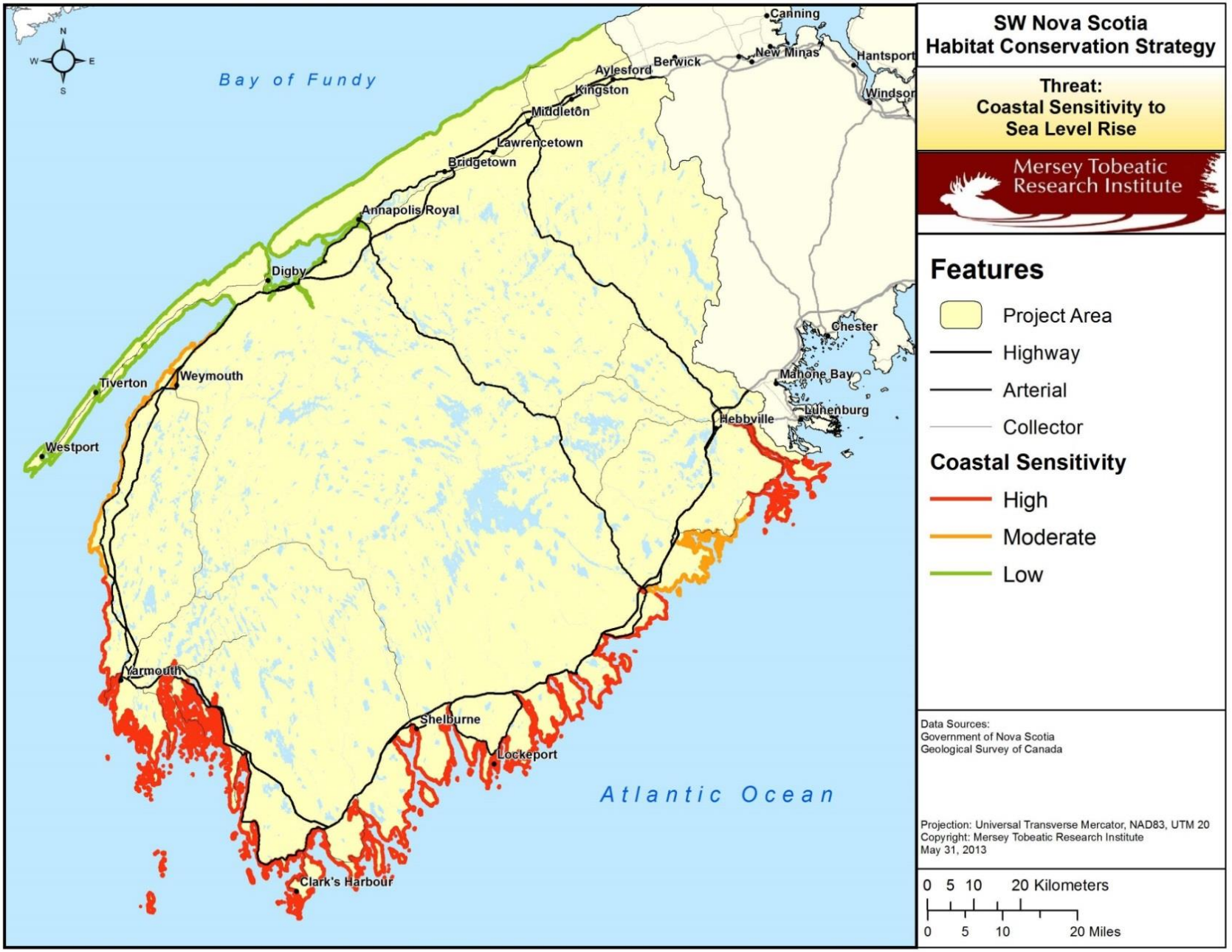

Figure 23. Coastal sensitivity to sea-level rise in the Southwest Nova Scotia bioregion.

C. Spatial Analyses

As part of this 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 SWNS 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 SWNS bioregion involved weighting (scoring) certain characteristics of the priority habitats higher than others. Freshwater wetland and Acadian Forest mosaic habitat occurrences were scored using a three-tiered equation that equally divides the scoring by size (minimum patch size), representivity (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 an 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. Existing protected areas and other conservation lands were not included in the analysis.

Priority habitat composite

The first map produced presents a composite of the priority habitat types, but 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, representivity, and size of individual patches of priority habitat types as described above. Figure 24 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.

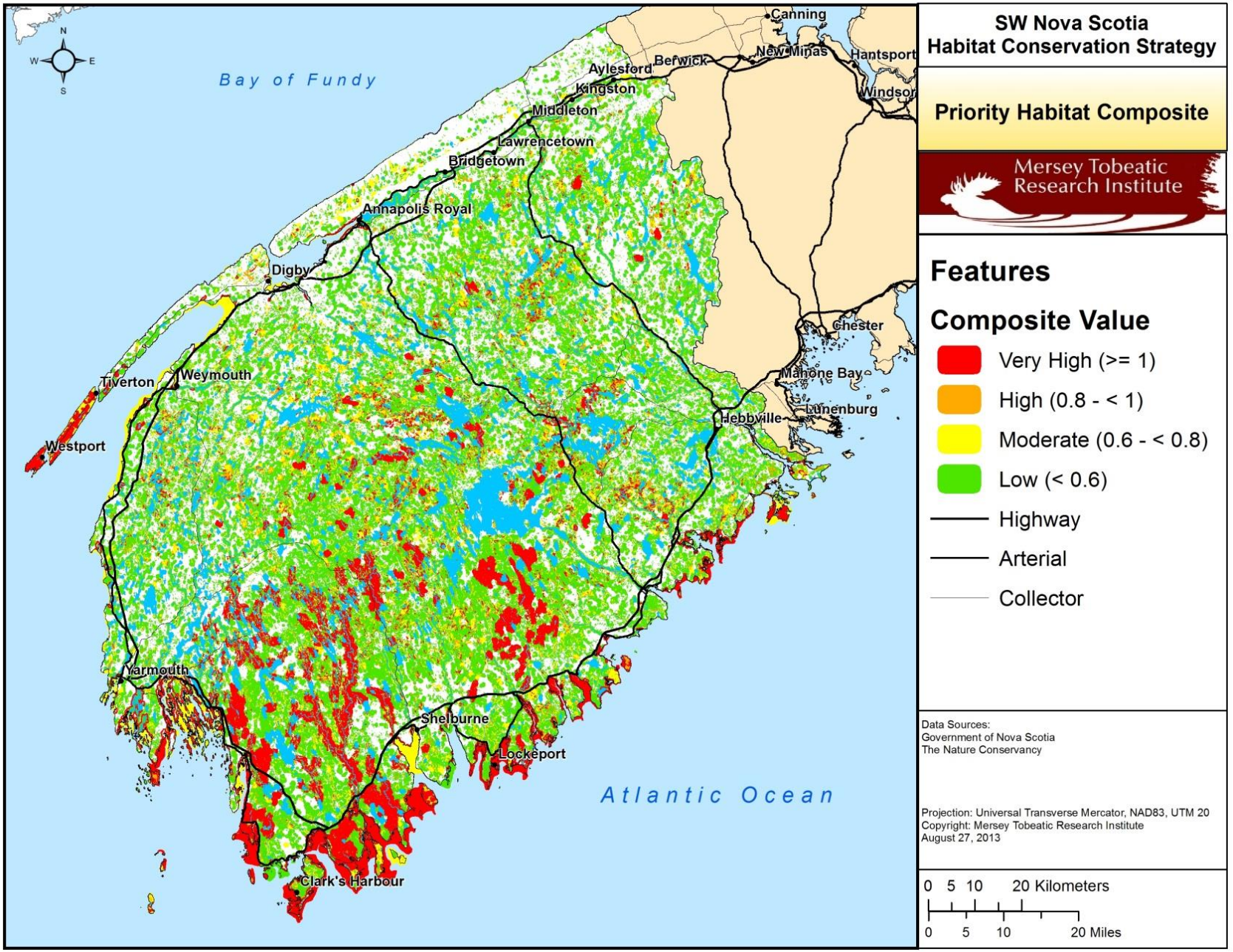

Figure 24. Priority habitat composite for the Southwest Nova Scotia bioregion.

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 F. 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 (Figure 25). 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). Table 15 below provides a description of the various priority species composites that were generated, and the information they present in Figure 25 to Figure 36. A detailed description of the methodology used and species data sources can be found in Appendix F. Lists of the priority species, including their conservation status, habitat associations, and occurrence data soures are provided in Appendices C and D.

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.

Table 15. Priority species composites generated and spatial data sources used for the Southwest Nova Scotia bioregion.

Fig.	Map Title	Description	# Spp	Data Source(s)	Pp.
25	All priority species composite	Likelihood of occurrence of all priority species	313	ACCDC Point Occurrence SAR Critical Habitat MBBA Relative Abundance MBBA Breeding Evidence	107
26	SAR[1] and rare[2] non-bird species composite	Likelihood of occurrence of all non-bird priority species	220	ACCDC Point Occurrence SAR Critical Habitat	108
27	SAR non-bird species composite	Likelihood of occurrence of all non-bird species at risk	37	ACCDC Point Occurrence SAR Critical Habitat	109
28	Habitat-limited[3] non-bird species composite	Likelihood of occurrence of non-bird habitat-limited priority species	84	ACCDC Point Occurrence SAR Critical Habitat	110
29	SAR and rare invertebrate species composite	Likelihood of occurrence of all invertebrate priority species	31	ACCDC Point Occurrence	111
30	SAR and rare reptile species composite	Likelihood of occurrence of all priority reptiles	2	ACCDC Point Occurrence SAR Critical Habitat	112
31	SAR and rare mammal species composite	Likelihood of occurrence of all priority mammals	5	ACCDC Point Occurrence	113
32	SAR and rare lichen and plant species composite	Likelihood of occurrence of all plant and lichen priority species	173	ACCDC Point Occurrence SAR Critical Habitat	114
33	SAR, rare, and priority[4] bird species relative abundance composite	Likelihood of occurrence of priority bird species for which relative abundance data derived from point count data collected for the MBBA was available	32	MBBA Relative Abundance	115
34	SAR, rare, and priority bird species breeding evidence composite	Likelihood of occurrence of bird priority species for which breeding evidence data collected within 10 × 10 km survey squares was used	67	MBBA Breeding Evidence	116
35	SAR bird species composite	Likelihood of occurrence of all bird species at risk	22	MBBA Relative Abundance MBBA Breeding Evidence SAR Critical Habitat	117
36	Habitat-limited bird species composite	Liklihood of occurrence of all habitat limited priority bird species	8	MBBA Breeding Evidence	118

[1] *All COSEWIC assessed endangered, threatened, and special concern species at risk, and* NS ESA *listed species.*
[2] *ACCDC assessed S1, S2, and S3 (G1, G2, or G3) species.*
[3] *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.*
[4] *BCR 14 NS and MBU 11 NS Priority Bird Species (Environment Canada 2013).*

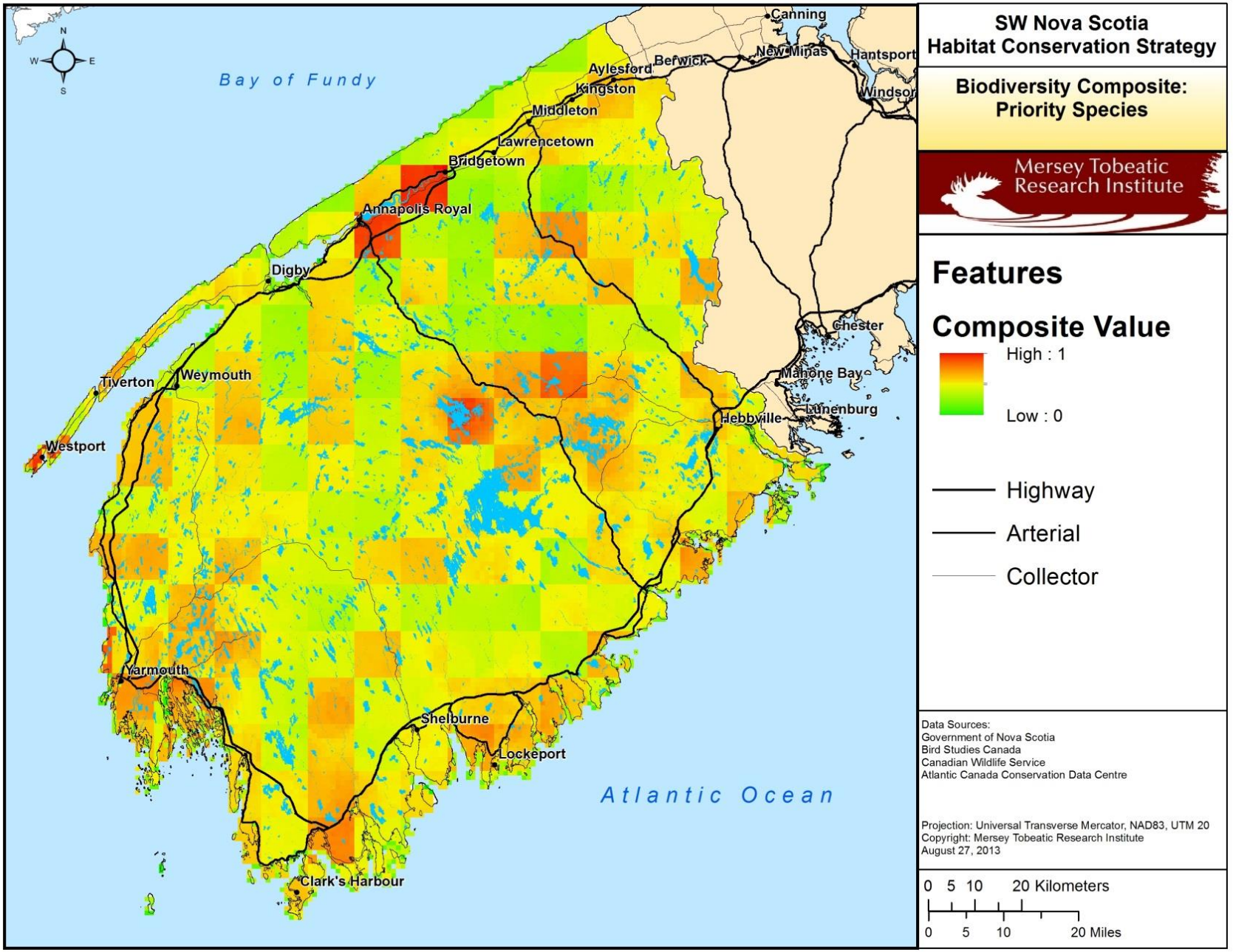

Figure 25. Species composite for all priority species in the Southwest Nova Scotia bioregion.

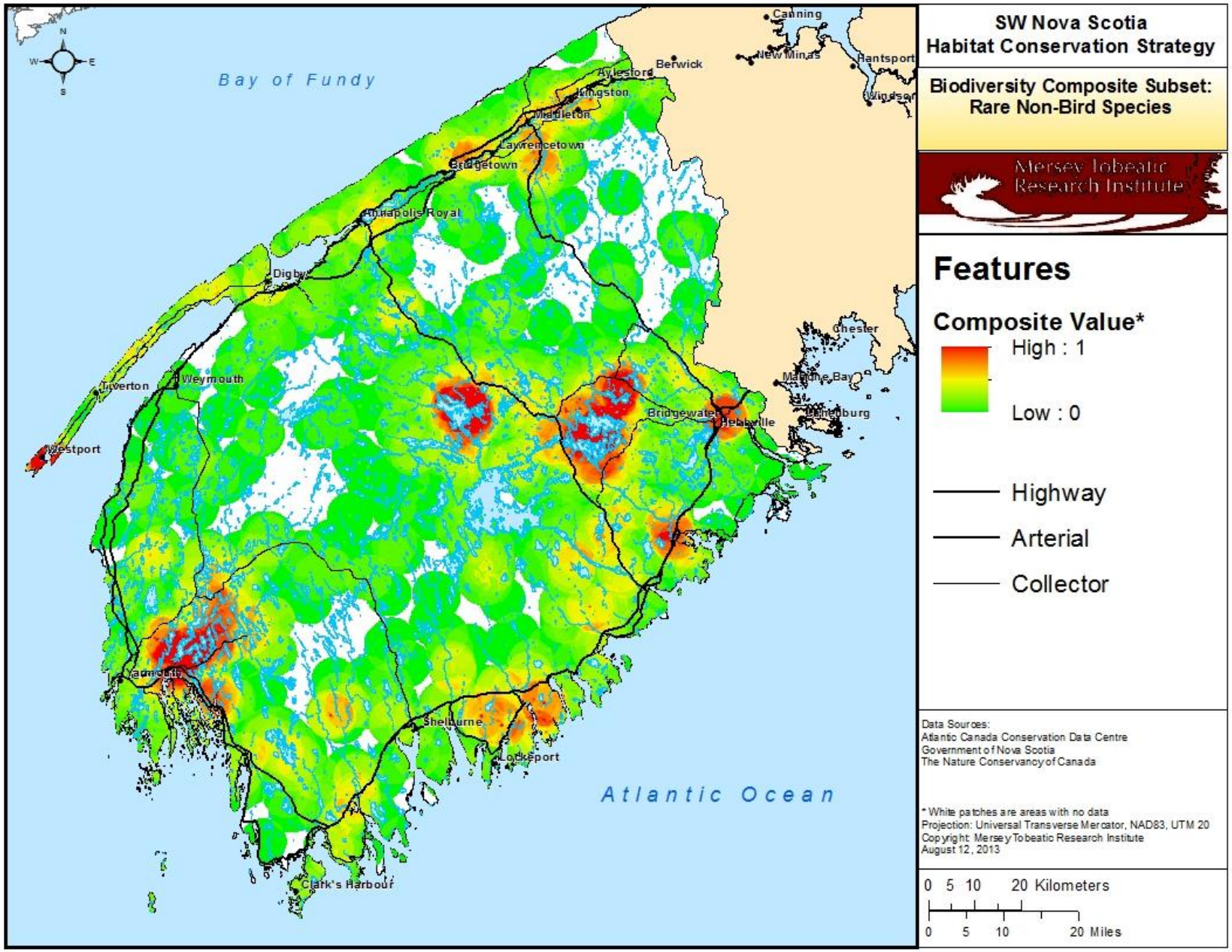

Figure 26. Species composite for species at risk (COSEWIC assessed and NS ESA listed) and rare non-bird priority species in the Southwest Nova Scotia bioregion.

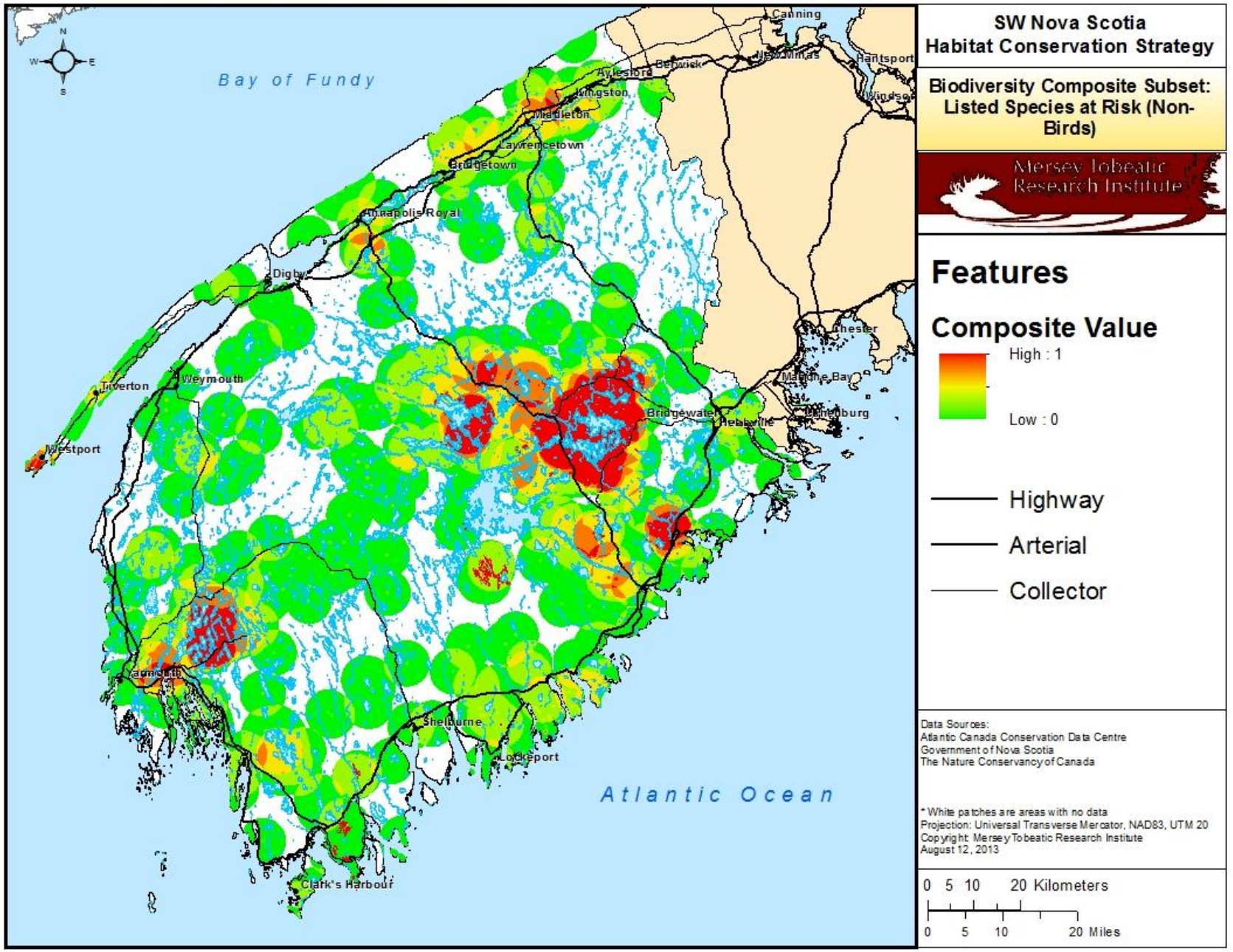

Figure 27. Species composite for non-bird species at risk (COSEWIC assessed and NS ESA listed) in the Southwest Nova Scotia bioregion.

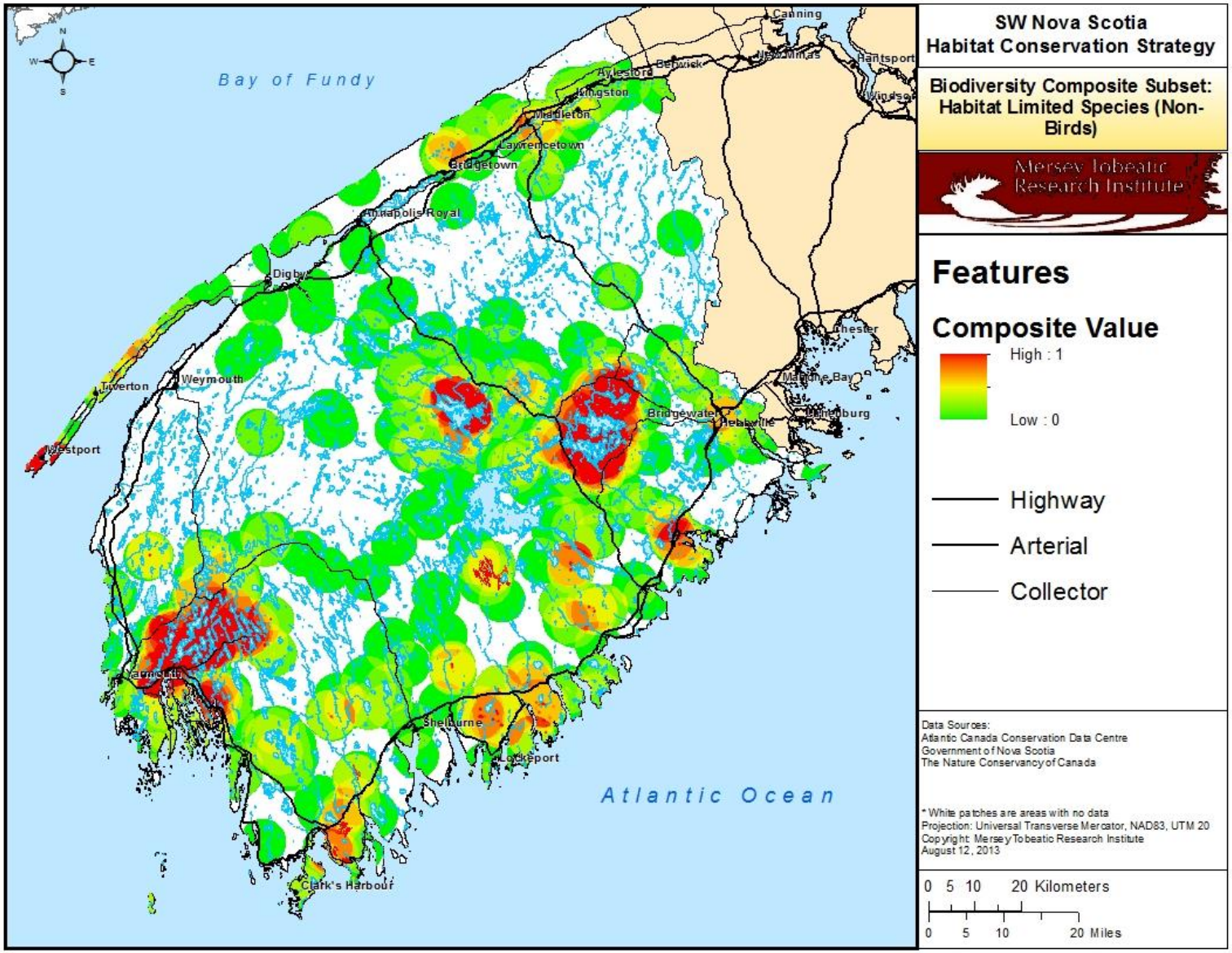

Figure 28. Species composite for rare and at risk non-bird habitat limited priority species[1] in the Southwest Nova Scotia bioregion.

[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.*

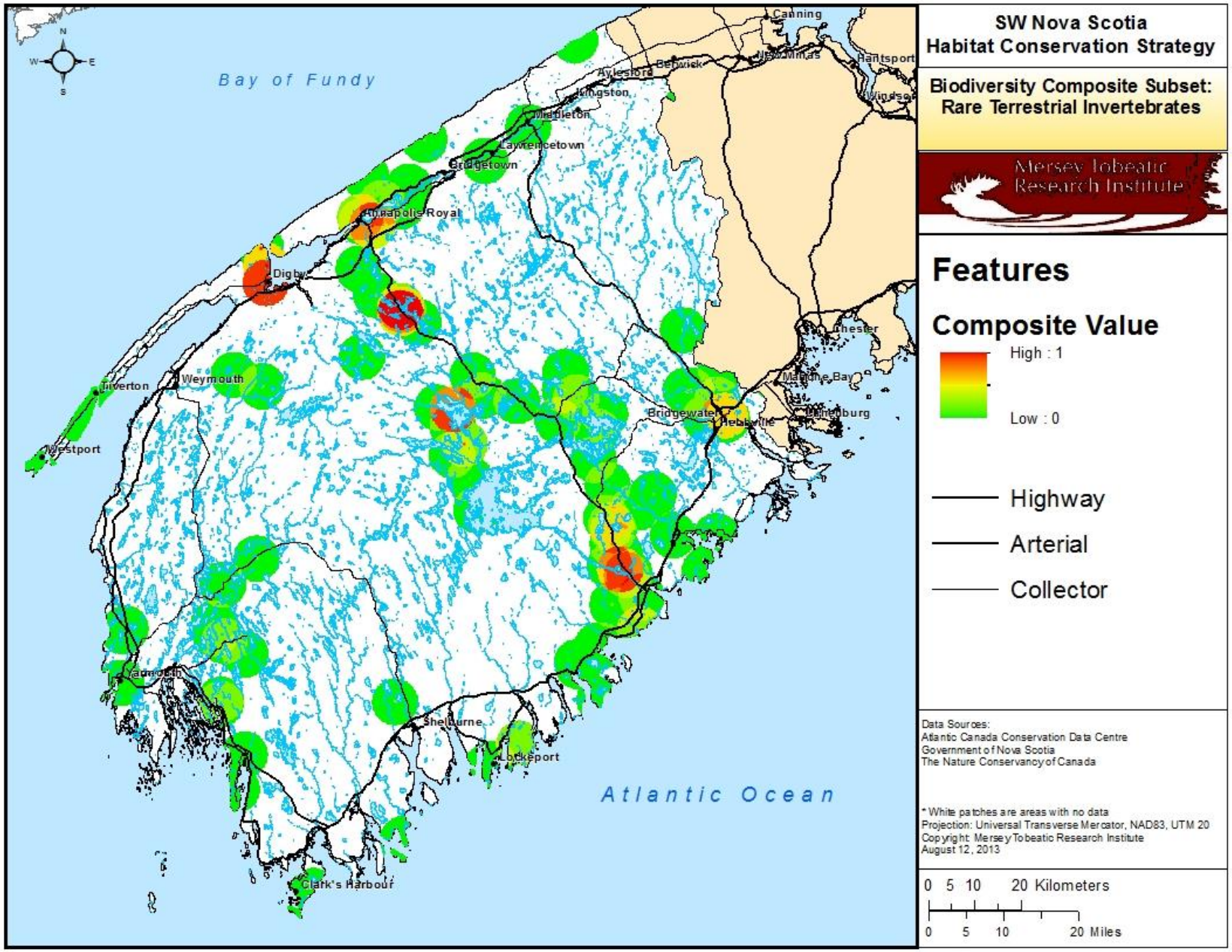

Figure 29. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) terrestrial invertebrate priority species in the Southwest Nova Scotia bioregion.

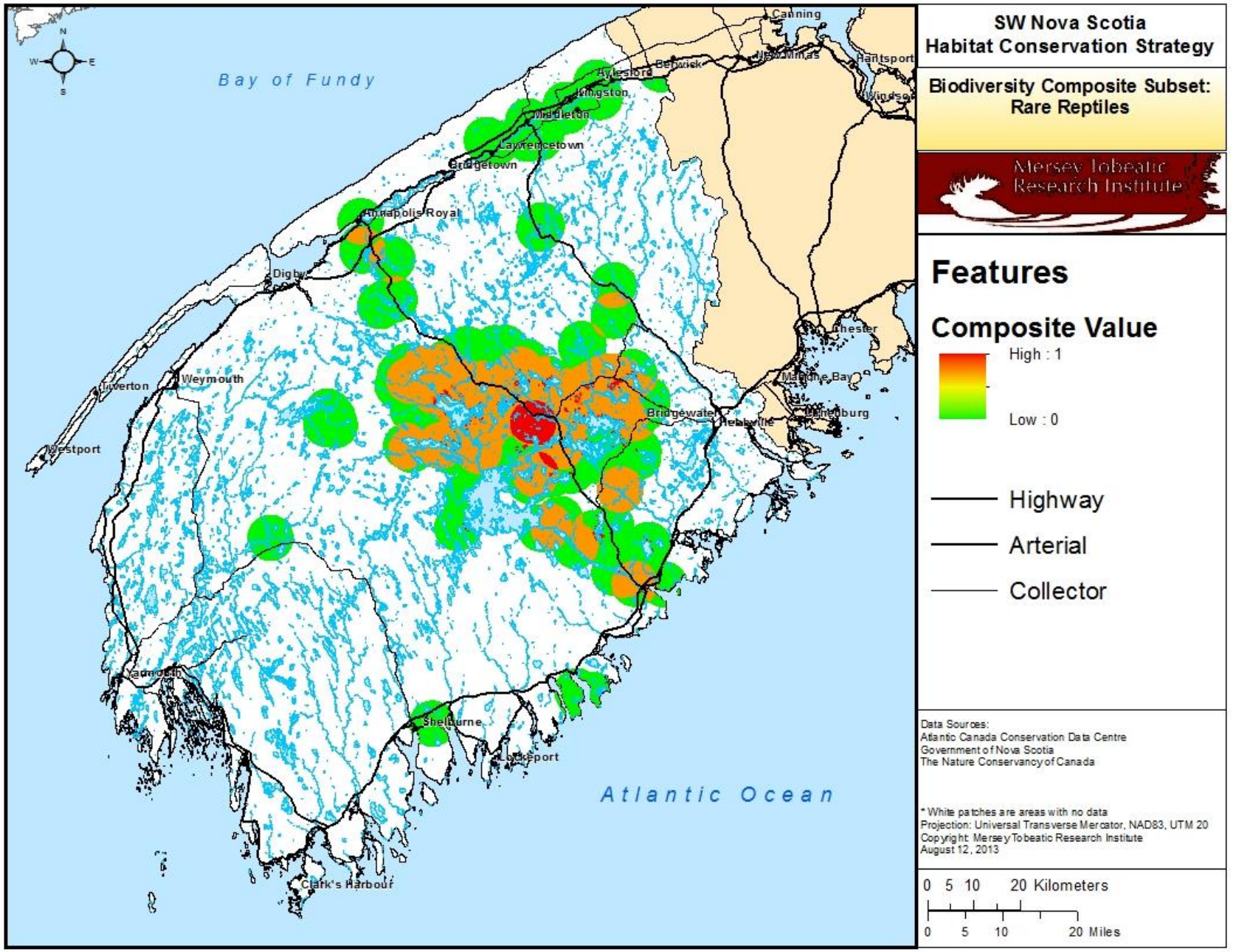

Figure 30. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) reptiles in the Southwest Nova Scotia bioregion.

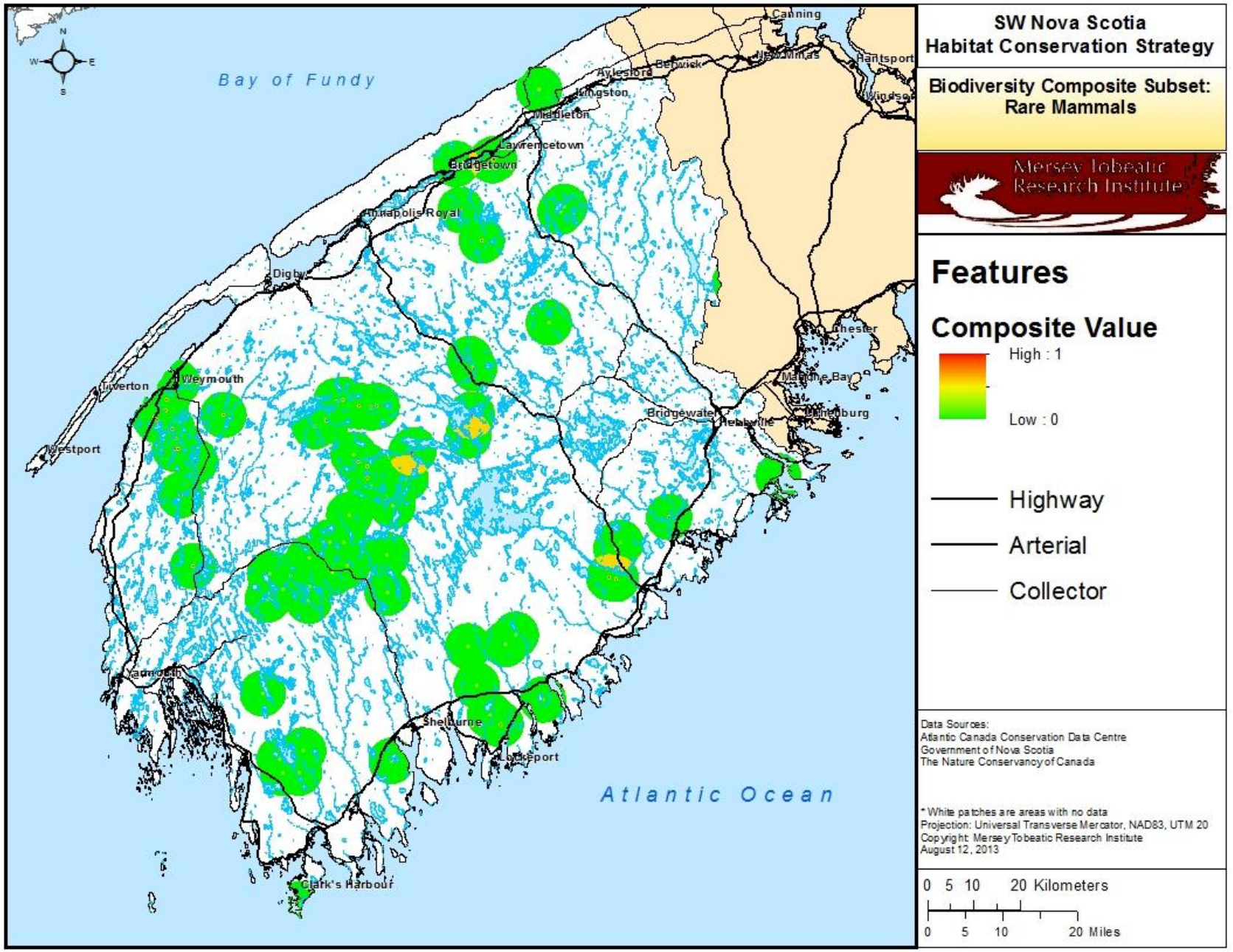

Figure 31. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) mammals in the Southwest Nova Scotia bioregion.

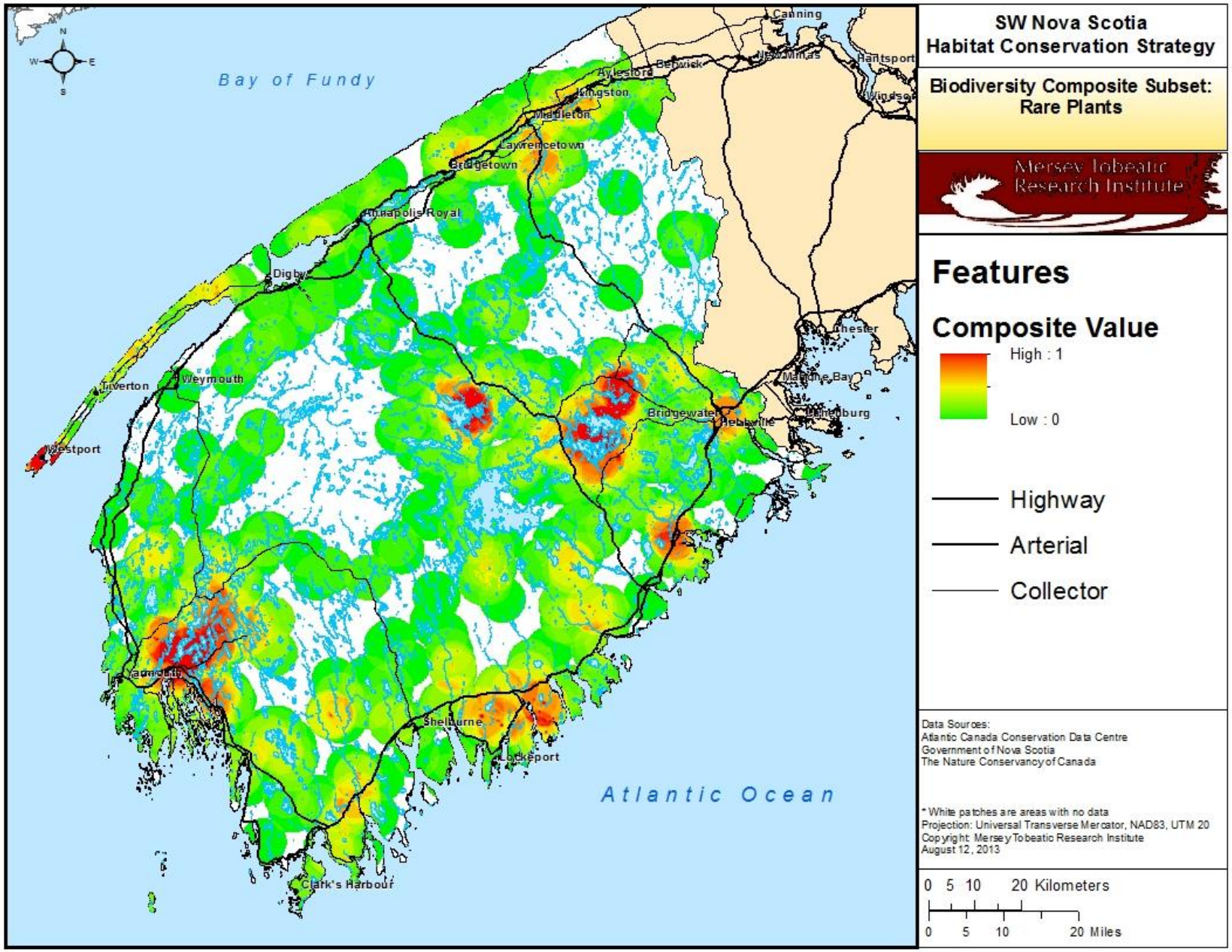

Figure 32. Species composite for rare and at risk (COSEWIC assessed and NS ESA listed) plant and lichen species in the Southwest Nova Scotia bioregion.

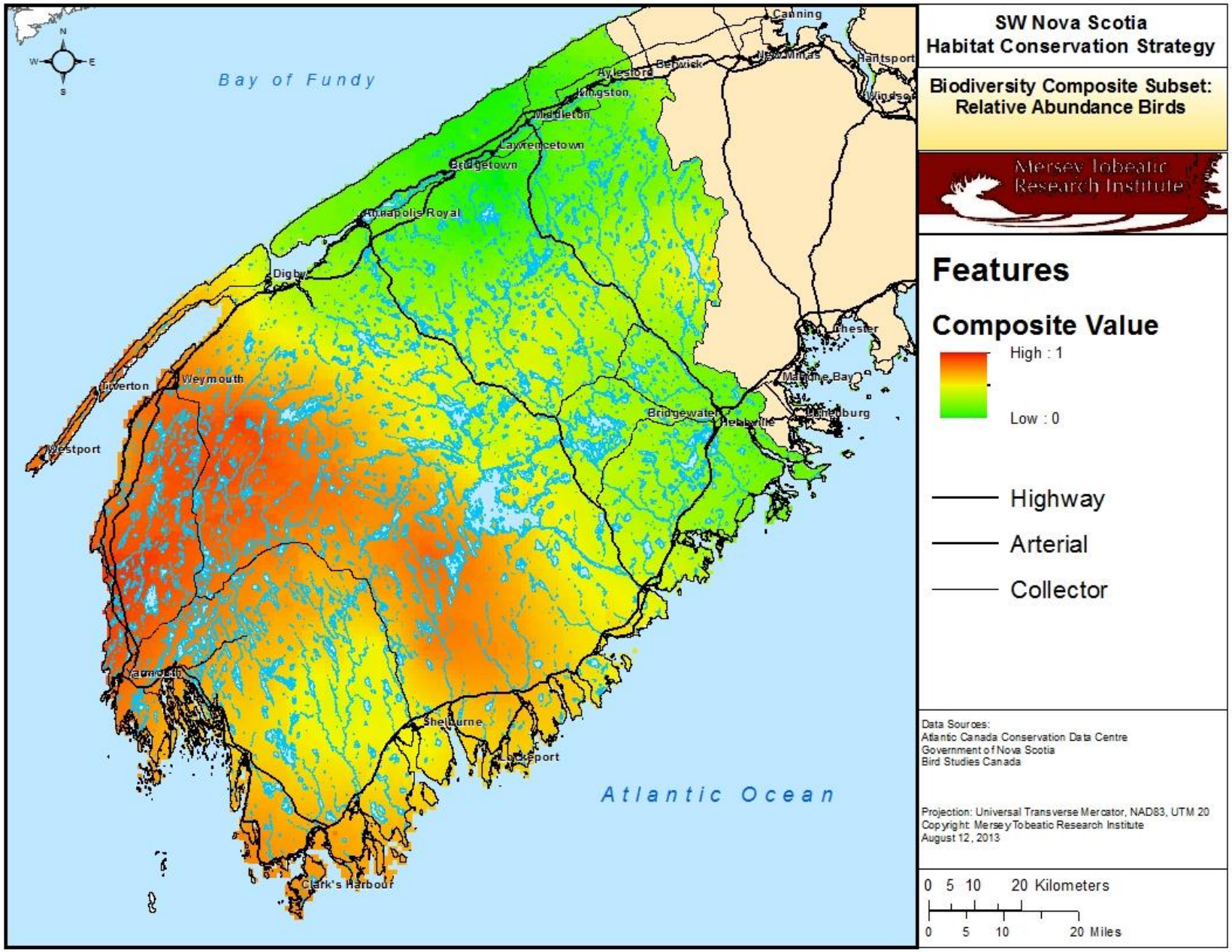

Figure 33. Relative abundance species composite for rare, at risk (COSEWIC assessed and NS ESA listed), and priority bird species in the Southwest Nova Scotia bioregion.

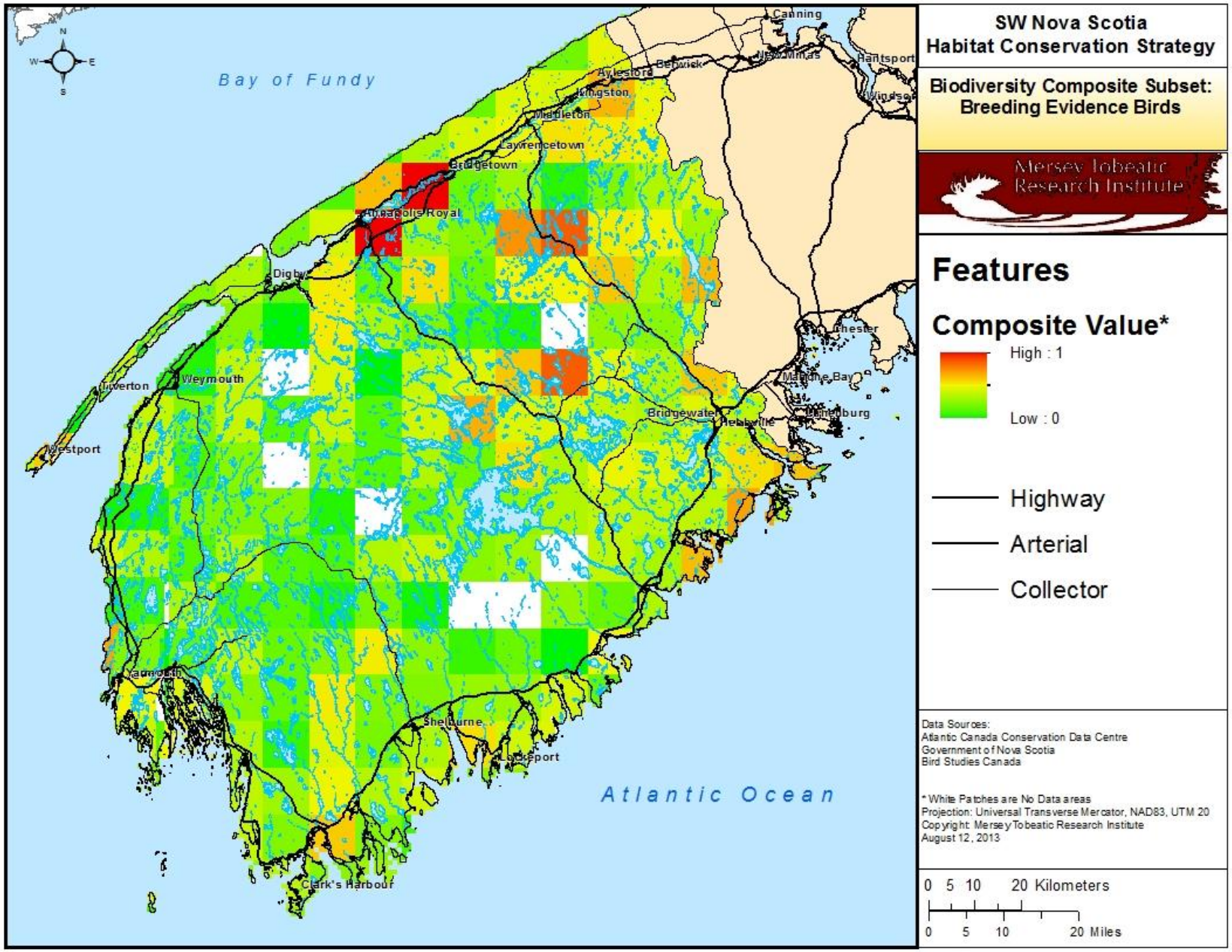

Figure 34. Breeding evidence species composite for rare, at risk (COSEWIC assessed and NS ESA listed), and priority bird species in the Southwest Nova Scotia bioregion.

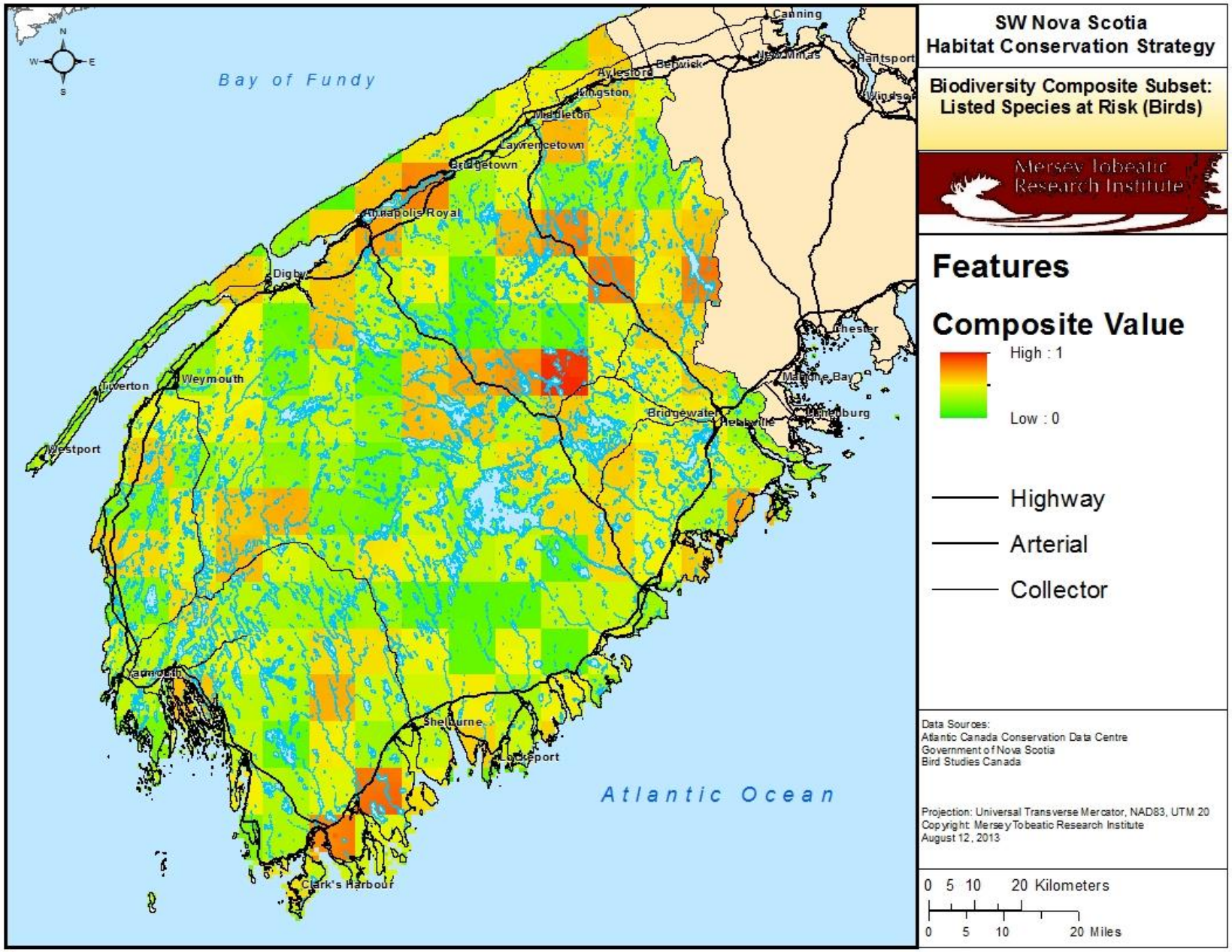

Figure 35. Species composite for bird species at risk (COSEWIC assessed and NS ESA listed) in the Southwest Nova Scotia bioregion (based on breeding evidence and relative abundance).

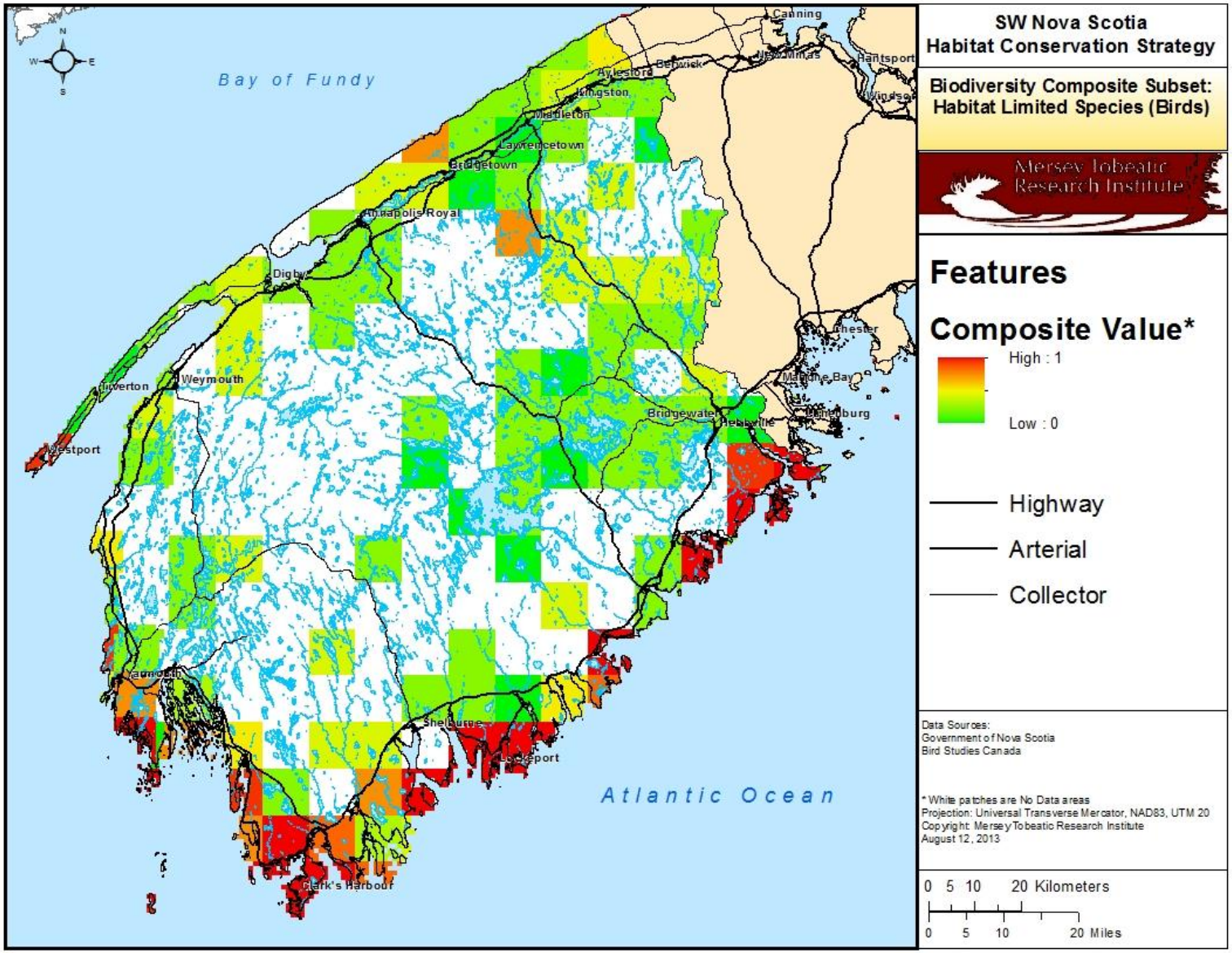

Figure 36. Breeding evidence composite for species at risk, rare and priority habitat limited bird species[1] in the SW Nova Scotia bioregion.

[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.*

iii. Conservation Value Index

The scores generated through development of the priority habitat composite and the priority species composite (using the full list of priority species) were combined to yield a conservation value index for the Southwest Nova Scotia bioregion, presented in Figure 37. Table 16 provides a summary of the results of the conservation value index analysis.

The results of the final prioritization seem to be consistent with firsthand knowledge of conditions across the SWNS bioregion, although the results of this analysis should be used in combination with field visits and local knowledge. Very discernible patterns emerge with respect to the Very High and High priority areas, most notably with the wetland and floodplain habitats of the Barrington/Clyde watershed, and coastal areas of Shelburne County. These patterns should be regarded relative, and would be most appropriately used to compare the conservation priority for habitats of the same type to one another, but not the absolute ecological value or quality of a habitat. Low conservation value rank does not indicate that an area is of little conservation value; rather it is of lesser conservation value than Very High or High-ranked areas.

Table 16. Summary results for the conservation value index for the Southwest Nova Scotia bioregion.

Conservation Value	Value Interval	Area (hectares)	% of Bioregion
Very High	≥ 1	541,335	34.1
High	0.8 to < 1	291,427	18.4
Moderate	0.6 to < 0.8	278,636	17.6
Low	0 to < 0.6	472,971	29.9
Total	**N/A**	**1,584,369**	**100**

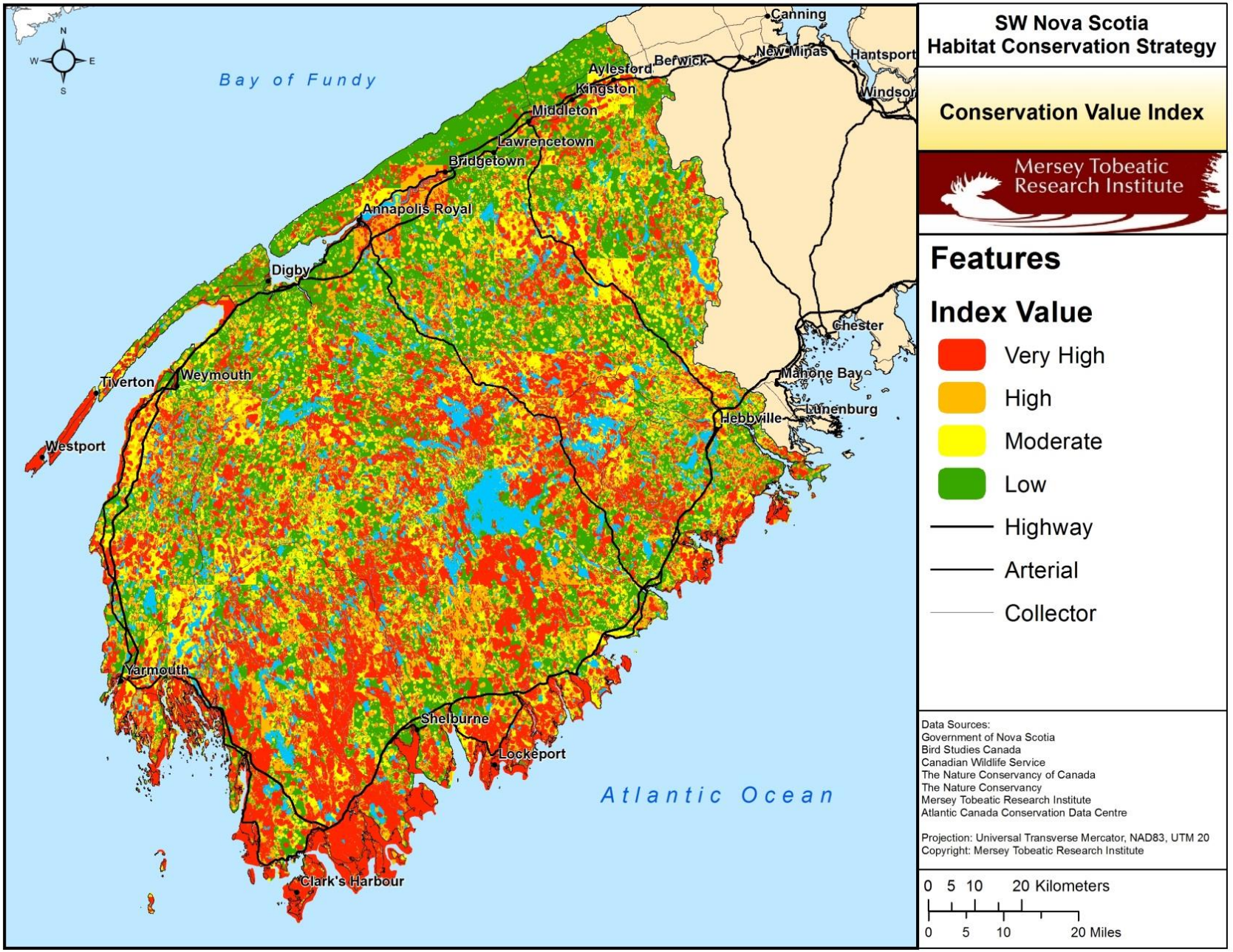

Figure 37. Conservation Value Index for the Southwest Nova Scotia bioregion.

3. CONSERVATION ACTIONS

This Habitat Conservation Strategy has been developed by partners and collaborators of the Eastern Habitat Joint Venture (EHJV) Nova Scotia Steering Committee and is intended to respond to the need to better communicate, coordinate, and inform conservation actions taken by regional and local conservation organizations. In addition to providing decision support for these groups, it is hoped that HCS development will create opportunities to enhance partnerships, recognizing that each organization is guided by its own particular mission, vision, and/or guiding principles.

A. Vision

The Southwest Nova Scotia bioregion is a hotspot for biodiversity and has retained its rich complement of species, with numerous rare and endemic species owing to its unique climate and geological history. The region contains a diverse assemblage of habitats, including rich and productive coastal estuaries, beach and dune systems, and coastal islands that support significant numbers of migratory waterfowl and shorebirds for breeding, staging, and over-wintering. Vast and healthy forests and aquatic ecosystems are protected in a network of connected conservation lands and sustainably managed working forests. Decisions with biodiversity implications are well-informed by research, and well-coordinated private and public conservation actions have benefited all native species and systems. Species at risk in the bioregion are recovering as their habitat viability improves through strategic and targeted conservation action. A strong sense of community and pride in the natural heritage of the region thrives as residents have been actively involved in locally-driven conservation and stewardship success.

B. 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.

C. Conservation partners

Environment 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 as National Wildlife

Areas under the *Canada Wildlife Act*. Within the SWNS bioregion, in addition to managing the Sand Pond National Wildlife Area and four Migratory Bird Sanctuaries, and 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 work is facilitated and supported by federal, provincial, industry, and other NGO partnerships. In the Atlantic region, BSC's programs focus on bird population monitoring, species at risk, and their associated habitats. Of particular interest to the SWNS bioregion, BSC coordinates with citizens and other conservation organizations to monitor annual population trends of Piping Plover, and monitors and promotes stewardship of roost and nest sites of Chimney Swifts (Maritimes Swiftwatch, 2010-present).

The Nature Conservancy of Canada

The Nature Conservancy of Canada (NCC) is the nation's leading land conservation organization, working to protect our 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 13,142 ha in 43 projects across the province. The NCC has secured approximately 8784 ha of coastal and inland wilderness in the SWNS bioregion.

Nova Scotia Nature Trust

The Nova Scotia Nature Trust (NSNT) is a conservation charity that works with private landowners to conserve ecologically significant habitat within Nova Scotia through securement and conservation easements. The NSNT's Endangered Species Program works to conserve critical habitat for species at risk in the bioregion, including Blanding's Turtle, Eastern Ribbonsnake, Piping Plover, and endangered species of ACPF, and currently protects approximately 1485 ha of coastal wilderness, critical freshwater habitats, old-growth forests, and habitat for species at risk in the bioregion.

Mersey Tobeatic Research Institute (MTRI)
The Mersey Tobeatic Research Institute (MTRI) is a non-profit co-operative with a mandate to promote sustainable use of natural resources and biodiversity conservation in the Southwest Nova Biosphere Reserve and beyond through research, education, and the operation of a field station. MTRI has a diversity of projects in the bioregion from species at risk research to landscape and aquatic connectivity.

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 biological diversity 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.

Clean Annapolis River Project
The Clean Annapolis River Project (CARP) is a charitable, community-based, non-governmental organization incorporated in 1990. Their mission is to enhance the ecological health of the Annapolis River watershed through science, leadership, and community engagement. Since 1990 CARP has developed several projects that address pertinent environmental issues in the Annapolis River watershed ranging from environmental monitoring to public education, to habitat restoration and home assessments.

Ducks Unlimited Canada (DUC)
Land protection is a critical tool by which Ducks Unlimited conserves waterfowl habitat throughout North America. DU protects land through several means including acquisitions, conservation easements and revolving lands strategy: 1) Land acquisition - In special cases, where intact waterfowl habitat is at imminent risk, DU may seek to acquire the property. Once purchased, the habitat is restored & conservation easements are placed on the land to perpetually protect its resource values; 2) Easements - Conservation easements can meet the needs of interested owners of working farms, ranches, timberlands, sporting properties and recreational lands, who wish to protect valuable natural resources while retaining ownership of the property; and 3) Revolving land - In locations where wildlife habitat has been degraded & the land is for sale, DU will seek to acquire it. Once purchased, the habitat will be restored and easements will be placed on land to perpetually protect resource values. DUC aims to develop initiatives to conserve existing coastal areas 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.

D. Opportunities

This section highlights opportunities to advance conservation partnerships and actions in the SWNS bioregion, from land acquisition and protection, to best management practices on Crown and privately owned woodlands, to opportunities to continue and advance stewardship activities in the bioregion.

Approximately 70% of the population of Nova Scotia lives on the coast, and 86% of the coastline is under private ownership (CBCL Ltd. 2009). Nonetheless, much of the Atlantic Coast remains undeveloped, particularly in the southwest with little development in the last 50 years around many of the small residential communities. Inland, there are hotspots of cottage and residential development around a

number of the larger lakes. Ferry services have operated between the town of Yarmouth and ports in Maine since the 1950s, and until recently cottage development along lake and river shorelines in Yarmouth County was on the rise, potentially threatening important habitat for species of Atlantic Coastal Plain Flora. Since Bay Ferries ceased its ferry service between Yarmouth and Bar Harbor, Maine in December 2009 however, cottage development in the vicinity has slowed. A ferry service to Portland, Maine is expected to resume in May 2014, which may once again lead to an increase in cottage development in Yarmouth County.

The SWNS bioregion, and in particular the Atlantic Coast, is an active area for regional land protection agencies. The Nature Conservancy of Canada, Nova Scotia Nature Trust, Ducks Unlimited Canada, and the Nova Scotia Eastern Habitat Joint Venture have all acquired and manage lands within the bioregion. Within the coastal zone of the bioregion there are eight nationally designated Important Bird Areas (IBAs), some of which are of global significance to breeding and migrating bird populations. Though these designations do not afford legal protection to these areas, which encompass both private and protected land, they do provide guidance for land protection and stewardship activities, and are active areas for land securement. Land values are variable throughout the region, but generally are lower inland than along the coast, and decrease as you move away from the larger urban centres (i.e., Bridgewater, Yarmouth, Annapolis Valley), and as you move west from the Halifax Regional Municipality. Areas of the Atlantic Coast that are within the boundaries of the bioregion have not, for the most part, seen inflated land values comparable to those in Mahone Bay, which attracts foreign buyers, skewing property values upward. In addition to land acquisition for conservation, local organizations such as the Nova Scotia Nature Trust work with private landowners to protect significant natural areas through the use of conservation easements, which are voluntary, legal agreements between a landowner and conservation organization or government agency that permanently limits uses of the land in order to protect its conservation values. Opportunity also exists to bring important areas of intertidal flats into the province's network of protected areas, given that in Nova Scotia a grant of land only extends to the ordinary high water mark of tidal or coastal land; land between the ordinary high and low water marks of coastal water is considered to be Crown land under management by the Nova Scotia Department of Natural Resources (CBCL Ltd. 2009; NSDNR 2013c).

Following the Province's acquisition of the former Bowater Mersey Paper Company woodlands, the Government of Nova Scotia initiated the Western Crown Land Planning Process for 1.5 million acres of Crown land in western Nova Scotia in January 2013. Following input and ideas from engaged citizens and stakeholder groups, the government developed a conceptual plan for western Nova Scotia[1], based on the values that Nova Scotians want to see guide the management of public land, including long-term environmental, social, and economic sustainability. This early stage plan provides strategic vision for land management in large geographic planning units designated for multiple values, conservation, parks and protected areas, resource management, and Mi'kmaw interests. More detailed planning is anticipated, including management plans for the use of individual sites within the larger planning units.

Inland, forestry remains a dominant economic stimulus in the SWNS bioregion, with large areas of wilderness managed primarily for forest products. The recent downturn in the forest industry however has changed the face of Nova Scotia's rural economy, and has resulted in the closure of numerous small-scale logging operations and sawmills, and several pulp and paper mills in the province. The Bowater Mersey Paper Company, which operated a pulp and paper mill in southwest Nova Scotia for over 80

[1] *Government of Nova Scotia. 2013. Crown Land Management: A Conceptual Plan for Western Nova Scotia.*

years, ended its operations in 2012. Though this represents a significant loss to the local economy, purchase of the Bowater lands by the Province provides equally significant opportunities for the future of forestry in the region, including improved environmental stewardship, development of innovative forest products, forest certification programs, and proposals by local groups to manage Community Forests to support long-term rural economic development. In December 2012, the Province announced a request for proposals from municipalities, wood co-operatives, not-for-profit organizations, and other community-based groups to establish and manage community forests on Crown land in southwest Nova Scotia. In general, community forests are locally managed, provide direct benefits to local communities, are managed for multiple values, including ecotourism, recreation, and education programs, and are managed sustainably for the long term. Following a review of proposals from communities in Southwest Nova Scotia, the Nova Scotia Department of Natural Resources recently announced that the province will negotiate a three-year Crown land forest agreement with the Medway Community Forest Co-operative to establish Nova Scotia's first community forest on 15,000 ha of forest in the Medway District of the former Bowater lands. The Medway Community Forest Co-operative is supported by several groups including the Mersey Tobeatic Research Institute, Wind Horse Woods, the North Queens Board of Trade, the Federation of Nova Scotia Woodland Owners, Nova Scotia Woodland Owners and Operators Association, Nova Scotia Co-operative Council, and the Ecology Action Centre, as well as numerous local community members, forestry contractors and local mills. The Co-operative plans to develop a locally governed, long-term, ecologically-based stewardship plan that allows multiple uses of a working forest, while nurturing new and innovative forest-based businesses that support the local economy (J. Barker, per. comm.).

Forest certification is another valuable and voluntary tool used to demonstrate sustainable and socially responsible forestry. Forest certification involves the evaluation of forest management practices that meet nationally and internationally recognized standards that reflect modern sustainable forestry concepts. Evaluations are completed by independent third party audit conducted by qualified certification bodies, enabling consumers to make informed decisions about the forest products they buy, and the forest management practices they support. All of the former Bowater Mersey Paper Company woodlands are certified to the Sustainable Forestry Initiative (SFI) standard, and the Medway District is certified to the Forest Stewardship Council (FSC) Maritime standard, and the Nova Scotia Department of Natural Resources has stated their intention to maintain these certificates. The number of small, privately-owned woodlots that are certified to the FSC Certification Standards for Best Forestry Practices in the Maritimes Region for Small and Low Intensity Forests is also on the rise. Since 2011, with funding provided by the Government of Nova Scotia, the Mersey Tobeatic Research Institute and the Federation of Nova Scotia Woodland Owners have been partnering to assist woodland owners in the certification of their small, private woodlands under one collective FSC group certificate. The MTRI has also developed a Guide to FSC Certification for Woodlot Owners in Nova Scotia, which provides useful information on Sustainable Forest Management practices. In addition, the Acadian Forest Keepers is an independent group of landowners and small businesses found throughout the Maritime Provinces that are also certified to the FSC Maritime Standard. A number of their members are located within the Bioregion.

Opportunities exist to develop effective partnerships among the various conservation organizations, and with the various levels of government operating within the SWNS bioregion. This includes numerous non-profit conservation and environmental organizations, including the Mersey Tobeatic Research Institute, Clean Annapolis River Project, Bird Studies Canada, Bluenose Coastal Action Foundation, Nova Scotia Nature Trust, Nature Conservancy of Canada, Tusket River Environmental Protection Association, Friends of Port Mouton Bay, Kingsburg Coastal Conservancy, and the Port Joli Basin Conservation

Society. Resources from these groups include scientific expertise, strong volunteer support, and strong community involvement.

There is a strong sense of volunteerism and stewardship in the SWNS bioregion, particularly through the Kejimkujik Southwest Nova Volunteer Program, which is a collaboration of Parks Canada, the Friends of Keji, the Mersey Tobeatic Research Institute, Bird Studies Canada, and Acadia University. This program facilitates opportunities for concerned citizens to contribute toward regional species at risk and conservation programs in and around Kejimkujik National Park and Seaside Adjunct. Through this program, over 350 volunteers contributed over 13,000 volunteer hours in 2012 on a diverse assemblage of projects including the protection of endangered Blanding's Turtle nests, surveying the shoreline with botanists for rare ACPF species, monitoring changes in water quality, creating habitat for the Monarch Butterfly, monitoring and tracking Brook Trout, surveying and participating in research on the endangered Piping Plover, searching for Eastern Ribbonsnake, counting Common Loons on lakes in southwest Nova Scotia, providing information to visitors in the campground, and helping to remove exotic species like Glossy Buckthorn and European Green Crab. Since April 2006, Bird Studies Canada has been directing the Nova Scotia Piping Plover Conservation Program and Piping Plover Guardian Project, in which staff and volunteers work closely with the Nova Scotia Department of Natural Resources, Environment Canada's Canadian Wildlife Service, and Parks Canada to ensure that breeding Piping Plovers are monitored and well protected on about two dozen beaches across Nova Scotia.

E. 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 SWNS 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 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.

The habitat and species composites are based on our current state of knowledge as it relates to the distribution of priority habitats and priority species and relies on existing spatial habitat data and species occurrence databases. Sampling effort varies substantially both among and between taxa, and spatially throughout the bioregion; therefore, data coverage is not meant to be construed as an exhaustive inventory of taxa in the bioregion. Additional occurrence records for species and taxa are known to exist but have not been provided to the Atlantic Canada Conservation Data Centre, and consequently were not available for the analyses. There were additional issues with combining different sources of data (e.g., ACCDC rare taxa occurrence records with MBBA II breeding evidence grids), and we sought to remedy this by providing species composites for subsets of the full list of priority species based on both taxa and data sources used. The results of the analyses have not been verified through field surveys and are meant to guide more detailed conservation actions on the ground.

With regards to ACPF, there is a recognized lack of population and distribution data within the bioregion, and limited information on the basic biology of ACPF species (Environment Canada & Parks Canada Agency 2010). Further monitoring and research of sensitive species and their habitats are required to further the recovery effort for species at risk. Regular surveys of known high priority occurrence sites as part of long-term monitoring to determine accurate populations abundance, distribution and trends, as well as habitat condition, would benefit the recovery effort. In addition,

identification of potential new sites and inventories to determine species presence or absence at additional locations should be on-going. A number of organizations are currently working collaboratively to improve these gaps in our knowledge of the population biology, distribution, and ecological requirements of ACPF in the SWNS bioregion needed to support their conservation and recovery (see actions below).

With regards to barrens, there is a lack of baseline inventories of plant and lichen species on both inland and coastal barrens, as well as poor understanding of the differences between various types of barrens (e.g., inland, coastal), and the ecological requirements for their persistence on the landscape (i.e., disturbance regimes, role of fire/grazing; J. Lundholm, per. comm.). Further inventories and research is required to rectify these knowledge gaps. In addition, given the unique and rare nature of the Annapolis Valley sand barrens, and the significant differences associated with their distribution and threats compared with other barren types in the bioregion, future habitat conservation strategies should consider sand barrens separately from barrens.

With regards to threats impacting conservation priority habitats and priority species in the SWNS bioregion, further research and monitoring is required to determine the extent and severity of threats and the pathways through which they are impacting species and habitats, particularly for high priority threats and threats where severity is unknown.

Finally, in order to conserve the majority of the priority species identified in this habitat conservation strategy, conservation work needs to go beyond improving on the network of protected areas in the SWNS bioregion. Conservation activities on managed landscapes through the research, development, and use of best practices are needed for a number of important industries and activities in the province (e.g., agricultural practices, forest harvesting practices, recreational off-highway vehicle use).

ii. Conservation Actions

The remainder of this section identifies the conservation actions planned for the next five-year period by the conservation partners to conserve the Southwest Nova Scotia bioregion's conservation priority habitats and priority species. Table 17 identifies which organizations and government agencies are working to conserve priority habitats and species in the SWNS bioregion and lists those actions that are being and will be taken to target specific habitats and threats. Note that some actions, though important, may not directly address identified threats. Instead, these actions 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 conservation action gaps and build partnerships strategically. Please note that action categories in this table are based on IUCN – CMP Unified Classification of Conservation Actions Needed (Version 2.0; Appendix I). Actions are not listed in order of importance.

Table 17. Conservation actions and associated information for conservation partners in the Southwest Nova Scotia bioregion.

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
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, EC, PC	Necessary	2020	Beaches and Dunes, Tidal Marshes, Tidal Flats, Coastal Islands	

[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] CRITICAL: Conservation actions that, without implementation, would clearly result in the reduction of viability of a biodiversity target or the increase in magnitude of a critical threat within the next 5-10 years. Also includes research information that is needed before key decisions can be made on the management of biodiversity targets. NECESSARY: Conservation actions that are needed to maintain or enhance the viability of biodiversity targets or reduce critical threats. Also includes research that will assist in decisions on management of biodiversity targets. BENEFICIAL: Conservation actions that will assist in maintaining or enhancing viability of biodiversity targets and reducing threats.

[3] Priority Habitats: Beaches and Dunes, Tidal Marshes, Tidal Flats, Coastal Islands, Freshwater Wetlands, Acadian Forest Mosaic, Riparian and Floodplain Systems, Grasslands/Agro-ecosystems, Barrens.

[4] 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	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
1.1 Site/Area Protection Province of Nova Scotia to designate 68 000 ha of new protected areas under the 14% Protected Areas Initiative.	Province of NS	Necessary	2025	Acadian Forest Mosaic, Freshwater Wetlands, Riparian and Floodplain Systems	
1.1 Site/Area Protection Complete a gap analysis for the system of protected areas in the province.	Province of NS	Beneficial		All	
1.1 Site/Area Protection Secure 500 ha of priority 1 and priority 2 coastal habitat to protect them from development.	NCC	Necessary	2025	Beaches and Dunes, Tidal Marshes, Tidal Flats, Coastal Islands, Barrens	1.1 Cottage and residential development
1.1 Site/Area Protection Secure 2500 ha of priority 1 and priority 2 forest habitat to protect them from harvesting.	NCC	Necessary	2025	Acadian Forest Mosaic	5.3 Forest harvesting practices
1.1 Site/Area Protection Secure 500 ha of priority 1 and priority 2 habitat for species at risk to protect them from development.	NCC	Necessary	2025		
1.1 Site/Area Protection Develop detailed assessment of land tenure within critical habitat areas for ACPF.	NCC	Beneficial	2017	Freshwater Wetlands, Riparian and Floodplain Systems	1.1 Cottage and residential development
1.1 Site/Area Protection Acquire priority coastal habitat and priority habitat for Blanding's Turtle, Eastern Ribbonsnake, ACPF, and Piping Plover as opportunities arise.	NSNT	Necessary	2025	Beaches and Dunes, Tidal Marshes, Tidal Flats, Coastal Islands, Freshwater Wetlands, Riparian and Floodplain Systems	
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.	EC, EHJV, USFWS, USGS	Necessary	Ongoing	Tidal Marshes, Tidal Flats, Coastal Islands, Freshwater Wetlands, Grasslands, Riparian and Floodplain Systems	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
2.1 Site/Area Management Implement management plans for Sand Pond National Wildlife Area and Sable River, Port Joli, Haley Lake, and Port Hebert Migratory Bird Sanctuaries.	EC	Necessary	Ongoing	Beaches and Dunes, Tidal Marshes, Tidal Flats, Coastal Islands, Acadian Forest Mosaic, Freshwater Wetlands, Riparian and Floodplain Systems, Barrens	
2.1 Site/Area Management Complete ecological risk assessments to assess 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.	Province of NS	Beneficial		All	
2.1 Site/Area Management Work collaboratively with partners and neighbours to 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, and where possible, take direct action to mitigate threats posing an imminent impact to conservation priority habitats. Continue to work to refine knowledge regarding the location of NCC key biodiversity targets to inform parcel prioritizations.	NCC	Necessary	Ongoing	All	
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	Necessary	Ongoing	Beaches and Dunes, Tidal Marshes, Tidal Flats, Coastal Islands, Freshwater Wetlands, Riparian and Floodplain Systems	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
2.1 Site/Area Management Continue ecological integrity monitoring to assess the state of forest, freshwater, wetland, and coastal ecosystem health in Kejimkujik National Park through the monitoring, analysis, and reporting of approximately 30 measures (e.g., forest birds, salamanders, water quality, soft-shell clams, Eelgrass, Brook Trout) and by summarizing these finding in the *State of the Park Report*.	Parks Canada through collaborative efforts with many partners	Necessary	Ongoing	All	
2.1 Site/Area Management Conduct wildlife connectivity analyses to identify optimal connectivity corridors between core protected areas/natural habitats.	NCC	Necessary	2018	Acadian Forest Mosaic, Freshwater Wetlands, Riparian and Floodplain Systems	
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	Necessary	Ongoing	Acadian Forest Mosaic	5.3 Forest harvesting practices
2.1 Site/Area Management Assess air quality and climate change using lichens within permanent sample plots.	Province of NS	Beneficial	Ongoing	Acadian Forest Mosaic	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.	MTRI, NCC	Necessary	Ongoing	Acadian Forest Mosaic, Riparian and Floodplain Systems	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
2.1 Site/Area Management Continue to monitor populations of endangered, threatened, and special concern species of ACPF on the 36 high priority lakes identified in the ACPF recovery strategy to complete a full inventory and to document lake-level population changes. Continue to sample water quality on a sub-set of the 36 high priority lakes. Continue to engage volunteers in the monitoring of ACPF and threats along lakeshores in southwest Nova Scotia. In Kejimkujik National Park and National Historic Site, continue annual Water-pennywort surveys on Kejimkujik and George Lakes.	MTRI, PC	Necessary	Ongoing	Riparian and Floodplain Systems, Freshwater Wetlands	1.1 Cottage and residential development
2.1 Site/Area Management Conduct botanical surveys of potential ACPF habitat between Tusket watershed and Queens County.	ACCDC	Necessary	2020	Tidal Marshes, Freshwater Wetlands, Riparian and Floodplain Systems	
2.1 Site/Area Management Conduct insect biodiversity surveys in southwestern Nova Scotia, focusing on the discovery of disjunct species associated with the Atlantic Coastal Plain, including targeted efforts to find species dependent on rare ACPF, such as Sweet Pepperbush and Eastern Baccharis.	ACCDC	Beneficial	2020	Tidal Marshes, Freshwater Wetlands, Riparian and Floodplain Systems	
2.1 Site/Area Management Map the 'active river area' (i.e., 100-year floodplain) to define floodplains for primary rivers in SWNS.	NCC	Necessary	2018	Riparian and Floodplain Systems	
2.1 Site/Area Management Conduct botanical surveys of open bedrock barrens near Shelburne-Yarmouth county line to refine parcel prioritization and document plant communities.	ACCDC	Necessary	2020	Barrens	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
2.1 Site/Area Management Synthesize existing data to produce a comprehensive classification of Acadian heathland ecosystem diversity.	St. Mary's University	Necessary	2020	Barrens	
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, MTRI	Beneficial	2020	All	8.1 Invasive non-native/ alien species/ diseases
2.2 Invasive/Problematic Species Control Raise awareness of invasive species in Nova Scotia and the role they play in ecosystems through the Backyard Biodiversity project.	PC, MTRI	Beneficial	Ongoing	All	8.1 Invasive non-native/ alien species/ diseases
2.2 Invasive/Problematic Species Control Continue to monitor and eradicate all mature, seed-producing Glossy Buckthorn plants within Kejimkujik National Park and National Historic Site as locations become known, and educate and engage the public on the ecological impacts of this species, its identification, and how to employ the most effective means of control.	PC, MTRI	Necessary	Ongoing	Acadian Forest Mosaic, Riparian and Floodplain Systems	8.1 Invasive non-native/ alien species/ diseases
2.2 Invasive/Problematic Species Control Continue research to investigate population dynamics of invasive European Green Crab, assess their ecological impacts on coastal ecosystems, and determine if physical removal (i.e., trapping) can effectively and sustainably control invasive green crab in Kejimkujik National Park Seaside Adjunct estuaries. Continue to work with local interests and other government departments to develop a positive use for removed crabs (e.g., lobster bait, fertilizer, compost).	PC	Critical	Ongoing	Tidal Marshes, Tidal Flats	8.1 Invasive non-native/ alien species/ diseases

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
2.3 Habitat and Natural Process Restoration Monitor the temporal trends in Eelgrass extent and condition within the Kejimkujik Seaside, and assess whether management responses (e.g., invasive European Green Crab reduction, Eelgrass transplanting) have been effective in reversing Eelgrass loss.	PC	Critical	Ongoing	Tidal Flats	8.1 Invasive non-native/ alien species/ diseases
3. Species Management					
3.1 Species Management Continue to work together through the coordination of volunteers and partners in Piping Plover monitoring (e.g., breeding success, threats), breeding habitat protection (e.g., on-beach signage, fencing), and stewardship on beaches in Southwest Nova Scotia, including joint monitoring collaborations, outreach, and volunteer celebration events.	BSC, EC, PC	Necessary	Ongoing	Beaches and Dunes	6.1 Recreational beach use
3.1 Species Management Engage with international (U.S. and Caribbean) partners in Piping Plover conservation to improve information sharing.	BSC	Beneficial	Ongoing		
3.1 Species Management Continue to systematically monitor population levels of Chimney Swift at known roost sites through a citizen-science monitoring and conservation program that brings together volunteers and community groups to act as stewards for Chimney Swift and their habitat, to advance knowledge of nesting ecology, and to increase awareness of this species at risk in the Maritimes. Continue to solicit the public for sightings of Chimney Swift and Chimney Swift nest locations.	MTRI, BSC, EC	Necessary	Ongoing		

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
3.1 Species Management Continue research to increase knowledge of Boreal Felt Lichen habitat requirements and contributing factors to their survivorship, and improve the predictive ability of a GIS habitat algorithm to locate Boreal Felt Lichen occurrences. Monitor known occurrences and protect newly found occurrences of Boreal Felt Lichen and other at risk lichens through work with forestry companies. Search for occurrences in potential habitat prior to planned harvests. Maintain a database of lichen occurrences and habitat data.	MTRI, Port Hawksbury Paper, NSDOE, NSDNR, Northern Pulp	Necessary	Ongoing	Acadian Forest Mosaic	5.3 Forest Harvesting Practices
3.1 Species Management Continue the long-standing volunteer program to protect Blanding's Turtle nests from predation, flooding, and other risks and work with landowners to protect turtles on their properties. Develop a long term monitoring plan and continue to monitor the three known populations in Southwest Nova Scotia to collect long term data on survivorship, clutch size, headstarting, hatchling success, habitat use, and site fidelity. Search for new populations by soliciting and following up on public sighting reports, and provide information on high priority sites to land trusts.	MTRI, PC, EC, Acadia University, Friends of Keji, Blanding's Turtle Recovery Team	Necessary	Ongoing	Freshwater Wetlands, Riparian and Floodplain Systems	
3.1 Species Management Continue to conduct systematic surveys and solicit public sightings of Eastern Ribbonsnake to determine their range and abundance in the bioregion. Continue to monitor the one known Eastern Ribbonsnake overwintering site to document site use, snake abundance, and site fidelity, and conduct field surveys around known concentration	MTRI, PC, Dalhousie University, Eastern Ribbonsnake Recovery Team	Necessary	Ongoing	Acadian Forest Mosaic, Riparian and Floodplain Systems	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
sites in spring and fall to locate additional overwintering sites.					
3.1 Species Management Continue the volunteer-based Kejimkujik and Mersey LoonWatch Programs to monitor loon abundance and breeding success on lakes in the Southwest Nova Biosphere Reserve, with a focus on the Mersey and Medway watersheds. Continue to work with partners on studies of reproduction, survivorship, and the role of mercury in the Kejimkujik ecosystem.	PC, MTRI, EC, Biodiversity Institute, Acadia University	Necessary	Ongoing	Riparian and Floodplain Systems	
3.1 Species Management Continue to monitor populations of endangered, threatened, and special concern species of ACPF on the 36 high priority lakes identified in the ACPF recovery strategy to document lake-level population changes. Continue to sample water quality on a sub-set of the 36 high priority lakes. Continue to engage volunteers in the monitoring of ACPF species and the identification of threats along lakeshores in southwest Nova Scotia. In Kejimkujik National Park and National Historic Site, continue annual Water-pennywort surveys on Kejimkujik and George Lakes.	MTRI, PC	Necessary	Ongoing	Riparian and Floodplain Systems, Freshwater Wetlands	1.1 Cottage and residential development
3.1 Species Management Continue to monitor the Eastern Mountain Avens on Brier Island and Digby Neck as needed and continue studies of reproduction and growth with partners. Assist with baseline studies of conditions in Big Meadow Bog and other critical habitat sites and monitor gull populations and vegetation threats in Big Meadow Bog.	Fernhill Institute for Plant Conservation, MTRI, NCC, EC, NSDNR, Acadia, Nova Scotia Museum of Natural History	Necessary	Ongoing	Freshwater Wetlands	1.1 Cottage and residential development

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
3.2 Species Recovery Engage and consult with all partners in the development of SAR recovery documents, and support the activities described within recovery documents for the schedule of studies for SAR and the identification of their critical habitat within the SWNS bioregion.	EC, NSDNR, Academic Institutions, NSNT, NCC, MTRI	Necessary	Ongoing	All	
4. Education and Awareness					
4.2 Training Continue to facilitate opportunities for volunteers to engage in regional SAR and environmental conservation programs in the Southwest Nova Biosphere Reserve through the Kejimkujik Southwest Nova Volunteer Program. This includes facilitating research and recovery opportunities on a variety of species and projects and recognizing efforts by tracking hours, the walk of honour, social media, volunteer news, and volunteer banquet. Stewardship tools and guides will be developed and distributed, including *Species at Risk in Nova Scotia, Atlantic Coastal Plain Flora in Nova Scotia*, *Healthy Lakes and Wetlands for Tomorrow*, *Healthy Beaches and Dunes*, *Invasive Alien Species in Nova Scotia*, and *Guide to FSC Certification for Woodlot Owners in Nova Scotia*.	PC, Friends of Keji, MTRI, BSC, Acadia University	Beneficial	Ongoing	All	
4.3 Awareness and Communications Update EC website regarding NCP Connecting Canadians to Nature, SAR, EC protected areas. Partner in biodivcanada.ca website, and adhere to biodiversity goals and targets for 2020 within the Canadian Biodiversity Strategy.	EC, Province of NS	Beneficial	Ongoing		

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
4.3 Awareness and Communications Address habitat threats through the education and engagement of stakeholders, landowners, and landusers.	NSNT	Beneficial	Ongoing		
4.3 Awareness and Communications Engage 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 farms.	EHJV	Necessary	Ongoing	Freshwater Wetlands, Riparian and Floodplain Systems, Grasslands	2.1 Incompatible agricultural practices
4.3 Awareness and Communications Continue to engage local citizens through outreach and social media to create habitat for the Monarch Butterfly by joining the Butterfly Club and planting butterfly gardens at their homes, businesses, community centers, and schools.	MTRI, PC	Beneficial	Ongoing	Freshwater Wetlands, Grasslands, Riparian and Floodplain Systems	
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, Saint Mary's University, Canadian Cooperative Wildlife Health Centre	Necessary	Ongoing		
4.3 Awareness and Communications Conduct door-to-door outreach and education for lakefront property owners with occurrences of ACPF and their habitat to communicate the significance of	MTRI	Necessary	Ongoing	Riparian and Floodplain Systems	1.1 Cottage and residential development

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
shoreline communities and potential threats associated with cottage development.					
4.3 Awareness and Communications Continue to work with partners to engage the communities of Brier Island and Digby Neck about Eastern Mountain Avens conservation through public meetings, the Gulf of Maine Institute youth group, and the community stewardship committee.	Fernhill Institute for Plant Conservation, MTRI, NCC, EC, NSDNR, Acadia University, NS Museum of Natural History	Necessary	Ongoing	Freshwater Wetlands	1.1 Cottage and residential 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).	EC, DFO	Necessary	Ongoing		
5.1.3 Legislation (Sub-national level) Participate in the review and update of the *Nova Scotia Mineral Resources Act* and seek appropriate mechanisms for resolution of conflicts between private conservation lands and sub-surface rights.	NCC, NSNT	Beneficial	2016		3.2 Mining and quarrying
5.2 Policies and Regulations Implement the federal policy on wetland conservation.	EC	Necessary	Ongoing	Tidal Marshes, Tidal Flats, Freshwater Wetlands, Riparian and Floodplain Systems	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
5.2 Policies and Regulations Collaborate with the Province of Nova Scotia and other stakeholders regarding changes to the *Code of Forest Practice for Crown Land*.	MTRI	Beneficial	Ongoing	Acadian Forest Mosaic, Freshwater Wetlands, Riparian and Floodplain Systems	5.3 Forest harvesting practices
5.2 Policies and Regulations Share generated spatial data and mapping with landuse planning decision makers, and participate in landuse planning stakeholder consultations to influence planning that impacts the Acadian Forest and other priority habitats.	NCC, MTRI, other eNGOs	Beneficial	Ongoing	All	
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	EC, Province of NS	Necessary	Ongoing	All	
6. Livelihood, Economic, and Other Incentives					
6.1 Linked Enterprises & Livelihood Alternatives Demonstrate strong environmental stewardship and woodland management through the development of the Medway Community Forest Cooperative, a locally governed, long-term, ecologically-based stewardship plan that allows multiple uses of a working community forest, while nurturing new and innovative forest-based businesses that support the local economy.	MTRI, Wind Horse Woods, North Queens Board of Trade, FNSWO, NSWOOA, NS Co-operative Council, EAC, mills, forestry contractors, community members	Beneficial	Ongoing	Acadian Forest Mosaic, Freshwater Wetlands, Riparian and Floodplain Systems	5.3 Forest harvesting practices
6.3 Market Forces Continue to assist small woodland owners in Southwest Nova Scotia to certify their woodlands under one collective Forest Stewardship Council	MTRI, FNSWO	Beneficial	Ongoing	Acadian Forest Mosaic	5.3 Forest harvesting practices

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
(FSC) group certification and provide training and education opportunities as a tool for woodlot owner engagement and to support sustainable woodland management. Continue research to explore awareness and attitudes of forest product consumers, and to investigate marketing strategies to support locally produced certified forest products.					
6.4 Conservation Payments Implement and encourage the use of EC Ecological Gifts (Ecogifts) program.	EC, NCC, NSNT	Necessary	Ongoing	All	
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	Beneficial	2018	Acadian Forest Mosaic	5.3 Forest harvesting practices
7. External Capacity Building					
7.1 Institutional and Civil Society Development Provide EC-CWS support and input into the development of Habitat Conservation Strategies.	EC, NCC, MTRI, NSNT, DUC, Province of NS, BSC, watershed groups, ACCDC, municipalities	Necessary	Ongoing	All	
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.	EC, Province of NS, NCC, MTRI, NSNT	Beneficial	2016	All	
7.2 Alliance and Partnership Development Provide EC-CWS input into: Staying Connected Initiative, Western Hemispheric Shorebird Reserve Network, and Important Bird Areas.	EC, NCC, MTRI, NSNT, DUC, Province of NS, BSC, ACCDC,	Beneficial	Ongoing	All	

Conservation Actions[1] Description of related action (specific and measurable if possible)	Collaborators	Importance[2] /Associated Conservation Goals	Date for Completion	Priority Habitat(s)[3]	Primary Related Threat(s)[4]
	International ENGOs, other government agencies, watershed groups, municipalities				
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).	EC, US Federal and State partners	Necessary	Ongoing	All	
7.3 Conservation Finance Implement and encourage the use of EC Ecological Gifts (Ecogifts) program.	EC, NCC, NSNT	Necessary	Ongoing	All	
7.3 Conservation Finance Continue to engage longstanding/key funding partners to support conservation work in the SWNS bioregion.	NCC, MTRI, NSNT, ENGOs	Necessary	Ongoing	All	

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APPENDICES

Appendix A. List of Abbreviations

Acronyms	Title
ACCDC	Atlantic Canada Conservation Data Centre
ACPF	Atlantic Coastal Plain Flora
AOI	Area of interest
BCR	Bird Conservation Region
BSC	Bird Studies Canada
CCWHC	Canadian Cooperative Wildlife Health Centre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DFO	Fisheries and Oceans Canada
DUC	Ducks Unlimited Canada
EC	Environment Canada
EHJV	Eastern Habitat Joint Venture
FNSWO	Federation of Nova Scotia Woodlot Owners
IBA	Important Bird Area
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	Nova Scotia Environment
NS ESA	Nova Scotia Endangered Species Act
NSNT	Nova Scotia Nature Trust
NWA	National Wildlife Area
OHV	Off-highway vehicle
Per. comm.	Personal communication
PC	Parks Canada
SAR	Species at Risk
SNBR	Southwest Nova Biosphere Reserve
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WHSRN	Western Hemisphere Shorebird Reserve Network
WNS	White Nose Syndrome

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.

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 designatable 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.

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.

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 59 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.

Appendix B. Glossary of Biodiversity and Conservation Ranks

Rarity Ranks

Sub-national (Provincial) Rank (S-RANK): sub-national conservation status assessments are generally carried out by Canadian Data Centre (CDC) scientists with input from federal and provincial experts on particular taxonomic groups, and are based on a combination of quantitative and qualitative information. Provincial ranks are used by CDCs and Nature Serve programs to set conservation priorities for rare species and vegetation communities and are not legal designations. 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)

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.

Global Conservation Status 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.
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.

Appendix C. Priority Species—Conservation Ranks and Data Sources

This appendix provides a list of priority species for the Southwest Nova Scotia bioregion. The basis of this list is primarily a subset of the Atlantic Canada Data Centre (ACCDC) database, Bird Studies Canada (BSC) rare and colonial birds database (2006-2010) and the Canada Wildlife Service colonial/migratory species dataset. Species occurrence records were refined to include only sightings recorded for species with a provincial rank of S1, S2, or S3 (with a global rank of G1, G2, or G3), or that are federally assessed (COSEWIC) or provincially listed (NS ESA) species at risk. Also included are the BCR 14 and MBU 11 priority bird species due to their importance to partners, which are not restricted to S1-S3 rankings. Appendix B provides a glossary of biodiversity and conservation ranks.

Common Name	*Scientific Name*	Conservation Status								Data Source			
		COSEWIC[1]	SARA[2]	NS ESA[3]	Global (G) Rank	Sub-national (S) Rank	NSDNR General Status	CWS Priority Bird Species[4]	Habitat Limited Species	ACCDC Occurrence Records	CWS Critical Habitat Mapping	MBBA Relative Abundance	MBBA Breeding Evidence
Invertebrates													
Banded Hairstreak	*Satyrium calanus*				G5	S2	5			x			
Bog Elfin	*Callophrys lanoraieensis*				G3G4	S1S2	2			x			
Brook Floater	*Alasmidonta varicosa*	SC	SC	TH	G3	S1S2	3			x			
Brook Snaketail	*Ophiogomphus aspersus*				G4	S1	2			x			
Carolina Saddlebags	*Tramea carolina*				G5	S1B	5			x			
Common Roadside Skipper	*Amblyscirtes vialis*				G5	S2	4			x			
Compton Tortoiseshell	*Nymphalis vaualbum j-album*				G5T5	S1S2				x			

[1] *Committee on the Status of Endangered Wildlife in Canada*
[2] Species at Risk Act *(2002)*
[3] Nova Scotia Endangered Species Act *(1999)*
[4] *Priority bird species in Bird Conservation Region 14, and Marine Biogeographic Units 11 in Nova Scotia (Environment Canada 2013).*

Common Name	*Scientific Name*	Conservation Status								Data Source			
		COSEWIC[1]	SARA[2]	NS ESA[3]	Global (G) Rank	Sub-national (S) Rank	NSDNR General Status	CWS Priority Bird Species[4]	Habitat Limited Species	ACCDC Occurrence Records	CWS Critical Habitat Mapping	MBBA Relative Abundance	MBBA Breeding Evidence
Delicate Emerald	*Somatochlora franklini*				G5	S1	3			x			
Early Hairstreak	*Erora laeta*				GU	S1	2			x			
Eastern Comma	*Polygonia comma*				G5	S2				x			
Eastern Pine Elfin	*Callophrys niphon*				G5	S2	4			x			
Ebony Boghaunter	*Williamsonia fletcheri*				G4	S1	2			x			
Forcipate Emerald	*Somatochlora forcipata*				G5	S2	2			x			
Grey Hairstreak	*Strymon melinus*				G5	S2	4			x			
Henry's Elfin	*Callophrys henrici*				G5	S2	4			x			
Juvenal's Duskywing	*Erynnis juvenalis*				G5	S2S3	4			x			
Kennedy's Emerald	*Somatochlora kennedyi*				G5	S1S2	2			x			
Leonard's Skipper	*Hesperia leonardus*				G4	S1				x			
Macropis Cuckoo Bee	*Epeoloides pilosula*	EN		EN	G1	S1							
Maine Snaketail	*Ophiogomphus mainensis*				G4	S1	2			x			
Monarch	*Danaus plexippus*	SC	SC		G5	S2B	3			x			
Mustard White	*Pieris oleracea*				G4G5	S2	3			x			
Orange Bluet	*Enallagma signatum*				G5	S1	2			x			
Pepper and Salt Skipper	*Amblyscirtes hegon*				G5	S2	4			x			
Prince Baskettail	*Epitheca princeps*				G5	S2	3			x			
Rusty Snaketail	*Ophiogomphus rupinsulensis*				G5	S1S2	2			x			
Satyr Comma	*Polygonia satyrus*				G5	S1	3			x			
Silvery Checkerspot	*Chlosyne nycteis*				G5	S2	5			x			

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Spot-Winged Glider	*Pantala hymenaea*				G5	S2B	3			x			
Tidewater Mucket	*Leptodea ochracea*				G3G4	S1	3			x			
Vesper Bluet	*Enallagma vesperum*				G5	S2S3	3			x			
Zebra Clubtail	*Stylurus scudderi*				G4	S1S2	2			x			
Fishes													
American Eel	*Anguilla rostrata*	TH	TH		G4	S5							
Atlantic Salmon	*Salmo salar*	EN	EN		G5	S2				x			
Atlantic Sturgeon	*Acipenser oxyrinchus*	TH	TH		G3	S1?							
Atlantic Whitefish	*Coregonus huntsmani*	EN	EN	EN	G1	S1				x			
Striped Bass	*Morone saxatilis*	EN	EN		G5	S1				x			
Birds													
American Bittern	*Botaurus lentiginosus*				G4	S3S4B	3	x					x
American Black Duck	*Anas rubripes*				G5	S5	4	x					x
American Coot	*Fulica americana*				G5	S1B	5						x
American Golden-Plover	*Pluvialis dominica*				G5	S3M	3	x					
American Oystercatcher	*Haematopus palliatus*				G5	S1B	5						x
American Redstart	*Setophaga ruticilla*				G5	S5B	4	x				x	
American Three-toed Woodpecker	*Picoides dorsalis*				G5	S1S2	5						x
American Woodcock	*Scolopax minor*				G5	S4S5B	4	x					x
Atlantic Puffin	*Fratercula arctica*				G5	S1BS4S5N	3		x				x

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Bald Eagle	*Haliaeetus leucocephalus*				G5	S4	4	x					x
Baltimore Oriole	*Icterus galbula*				G5	S2S3B	2						x
Bank Swallow	*Riparia riparia*	TH			G5	S3B	2	x				x	
Barn Swallow	*Hirundo rustica*	TH	TH	EN	G5	S3B	3	x					x
Barrow's Goldeneye (Eastern)	*Bucephala islandica*	SC	SC		G5	S1N	1	x					
Bay-breasted Warbler	*Dendroica castanea*				G5	S3S4B	3	x				x	
Belted Kingfisher	*Megaceryle alcyon*				G5	S5B	4	x				x	
Black Scoter	*Melanitta americana*				G5	S5N	4	x					x
Black Tern	*Chlidonias niger*				G4	S1B	2						x
Black-and-white Warbler	*Mniotilta varia*				G5	S4S5B	4	x				x	
Black-bellied Plover	*Pluvialis squatarola*				G5	S4M	4	x					
Black-billed Cuckoo	*Coccyzus erythropthalmus*				G5	S3?B	2	x					x
Blackburnian Warbler	*Setophaga fusca*				G5	S4B	4	x				x	
Black-crowned Night-heron	*Nycticorax nycticorax*				G5	S1B	2						x
Black-legged Kittiwake	*Rissa tridactyla*				G5	S2BS4S5N	3	x					x
Black-throated Green Warbler	*Setophaga virens*				G5	S4S5B	4	x				x	
Blue-headed Vireo	*Vireo solitarius*				G5	S5B	4	x				x	
Bobolink	*Dolichonyx oryzivorus*	TH		VU	G5	S3S4B	3	x					x
Bonaparte's Gull	*Chroicocephalus philadelphia*				G5	S5M	4	x					

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Boreal Chickadee	*Poecile hudsonica*				G5	S3	3	x				x	
Boreal Owl	*Aegolius funereus*				G5	S1B	5						x
Brown Thrasher	*Toxostoma rufum*				G5	S1?B	5						x
Brown-headed Cowbird	*Molothrus ater*				G5	S2S3B	4					x	
Canada Goose	*Branta canadensis*				G5	SNABS4N	4	x					x
Canada Warbler	*Cardellina canadensis*	TH	TH	EN	G5	S3B	1	x				x	
Cape May Warbler	*Setophaga tigrina*				G5	S3?B	3	x					x
Chimney Swift	*Chaetura pelagica*	TH	TH	EN	G5	S2S3B	1	x					x
Common Eider	*Somateria mollissima*				G5	S4	4	x	x				x
Common Goldeneye	*Bucephala clangula*				G5	S2BS5N	4	x					x
Common Loon	*Gavia immer*				G5	S3BS4N	2	x				x	
Common Moorhen	*Gallinula chloropus*				G5	S1B	5						x
Common Murre	*Uria aalge*				G5	S4N	4	x					x
Common Nighthawk	*Chordeiles minor*	TH	TH	TH	G5	S3B	1	x					x
Common Tern	*Sterna hirundo*				G5	S3B	3	x					x
Cooper's Hawk	*Accipiter cooperii*				G5	S1?BSNAN	5						x
Cory's Shearwater	*Calonectris diomedea*				G5	SNA	8	x					
Dovekie	*Alle alle*				G5	S5N	4	x					
Dunlin	*Calidris alpina*				G5	S4M	4	x					
Eastern Kingbird	*Tyrannus tyrannus*				G5	S3S4B	3	x					x
Eastern Meadowlark	*Sturnella magna*	TH			G5	S1B	3						x

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Eastern Whip-poor-will	*Antrostomus vociferus*	TH	TH	TH	G5	S1?B	1	x					x
Eastern Wood-Pewee	*Contopus virens*	SC	SC	VU	G5	S3S4B	3	x				x	
Evening Grosbeak	*Coccothraustes vespertinus*				G5	S4BS5N	4	x				x	
Gadwall	*Anas strepera*				G5	S2B	2						x
Gray Catbird	*Dumetella carolinensis*				G5	S3B	2	x				x	
Gray Jay	*Perisoreus canadensis*				G5	S3S4	3	x					x
Great Cormorant	*Phalacrocorax carbo*				G5	S3	3	x					x
Great Crested Flycatcher	*Myiarchus crinitus*				G5	S2B	2						x
Great Shearwater	*Puffinus gravis*				G5	S5N	4	x					
Great Skua	*Stercorarius skua*				G4G5	SNA	4	x					
Green-winged Teal	*Anas crecca*				G5	S4S5B	4	x					x
Harlequin Duck (Eastern)	*Histrionicus histrionicus*	SC	SC	EN	G4T4	S2N	1	x					x
Horned Grebe (Western)	*Podiceps auritus*	SC			G5	S1S2BS4N	4	x					
Horned Lark	*Eremophila alpestris*				G5	S1S2BS4N	4						x
Hudsonian Godwit	*Limosa haemastica*				G4	S3M	3	x					
Indigo Bunting	*Passerina cyanea*				G5	S1S2B	5						x
Ivory Gull	*Pagophila eburnea*	EN	EN		G5	SNA	8	x					
Killdeer	*Charadrius vociferus*				G5	S3S4B	3	x					x
Leach's Storm-Petrel	*Oceanodroma leucorhoa*				G5	S4S5B	4	x	x				x
Least Sandpiper	*Calidris minutilla*				G5	S1BS5M	4	x					x
Lesser Yellowlegs	*Tringa flavipes*				G5	S5M	4	x					

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Long-eared Owl	*Asio otus*				G5	S2	2						x
Long-tailed Duck	*Clangula hyemalis*				G5	S4N	4	x					
Magnolia Warbler	*Dendroica magnolia*				G5	S5B	4	x				x	
Mallard	*Anas platyrhynchos*				G5	S5	4	x					x
Manx Shearwater	*Puffinus puffinus*				G5	S1?BS4N	4	x					
Marsh Wren	*Cistothorus palustris*				G5	S1B	5						x
Mourning Warbler	*Geothlypis philadelphia*				G5	S4B	4	x				x	
Nelson's Sparrow	*Ammodramus nelsoni*				G5	S4B	4	x					x
Northern Goshawk	*Accipiter gentilis*				G5	S3S4	4						
Northern Parula	*Setophaga americana*				G5	S5B	4	x				x	
Northern Pintail	*Anas acuta*				G5	S2B	2						x
Northern Shoveler	*Anas clypeata*				G5	S2B	2						x
Olive-sided Flycatcher	*Contopus cooperi*	TH	TH	TH	G4	S3B	1	x				x	
Peregrine Falcon (anatum/tundrius ssp.)	*Falco peregrinus anatum/tundrius*	SC	SC	VU	G4T4	S1B	3	x	x				x
Philadelphia Vireo	*Vireo philadelphicus*				G5	S2?B	5						x
Pied-billed Grebe	*Podilymbus podiceps*				G5	S3B	3	x					x
Pine Grosbeak	*Pinicola enucleator*				G5	S3?BS5N	2	x				x	
Piping Plover (melodus ssp.)	*Charadrius melodus melodus*	EN	EN	EN	G3TNR	S1B	1	x	x		x		x
Purple Finch	*Carpodacus purpureus*				G5	S4S5	4	x				x	
Purple Martin	*Progne subis*				G5	S1B	2						x

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Purple Sandpiper	*Calidris maritima*				G5	S3N	3	x					
Razorbill	*Alca torda*				G5	S1BS4N	3	x	x				x
Red Knot (rufa ssp.)	*Calidris canutus rufa*	EN	EN	EN	G4T1	S2S3M	1	x					
Red Phalarope	*Phalaropus fulicarius*				G5	S2S3M	3	x					
Red-necked Grebe	*Podiceps grisegena*				G5	S4N	4	x					
Red-necked Phalarope	*Phalaropus lobatus*				G4G5	S2S3M	3	x					
Red-throated Loon	*Gavia stellata*				G5	S4N	4	x					
Ring-billed Gull	*Larus delawarensis*				G5	S1?BS5N	4						x
Ring-necked Duck	*Aythya collaris*				G5	S5B	4	x					x
Roseate Tern	*Sterna dougallii*	EN	EN	EN	G4	S1B	1	x	x		x		x
Ruffed Grouse	*Bonasa umbellus*				G5	S4S5	4	x				x	
Rusty Blackbird	*Euphagus carolinus*	SC	SC	EN	G4	S2S3B	2	x				x	
Sanderling	*Calidris alba*				G5	S4MS2N	4	x					
Savannah Sparrow (princeps ssp.)	*Passerculus sandwichensis princeps*	SC	SC		G5T2	S1B	4	x	x			x	
Scarlet Tanager	*Piranga olivacea*				G5	S2B	5						x
Semipalmated Plover	*Charadrius semipalmatus*				G5	S1S2BS5M	4						x
Semipalmated Sandpiper	*Calidris pusilla*				G5	S3M	3	x					
Short-eared Owl	*Asio flammeus*	SC	SC		G5	S1S2	2	x					x
Solitary Sandpiper	*Tringa solitaria*				G5	S1?BS4 S5M	4	x				x	

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Sooty Shearwater	*Puffinus griseus*				G5	S5N	4	x					
Sora	*Porzana carolina*				G5	S4S5B	4	x					x
South Polar Skua	*Stercorarius maccormicki*				G5	SNA	8	x					
Spotted Sandpiper	*Actitis macularius*				G5	S3S4B	3	x				x	
Spruce Grouse	*Falcipennis canadensis*				G5	S5	4	x					x
Surf Scoter	*Melanitta perspicillata*				G5	S5N	4	x					
Thick-billed Murre	*Uria lomvia*				G5	S4N	4	x					
Tree Swallow	*Tachycineta bicolor*				G5	S4B	3	x				x	
Turkey Vulture	*Cathartes aura*				G5	S2S3B	3						x
Veery	*Catharus fuscescens*				G5	S4B	4	x				x	
Vesper Sparrow	*Pooecetes gramineus*				G5	S2S3B	2					x	
Virginia Rail	*Rallus limicola*				G5	S2B	5	x					x
Warbling Vireo	*Vireo gilvus*				G5	S1?B	5						x
Whimbrel	*Numenius phaeopus*				G5TNR	S3M	3	x					
White-throated Sparrow	*Zonotrichia albicollis*				G5	S5B	4	x				x	
White-winged Scoter	*Melanitta fusca*				G5	S5N	4	x					
Willet	*Tringa semipalmata*				G5	S2S3B	2	x				x	
Willow Flycatcher	*Empidonax traillii*				G5	S2B	3						x
Wilson's Snipe	*Gallinago delicata*				G5	S3S4B	3	x				x	
Wood Thrush	*Hylocichla mustelina*	TH			G5	S1B	5						x

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Reptiles													
Blanding's Turtle	*Emydoidea blandingii*	EN	EN	EN	G4	S1	1		x	x	x		
Eastern Ribbonsnake	*Thamnophis sauritus*	TH	TH	TH	G5	S2S3	1			x	x		
Snapping Turtle	*Chelydra serpentina*	SC	SC	VU	G5	S5	4						
Wood Turtle	*Glyptemys insculpta*	TH	TH	TH	G4	S3	3						
Mammals													
American Marten	*Martes americana*			EN	G5	S1	1			x			
Eastern Red Bat	*Lasiurus borealis*				G5	S1	5						
Fisher	*Martes pennanti*				G5	S2	3			x			
Hoary Bat	*Lasiurus cinereus*				G5	S1	5						
Little Brown Myotis	*Myotis lucifugus*	EN		EN	G3	S1	3			x			
Moose (Mainland)	*Alces americanus*			EN	G5	S1	1			x			
Northern Myotis	*Myotis septentrionalis*	EN		EN	G1G3	S1	3						
Silver-haired Bat	*Lasionycteris noctivagans*				G5	S1	5						
Southern Flying Squirrel	*Glaucomys volans*				G5	S2S3	3			x			
Tri-colored Bat	*Perimyotis subflavus*	EN		EN	G3	S1	3						
Lichens													
Appressed Jellyskin Lichen	*Leptogium subtile*				GNR	S1S3	3			x			
Black-foam Lichen	*Anzia colpodes*				G3G5	S3?	3			x			
Blistered Jellyskin Lichen	*Leptogium corticola*				G3G5	S2S3	3		x	x			
Blistered Tarpaper Lichen	*Collema nigrescens*				G5?	S2S3	3		x	x			

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Blue Felt Lichen	*Degelia plumbea*	SC		VU	GNR	S2	4		x	x			
Boreal Felt Lichen	*Erioderma pedicellatum*	EN	EN	EN	G1G2Q	S1S2	1		x	x	x		
Bottlebrush Frost Lichen	*Physconia detersa*				G5?	S2S3	3			x			
Crumpled Bat's Wing Lichen	*Collema leptaleum*				GNR	S2S3	3			x			
Eyed Mossthorns Woollybear Lichen	*Polychidium muscicola*				G3G5	S1S2	2			x			
Ghost Antler Lichen	*Pseudevernia cladonia*				G2G4	S2S3	3			x			
Hairy-spined Shield Lichen	*Parmelinopsis horrescens*				G5	S1?	2			x			
Naked Kidney Lichen	*Nephroma bellum*				G3G5	S3?	3			x			
Peppered Moon Lichen	*Sticta fuliginosa*				G3G5	S3?	3			x			
Pimpled Kidney Lichen	*Nephroma resupinatum*				G3G5	S1S2	2			x			
Poor-man's Shingles Lichen	*Parmeliella parvula*				GNR	S1?	2			x			
Powdered Moon Lichen	*Sticta limbata*				G3G4	S1S2	2		x	x			
Rimmed Shingles Lichen	*Fuscopannaria leucosticta*				G3G5	S1S2	2		x	x			
Scaly Fringe Lichen	*Heterodermia squamulosa*				G3G5	S2S3	3			x			
Stretched Jellyskin Lichen	*Leptogium milligranum*				G5	S2S3	3			x			
Veined Shingle Lichen	*Pannaria lurida*				G3G5	S1?	2		x	x			
Vole Ears Lichen	*Erioderma mollissimum*	EN	EN	EN	G4G5	S1S2	2		x	x			
Non-vascular Plants													
Wulf's Peat Moss	*Sphagnum wulfianum*				G5	S2S3	3			x			

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Vascular Plants													
Acadian Quillwort	*Isoetes acadiensis*				G3Q	S3	3			x			
Alpine Bilberry	*Vaccinium uliginosum*				G5	S2	3		x	x			
American Cancer-root	*Conopholis americana*				G5	S1S2	2		x	x			
American False Pennyroyal	*Hedeoma pulegioides*				G5	S2S3	3			x			
Atlantic Sedge	*Carex atlantica ssp. capillacea*				G5T5?	S2	4			x			
Big-leaved Marsh-elder	*Iva frutescens ssp. oraria*				G5T5	S2			x	x			
Black Ash	*Fraxinus nigra*			TH	G5	S2S3	3			x			
Blood Milkwort	*Polygala sanguinea*				G5	S2S3	3			x			
Blue Cohosh	*Caulophyllum thalictroides*				G4G5	S2	2		x	x			
Blunt-leaved Bedstraw	*Galium obtusum*				G5	S1S2	2			x			
Bog Willow	*Salix pedicellaris*				G5	S2	3		x	x			
Boreal Aster	*Symphyotrichum boreale*				G5	S2?	3			x			
Canada Anemone	*Anemone canadensis*				G5	S2	2		x	x			
Canada Rice Grass	*Piptatherum canadense*				G5	S2	3			x			
Canada Tick-trefoil	*Desmodium canadense*				G5	S1	2		x	x			
Case's Ladies'-Tresses	*Spiranthes casei var. casei*				G4T4	S1	3			x			
Case's Ladies'-Tresses	*Spiranthes casei var. novaescotiae*				G4TNR	S2				x			
Chaffweed	*Anagallis minima*				G5	S1	2			x			
Chinese Hemlock-parsley	*Conioselinum chinense*				G5	S2	3			x			

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Coastal Plain Blue-eyed-grass	*Sisyrinchium fuscatum*				G5?	S1	2		x	x			
Coastal Plain Joe-pye-weed	*Eupatorium dubium*				G5	S2			x	x			
Common Bedstraw	*Galium aparine*				G5	S1	7			x			
Cursed Buttercup	*Ranunculus sceleratus*				G5	S1S2	2		x	x			
Disguised St John's-wort	*Hypericum dissimulatum*				G5	S2S3	3			x			
Downy Rattlesnake-Plantain	*Goodyera pubescens*				G5	S2	2		x	x			
Dudley's Rush	*Juncus dudleyi*				G5	S2?	3			x			
Eastern Baccharis	*Baccharis halimifolia*	TH		TH	G5	S1	2		x	x			
Eastern Lilaeopsis	*Lilaeopsis chinensis*	SC	SC	VU	G5	S2	3		x	x			
Eastern Mountain Avens	*Geum peckii*	EN	EN	EN	G2	S1	1		x	x	x		
Eastern White Cedar	*Thuja occidentalis*			VU	G5	S1S2	1			x			
Fall Panic Grass	*Panicum dichotomiflorum var. puritanorum*				G5T4	S1?	4		x	x			
Farwell's Water Milfoil	*Myriophyllum farwellii*				G5	S2	3			x			
Fernald's Serviceberry	*Amelanchier fernaldii*				G2G4Q	S2?	5			x			
Few-flowered Spikerush	*Eleocharis quinqueflora*				G5	S2	2		x	x			
Fleshy Stitchwort	*Stellaria crassifolia*				G5	S1	2			x			
Forked Bluecurls	*Trichostema dichotomum*				G5	S1			x	x			
Fringed Blue Aster	*Symphyotrichum ciliolatum*				G5	S2S3	3			x			
Gaspé Arrowgrass	*Triglochin gaspensis*				G3G4	S1?	5			x			

Common Name	*Scientific Name*	Conservation Status								Data Source			
		COSEWIC[1]	SARA[2]	NS ESA[3]	Global (G) Rank	Sub-national (S) Rank	NSDNR General Status	CWS Priority Bird Species[4]	Habitat Limited Species	ACCDC Occurrence Records	CWS Critical Habitat Mapping	MBBA Relative Abundance	MBBA Breeding Evidence
Glaucous Rattlesnakeroot	*Prenanthes racemosa*				G5	S1	2		x	x			
Goldencrest	*Lophiola aurea*	SC	TH	VU	G4	S2	1		x	x	x		
Greene's Rush	*Juncus greenei*				G5	S1S2	2		x	x			
Greenland Stitchwort	*Minuartia groenlandica*				G5	S2	3		x	x			
Hairy Goldenrod	*Solidago hispida*				G5	S1?	2			x			
Hairy Lettuce	*Lactuca hirsuta var. sanguinea*				G5?T5?	S2				x			
Halberd-leaved Tearthumb	*Polygonum arifolium*				G5	S2							
Hayden's Sedge	*Carex haydenii*				G5	S1	2			x			
Horned Sea-blite	*Suaeda calceoliformis*				G5	S2S3	4			x			
Horn-leaved Riverweed	*Podostemum ceratophyllum*				G5	S1	2		x	x			
Houghton's Sedge	*Carex houghtoniana*				G5	S2?	3			x			
Intermediate Mermaidweed	*Proserpinaca intermedia*				G4?Q	S1	2			x			
Inverted Bladderwort	*Utricularia resupinata*				G4	S1S2	2			x			
Kalm's Hawkweed	*Hieracium kalmii*				G5	S2?				x			
Knotted Pearlwort	*Sagina nodosa*				G5	S2S3	4		x	x			
Lance-leaved Figwort	*Scrophularia lanceolata*				G5	S1	5			x			
Large Round-Leaved Orchid	*Platanthera macrophylla*				G5T4	S2	3		x	x			
Large St John's-wort	*Hypericum majus*				G5	S1	2			x			
Large Tick-Trefoil	*Desmodium glutinosum*				G5	S1	2		x	x			
Least Moonwort	*Botrychium simplex*				G5	S2S3	3			x			
Lesser Pyrola	*Pyrola minor*				G5	S2	3			x			

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Lesser Spearwort	*Ranunculus flammula var. flammula*				G5T4T5	S2	4			x			
Limestone Meadow Sedge	*Carex granularis*				G5	S1	5			x			
Little Curlygrass Fern	*Schizaea pusilla*				G3G4	S3	4		x	x			
Long's Bulrush	*Scirpus longii*	SC	SC	VU	G2G3	S2S3	3		x	x			
Long's Sedge	*Carex longii*				G5	S1?	2		x	x			
Low Flatsedge	*Cyperus diandrus*				G5	S1	5		x	x			
Maidenhair Spleenwort	*Asplenium trichomanes*				G5	S2	3		x	x			
Maleberry	*Lyonia ligustrina*				G5	S1			x	x			
Marsh Mermaidweed	*Proserpinaca palustris var. palustris*				G5T5	S1?	4			x			
Nantucket Serviceberry	*Amelanchier nantucketensis*				G3Q	S1	2			x			
Narrow-leaved Evening Primrose	*Oenothera fruticosa ssp. glauca*				G5	S2	5			x			
Narrow-leaved Panic Grass	*Dichanthelium linearifolium*				G5	S2?	3			x			
Necklace Spike Sedge	*Carex ormostachya*				G4	S1	2			x			
Netted Chain Fern	*Woodwardia areolata*				G5	S2S3	3		x	x			
Newfoundland Dwarf Birch	*Betula michauxii*				G3G4	S2	3		x	x			
Northern Adder's-tongue	*Ophioglossum pusillum*				G5	S2S3	3			x			
Northern Bedstraw	*Galium boreale*				G5	S2	2			x			
Northern Blueberry	*Vaccinium boreale*				G4	S2	2		x	x			
Northern Bog Violet	*Viola nephrophylla*				G5	S2	3		x	x			
Northern Dewberry	*Rubus flagellaris*				G5	S1?	5			x			

Common Name	*Scientific Name*	Conservation Status								Data Source			
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Northern Maidenhair Fern	*Adiantum pedatum*				G5	S1	2		x	x			
One-sided Rush	*Juncus secundus*				G5?	S1	2			x			
Ovate Spikerush	*Eleocharis ovata*				G5	S2?	3			x			
Pale False Manna Grass	*Torreyochloa pallida var. pallida*				G5T5?	S1	4			x			
Peach-leaved Dock	*Rumex persicarioides*					S2?	2		x	x			
Philadelphia Fleabane	*Erigeron philadelphicus*				G5	S2	3			x			
Pinebarren Golden Heather	*Hudsonia ericoides*				G4	S2	3		x	x			
Pink Coreopsis	*Coreopsis rosea*	EN	EN	EN	G3	S1	1		x	x	x		
Plymouth Gentian	*Sabatia kennedyana*	EN	EN	EN	G3	S1	1		x	x	x		
Poison Sumac	*Toxicodendron vernix*				G5	S1	2		x	x			
Porcupine Sedge	*Carex hystericina*				G5	S2	2		x	x			
Prairie Sedge	*Carex prairea*				G5?	S1	2		x	x			
Prickly Hornwort	*Ceratophyllum echinatum*				G4?	S2?	2			x			
Prototype Quillwort	*Isoetes prototypus*	SC	SC	VU	G2G3	S2	3		x	x			
Purple-veined Willowherb	*Epilobium coloratum*				G5	S2?	3			x			
Racemed Milkwort	*Polygala polygama*				G5	S1	5			x			
Red Ash	*Fraxinus pennsylvanica*				G5	S1	2			x			
Red Pigweed	*Chenopodium rubrum*				G5	S1?	2		x	x			
Redroot	*Lachnanthes caroliniana*	SC	SC	VU	G4	S2	1		x	x	x		
Robinson's Hawkweed	*Hieracium robinsonii*				G2G3	S2	3		x	x			
Rock Spikemoss	*Selaginella rupestris*				G5	S1	2		x	x			

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Rockrose	*Helianthemum canadense*			EN	G5	S1	2		x	x			
Round-lobed Hepatica	*Hepatica nobilis var. obtusa*				G5T5	S1S2			x	x			
Rugel's Plantain	*Plantago rugelii*				G5	S2	5			x			
Tidal marsh Agalinis	*Agalinis maritima*				G5	S1S2	2		x	x			
Seabeach Ragwort	*Senecio pseudoarnica*				G5	S2	3		x	x			
Seaside Brookweed	*Samolus valerandi ssp. parviflorus*				G5T5	S2			x	x			
Sharp-fruited Knotweed	*Polygonum raii*				G3G5Q	S2S3				x			
Shining Ladies'-Tresses	*Spiranthes lucida*				G5	S2	2		x	x			
Short-awned Foxtail	*Alopecurus aequalis*				G5	S2S3	3			x			
Silky Willow	*Salix sericea*				G5	S2	2		x	x			
Sleepy Catchfly	*Silene antirrhina*				G5	S1	2			x			
Slender Blue Flag	*Iris prismatica*				G4G5	S1	2			x			
Slender Cottongrass	*Eriophorum gracile*				G5	S2	3			x			
Slender Panic Grass	*Dichanthelium xanthophysum*				G5	S1	2		x	x			
Slender Rice Grass	*Piptatherum pungens*				G5	S2	3		x	x			
Slender Wood Sedge	*Carex digitalis*				G5	S1	2		x	x			
Slim-stemmed Reed Grass	*Calamagrostis stricta ssp. stricta*				G5T5	S1S2			x	x			
Small-flowered Bittercress	*Cardamine parviflora var. arenicola*				G5T5	S2	3		x	x			
Small-spike False-nettle	*Boehmeria cylindrica*				G5	S1	2		x	x			
Southern Twayblade	*Listera australis*				G4	S2	2			x			
Spotted Pondweed	*Potamogeton pulcher*			VU	G5	S1S2	2			x			

Common Name	*Scientific Name*	Conservation Status								Data Source			
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Stalked Bulrush	*Scirpus pedicellatus*				G4	S1	5			x			
Sturdy Bulrush	*Schoenoplectus robustus*				G5	S1?				x			
Swamp Milkweed	*Asclepias incarnata ssp. pulchra*				G5T5	S2S3	4			x			
Swan's Sedge	*Carex swanii*				G5	S2S3	3			x			
Swedish Bunchberry	*Cornus suecica*				G5	S1S2	3			x			
Sweet Pepperbush	*Clethra alnifolia*	SC	SC	VU	G5	S1	3		x	x			
Tall Beakrush	*Rhynchospora macrostachya*				G4	S1	2		x	x			
Tender Sedge	*Carex tenera*				G5	S1S2	3			x			
Thread-leaved Sundew	*Drosera filiformis*	EN	EN	EN	G4	S1	1		x	x	x		
Thread-Like Naiad	*Najas gracillima*				G5?	S1S2	2			x			
Torrey's Bulrush	*Schoenoplectus torreyi*				G5?	S1	2			x			
Tower Mustard	*Arabis glabra*				G5	S1	5			x			
Triangular-valve Dock	*Rumex salicifolius var. mexicanus*				G5T5	S2				x			
Tubercled Orchid	*Platanthera flava var. flava*				G4T4?Q	S2			x	x			
Tubercled Orchid	*Platanthera flava var. herbiola*				G4T4Q	S1S2	3		x	x			
Tubercled Spike-rush	*Eleocharis tuberculosa*	SC	SC	VU	G5	S2	1		x	x	x		
Tuckerman's Panic Grass	*Panicum tuckermanii*				G5	S2S3	3			x			
Water Blinks	*Montia fontana*				G5	S1	2		x	x			
Water Pygmyweed	*Crassula aquatica*				G5	S2	3		x	x			
Water-pennywort	*Hydrocotyle umbellata*	TH	TH	EN	G5	S1	1		x	x	x		
Wavy-leaved Aster	*Symphyotrichum undulatum*				G5	S2	3			x			

Common Name	*Scientific Name*	Conservation Status								Data Source			
		COSEWIC[1]	SARA[2]	NS ESA[3]	Global (G) Rank	Sub-national (S) Rank	NSDNR General Status	CWS Priority Bird Species[4]	Habitat Limited Species	ACCDC Occurrence Records	CWS Critical Habitat Mapping	MBBA Relative Abundance	MBBA Breeding Evidence
White Sea-blite	*Suaeda maritima ssp. richii*				G5T3	S1	4			x			
Wiegand's Sedge	*Carex wiegandii*				G4	S1	2			x			
Wild Chives	*Allium schoenoprasum var. sibiricum*				G5	S2	2		x	x			
Wild Leek	*Allium tricoccum*				G5	S1	2		x	x			
Wood Anemone	*Anemone quinquefolia*				G5	S2	3		x	x			
Woolly Panic Grass	*Dichanthelium acuminatum var. lindheimeri*				G5T5	S1?	4			x			
Yellow Ladies'-tresses	*Spiranthes ochroleuca*				G4	S2S3	3			x			
Yellow Lady's-slipper	*Cypripedium parviflorum var. makasin*				G5T4Q	S2	3		x	x			
Yellow Lady's-slipper	*Cypripedium parviflorum var. pubescens*				G5T5	S2			x	x			
Yellow Spikerush	*Eleocharis olivacea*				G5	S2S3				x			

Appendix D. Priority Species—Habitat Associations

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems				Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens	Reference	
Invertebrates																						
Banded Hairstreak	*Satyrium calanus*												x						x		2,3	Woodlands, barrens, roadsides, and urban areas with milkweed
Bog Elfin	*Callophrys lanoraieensis*										x	x	x			x					2	Acidic bogs with black spruce or black spruce forests on peaty wetlands
Brook Floater	*Alasmidonta varicosa*						x														1	Shallow rivers and streams with moderate water flow, and small sandy-bottomed lakes
Brook Snaketail	*Ophiogomphus aspersus*						x	x													2	Clear streams where shallow current ripples over sand
Carolina Saddlebags	*Tramea carolina*																					
Common Roadside Skipper	*Amblyscirtes vialis*							x					x	x							2	Usually deciduous forest edges and clearings, stream sides
Compton Tortoiseshell	*Nymphalis vaualbum j-album*												x	x	x						3	Woodlands
Delicate Emerald	*Somatochlora franklini*																					
Early Hairstreak	*Erora laeta*												x	x	x						2	Deciduous and mixedwood forest
Eastern Comma	*Polygonia comma*							x				x	x								2,3	Clearings or along edges of moist woodlands, floodplains
Eastern Pine Elfin	*Callophrys niphon*												x		x	x					2	Pine dominated or mixed pine forest
Ebony Boghaunter	*Williamsonia fletcheri*										x										2	Bogs and fens

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems				Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens	Reference	
Forcipate Emerald	*Somatochlora forcipata*																					
Grey Hairstreak	*Strymon melinus*												x					x	x		2,3	A variety of open to lightly wooded habitats
Henry's Elfin	*Callophrys henrici*										x		x	x	x	x			x		2	Forests, tall shrub bogs, and occasionally barrens
Juvenal's Duskywing	*Erynnis juvenalis*												x	x	x						2	Deciduous and mixedwood forest with oak
Kennedy's Emerald	*Somatochlora kennedyi*																					
Leonard's Skipper	*Hesperia leonardus*												x	x	x			x			2	Open deciduous and mixedwood forests, usually with oak, and dry grasslands near forest
Macropis Cuckoo Bee	*Epeoloides pilosula*							x				x									4	Dependent on *Lysimachia*, which grow in swamps, roadside ditches, and riparian zones
Maine Snaketail	*Ophiogomphus mainensis*						x	x													2	Clear rivers and streams with strong current over coarse cobbles
Monarch	*Danaus plexippus*							x										x			2,5	Open fields, meadows, and along roadsides where milkweed is found
Mustard White	*Pieris oleracea*										x	x	x	x	x			x			2	Moist deciduous or mixed woodlands, moist fields near woods, fens and shrubby wetlands
Orange Bluet	*Enallagma signatum*																					
Pepper and Salt Skipper	*Amblyscirtes hegon*							x					x	x	x	x					2	Forests along edges, roadsides, or streams

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems				Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens	Reference	
Prince Baskettail	*Epitheca princeps*																					
Rusty Snaketail	*Ophiogomphus rupinsulensis*																					
Satyr Comma	*Polygonia satyrus*							x					x			x					2,3	Boreal forest and woodlands, often near streams
Silvery Checkerspot	*Chlosyne nycteis*							x					x								2	Forested riparian areas
Spot-Winged Glider	*Pantala hymenaea*																					
Tidewater Mucket	*Leptodea ochracea*						x														2	Shallow rivers and streams
Vesper Bluet	*Enallagma vesperum*																					
Zebra Clubtail	*Stylurus scudderi*							x													2	Streams and rivers with slow to moderate current and gravel to muddy bottoms
Fishes																						
American Eel	Anguilla rostrata						x	x	x												33	Catadromus; freshwater streams, rivers, and lakes
Atlantic Salmon	*Salmo salar*						x	x	x												6	Anadromus; clean, cool, flowing rivers with gravel or boulder substrates
Atlantic Sturgeon	*Acipenser oxyrinchus*						x	x	x												34	Anadromus; deep channels and strong currents in rivers with sea access, estuaries, nearshore marine waters
Atlantic Whitefish	*Coregonus huntsmani*						x	x	x												7	Lakes in the Petite Rivière watershed
Striped Bass	*Morone saxatilis*						x	x	x												8	Anadromus; fresh or brackish rivers and estuaries

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems			Reference	Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens		
Birds																						
American Bittern	*Botaurus lentiginosus*			x				x		x											9, 10	Tall, emergent vegetation in/near marshes, bogs, fens, swamps, and tidal marshes
American Black Duck	*Anas rubripes*		x	x		x	x	x	x	x	x	x						x			9, 10	Freshwater wetlands, fields near water, lakes, riparian areas, shallow nearshore waters
American Coot	*Fulica americana*							x	x	x											2, 11	Lakes, ponds, marshes, and coastal areas
American Golden-Plover	*Pluvialis dominica*		x	x														x	x		9	Natural herbaceous habitats, fields, and beaches
American Oystercatcher	*Haematopus palliatus*	x		x	x	x															2, 11	Rocky and sandy seacoasts and islands, tidal marshes, and intertidal flats
American Redstart	*Setophaga ruticilla*							x		x		x	x	x				x	x		9, 10	Second growth forest and open areas with abundant shrubs and saplings, near water or edge
American Three-toed Woodpecker	*Picoides dorsalis*										x		x			x					11	Mature black spruce swamps
American Woodcock	*Scolopax minor*												x		x				x		9, 10	Early-successional forest with openings, shrubland
Atlantic Puffin	*Fratercula arctica*				x	x															2, 11	Breeds in colonies on offshore islands
Bald Eagle	*Haliaeetus leucocephalus*						x	x					x			x		x			9	Mature forest near water, riparian areas, beaches, estuaries, and tidal marshes
Baltimore Oriole	*Icterus galbula*							x					x	x	x						2, 11	Open, riparian woodlands and deciduous forest edge habitat

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems			Reference	Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens		
Bank Swallow	*Riparia riparia*							x			x							x			9	Banks/cliffs with soft, sandy soil, riparian areas
Barn Swallow	*Hirundo rustica*						x			x								x			9, 10	Open areas near water with available nest sites (buildings and bridges)
Barrow's Goldeneye (Eastern)	*Bucephala islandica*					x	x		x												10	Rocky coastal areas with sheltered bays, estuaries, and inland open water in winter
Bay-breasted Warbler	*Dendroica castanea*							x					x		x	x					9, 10	Mature to Old Growth coniferous and mixedwood forest, riparian areas
Belted Kingfisher	*Megaceryle alcyon*			x			x	x	x				x		x	x					9, 10	Clear water for foraging near available habitat for nest burrows, riparian areas, and estuaries
Black Scoter	*Melanitta americana*					x															10	
Black Tern	*Chlidonias niger*							x		x											10	Wetlands, coastal areas & grasslands
Black-and-white Warbler	*Mniotilta varia*							x				x	x	x	x	x					9, 10	Young, immature moist forest, riparian areas
Black-bellied Plover	*Pluvialis squatarola*	x	x	x																	9	Estuaries, tidal marshes, and intertidal mudflats
Black-billed Cuckoo	*Coccyzus erythropthalmus*												x	x	x			x	x		9, 10	Second-growth deciduous and mixedwood forest with abundant shrubs, shrubs in old fields
Blackburnian Warbler	*Setophaga fusca*												x	x	x	x					9, 10	Mature to Old Growth forest with hemlock

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems			Reference	Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Barrens/Shrublands	Sandbarrens			
Black-crowned Night-heron	*Nycticorax nycticorax*			x				x	x	x		x									2	Freshwater and brackish marshes, swamps, and riparian areas, and shores of lakes, ponds
Black-legged Kittiwake	*Rissa tridactyla*		x		x	x															9	Nearshore coastal waters, predator-free islands
Black-throated Green Warbler	*Setophaga virens*												x	x	x	x					9, 10	Interior, middle-aged to mature, coniferous and mixedwood forest
Blue-headed Vireo	*Vireo solitarius*							x		x	x	x	x		x	x					9	Mid-class to mature coniferous and mixedwood forest
Bobolink	*Dolichonyx oryzivorus*			x						x								x	x		9, 10	Large open areas with high grasses, marshes, and tidal marshes
Bonaparte's Gull	*Chroicocephalus philadelphia*					x															9	Nearshore coastal waters, estuaries
Boreal Chickadee	*Poecile hudsonica*											x	x			x					9, 10	Spruce-fir forest
Boreal Owl	*Aegolius funereus*												x		x	x					12	Dense coniferous or mixedwood forest and alder thickets
Brown Thrasher	*Toxostoma rufum*																	x	x		2	Thickets in deciduous clearings, edge habitat
Brown-headed Cowbird	*Molothrus ater*																	x	x		2, 10	Forest-field edge habitat and clearings in forests
Canada Goose	*Branta canadensis*			x		x															9, 12	Fields, freshwater wetlands with adjacent grasslands, lakes, riparian areas, estuaries, tidal marshes, and intertidal mudflats
Canada Warbler	*Cardellina canadensis*							x				x	x	x	x	x					9, 10	Moist forest with dense understory, hardwood and cedar swamps

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems			Reference	Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Barrens/Shrublands	Sandbarrens			
Cape May Warbler	*Setophaga tigrina*												x			x					9, 10	Mature coniferous forest
Chimney Swift	*Chaetura pelagica*												x	x	x	x					10, 15	Large snags and hollow trees in mature to Old Growth forest, and chimneys
Common Eider	*Somateria mollissima*				x	x															9	Nearshore coastal waters, and predator-free islands
Common Goldeneye	*Bucephala clangula*		x			x		x	x												9	Nearshore waters with sandy to rocky substrates, and estuaries
Common Loon	*Gavia immer*					x	x	x	x	x	x										9, 10	Large, freshwater lakes with small islands and sheltered coves, nearshore coastal waters, and estuaries
Common Moorhen	*Gallinula chloropus*						x	x		x											11, 13	A variety of fertile wetlands and riparian areas
Common Murre	*Uria aalge*				x	x															9	Nearshore coastal waters, and islands or cliffs for nesting
Common Nighthawk	*Chordeiles minor*									x	x	x	x		x	x		x	x		9, 10	Open, mature forest, barrens, fields, gravel pits, bogs, marshes, and tidal marshes
Common Tern	*Sterna hirundo*			x	x	x		x	x												9	Lakes and nearshore coastal waters with clear water for foraging, tidal marshes, estuaries, and sparsely vegetated islands for nesting
Cooper's Hawk	*Accipiter cooperii*												x	x							11	
Cory's Shearwater	*Calonectris diomedea*																				9	Warm offshore waters
Dovekie	*Alle alle*					x															9	Nearshore and offshore coastal waters
Dunlin	*Calidris alpina*	x	x	x																	9	Estuaries, and intertidal flats

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems				Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Barrens/Shrublands	Sandbarrens	Reference	
Eastern Kingbird	*Tyrannus tyrannus*							x		x								x	x		9, 10	Open areas with scattered shrubs, herbaceous habitats, fields, swamps, and riparian areas
Eastern Meadowlark	*Sturnella magna*																	x	x		16	Grasslands
Eastern Whip-poor-will	*Antrostomus vociferus*												x	x	x						9	Open forest with well-developed leaf litter
Eastern Wood-Pewee	*Contopus virens*							x		x			x	x	x						9, 10	Intermediate to mature deciduous and mixedwood forest
Evening Grosbeak	*Coccothraustes vespertinus*												x			x					9, 10	Mid-class to mature, open coniferous and mixedwood forest
Gadwall	*Anas strepera*							x		x		x									11, 13	Tall, emergent vegetation near inland marshes
Gray Catbird	*Dumetella carolinensis*							x										x	x		9, 10	Shrublands, fields, and riparian areas
Gray Jay	*Perisoreus canadensis*										x		x		x	x					9, 10	Mature coniferous forest, black spruce bogs
Great Cormorant	*Phalacrocorax carbo*			x	x	x															9, 12	Sheltered coastal bays with nearby perch sites, predator free islands or cliffs for nesting
Great Crested Flycatcher	*Myiarchus crinitus*							x					x	x							2,10	Natural cavities in open deciduous and mixed forest
Great Shearwater	*Puffinus gravis*					x															9	Nearshore and offshore coastal waters
Great Skua	*Stercorarius skua*																				9	Offshore waters
Green-winged Teal	*Anas crecca*			x				x	x	x								x			9	Freshwater wetlands, wooded ponds, and riparian areas

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic						Grasslands/Agro-ecosystems				Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens	Reference	
Harlequin Duck (Eastern)	*Histrionicus histrionicus*				x	x															9	Nearshore waters with rocky coastlines and exposed headlands
Horned Grebe (Western)	*Podiceps auritus*				x	x															9	Sheltered nearshore coastal areas between islands, and estuaries
Horned Lark	*Eremophila alpestris*	x																x			13	Grasslands
Hudsonian Godwit	*Limosa haemastica*	x	x	x																		Estuaries, tidal marshes, and intertidal mudflats
Indigo Bunting	*Passerina cyanea*												x	x				x	x		2	Deciduous forest edge, clearings, and open woodlands
Ivory Gull	*Pagophila eburnea*					x																Offshore waters
Killdeer	*Charadrius vociferus*	x		x				x										x			9, 10	Marshes, fields, gravel pits, and beaches
Leach's Storm-Petrel	*Oceanodroma leucorhoa*				x	x															9	Offshore waters, and vegetated islands with soft soil for nest burrows
Least Sandpiper	*Calidris minutilla*	x	x	x																	9	Estuaries, tidal marshes, and intertidal mudflats
Lesser Yellowlegs	*Tringa flavipes*		x	x																	9	Shallow water in marshes, bogs, estuaries, tidal marshes, and intertidal mudflats
Long-eared Owl	*Asio otus*												x	x	x	x		x	x		11	Open and sparsely forested habitats
Long-tailed Duck	*Clangula hyemalis*					x															9	Protected coastal bays and shorelines with steep slopes
Magnolia Warbler	*Dendroica magnolia*											x	x			x					9, 10	Regenerating forest with balsam fir, shrublands

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		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest		Barrens/Shrublands	Sandbarrens		
Mallard	*Anas platyrhynchos*			x				x	x	x								x			9	Freshwater wetlands, fields near water, lakes, riparian areas, estuaries, and tidal marshes
Manx Shearwater	*Puffinus puffinus*																				9	Nearshore and offshore coastal waters
Marsh Wren	*Cistothorus palustris*			x				x		x											13	
Mourning Warbler	*Geothlypis philadelphia*												x	x	x				x		9	Second-growth deciduous and mixedwood forest, shrublands
Nelson's Sparrow	*Ammodramus nelsoni*			x				x										x			9	Dykeland drainage ditches, marshes, tidal marshes
Northern Goshawk	*Accipiter gentilis*												x	x	x	x					2	Nests in mature to old-growth deciduous, coniferous, and mixedwood forest.
Northern Parula	*Setophaga americana*							x				x	x	x	x	x					9, 10	Nests in *Usnea* lichen in second-growth and mature forest, swamps, and riparian areas
Northern Pintail	*Anas acuta*			x						x											11	Shallow wetlands
Northern Shoveler	*Anas clypeata*			x				x	x	x								x			11, 13	Open water and wetlands
Olive-sided Flycatcher	*Contopus cooperi*										x	x	x			x					9, 10	Second-growth to mature coniferous forest near edges and open areas, and bogs
Peregrine Falcon (anatum/tundrius ssp.)	*Falco peregrinus anatum/tundrius*							x					x		x	x					9, 17	Cliff ledges for nesting, beaches and exposed riparian areas for foraging
Philadelphia Vireo	*Vireo philadelphicus*												x	x							2, 13	Open deciduous or mixedwood forest, and forest edge habitat

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Pied-billed Grebe	*Podilymbus podiceps*			x				x	x	x											9	Marshes and lakes with dense emergent vegetation and open water
Pine Grosbeak	*Pinicola enucleator*												x	x		x					9, 10	Open coniferous forest, mostly spruce
Piping Plover (melodus ssp.)	*Charadrius melodus melodus*	x	x																		9, 18	Wide sandy to medium-cobble beaches with sparse vegetation
Purple Finch	*Carpodacus purpureus*												x			x					9, 10	Moist, immature coniferous forest
Purple Martin	*Progne subis*							x	x	x								x			9	Nest-box dependent in open areas near water
Purple Sandpiper	*Calidris maritima*		x																		9	Rocky coastal shorelines exposed to wave action
Razorbill	*Alca torda*				x	x															9	Nearshore and offshore coastal waters, and predator-free islands or cliffs for nesting
Red Knot (rufa ssp.)	*Calidris canutus rufa*	x	x	x																	9	Tidal marshes and intertidal flats
Red Phalarope	*Phalaropus fulicarius*		x			x															9	Nearshore and offshore waters
Red-necked Grebe	*Podiceps grisegena*		x	x		x															9	Nearshore coastal waters, estuaries
Red-necked Phalarope	*Phalaropus lobatus*		x			x															2	Nearshore and offshore waters
Red-throated Loon	*Gavia stellata*					x															9	Sheltered, shallow nearshore coastal waters and estuaries
Ring-billed Gull	*Larus delawarensis*	x	x	x		x			x												2, 11	Coastal bays and estuaries, and sparsely vegetated islands in large lakes

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		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest		Barrens/Shrublands	Sandbarrens	Reference	
Ring-necked Duck	*Aythya collaris*							x	x	x											9, 10	Marshes with open water, and lakes
Roseate Tern	*Sterna dougallii*				x	x															9, 12	Nearshore waters, nests colonially on islands with sandy substrates
Ruffed Grouse	*Bonasa umbellus*												x	x	x	x					9, 10	Ground and understory of deciduous and mixedwood forest with coarse woody debris
Rusty Blackbird	*Euphagus carolinus*							x		x		x	x	x		x		x			9, 19	Moist, coniferous and mixedwood forest, wetlands, riparian areas, and occasionally grasslands
Sanderling	*Calidris alba*	x	x	x																	9	Estuaries and intertidal sandflats
Savannah Sparrow (princeps ssp.)	*Passerculus sandwichensis princeps*	x																	x		9, 10	Heath-dominated barrens, and marram grass dunes
Scarlet Tanager	*Piranga olivacea*							x					x	x	x						2, 10	Mature deciduous and floodplain forest
Semipalmated Plover	*Charadrius semipalmatus*	x	x	x																	2, 11	Well-drained, gravelly beaches, tidal marshes, and intertidal flats
Semipalmated Sandpiper	*Calidris pusilla*	x	x	x																	9	Sand/gravel beaches with sparse vegetation, estuaries, and intertidal flats
Short-eared Owl	*Asio flammeus*			x						x	x		x					x	x		9, 20	A wide variety of open habitats including grasslands, bogs, marshes, tidal marshes
Solitary Sandpiper	*Tringa solitaria*		x					x	x	x		x	x			x					9	Lake and stream margins, swamp dominated by emergent vegetation, estuaries
Sooty Shearwater	*Puffinus griseus*					x															9	Nearshore and offshore coastal waters

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		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Grasslands/Agro-ecosystems	Barrens/Shrublands	Sandbarrens	Reference	
Sora	*Porzana carolina*							x	x	x								x			9	Marshes, including tidal marshes, with shallow water and dense emergent vegetation, and adjacent fields/pastures
South Polar Skua	*Stercorarius maccormicki*																				9	Offshore waters
Spotted Sandpiper	*Actitis macularius*							x	x									x			9	Fields near open shoreline for foraging, riparian areas, and beaches
Spruce Grouse	*Falcipennis canadensis*										x	x	x			x					9, 10	Second-growth pine forest, forested bogs
Surf Scoter	*Melanitta perspicillata*					x															9	Shallow nearshore coastal waters with sandy to rocky substrates
Thick-billed Murre	*Uria lomvia*					x															9	Nearshore and offshore coastal waters
Tree Swallow	*Tachycineta bicolor*							x		x								x	x		9, 10	Cavities near open areas and water for foraging
Turkey Vulture	*Cathartes aura*												x					x			11	Grasslands close to undisturbed forest for perching and nesting
Veery	*Catharus fuscescens*							x		x		x	x	x				x	x		9, 10	Second-growth deciduous and mixedwood forest with dense understory, shrublands
Vesper Sparrow	*Pooecetes gramineus*																	x			13	Grasslands
Virginia Rail	*Rallus limicola*							x		x	x	x									9	Shallow marshes with emergent vegetation
Warbling Vireo	*Vireo gilvus*							x					x	x							2, 13	Open deciduous and mixedwood forest, and riparian areas
Whimbrel	*Numenius phaeopus*		x	x														x	x		9	Grasslands, coastal barrens, estuaries, tidal marshes, and intertidal sandflats

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		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Barrens/Shrublands	Sandbarrens			
White-throated Sparrow	*Zonotrichia albicollis*												x			x		x	x		9	Any forest type with abundant shrubs, fields
White-winged Scoter	*Melanitta fusca*					x															9	Nearshore coastal waters
Willet	*Tringa semipalmata*	x	x	x																	9	Beaches, estuaries, and tidal marshes
Willow Flycatcher	*Empidonax traillii*							x		x		x									11, 13	Dense shrub and riparian areas
Wilson's Snipe	*Gallinago delicata*							x	x	x	x							x	x		9	Freshwater wetlands, wet grasslands, lakes, and riparian areas
Wood Thrush	*Hylocichla mustelina*							x					x	x	x						2, 11	A variety of deciduous and mixed forest with dense understory
Reptiles																						
Blanding's Turtle	*Emydoidea blandingii*						x	x	x	x	x	x									5	Dark, slow-moving water in marshes, swamps, bogs, and lakeshores; exposed gravelly or sandy areas for nesting
Eastern Ribbonsnake	*Thamnophis sauritus*							x	x	x	x	x									5	Marshes, swamps, bogs, and lakeshores within 30m of water
Snapping Turtle	*Chelydra serpentina*						x	x	x	x											31	A variety of habitats, prefer slow-moving water with a soft mud bottom and dense aquatic vegetation; sand and gravel banks along waterways for nesting
Wood Turtle	*Glyptemys insculpta*						x	x	x												5	Clear, moderately flowing rivers in forests or floodplains; sandy bars in rivers or gravelly areas for nesting

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Mammals																						
American Marten	*Martes americana*												x		x	x					2,5	Mature coniferous, mixed forest with coarse woody debris, abundant prey
Eastern Red Bat	*Lasiurus borealis*												x								2	Roost in tree foliage in forest
Fisher	*Martes pennanti*							x					x	x	x	x					2	Dense coniferous, mixedwood, and deciduous forest, particularly riparian areas
Hoary Bat	*Lasiurus cinereus*												x	x		x					2	Roost in tree foliage in coniferous or deciduous forest
Little Brown Myotis	*Myotis lucifugus*							x					x	x	x	x					2	Maternity colonies roost in tree cavities and buildings in a variety of habitats; hibernacula include natural caves and mines
Moose (Mainland)	*Alces americanus*								x	x		x	x			x					2, 21	A mosaic of second-growth forest, openings, swamps, lakes, and wetlands; mature coniferous forest in summer for thermoregulation
Northern Myotis	*Myotis septentrionalis*												x	x	x	x					2	Maternity colonies roost in tree cavities in mature, interior forest stands; hibernacula include natural caves and mines
Silver-haired Bat	*Lasionycteris noctivagans*							x	x				x			x					2	Roost in tree foliage, cavities, or under loose bark in forest, often coniferous, near open water
Southern Flying Squirrel	*Glaucomys volans*												x		x						22, 23	Cavities in mature, species-rich mixedwood forests with red oak
Tri-colored Bat	*Perimyotis*											x	x			x					2	Maternity colonies roost in *Usnea* lichen,

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	subflavus																					typically in black spruce in poorly-drained coniferous stands; hibernacula include natural caves and mines
Lichens																						
Black-foam Lichen	*Anzia colpodes*																					
Blistered Jellyskin Lichen	*Leptogium corticola*											x									32	Red maples in treed swamps
Blistered Tarpaper Lichen	*Collema nigrescens*											x									32	Red maples in treed swamps
Blue Felt Lichen	*Degelia plumbea*							x				x	x	x	x						24	Cool, humid, mature deciduous and mixedwood forests, swamps, and riparian areas
Boreal Felt Lichen	*Erioderma pedicellatum*												x			x	x				5	Forested balsam fir stands within 25 km of the coast
Bottlebrush Frost Lichen	*Physconia detersa*																					
Crumpled Bat's Wing Lichen	*Collema leptaleum*																					
Eyed Mossthorns Woollybear Lichen	*Polychidium muscicola*																					
Ghost Antler Lichen	*Pseudevernia cladonia*												x			x	x				5	Foggy, cool coastal spruce-fir forest
Hairy-spined Shield Lichen	*Parmelinopsis horrescens*																					

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		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest						
Naked Kidney Lichen	*Nephroma bellum*																						
Peppered Moon Lichen	*Sticta fuliginosa*																						
Pimpled Kidney Lichen	*Nephroma resupinatum*																						
Poor-man's Shingles Lichen	*Parmeliella parvula*																						
Powdered Moon Lichen	*Sticta limbata*											x										32	Red maples in treed swamps
Rimmed Shingles Lichen	*Fuscopannaria leucosticta*											x										32	Red maples in treed swamps
Scaly Fringe Lichen	*Heterodermia squamulosa*																						
Stretched Jellyskin Lichen	*Leptogium milligranum*																						
Veined Shingle Lichen	*Pannaria lurida*											x										32	Red maples in treed swamps
Vole Ears Lichen	*Erioderma mollissimum*												X			x	x					25	Humid coastal coniferous forest
Appressed Jellyskin Lichen	*Leptogium subtile*																						
Non-vascular Plants																							
Wulf's Peat Moss	*Sphagnum wulfianum*											x				x							Coniferous forests and swamps

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Vascular Plants																						
Acadian Quillwort	*Isoetes acadiensis*	x					x	x	x												26	Submergent aquatic
Alpine Bilberry	*Vaccinium uliginosum*																		x		35	Barrens
American Cancer-root	*Conopholis americana*												x	x							26	
American False Pennyroyal	*Hedeoma pulegioides*	x							x									x	x		26	Gravelly shores, and open barren fields
Atlantic Sedge	*Carex atlantica ssp. capillacea*										x	x	x						x		26, 27	Bogs, peaty barrens, and open, forested swamps
Big-leaved Marsh-elder	*Iva frutescens ssp. oraria*	x		x																	26	Tidal marshes, beaches, and disturbed areas
Black Ash	*Fraxinus nigra*							x				x	x	x							26	Swamps and floodplains
Blood Milkwort	*Polygala sanguinea*																	x			26	Open damp areas and disturbed roadsides
Blue Cohosh	*Caulophyllum thalictroides*							x					x	x							26	Floodplains
Blunt-leaved Bedstraw	*Galium obtusum*							x		x	x	x	x								26, 27	Marshes, swamps, boggy swales, stream banks, and floodplains
Bog Willow	*Salix pedicellaris*									x	x										26	Marshes and fens
Boreal Aster	*Symphyotrichum boreale*										x	x	x								26	Fens, swamps
Canada Anemone	*Anemone canadensis*							x	x												26	Shorelines and floodplains
Canada Rice Grass	*Piptatherum canadense*	x						x	x		x										26, 28	Sandy barrens and rocky clearings

Common Name	*Scientific Name*	Coastal					Freshwater Habitats and Wetlands						Acadian Forest Mosaic					Grasslands/Agro-ecosystems			Reference	Habitat Notes
		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest	Barrens/Shrublands	Sandbarrens			
Canada Tick-trefoil	*Desmodium canadense*								x												26	Shorelines
Case's Ladies'-Tresses	*Spiranthes casei var. casei*																	x			26	
Case's Ladies'-Tresses	*Spiranthes casei var. novaescotiae*																	x	x		26, 27	Acid and sandy soils in dry fields and open barrens
Chaffweed	*Anagallis minima*			x																	26	Brackish habitats, roadside
Chinese Hemlock-parsley	*Conioselinum chinense*								x			x									26	Shorelines and swamps
Coastal Plain Blue-eyed-grass	*Sisyrinchium fuscatum*																			x	26, 27	Dry, sandy habitats, sandbarrens
Coastal Plain Joe-pye-weed	*Eupatorium dubium*								x												26, 27	Rocky, muddy or peaty shores of lakes and rivers
Common Bedstraw	*Galium aparine*							x					x					x			26, 29	Forest edges, riparian areas, and grasslands
Cursed Buttercup	*Ranunculus sceleratus*	x		x																	26	Tidal marshes and beaches
Disguised St John's-wort	*Hypericum dissimulatum*							x	x												26	Shorelines
Downy Rattlesnake-Plantain	*Goodyera pubescens*												x	x	x						26, 28	Dry-moist coniferous & mixedwood. Often sandy substrates with oak & pine.
Dudley's Rush	*Juncus dudleyi*								x												26	Shorelines and disturbed areas
Eastern Baccharis	*Baccharis halimifolia*			x																	26, 27	Tidal marsh edges
Eastern Lilaeopsis	*Lilaeopsis chinensis*			x																	5, 26	Muddy slopes in the brackish waters of estuaries

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		Beach/Dune	Tidal flats	Salt/brackish marsh	Coastal Islands	Nearshore waters	Aquatic	Riparian/Floodplain	Lakes/Shorelines	Marsh	Bog/Fen	Shrub/Treed Swamp	Forest Mosaic	Deciduous	Mixedwood	Coniferous	Coastal Forest		Barrens/Shrublands	Sandbarrens		
Eastern Mountain Avens	*Geum peckii*							x	x		x	x									5, 26	Riparian areas, swamps, lakeshores, bogs and fens
Eastern White Cedar	*Thuja occidentalis*							x				x	x					x			5, 26	Riparian areas along streams, swamps, lakeshores, and open pastures
Fall Panic Grass	*Panicum dichotomiflorum var. puritanorum*								x												26, 27	Sandy or gravelly lakeshores
Farwell's Water Milfoil	*Myriophyllum farwellii*						x		x												26	Aquatic submergent
Fernald's Serviceberry	*Amelanchier fernaldii*								x										x		2, 26	Calcareous thickets, open barrens, shores, and ravines
Few-flowered Spikerush	*Eleocharis quinqueflora*								x		x										26	Shorelines and fens
Fleshy Stitchwort	*Stellaria crassifolia*			x																	26	Tidal marshes (upper)
Forked Bluecurls	*Trichostema dichotomum*																		x		36	Inland barrens
Fringed Blue Aster	*Symphyotrichum ciliolatum*																					
Gaspé Arrowgrass	*Triglochin gaspensis*			x																	26	Tidal marshes
Glaucous Rattlesnakeroot	*Prenanthes racemosa*							x			x							x			26, 29	Sandy alluvial soils of stream banks, wet meadows, fens, and bogs
Goldencrest	*Lophiola aurea*								x		x										5, 26	Gently sloping cobble lakeshores, fens, and bogs
Greene's Rush	*Juncus greenei*	x							x									x			26, 29	Dry, well-drained lakeshores, sand dunes, and disturbed areas

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Greenland Stitchwort	*Minuartia groenlandica*																	x			26, 29	Rocky and gravelly slopes and ledges, inland barrens
Hairy Goldenrod	*Solidago hispida*																				26	
Hairy Lettuce	*Lactuca hirsuta var. sanguinea*												x								26, 29	Openings in forest
Halberd-leaved Tearthumb	*Polygonum arifolium*									x		x									26	Swamps, marshes
Hayden's Sedge	*Carex haydenii*									x											26	Marshes
Horned Sea-blite	*Suaeda calceoliformis*	x		x																	26	Tidal marshes, beaches
Horn-leaved Riverweed	*Podostemum ceratophyllum*						x														26	Aquatic submergent
Houghton's Sedge	*Carex houghtoniana*												x						x		26, 29	Dry to moist sandy or gravelly soils in open, disturbed sites, and rocky ledges
Intermediate Mermaidweed	*Proserpinaca intermedia*						x		x	x	x	x									26, 27	Aquatic emergent vegetation in marshes, bogs, swamps, and shorelines
Inverted Bladderwort	*Utricularia resupinata*						x		x												27	Sandy, muddy, or peaty lakeshores, often in shallow water
Kalm's Hawkweed	*Hieracium kalmii*																	x			2,26	Open, disturbed sites, especially in sandy soils
Knotted Pearlwort	*Sagina nodosa ssp. borealis*			x																	26	Tidal marshes
Lance-leaved Figwort	*Scrophularia lanceolata*												x					x			26, 28	Open woods and old fields
Large Round-Leaved Orchid	*Platanthera macrophylla*												x	x		x					26, 29	Wet coniferous and deciduous forest

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Large St John's-wort	*Hypericum majus*								x												26	Shorelines and disturbed areas
Large Tick-Trefoil	*Desmodium glutinosum*								x				x	x							26	Shorelines
Least Moonwort	*Botrychium simplex*												x					x	x		2, 26	A variety of habitats including meadows, barrens and woodlands
Lesser Pyrola	*Pyrola minor*							x					x			x					26, 29	Moist, often mossy sites in coniferous forests, riparian areas
Lesser Spearwort	*Ranunculus flammula var. flammula*								x												26	Shorelines
Limestone Meadow Sedge	*Carex granularis*								x		x	x						x			26, 29	Open habitats including meadows, fens, shorelines, and swamps, and edge habitat
Little Curlygrass Fern	*Schizaea pusilla*								x		x										26, 27	Peaty lakeshores and wetlands
Long's Bulrush	*Scirpus longii*								x		x										5, 26	Stillwater meadows, fens, bogs, and peaty shorelines
Long's Sedge	*Carex longii*								x		x	x	x								26, 27	Red maple swamps, bogs, river and lakeshores, and coastal wetlands
Low Flatsedge	*Cyperus diandrus*							x	x			x									26	Floodplains and shorelines
Maidenhair Spleenwort	*Asplenium trichomanes*																				2, 26	Moist, rocky, calcareous cliff crevices and talus slopes
Maleberry	*Lyonia ligustrina*								x		x	x	x								29	Acidic woodlands, swamps, bogs, and riparian areas

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Marsh Mermaidweed	*Proserpinaca palustris var. palustris*						x		x	x	x	x									26, 27	Aquatic emergent vegetation in marshes, bogs, swamps, and shorelines
Nantucket Serviceberry	*Amelanchier nantucketensis*																	x	x	x	26, 27	Dry habitats such as fields, barrens, and disturbed areas
Narrow-leaved Evening Primrose	*Oenothera fruticosa ssp. glauca*																				26	
Narrow-leaved Panic Grass	*Dichanthelium linearifolium*							x				x									26	Riparian areas and floodplains
Necklace Spike Sedge	*Carex ormostachya*												x	x	x	x					26, 29	Deciduous, mixedwood, or coniferous forest
Netted Chain Fern	*Woodwardia areolata*							x	x		x	x	x						x		26, 27	Stream edges, swamps, bogs, and lakeshores
Newfoundland Dwarf Birch	*Betula michauxii*										x										26, 35	Peatlands and barrens
Northern Adder's-tongue	*Ophioglossum pusillum*								x	x		x						x			26	Marshes, swamps, and shorelines
Northern Bedstraw	*Galium boreale*							x				x	x					x			26, 29	Open forest, swamps, and grasslands
Northern Blueberry	*Vaccinium boreale*										x										26	Peatlands
Northern Bog Violet	*Viola nephrophylla*								x		x										26	Shores, fens
Northern Dewberry	*Rubus flagellaris*																				26	
Northern Maidenhair Fern	*Adiantum pedatum*							x					x	x							26	Floodplains

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One-sided Rush	*Juncus secundus*																	x			26, 29	Exposed sites, usually with well-drained sandy soil
Ovate Spikerush	*Eleocharis ovata*								x	x											26	Shorelines and marshes
Pale False Manna Grass	*Torreyochloa pallida var. pallida*								x	x		x									26	Marshes, swamps, shores
Peach-leaved Dock	*Rumex persicarioides*			x																	26	Tidal marshes
Philadelphia Fleabane	*Erigeron philadelphicus*									x			x					x			29	Open, disturbed sites and edge habitat
Pinebarren Golden Heather	*Hudsonia ericoides*	x																	x	x	26, 27	Dry barrens on sand, dunes, or rick outcrops
Pink Coreopsis	*Coreopsis rosea*								x												5, 26	Rocky or sandy shorelines
Plymouth Gentian	*Sabatia kennedyana*								x												5, 26	Gently sloping, infertile sand, gravel, peat, or cobblestone shorelines
Poison Sumac	*Toxicodendron vernix*							x	x		x	x									26, 27	Boggy or swampy shorelines of lakes and streams
Porcupine Sedge	*Carex hystericina*								x												26	Shore seeps
Prairie Sedge	*Carex prairea*										x										26	Fens
Prickly Hornwort	*Ceratophyllum echinatum*						x		x												26	Aquatic submergent
Prototype Quillwort	*Isoetes prototypus*						x														5, 26	Submergent aquatic in spring-fed lakes
Purple-veined Willowherb	*Epilobium coloratum*							x	x			x									26, 28	Shorelines and sandy swamp margins
Racemed Milkwort	*Polygala polygama*												x								2	Dry, open woodlands

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Red Ash	*Fraxinus pennsylvanica*											x	x								26	Swamps
Red Pigweed	*Chenopodium rubrum*	x		x				x	x												26	Tidal marshes, beaches, and shorelines
Redroot	*Lachnanthes caroliniana*								x		x										5, 26	Peat, sand, and gravel shorelines
Robinson's Hawkweed	*Hieracium robinsonii*							x	x												2, 26	Gravelly shorelines and rocky ledges along rivers
Rock Spikemoss	*Selaginella rupestris*																		x		26, 29	Dry ledges and rock crevices and barrens
Rockrose	*Helianthemum canadense*								x											x	5, 26	Sandbarrens
Round-lobed Hepatica	*Hepatica nobilis var. obtusa*												x	x							2, 26	Moist, rich woodlands
Rugel's Plantain	*Plantago rugelii*																				26	
Tidal marsh Agalinis	*Agalinis maritima*			x																	26	Tidal marshes
Seabeach Ragwort	*Senecio pseudoarnica*	x																			26	Beaches
Seaside Brookweed	*Samolus valerandi ssp. parviflorus*																				26	Brackish wetlands
Sharp-fruited Knotweed	*Polygonum raii*	x		x																	26	Tidal marshes and beaches
Shining Ladies'-Tresses	*Spiranthes lucida*							x	x												26	Shore seeps
Short-awned Foxtail	*Alopecurus aequalis*								x												26	Shorelines

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Silky Willow	*Salix sericea*							x	x		x										26, 27	Shorelines of rivers and lakes, and bogs
Sleepy Catchfly	*Silene antirrhina*																				26	
Slender Blue Flag	*Iris prismatica*									x		x	x								26, 27	Swamps near the coast and brackish wetlands
Slender Cottongrass	*Eriophorum gracile*										x							x			26, 28	Peatlands
Slender Panic Grass	*Dichanthelium xanthophysum*								x				x	x							26	Shorelines
Slender Rice Grass	*Piptatherum pungens*												x					x			26, 28	Rocky or sandy, open woods and clearings
Slender Wood Sedge	*Carex digitalis*												x	x	x						26, 29	Deciduous or mixedwood forest
Slim-stemmed Reed Grass	*Calamagrostis stricta ssp. stricta*			x							x										26	Upper tidal marshes and fens
Small-flowered Bittercress	*Cardamine parviflora var. arenicola*																				26	
Small-spike False-nettle	*Boehmeria cylindrica*							x	x			x	x	x							26	Floodplains, swamps, and shorelines
Southern Twayblade	*Listera australis*										x	x	x	x							26, 27	Shaded bogs and swamps, and moist forest
Spotted Pondweed	*Potamogeton pulcher*						x	x	x												26, 27	Aquatic submergent in open, shallow water in muddy lakes and brooks
Stalked Bulrush	*Scirpus pedicellatus*							x		x											26	Floodplains, marshes
Sturdy Bulrush	*Schoenoplectus robustus*			x																	26	Tidal marshes

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Swamp Milkweed	*Asclepias incarnata ssp. pulchra*								x	x											26	Marshes and shorelines
Swan's Sedge	*Carex swanii*												x	x							26, 29	Dry to wet forests
Swedish Bunchberry	*Cornus suecica*										x										26	Peatlands
Sweet Pepperbush	*Clethra alnifolia*							x	x												5, 27	In the shrub zone along river and lake shorelines
Tall Beakrush	*Rhynchospora macrostachya*								x												26, 27	Wet and exposed sandy or mucky lakeshores
Tender Sedge	*Carex tenera*												x	x				x			26, 29	Dry to moist, open forests and meadows
Thread-leaved Sundew	*Drosera filiformis*										x										5, 26	Raised bogs and peatlands
Thread-Like Naiad	*Najas gracillima*						x		x												26, 27	Aquatic submergent rooted in sandy or muddy lake bottoms in shallow to moderately deep water
Torrey's Bulrush	*Schoenoplectus torreyi*						x														26	Aquatic emergent
Tower Mustard	*Arabis glabra*																				26	
Triangular-valve Dock	*Rumex salicifolius var. mexicanus*								x												26	Brackish shorelines, disturbed areas
Tubercled Orchid	*Platanthera flava var. flava*								x		x	x									26, 27	Sandy and gravelly lakeshores, river margins, bogs, and swamps

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Tubercled Orchid	*Platanthera flava var. herbiola*								x												26	Shore seeps
Tubercled Spike-rush	*Eleocharis tuberculosa*								x		x										5, 26	Lake shorelines and peatlands
Tuckerman's Panic Grass	*Panicum tuckermanii*								x												26	Shorelines and disturbed areas
Water Blinks	*Montia fontana*								x												26	Brackish seeps and shorelines
Water Pygmyweed	*Crassula aquatica*			x																	26	Brackish habitats
Water-pennywort	*Hydrocotyle umbellata*						x		x												5, 26	Emergent aquatic vegetation on sand, gravel, or cobble lakeshores
Wavy-leaved Aster	*Symphyotrichum undulatum*																				26	
White Sea-blite	*Suaeda maritima ssp. richii*		x	x																	26, 27	Tidal marshes and saline mudflats
Wiegand's Sedge	*Carex wiegandii*							x		x	x	x	x								26	Swamps, marshes, and peatlands
Wild Chives	*Allium schoenoprasum var. sibiricum*								x												26	Shorelines/shore seeps
Wild Leek	*Allium tricoccum*							x					x	x							26	Rich floodplains
Wood Anemone	*Anemone quinquefolia*							x					x	x							26	Floodplains
Woolly Panic Grass	*Dichanthelium acuminatum var. lindheimeri*								x												26	
Yellow Ladies'-tresses	*Spiranthes ochroleuca*																				26	

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Yellow Lady's-slipper	*Cypripedium parviflorum var. makasin*										x	x	x		x	x		x			26, 29	Wet meadows, open coniferous and mixed forest, and fens
Yellow Lady's-slipper	*Cypripedium parviflorum var. pubescens*										x	x	x	x		x		x			26, 29	Wet deciduous and coniferous forest, clearings, meadows, and fens
Yellow Spikerush	*Eleocharis olivacea*								x												26	Shorelines
Total Species by Habitat Type		**26**	**23**	**48**	**12**	**32**	**31**	**99**	**93**	**50**	**52**	**61**		**55**	**41**	**51**	**3**	**60**	**35**	**4**		
Total Species by Coarse-filter Habitat		**26**	**23**	**48**	**12**			**149**		**111**			**115**					**60**	**35**			

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Appendix E. Priority habitat composite methodology

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. 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.

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 Natural Landscape and within the bioregion), representivity (by Natural Landscape), 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.

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 work 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.

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 Southwest Nova Scotia bioregion:

1) Beaches and dunes
2) Tidal marshes
3) Tidal flats
4) Coastal islands
5) Freshwater wetlands
6) Acadian Forest mosaic
7) Riparian and floodplain systems
8) Grasslands/agro-ecosystems
9) Barrens

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.

Habitat data sources:

- **Beaches and dunes** - Beaches and dunes were selected from the Nova Scotia Provincial Forest Resource Inventory (FORNON = 94), the Department of Environment Small Patch Ecosystems layer (Feature1_ = beach/dune) and the Nova Scotia Wetlands Inventory (WTY1 = B and D)
- **Tidal marsh** - Tidal marsh were selected from the updated Nova Scotia wetlands inventory (WETLAND = tidal marsh), the Department of Environment Small Patch Ecosystem layer (Feature1_ = tidal marsh) and the Nova Scotia Wetlands Inventory (WTY1 = S). A 275 metre buffer was applied to all of the polygons (Environment Canada 1998)
- **Freshwater wetlands** - Six types of freshwater wetlands were selected as habitat targets within the bioregion. They were selected from the updated Nova Scotia Wetlands Inventory and included: bogs, fens, unclassified peatlands (bogs or fens), marsh, and swamp. Swamp polygons were further classified by vegetation type when overlaid with the Department of Natural Resources' wetland vegetation type layer into shrub or treed swamps. A 275 metre buffer was applied to all of the freshwater wetland polygons (Environment Canada 1998).
- **Tidal flats** - Tidal flats were selected from the Nova Scotia Wetlands Inventory (WTY1= MF and EF) and the Small Patch Ecosystems (Feature1_ = estruine flat or tidal flat)
- **Barrens** - Barrens were selected from the Nova Scotia Forest Resource Inventory (FORNON = 84 and 85). Sand barrens were selected from the Small Patch Ecosystems layer (Feature1_ = sand barren). Sand barrens were erased from the FRI barrens to create a seamless layer for later scoring. A 500 metre buffer[1] was created around the coastline of the bioregion and all barrens (not including sand barrens) located within the buffer were re-classified as Coastal Barrens. All barrens found outside the coastal buffer (not including sand barrens) were re-classified as "inland barrens".
- **Coastal islands** - Coastal Islands were selected from the Nova Scotia Forest Resource Inventory (landclass = 97 - offshore islands).
- **Riparian areas** - Riparian areas were derived by adding a 275 metre buffer to the Nova Scotia Provincial Major Watercourses layer (FCODE =302). NAAP critical floodplains were also

[1]Coastal buffer size recommended when roughly identifying coastal barrens (Oberndorfer and Lundholm 2009).

included. Riparian areas were used to increase the score of other habitat types that were found within them. It was not an independent target habitat for the purposes of this analysis.

- **Forest mosaic** - Forest data was first assembled and classified into the following forest community types by the Nova Scotia Department of Natural Resources office in Truro.
    - Tolerant hardwood (HTHw) - <= 20% softwood and >= 60% tolerant hardwood species in hardwood stands
    - Tolerant mixedwood (MTHw) - 21 - 79% softwood and >= 50% tolerant hardwood species in hardwood stands
    - Softwood - >=80% softwood species
        - Balsam fir dominant (SbFDom) - >= 60% balsam fir in softwood stands
        - Red/black spruce dominant (SrSbSDom) - >= 60% Spruce, >= 50% red/black/hybrid spruce
        - White spruce dominant (SwSDom) - >= 60% Spruce, < 50% red/black/hybrid spruce
        - Spruce/fir dominant (SSpbFDom) - >= 60% fir + spruce
        - Pine dominant (SpiDom) - >= 60% pine
        - Mixed spruce/pine/hemlock (SMHePiSp) - > 0% spruce + fir + pine + hemlock

  From all of these community types, only development class mature or multiaged and a seral score of 38 - 50 (late successional) were selected to be included in the analysis. The resulting selection was dissolved based on community type to ensure the largest patch size. All forest polygons located within any of the 5 coastal Natural Landscapes were sub-classified as coastal forest.

Cleaning the data

The first step prior to the habitat prioritization analysis was to clean the GIS data before assignment of weights was 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 patches. The selected patches were then dissolved to form new contiguous polygons. The area of each patch was recalculated using 'calculate geometry' and weights were then assigned based on the new area of the dissolved polygons.

Weighting the data

For each conservation priority habitat, final scores between 0 and 1 were assigned, the latter representing completely suitable habitat for nested species. All priority habitat occurrences (i.e., patches), with the exception of coastal islands, barrens, and riparian areas (see below), were scored using a three-tiered equation that equally divides the score by habitat uniqueness, representivity, and size:

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

Uniqueness

Conceptually, variations in enduring features across the landscape (e.g., geology, climate, topography, soils) can potentially result in different ecological attributes of a habitat type (for example, high elevation bogs host different specie assemblages than coastal blanket bogs). Uniqueness is a measure of the rarity of a habitat type within each Natural Landscape and within the bioregion. The uniqueness calculation was created to take into account the potential differences of habitat types within each

natural landscape present in the bioregion. To determine the uniqueness of each categorized habitat type across the bioregion (i.e., area of interest, AOI), two area based assessments were conducted (U_1 and U_2) as follows:

$$U_1 = 1 - \left(\frac{Habitat_{AOI-Natural\ Landscape}}{Habitat_{AOI-Total}} \right) \qquad U_2 = 1 - \left(\frac{Habitat_{AOI-Total}}{Ecosystem_{AOI-Total}} \right)$$

Habitat refers to the specific form of habitat (e.g., marsh) that is nested within a particular *Ecosystem* type (e.g., freshwater wetlands). U_1 calculates the area of a particular habitat type habitat within each Natural Landscape compared to the area of that habitat type within the AOI, or bioregion. U_2 calculates the area of the habitat type within the bioregion compared to the total parent ecosystem within the bioregion. The final uniqueness score is an average of the two:

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

Habitat types that are not nested (i.e., tidal marsh, tidal flats, beaches and dunes) did not require the use of the U_2 calculation and were scored for uniqueness based on U_1 alone.

Representivity

Based on the assumptions of Natural Landscapes mentioned above, representivity was calculated using two area based assessments (R_1 and R_2), as follows:

$$R_1 = \frac{Natural\ \text{Landscape}_{AOI}}{Natural\ Landscape_{Total}} \qquad R_2 = \frac{Habitat_{AOI-\ \text{Natural Landscape}}}{Habitat_{Natural\ \text{Landscape}}}$$

R_1 is the proportion of each Natural Landscape within the bioregion. R_2 is the proportion of each priority habitat type within each Natural Landscape in the bioregion, regardless of the proportion that is within the bioregion. The final representivity score is as follows:

$$Representivity = 1 - \left(\frac{R_1}{R_2} \right)$$

This method of calculating representivity accounts for the total area of each Natural Landscape represented within the AOI boundary (R_1) and is prorated by the percent of habitat that occurs within the portion of the Natural Landscape located within the AOI. Conceptually, if both R_1 and R_2 are equal, then the habitat type is equally represented across the Natural Landscape, both inside and outside the AOI boundary (*Representivity* = 0). If R_1 is smaller than R_2, than a higher proportion of habitat is located within the AOI portion of the Natural Landscape, which results in a higher score (*Representivity* > 0). If R_1 is larger than R_2, than a lower proportion of habitat is located within the AOI portion of the Natural Landscape than outside of it. This results in a negative score (*Representivity* < 0), meaning that the habitat type is better represented outside the AOI portion of the Natural Landscape. All negative values are converted to 0.

Size

Size is a patch based metric. The area of each patch for each habitat type was divided by a critical minimum patch size[1] specific to each habitat type (see below for minimum patch sizes).

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

If a patch was the same size or larger than its respective minimum patch size, that patch was given a size score of 1. Other patches were scored on a scale from 0 to 0.99 based on their proportion of the critical minimum patch size. See table below for a summary of the minimum size criteria used within the analysis. Barrens and coastal islands did not receive a size score; upon consultation with field experts, it was communicated that size does not appear to be a limiting factor when determining the ecological value of these two habitat types (K. Porter, K. Allard, per. comm.).

Table 18. Minimum size criteria for each habitat type within the Southwest Nova Scotia bioregion.

Habitat Conservation Priority	Minimum Size (ha)
Beaches and Dunes	8.1
Rocky Shores	4.0
Tidal marsh	24.3
Tidal Flats	40.5
Freshwater Wetlands	20.2
Barrens	NA
Coastal Islands	NA
Acadian Forest Mosaic[2]	
Late Successional (LS) Hardwood	40
LS Mixedwood	60
LS Spruce, Fir, Spruce/Fir Mix	50
LS Pine	15
LS Spruce/Pine/Hemlock Mix[3]	50

Coastal islands, barrens, and riparian area scoring

- **Coastal islands** - Because coastal islands may not adhere to the enduring features which describe Natural Landscapes, a different scoring method was applied. Islands were scored based on three criteria: 1) Habitat (the number of habitat types present)[4]; 2) Development

[1] Developed as part of The Nature Conservancy's NAAP report (2006).

[2] For forest communities, minimum patch sizes were adapted from the *NB Provincial Old Forest Community and Wildlife Definitions* (2005). With the exception of spruce, fir, and spruce fir mix at 375 ha, the largest patch size for each community was used to capture all species that were identified for the community type. Given the small number of contiguous spruce and fir patches 375 ha or greater, the second largest patch size (50 ha) was used.

[3] Based on minimum patch size for Northern Goshawk as reported in *Maintaining the Integrity of Northern Goshawk Nesting and Post-fledging Areas in the Ecosystem Based Management Plan Area of Coastal British Columbia: Guidance for Forest Professionals* (2012).

[4] Habitat types were identified from the Nova Scotia Forest Resource Inventory and included: natural forest stand, grass, brush, wetland, open bog, treed bog, cliff dune, rocky shore, rock barren, barren, beach. If 3 or more habitat types were found on an island, the habitat score was 0.4, otherwise it was 0.

(presents of buildings)[1]; and 3) Colonial bird species presence (within 200 m of the island)[2]. Scores for the three individual criteria are summed for a maximum score of 1.

- **Barrens** - Barrens were scored based on a two tier equation by removing the size component from the 3 tiered equation.
- **Riparian areas** - A score of 0.2 was given to all riparian areas. If a priority habitat patch fell within a riparian area, the score for the overlapping priority habitat patch would increase by 0.2. NAAP critical floodplains were scored 0.4 so that overlapping habitat patches would have an increase in score of 0.4.

Buffer weighting

Tidal marsh and freshwater wetland habitat types were assigned buffers of 275 m. Buffers were assigned the score of their respective habitat occurrence. Where 2 buffers overlapped, priority was given to the higher score, both within the same layer as well as between layers.

Additional Scoring Adjustments

1. NAAP Critial Habitat - All priority habitat polygons that intersect with NAAP critical habitat polygons of the same type were automatically given the maximum score of 1.
2. Important Bird Areas - For all beach and dune, coastal island, tidal marsh, and tidal flat polygons that fell within an Important Bird Area, the score for the polygon was increased by 0.2.
3. Vernal Pools - The score of any forest mosaic polygon that contained a 30 metre (Semlitsch 1998) buffered vernal pool from the Small Patch Ecosystems Layer, was increased by 0.1; a marginal increase given the on-the-ground uncertainty of the vernal pool data.
4. The following data layers were converted to rasters and given additional scores to boost the values of forest patches that overlapped with them. This takes into account the repeated identification of particular forests as having high conservation value for different attributes, thus resulting in a higher final score.

PSOUF - This 2005 layer was created by the DOE and further updated with David Coleville's work on temporal landscape change in SW Nova Scotia. Satellite imagery was used to remove areas from the original PSOUF layer that had been disturbed. The remaining patches represent what was left undisturbed as of late 2012. These patches were given a score of 0.2. If a 30 m buffered vernal pool (described in number 3 above) was found inside a PSOUF patch, a score of 0.3 was given.

Calcareous forest - Identified for its rarity in the bioregion, these patches were queried from the Small Patch Ecosystems layer and given a score of 0.2 and 0.3 if a 30 m buffered vernal pool was found within them.

DNR A list - These patches of high conservation value forests were given a score of 0.2 or 0.3 if a vernal pool was found within them.

DNR old growth forest scores - These patches of suspected old growth forest were scored 0.2 and 0.3 if a vernal pool was found within them.

[1] A buildings point layer was used such that if a building was found on an island, the score was 0, and if no building was found, the development score was 0.3.

[2] If there was a data point from Bird Studies Canada/CWS rare/colonial bird species data within 200 m of an island, the score was 0.3.

MTRI potential Medway old growth forest - These patches of field verified old growth forests were scored 0.2 and 0.3 if a vernal pool was found within them.

If a forest mosaic polygon contained any of the five layers listed above, the scores from these layers were added to the score of the original polygons. For example: A LSTH polygon had an original score of 0.5. A PSOUF polygon with no vernal pool was also found to be within this polygon and a DNR old growth forest score polygon with a vernal pool was also present. The final score of the area of the LSTH that contained these additional two layers would be 0.5 + 0.2 + 0.3 = 1. This ensures that the repeated identification of this area as having a high conservation value for different attributes is considered in the final score.

Priority habitat composite

The resulting priority habitat composite map for the SWNS bioregion can be found in Figure 24, p. 104.

Appendix F. Priority species composites methodology

Priority species occurrence data

As part of collaboration with the Canadian Wildlife Service, the Nature Conservancy of Canada, and other conservation organizations within the Maritimes region, GIS methods were developed to map the likelihood of occurrence of individual priority species within the bioregion using a kernel density estimation based on existing occurrence data. Suites of individual priority species layers were then combined to create the multispecies composite layers. The objective of the species composites was to determine "hotspots" for priority species within the bioregion, thus contributing to the identification of areas of high conservation value.

Multiple sources of species occurrence data were included in the analyses. The collation of data from such a large number of sources represents a new phase in collaboration and data availability, and means that other groups will avoid having to redo work already completed, and that all groups are working with all of the data available. Data used to generate the species composites are provided in Table 19. The priority species composite index was normalized between 0 and 1, 1 being the areas where the likelihood of presence of priority species was highest, based on the methodology of the Kernel analysis.

Table 19. Data layers, sources, and types used to describe priority species spatial distribution within the Southwest Nova Scotia bioregion.

Data layers	Data source	Source data type
Point occurrence records of rare and at risk mammals, reptiles, amphibians, vascular plants, non-vascular plants, lichens, etc.	Atlantic Canada Conservation Data Centre (ACCDC)	Points with a precision of 5 km or less
Relative abundance of breeding bird species detected by point count, the preferred data source for bird species	MBBA[1] point count	Points, counts
Breeding evidence of bird species, consisting of breeding evidence categories within 10 km by 10 km survey squares, used for those species that were not adequately captured through the MBBA point count surveys	MBBA breeding evidence	Polygons (10 km X 10 km survey squares)
Occurrence and abundance of rare and colonial breeding bird species (specifically to map non-waterbird colonies)	MBBA rare/colonial species	Points, counts
Occurrence and abundance of shorebirds (non-breeding migratory flocks)	Atlantic Canada Shorebird Survey database	Points, counts
Occurrence and abundance of colonial waterbirds	Atlantic Region Colonial Waterbird database	Points, counts
Occurrence and abundance of coastal waterfowl (non-breeding and migratory flocks)	Atlantic Canada Coastal Waterfowl Survey database	Polygons (irregular blocks), counts
Occurrence of critical habitat[1] for species listed as threatened or endangered under the *Species at Risk Act*	CWS Atlantic Region Critical Habitat Mapping Database	Polygons (irregular)

[1] Maritime Breeding Bird Atlas II (MBBA)

Atlantic Canada Conservation Data Centre (ACCDC) species occurrence data

The ACCDC dataset contains point data records for a large number of species occurring in Atlantic Canada (mostly Maritimes). The goal of this analysis was to generate species-specific raster layers estimating the likelihood of occurrence. The methods used to prepare these data for inclusion in the final biodiversity composite are described below.

Occurrence points were buffered using a kernel density analysis based on their geographic precision such that points with a low geographic precision were given a large buffer with a low score. This method leads to artificially overweighting areas where two low precision buffers overlap; therefore, a two-layer buffering method was used.

A primary buffer was generated using a kernel density analysis based on the ACCDC precision codes of the point data (Table 20). The precision codes were recalculated so that they ranged from 0 to 0.8. Points with a higher geographic certainty were given a higher rank, recorded as a new field (titled Population; Figure 38). These points were then buffered using a kernel density analysis for each individual species, using a 500 m radius, a 100 m output cell size and the appropriate 'POPULATION' parameter value. This approach attributed higher value to pixels closest to the centroid with more precise observations, and resulted in raster layers for each of the species in the ACCDC database with pixel values ranging from 0 to 0.8.

A secondary buffer was also generated for each individual species. Each point was buffered to 5000 m, and the entire area of the buffer was given a rank of 0.2. These layers were converted into raster layers with a pixel size of 10 m. The primary and secondary buffer rasters were then combined to create a single layer for each species, with values ranging from 0 to 1 based on the likelihood of occurrence of the given species.

Table 20. Precision codes, definitions, spatial context, unit size, and range of values for species occurrence records within the ACCDC 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

[1] Critical habitat is defined in the SARA (S.C. 2002, c.29) as "…the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species" (s. 2(1)).

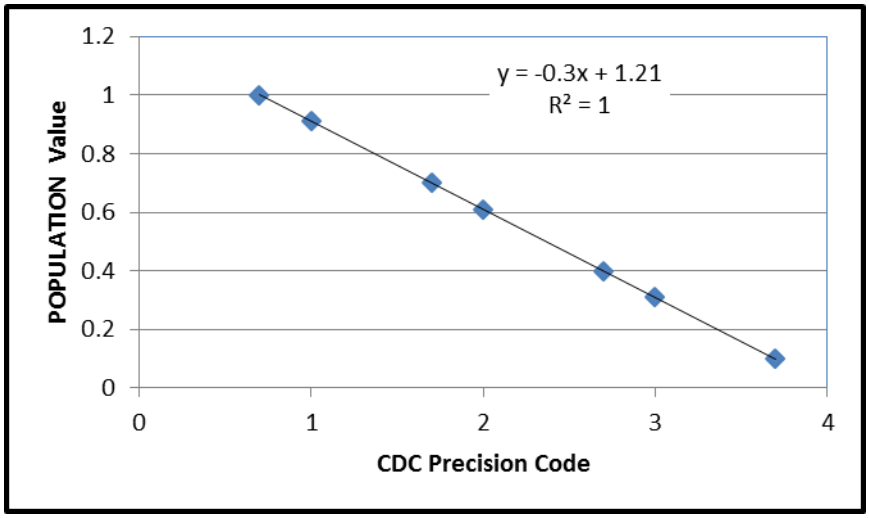

Figure 38. Population values derived for the purpose of informing the kernel density point process using precision code values found within the ACCDC dataset (linear equation can be used to populate a new attribute field with POPULATION value information).

ACCDC data steps

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 19).
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 38). 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'.

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.

Maritimes Breeding Bird Atlas (MBBA) II 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.

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

MBBA point count data steps

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 data steps

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.

Atlantic Region Species at Risk Critical Habitat mapping

Mapping of Critical Habitat for Species at Risk in the Atlantic Region involves 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 has been identified for 13 species in the bioregion. 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.

AR SAR CH mapping data steps

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.

Priority species composites

Individual species raster layers were combined to create multispecies composites. In order to combine rasters from the 3 data sources, all species were 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 normalization as they were previously calculated to be between 0 and 1. The species rasters were then input into the Cell Statistics Tool in Arc GIS 10.1 and a raster sum was calculated to create the multispecies composites. 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. Species composites can also 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.

Priority species composites

See Table 15, p. 106 for a complete list of the priority species composites that were developed with descriptions and data sources, as well as figure numbers and page numbers where the respective priorty species composite map can be found.

Appendix G. Conservation value index methodology

The scores generated through development of the priority habitat composite (see Appendix E) and the priority species composite using the full list of priority species (see Appendix F) were combined to yield a conservation value index for the Southwest Nova Scotia bioregion, presented in Figure 37, p. 120. The goal was to identify areas within the bioregion that are the most critical for the defined priority habitats and species, where conservation efforts should be concentrated.

Combining the data

Once all vector layers (shapefiles) and individual species composites (GRIDS) were prepared, each was converted into raster format using a cell size of 10 m. A small cell size was based on the error of the data layers and was used in order to ensure the resolution of the data would not be generalized. All rasters were then overlaid and added together to give an overall scoring across the bioregion (using the cell statistics tool). Each priority habitat was weighted the same when the final score was calculated. While combining these data sets may present some bias do to the differing methods used in creating the individual species rasters, it can still present a general indication of areas with the highest concentrations of priority species. Table 20 provides the list of all rasters that were combined for prioritization with their respective scoring.

Table 21. List of rasterized layers used in the conservation value index analysis with their respective scoring range.

Prioritization Raster	Scoring Values
Beaches and Dunes	0.15 – 1
Tidal marsh	0.15 – 1
Tidal Flats	0.17- 1
Acadian Forest Mosaic	0.19 – 1
Freshwater wetlands	0.20 – 1
Buffers (tidal marsh and freshwater wetlands)	0.15 – 1
Coastal Islands	0 – 1
Riparian Areas	0.2[1] or 0.4[2]
Barrens	0.18 – 1
PSOUF	0.2 or 0.3
Calcareous Forest	0.2 or 0.3
NS DNR A-List Forests	0.2 or 0.3
NS DNR Old Growth Forest Scores	0.2 or 0.3
MTRI Medway Old Growth Forest	0.2 or 0.3
Species composite	0 – 1

[1] Major Watercourses FCODE 302 Rivers 275 Buffer
[2] NAAP Critical Floodplains

Appendix H. 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 nonhousing 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 siviculture, 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 semidomesticated 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 nonconsumptive 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, sivicultural, 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 ecoystems 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 I. IUCN Conservation Actions Classification

World Conservation Union-Conservation Measures Partnership (IUCN-CMP) classification of conservation actions (version 2.0).

Conservation Actions	Definitions
1. Land/water protection	**Actions to identify, establish or expand parks and other legally protected areas**
1.1 Site/area protection	Establishing or expanding public or private parks, reserves, and other protected areas roughly equivalent to IUCN Categories I-VI (includes marine protected areas)
1.2 Resource & habitat protection	Establishing protection or easements of some specific aspect of the resource on public or private lands outside of IUCN Categories I-VI
2. Land/water management	**Actions directed at conserving or restoring sites, habitats and the wider environment**
2.1 Site/area management	Management of protected areas and other resource lands for conservation
2.2 Invasive/problematic species control	Controlling and/or preventing invasive and/or other problematic plants, animals, and pathogens
2.3 Habitat & natural process restoration	Enhancing degraded or restoring missing habitats and ecosystem functions; dealing with pollution
3. Species management	**Actions directed at managing or restoring species, focused on the species of concern itself**
3.1 Species management	Managing specific plant and animal populations of concern
3.1.1 Harvest management	
3.1.2 Trade management	
3.1.3 Limiting population growth	
3.2 Species recovery	Manipulating, enhancing or restoring specific plant and animal populations, vaccination programs
3.3 Species re-introduction	Re-introducing species to places where they formally occurred or benign introductions
3.3.1 Reintroduction	
3.3.2 Benign introduction	
3.4 Ex-situ conservation	Protecting biodiversity out of its native habitats
3.4.1 Captive breeding/artificial propagation	
3.4.2 Genome resource bank	
4. Education & awareness	**Actions directed at people to improve understanding and skills, and influence behaviour**
4.1 Formal education	Enhancing knowledge and skills of students in a formal degree programme
4.2 Training	Enhancing knowledge, skills and information exchange for practitioners, stakeholders, and other relevant individuals in structured settings outside of degree programmes

Conservation Actions	Definitions
4.3 Awareness & communications	Raising environmental awareness and providing information through various media or through civil disobedience
5. Law & policy	**Actions to develop, change, influence, and help implement formal legislation, regulations, and voluntary standards**
5.1 Legislation	Making, implementing, changing, influencing, or providing input into *formal government sector legislation or policies* at all levels: internation, national, provincial, local, tribal
5.1.1 International level	
5.1.2 National level	
5.1.3 Sub-national level	
5.1.4 Scale unspecified	
5.2 Policies and regulations	Making, implementing, changing, influencing, or providing input into *policies and regulations affecting the implementation of laws* at all levels: internation, national, provincial, local, tribal
5.3 Private sector standards & codes	Setting, implementing, changing, influencing, or providing input into voluntary standards and professional codes that govern private sector practice
5.4 Compliance and enforcement	Monitoring and enforcing compliance with laws, policies and regulations, and standards and codes at all levels
5.4.1 International level	
5.4.2 National level	
5.4.3 Sub-national level	
5.4.4 Scale unspecified	
6. Livelihood, economic & other incentives	**Actions to use economic and other incentivies to influence behaviour**
6.1 Linked enterprises & livelihood alternatives	Developing enterprises that directly depend on the maintenance of natural resources or provide substitute livelihoods as a means of changing behaviours and attitudes
6.2 Substitution	Promoting alternative products and services that subsitute for environmentally damaging ones
6.3 Market forces	Using market mechanisms to change behaviours and attitudes
6.4 Conservation payments	Using direct or indirect payments to change behaviours and attitudes
6.5 Non-monetary values	Using intangible values to change behaviours and attitudes
7. External capacity building	**Actions to build the infrastructure to do better conservation**
7.1 Institutional and civil society development	Creating or providing non-financial support and capacity building for non-profits, government agencies, communities, and for-profits
7.2 Alliance and partnership development	Forming and facilitating partnerships, alliances, and networks of organizations
7.3 Conservation finance	Raising and provinding funds for conservation work