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Habitat Conservation Strategy

Miramichi Watershed



**Report to Environment and Climate Change Canada by the Miramichi River
Environmental Assessment Committee (MREAC) 2018**

EXECUTIVE SUMMARY

This Habitat Conservation Strategy (HCS) was developed through collaboration among the collaborating members of Eastern Habitat Joint Venture (EHJV) and other habitat conservation groups. The Miramichi River Environmental Assessment Committee (MREAC), the Nature Conservancy of Canada (NCC) and the staff of the Canadian Wildlife Service (CWS) in Sackville New Brunswick are the main contributors to the Miramichi HCS. The NCC, “Miramichi Watershed Natural Area Conservation Plan” (2015) is a foundation document for the HCS - Miramichi. Other advisors and contributors are acknowledged. This HCS is part of a series planned to encompass the entire geographic area of New Brunswick.

HCSs are 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 short term and long term direction for these groups, following an ecosystem approach, it is hoped that HCS development will promote partnerships and result in shared outcomes to protect shared ecological values and work to overcome threats. It is understood that each organization will continue to be guided by their own particular mission, vision, and/or guiding principles.

A Shared Approach

HCSs and their bioregional boundaries are based on meaningful ecological units and important watershed boundaries. HCS bioregions are scaled in a way that captures regional conservation context, priorities, threats and conservation actions.

Each HCS presents descriptions of the spatial extent and the ecological significance of the bioregion, the dominant ecological systems found within the bioregion. Each HCS also presents the significance of important habitats for identified species of conservation significance, with a focus on species at risk and other rare taxa, including Bird Conservation Region 14 priority birds (see Priority Species: Appendix 1) . The approach taken in the development of the narrative is not meant to be exhaustive but where possible referencing other work and significant studies.

Habitat prioritization on public lands (Figure 15) is provided by NCC and based on uniqueness and relative ecological significance within the natural area. It also presents a species-based

prioritization, by looking at various assemblages of species. Species-based prioritization relies on relative abundance maps derived from best available occurrence data for each species. The reader is cautioned that best available occurrence data for species remains incomplete with significant variability, as a function of survey timing and survey effort, leading to a notable bias in some related maps. As such, multi-species composite maps and all other maps derived from the individual species maps also are vulnerable to bias. This bias also reflects the reality that contrasting approaches to conservation may be required for the conservation of different species and the habitats that host them (i.e. land acquisition versus stewardship)

Threats to conservation priority habitats and species are determined. Those identified are assessed, and where possible, mapped at the bioregional scale.

Each HCS also presents conservation and stewardship actions that organizations plan to undertake to mitigate identified threats and/or contribute to the conservation of habitats (and the species they host) over the course of a 5-year planning period. These cannot be considered comprehensive. Actions are presented for each partner organization.

In addition to presenting avenues for potential collaboration in the implementation of conservation actions, this analysis may suggest gaps that can be interpreted as potential opportunities for development of new complementary conservation actions. It should be noted that 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, New Brunswick Environmental Trust Fund, and New Brunswick Wildlife Trust Fund) are strongly encouraged to make specific reference to relevant information contained within the appropriate HCS.

No single map can provide decision support that aligns fully with all priorities of all conservation partners. As such, users of this and all other HCSs are encouraged to carefully consider the full suite of maps and information presented to obtain the decision support that is most appropriate to their needs.

Ecological Context

This Miramichi NA (bioregion) encompasses 1,162,100 ha and represents 16% of provincial lands. Five ecoregions range from the extensive Eastern Lowlands and Valley Lowlands that cover 6551.85 sq. km of the NA and 56.38% of the NA respectively to the higher elevations represented in the Highlands Ecoregion, Northern Uplands and Central Uplands Ecoregions with an area of 5068.78 sq. km and 43.62% respectively of the NA. The vast majority of settlement is concentrated in the Eastern Lowland along the Southwest Miramichi River and the main branch Miramichi River. The forest composition of each ecoregion represented in the NA is in part an expression of these unique conditions but still captured in the diverse character of the Acadian Forest.

The New Brunswick Miramichi NA or bioregion has ecological significance primarily because of its size as a large free flowing river system with multiple major tributaries draining a topographically diverse landscape. Abundant wetland complexes and river valleys offer diverse habitat conditions. The NA offers a refuge for twelve species at risk including the Wood turtle (*Glyptemys insculpta*), the freshwater mussel Brook Floater (*Alasmidonta varicosa*), a small dragonfly the Pygmy snaketail (*Ophiogomphus howei*) and in the remote highlands, habitat for the Bicknell's thrush (*Catharus bicknelli*).

Conservation Priority Habitat Types

Seven habitat types are identified as the habitat types containing species of conservation priority in the bioregion:

1. Aquatic
2. Riparian
3. Forested Wetlands
4. Other Wetlands
5. Acadian Forest
6. Open Habitats
7. Disturbed

Different perspectives on species-based prioritizations are presented in the priority species composite maps in various figures which illustrate the distribution of priority species

assemblages derived from best available occurrence data for each species. The reader is cautioned that best available occurrence data for most species remains incomplete. As such, multi-species composite maps and all other maps derived from the individual species maps are vulnerable to bias.

The integration of priority habitat data and priority species information results in a Prioritization Analysis (Figure 15), on public lands excluding industrial lease-hold and industrial free-hold properties (courtesy of NCC). This map was developed to identify sites within the Miramichi NA that have the highest conservation value in terms of priority habitat attributes and priority species, given the available data. To supplement these figures Appendix 1 presents a summary of the priority species.

Goals

The conservation goals that have been identified to guide the development of the Miramichi Natural Area Habitat Conservation Strategy are:

1. Identify areas of importance 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. Protect and support the management of habitat corridors between existing protected areas and other conservation lands through land securement, partnerships, and community outreach.
5. Support the recovery of species at risk through the conservation actions of partner organizations, supported and enhanced by federal and provincial knowledge and guidance 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.

Vision

We envision a resource rich Miramichi Watershed Natural Area that retains many natural values and habitat conditions that are currently intact, highly valued and protected in the face of incompatible future resource extraction and development. Sustainable practices in all sectors be employed and more fully engaged where needed to retain ecological integrity. Ecological well-being of the Miramichi Watershed Natural Area is evidenced by the continued return of diadromous and healthy resident fishes. Tourism, resource extraction and other uses are conducted with the foresight to avoid conflict and minimize ecological harm. Communities and rural residents understand the link between healthy ecosystems, economic prosperity and human well-being, taking pride in the natural heritage of their region. Both aquatic and terrestrial ecosystems are managed and conserved to promote healthy wildlife populations and maintain their full suite of biodiversity for the benefit of future generations.

Threats summary

The following threats were identified and classified using the International Union for Conservation of Nature (IUCN) nomenclature. All have been assessed as either Low or Medium for the Miramichi NA (bioregion).

Residential and Commercial Development

- 1.1 Housing and Urban Areas (Threat: Low)
- 1.2 Commercial and Industrial Areas (Threat: Low)
- 1.3 Tourism and Recreational Areas (Threat: Low)

Agriculture and Aquaculture

- 2.1 Wood and Pulp Plantations (Threat: Medium)

Energy Production and Mining

- 3.1 Oil and Gas Drilling – (Threat: Low)
- 3.2 Mining and Quarrying (Threat: Low)
- 3.3 Renewable energy (Threat: Low)

Transportation and Service Corridors

- 4.1 Roads and Railways (Threat: Medium)
- 4.2 Utility and Service Lines (Threat: Low)

Biological Resource Use

- 5.1 Hunting and Collecting Terrestrial Animals (Threat: Low)
- 5.2 Gathering of Terrestrial Plants (Threat: Low)
- 5.3 Logging and Wood Harvesting: (Threat: Medium)
- 5.4 Fishing and harvesting Aquatic Resources (Threat: Medium)

Human Intrusion and Disturbance

- 6.1 Recreational activities (Threat: Low)
- 6.2 Work and Other Activities (Threat: Low)

Natural Systems Modifications

- 7.1 Fire and Fire Suppression (Threat: Low)
- 7.2 Dams and Water Management /Use (Threat: Low)
- 7.3 Other Ecosystem Modifications (Threat: Low)

Invasive and Other Problematic Species and Genes

- 8.1 Invasive Non-Native/Alien Species (Threat: Medium)
- 8.2 Problematic Native Species (Threat: Low)

Pollution

- 9.1 Household Sewage and Urban Waste Water (Threat: Low)
- 9.2 Agricultural and Forestry Effluents (Threat: Low)
- 9.3 Garbage and Solid Waste: (Threat: Low)
- 9.4 Air-borne Pollutants (Threat: Low)

Climate Change and Severe Weather

10.1 Habitat Shifting and Alteration: (Threat: Low)

10.2 Storms and Flooding: (Threat: Low)

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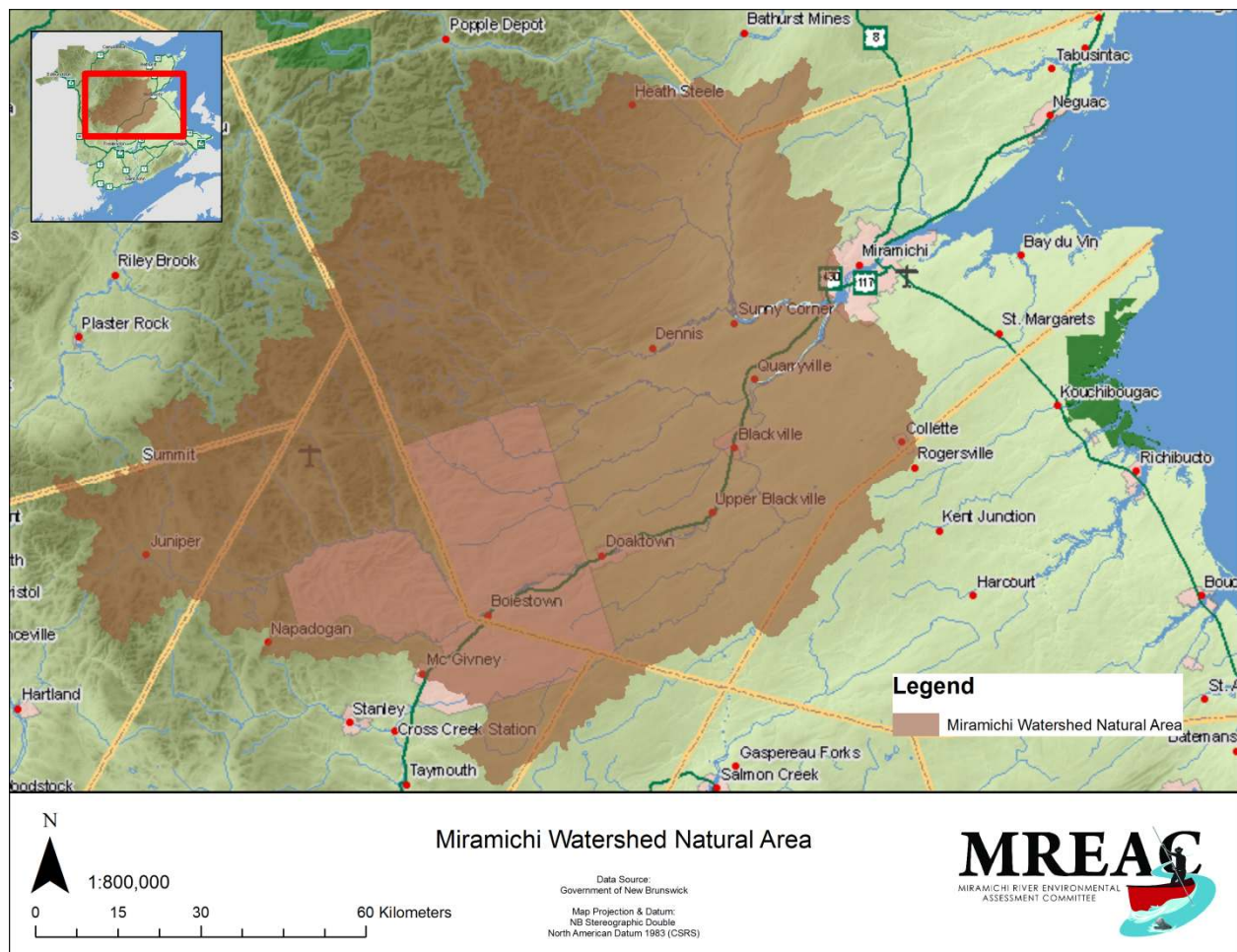
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1.0 CONSERVATION CONTEXT

1.1 Bioregional Scope

The Habitat Conservation Strategy – Miramichi Natural Area (NA) is bounded by the freshwater divide of the Miramichi watershed or basin (Figure 1) hereafter referred to as the Miramichi Natural Area (NA). The Miramichi River Environmental Assessment Committee (MREAC) was contracted to undertake this project. MREAC endorsed the support of several other key conservation and resource use partners in developing this report.

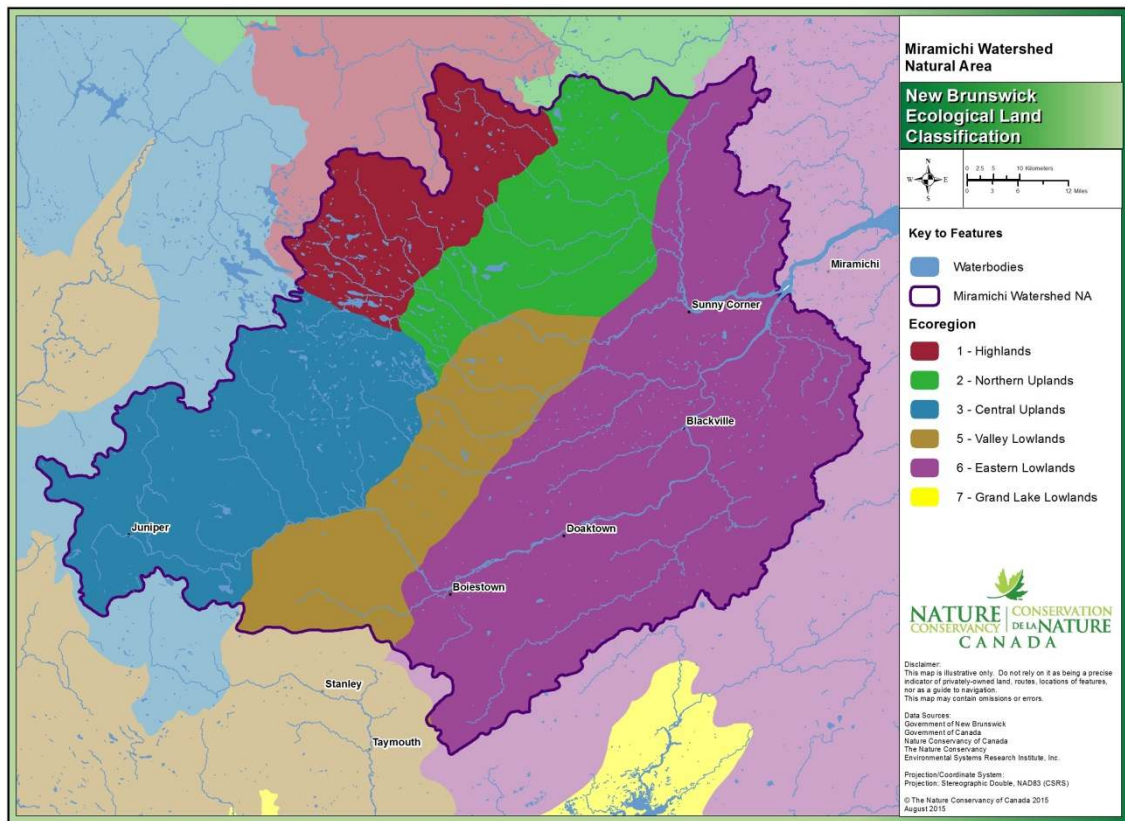
Figure 1: Miramichi Watershed Natural Area



1.2 Location & Size

The Miramichi NA is located in the Atlantic Maritime Ecozone and the Northern Appalachian-Acadian Ecoregion (*Anderson et al. 2006*), broad scale ecological land units. This Miramichi NA (bioregion) encompasses 1,162,100 ha and represents 16% of provincial lands. Five ecoregions range from the extensive Eastern Lowlands and Valley Lowlands that cover 6,551,850 ha and 56.4% of the NA, to the Highlands Ecoregion, Central Uplands and Northern Uplands with an area of 5,068,780 ha and cover 43.6% of the NA (Figure 2).

Figure 2: Miramichi Watershed Natural Area Ecoregions



1.3 Boundary Justification

The Miramichi watershed is the largest watershed entirely contained within the province of New Brunswick (Figure 1). The NA under consideration herein is the freshwater

portion of this watershed, which encompasses 11,621 sq. km and represents 16% of provincial lands.

An adjacent Habitat Conservation strategy for the Northumberland Strait extends from the upper estuary of the Miramichi from the junction of the Southwest Miramichi and Northwest Miramichi, extending eastward and southward to the Northumberland Strait and to the Nova Scotia border respectively.

Five ecoregions are included within the watershed: the Highlands, Northern Uplands, Central Uplands, Valley Lowlands, and Eastern Lowlands (Figure 2). This illustrates the diverse geology and topography represented within the NA. These ecoregions also contribute to the diversity of habitat and the plant and animal life associated with each. While not untrammelled wilderness, the Miramichi NA has the scale and feel of wilderness to most New Brunswickers. The low levels of habitation, paved transportation routes and other infrastructure are concentrated on the Eastern Lowland, leaving the Uplands (Northern and Central) and Highlands virtually unoccupied. This higher ground represents approximately 44% of the Miramichi NA.

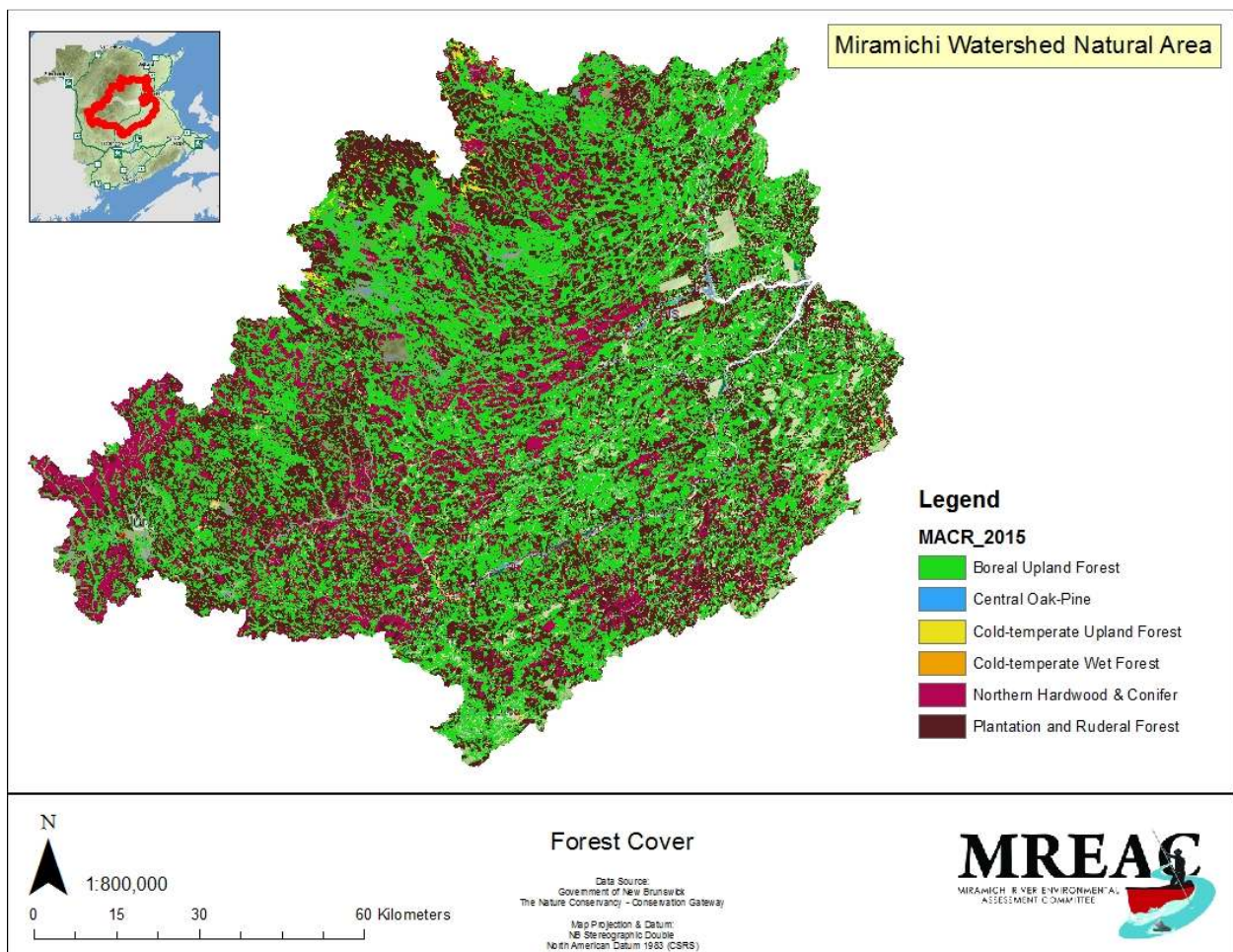
1.4 Ecological Significance

With European arrival to this new world, large white pines had been the first to be harvested as early as the late 1600's. Successional markets resulted in periods of intensive harvests of target tree species almost to the point of exhaustion (McAlpine, Smith 2010). Eastern hemlocks (*Tsuga canadensis*) were harvested for their bark, used in the leather tanning industry. White birch (*Betula papyrifera*) was later depleted for spool wood. Eastern white cedar (*Thuja occidentalis*) was popular for fence post, rails and for other applications that required rot resistant properties. Each of these harvesting campaigns contributed to dramatic changes to what was the original tree assemblage of the Acadian Forest. Modern industrial scale forestry, using clear cut methods, has been the practice for many decades now. Forests are intensively harvested with relatively short term rotational practices, targeting Balsam fir (*Abies balsamea*) and Spruce species (*Picea glauca*, *Picea mariana*, and *Picea rubens*). Large plantations of these preferred species, especially Balsam fir, are now a significant part of the NA landscape.

Just as the abundant Atlantic salmon historically supplied the Mi'kmaq communities, they were also available to and consumed by the Europeans. Salmon abundance went into steep decline once the Salmon life cycle was better understood, resulting in a major commercial fishery off Greenland on important salmon feeding grounds. On the Miramichi, the lure of this spectacular fighting fish became the pursuit of recreational fisherman. In time the Miramichi became world renowned for the thrill of catching this prize fighting fish on a rod, reel, and fly. This opportunity cultivated a worldwide clientele. The Atlantic Salmon Museum in Doaktown celebrates this legacy and the importance of this fish in bringing settlement and wealth to the Miramichi.

Lumber and Atlantic salmon were a mainstay in the historic development of the Miramichi NA and remain such until today.

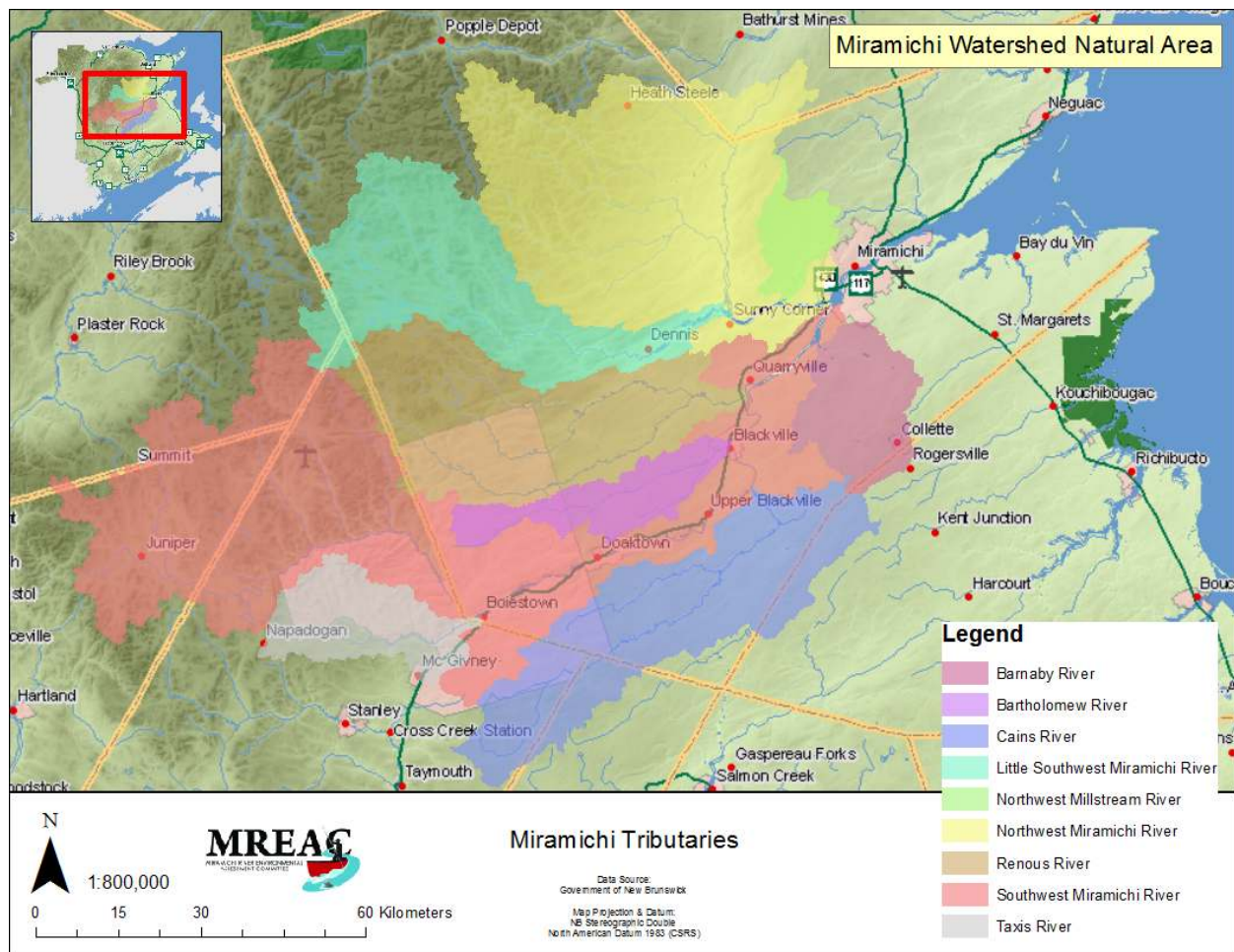
Figure 3: Forest Cover



2.0 ECOLOGICAL CONTEXT

The Miramichi Natural Area (NA) contains much significant habitat. The Miramichi watershed, or drainage basin, has been determined as the boundary. This is both logical and practical as the focus will target on habitat conservation within the nine major tributaries of the Miramichi these being the Barnaby River, Bartholomew River, Cains River, Little Southwest Miramichi River, Northwest Millstream, Northwest Miramichi River, Renous River, Southwest Miramichi River and Taxis River (Figure 4). This makes even greater sense with three of the priority habitats; aquatic, riparian and wetlands, all directly related to this boundary choice.

Figure 4: Miramichi Watershed Natural Area Tributaries



2.1 Dominant Ecological Processes

Climate conditions and hydrology of the NA are described by Daniel Caissie and N. El-Jabi (1994) and show a marine-influenced continental climate influenced by westerly flow but moderated by the surrounding marine waters of the Northumberland Strait, Bay of Fundy and Atlantic Ocean. Annual precipitation averages 1130 mm with a relatively even distribution of precipitation (rain or snow) throughout the year. The coldest month is January with a mean monthly temperature of -11.8° C and the warmest is July with a mean monthly temperature of 18.8° C. Sixty-three percent of the total rainfall is discharged as surface water leaving 37% for uptake in vegetation or going to groundwater.

Land use impacts are relatively uncomplicated in this NA, albeit profound. This is due to the large geographical area and the relatively low human population (~12,000) in the NA which averages approximately 1.0 person per sq. km, well below the national average population of 3.9 persons/km² (Statistics Canada 2016).

2.2 Species at Risk and Introduced Species

The Miramichi is a refuge for several species-at-risk, in part due to the many intact natural values that it maintains. Wood turtles (*Glyptemys insculpta*), listed as a threatened species (COSEWIC), have critical habitat located within the watershed. Rare freshwater mussel species find refuge in Miramichi waterways. The Brook floater mussel (*Alasmidonta varicosa*), a species listed “threatened” (COSEWIC), has a footing in the watershed on select rivers, all located within the Eastern Lowlands ecoregion. Eastern pearlshell (*Margaritifera margaritifera*) is widespread throughout the NA despite being “endangered” globally (IUCN 1996). This is no doubt due in part to the currently sustained populations of its host fish species, the Atlantic salmon (*Salmo solar*).

Appendix A provides a list of priority species, identifying twenty-three species at risk (COSEWIC) within the NA. Of these, six are of “special concern”, twelve are “threatened” and five “endangered”.

Introduced species are a threat to habitat to the Miramichi NA. More recently (~2008) Smallmouth bass (*Micropterus dolomieu*) were purposely introduced into Miramichi Lake, headwaters of the Southwest Miramichi. Since that time significant efforts have been implemented to eliminate this fish or, barring that, contain them in the lake to prevent their spread throughout the Miramichi waterways. The introduction of Chain pickerel (*Esox niger*) to Depres Lake in ~2000 was dealt with in 2001 through the use of the chemical Rotenone. Other well established introduced species are widespread throughout the NA but none seem to pose an immediate threat to priority habitats.

The Southern Gulf of St Lawrence population of Striped bass (*Morone saxatilis*) has exploded over recent years. With their spawning fidelity to the Miramichi estuary there is a perceived threat to Atlantic salmon, especially at the smolt stage when the juvenile salmon are making their way toward the open ocean. Due to the controversy over this issue, considerable effort in fisheries science is underway to determine this level of risk. Despite their recent resurgence, this Northumberland Strait stock of Striped bass is still listed as a species of “special concern” (COSEWIC, 2012).

The Miramichi NA, as is true throughout the province, has lost bird habitat and bird abundance. Some species dependent on mature to old forest stands have experienced declines which may be linked to the intensive forest harvesting regime that limits habitat. With only 4.4% of the NA having protected area status, this provides very limited habitat to allow for what might be deemed natural population levels. Appendix A provides a list of bird species with national and international ranking. This in large part is due to both loss of habitat and mortality outside of the Miramichi NA, within the natural ranges of these species.

Appendix A also identifies sixty-two priority bird species, thirteen of these listed by COSEWIC as either of special concern or threatened. As would be expected, these have diverse habitat requirements, each species finding these within the Miramichi NA. Of special note, Bicknell’s thrush (*Catharus bicknelli*) is believed to retain non-breeding habitat in the eastern lowlands and northern uplands (IUCN 1996).

3.0 CONSERVATION GOALS

The following conservation goals are identified to guide the development of a Miramichi Habitat Conservation Strategy.

- a. Identify Miramichi NAs of importance for the conservation of priority habitats and species.
- b. Establish, support, and enhance conservation partnerships to facilitate decision-making and focus collective conservation efforts.
- c. Maintain healthy, intact, and fully-functioning ecosystems by building on existing conservation work by the partnership and informing efforts to acquire land for conservation.
- d. Support the recovery of species at risk through the conservation actions of partner organizations, supported and enhanced by federal and provincial knowledge and guidance on species at risk.
- e. Engage community support and promote understanding of biodiversity issues, values, and inform local stewardship initiatives.

4.0 PRIORITY SPECIES

Priority species are defined as any species with a federal assessment (COSEWIC) of Special Concern, Threatened or Endangered (including all species on Schedule 1 of the SARA), any species at risk on the provincial listing of Venerable, Threatened, or Endangered, any rare 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), or any BCR14 priority bird species that occurs with regularity in the bioregion.

Figure 5 provides bird species at risk. Other non-bird priority species are provided in Appendix A. Twelve birds at risk are identified along with eight non-bird species for a total of twenty-one species. A further detailed discussion of some classes of resident animals follows:

4.1 Fishes:

The Miramichi River and her tributaries are globally renowned for recreational fishing. A sizable industry has been created around this activity with a network of lodges and

camps situated throughout the NA for resident and non-resident owners. The main target for recreational fishers is the anadromous Atlantic salmon (*Salmo salar*) due to its spectacular fighting nature. Brook trout (*Salvelinus fontinalis*) are another popular target species.

Atlantic salmon share the Miramichi with many other freshwater species including other catadromous species (i.e. American eel) and other anadromous species (i.e. Alewife {*Alosa pseudoharengus*} Rainbow smelt {*Osmerus mordax*}).

Steady declines of Atlantic salmon that return to spawn on the Miramichi over recent decades raise concern about the long term stability of this population. Overfishing at sea, predation and a warming climate are all deemed to be contributing to this decline. Active management measures are in place to support the freshwater salmon stocks and monitor at-sea movements of the migrating adults. Climate warming is problematic to Miramichi salmonids that have a distinct cold water preference. Active monitoring of water temperatures demonstrate that summer temperatures reach levels that threaten survivability of salmonids.

Concern over the conditions of Atlantic salmon habitat prompted the Catamaran Brook habitat Research Project in 1990 (Cunjak 1996). This 15 year (1990 to 2005) research project was designed to address questions related to the impact New Brunswick forestry practices are having on aquatic habitat, especially habitat for the Atlantic Salmon. On a near pristine sub-watershed of 5000 ha the study was divided into three five year segment of pre-logging, logging and post logging assessments. Throughout the project term much collaboration and related science was undertaken, totaling over 100 research projects. The research has continued, now for over 25 years, and is managed by the Canadian Rivers Institute. Key to the success of this project was the cooperation of REPAP (now Fornebu Lumber), who manage the lease-hold crown lands that include the Catamaran Brook drainage basin.

Introduced fish species, whether purposeful or accidental, are a major concern and a potential threat to the indigenous species. Recent purposeful introductions of Chain

pickerel (*Esox niger*) and Smallmouth bass (*Micropterus dolomieu*) are noted and efforts to eradicate these species are having different levels of success.

No major dams limit fish passage in the NA. Thousands of culverts throughout the NA are generally felt to be well installed and present little to no barrier to fish passage (Pers. comm. Hollie LaBadie)

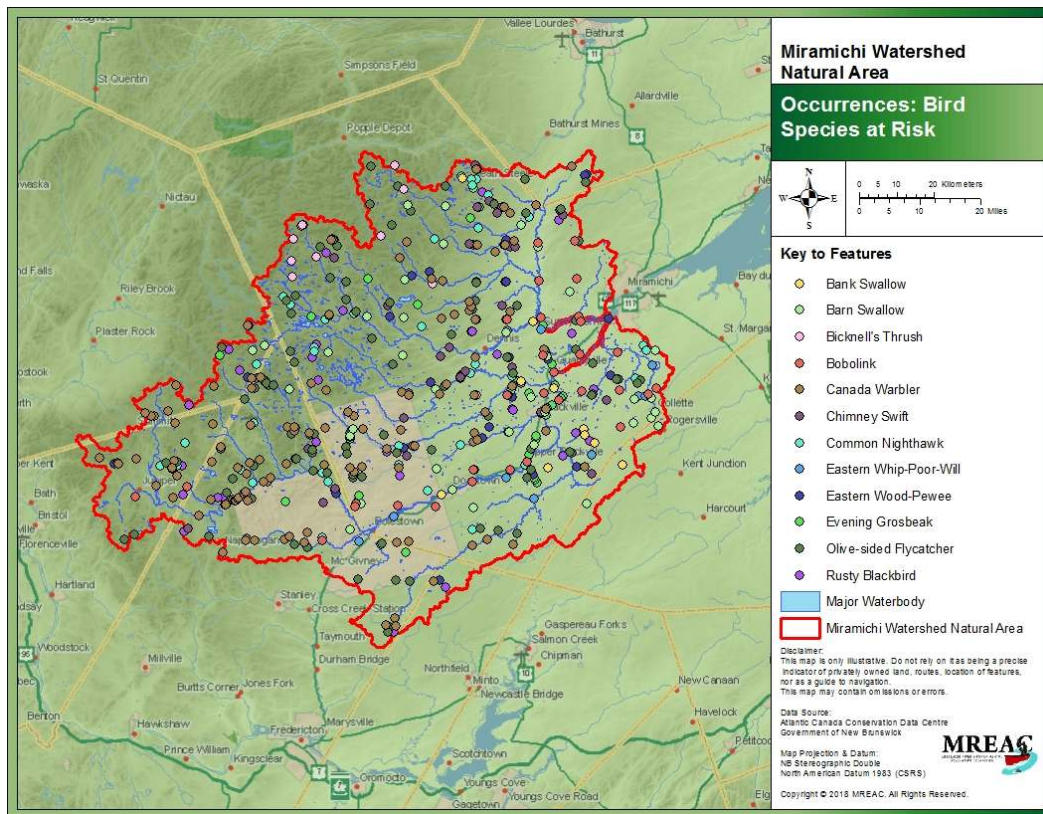
4.2 Birds

Sixty two birds make the priority list (Appendix A) in the Bird Conservation Region 14 New Brunswick (BCR 14 NB). This strategy, one developed for each bird conservation region across Canada, is designed to serve as a framework for implementing bird conservation for the region's priority bird species (Environment Canada 2013). 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. 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.

The following is an excerpt from Environment Canada (2013) "In BCR 14 NB, the only threats given a very high rank were threats due to the loss or fragmentation of coniferous and deciduous forests as a result of logging activities (5.3 Logging & wood harvesting). These threats were ranked high in mixed wood forests, riparian forests and forested wetlands. For instance, the loss or fragmentation of cedar swamps because of logging activities ranked as a high threat to Canada Warbler. The most frequently identified threats were decreases in diet quality, in the health of birds, or in prey availability due to the contamination of food sources from biocides such as pesticides, herbicides or fungicides used by the forestry or agricultural industries...".

Twelve bird species at risk (COSEWIC) in New Brunswick are shown in Figure 5. These twelve may not remain faithful to the NA boundary, either as resident or visitors, on any given year but have been recorded within the NA.

Figure 5: Bird Species at Risk



4.3 Reptiles

One reptile, the Wood turtle (*Glyptemys insculpta*) makes the Priority Species list for the Miramichi NA. Wood turtles are a “threatened” species (COSEWIC 2010) in their North American range. It is resident in the Miramichi NA principally on the Eastern Lowlands Ecoregion and Valley Lowlands Ecoregion. The data related to Wood turtle abundance and locations is guarded to avoid the threat of pet or food collection. The Miramichi NA is one of the remaining areas where considerable populations of Wood turtle appear to have stable and secure habitat conditions.

Snapping turtles (*Chelydra serpentina*) are also resident, albeit rare encounters, in the NA. No accurate population or range data is available. This turtle has not up until now been recognized as resident in the NA but one confirmed record was made near Metepenagiag (Red Bank) in 2016 (Pers. comm. Nelson Cloud). This turtle is of “special

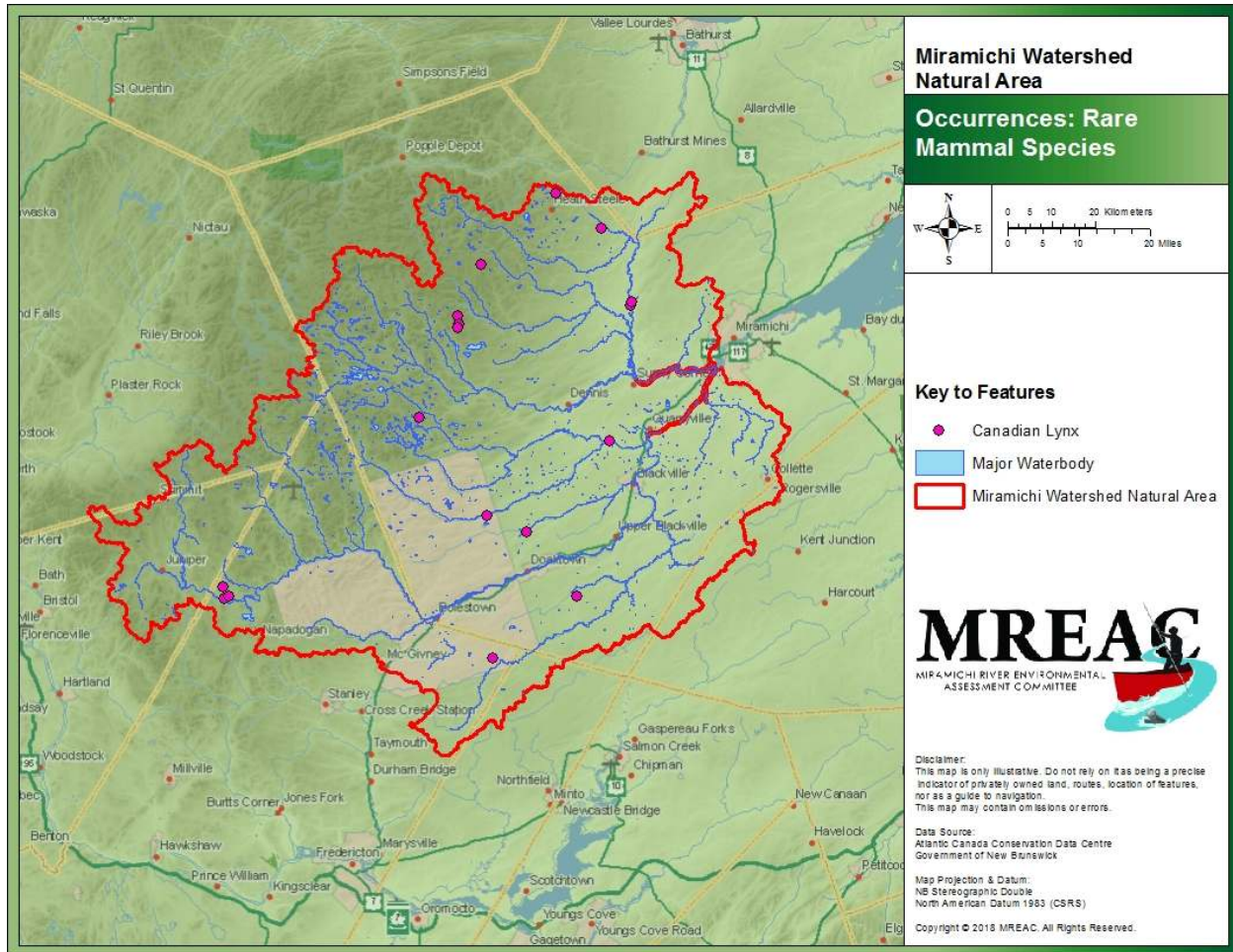
concern” (COSEWIC 2008). This turtle is also confirmed to be resident in the adjoining Northumberland Strait Habitat Conservation Strategy Natural Area.

None of the indigenous snakes in the NA are noted as a species at risk or considered a priority species, possibly based on limited data availability.

4.4 Mammals

Eight priority species are noted among mammals within the NA. The largest and best documented is the Canada Lynx (*Lynx canadensis*) (Figure 6). The remaining seven species (Appendix A) fall among the insectivores and rodents. Little is known about their biology and it is observed (Forbes et al 2010) that although species may be rare they may not be threatened. The status of the three bat species (*Myotis lucifugus*, *Myotis septentrionalis* and *Perimyotis subflavus*) is “endangered” with COSEWIC and likewise with the province.

Figure 6 - Rare Mammal Species



4.5 Mollusks:

The Brook Floater (*Alasmodonta varicosa*) is the only priority species noted among the mollusks. Concerted searches over several years have shown them to be resident on the Barnaby River, Southwest Miramichi River, and Taxis River. While not a priority species within the NA due to its wide range and abundance, the Eastern pearlshell (*Margaritifera margaritifera*) is globally rare and its status on the Miramichi NA is to be celebrated.

5.0 PROTECTED AREAS

An assessment of the protected lands in the Miramichi Natural areas shows that only 4.4% of the landscape is under significant protection against habitat degradation (Figure 7). This is in keeping with the current status of protected lands in New Brunswick at 4.5%. These designated lands meet the level of protection defined by the International Union for Conservation of Nature wherein a protected area is “a clearly defined geographical space, recognized and managed, through legal and other effective means to achieve the long term conservation of nature with associated ecosystem services and cultural values” (Duby 2008).

New Brunswick is well behind national and international targets for protected lands, illustrated in that by the year 2020, 17% of terrestrial area is to be in protected lands status (Environment and Climate Change Canada 2017). Due to the scale of the watershed one would hope to see movement toward significant additions to protected areas, representing the diversity of the landscapes. Table 1 supplements the protected area map (Figure 7), featuring those areas with meaningful habitat protection within the NA.

The Kennedy Lakes Protected Natural Area is by far the largest of the provincially protected lands in the NA with over 22,000 ha. The Nature Conservancy of Canada protects a property within the NA on the Bartholomew River, a property of 852 ha. Nature Trust of New Brunswick has a property of 48 ha on the Northwest Miramichi.

Figure 7: Protected Areas and Conservation Lands

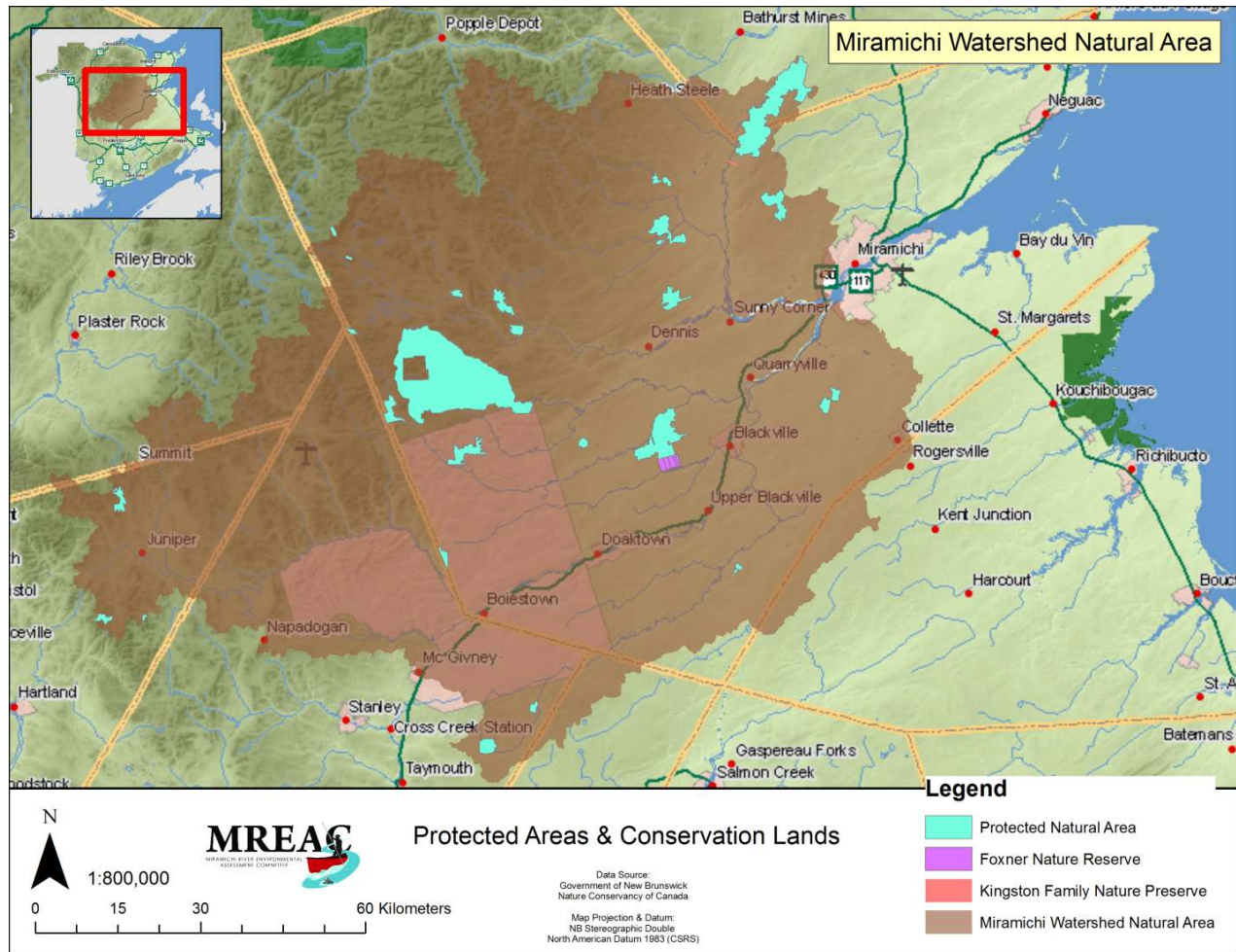


Table 1 - Protected Areas & Conservation Lands

Name (Agency/Organization)	Area (ha)	% of Bioregion
Protected Natural Areas (Department of Energy and Resource Development)		
Dungarvon Whooper Spring Woodlot	4,086.15	0.35
Cains River	206.45	0.02
Kennedy Lakes	22,629.83	1.95
Patchell Brook	255.66	0.02
Gover Mountain	62.63	0.01
Big Rocky Brook	233.83	0.02
Shinnickburn	149.01	0.01
Big Bald Mountain	24.64	< 0.01
Stony Brook	365.21	0.03
Semiwagan Meadows	723.82	0.06
Welch Brook	550.68	0.05
Little Southwest Miramichi River	391.17	0.03
Bellefond	1,281.38	0.11
North Pole Stream	225.50	0.02
Upper Dungarvon River	840.09	0.07
Tuadook River	131.23	0.01
Bantalor	728.41	0.06
South Branch Big Sevogle River	1,482.42	0.13
Lower North Branch Little SW Miramichi River	820.62	0.07
Howard Brook	681.48	0.06
McCluskey Brook	613.26	0.05
Golden Ridge	393.34	0.03
Dungarvon	1,372.52	0.12
McNeal Brook	1,034.28	0.09
East Branch Portage River	10,896.74	0.94
Spud Brook	293.79	0.03
Land Conservation		
Foxner Nature Reserve (Nature Conservancy of Canada)	852.38	0.07
Kingston Family Nature Preserve (Nature Trust of New Brunswick)	48.30	< 0.01
Total Conservation Lands in Bioregion	51,374.80	4.41

6.0 SOCIAL AND ECONOMIC CONSIDERATIONS

“Miramichi” was derived from the Montagnais words “Maissimeu Assi” (meaning Mi’kmaq Land). The Miramichi Natural Area (NA) lands supported traditional, and now support current, settlements and grounds of the Mi’kmaq First Nation. Mi’kmaq settlements were selected adjacent to Mi’kmaq river travel routes, inland from the exposed coastline and in the shelter of the Acadian Forest but still on tidal influenced waters. Metepenagiag (Red Bank) is situated at the head of tide on the Little Southwest Miramichi as the oldest continuously occupied community in New Brunswick and celebrated as “the village of 30 centuries” at the

Metepenagiag Heritage Park. Metepenagiag and Eel Ground are the two indigenous communities within the Miramichi NA.

A landmark event in the history of New Brunswick was the expulsion of the Acadian population of settlers beginning in 1755. Most Acadian settlers were concentrated as farmers on more productive coastal lands and so had no known settlement in the Miramichi NA. However, as many families and individuals escaped the expulsion and ‘took to the woods’ the NA undoubtedly became a refuge for some. Other European arrivals likewise resulted in minimal settlement within the NA, but in the late 1700’s, rich timber resources from the Acadian Forest became a valued commodity to be shipped to European markets, especially England. Log drives, lumberjacks and life at the lumber camps are the stuff of folklore and legend in much of Eastern Canada. Forests in eastern Canada, including the Miramichi, were being opened to lumbering activity. The Woodmen's Museum in Boiestown celebrates this legacy.

The industrial scale forestry operations of today, typically using clear cutting methods, far exceed any other land use activity and have the biggest impact on terrestrial habitat and significant impact on aquatic habitat. With the limited amount of protected lands (4.4% of the NA), most of the remaining lands are intensively managed either as lease-hold properties by industrial forestry operations or large industrial free-hold forest tracts. A significant amount of these forest lands have been converted to forest plantation further removing these from natural habitat conditions. Many small woodlot owners also contribute to the wood harvest budget within the NA. The Department of Energy and Resource Development have jurisdiction over these forested lands under A Strategy for Crown Lands Forest Management (2014). Two large forest industry companies (JDI Inc. and Fornebu Lumber Inc.) hold the major crown land leases within the NA.

Transportation corridors and recreational activities focused on the many Miramichi tributaries also come into play, concentrated, as noted, in the Eastern Lowlands. Also, the density of woods roads in New Brunswick is very high (Figure 11). Much of this is a result of the intensity of forest harvesting and the associated woods roads built by this industry sector.

Mining has had significantly negative impacts on the headwater streams of the Northwest Miramichi River in past decades, but is currently minimal. A large base-metal mining operation and smelter (Heath Steele Mine) had dire effects on smaller receiving streams downstream of their operations due to acid-mine drainage and high concentrations of metals (i.e. Zn and Cu) (Noland, Davis & Associates. 1990). Site closure (2000), remediation, and subsequent decommissioning of the mine, smelter and other infrastructure have resulted in the recovery of habitat for salmonids and benthic taxa. Treatment of the drainage from the mine site is ongoing and expected to continue in perpetuity. The potential threat for a future uncontrolled spill from Heath Steele seems significantly reduced considering the remediation efforts of returning much of the acid generating rock underground and the ongoing controls in place.

A base metal mine at Half Mile Lake in the Northwest Miramichi headwaters is currently closed but future mine exploration and commodity prices may align to renew this mine and other mine sites in this vicinity. Future mines are required to meet much more rigorous environmental protection standards than those previously required.

The controversial shale gas exploration and extraction sector does not appear to be on the immediate horizon, although shale gas resources are expected to be found in the NA. Peat harvesting has some potential but again there seem to be no immediate plans for expanding this industry sector in the NA. A potential pipe-line development for oil transport (Energy East Pipeline) crossing the headwaters of the Southwest Miramichi is worth tracking, with impact monitoring being put in place if ever realized.

Relatively little impact in way of agriculture is currently noted based on the small land base it occupies within the Miramichi watershed. No large scale traditional farming, industrial or family, occurs within the NA. A large scale cranberry growing operation has been established in the headwaters of the Barnaby and Cains river sub-watersheds with expansion plans that may be realized in future years. Considerable potential is also recognized in blueberry production. One large grower has a 227 hectare operation on the Renous watershed and some larger scale developments are currently underway.

Ice jams, the spring freshets and high level rainfall events can be and have been a significant factor in impacting habitat conditions along waterways and flood plains. Ice scouring in the spring can have dramatic impacts throughout the flood plain, including damage to human infrastructure. Recent events, including those in mid-summer (e.g. post tropical storm Arthur, 2010) have demonstrated the strength of such events with a river level rise of 2.2 meters at Doaktown within a 38 hour period.

The Miramichi watershed does not have the significant issues and complications of water level controls due to impoundments by dams. No dams exist on any major tributary and relatively few exist on smaller waterways. Thousands of culverts are widely dispersed throughout the NA and are principally the property of the province (Department of Transportation and Infrastructure) or forestry companies. No inventory is available to indicate the number of these that may impair fish passage but these are not felt to be a significant limiting factor to fish passage.

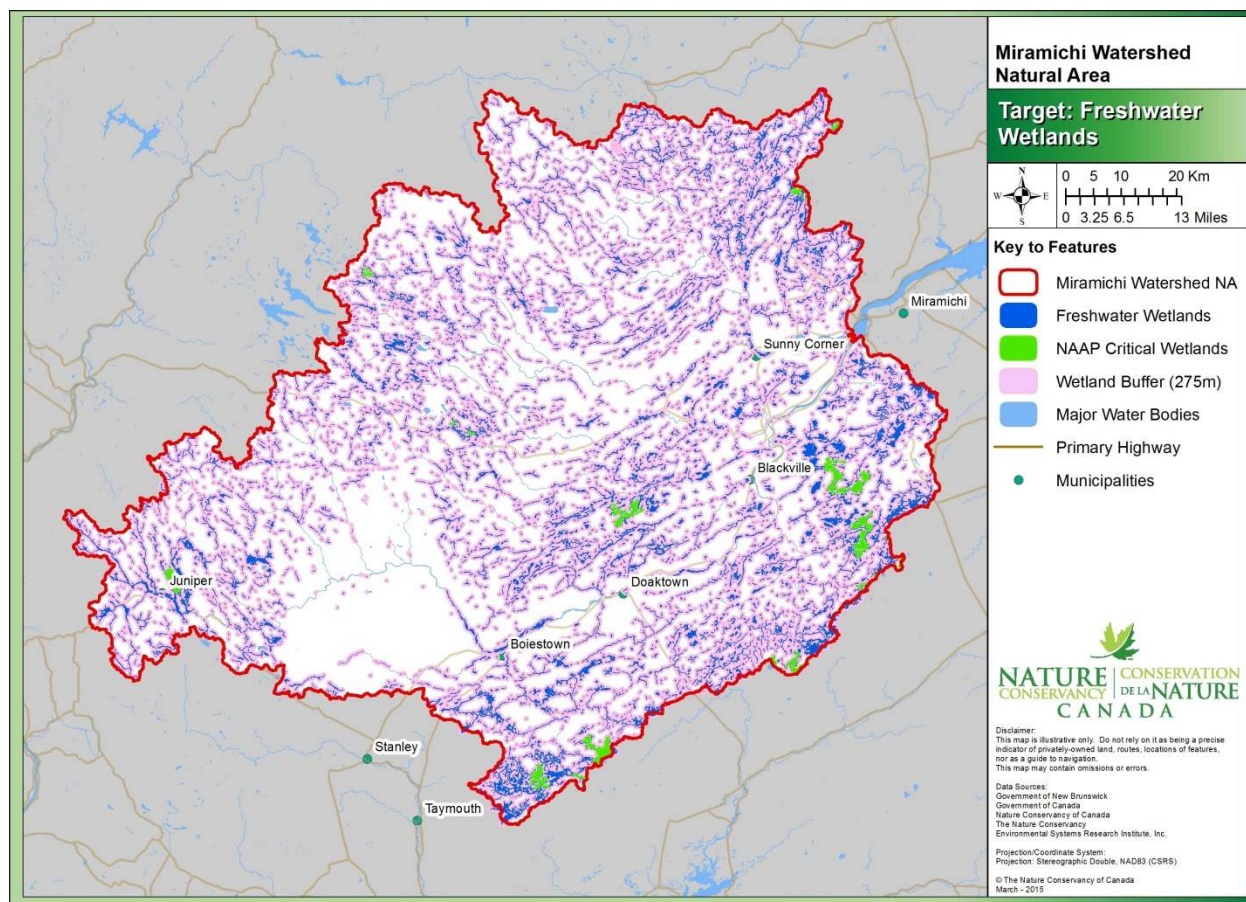
Low water conditions and associated high water temperatures in the summer months have caused concern for the health of salmonids (i.e. Atlantic salmon and Brook trout) as cold water fishes. These conditions test their thresholds of temperature tolerance (Caissie, 2006). The impacts on lesser known fish and invertebrates during warm-water events are not obvious and poorly understood. These higher water temperature events impact habitats beyond the Miramichi NA, into the Miramichi estuary, and the Northumberland Strait. Adjoining watersheds of course are impacted by the same climate change effects.

7.0 CONSERVATION PRIORITY HABITAT TYPES

Six priority habitat types, between them containing all species of conservation priority in the Miramichi NA, were identified (Table 2)

Table 2 Priority Habitats	Sub-categories
Aquatic	open water, lakes, ponds, rivers
Riparian	floodplain, rivershore, lakeshore
Forested wetlands	cedar swamps, other forested wetlands
Other wetlands	bogs, fens, beaver ponds, marshes,
Acadian forest	coniferous, mature hardwood, mixed mature, young mixed
Open habitats	rocky outcrops, ledges, talus, upland barrens, fields & meadows
Disturbed	roadside, burns, clearings, clearcuts

Figure 8: Freshwater Wetlands



8.1 Habitat Threat Assessment

The threat nomenclature and numeration strategy that follows is taken from the IUCN classification of Level 1 and 2 Direct Threat Classes (IUCN_CMP 2006a)

1. Residential and Commercial Development

1.1 Housing and Urban Areas (Threat: Low) Small villages and ribbon rural residences along the major transportation routes suggest the “low” threat status here. A low-density population within the NA is getting even lower as out migration is the current trend with no projections that this will change in the foreseeable future. No significant threat to priority habitat is anticipated.

1.2 Commercial and Industrial Areas (Threat: Low) One large lumber mill (J D Irving Doaktown Sawmill) is situated in the heart of this NA in Doaktown. This modern facility has no direct discharge (i.e. operates as a closed loop) to the Southwest Miramichi River and normally operates within the provincial limits of air quality discharges. JD Irving also operates a large-scale tree nursery in the Juniper area. Impacts (threats) from this operation are minimal. No other developments have generated long-standing concern to communities or officials. Occasional occurrence reports are handled by provincial Department of Environment and Local Government Staff. No significant threat to priority habitat is anticipated.

1.3 Tourism and Recreational Areas (Threat: Low) The low level of tourism traffic on the Miramichi in itself dictates a “low” level threat to the ecosystems that tourist and visitors might frequent. The “drive through” sight seers offer no threat on the few main thoroughfares. As an internationally renowned river for Atlantic salmon angling, Miramichi sport fishers are commonly destined for one of the many lodges and outfitting operations and their impact mitigated by this structured visit in this well established tourism sector. Resident recreational fishing by locals is less structured and may have negative impacts on river and shorelines through the use of off-road vehicles, creating erosion problems and destruction of riverine habitat. Again, the

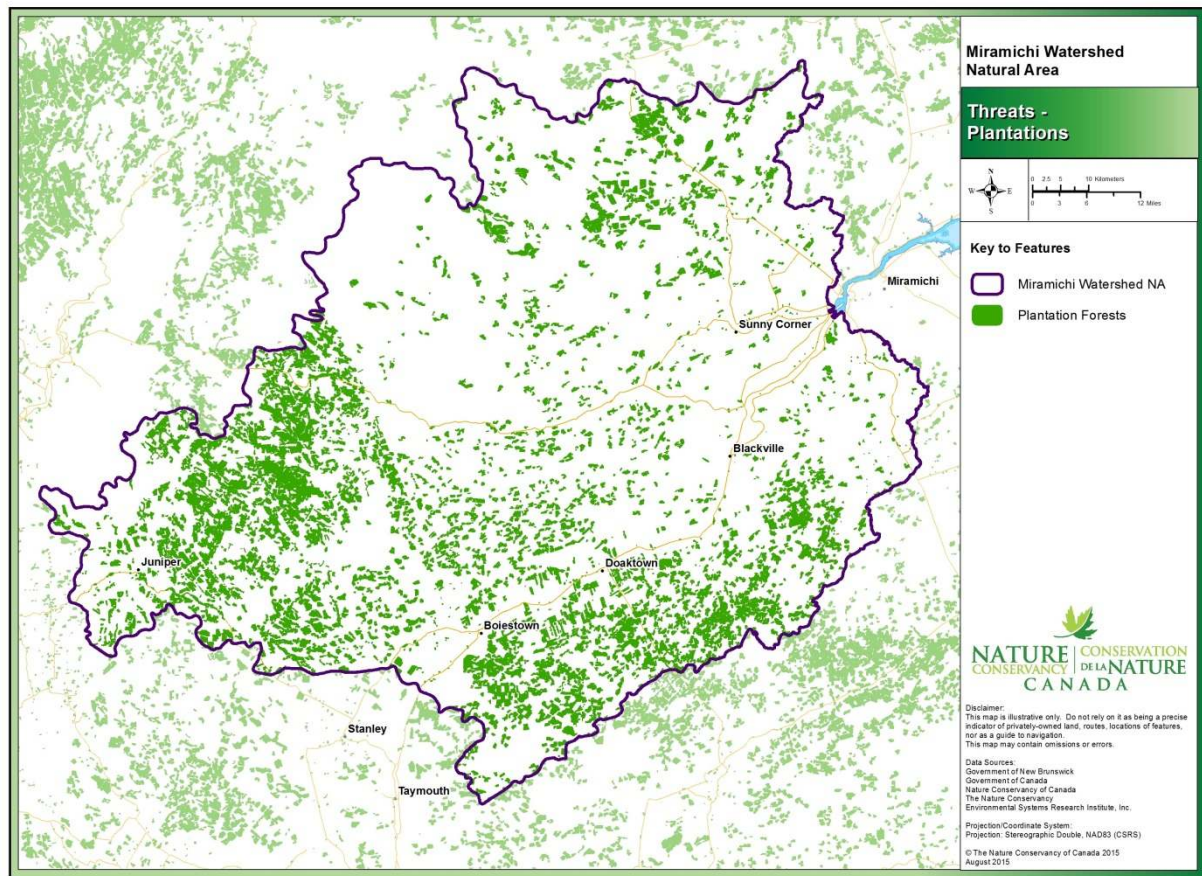
numbers are poorly known but understood to be low enough to be dismissed as having a significant negative impact. Watercraft, principally canoes or kayaks, are common but not abundant and, again, relative to the size of area, have impacts that are minimal.

River tubing, currently concentrated on the Little Southwest Miramichi, has impacted a reach of 6 kms. The impacts related to litter and water quality is mitigated in part by the clean-up offered by the operators as well as johnny-on-the-spots. The operators also provide guidelines (i.e. a code of conduct) for users that seem to have reasonable compliance. Other operators of tubing runs are now found on the Southwest Miramichi. A final recreational sector worthy of mention is snowmobilers, those engaged in the “white gold rush”. The numbers are poorly documented but with the protection of snow and ice cover, the impacts are believed to be minimal. Little threat to priority habitat is anticipated through tourism and recreational activities.

2. Agriculture and Aquaculture

2.1 Wood and Pulp Plantations (Threat: Medium) The methods of forest management within the industrial sector include extensive clear-cutting of forest stands with follow-up replanting of single species softwood trees (plantations) to produce a future supply of wood fiber (Figure 9). This practice removes the forest stand away from the diversity and structure that was the “Acadian Forest”. It further makes the forest lands more susceptible to disease and infestation of insects (e.g. Spruce budworm).

Figure 9: Threats - Plantations



3. Energy Production and Mining

3.1 Oil and Gas Drilling – (Threat: Low) The interest in identifying and extracting shale gas resources in New Brunswick became very controversial in 2012, and the provincial government put an indefinite moratorium on this sector. The Miramichi NA is believed to have significant potential for shale gas production and the communities remain divided over the perceived ecological threats from this natural resource sector. No significant advancement in this development is anticipated over the foreseeable future both for reasons of this controversy and depressed market prices. This is not to say however that this issue could not arise within the foreseeable future. No other potential for the oil and gas sector is anticipated in this NA.

3.2 Mining and Quarrying (Threat: Low) The Miramichi NA has a considerable history in base metal mining and some in rock quarrying (Figure 10). The headwaters of the Northwest Miramichi have been a focal area for the mining sector and active mines from this area are now depleted or in shut-down. Half Mile Lake Mine has been closed but remaining ore deposits may result in future activity there and elsewhere in this NA. Currently this sector is very low key but the potential being explored.

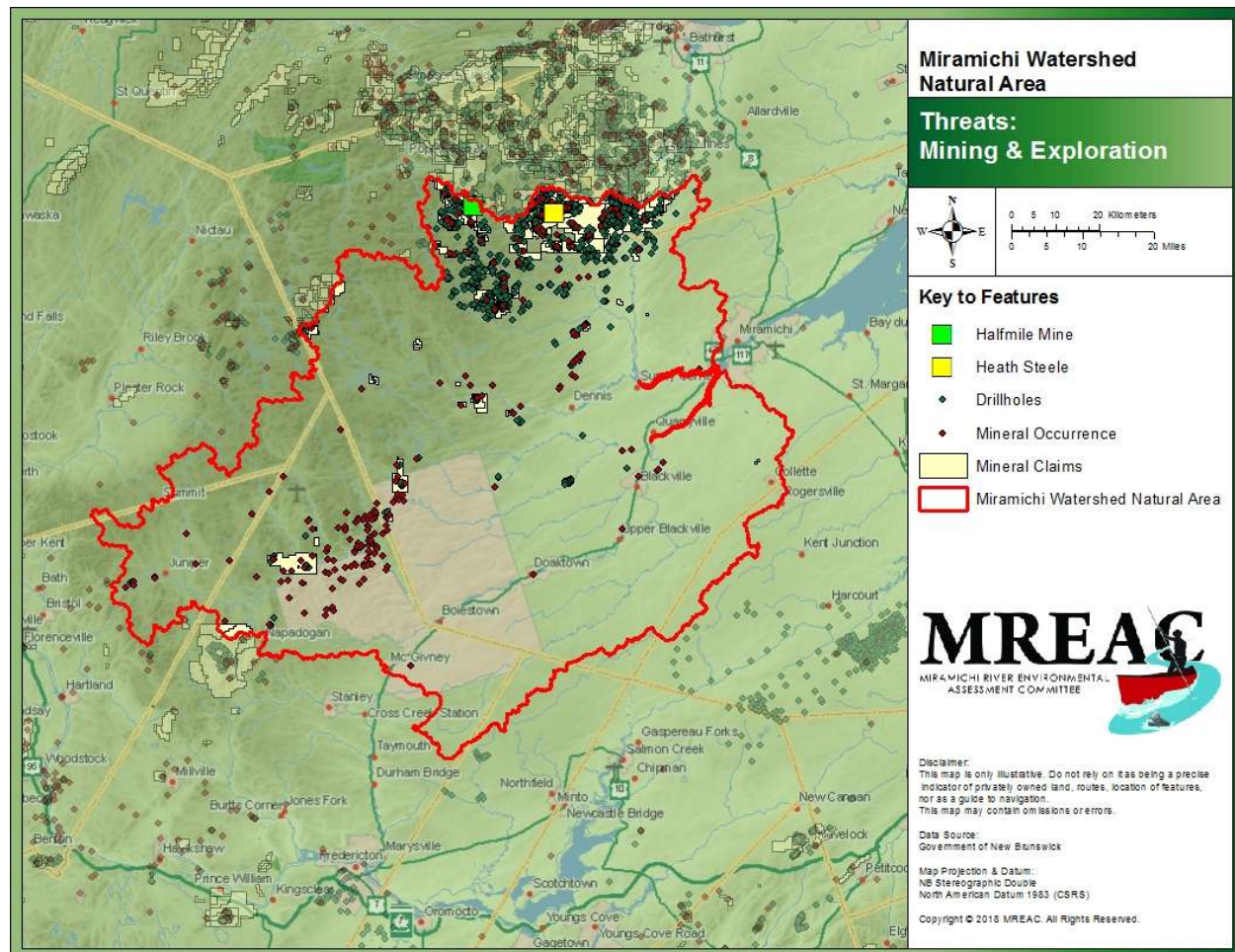
A decommissioned mine on the Northwest Miramichi watershed requires perpetual water treatment with controlled release due to former issues of acid rock/mine drainage. Past decades have shown the mining sector threat to aquatic habitat and aquatic life has been significant with fish mortality and damage to other aquatic species. This is a landmark site in Canadian mining for hard lessons learned in this industrial sector.

Prospecting has also been actively pursued concentrated in the northern half of the NA based on the regional geology.

3.3 Renewable energy (Threat: Low) The potential for renewable energy is significant in this NA, especially in the production of biomass for heat production. This is a developing sector and as yet has limited uptake. It is viewed as a positive potential with little ecological impact. However, the removal of organic material from sites that are inherently nutrient poor or impoverished is to be avoided if healthy forests are to be maintained.

Additionally, the highlands are identified in the New Brunswick Wind Atlas (Government of New Brunswick 2018) as having potential for wind generated energy. To date no high power tension lines are located in these highlands, with no immediate prospects for development in the foreseeable future.

Figure 10: Threats – Mining and Exploration



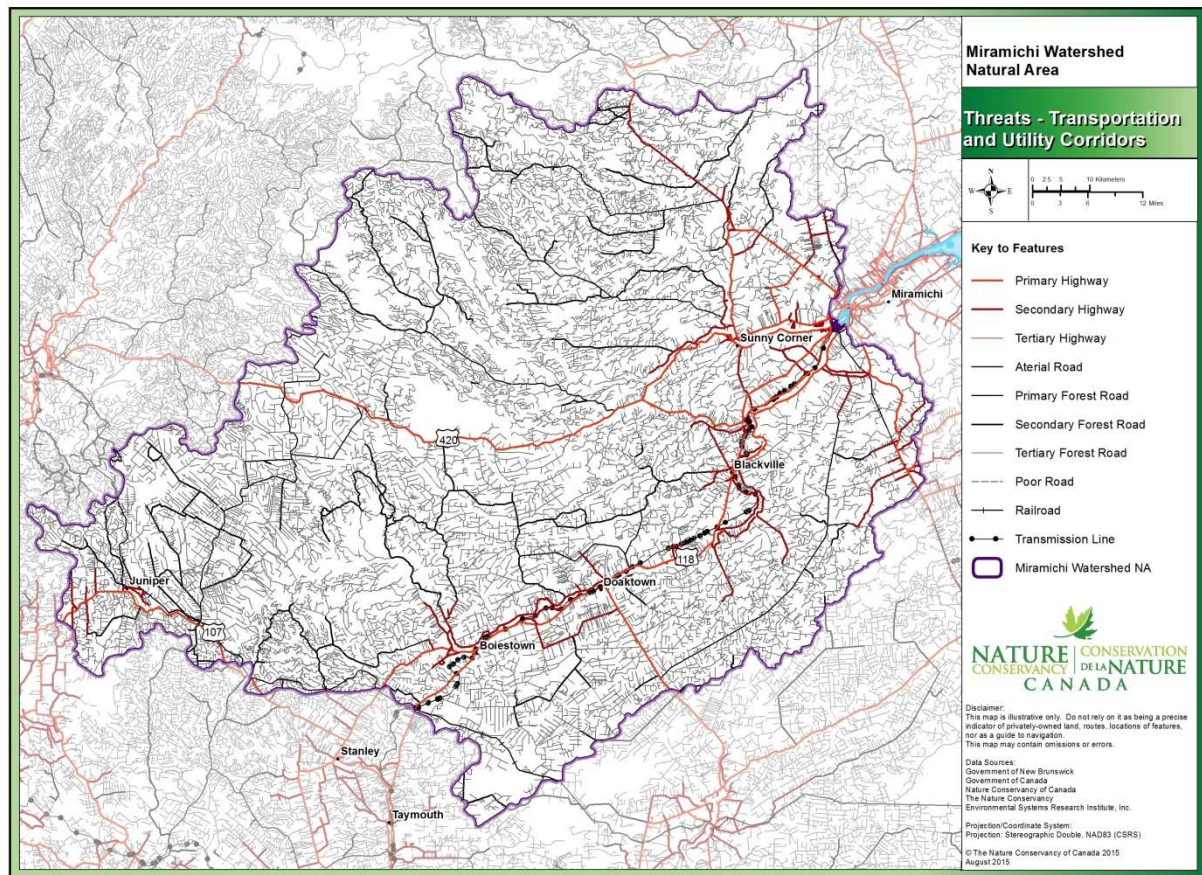
4. Transportation and Service Corridors

4.1 Roads and Railways (Threat: Medium) A Canadian National Railway train derailment in 2007 near Juniper illustrates the risk posed by the railway to this waterway. There is approximately 70 km of railway line within the Miramichi watershed in the headwaters of the Southwest Miramichi. The payload of the train and the specific location and timing of a spill may, in large part, determine the level of risk involved to habitat. The threat to habitat by the railway line itself is considered low.

A proliferation of woods roads and woods trails, developed within the forestry sector, provides a higher level of threat due to its impact on the landscape and wildlife habitat. Large scale clear-cuts, as can be witnessed from provincial highways within

the NA, illustrate the fragmentation with potential negative impacts on wildlife movement. The long term management plan and rotational harvesting of the landscape by forest industry lease-holders is deemed acceptable to provincial forest managers. A second level impact is noted in the use of roadways and wood roads by recreational users to access wilderness and remote locations.

Figure 11: Threats – Transportation and Utility Corridors



4.2 Utility and Service Lines (Threat: Low) A very low density of these lines within the NA result in a low threat level.

5. Biological Resource Use

5.1 Hunting and Collecting Terrestrial Animals (Threat: Low) There is a tradition of hunting and fishing within the Miramichi NA. The hunting of large game animals, Moose (*Alces alces*) and White-tailed deer (*Odocoileus virginianus*), is managed by the province and shown to be sustainable over many decades. The same can be said of other game animals (e.g. Ruffed grouse [*Bonasa umbellus*] and Snowshoe hare [*Lepus americanus*]). Hunting pressure is also on the decline as it seems to hold little appeal to younger generations.

Some trapping is ongoing within the NA but this pressure is felt to be acceptable and under its capacity.

5.2 Gathering of Terrestrial Plants (Threat: Low) Too little is known about actual levels of such gathering but the sense is that it poses little threat. The gathering of “fiddle-heads” in the spring (i.e. Fiddleheads being the frond stage of the Ostrich fern [*Matteuccia struthiopteris*]) is a widespread activity and long-standing tradition during a short window of time in the spring when this fern is tender and succulent. This plant is harvested recreationally, for personal consumption, and commercially. Tributaries of the Miramichi are a particularly rich source of this seasonal delicacy but the plant does not appear to be reducing in abundance and has much habitat annually that remains untouched. A recent interest in harvesting the fungi Chaga (*Inonotus obliquus*) has people examining yellow and white birch trees for this unique and scarce fungi with its’ apparent anti-oxidant properties, consumed in a chaga tea. There is no information as to the impact this harvesting may be having on the abundance of this plant.

5.3 Logging and Wood Harvesting: (Threat: Medium) This is an intensive activity within the Miramichi NA. The forest sector is by far the largest contributor to the local area economy. The province-wide harvest techniques and forest management strategy on crown lands is controversial with considerable evidence to support that these have significant impact on reducing diversity and general ecological health. A trend toward plantation forests, following the harvesting of natural forest, also favors

the cyclical infestations of the Spruce budworm (*Choristoneura fumiferana*). Of note a strategy is currently in place to combat a major infestation of Spruce budworm in Quebec and trending toward New Brunswick.

Over 90% of the Miramichi NA is forested (Figure 3) and generally referred to as the Acadian Forest (Nature Conservancy Canada. 2015). With the response to forest industry demand for more fiber, a 2014 agreement was struck entitled, “A Strategy For Crown Lands Forest Management” This strategy placed much more of the currently unavailable crown lands into fiber production. This development seriously challenges the prospect of adding to an already low level of protected lands (4.4%) within the NA.

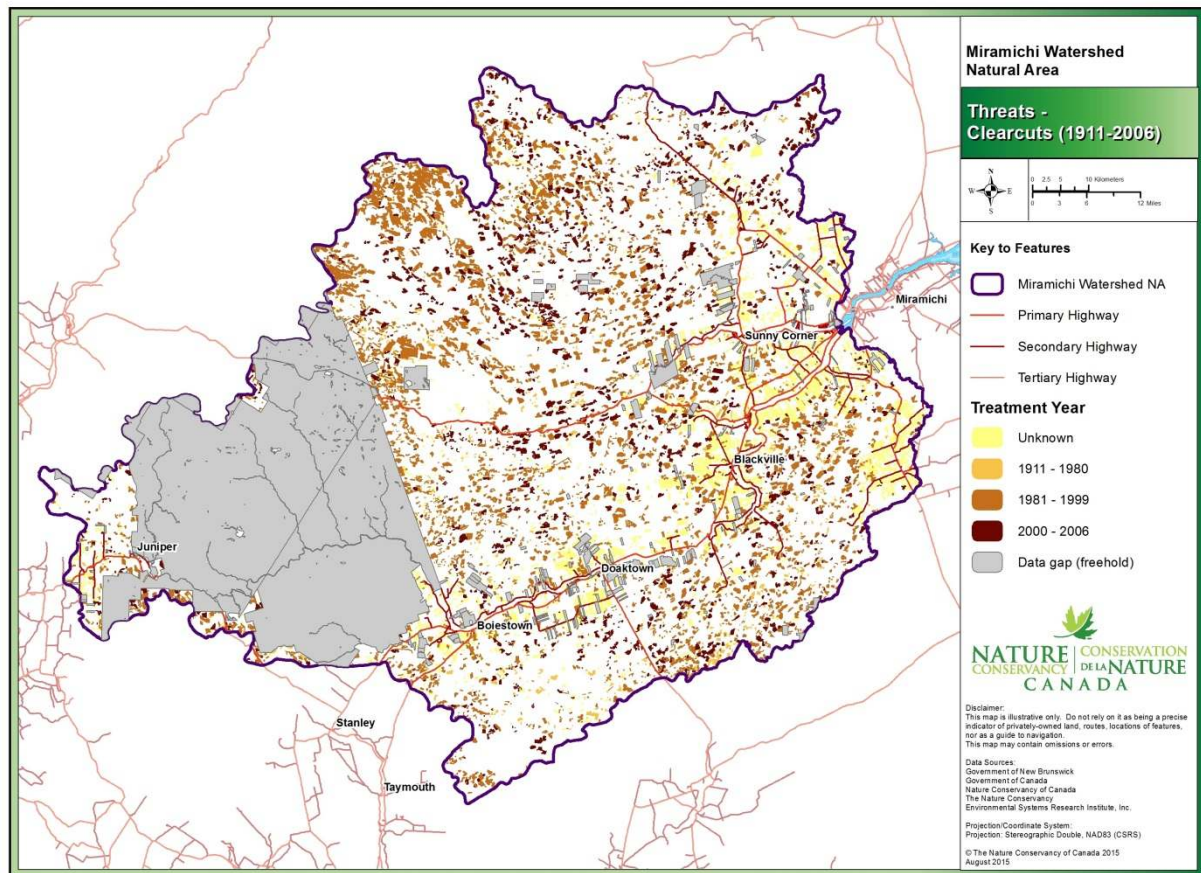
As discussed, the “Acadian Forest” of today is far removed from the Acadian Forest of early settlers in New Brunswick. Decades of intensive forest management has changed the forest structure and removes us even further from the original Acadian Forest composition with loss of diversity. The foresting harvesting method used by the larger forest companies is principally clear-cutting (Figure 12). Climate change is expected to shift the forest complex even further away from its historic structure. As Figure 3 illustrates, the forested landscape can be categorized by six forest cover types. Due to the scope and ultimate longer-term irreversibility of the current management practices, and the anticipated changes these will make to habitat conditions the threat is considered medium.

5.4 Fishing and harvesting Aquatic Resources (Threat: Medium) There is growing concern about the sustainability of Atlantic salmon resources on the Miramichi NA and beyond. Significant declines over past decades, attributed to conditions mostly beyond the boundary of the NA, have resulted in tangible threats to the sustainability of this fish on the Miramichi. Record high temperatures over the past years are reflected in water temperatures that bring enhanced stress levels to salmonids. These conditions are increasingly of management concern and a matter of study. (Breau and Cunjak 2006). Other management issues within the NA remain worrisome. It is the collective impacts of fish mortality from recreational angling, traditional food harvesting for first nations communities and poaching that has challenged the

sustainability of this anadromous fish and result in this “medium” threat level. These challenges come together more intensively on the Northwest Miramichi to a point where the sustainability of the annual salmon run is in doubt.

In response to concerns around Atlantic salmon, a recent project “CAST” has been instituted to support the remaining populations in Atlantic Canadian salmon bearing rivers. CAST, standing for “Collaboration for Atlantic Salmon Tomorrow” is a multi-year funded pilot project engaging a wide suite of the stakeholders (i.e. community, industry, academia, government, and first nations) to address and define.

Figure 12 Threats – Clearcuts (1911-2006)



remedial work toward recovery to healthy levels of returning salmon to the many tributaries of the Miramichi and other Atlantic salmon bearing rivers in Atlantic Canada.

With the cumulative impacts on the freshwater fishes stocks from beyond and from within the NA, especially those impacting the much cherished Atlantic salmon, the overall threat level is considered medium

6. Human Intrusion and Disturbance

6.1 Recreational activities (Threat: Low)

The use of off-road vehicles including all-terrain vehicles (ATV), four-wheel drives and snowmobiles is a common practice within the Miramichi NA. Little is known about the actual numbers and impacts on the local environment. ATV's and four-wheel drive trucks present the greater risk as these are active during the open water season and have been noted to damage and destroy habitat due to instream use and create problems with siltation. These vehicles have also created pathways for erosion at fording sites and in wetlands. Organized clubs are in place and these promote best practices and heighten awareness among their members. Other users simply operate ATV's to access favorite fishing holes. The impacts of ATV's on Wood turtles and Wood turtle nests is not well understood, nor is their impact on freshwater mussels, especially the threatened Brook floater (*Alasmidonta varicosa*). The relatively low density of these vehicles in a large NA limits the overall impact and the threat level to priority habitat is thus considered low.

Tubing (a lazy river drift downstream on an inner tube) has grown dramatically over the past two decades on the Little Southwest Miramichi and thousands now engage annually in the commercial tubing operations on this waterway. Other smaller scale operators are now involved in tubing on the Southwest Miramichi. It is unclear what habitat impacts might accrue, but litter and sanitation have been an issue. The limited season and fair-weather conditions required for this activity mitigate much of the impact. These considerations suggest the threat level of this activity on priority habitat remains low.

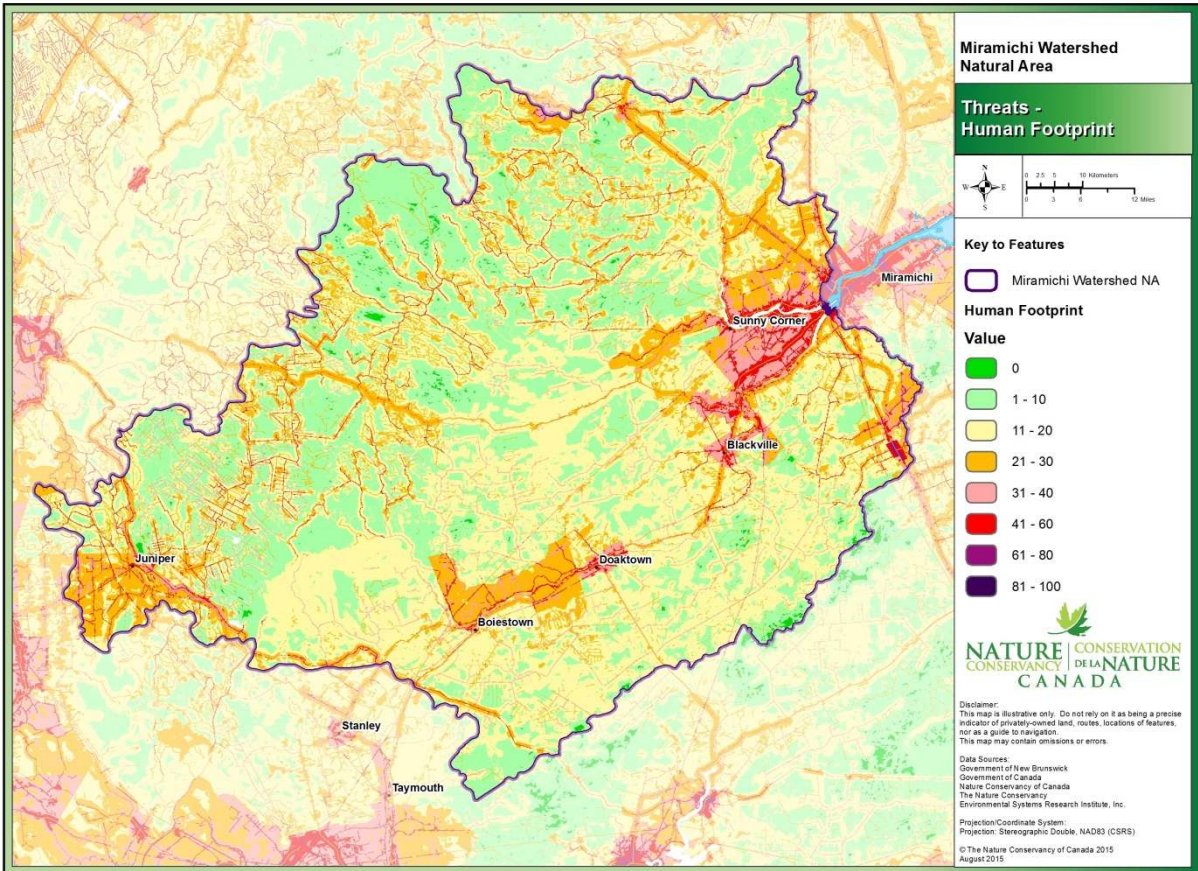
Snowmobiles are in use when snow and ice offer a protective cover to the landscape and this minimizes their impact. An established trail system is utilized, especially by outsiders, which further contains the impact. The impact on wildlife is not well monitored and thus not well known but with a relatively low level of usage is not deemed a threat. To date, snowmobile usage is not held to be of significant concern and not seen to be an issue related to priority habitat.

6.2 Work and Other Activities (Threat: Low)

By excluding “Logging and Wood Harvesting” (see 5.3) there is little activity in the NA to report and this limited amount results in minimal impact. Some prospecting and fur trapping occur within the NA but is limited and no marked increase is anticipated in the foreseeable future.

Figure 13 below (courtesy of the NCC) illustrates the collective Human Footprint of on the Miramichi NA. Wood harvesting is clearly the biggest impact but other anthropogenic factors have contributed to the “threat” levels illustrated within the figure.

Figure 13 Threats – Human Footprints



7. Natural Systems Modifications

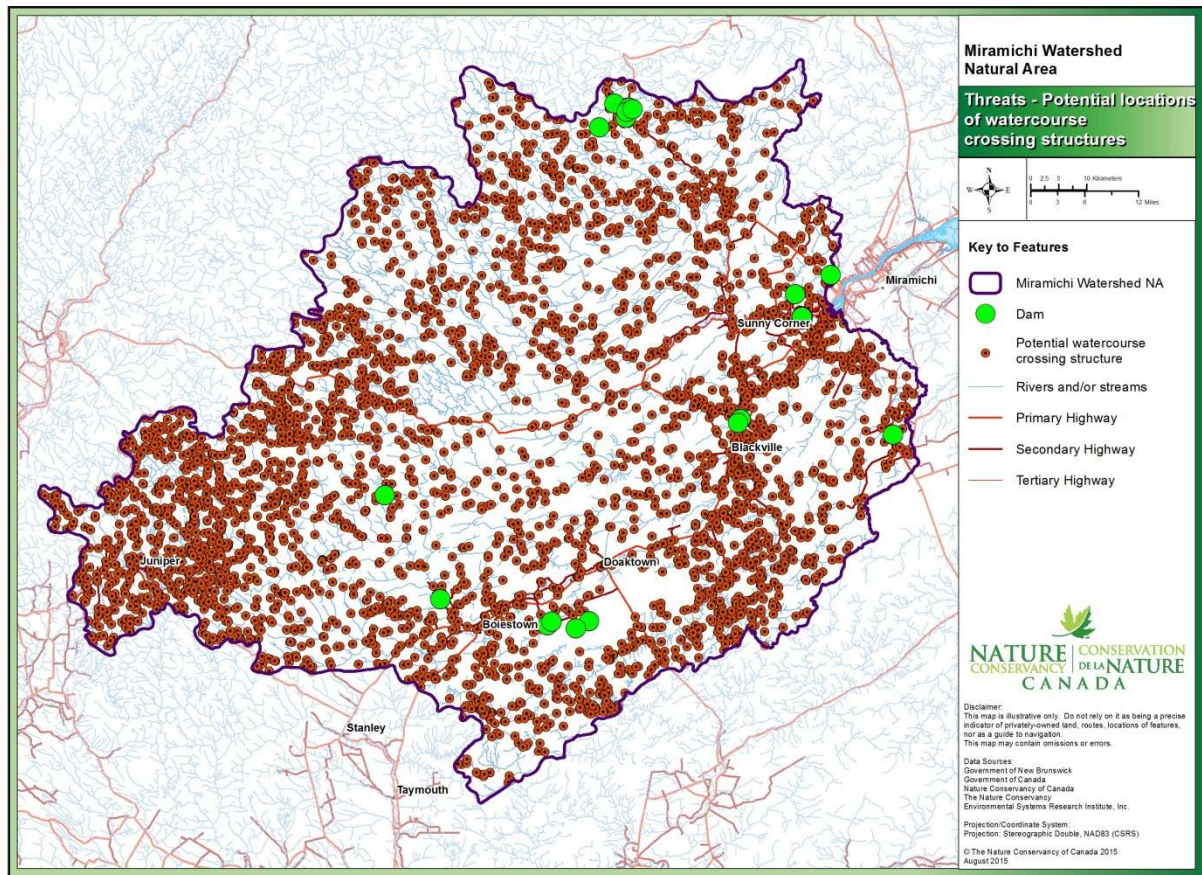
7.1 Fire and Fire Suppression (Threat: Medium)

Fires are suppressed in the NA rapidly and effectively both for reasons of forest management and public safety. This virtually removes the landscape from natural fire rotation periods. It has been argued that forest harvesting mimics in part the impacts of fire rotation but clearly the fit is a poor one with fire rotation periods estimated at 2900 years (Crossland 2006) and forest successional stages being negatively impacted by nutrient loss during harvesting periods. The remaining Acadian Forest of today is far removed from the composition and richness experienced by early settlers (H.Y. Hind et al 1865) to this NA. Changes over the past decades have resulted in a new normal. The perceived threat of fire and fire suppression to priority habitat is considered low.

7.2 Dams and Water Management /Use (Threat: Low)

Relatively few impoundments (or water extractions) are in place and at such a small scale that this threat is considered low. Figure 14 shows the proliferation of the culverts, widespread throughout the NA, the majority of which were originally placed to allow access to merchantable forest product. Figure 14 data is dated and the relatively few dams indicated have been reduced even further in the recent decades by dam removal.

Figure 14 Threats – Potential Locations of Watercourse Crossing Structures



7.3 Other Ecosystem Modifications (Threat: Low)

Pool enhancements are more and more common in the effort to improve Atlantic salmon habitat. These instream modifications have been “engineered”, vetted and approved by the province and thus deemed appropriate. Unintended impacts involving

risks from the use of instream machinery and change to the watercourse remain in question. In the absence of adverse impacts recorded to date the threat level is considered low.

8. Invasive and Other Problematic Species and Genes

8.1 Invasive Non-Native/Alien Species (Threat: Medium)

The introduction of Small-mouthed bass (*Micropterus dolomieu*) into Miramichi Lake, headwaters to the Southwest Miramichi, in 2008 has been a concern to all engaged with Atlantic salmon fishing and conservation. The bass are felt to be a real competitor for Atlantic salmon habitat and, as predatory fish, the worry is that they will do significant damage to the salmon population. In assessing the risk of this fish as an introduced species, DFO Science staff (DFO 2009) identify the risk as “high” in lake systems and “moderate” in riverine environments. The “medium” threat status is offered. Despite considerable effort being applied to control (eradicate if possible) the spread of this species, annual recruitment continues to occur as shown in Miramichi Lake monitoring. Smallmouth bass have escaped from the lake and captured in the drainage brook (Lake Brook). However, there is no evidence to date that Smallmouth bass are breeding beyond the boundary of the lake. Due to the potential severity and irreversibility of these fish, if they spread throughout the Miramichi watershed, the threat is considered Medium.

8.2 Problematic Native Species (Threat: Low) Striped bass (*Morone saxatilis*) have been a species of significant controversy in recent years on the Miramichi. Normally these fish remain within the estuarine waters and do not enter fresh water, in this case the Miramichi NA. This has changed and this species has been caught as high as the Cains River with expectation that they may migrate further upriver. Striped bass are predatory fish that grow rapidly and can grow to beyond one metre in length. Beyond the issue of invading the freshwaters of the Miramichi watershed, their population has recently exploded throughout the Southern Gulf of St Lawrence. With their spawning affinity for the Miramichi estuary, Atlantic salmon smolt is more likely to be eaten as they migrate through Miramichi Bay to the Northumberland Strait and then North Atlantic. Considerable time and resources have been expended in advancing the

science to understand the impact of Striped bass predation and overall impact on Atlantic salmon. This effort continues with additional support becoming available through the CAST project. Stock management techniques can come to bear on Striped bass and limit their impact, leading to an assessment of the threat to priority habitat as being low.

9. Pollution

9.1 Household Sewage and Urban Waste Water (Threat: Low)

MREAC volunteers and staff have dedicated much time to assessing and addressing issues around failing on-site septic systems. The awareness level of proper care and maintenance of septic tanks is low and this often results in system failure. Other issues around the limited life span of use of steel septic tanks further exacerbate the problem of system failures. These problems are more acute among low income residents that often do not have the resources to replace failing tanks and tile fields. These issues remain but the low populations involved, and relatively good soil conditions along much of the area of un-serviced rural ribbon communities (i.e. Southwest Miramichi) reduce risk of river contamination significantly. Additionally the assimilation capacity of a large waterway, such as the Southwest Miramichi, assists in mitigating the impact of sewage that enters. The threat to priority habitat is thus considered low.

9.2 Agricultural and Forestry Effluents (Threat: Low)

Very few agricultural activities occur within this NA and their impact is thereby minimal. Conversely, forestry spray programs were historically very damaging with the use of DDT in this NA (Carson et al 1962). The current day scale of the forest spray program is reduced and the spray products more targeted with fewer side effects on non-target species. Cranberry production is localized and the impact on priority species considered low. Cranberry operations engage closed-loop water systems during all or most of the growing season which further limits impact. Large scale blueberry production is anticipated in the foreseeable future but not on the immediate horizon and the impacts of this sector remain an unknown. The current threat to priority habitat is considered low.

9.3 Garbage and Solid Waste: (Threat: Low) Household waste collection and management within this NA is effective and presents little risk to the environment. Illegal dump sites and ongoing dumping by litterbugs (*Swineus vulgaris*) continue to frustrate citizens and solid waste managers alike but these multiple sites are unsightly rather than a significant risk to the environment. The threat to priority habitat is considered low.

9.4 Air-borne Pollutants (Threat: Low) Air quality is generally good to very good throughout the Miramichi NA. Little to compromise air quality is found in the NA with regard to industrial discharge. The relatively low density of housing within the villages and rural settings make for low impact on air quality from wood stoves. Most rural residents have some level of wood heating that may generate localized issues under certain climatic conditions (i.e. an inversion). The Miramichi NA is outside of the major North American airstream that is impacted by industrial areas of Canada and the United States. The perceived threat to priority due to air pollutants is considered low.

10. Climate Change and Severe Weather

10.1 Habitat Shifting and Alteration: (Threat: Low) Impacts on the forest structure and composition is anticipated with Climate Change. Due to the gradual rate of these changings the threat is considered “low”. However, both government and industrial managers do well to be aware of these projected changes and build this reality into long-term landscape planning.

10.2 Storms and Flooding: (Threat: Low) In recent memory the frequency and intensity of storms, winter and summer have been notably higher than many ‘ol’timers’ remember experiencing. However the NA has a long history of storms and flooding events that impact habitat, especially waterways. These occurrences may, as predicted, be more dramatic with a changing climate. The impact on riverine habitats is poorly understood but may be responsible for the mortality of Wood turtles if a flood event occurs during their winter dormancy. The potential for increase in threat

level is significant as climate conditions continue to change, and more extreme conditions are realized. In the meantime, the threat level remains low.

Table 3 Threat Assessment		Miramichi Bioregion (Natural Area)				
		Scope	Severity	Irreversibility	Summary Threat Rating	Comments
<i>1. Residential and Commercial Development</i>	<i>1.1 Housing and Urban Areas</i>	Low	Low	Low	Low	
	<i>1.2 Commercial and Industrial Areas</i>	Low	Low	Low	Low	
	<i>1.3 Tourism and Recreation Areas</i>	Low	Low	Low	Low	
<i>2. Agriculture and Aquaculture</i>	<i>2.1 Wood and Pulp Plantations</i>	Med	Med	Med	Med	
<i>3. Energy Production and Mining</i>	<i>3.1 Oil and Gas Drilling</i>	Low	Low	Low	Low	
	<i>3.2 Mining and Quarrying</i>	Low	Low	Low	Low	
	<i>3.3 Renewable Energy</i>	Low	Low	Low	Low	
<i>4. Transportation and Service Corridors</i>	<i>4.1 Roads and Railroads</i>	Med	Med	Low	Med	
	<i>4.2 Utility and Service Lines</i>	Low	Low	Low	Low	
<i>5. Biological Resource Use</i>	<i>5.1 Hunting and Collecting Terrestrial Animals</i>	Low	Low	Low	Low	
	<i>5.2 Gathering Terrestrial Plants (e.g. peat)</i>	Low	Low	Low	Low	
	<i>5.3 Logging and Wood Harvesting (incompatible forestry practices)</i>	Med	Med	Med	Med	
	<i>5.4 Fishing and Harvesting Aquatic Resources (salmon, striped bass, eel fishing)</i>	Med	Med	High	Med	
Threats		Miramichi Bioregion/Natural Area				

		Scope	Severity	Irreversibility	Summary Threat Rating	Comments
6. Human Intrusions and Disturbance	6.1 Recreational Activities	Low	Low	Low	Low	
	6.2 Work and Other Activities	Low	Low	Low	Low	
7. Natural System Modifications	7.1 Fire & Fire Suppression	Low	Med	Med	Med	
	7.2 Dams and Water Management/Use	Low	Low	Low	Low	
	7.3 Other Ecosystem Modifications (e.g. rip rap use)	Low	Low	Low	Low	
8. Invasive & Other Problematic Species, Genes & Diseases	8.1 Invasive Non-Native/Alien Species/Diseases	Med	Med	High	Med	
	8.2 Problematic Native Species	Med	Low	Low	Low	
9. Pollution	9.1 Domestic and Urban Waste Water	Low	Low	Low	Low	
	9.2 Agricultural and Forestry Effluents (e.g. nutrient runoff)	Low	Low	Low	Low	
	9.3 Garbage and Solid Waste (e.g. garbage which could entangle wildlife on coastal areas)	Low	Low	Low	Low	
	9.4 Garbage and Solid Waste	Low	Low	Low	Low	
	9.5 Air-borne Pollutants	Low	Low	Low	Low	
11. Climate Change & Severe Weather	11.1 Habitat Shifting & Alteration	Low	Low	Low	Low	
	11.4 Storms and Flooding	Low	Low	Low	Low	

Threat category (IUCN) High The threat is likely to seriously degrade the priority habitat type
Medium The threat is likely to moderately degrade the priority habitat type
Low The threat is likely to only slightly impair the priority habitat type

8.0 CONSERVATION ACTIONS

Conservation actions to address threats and conserve and protect species and priority habitats within the bioregion were identified and developed through input from conservation partners. A summary of major conservation actions associated with partner organizations is offered below.

ACCDC (Atlantic Canada Conservation Centre)

- Enhance data management and information on biodiversity in the bioregion through the maintenance of the most comprehensive and current database on the distribution of biological diversity in Atlantic Canada.
- Conduct biological surveys in areas of high biodiversity significance throughout the bioregion to further understanding of rare species' status and distribution. Focus may be species-specific (i.e. Beach Pinweed, Bathurst Aster, Pygmy Snaketail) or on habitats rich in rare species, such as flood-scoured shorelines, rock outcrops and cliffs, rich floodplain forests, and backwater wetlands along major rivers, or freshwater and brackish tidal estuaries, dunes and saltmarshes along the coast

Anqotum Resource Management (North Shore Micmac District Council)

- Services to its member communities, including but not limited to Technical Advisory; Capacity Building; Training; Advocacy and Project Management.
- Pursue a number of aquatic-based environmental initiatives in the Miramichi watershed as well as others.
- A significant focus of work has on species at risk and watershed stewardship.

Environment and Climate Change Canada

- Inform and implement the North American Waterfowl Management Plan (NAWMP) and conduct waterfowl surveys as required by the plan (in partnership with the EHJV).
- Collaboration to implement species at risk recovery strategies and critical habitat designation in the bioregion.

- Implement the following Acts and regulations as required: the Migratory Bird Convention Act (MBCA); Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act (WAPPRITA); 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); the Federal Policy on Wetland Conservation.
- Communication and engage with the public and conservation groups on financial programs for the protection of habitat.

Miramichi River Environmental Assessment Committee (MREAC)

- MREAC works within the Miramichi NA boundary to conserve and maintain those environmental values already intact and help restore or recover those that are in decline.

Miramichi Salmon Association (MSA)

- The MSA provides leadership, stewardship, and conservation practices on the Miramichi Watershed to continuously preserve and advance its environmental integrity for the benefit of all species, in particular the Atlantic salmon.
- The MSA is a major partner in the implementation of the Conservation of Atlantic Salmon For Tomorrow (CAST) project on the Miramichi Watershed throughout the term of this program.

Nature Conservancy of Canada (NCC)

- The NCC will continue with additional acquisition of high conservation value habitat as opportunities for land donation or purchase arise.
- The NCC will continue to provide stewardship of newly acquired lands and develop management plans for these properties for their ongoing conservation.
- Protect in perpetuity the habitat conditions on the Foxner Nature Reserve within the Miramichi NA.
- Apply to the Province of New Brunswick to designate NCC lands in the bioregion under the NB Protected Natural Areas Act, thus preventing sub-surface claims.

NatureNB

- Nature NB will celebrate, conserve and protect New Brunswick's natural heritage through education, networking and collaboration in the Miramichi NA.
- Nature NB recognizes the importance of taking actions to preserve and maintain the natural heritage of the Miramichi NA

Nature Trust of New Brunswick

- The Nature Trust of New Brunswick will pursue permanent protection of high conservation-value habitat within the Miramichi River bioregion as opportunities for land donation or purchase arise.
- The Nature Trust of New Brunswick will pursue long-term protection of high conservation-value habitat within the Miramichi River bioregion by working with landowners to develop voluntary stewardship agreements on private land. These activities will address specific threats to Species at Risk, rare species communities, and threatened ecosystems.
- The Nature Trust will continue to monitor Ecological Significant Areas sites that are located on or adjacent to its current nature preserves in the region. The Nature Trust will train nature preserve stewardship volunteers to monitor Nature Trust properties annually for impacts from use, and to respond to any potential threats to biodiversity targets.
- Continue to monitor known rare and at-risk species on all Nature Trust preserves within the bioregion.

New Brunswick Department of Energy and Resource Development

- Protect and manage the Protected Natural Areas in the NA containing representative forest and wetland ecosystems.
- Implement sustainable forest management on the approximately 743,933 hectares of Crown Timber License lands within the bioregion and ensure activities on the remaining Crown lands are planned and undertaken in a manner consistent with the protection of water quality, species at risk and other conservation priorities.

- Implement and enforce the New Brunswick Fish and Wildlife Act, Protected Natural Areas Act, Species at Risk Act, Clean Environment Act, Clean Water Act, Wetland Conservation Policy and Coastal Areas Protection Policy to conserve fish and wildlife populations, species at risk and the ecological, economic and social functions of these ecosystems on Crown and private lands.
- Continue to collaborate with and support non-government organization efforts on biodiversity, species at risk, habitat and ecosystem identification, conservation and stewardship through direct and in-kind support.

New Brunswick Department of Environment and Local Government

- Continue to enforce the “Rules of Engagement for the Short Term Measures”, which provide protection under the NB Wetlands Conservation Policy for Provincially Significant Wetlands in the province.
- Continue to require and review EIAs for activities which fall under Schedule A of the Clean Water Act.
- In partnership with University of New Brunswick, completion of the Wet Areas Mapping project which will provide improved knowledge of area of extent and types of watercourses in NB.
- Develop and implement a new Long-Term Wetlands Strategy for New Brunswick.

Parks Canada

- One National Historic Site within the NA (Beaubears Island Shipbuilding National Historic Site) is preserved for its historic values.

9.0 KNOWLEDGE GAPS

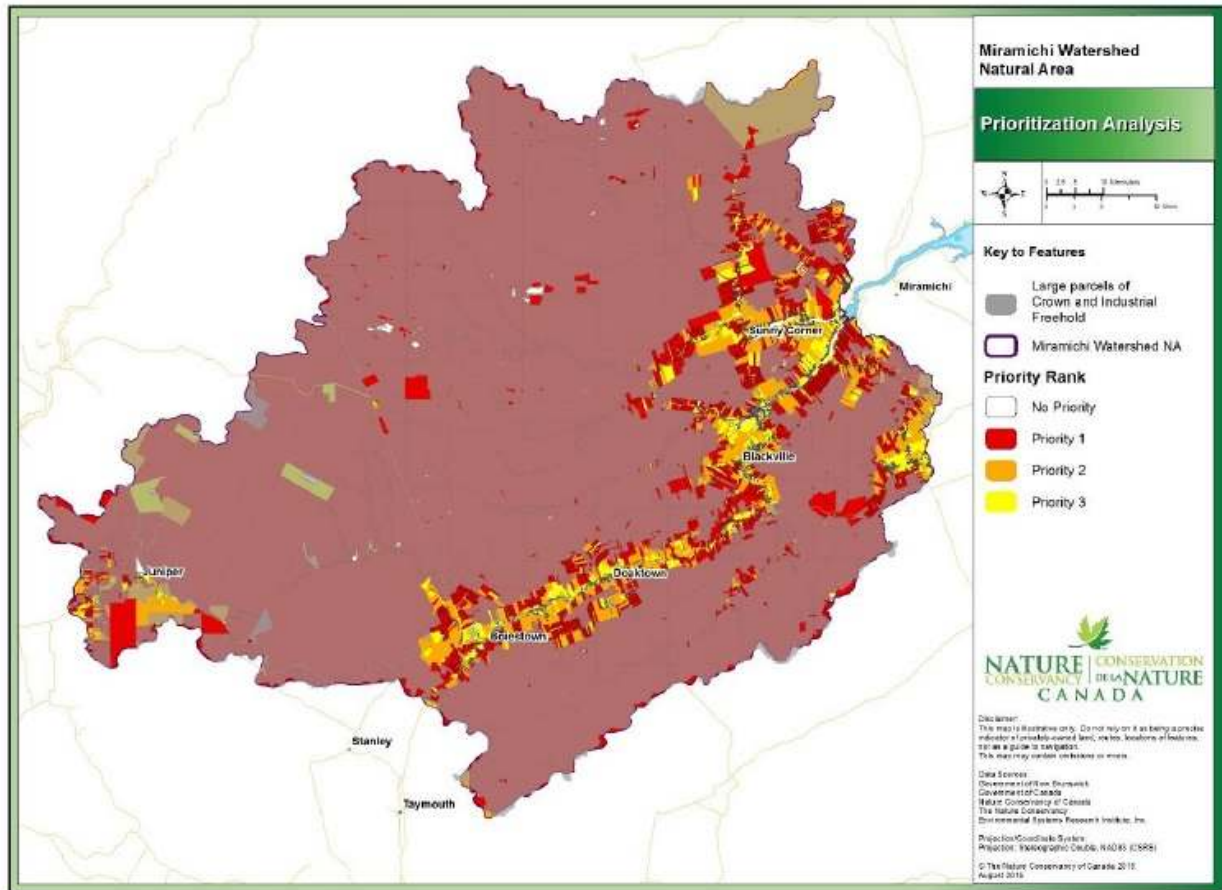
The Miramichi NA is large and much of it very remote. Apart from commercial forests and the tracking of these resources by the forestry sector there is limited knowledge of, and little research on, this large NA related to the aquatic, riparian, forested wetlands, other wetlands and open priority habitats.

- Despite the advancements in provincial wetland mapping, forested wetlands continue to be problematic and show significant levels of error
- Improved communication and knowledge sharing amongst conservation partners continues to be wanting.
- Greater care and attention to presence, spread, and range of invasive species is recommended as these are likely to get increasingly problematic with a changing climate.
- In association with forested wetlands, vernal pools and the important habitat these contain are poorly known or understood.
- Work related to understanding and protecting species-at-risk has been ongoing but will require further attention in future years.
- Ongoing assessment and understanding of the impacts of a changing climate on habitats is required.

10.0 PRIORITIZATION ANALYSIS - PUBLIC LANDS

Lead-in work on the Miramichi NA by the Nature Conservancy Canada generated a prioritization analysis on private lands only. This was completed for purposes of future potential land procurement within the NA. However, the analysis and priority ranking is valuable and as valid for this report as it was the NCC report. (NCC 2015). The foundation of the ranking was based on the ecological significance of habitat, landscape context and species. Beyond that a three-tiered equation was applied relating to size, representivity and habitat uniqueness with the NA. Other factors are described in their 2015 report (unpublished). The scope of this HCS exercise has not allowed the application of a Conservation Value Index to be applied to entire NA, most is which is managed as lease-hold lands by forestry sector companies. (Figure 15)

Figure 15: Prioritization Analysis



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Appendix A - Priority Species

BIRDS							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Botaurus lentiginosus</i>	American Bittern	G4	1				S4B
<i>Anas rubripes</i>	American Black Duck	G5	1				S5B, S4N
<i>Setophaga ruticilla</i>	American Redstart	G5	1				S85
<i>Picoides dorsalis</i>	American Three-toed Woodpecker	G5					S2,S3
<i>Scolopax minor</i>	American Woodcock	G5	1				S5B
<i>Haliaeetus leucocephalus</i>	Bald Eagle	G5	1	NAR		E	S4B
<i>Icterus galbula</i>	Baltimore Oriole	G5					S3B,S3M
<i>Riparia riparia</i>	Bank Swallow	G5	1	T			S2S3B,S2S3M
<i>Hirundo rustica</i>	Barn Swallow	G5	1	T		T	S3B,S3M
<i>Setophaga castanea</i>	Bay-breasted Warbler	G5	1				S4B
<i>Megaceryle alcyon</i>	Belted Kingfisher	G5	1				S5B
<i>Catharus bicknelli</i>	Bicknell's Thrush	G4	1	T	T	T	S2B,S2M
<i>Picoides arcticus</i>	Black-backed Woodpecker	G5	1				S4
<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo	G5	1				S3B,S3M
<i>Dendroica fusca</i>	Blackburnian Warbler	G5	1				S85
<i>Dendroica caerulescens</i>	Black-throated Blue Warbler	G5	1				S85
<i>Setophaga virens</i>	Black-throated Green Warbler	G5	1				S5B
<i>Vireo solitarius</i>	Blue-headed Vireo	G5	1				S5B
<i>Dolichonyx oryzivorus</i>	Bobolink	G5	1	T		T	S3B,S3M
<i>Poecile hudsonicus</i>	Boreal Chickadee	G5	1				S1S2B
<i>Aegolius funereus</i>	Boreal Owl	G5					S1S2B
<i>Molothrus ater</i>	Brown-headed Cowbird	G5					S3B,S3M
<i>Toxostoma rufum</i>	Brown Thrasher	G5					S2B,S2M
<i>Branta canadensis</i>	Canada Goose	G5	1				SNA B, S4M
<i>Wilsonia canadensis</i>	Canada Warbler	G5	1	T	T	T	S3S4B,S3S4M
<i>Setophaga tigrina</i>	Cape May Warbler	G5	1				S3B,S4S5M
<i>Chaetura pelagica</i>	Chimney Swift	G5	1	T	T	T	S2S3B,S2M
<i>Hirundo rustica</i>	Cliff Swallow	G5					S2S3B,S2S3M
<i>Bucephala clangula</i>	Common Goldeneye	G5	1				S4B, S5M,S4N
<i>Gavia immer</i>	Common Loon	G5	1				S4B, S5M, S4N
<i>Chordeiles minor</i>	Common Nighthawk	G5	1	T	T	T	S3B,S4M
<i>Tyrannus tyrannus</i>	Eastern Kingbird	G5	1				S3S4B,S3S4M
<i>Antrostomus vociferus</i>	Eastern Whip-Poor-Will	G5	1	T	T	T	S2B,S2M
<i>Contopus virens</i>	Eastern Wood-Pewee	G5	1	SC		SC	S4B,S4M
<i>Coccothraustes vespertinus</i>	Evening Grosbeak	G5	1	SC			S3B,S3S4
<i>Myiarchus crinitus</i>	Great Crested Flycatcher	G5					S2S3B,S2S3M
<i>Anas crecca</i>	Green-winged Teal	G5	1				S4S5B
<i>Charadrius vociferus</i>	Killdeer	G5	1				S3B,S3M
<i>Setophaga magnolia</i>	Magnolia Warbler	G5	1				S5B
<i>Anas platyrhynchos</i>	Mallard	G5	1				S5B, S4N
<i>Accipiter gentilis</i>	Northern Goshawk	G5	1				S4
<i>Mimus polyglottos</i>	Northern Mockingbird	G5					S2B,S2M
<i>Contopus cooperi</i>	Olive-sided Flycatcher	G5	1	T	T	T	S3S4B,S3S4M
<i>Setophaga palmarum</i>	Palm Warbler	G5	1				S5B,S5M
<i>Podilymbus podiceps</i>	Pied-billed Grebe	G5	1				S4B
<i>Haemorhous purpureus</i>	Purple Finch	G5	1				N5B,N5N
<i>Aythya collaris</i>	Ring-necked Duck	G5	1				S5B
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	G5	1				S4B
<i>Bonasa umbellus</i>	Ruffed Grouse	G5	1				S5
<i>Euphagus carolinus</i>	Rusty Blackbird	G4	1	SC	SC	SC	S3B,S3M
<i>Porzana carolina</i>	Sora	G5	1				S4B
<i>Actitis macularius</i>	Spotted Sandpiper	G5	1				S3S4B,S5M
<i>Tachycineta bicolor</i>	Tree Swallow	G5	1				S4B
<i>Catharus fuscescens</i>	Veery	G5	1				S4B
<i>Poecetes gramineus</i>	Vesper Sparrow	G5					S2B,S2M
<i>Rallus limicola</i>	Virginia Rail	G5	1				S3B
<i>Sitta carolinensis</i>	White-breasted Nuthatch	G5	1				S5
<i>Zonotrichia albicollis</i>	White-throated Sparrow	G5	1				S5B
<i>Gallinago delicata</i>	Wilson's Snipe	G5	1				S3S4B,S5M
<i>Aix sponsa</i>	Wood Duck	G5	1				S4B
<i>Hylocichla mustelina</i>	Wood Thrush	G5	1	T		T	S1S2B,S1S2M
<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker	G5	1				S5B

VASCULAR PLANTS							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Agalinis paupercula</i> var. <i>borealis</i>	Small-flowered Agalinis	G5T4?					S1
<i>Agrostis mertensii</i>	Northern Bent Grass	G5					S2
<i>Allium canadense</i>	Canada Garlic	G5					S1
<i>Arabis drummondii</i>	Drummond's Rockcress	G5					S2
<i>Arnica lanceolata</i>	Lance-leaved Arnica	G3					S3
<i>Barbarea orthoceras</i>	American Yellow Rocket	G5					S2S3
<i>Betula glandulosa</i>	Glandular Birch	G5					S1
<i>Betula minor</i>	Dwarf White Birch	G4Q					S2
<i>Bidens eatonii</i>	Eaton's Beggarticks	G3					S1
<i>Calypso bulbosa</i> var. <i>americana</i>	Calypso	G5T5?					S2
<i>Carex adusta</i>	Lesser Brown Sedge	G5					S2S3
<i>Carex albicans</i> var. <i>emmonsii</i>	White-tinged Sedge	G5T5					S2
<i>Carex bigelowii</i>	Bigelow's Sedge	G5					S1
<i>Carex hirtifolia</i>	Pubescent Sedge	G5					S2
<i>Carex rostrata</i>	Narrow-leaved Beaked Sedge	G5					S2
<i>Carex saxatilis</i>	Russet Sedge	G5					S1
<i>Castilleja septentrionalis</i>	Northeastern Paintbrush	G5					S2
<i>Ceratophyllum echinatum</i>	Prickly Hornwort	G4?					S2S3
<i>Coeloglossum viride</i> var. <i>virescens</i>	Long-bracted Frog Orchid	G5T5					S2
<i>Corallorhiza maculata</i> var. <i>occidentalis</i>	Spotted Coralroot	G5T3T5					S2S3
<i>Crataegus scabrada</i>	Rough Hawthorn	G5?					S2
<i>Cryptotaenia canadensis</i>	Canada Honewort	G5					S1
<i>Cyperus bipartitus</i>	Shining Flatsedge	G5					S1
<i>Cyperus diandrus</i>	Low Flatsedge	G5					S1
<i>Desmodium glutinosum</i>	Large Tick-Trefoil	G5					S1
<i>Dichanthelium linearifolium</i>	Narrow-leaved Panic Grass	G5					S2
<i>Dichanthelium xanthophyllum</i>	Slender Panic Grass	G5					S1
<i>Elatine americana</i>	American Waterwort	G4					S2S3
<i>Eriocaulon parkeri</i>	Parker's Pipewort	G3		NAR		Endangered	S2
<i>Galium kamtschaticum</i>	Northern Wild Licorice	G5					S2
<i>Galium obtusum</i>	Blunt-leaved Bedstraw	G5					S2?
<i>Gentiana linearis</i>	Narrow-Leaved Gentian	G4G5					S2
<i>Goodyera oblongifolia</i>	Menzies' Rattlesnake-plantain	G5?					S2
<i>Hepatica nobilis</i> var. <i>obtusata</i>	Round-lobed Hepatica	G5T5					S2
<i>Hieracium robinsonii</i>	Robinson's Hawkweed	G2G3					S1
<i>Humulus lupulus</i> var. <i>lupuloides</i>	Common Hop	G5T5					S2?
<i>Huperzia selago</i>	Northern Firmoss	G5					S1
<i>Ionactis linariifolius</i>	Stiff Aster	G5					S2
<i>Isoetes acadiensis</i>	Acadian Quillwort	G3Q					S2S3
<i>Isoetes prototypus</i>	Prototype Quillwort	G2G3		SC	SC	Endangered	S2
<i>Juglans cinerea</i>	Butternut	G4		E	E	Endangered	S1
<i>Juncus greenei</i>	Greene's Rush	G5					S1
<i>Juncus stygius</i>	Moor Rush	G5					S1
<i>Juncus subtilis</i>	Creeping Rush	G4					S1
<i>Juncus trifidus</i>	Highland Rush	G5					S1
<i>Juncus vaseyi</i>	Vasey Rush	G5?					S2
<i>Listera auriculata</i>	Auricled Twayblade	G3G4					S2S3
<i>Listera australis</i>	Southern Twayblade	G4				Endangered	S2
<i>Lycopodium sitchense</i>	Sitka Clubmoss	G5					S2
<i>Myriophyllum humile</i>	Low Water Milfoil	G5					S2
<i>Orobanche uniflora</i>	One-Flowered Broomrape	G5					S2
<i>Osmorhiza depauperata</i>	Blunt Sweet Cicely	G5					S2
<i>Osmorhiza longistylis</i>	Smooth Sweet Cicely	G5					S2
<i>Piptatherum canadense</i>	Canada Rice Grass	G5					S2
<i>Piptatherum pungens</i>	Slender Rice Grass	G5					S2
<i>Podostemum ceratophyllum</i>	Horn-leaved Riverweed	G5					S2
<i>Potamogeton nodosus</i>	Long-leaved Pondweed	G5					S1
<i>Pseudognaphalium macounii</i>	Macoun's Cudweed	G5					S2
<i>Ranunculus lapponicus</i>	Lapland Buttercup	G5					S1
<i>Rosa acicularis</i> ssp. <i>sayi</i>	Prickly Rose	G5T5					S2
<i>Sagittaria calycina</i> var. <i>spongiosa</i>	Long-lobed Arrowhead	G5T4					S2
<i>Salix myricoides</i>	Bayberry Willow	G4					S2?
<i>Schoenoplectus smithii</i>	Smith's Bulrush	G5?					S1
<i>Spiranthes cernua</i>	Nodding Ladies'-Tresses	G5					S2S3
<i>Spiranthes lucida</i>	Shining Ladies'-Tresses	G5					S2
<i>Stellaria longifolia</i>	Long-leaved Starwort	G5					S2
<i>Symphyotrichum laeve</i>	Smooth Aster	G5					S1
<i>Toxicodendron radicans</i>	Poison Ivy	G5					S2?
<i>Triadenum virginicum</i>	Virginia St John's-wort	G5					S1
<i>Vaccinium boreale</i>	Northern Blueberry	G4					S1
<i>Viola novae-angliae</i>	New England Violet	G4					S2
<i>Woodsia alpina</i>	Alpine Cliff Fern	G4					S2
<i>Zizania aquatica</i> var. <i>aquatica</i>	Indian Wild Rice	G5T5					S2
<i>Zizania aquatica</i> var. <i>brevis</i>	Indian Wild Rice	G5T3					S1

MAMMALS							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Lynx canadensis</i>	Canadian Lynx	G5		NAR		E	S3
<i>Sorex dispar</i>	Long-tailed Shrew	G4		NAR	SC		S2
<i>Sorex maritimensis</i>	Maritime Shrew	G3					S3
<i>Synaptomys borealis</i>	Northern Bog Lemming	G5					S1
<i>Microtus chrotorrhinus</i>	Rock Vole	G4					S1
<i>Myotis lucifugus</i>	Little Brown Myotis	G3		E	E	E	S?
<i>Myotis septentrionalis</i>	Northern Myotis	G1,G2		E	E	E	S?
<i>Perimyotis subflavus</i>	Tri-colored Bat	G2,G3		E	E	E	S?

FISH							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Anguilla rostrata</i>	American Eel	G4		T		T	S4
<i>Salvelinus alpinus</i>	Arctic Char	G5					S1
<i>Salmo salar</i>	Atlantic Salmon (Gaspé-Southern Gulf of St. Lawrence population)	G5					S2S3
<i>Morone saxatilis</i>	Striped Bass	G5		SC			S?

MOLLUSCS							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Alasmodonta varicosa</i>	Brook Floater	G3					S1S2

INSECTS							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Somatochlora tenebrosa</i>	Clamp-Tipped Emerald	G5					S2
<i>Callophrys henrici</i>	Henry's Elfin	G5					S2
<i>Danaus plexippus</i>	Monarch	G5		E		SC	S3B
<i>Somatochlora septentrionalis</i>	Muskeg Emerald	G5					S1
<i>Ophiogomphus howei</i>	Pygmy Snaketail	G3		SC			S1
<i>Somatochlora brevicincta</i>	Quebec Emerald	G4					S2
<i>Aeshna juncea</i>	Rush Darner	G5					S2
<i>Coenagrion interrogatum</i>	Subarctic Bluet	G5					S2

REPTILES & AMPHIBIANS							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Glyptemys insculpta</i>	Wood Turtle	G3		T	T	T	S2S3

BRYOPHYTES							
Scientific Name	Common Name	G-RANK	BCR Priority	COSEWIC	SAR PROT	PROV PROT	S-RANK
<i>Barbilophozia lycopodioides</i>	Greater Pawwort	G5					S2?
<i>Pallavicinia lyellii</i>	Lyell's Ribbonwort	G5					S1S2
<i>Sphagnum flexuosum</i>	Flexuous Peatmoss	G5					S2

Appendix B Priority Species-Habitat Associations with Ranking

Priority species	COSEWIC	Special Concern, Threatened, or Endangered	<i>Priority species</i> are defined as any species with a
	BCR 14 priority bird species	S1,S2,S3	BCR 14
	S-Ranking	1,2 or 3	S1, S2
	G-Ranking	1, 2 or 3	S3 + a G ranking of 1, 2 or 3
Priority Habitats	Native biological entities (i.e., ecological systems, communities and/or species) that the HCS is aiming to conserve.		
Aquatic	Open water areas in rivers, lakes and ponds, fast running and standing water	Acadian Quillwort, American Eel, American Eel, American Waterwort, Arctic Char, Atlantic Salmon (Gaspé-Southern Gulf of St. Lawrence population), Barn Swallow, Brook Floater, Canada Goose, Common Goldeneye, Common Loon, Creeping Rush, Green-winged Teal, Horn-leaved Riverweed, Indian Wild Rice, Indian Wild Rice, Long-leaved Pondweed, Long-lobed Arrowhead, Low Water Milfoil, Pied-billed Grebe, Prototype Quillwort, Ring-necked Duck, Striped Bass, Tree Swallow, Wood Turtle	
Riparian	Ecosystems along rivers, lake and pondshores; including floodplain forests, herbaceous and woody alluvial wetlands, sandbars		
Forested wetlands	Forested areas with standing water, also temporary standing water; includes cedar swamps		
Other wetlands	Wetlands, including marshes, fens, bogs, beaverponds		
Acadian Forest	All forests occurring in the region, including mature coniferous, mature hardwood, mixed mature, and young mixed		
Open habitats	Open habitats include rocky outcrops, ledges along rivers, talus slopes, upland barrens also over peat, fields and meadows		
Priority habitat & species associations	Species were associated to habitats that they occur, nest in, or feed in.		
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)	Status	Description	
	Extinct (EXT)	A species that no longer exists	
	Extirpated (EXP)	A species no longer existing in the wild in Canada, but occurring elsewhere in the wild	
	Endangered (END)	A species facing imminent extirpation or extinction throughout its range	
	Threatened (THR)	A species likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction	
	Special Concern (SC)	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events, but does not include an extirpated, endangered or threatened species	
	Not At Risk (NAR)	A species that has been evaluated and found to be not at risk	
	Data Deficient (DD)	A species for which there is insufficient information to support a status designation	

Global Rank (G-RANK)	Rank	Definition
		Presumed Extinct (species): Not located despite intensive searches and virtually no likelihood of rediscovery.
	GX	Eliminated (ecological communities): Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
		Possibly Extinct (species): Missing; known from only historical occurrences but still some hope of rediscovery.
	GH	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.
Sub-national (Provincial) Rank (S-RANK)	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.
	S#B	The conservation status of migratory species (specifically those that do not overwinter in the Maritimes) during migration.
	S#M	The conservation status of migratory species (specifically those that do not overwinter in the Maritimes) during migration.

NatureServe Explorer Abbreviation	COSEWIC Status	Definition
X	Extinct	A wildlife species that no longer exists.
XT	Extirpated ¹	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
E	Endangered ¹	A wildlife species facing imminent extirpation or extinction.
T	Threatened ¹	A wildlife species likely to become endangered if limiting factors are not reversed.
SC	Special Concern ¹	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
NAR	Not At Risk	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
DD	Data Deficient	A category that applies when the available information is insufficient: a) to resolve a wildlife species' eligibility for assessment; or b) to permit an assessment of the wildlife species' risk of extinction.
C	Candidate	A wildlife species that is not yet assessed by COSEWIC but has been identified by the Species Specialist Subcommittees (SSCs) or by the Aboriginal Traditional Knowledge (ATK) Subcommittee as a potential species needing a detailed status assessment.
	Null value	A wildlife species that does not have any COSEWIC status, has not been evaluated by COSEWIC, or its status does not yet appear on NatureServe Explorer because of the possible lag time between the NatureServe central databases and the refresh of the data on the website.

Appendix C – Habitat/Species Association

Priority Habitats	# of priority species	Associated Priority Species
Aquatic: open water, lakes, ponds, rivers	23	Acadian Quillwort, American Eel, American Waterwort, Arctic Char, Atlantic Salmon (Gaspe-Southern Gulf of St. Lawrence population), Barn Swallow, Brook Floater, Canada Goose, Common Goldeneye, Common Loon, Creeping Rush, Green-winged Teal, Horn-leaved Riverweed, Indian Wild Rice, Long-leaved Pondweed, Long-lobed Arrowhead, Low Water Milfoil, Pied-billed Grebe, Prototype Quillwort, Ring-necked Duck, Striped Bass, Tree Swallow, Wood Turtle
Riparian: floodplain, rivershore, lakeshore	72	Alpine Cliff Fern, American Bittern, American Black Duck, American Redstart, American Waterwort, American Woodcock, American Yellow Rocket, Auricled Twayblade, Bald Eagle, Bank Swallow, Bayberry Willow, Belted Kingfisher, Blunt-leaved Bedstraw, Butternut, Canada Garlic, Canada Goose, Canada Honewort, Canada Rice Grass, Canada Warbler, Clamp-Tipped Emerald, Common Goldeneye, Common Hop, Creeping Rush, Drummond's Rockcress, Eaton's Beggarticks, Flexuous Peatmoss, Green-winged Teal, Horn-leaved Riverweed, Indian Wild Rice, Indian Wild Rice, Killdeer, Lance-leaved Arnica, Large Tick-Trefoil, Little Brown Myotis, Long-leaved Starwort, Long-lobed Arrowhead, Low Flatsedge, Lyell's Ribbonwort, Mallard, Monarch, Narrow-leaved Beaked Sedge, Narrow-Leaved Gentian, New England Violet, Northeastern Paintbrush, Northern Bent Grass, Northern Firmoss, Olive-sided Flycatcher, One-Flowered Broomrape, Parker's Pipewort, Poison Ivy, Prickly Hornwort, Prickly Rose, Pubescent Sedge, Pygmy Snaketail, Ring-necked Duck, Robinson's Hawkweed, Russet Sedge, Shining Flatsedge, Shining Ladies'-Tresses, Slender Panic Grass, Small-flowered Agalinis, Smith's Bulrush, Spotted Sandpiper, Stiff Aster, Tree Swallow, Vasey Rush, Veery, White-tinged Sedge, Wilson's Snipe, Wood Duck, Wood Thrush
Forested wetlands: cedar swamps, other forested wetlands	19	American Black Duck, American Redstart, American Woodcock, Bald Eagle, Bank Swallow, Belted Kingfisher, Canada Goose, Canada Warbler, Canadian Lynx, Common Goldeneye, Eastern Kingbird, Green-winged Teal, Killdeer, Little Brown Myotis, Mallard, Menzies' Rattlesnake-plantain, Olive-sided Flycatcher, Ring-necked Duck, Rusty Blackbird, Spotted Sandpiper, Tree Swallow, Tri-colored Bat, Veery, Wilson's Snipe, Wood Duck, Wood Thrush
Other wetlands: bogs, fens, beaver ponds, marshes	43	American Bittern, American Black Duck, American Woodcock, Bald Eagle, Bank Swallow, Barn Swallow, Belted Kingfisher, Calypso, Canada Goose, Canada Warbler, Clamp-Tipped Emerald, Common Goldeneye, Common Hop, Eastern Kingbird, Flexuous Peatmoss, Green-winged Teal, Greene's Rush, Indian Wild Rice, Indian Wild Rice, Little Brown Myotis, Mallard, Maritime Shrew, Monarch, Moor Rush, Narrow-Leaved Gentian, Northern Bog Lemming, Olive-sided Flycatcher, Pied-billed Grebe, Pygmy Snaketail, Quebec Emerald, Rush Darner, Russet Sedge, Rusty Blackbird, Sora, Southern Twayblade, Spotted Sandpiper, Subarctic Bluet, Tree Swallow, Tri-colored Bat, Virginia Rail, Virginia St John's-wort, Wilson's Snipe, Wood Turtle
Acadian Forest: coniferous, mature hardwood, mixed mature, young mixed	54	American Redstart, American Three-toed Woodpeckers, American Woodcock, Baltimore Oriole, Bay-breasted Warbler, Belted Kingfisher, Bicknell's Thrush, Black-backed Woodpecker, Black-billed Cuckoo, Black-throated Blue Warbler, Black-throated Green Warbler, Blackburnian Warbler, Blue-headed Vireo, Blunt Sweet Cicely, Boreal Chickadee, Boreal Owl, Brown Thrasher, Calypso, Canadian Lynx, Cape May Warbler, Chimney Swift, Eastern Whip-Poor-Will, Eastern Wood-Pewee, Evening Grosbeak, Flexuous Peatmoss, Great Crested Flycatcher, Greater Pawwort, Lapland Buttercup, Little Brown Myotis, Long-bracted Frog Orchid, Long-tailed Shrew, Magnolia Warbler, Northern Bog Lemming, Northern Goshawk, Northern Myotis, Northern Wild Licorice, Pubescent Sedge, Purple Finch, Rock Vole, Rose-breasted Grosbeak, Round-lobed Hepatica, Ruffed Grouse, Slender Panic Grass, Slender Rice Grass, Smooth Sweet Cicely, Spotted Coralroot, Tree Swallow, Tri-colored Bat, Veery, White-breasted Nuthatch, White-throated Sparrow, Wood Thrush, Wood Turtle, Yellow-bellied Sapsucker
Open habitats: rocky outcrops, ledges, talus, upland barrens, fields & meadows	34	Alpine Cliff Fern, American Black Duck, American Woodcock, Bald Eagle, Bank Swallow, Barn Swallow, Bicknell's Thrush, Bigelow's Sedge, Bobolink, Brown-headed Cowbird, Canada Goose, Canada Rice Grass, Cliff Swallow, Common Nighthawk, Dwarf White Birch, Eastern Kingbird, Glandular Birch, Greater Pawwort, Green-winged Teal, Highland Rush, Killdeer, Long-tailed Shrew, Maritime Shrew, Monarch, Northern Bent Grass, Northern Blueberry, Rock Vole, Sitka Clubmoss, Slender Panic Grass, Smooth Aster, Tree Swallow, Vasey Rush, Vesper Sparrow, Wilson's Snipe