HISTORY, STATUS AND PRESENT DISTRIBUTION OF MOOSE IN NOVA SCOTIA

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ABSTRACT: A brief history of moose distribution, management and hunting in Nova Scotia from first European contact to 1995 is presented. At present, the distribution of moose on mainland Nova Scotia is similar to distributions during the 1960's, although densities are much reduced. Winter aerial surveys indicate a decrease from 0.49 moose/km^2 in 1968 to 0.08 moose/km^2 in 1994 for traditional moose ranges in the northern mainland. Preliminary aerial surveys in 1993 of the southwestern (Tobeatic) region of the province suggest densities may reach 0.35 moose/km^2. Densities on western Cape Breton Island for 1993 range from 0.98 moose/km^2 in the south to 2.80 moose/km^2 in the north. Associations with deer, current forest management practices, hunting and predation are discussed as possible causes for changes in population levels and distribution. Management implications are discussed.

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Moose (*Alces alces*) have a long and prominent history in Nova Scotia. As a game species, they have contributed to the quality of human existence in this region for many hundreds of years. The following section, detailing a brief history of moose abundance, distribution, management and hunting in Nova Scotia is a compilation of information from Benson and Dodds (1980), and various other Nova Scotia Department of Natural Resources (NSDNR) documents.

HISTORY

1600-1800

When Europeans first settled in Nova Scotia during the early 17th century, they encountered an eastern moose (*A a. americana*) population that was plentiful and relatively uninfluenced by non-human predators. Unlike many areas of North America where present-day moose populations exist, wolves do not appear to have significantly influenced Nova Scotia moose herds since European arrival. Dodds (1993) reported that wolves were considered rare in Nova Scotia since at least 1786 and most likely extirpated from the province by 1847. Although it is possible, and indeed likely that Nova Scotia had a resident wolf population prior to European occupation, it would appear from early records that they were never considered plentiful. In Nova Scotia, moose have always been the dominant large ungulate, persisting throughout much of their historical range, despite a number of significant population declines over the last 300 years.

Evidence gathered from shell heaps at various locations in Nova Scotia indicate that moose and woodland caribou (*Rangifer tarandus*) were abundant and important staples of Native peoples for several hundred years prior to the arrival of Europeans. When European colonizers did reach Nova Scotia, moose and caribou could still be found in large numbers throughout the province. During Nova Scotia's period of settlement and rapid human population growth, moose populations were substantially diminished by overharvesting and habitat loss. Settlers soon recognized, and exploited the obvious value and importance of moose as an easily obtainable source of food, tallow and hides. One account from early records of Liverpool township reports that dozens of moose were

killed annually during winter months when conditions allowed for both hunters and dogs to approach animals that were floundering in deep snow. By the mid to late 1700's it was obvious that the provincial moose herd could not accommodate the constantly growing demands for meat and hides by Natives, settlers and market hunters. By the beginning of the 19th century, the effects of overharvesting lead to the virtual extirpation of moose from the eastern two thirds of the mainland.

1800-1890

By 1825 the affects of unrestricted moose harvests on Cape Breton Island were evident as well, with declining numbers. Various references to trade at that time report that moose were being harvested exclusively to satisfy a growing export market for their hides. Reports of mounds of moose meat rotting along the shores and stenches smelled several miles off the coast from the same were common at the time. As moose numbers continued to decline throughout Nova Scotia, Halifax based sport hunters and game enthusiasts became more intolerant of subsistence and market hunters, openly blaming the latter for the condition of the moose herd. Debate between the two groups raised the profile of this issue and in 1843 and 1844 legislation capable of regulating hunting in Nova Scotia was passed. However, it was not until 1856 that Nova Scotia set its first big game season, restricting moose hunting to the period September 1 to February 1, although with no apparent restrictions on bag limits, killing methods or sale of meat.

For the next several years concerns over fluctuating moose numbers resulted in additional restrictive legislation, including the protection of cows and a ban on export of hides. In 1874 Nova Scotia closed its moose season for the first time. With this closure and other protective legislation, Nova Scotia needed and appointed its first provincial game wardens in 1874. At the end of a three year period, mainland moose populations increased and an open season was again declared in 1877. In 1879 snaring moose and hunting them with dogs was made illegal. In 1908 the reporting of all moose kills to the Provincial Chief Game Commissioner became mandatory and would serve as Nova Scotia's initial step in gathering biological information from hunters.

Coincidentally, white-tailed deer (*Odocoileus virginianis*) were beginning to recolonize their previous occupied northern ranges with increasing numbers throughout the northeast.

1890-1960

Concurrent with natural range expansion of white-tailed deer into Nova Scotia from New Brunswick, was the introduction of 17 or 18 deer from that province to Nova Scotia between 1894 and 1910. These introductions together with an immigration from New Brunswick resulted in the spread of deer throughout mainland Nova Scotia.

While white-tailed deer were rapidly expanding their range in the province between 1890 and 1920, moose numbers on the mainland were also increasing. Unfortunately, the herd exceeded the carrying capacity of their range and the population crashed in the early 1920's. Following this decline, moose numbers rebounded once again. In 1927 an 18 year restriction on cow harvest was lifted, resulting in a harvest of 1677 animals, the highest reported harvest of moose in the province to that date (Benson 1957). For the next nine years managers attempted to control the harvest by altering season lengths, without recognizing the importance of relationships between winter range, carrying capacity and herd size. Consequently, in 1937 with the provincial moose herd declining once again, the season was closed. Within 10 years of this closure, the mainland herd increased, peaked, and then crashed between

1949 and 1951.

The moose population on Cape Breton Island did not experience similar fluctuations, never having recovered from a decline at the turn of the 20th century. In an attempt to rebuild the herd, 7 moose from the mainland were released to the western portion of the island during 1928 and 1929. This venture proved unsuccessful. In 1947 and 1948 a second attempt was made. Eighteen moose from Alberta (*A. a. andersoni*) were released in Cape Breton Highland National Park. These animals, along with those surviving from the eastern race, have formed the basis of the present Cape Breton Highland's moose herd (Fig. 1).

By 1928 deer were abundant throughout Nova Scotia, and by 1935 deer herds in some areas of the province experienced high levels of winter mortality. Biologists openly voiced their concerns about the effects that the rapidly expanding deer population might have on moose as early as 1932. By 1935, these concerns appeared well founded following a period of "moose sickness" in the Liscombe Game Sanctuary. Moose mortality was not strictly confined to the sanctuary. However, it was evident that in areas where deer were abundant, moose populations declined more quickly than in areas where deer were scarce. Although "moose sickness" was not officially suggested as the cause of moose declines in Nova Scotia until 1958, other areas (Maine, Minnesota and Ontario) documented many cases of moose with similar symptoms, years earlier. In all cases the outbreak and spread of the disease was thought to be related to forest cutting and ingress of white-tailed deer.

Moose numbers did not increase again until after 1957 which was coincident with a marked decline in the provincial deer herd. This increase took place primarily in the eastern mainland (Cumberland, Colchester, Pictou, Antigonish, Guysborough and Halifax Counties, Fig. 2).

1960-1995

By the early 1960's moose were once again a high profile big game species in Nova Scotia. Surveys conducted in the 1950s were re-examined, and studies were initiated to better understand habitat selection, population size, sex and age structure and the effects of deer and moose interactions. In 1963 the mainland herd was estimated at between 3600 and 4000, with the highest densities reported in the Cobequid Hills and the Pictou-Antigonish Highlands (Fig. 1).

As a result of the 1963 survey, an experimental ten day hunt was held in 1964 in those areas of higher moose concentrations. The results were analyzed in 1965 and hunting resumed in 1966, continuing annually until 1974. Licenses were issued by lottery and increased from 400 (1964) to 800 (1966) and to 1000 for the next eight years. The season was closed in 1975 for two years, after kill data suggested that unequally distributed hunting pressure was adversely affecting moose distribution.

In other areas of the province, from the late 1960s into the 1970s, moose numbers were increasing. This was most evident in the southwest as well as Lunenburg, Hants, Kings, Inverness and Victoria Counties. In 1977 the moose hunting season was re-opened on the mainland and 650 licenses were issued by lottery draw for six zones (Fig. 2) within the same counties hunted from 1966 to 1974. Unlike past hunts the number of licenses issued were based on predetermined harvest quotas. This format continued until the season was closed following the 1981 hunt due to declining hunter success and herd size.

While numbers of moose on the mainland appeared to decline, the Cape Breton Highland's herd was healthy and growing. This population had continued to grow since the 1948/49 introductions, but went unnoticed due to poor access. Extensive road development in the late 1970s to salvage wood damaged by spruce budworm

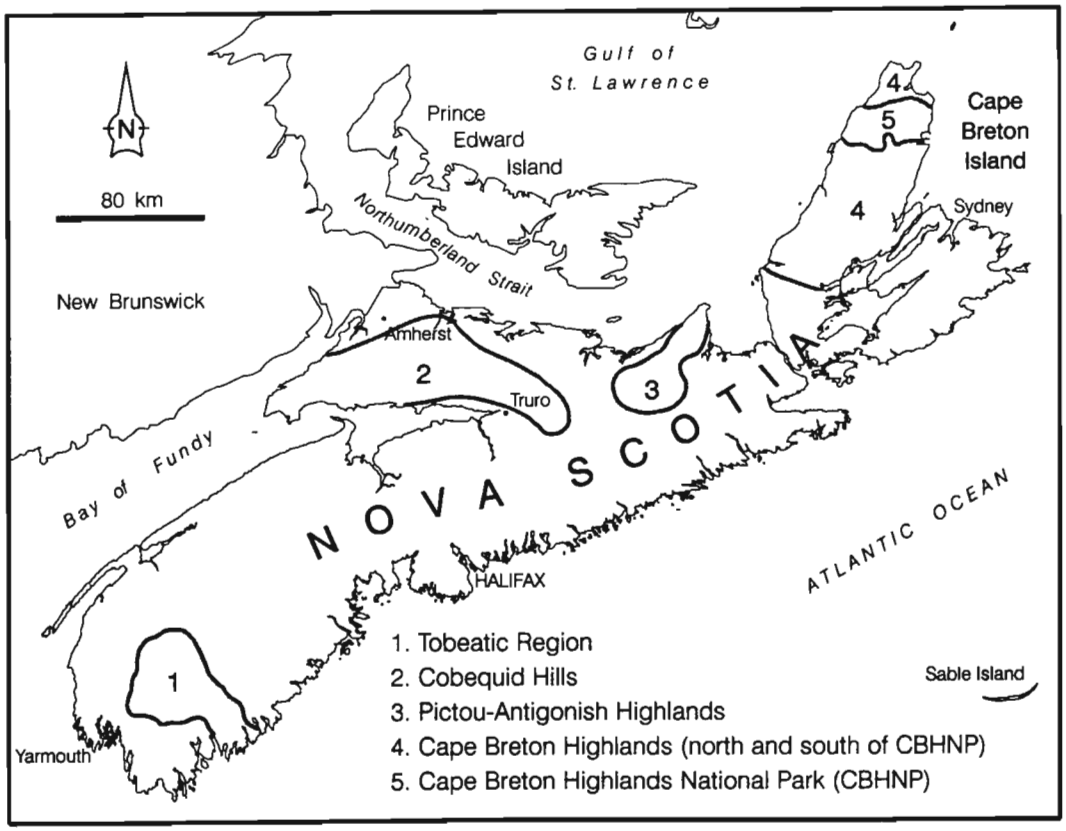

Fig. 1. Areas where moose populations have declined, are relatively abundant, or high.

(*Choristoneura fumiferana*) provided access and the size of the herd was soon realized. Consequently, in 1980 and 1981 a Cape Breton Highlands zone (8, Fig. 2) was established in conjunction with the mainland hunt. Harvest results in 1980 and 1981, together with population surveys indicated that the area could sustain future limited entry hunts. Between 1986 and 1992, 200 licenses were issued by lottery draw for a one week season. In 1993 season length was increased to two weeks to provide greater recreational opportunity. Hunter success for 1986 through 1994 averaged 78%, and ranged from 57% to 93%. Harvest of moose by Natives on the Cape Breton Highlands was essentially unregulated until 1989. At that time, Nova Scotia signed a one year conservation agreement with the Native community agreeing to a minimum harvest of 50 animals and a maximum of 200 based on sport licenses issued but not filled. Although this agreement has not been renewed, Natives still harvest moose in the area before and after the lottery hunt. At present the number of moose taken annually by Natives is unknown, although estimates based on confirmed and/or reliable reports indicate that numbers are likely between 100 and 200.

STATUS AND DISTRIBUTION

From an extensive 1964 aerial survey, Telfer (1968) identified regions of high, medium and low moose density on the Nova Scotia mainland. High density (0.46 moose /km^2) areas accounted for 15% (5473 km^2) of available range and were restricted to the Cobequid Hills and Pictou-Antigonish Highlands. Both areas are characterized by tolerant hardwood plateaus with softwoods typi-

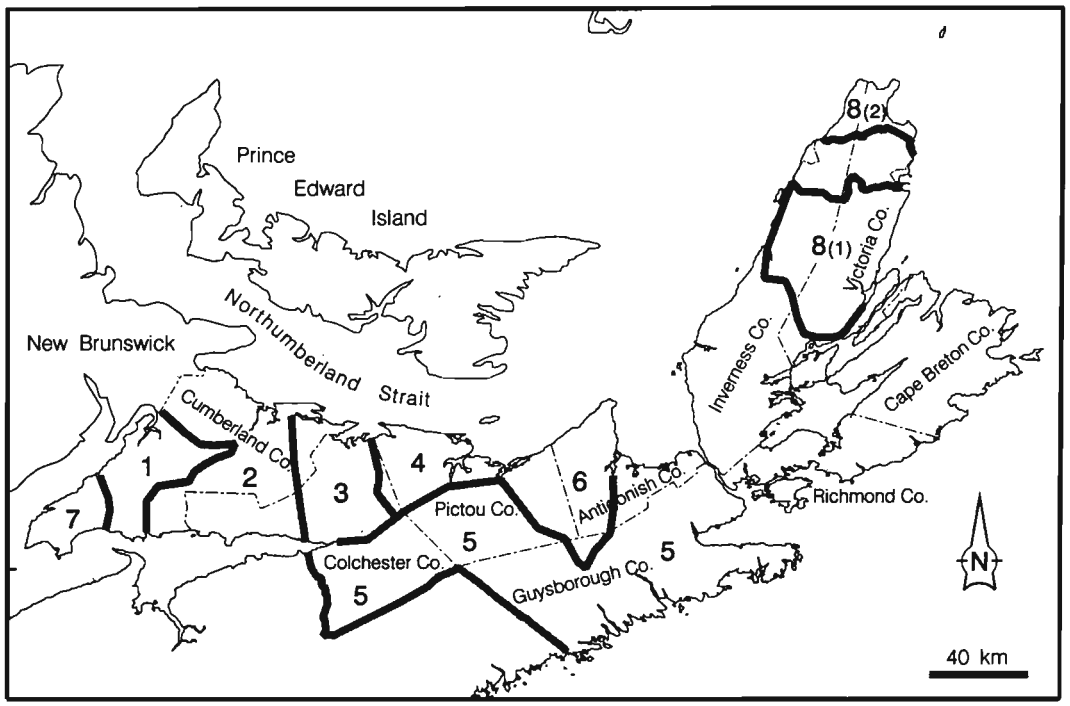

Fig. 2. Boundaries of moose management zones and counties for the northern mainland and Cape Breton Island where winter aerials surveys were conducted.

cally found in wet areas, within mixed stands, on slopes, or as isolated pockets within the hardwood matrix on the plateaus. Medium density (0.05 moose /km^2) areas accounted for 20% of available range and were located in the Tobeatic region (Fig. 1) and areas adjacent to high density zones. Estimated density for the remaining range was 0.02 moose/km^2.

Later surveys focused on the four counties where high moose densities were reported by Telfer (1968). These surveys demonstrated that moose numbers remained high through the late 1960s (Prescott 1968), but were in decline by the mid 1970s (Scott 1976). Consequently, moose management zones were established in 1977 for this region.

Unpublished Nova Scotia Department of Natural Resources (NSDNR) winter aerial survey data confirms that distribution patterns on the mainland have not changed since the 1960's, although densities have. Today, it appears that moose in Nova Scotia are generally distributed at low densities, are locally extirpated, and exist in relatively high densities in only two localized regions.

In all instances where the data allows for comparison, moose densities within the Cobequid-Pictou-Antigonish Highland zones have declined steadily over a thirty year period (Table 1).

These data are further supported by evidence from pellet group surveys that show a decline in moose numbers between 1979 and 1985 (Hall 1986). Despite lower densities, these areas continue to support a relatively large proportion of the mainland moose herd.

An informal aerial survey flown in winter 1993 over a 400 km^2 portion of the Tobeatic region indicated the possibility of a relatively large herd (0.35 moose/km^2) for that area.

Table 1. Chronology of winter aerial moose surveys with densities for management zones in the Cobequid-Pictou-Antigonish Highlands.

		Density^ /km² by Zone (s)				
Year	Author	1,7	2	3	6	1 - 7*
1964	Telfer[1]					0.46
1968	Prescott[2]					0.49
1975	Scott[3]	0.19	0.13	0.16	0.20	0.14
1978**	Hall[3]			0.11		
1981	Hall[3]	0.14				
1985	Bancroft[4]				0.28	
	Hall[4]			0.11		
1992	Hall[4]	0.10				
	Pulsifer[3]				0.12	
1994	Hall[5]		0.06	0.01		
	Pulsifer[5]				0.09	
1992/94[a]	Hall/Pulsifer[5]					0.08

^ Density estimates from 1975 to 1994 based on better moose ranges within zones.

* Excluding Guysborough County

** All surveys after 1975 conducted by NSDNR Regional Biologists

1. Fixed wing aircraft, random plots (6.4 x 6.4 km), transects 0.8 km apart within plots
2. Fixed wing aircraft, random plots (6.4 x 6.4 km), transects 0.4 km apart within plots
3. Fixed wing, transects 1.6 km apart
4. Helicopter, transects 3.2 km apart
5. Helicopter, random plot (2.5 x 10 km), transects 0.6 km apart within plots

a. Combined results of surveys conducted by Hall and Pulsifer between 1992 and 1994.

This result must be interpreted cautiously because this survey covered a relatively small area of high moose sightability, but not the surrounding more densely vegetated habitat. Telfer (1968) included this area as part of a much larger region (7283 km²) designated as "low density" (0.05 moose/km²) range. During the 1993 survey, moose were found almost exclusively on, or adjacent to, shrub semi-barrens, dominated by densely growing course vegetation and rocky terrain. Subsequent informal survey flights over this same area have failed to locate a comparable number of moose.

The largest and most stable population of moose in Nova Scotia occurs in the highland region of Cape Breton Island (2400 km²) (Fig. 1). This area represents the true boreal eco-region of the province with barrens and bogs dispersed throughout the softwood dominated plateau. For management purposes this area is divided into three regions: Cape Breton Highlands National Park (CBHNP, 950 km²) and areas north (230 km²) and south (1220 km²). Moose densities vary between north and south of CBHNP. Northern densities have increased from 1.5 moose/km² in 1989 to 2.8 moose/km² in 1993. Southern moose densities in the area where most hunting has traditionally occurred, remained sta-

ble between 1989 (0.86 moose/km^2) and 1992 (1.01 moose/km^2) (NSDNR unpubl. data). No comprehensive surveys have been conducted for this area since 1992. Density estimates for CBHNP in 1994 ranged from 1.90 moose/km^2 to 2.61 moose/km^2 (Parks Can. Atl., unpubl. data).

DISCUSSION

With the closing of the mainland moose hunting season in 1982, there has been no focused moose survey program other than regular surveys on Cape Breton Island to assess the status of the hunted population. When white-tailed deer numbers escalated throughout the 1970s and into the 1980s, strong public sentiment directed management efforts towards that species. Since the mid 1970s, local area surveys have been conducted independently by NSDNR biologists who required basic population data for forest harvest planning and monitoring purposes. Consequently, aerial survey data has been collected using a variety of survey formats.

As a study area, Nova Scotia presents a number of challenges when surveying moose. One of the most important influences affecting the ability to monitor this species is winter weather. The unpredictability and inconsistency of weather patterns during winter months, frequently dictates that surveys are attempted when possible, under a variety of conditions. Coastal regions experience relatively little snow that may last for only a few days. Interior and upland regions accumulate more snow, however, the frequency of localized snow squalls is also greater, often resulting in cancelled or incomplete aerial surveys. When suitable survey conditions do arise following a snowfall, helicopter support may not be available. Depending on the region, the amount of snow cover and depth, surveys may be completed within a few days, take several weeks, or remain partially completed. Under these circumstances temporal and/or regional comparisons of two or more areas may require comparisons of early and late winter surveys. For this reason data must be interpreted cautiously.

With the exception of the Cape Breton Highlands and a relatively small area in the southwestern part of the province, moose numbers have steadily decreased throughout Nova Scotia since 1964. Of particular concern is the decline in the Cobequid-Pictou-Antigonish Highlands herd. The abrupt change in density reported between 1968 and 1975 is significant, and possibly questionable. Declines of this magnitude for these years cannot be explained by high deer numbers or changes in habitat. Dodds and Patton (undated, unpublished) reviewed survey and productivity data (Vukelich 1978) for these years, and suggested that 0.25 moose/km^2 is a more reasonable estimate for this area. They believed that population estimates by Telfer (1968) and Prescott (1968) were over estimated, while Scott's (1976) estimates were slightly low. Regardless of which estimates better reflect the actual size of the herd for that time, the trend remains the same.

Reasons for these declines have not been quantified. In an earlier work, Dodds (1974) explained changes in moose distribution and density in Nova Scotia on the basis of various mortality factors and habitat changes, including wildfire, forest cutting, insect pests, tree diseases and snow depth. We concur with Dodds' (1974) assertion that provincial moose populations reflect the synergistic effects of a number of external influences. It is our belief that interactions with deer, habitat fragmentation through forest management, illegal hunting and possibly predation of calves by black bear have played a significant role in influencing the size and distribution of moose populations in Nova Scotia today.

Association with white-tailed deer

Dodds (1974) asserted that increases in white-tail deer and their parasitic nematode, *Parelaphostrongylus tenuis* have had the greatest impact on moose distributions in Maine and probably New Brunswick and Nova Scotia. Dodds (1974) argues that forest harvest practices in the northeast, having favoured the ingress of white-tailed deer, facilitated the spread of *P. tenuis*, and ultimate decline in moose numbers.

In Nova Scotia, several researchers have examined the use of habitat by deer and moose (Telfer 1967, Prescott 1968, Benson and Dodds 1980) and the incidence and biology of *P. tenuis* (Parker 1966, Thomas and Dodds 1988).

Recently, Whitlaw and Lankester (1994) examined historical data in a number of jurisdictions, including Nova Scotia, to test the hypothesis that the incidence of moose sickness was correlated with moose declines. Their results indicate that although moose declines frequently occurred whenever deer densities exceeded 5/km^2, the historical information did not support the hypothesis when tested. Despite these findings, we feel that this relationship remains unclear and requires further investigation.

In Nova Scotia, circumstantial evidence suggests a relationship does exist between deer and moose numbers. On two occasions since 1950, significant increases in deer numbers were followed by equally dramatic declines in the provincial moose herd, despite a closure of the moose season in one instance (Benson and Dodds 1980, NSDNR). Results from pellet group surveys conducted on a series of plots in the Cobequid Hills region from 1979 through 1985 suggest that deer increased by nearly 300%, while moose decreased overall (Hall 1986). Finally, Nova Scotia's best surviving moose herds today exist on the Cape Breton Highlands and in the Tobeatic, where due to topography, habitat type, snow depth and exposure, moose have minimal or no contact with deer, particularly during winter and spring months.

Presently, deer numbers are low in Nova Scotia and have been for the past seven years. If *P. tenuis* has limited herd recovery in the past, a positive response in moose numbers on the mainland would be expected. During the early 1960s, moose responded positively and relatively quickly to declining deer herds (Benson and Dodds 1980). Today, mainland moose populations may be experiencing a similar recovery, although at a slower rate, due to the combined effects of habitat changes, increases in unregulated hunting related to greater access and use of all-terrain vehicles, and possible predation of calves by black bear. In the past eighteen months, reports of moose sightings by the public in some districts has apparently increased. Unfortunately, poor winter survey conditions have prevented the completion of surveys to verify population status.

Habitat Changes

Forest harvesting in general, is known to benefit moose because of the increased availability of browse (Dodds 1974). Although there is no evidence to show that moose declines in Nova Scotia are the direct result of forest management activities, significant changes in the amount and distribution of mature softwood cover on the northern mainland may have played a role in this reduction. Since 1975 extensive softwood harvesting in this region has altered habitat at local and landscape levels. Coniferous cover is recognized as an important habitat component for moose (Peterson 1955, Joyal 1987, Thompson and Euler 1987, Schwab and Pitt 1991, Forbes and Theberge 1993). Schwab and Pitt (1991) have shown that moose in British Columbia seek out mature and near mature softwood with canopy closure >70% to reduce heat stress in summer and late winter. Studies by Telfer (1967) and Prescott (1968) in Nova Scotia indicate that softwood patches are

important landscape features frequently used by moose for shelter in winter. The importance of softwood forests to moose and the extent to which forest harvest may have affected moose behaviour, distribution and productivity in Nova Scotia is unknown. Softwood cover may play a critical role in the survival of moose in this province. We suggest that with extensive softwood harvest throughout much of the northern mainland, the overall ability of the range to support moose may have been diminished, although this statement has not been substantiated with appropriate research.

One of the most obvious habitat changes associated with forest harvesting is the network of roads and hauling trails developed on private and provincially owned lands. In Nova Scotia, the increase in access afforded by these roads often results in moose being more vulnerable to hunting (Peek *et al.* 1987). In Antigonish County (Figure 2), a cursory investigation demonstrated that between 1980 and 1993 an increase from 0.35 to 0.53 km of road/km^2 was developed within moose range (NSDNR unpubl. data). These conditions contrast sharply with the Tobeatic and areas north of CBHNP where access is very limited. This may not adequately explain declines in moose populations over all ranges. However, in localized high access areas where moose numbers are low, increases in herd size may be prevented through unregulated hunting.

Predation

The role that non-human predation plays in influencing moose numbers in Nova Scotia is presently unknown. Although Nova Scotia has no resident wolf population, moose mortality has been attributed to coyotes (*Canis latrans*), on at least one occasion in other jurisdictions (Chuck Schwartz pers. comm. 1995). In this province, there has been one unconfirmed report of a group of eastern coyotes, harassing a moose calf on Cape Breton Island. Although it is not known whether this alleged event was an isolated incident, it is unlikely that coyotes play a role of any significance in mortality of moose (Parker 1995).

Predation by black bears (*Ursus americanus*), has been identified as an important cause of mortality for young moose (Franzmann *et al.* 1980, Stewart *et al.* 1985, Ballard *et al.* 1990).

Black bear are indigenous to Nova Scotia. Recent harvest records and nuisance bear reports indicate that bears are abundant throughout most areas of Nova Scotia and have increased substantially since about 1990. If the impact of black bear predation on moose calves in this province is similar to other jurisdictions, herd growth in areas of low and scattered moose numbers may be prevented.

Management Implications

Historic records indicate that moose were abundant throughout most of Nova Scotia until the 1800s when numbers declined, presumably due to heavy hunting pressure, driven by commercial interests. During the past 100 years, moose numbers have fluctuated and hunting seasons and regulations have been adjusted accordingly. In spite of many total season closures (and openings) moose have never recovered to levels that could be considered abundant throughout the animal's historic range.

Although there have been extensive forest harvest activities during the past 100 years, and some relatively small areas of the province developed for intensive agriculture, much of the province remains intact and available as moose habitat. It is therefore assumed that adequate habitat (i.e., climate and vegetation) still exists for viable moose populations throughout most of their former range in Nova Scotia.

The two relatively healthy populations that currently exist within the province do

not share habitat with white-tailed deer during the winter and spring period. Although this relationship remains unclear, it has been suggested that *P. tenuis* may be a factor limiting recovery of moose where moose and deer range overlap. This belief of *P. tenuis* being the limiting factor, has been further supported by the fact that deer were not present in the province during the period of widespread moose abundance, having only become established here in the early 1900's.

It is possible that some level of tolerance by moose for *P. tenuis* exists or has developed, as evidenced by the continued persistence of scattered remnant populations where deer and moose ranges overlap. However, if *P. tenuis* is a major limiting factor, it is unrealistic to expect that moose can attain abundant levels, or occupy all of their former range throughout the mainland, as long as white-tailed deer are present in moderate to high numbers. In all probability, it is unlikely we can realize high numbers of both deer and moose on the same range. Therefore, we must attempt to establish a balance between the two. To do so will require that future management objectives for these species must not be made independantly.

Other factors that may be preventing the recovery of moose numbers throughout Nova Scotia, include; extensive forest harvesting resulting in an inadequate availability of thermal cover, illegal hunting, and predation of calves by black bear.

Poor survey conditions, due to infrequent and short lived snow cover, have prevented the completion of appropriate surveys to confidently assess the status of mainland moose populations. However, our mandate dictates that we must strive to achieve a more detailed knowledge of this wildlife resource, and implement appropriate measures where possible, to maintain a healthy abundance of moose throughout its former range. To meet these objectives, a more determined effort must be made to conduct properly designed aerial surveys during the brief windows of opportunity available. As well, greater understanding of causes of mortality and key habitat requirements (e.g. quantity and distribution of closed canopy conifer forest) must be achieved. To do so , will necessitate a well designed research project. Securing the required funds for a study of this nature will perhaps be our greatest challenge.

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