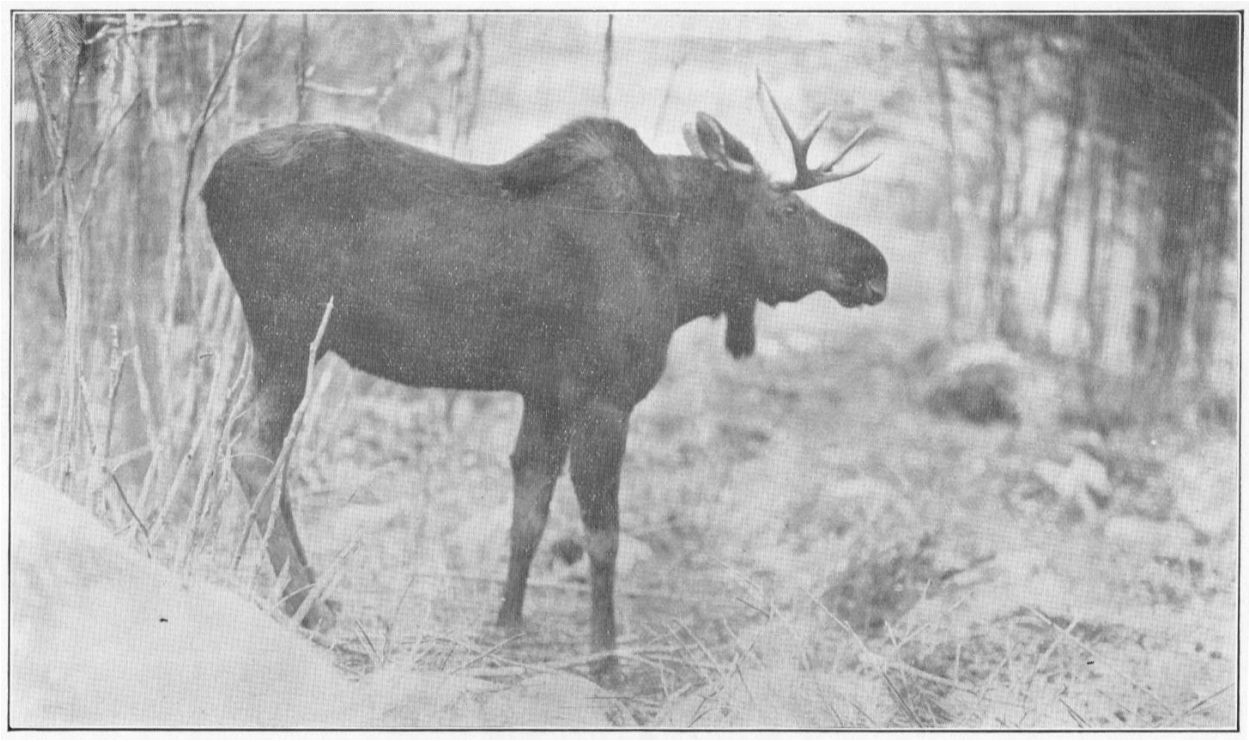
Nova Scotia Endangered Species Act
Recovery Plan Series

Recovery Plan for Moose (*Alces alces americana*) in Mainland Nova Scotia



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Additional copies:

Additional copies can be downloaded from the Nova Scotia Department of Natural Resources Species Recovery and Conservation webpage. (http://www.gov.ns.ca/natr/wildlife/biodiv/species_recovery.htm#moose)

Cover illustration:

From 1936 Nova Scotia Department of Lands & Forests Annual Report

Recovery Plan for Moose (*Alces alces americana*) in Mainland Nova Scotia

March 2007

Recovery of this species is considered technically or biologically feasible at this time.

RESPONSIBLE JURISDICTIONS

Government of Nova Scotia:
Nova Scotia Department of Natural Resources

ACKNOWLEDGEMENTS

The Nova Scotia Mainland Moose Recovery Team provided much of the information which is the grounding and basis for the contents of this recovery plan. A list of members and their affiliations is found in Section 4. Special thanks to the Mersey Tobeatic Research Institute for their help in completing this recovery plan. In particular, thanks to Crystal Doggett, the coordinating author.

PREFACE

This recovery plan has been prepared by the responsible jurisdiction, the Nova Scotia Department of Natural Resources in cooperation with the Nova Scotia Mainland Moose Recovery Team. The recovery plan defines the recovery goal, objectives, strategies, and actions that are deemed necessary to protect, conserve, and recover mainland moose in Nova Scotia. The plan does not necessarily represent the views of all of the individuals involved in its formulation, nor of the governments or organizations with which the individual team members are associated. The goal, objectives, strategies, and actions are based on the best existing knowledge and are subject to modification resulting from changed objectives and new findings. The implementation of the recovery plan shall take place over the next 5 years (2007-2012) and will be subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations. Therefore, some aspects of this recovery plan may not necessarily be implemented immediately, concurrently, or in their entirety.

Recovery plans are not designed to provide a comprehensive summary of the biology and status of moose on mainland Nova Scotia. For more information regarding mainland moose, a pfd. copy of the Status Report on the Eastern Moose (*Alces alces americana*) in Mainland Nova Scotia by Gerry Parker June 2003 is available at: www.gov.ns.ca/natr/wildlife/biodiv/species_recovery/statusreports/StatusReportMooseNS Complete.pdf . Projected costs associated with many of the individual recovery actions identified in this plan cannot be calculated at the time of report writing.

EXECUTIVE SUMMARY

In October 2003, moose on mainland Nova Scotia were listed as "endangered" under the Nova Scotia Endangered Species Act. In 2004, the Nova Scotia Department of Natural Resources brought together knowledgeable moose scientists, biologists and partners from the Maritime region, and one representative of the North American Moose Foundation to form the Nova Scotia Mainland Moose Recovery Team. The recovery team worked with the Nova Scotia Department of Natural Resources to develop this plan. Nova Scotians value moose as part of the Province's identity and have a stake in the recovery of mainland moose.

Moose were the most abundant large mammal in Nova Scotia when European settlers first arrived in the 1600's. Their numbers are believed to have fluctuated widely before and after European settlement but since that time their numbers have dwindled. The native Cape Breton Island population disappeared completely by the late 1800s. The robust population found there today is a result of a re-introduction of moose from Alberta in the 1940's and is a distinct population from the mainland Nova Scotia moose population. Today, on the mainland portion of the province, the number remaining is thought to total 1000-1200 animals.

Factors affecting the status of moose on mainland Nova Scotia are many, complex and poorly understood. Further studies are required to fully understand the weighting of factors limiting mainland moose recovery. Governments and researchers alone will not be effective in recovering this species. Success will depend on a high level of awareness and strong determination within the general public of Nova Scotia to maintain and enhance conditions for moose numbers to increase. Mainland moose face threats from a number of sources including: disease and parasites, poaching, access to moose habitat, development, forest practices, acid rain and climate change.

The overall goal of this recovery plan is to maintain the population of mainland moose in Nova Scotia within their current range. The recovery activities endorsed in this recovery plan will be carried out in part or in whole within the next five years (2007–2012). The objectives of the recovery plan are to: 1) maintain and enhance the current population and distribution; 2) mitigate threats (where possible) that limit recovery; 3) initiate research to address priority knowledge gaps; and 4) maintain and enhance habitat.

Objectives will be achieved through recovery actions that are delineated as research, monitoring, management, education, or stewardship. Recovery actions include the following:

Research:

- Improve understanding of the weighting and interrelationship(s) of threats and limiting factors
- Improve understanding of habitat suitability, availability and selection
- Improve efforts to provide insight into the structure and genetic profile of mainland moose
- Investigate the cause of death/illness of all found dead and apparent "sick" moose

Monitoring:

- Initiate a rigorous long-term monitoring program to provide reliable data on the distribution and demographics of moose on mainland Nova Scotia
- Establish means of monitoring the impact severity of each factor (threat) known to inhibit growth of localized moose herds/groups

Management:

- Develop and implement a strategy to reduce poaching
- Decrease occurrence of preventable mainland moose mortality
- Determine the feasibility of translocating adult moose and/or orphans from New Brunswick and proceed as appropriate
- Review and adapt forest management practices as habitat requirements of moose in Nova Scotia are better understood

Education:

- Raise public awareness of the status of mainland moose, threats and recovery efforts

Stewardship:

- Promote public reporting of poaching and moose observations
- Engage partners in recovery activities
- Engage landowners in stewardship of mainland moose and their habitat

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1. BACKGROUND

1.1 Species Assessment Information

Date of Assessment: 2003

Common Name: Eastern Moose (Mainland Nova Scotia)

Scientific Name: *Alces alces Americana* (Clinton 1822)

Conservation Status: Endangered

Reason for designation: The native population of moose in Nova Scotia is limited to approximately 1000 individuals in isolated herds/groups across the mainland. The population has declined by at least 20% over the past 30 years with much greater reductions in distribution and population size over more than 200 years, despite extensive hunting closures since the 1930's. The decline is not well understood but may involve a complex of threats including: historic excessive hunting, poaching, climate change, parasitic brainworm, increased road access to moose habitat, spread of white-tailed deer, possible high levels of cadmium and dietary deficiencies (e.g. cobalt), unknown viral disease, and disturbance.

Moose on Cape Breton Island are not at risk as they are abundant and the result of a re-introduction of moose from Alberta in the 1940's.

Canadian Occurrence: Nova Scotia (Mainland, *Alces alces Americana,* and Cape Breton, *Alces alces andersoni,* are separate subspecies), New Brunswick, Newfoundland, Quebec and Ontario.

1.2 Description

1.2.1 Description of the Species

As the largest member of the deer (*cervidae*) family, moose have a distinctive appearance. Moose have a solid torso and short tail, with long legs and broad, high shoulders. They have a short neck, broad overhanging muzzle and long ears. Their coat of hair has a coarse, brittle texture and varies in colour from shades of brown, to brown-black, to gray. Adult males are known for their large, palmate (broad and flattened) antlers and the "bell" or dewlap that hangs on the upper throat region. Mainland moose usually weigh less than four hundred and fifty kilograms.

Calving occurs in late May, usually resulting in one to two calves weighing about twelve kilograms each. Calves have short bodies, long legs and ears and light reddish-brown fur with a dark, dorsal stripe. They quickly grow to resemble the blackish brown colour of adults with brown shading into yellowish-gray on the legs and belly (Merrill 1916). The cow and calf will stay together for a year.

1.3 Populations and Distribution

With the exception of Prince Edward Island, moose occur in all other provinces and territories in Canada. Four subspecies of moose are recognized in North America by Peterson (1955). In northern Ontario the range of the northwestern moose (*Alces alces andersoni*) gives way to the range of the eastern moose that inhabits regions eastward to Maine, mainland Nova Scotia, New Brunswick and Quebec. The current population on Cape Breton Island is the result of an introduction of moose from Elk Island National Park in Alberta. Therefore, the Cape Breton population is considered part of the northwestern moose subspecies (*Alces alces andersoni*).

The presence of deciduous shrubs such as those found in recently disturbed forests is closely associated with the abundance of moose in Nova Scotia through time. Based on moose densities in similar habitats, under comparable circumstances, it is estimated that before European settlement, there may have been approximately 15,000 moose in Nova Scotia (Parker 2003). The accelerated European colonization of the New England states in the 1700s-1800s led to habitat loss and over-hunting, resulting in a moose population decline to several thousand and a reduction in distributional range. The trend continued slowly into New Brunswick and Nova Scotia so that in 1875 there had been a tremendous decline in both provinces, initiating game laws to restrict hunting. Subsequently, moose began to recover and were once again plentiful in mainland Nova Scotia, perhaps approaching a number close to that before European colonization. However, moose had already been extirpated from Cape Breton and did not become established again until the introduction of eighteen moose from Alberta in 1947 and 1948 (Dodds 1974; Corbett 1995). Moose hunting was closed in Nova Scotia in 1937, but the population continued to decline.

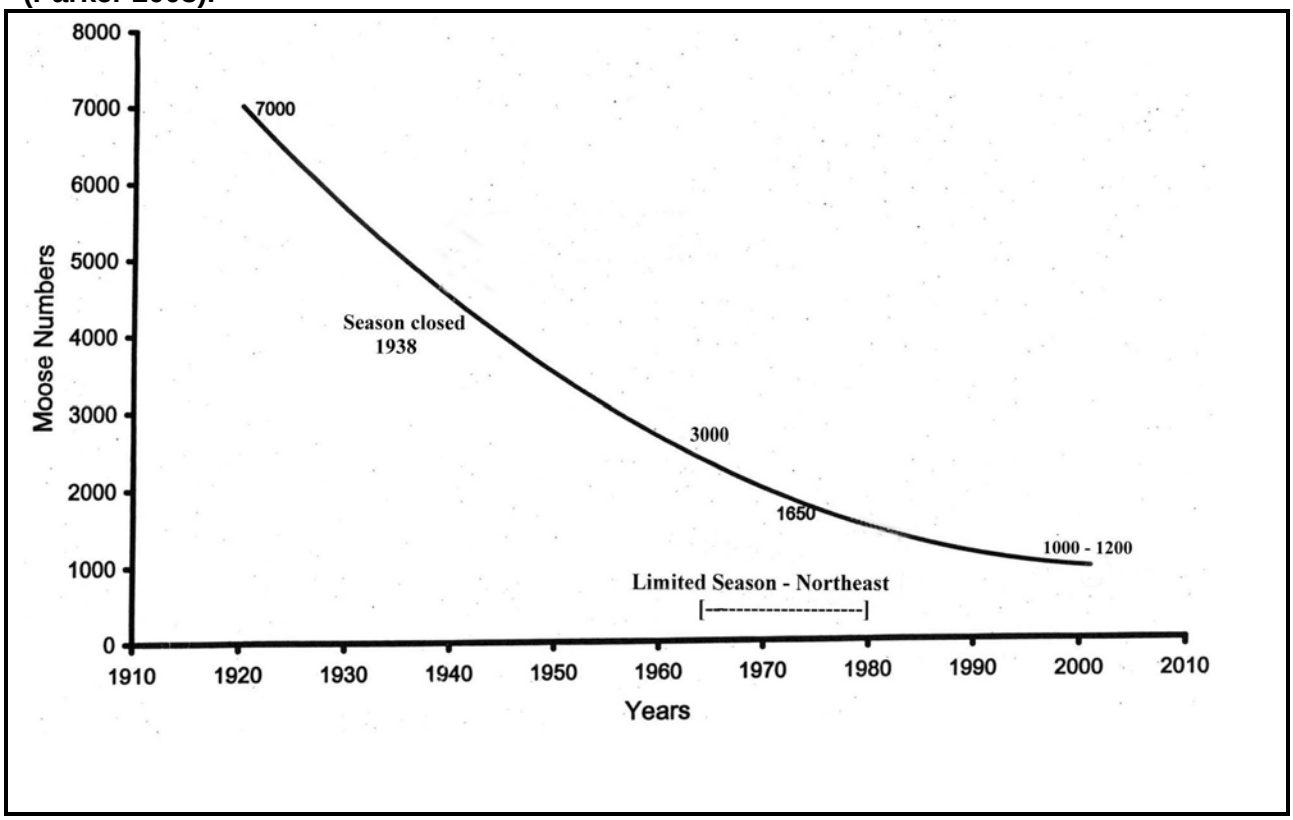
Aerial surveys were first used to count mainland moose in the 1960s. Results indicated that the population was between 2500 and 4000 animals. Based on these findings, the two areas with the highest densities (in eastern mainland, Nova Scotia) were opened for a restricted hunting season in 1964. By the mid-1970s, the population was estimated to have declined to 1600 - 1700 moose (Parker 2003).

In 1975, survey results and moose management recommendations prompted the province to designate six management zones for the four northeastern mainland counties. Moose hunting seasons on mainland Nova Scotia have been closed since the season of 1981. Despite these closures, aerial and pellet group surveys indicated further significant decline in moose densities by the mid-1990s, with an estimate of only 357 moose in the northeastern mainland.

Nova Scotia wildlife managers and biologists agree that the mainland moose population has experienced significant and continuous decline over the past thirty years (Parker 2003). A ‘best estimate’ population curve (Figure 1) based on historical trends was generated for the 2003 Status Report on mainland moose. Although it is not a heartening picture, the decline appears to have evened out and the provincial population may have stabilized at 1000-1200 moose (Parker 2003). Mainland moose have retained a similar distribution since the 1960s, with localized groups occupying the northern Cobequid Hills and Pictou-Antigonish Highlands, the southwestern interior in and around the Tobeatic Wildlife Management Area, and scattered

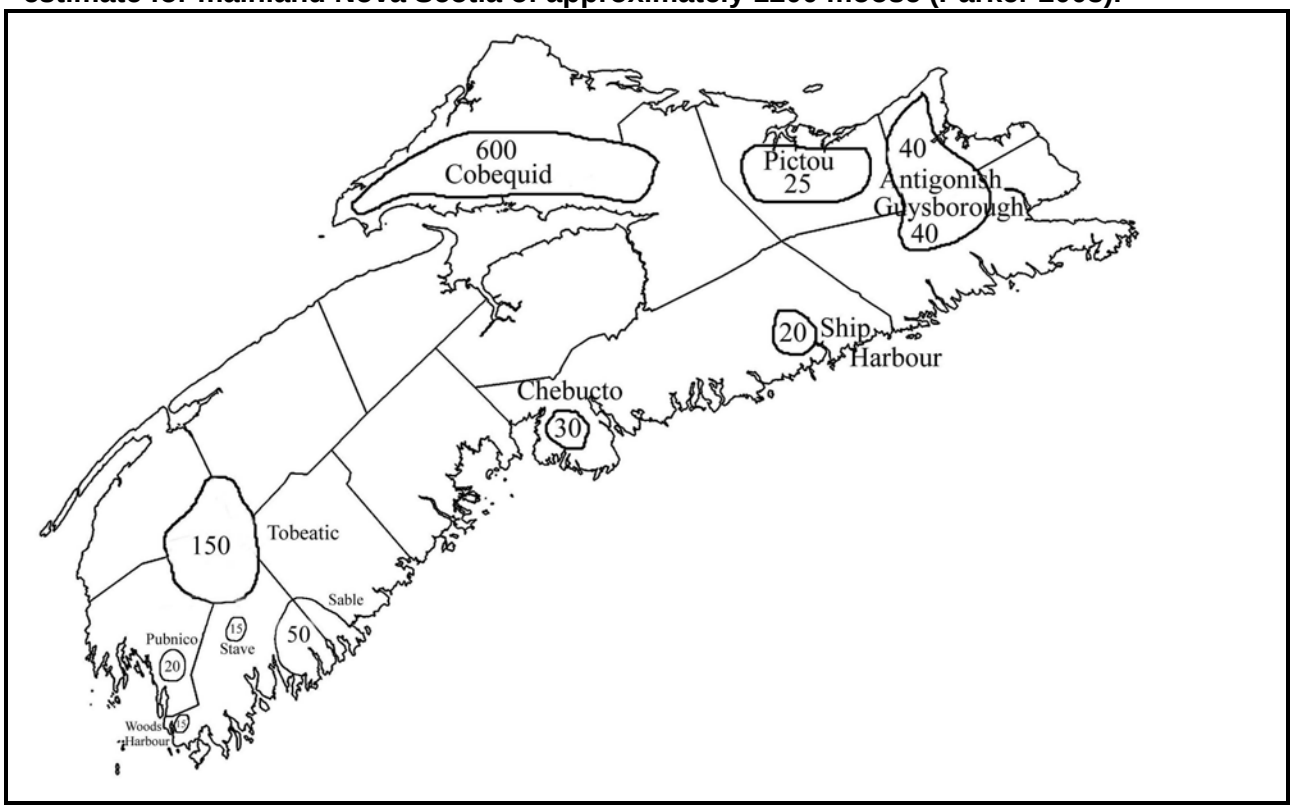
pockets along the eastern shores of Guysborough, Halifax, Shelburne, Queens and Yarmouth Counties (Figure 2).

Figure 1. Projected slope of decline in numbers of moose on mainland Nova Scotia based upon early "estimate" and subsequent aerial and ground surveys (1920 – 2003) (Parker 2003).



The moose groups/herds in the Cobequid Hills of Cumberland and Colchester counties comprise approximately half of the total mainland population (approx 600 animals). The second largest concentration of moose (est. 250-275) inhabits southwest Nova Scotia. Survival of calves appears to be low which may be a result of predation by bears in the spring and early summer. Antigonish County and northern Guysborough Counties are the only other areas with moderate numbers. The Chebucto (Halifax) Peninsula and northeastern Halifax County (near Ship Harbour) each have a small and vulnerable localized group of approximately 20 - 30 moose.

Figure 2. Core areas of moose distribution on mainland Nova Scotia and approximate numbers based upon personal interviews with regional biologists. Numerical estimates are based upon data collected using different methodologies. Another 150 moose scattered throughout Halifax, Guysborough and Pictou Counties provides a total estimate for mainland Nova Scotia of approximately 1200 moose (Parker 2003).



1.4 Needs of Moose in Mainland Nova Scotia

1.4.1 Habitat and Biological Needs

Moose are herbivores associated with varying ages and types of boreal and temperate mixed-wood forest habitats with an abundance of twigs, stems and foliage of young deciduous trees and shrubs that they use for food. These habitat mosaics are achieved through natural disturbances (*e.g.* fire, wind, disease) and human induced disturbances (*e.g.* timber harvesting).

Wetlands and access to submerged and emergent aquatic vegetation is an important summer habitat preference where available. Cows when giving birth in spring sometimes use islands and peninsulas. Moose often seek out streams, ponds and shorelines of lakes in summer to escape heat and insects (Franzmann and Schwartz 1998).

A mosaic of habitat types are utilized by moose in winter. Recently disturbed mixed-wood forests provide food, and mature conifer or mixed-wood forest affords shelter and protection from predators and weather. In years with deep snow, moose often congregate in groups of two to six, at locations commonly referred to as 'yards'. Groups remain in yards from January through March. The winter diet of moose in Nova Scotia is comprised of the terminal twigs and

branches of coniferous and deciduous woody plants, such as mountain maple (*Acer spicatum*), yellow birch (*Betula lutea*), sugar maple (*Acer saccharum*) and balsam fir (*Abies balsamea*) (Prescott 1968). In times when food is scarce, moose will break saplings to access otherwise unreachable browse.

Aquatic and semi-aquatic plants when available, supplement the summer diet of moose in mainland Nova Scotia. Preferred species include pondweed (*potamogeton* spp.), common yellow pond lily (*Nuphar lutea),* water shield (*Brasenia schreberi)* and bur-reed (*Sparganium fluctuans*) (Parker 2003). Closed conifer forest is important to moose in summer for thermoregulation (Schwab and Pitt 1991). Moose leave wetlands and move back into the forests as the autumn frosts arrive, utilizing open habitats until January. During late winter they increasingly utilize closed conifer and mixed-wood cover (Franzmann and Schwartz 1998).

Regardless of the season, deciduous woody plants make up the bulk of the moose diet. Diversity of foods in spring increases as new leaves and growth appear. Balsam fir appears to be avoided in the summer but is utilized again after October frosts (Peterson 1955). Although common in southwestern Nova Scotia, spruce and pine are rarely eaten by moose except in times of starvation.

The 2003 Status Report for mainland moose suggests that, "although the forested landscape of mainland Nova Scotia has experienced considerable changes through the past several hundred years, most of the food species preferred by moose, especially in northern districts, are common and widely available. If anything, food may be more available than ever given the intensity of forest harvesting and the proliferation of young regenerating deciduous and mixed forest stands (Parker 2003)." Low quality of habitat in southwest Nova Scotia is indicated by larger home ranges than found by studies elsewhere (Brannen 2004). Southwestern Nova Scotia has little buffering capacity against acid precipitation and, in recent years, effects of acidification have become apparent in water chemistry (Pollock 2006; Kerekes *et.al.* 1986). It is likely that these changes are affecting the availability and quantity of aquatic food species and perhaps the quality of terrestrial browse species for mainland moose.

1.4.2 Limiting Factors

Mainland moose are known or reasonably inferred to be limited by small population size, distribution in small pockets, reproductive fecundity, being large ungulates at the southern edge of their range in North America, sympatric overlap with white-tailed deer which heightens incidence and probability of brainworm (*Parelaphostrongylus tenuis)*, sexual maturity usually reached at two and a half years, calf survival, predation and possibly additional unknown factors.

A deficiency of trace elements (*e.g.* copper, selenium, cobalt) or elevated levels of heavy metals (*e.g.* cadmium) can affect the physiology of moose and be expressed in many ways, including decreased reproduction and elevated calf mortality rates. This is an area that needs further investigation and there are information gaps in the levels required by or negatively affecting moose.

1.5 Threats

1.5.1 Threat Classification

The order of threats presented in the following table represents an approximate ordering of priority based on known information. An explanation of the threat table fields is provided in Appendix A.

Table 1. Threat Classification Table

1 Disease and Parasites		**Threat Information**		
Threat Category	Natural processes	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Elevated incidence of non-compensatory mortality	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Non-age specific mortality	**Causal Certainty**	Unknown	Unknown
		Severity	High	High
Stress	Reduced population recruitment; reduced breeding potential	**Level of Concern**	High	High

2 Poaching		**Threat Information**		
Threat Category	Consumptive use	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Poaching	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Elimination of moose from population (Non-compensatory mortality)	**Causal Certainty**	High	High
		Severity	High	High/Unknown
Stress	Reduced population size and viability; local extinctions; disturbance	**Level of Concern**	High	High

3 Access to Moose Habitat		**Threat Information**		
Threat Category	Disturbance or persecution	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Roads and highways, OHV trails, waterway access	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Increased opportunity for illegal harvest, heightened accidental mortalities	**Causal Certainty**	High	High
		Severity	High	High
Stress	Reduced population size, viability, recruitment and connectivity with other herds/groups	**Level of Concern**	High	High

4 Development (commercial, rural, agriculture)		**Threat Information**		
Threat Category	Habitat loss or degradation; disturbance or persecution	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Housing and commercial development, noise pollution, long-term loss of habitat suitability	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Fragmentation of habitat; habitat conversion; behavioral disruption	**Causal Certainty**	High	High
		Severity	High	High
Stress	Reduced population size and viability; increased mortality; behavioral changes; range abandonment	**Level of Concern**	High	High

5 Forest Practices		**Threat Information**		
Threat Category	Habitat alteration or degradation (*i.e.* short-term loss of quality and/or quantity)	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Reduced representation of older conifer forest in configuration with other habitat types	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Fragmentation of habitat; changes in the quality and/or quantity of thermal cover; reduced opportunity for immigration or emigration; increased human interaction	**Causal Certainty**	Medium	Medium
		Severity	Moderate	Moderate
Stress	Short-term habitat conversion (may also improve habitat quality); changes in the landscape mosaic of forest habitats that affects carrying capacity;	**Level of Concern**	Low	Low

6 Acid Rain		**Threat Information**		
Threat Category	Pollution	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Acid precipitation; heavy toxic metals and availability of essential trace elements	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Alteration of water chemistry and chemically induced release of heavy metals (*e.g.* cadmium) in soils and uptake by vegetation	**Causal Certainty**	Medium	Medium
		Severity	Unknown	Unknown
Stress	Changes in pH affecting abundance and diversity of aquatic food plants; unknown physiological changes.	**Level of Concern**	Unknown	Unknown

7 Climate Change		**Threat Information**		
Threat Category	Climate	**Extent**	Widespread	
			Local	**Range-wide**
General Threat	Multiple variables of life history requisites that are irrevocably altered within a geographic area	**Occurrence**	Current	Current
		Frequency	Continuous	Continuous
Specific Threat	Loss of range	**Causal Certainty**	Medium	Medium
		Severity	Unknown	Unknown
Stress	Change in weather patterns; increase in occurrence of disease and parasites (brainworm & winter ticks); critical energy deficits (*e.g.* thermoregulation)	**Level of Concern**	Unknown	Unknown

1.5.2 Description of Threats

Disease and Parasites

The disease posing the greatest threat to the moose is a parasitic worm, (*Parelaphostrongylus tenuis)* which infects the nervous system of moose and has also been called ‘moose sickness’ or ‘brainworm’. A number of researchers in the northeast have taken part in research since the 1930s to understand the cause and epidemiology of this disease. It has since been determined that white-tailed deer are the normal final host for the parasite and that moose appear to have a high rate of contraction where their range overlaps with that of deer. The parasite, when contracted by moose, can result in a variety of symptoms including: loss of fear of man; weakened and emaciated condition; aimless wandering or refusal to leave a certain place; partial or complete blindness; traveling in circles; drooping of an ear; holding of the head to one side;

partial paralysis of the limbs; and the inability to rise or stand, often followed by death **(**Franzmann and Schwartz 1998; Peterson 1955).

The ecological relationship between moose and the white-tailed deer is not completely understood. There is little evidence that deer themselves are a threat to moose through displacement or competition for food. Numerous hypotheses and studies have centered on the relationship between white-tailed deer and the occurrence of brainworm, which is often lethal to moose. The infection rate of in Nova Scotia deer is approximately 65%. Where moose and deer range overlap, brainworm is a significant mortality factor. Where moose and deer are separated (usually in areas where snow generally becomes too deep for deer in winter) groups/herds of moose seem to be less affected by brainworm. On sympatric range, it is generally accepted that the disease can be responsible for declines in a moose population over periods concurrent with increasing white-tailed deer numbers. However, there have been records of stable or increasing moose populations on ranges where cohabitation with white-tailed deer exists. This is an important issue and one that will continue to be explored by researchers interested in the health of eastern North American moose populations.

The winter or moose tick, *Dermacentor albictus*, is known to exist on moose throughout mainland Nova Scotia. Nymphs and adult ticks engorge on blood during March and April, a critical period of progressive nutritional and energetic stress, and then drop off (Glines and Samuel 1989). Ticks are not able to survive if the engorged female drops in snow in April. They are likely not as abundant in the Picotu/Antigonish Highlands and the Cobequid Hills which normally have more (and later) snow than other areas of mainland (T. Nette pers. comm. 2007).

Although the winter tick has been associated with historical die-offs of central Albertan moose populations (Webb 1959; Samuel and Barker 1979) and the decline of moose on Isle Royale during 1988-90 (DelGiudice *et al.* 1997), it does not appear to be a significant problem in eastern Canada. When moose numbers are low, infection rate of ticks will likely be low as well (B. Samuel pers. comm. 2007). While the winter tick is considered an irritant to moose in mainland Nova Scotia, it is not believed to pose a significant health threat.

Poaching

It is impossible to quantify with confidence, the level of population effects poaching exerts across the province, due to the covert nature and the variable geographic engagement in this illegal activity. Recent enforcement actions initiated by the Nova Scotia Department of Natural Resources (NSDNR) show clearly however, that illegal harvest is a serious threat to the long-term viability of moose in some areas on the mainland of the province. This threat may be closely linked to increased access to moose habitat and the introduction of snowmobiles, all terrain vehicles (ATVs), and other off-highway vehicles (OHVs) all of which increase and facilitate opportunities for illegal harvest.

Access to Moose Habitat

Access to moose habitat is facilitated by an array of vectors including development and forest practices. Access constitutes one of the most significant threats to mainland moose primarily because it increases opportunity and feasibility for illegal harvest and disturbance, resulting in non-compensatory mortality and range abandonment. The result to localized herds/groups is reduced population size and viability. Sustained access and resulting disturbance to moose causes loss of security resulting in range abandonment (Colescott and Gillingham 1998; Ferguson and Keith 1982; Altman 1958). Access and disturbance effects on moose in Nova Scotia are not well understood and require further study.

The introduction of snowmobiles in the 1960s and ATVs in the 1970s has led to increasing popularity of OHV travel in areas where traditional motor vehicles such as cars and trucks can not easily travel. OHV numbers have continued to rise resulting in increased access for humans into back country. OHV owners have cut mosaics of trails over the landscape often in remote areas with the highest quality occupied habitats remaining, increasing opportunities for poaching. OHVs and their impacts have not been adequately studied to fully understand and discern what direct and indirect impacts they may be having on moose.

Development

The development of land for residential, commercial, agricultural (especially the blueberry industry), recreational and transportation purposes has resulted in both the loss and the fragmentation of mainland moose habitat. Land conversion, power line corridors, quarries, road construction and wind power developments fragment the landscape and increasingly isolate herds and groups of moose from one another. In main pockets where mainland moose are found (*i.e.* the Cobequid Hills, Pictou-Antigonish Highlands and the Tobeatic Wildlife Management Area) the largest viable herds are generally associated with the most remote wilderness areas, suggesting the cumulative threats of development, long-term habitat loss and habitat fragmentation. Cumulative loss of habitat is perhaps one of the most serious challenges to maintaining long-term viability of the mainland population. Geographic isolation increases the risk to moose of reduced individual health and productivity, and possibly progressive genetic deterioration (currently under investigation) and may eventually lead to local extirpations (Snaith 2001).

Although difficult to distinguish cause from effects, moose are likely affected by an interplay of factors including permanent land conversion and loss of connectivity resulting in loss of functional habitat and carrying capacity. Potential impacts of proposed wind farm developments in high elevation areas, or their cumulative impacts on mainland moose using these areas are unknown and poorly addressed by existing studies in eastern North America.

Forest Practices

Forest practices can be considered a threat to moose in some ways, but are also a valuable tool in recovery efforts. Forest harvesting creates a disturbance much like fire and insect damage that has long-term benefits to moose that do well in young regenerating forests. The main issue for

which there are not clear answers at this time is whether current forest harvesting practices properly accommodate moose by providing the right mosaic of forest types and age classes for both forage and cover components of habitat. Similar questions surround whether or not existing buffer widths around important wetland habitats are adequate.

Moose use mature conifer stands for shelter, ease of travel due to low snow levels under cover, and protection in the winter, for feeding in late summer and possibly also for cooling in spring and summer months. These stands are attractive to foresters for commercial harvest and as a result this type of habitat is decreasing.

Acid Rain

Acidification is very closely linked to the appearance of heavy metals in the kidneys and livers of moose. Air pollutants can exacerbate changes in soil and surface water pH. Further, surficial geology determines the buffering capacity of soils and the level of local impact. Eighty five percent of Nova Scotia, including much of southwestern and northwestern mainland Nova Scotia and the Cape Breton Highlands, have terrain characteristics with a minimal buffering capacity to neutralize acid precipitation (Pollock 2006; Hirvonen 1984). Acidification can release the naturally occurring metals present in bedrock, resulting in toxic materials being absorbed into the ecosystem through plant uptake and subsequently into herbivorous animals such as deer and moose (Pollock 2006). Through bioaccumulation, levels of heavy metals including cadmium, are compounded in the liver and kidneys throughout the lifetime of an animal.

Cadmium has recently been found in high concentrations in the livers and kidneys of both moose and deer in Nova Scotia. The concentrations represent some of the highest reported for wild herbivores in the northeastern states and eastern provinces (Pollock 2006). Toxic levels of cadmium are known to cause kidney and liver dysfunction, brittle bones and reproductive failure (Scheuhammer 1991). However, there have been no reports to date of health effects related to elevated cadmium levels in wild deer or moose in North America, including Nova Scotia (Pollock 2006). Although researchers are concerned about the high levels of cadmium in the moose and deer of Nova Scotia and will continue to monitor trends, there have been no incidences of illness or disease attributed to this cause.

Climate Change

Climate change is likely to impact Nova Scotia forests and impede long-term viability of the mainland moose population. Variable and erratic fluctuations in seasonal temperatures may affect moose by allowing higher abundance of the winter tick and resulting in higher numbers of deer spreading into what has been primarily moose range. Thermoregulation may become of greater concern with increasing extreme temperatures (Schwab 1985; Schwab and Pitt 1991). Although the impact of climate change on mainland moose is speculative and difficult to measure at this time, it is likely that its consequences will become more apparent in the future.

1.6 Actions Already Completed or Underway

Moose Management

In 2000, mainland moose were assessed by the General Status of Nova Scotia Wildlife assessment process and assigned "Red" status. The designation of a species as "Red" indicates that species is known, or is thought to be at risk of extirpation or extinction. While this designation carried no legal protection, it was enabling in the absence of a formal listing under the Nova Scotia Endangered Species Act (NSESA), and identified relevant conservation concerns to a variety of resource users. Mainland moose were designated "endangered" under the NSESA in 2003. An endangered species is defined as, "a species facing imminent extirpation or extinction". The Act prohibits the killing or disturbing species at risk (s11), destroying or disturbing its residence (s13), and destroying or disturbing core habitat (s13).

In the absence of a legal harvest of moose, management approaches to date have focused on monitoring, research, enforcement and habitat management.

Monitoring

The Wildlife Division of the NSDNR coordinates all inventories and monitoring of the mainland moose and maintain a GIS database of information. The NSDNR has monitored deer populations in Nova Scotia using spring-early summer counts of deer pellet groups along established transects (Pellet Group Inventory [PGI]) to determine indices of relative abundance and distribution of deer. Since its inception in 1983, any moose pellet groups encountered on the deer PGI transects, have been recorded. Though this has provided some valuable insight into relative abundance and distribution of moose, the program was not designed to track moose so has been of limited value in its ability to provide information on moose.

Every third year since 2000 (*i.e.* 2000, 2003, 2006, etc.), the Department has redirected staff effort from the deer PGI program to do transects in areas known to be occupied by moose. In these "moose focused years," any deer PGI transects for which there had been moose pellets recorded in the past, are completed as well. The intent of this program is not to estimate actual moose densities/numbers, but to provide the ability to detect changes in moose abundance over time. This program is limited to providing information relative to winter distribution only.

Winter snow provides a good contrast to view moose and moose sign from the air. Aerial monitoring efforts are made annually across the mainland when conditions are suitable. Unfortunately in recent years, with less snow in early winter, it has been nearly impossible to make any significant use of this technique to monitor distribution or numbers over most of the mainland.

Stewardship

In 2005 the NSDNR posted large roadside signs at local DNR Area Offices declaring that poaching is illegal and mainland moose are endangered. The signs also include a 1-800 number for people to call to report illegal activity.

In an effort to gain the public's help in locating mainland moose, NSDNR recommends that people call their local NSDNR Area Office with reports of moose sightings and signs. The NSDNR website at: **www.gov.ns.ca/natr/wildlife/web/msform.htm** gives the public access to a form to fill in information about their observations that is then submitted directly to the Department. The Nova Scotia Hunting and Fur Harvesting License and Summary of Regulations booklet, which goes out to approximately 60,000 hunters annually, also contains a moose report sighting form.

Poaching and sighting reports are used to provide insight into where the remaining mainland moose populations or groups are, what broad habitat types are used most often, and where humans are likely to encounter moose. The Department investigates all reports of "sick" moose from the public (more information below in the Overall Health and Condition section).

Decoy Moose Model

In 2005, NSDNR adopted a new enforcement tool aimed at catching moose poachers. Since then, nine arrests have been made using life-sized robotic moose decoys named, 'Bullwinkle'. Education and public awareness about the status of the mainland moose population combined with the knowledge that theses tools are being employed by the NSDNR serves as a deterrent for 'would be' poachers. Due to the covert nature of poaching it is difficult to determine with confidence how many mainland moose are illegally killed in any given area or season.

GPS Telemetry

Since 2002, the NSDNR has utilized GPS telemetry (*i.e.* collars) technology on moose in some areas of the mainland to collect data on spatial aspects of their ecology. This research is directed toward addressing questions surrounding spatial and temporal aspects of site selection and movements of individual moose in relation to seasons, temperature, calving and roads (H. Broders pers. comm.). Currently these data are being analyzed at Saint Mary's University.

Genetic Research

Genetic comparisons between moose herds/groups are used to determine similarity or dissimilarity among them and the degree of genetic isolation. Although these studies on molecular genetics have been ongoing since 2003, the work is still considered preliminary because the sample sizes are too small to be conclusive. Work to date has centred on the examination of genetic similarity/dissimilarity between New Brunswick, Cape Breton, and three areas within mainland Nova Scotia (Tobeatic, Cumberland and Guysborough). Although geneflow was observed among Tobeatic and Guysborough sampling areas and among the Cumberland and Guysborough areas, there was little genetic exchange apparent among mainland Nova Scotia moose populations and those occurring in New Brunswick and Cape Breton Island (Ball 2003). According to Bayesian population assignment tests, New Brunswick, Cape Breton and mainland Nova Scotia are each genetically distinct (Ball 2003). A larger sample size of genetic samples is required to confidently determine the substructure and degree of genetic diversity within moose groups/herds on mainland Nova Scotia and their relatedness to moose elsewhere.

Overall Health and Condition

Dr. Scott McBurney of the Canadian Cooperative Wildlife Health Centre (CCWHC) at the Atlantic Veternairy College (University of Prince Edward Island [UPEI]) diagnostic laboratory in Charlottetown, Prince Edward Island, has been involved in investigations to determine the overall health of mainland moose. Since 2000, the health of the mainland moose population has been evaluated opportunistically, on an ongoing basis by the post mortem examination of all moose mortalities, no matter the circumstances of death (*i.e.* natural mortality, trauma or euthanized). To date, vehicular trauma and brainworm are the most common causes of mortality in the population (Beazley *et al.* 2006). Continued disease surveillance, with complete necropsies when possible, integrated with targeted research designed to address the additional potential health problems previously identified in the population (*e.g.* nutrient deficiencies and calf mortality), is essential to determine the impact of health related issues on the recovery of the mainland moose population (Beasley *et al.* 2006).

The NSDNR purchased a horse trailer in late 2006 for the purpose of safely transporting sick or injured moose in Nova Scotia to quarantine facilities at Shubenacadie Wildlife Park. Previously, the NSDNR used trucks and could only safely transport animals for an hour before sedation wore off.

Normally, moose are euthanized only when the condition of the animal is assessed and deemed terminal and the full carcass then transported to UPEI. If transport of the full carcass is not possible, key organs and tissues are collected for analysis. Necropsies of organs and/or tissue samples collected from and deceased mainland moose (*e.g.* road kill, sickness, drowning, poaching and unknown cause) are conducted by Dr. Scott McBurney at the CCWHC.

Habitat Suitability Analysis and Population Viability

A 2002 study estimated the population viability for mainland moose based on a number of assumptions (due to the lack of mainland moose population specific data). The results indicated that it is not likely that isolated, localized groups of less than 500 individuals can persist in the short-term (Snaith 2002; Beazley *et al.* 2006). Without genetic interchange between groups/herds across the province with other populations (*i.e.* New Brunswick and Cape Breton Island), mainland moose may not persist over the long-term at under 5000 individuals (Snaith 2002; Beazley *et al.* 2006). Due to the lack of accurate population demographic based information, genetic information, and information on the amount of interchange between remaining groups/herds, these determinations are uncertain. Although these results can only be considered preliminary until more data is available, they raise concern that at current estimated numbers, mainland moose are in a precarious state and long-term viability is uncertain.

A coarse-scale habitat analysis was also undertaken to quantify the proportional availability of forage, softwood cover, mixed cover and wetlands based on a habitat suitability index (HSI) model developed in Ontario and adapted for Nova Scotia (Snaith 2002; Beazley *et al.* 2006). Of six theoretical models developed for Nova Scotia, there was little indication of optimal moose habitat on the mainland, with only 1000 to 6000 km^2 scoring as very good or good habitat (Snaith, 2002; Beazley *et al.* 2006). The HSI values did not correlate with the moose pellet

presence/absence locations maintained by NSDNR. Considered alone, forage and forage-in-proximity-of-cover suitability index values were able to predict pellet presence or absence (Snaith 2002; Beazley *et al.* 2006). These results raised questions about whether the differences between moose habitat components applied in the Ontario model (developed for application within the boreal forest region) are transferable to Nova Scotia's Acadian forest region.

Results of the same study showed that there were significant correlations between moose pellet presence or absence and road density (Snaith 2003; Beazley *et al.* 2006). Is should be noted that use of pellet data is only an indication of winter habitat use and the PGI data is incomplete and has other inherent sampling biases. Taking these factors into consideration however, it still appears that where road densities are higher, the likelihood of moose being present is reduced (Beazley *et al.* 2004). While findings of this study are important, it focused primarily on determining a method to predict the locations of suitable moose habitat and the identification of other causal factors that could be implicated. The relationship between the known distribution of moose, road densities and the array of other causal factors that maybe implicated remain unknown (Beazley *et al.* 2006).

1.7 Knowledge Gaps

Knowledge gaps impacting the recovery efforts for mainland moose include:

- Basic demographic data on herd/group size and structure
- Reproduction and recruitment
- Disease and mortality
- Extent and level of illegal harvest on herds/groups
- Habitat preference and availability
- Critical loadings of heavy metals and other toxins
- Dietary deficits (*i.e.* trace elements)
- Disturbance factors
- Genetic diversity
- The significance of all above factors to each herd/group
- Interrelatedness of these factors

2. RECOVERY FEASIBILITY

2.1 Recovery Feasibility

Factors affecting the status of moose on mainland Nova Scotia are many, complex and in most cases poorly understood. With small widely distributed herds/groups across the mainland and low overall numbers, the feasibility of designing effective field studies that can provide results that can be applied with confidence is logistically problematic. While recovery is considered feasible there are formidable research and conservation challenges. There is reason for optimism however, since there is evidence of successful reproduction, habitat is broadly available and a number of conservation actions have already shown some success. Continuing research and monitoring have the promise to resolve many of the gaps in our current knowledge.

There is enough data available for three of the herd/group centers to suggest that they have active breeding/reproduction (T. Nette pers. comm. 2007). Public reports of moose sightings throughout all seasons indicate sporadic presence throughout mainland Nova Scotia, suggesting regular movements and exchange of individuals between herds/groups. Future studies may be able to address whether or not there is sufficient movement between groups/herds to maintain genetic vigour.

The variable weighting of threats and limiting factors across the mainland must be better understood through research and reinforced management actions. Ongoing recovery activities are showing some success and include heightened enforcement efforts, new research, increased effort to investigate cases of sick moose and management to assess overall herd/group health and condition. Cooperation and communication with foresters has improved over the last two decades in working toward understanding how forest practices may positively or negatively impact moose. Many of the recovery actions identified in this plan have been used successfully to manage moose in other jurisdictions.

Although not a direct result of moose recovery efforts, the recently enacted Off-Highway Vehicle Act has the promise of better controlling human disturbance and poaching in remote interior areas occupied by moose. For recovery to be successful, stewardship and cooperation between First Nations, industry, governments, and the public is essential. All of these groups need to be empowered with the knowledge that poaching constitutes a crime that affects society. Natural resource users across the mainland that affect habitat change at landscape levels will need to build close working relationships and innovative approaches in the future to conserve moose habitat. Nova Scotians can contribute to the recovery of mainland moose through reporting observations of animals and illegal activities.

2.2 Recovery Goal

To maintain the population of mainland moose in Nova Scotia within their current range.

2.3 Recovery Objectives

The short-term objectives of the recovery plan for the mainland moose in Nova Scotia from 2007 to 2012 are to:

1. Maintain and enhance the current population and distribution
2. Mitigate threats (where possible) that limit recovery
3. Initiate research to address priority knowledge gaps
4. Maintain and enhance habitat

2.4 Approaches Recommended to Meet Recovery Objectives

2.4.1 Recovery Planning

The following table summarizes recovery actions, specific steps that need to be taken and the priority of these actions to effect recovery of moose on the mainland of the province. Appropriate timelines for implementing these actions and their costs associated will need to be more thoroughly developed and defined by the recovery team in cooperation with the NSDNR.

Table 2. Recovery Planning Table

[a] Priorities are defined as follows: Urgent = top priority action, without which population will decline; Necessary = action needed to evaluate and guide recovery actions; Secondary = action beneficial if urgent actions are already under way.
[b] Threats: (1) Disease and Parasites; (2) Poaching; (3) Access to Moose Habitat; (4) Development; (5) Forest Practices; (6) Acid Rain; (7) Climate Change; (8) Knowledge Gaps

Priority[a]	Recovery Action	Objectives Addressed	Threats Addressed[b]	Specific Steps
	Research			
Urgent	• Improve understanding of the weighting and interrelationship(s) of threats and limiting factors	1,2,3	All	• Develop research proposals
Necessary	• Improve understanding of habitat suitability, availability and selection	3,4	3,4,6,7,8	• Evaluate GPS telemetry collars data to date • Determine data significance to habitat use/ structure and the potential management implications • Design/initiate future studies
Necessary	• Improve efforts to provide insight into the structure and genetic profile of mainland moose	3	8	• Increase genetic sample size from prelim. investigations
Necessary	• Investigate the cause of death/illness of all found dead and apparent “sick” moose	3, 2	1,2,6,7	• Recover and analyze all mortalities and ill animals

[a] Priorities are defined as follows: Urgent = top priority action, without which population will decline; Necessary = action needed to evaluate and guide recovery actions; Secondary = action beneficial if urgent actions are already under way.
[b] Threats: (1) Disease and Parasites; (2) Poaching; (3) Access to Moose Habitat; (4) Development; (5) Forest Practices; (6) Acid Rain; (7) Climate Change; (8) Knowledge Gaps

Priority[a]	Recovery Action	Objectives Addressed	Threats Addressed[b]	Specific Steps
	Monitoring			
Necessary	• Initiate a rigorous long-term monitoring program to provide reliable data on the distribution and demographics of moose on mainland Nova Scotia	1,3	1,3,4,5,	• Evaluate methods currently used • Determine feasibility of methods used elsewhere for use in Nova Scotia • Develop and initiate monitoring protocol
Secondary	• Establish means of monitoring the impact severity of each factor (threat) known to inhibit growth of localized moose herds/groups	1,2	All	• Assess all information about known mortalities and associated causes and any new information about threats, on an ongoing basis
	Management			
Urgent	• Develop and implement a strategy to reduce poaching	1,2,3	2,3	• Develop an enforcement/ public relations strategy with measurable outcomes
Necessary	• Decrease occurrence of preventable mainland moose mortality	1,2	3,4,7	• Identify locations where moose/vehicle collisions and preventable natural mortality are most prevalent • Employ techniques such as signage, lighting, fencing, passage and bog pond ramps
Secondary	• Determine the feasibility of translocating adult moose and/or orphans from New Brunswick and proceed as appropriate	1,2	8	• Consider biological basis and need • Contact NB DNR to discuss

[a] Priorities are defined as follows: Urgent = top priority action, without which population will decline; Necessary = action needed to evaluate and guide recovery actions; Secondary = action beneficial if urgent actions are already under way.
[b] Threats: (1) Disease and Parasites; (2) Poaching; (3) Access to Moose Habitat; (4) Development; (5) Forest Practices; (6) Acid Rain; (7) Climate Change; (8) Knowledge Gaps

Priority[a]	Recovery Action	Objectives Addressed	Threats Addressed[b]	Specific Steps
Necessary	• Review and adapt forest management practices as habitat requirements of moose in Nova Scotia are better understood	1,2	2,3,5,7	• Recovery Team to review practices as necessary
	Education			
Urgent	• Raise public awareness of the status of mainland moose, threats and recovery efforts	1,2	1,2,3,4,5	• Develop and implement a strategic communications plan
	Stewardship			
Secondary	• Promote public reporting of poaching and moose observations	1,2	1,2,3	• Develop business sized card with contact information • Ensure upkeep of anti-poaching highway signs
Necessary	• Engage partners in recovery activities	1,2,3	2,4,5,7	• Target foresters, First Nations, hunters, industry, landowners, universities, conservation organizations, etc.
Necessary	• Engage landowners in stewardship of mainland moose and their habitat	1,2,4	2,4,5,7	• Develop and deliver stewardship packages for landowners

2.4.2 Narrative to Support Recovery Planning Table

Research

Actions to be initiated:

Improve understanding of the weighting and interrelationship(s) of threats and limiting factors

Although there has been some preliminary work done to determine the weighting of threats affecting moose survival that may impede or facilitate recovery, large knowledge gaps remain. To ensure that the best decisions on priorities are implemented for mainland moose, more knowledge gained through research is required for the effective implementation of recovery actions.

Research is necessary to fill knowledge gaps surrounding the impact of human activities and moose habitat requirements at functional scales that include site specific, intra and inter-landscape levels. Cumulative long-term habitat loss through development requires research to understand tolerance thresholds and carrying capacity for moose at landscape levels. Development activities that affect long-term loss of habitat and local scale activities that change the configuration and types of habitats (*e.g.* forestry) over shorter time periods need to be discerned at ecosystem scales. In particular, fragmentation by-products at both of these scales through road construction, creation of linear corridors (*e.g.* power lines and pipelines) and their compounded limiting effects on moose must be better understood. Results of such research are critical to the informed direction of future recovery actions. This research will also help to guide materials for a stewardship program to educate people about best management practices to recover mainland moose.

Improve understanding of habitat suitability, availability and selection

The NSDNR has been using GPS telemetry collars on moose to collect data on special aspects of their ecology. By analyzing all of these data collected to date, the value of this information can be determined and used to direct management initiatives and improve the design of future studies. To date, moose collar data does not provide adequate representation of all seasons or age/sex classes due to small sample size, and is not reflective of varying regional habitats currently occupied by moose. Continued use of GPS collars and employment of real-time data GPS collars, are recommended to more confidently address these factors.

Improve efforts to provide insight into the structure and genetic profile of mainland moose

Genetic investigations can reveal much about the condition and evolutionary history of a species. Preliminary molecular genetics research has shown that larger sample sizes are required to determine whether substructure exists within and among herds and groups on the mainland.

Investigate the cause of death/illness of all found dead and apparent "sick" moose

Accurate knowledge about the health and incidence of disease and mortality is important to understanding population ecology of moose across the mainland. Animals identified as "sick" will be examined and when appropriate, transported alive to the quarantine facilities in Shubenacadie, Nova Scotia; otherwise, they will be humanely euthanized and sent to UPEI for a complete post mortem examination.

Outcomes or deliverables by or before 2012:

- Prioritize and initiate studies to evaluate the most significant factors limiting population growth (*e.g.* population demographics)
- Complete analysis of existing GPS telemetry data and summarize findings to evaluate the effectiveness of this technology for future use
- Complete molecular genetic studies
- Continue to collect and analyze dead and sick mainland moose for necropsy
- Collect blood, hair, tissue for DNA and fecal samples of all moose handled during future collaring activities, for analysis and assessment of health and condition

Monitoring

Actions to be initiated:

Initiate a rigorous long-term monitoring program to provide reliable data on the distribution and demographics of moose on mainland Nova Scotia

To date, pellet group inventory and aerial surveys have been the methods used to determine the distribution and population demographics of mainland moose. Both of these methods are problematic, used in winter, and therefore do not give information on the summer distribution. Moreover, annual winter aerial surveys cannot be used reliably or regularly with confidence over the entire mainland. The methods used to date must be re-evaluated to assess their utility and methods applied elsewhere (*i.e.* new infrared imaging technology) evaluated to determine their practicability for application in Nova Scotia. A plan must be prepared to initiate a reliable, repeatable long-term monitoring program to provide data on the distribution and demographics of moose on mainland Nova Scotia.

Establish means of monitoring the impact severity of each factor (threat) known to inhibit growth of localized moose herds/groups

Understanding the significance and weight of single factors and the interplay between factors that may vary over the mainland is important to implementing timely and effective recovery actions. Research is necessary to help fill gaps in our knowledge. Similarly, synthesis and regular reporting of existing information such as causes of fatalities and the health and condition will be essential. The combination of these approaches is necessary to determine the most appropriate geographic scales for recovery units.

Outcomes or deliverables by or before 2012:

- Establish a long-term monitoring program designed to provide reliable data on relative numbers and distribution of moose on mainland Nova Scotia
- A report will be presented every two years to the Recovery Team compiling numbers and causes of known deaths and additional insight acquired relative to overall health and condition of mainland moose in Nova Scotia

Management

Actions to be initiated:

Develop and implement a strategy to reduce poaching

A comprehensive enforcement/public relations strategy for mainland moose is required. Community education, awareness and promoting stewardship will be important objectives. The enforcement strategy will identify:

- Enforcement priorities (*i.e.* effective procedures)
- Objectives (*i.e.* reduce poaching, increase reporting on illegal activities)
- Actions and approaches to be used (*i.e.* mechanical moose model, cash reward for information leading to arrests)
- Key messages to be communicated to the public (*i.e.* poaching undermines all mainland moose recovery efforts)
- An implementation plan with timelines
- A mechanism for measuring the effectiveness of enforcement activities. (*i.e.* interviews, surveys, behavioral based results)

Decrease occurrence of preventable mainland moose mortality

There are some causes of mortality in mainland moose that may be managed to minimize mortalities. After identifying the locations where moose/vehicle collisions and preventable natural mortality are most prevalent, these areas could be targeted (*e.g.* moose road crossings, bog drowning ponds). Techniques that could be employed include signage, lighting, fencing, passage over/under roads and bog pond ramps.

Determine the feasibility of translocating adult moose and/or orphans from New Brunswick and proceed as appropriate

Any decision to translocate moose must be made with careful consideration of all relevant facts pertinent to the species. The biological basis and need for introducing moose from elsewhere must be founded on genetics information and with consideration of potential threats (*e.g.* disease) that may be incurred to the population. The merits of such an introduction would require a solid foundation of research prior to the introduction with post introduction follow-up. Negotiation with the New Brunswick Department of Natural Resources would be necessary to determine whether this province would be prepared to assist in providing a source of animals for translocation.

Review and adapt forest management practices as habitat requirements of moose in Nova Scotia are better understood

Special management practices applied by the NSDNR on crown lands are intended to support the recovery of mainland moose. As new information becomes available, these practices are reviewed and revised by NSDNR from time to time. In future, revisions to these special management practices should also be reviewed by the Recovery Team.

Outcomes or deliverables by or before 2012:

- Apply actions and approaches to reduce poaching as described in the Enforcement Strategy
- Apply techniques to reduce instances of preventable mortality where appropriate
- Determine whether translocation of moose is required and logistically feasible
- Special management practices will be reviewed by the Recovery Team

Education

Actions to be initiated:

Raise public awareness of mainland moose, threats and recovery efforts

A plan is required to raise public awareness about mainland moose.

The plan should identify:

- Target audiences (*e.g.* First Nations, youth, hunters, forest companies, etc.)
- Objectives
- Priorities (*e.g.* youth-oriented curriculum)
- Key messages
- Delivery methods and approaches
- Performance indicators
- Timelines

Outcomes or deliverables by or before 2012:

- Develop and deliver an effective communication plan

Stewardship

Actions to be initiated:

Promote public reporting of poaching and moose observations

DNR Conservation Officers and Regional Biologists are responsible for managing a diversity of wildlife species within large geographic areas of the province. The general public and many people working or recreating in moose habitat can assist by providing information about moose distributions, the observed sex and age of animals and reporting illegal activities, which are extremely valuable data.

In winter months, local DNR depots each display an anti-poaching sign featuring an image of a mainland moose and the provincial phone number to report illegal activity (1-800-565-2224). Upkeep of these signs and use of local media to reinforce the importance of sharing sighting observations and reporting poacher activity would be valuable to recovery efforts.

Engage partners in recovery activities

Recovery of the mainland moose will require not only commitments on the part of NSDNR, but also ongoing support by an array of dedicated partners including foresters, First Nations, hunters, industry, landowners, universities and conservation organizations.

Engage landowners in stewardship of mainland moose and their habitat

It is clearly apparent that moose are a high profile species for which Nova Scotians feel a sense of ownership. No one wants to see moose numbers decline further. Nova Scotians, could be offered a stewardship package of information about 'best' management practices to enhance and support mainland moose recovery on their lands. These packages could be delivered in conjunction with workshops/information sessions provided throughout the mainland.

The stewardship information package could include:

- 'Best' forest management practices
- Development and recreational ethics on your property
- Frequently asked questions
- Contact information to report observations or illegal activities

Outcomes or deliverables by or before 2012:

- Print and distribute business sized cards with contact information to report sightings or illegal poaching activity
- Maintain signage at NSDNR depots promoting anti-poaching
- Identify and enable partners who can assist in achieving the goal and objectives of this recovery plan
- Develop tools and approaches to affect stewardship

2.5 Core Habitat

By definition, in the Nova Scotia Endangered Species Act, " 'core habitat' means specific areas of habitat essential for the long-term survival and recovery of endangered or threatened species and that are designated as core habitat pursuant to Section 16 or identified in an order made pursuant to Section 18." Under the NSESA, the province of Nova Scotia may identify "core habitat" for provincially endangered species.

Insufficient qualitative, quantitative, spatial and temporal information exists at this time necessary to identify core habitat for mainland moose. Moose use a broad array of habitat types that are variable in space and time. Significant information gaps surrounding the life history, landscape ecology and biology of mainland moose will need to be addressed before core habitat can be defined.

2.6 Existing and Recommended Approaches to Habitat Protection

In addition to the Nova Scotia Endangered Species Act, protection is afforded to mainland moose under the: Wildlife Act, Habitat Watercourse Protection Regulations, Forestry Act, Integrated Resource Management Land Classification on Crown Lands, Off-Highway Vehicles Act, Protected Areas Legislation, and Wilderness Areas Act.

2.7 Effects on Other Species

It is very likely that recovery efforts for mainland moose will benefit other species forest dwelling wildlife. Adaptive approaches towards improving forest management practices, including road access and habitat management could have both direct and indirect benefits to other species and ecological function at landscape scales.

2.8 Recommended Approach for Recovery Implementation

A combination of ecosystem scaled and single-species recovery actions will be pursued for the mainland moose in Nova Scotia.

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APPENDIX A: EXPLANATION OF THREAT TABLE

The outline for the threat table is taken from *Guidelines on Mitigating Threats to Species at Risk,* Environment Canada, 2006. A brief definition and explanation of each field in the table is given below.

Threat Category: Broad Category indicating the type of threat

General Threat: Typically the general activity causing the specific threat. To be determined by Status Report author or recovery team/planner.

Specific Threat: The specific factor or threat causing stress to the population. To be determined by Status Report author or recovery team/planner. Note that not every threat can be specified to all three levels in this classification hierarchy. Thus, in these situations, specify either a general or specific threat.

Stress: Indicated by an impairment of a demographic, physiological, behavioral attribute of a population in response to an identified or unidentified threat that results in a reduction of its viability. To be determined by Status Report author or recovery team/planner.

Extent: Indicate whether the threat is widespread, localized, or unknown across the species range.

Occurrence: Indicate whether the threat is historic (contributed to the decline but no longer affecting the species), current (affecting the species now), imminent (is expected to affect the species very soon), anticipated (may affect the species in the future), or unknown. If applicable, also indicate whether the occurrence differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Frequency: Indicate whether the threat is a one-time occurrence, seasonal (either because the species is migratory or the threat only occurs at certain times of year- indicate which season), continuous (on-going), recurrent (reoccurs from time to time but no on an annual or seasonal basis), or unknown. If applicable, also indicate whether the frequency differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Causal certainty: Indicate whether the best available knowledge about the threat and its impacts on population viability is high (evidence causally links to the threat to stresses on population viability), medium (correlation between the threat and population viability, expert opinion, etc), or low (assumed or plausible threat only). This should be a general reflection of the degree of evidence that is known for the threat, which in turn provides information on the risk that the threat has been misdiagnosed. If applicable, also indicate whether the level of knowledge differs between 'local' and 'range-wide' distribution.

Severity: Indicate whether the severity of the threat is high (very large population-level effect), moderate, low, or unknown. If applicable, also indicate whether the severity differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Level of concern: Indicate whether managing the threat is an overall high, medium, or low concern for recovery of the species, taking into account all of the above factors.

Local: Indicates threat information that relates to a specific site or narrow portion of the range of the species.

Range-wide: Indicated threat information relates to the whole distribution or large portion of the range of the species.

APPENDIX B: GLOSSARY OF TERMS

From Franzmann A.W. and C.C. Schwartz, 1998

cervid- a member of the deer family

dewlap- a flap of skin hanging from the neck that functions as a visual communicator

palmate - having a shape similar to that of a hand with the fingers extended

ungulate – an animal that bears hooves