RESPONSE OF MOOSE CALF SURVIVAL TO REDUCED BLACK BEAR DENSITY

AN ASSESSMENT OF THE STRESSES LIKELY AFFECTING THE MOOSE POPULATION ON HECLA ISLAND

By

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ABSTRACT

An 18-week (government) black bear translocation program was closely monitored and assessed as to its impact on subsequent moose calf survival rates on Hecla Island, Manitoba in Summer 2000. A total of 12 black bears (or 0.73 bears/10km^2) were removed from the island. Alternative timber wolf - white-tailed deer interactions were monitored and big game population estimates were assessed through several different methods. Various human related stresses on moose and land development stresses on moose habitat were also examined and assessed as to their possible impacts on the island's declining moose population.

Results from an aerial wildlife survey conducted several months after bear removal indicated a significant increase in the moose calf population. Comparisons of the new moose calf population data with prediction intervals based on regression analyses of past survey data indicated that the calves/100 cows relation realized a significant increase from a pre-treatment ratio of 0:100 to a post-bear removal ratio of 40:100, and the calves/100 adults relation realized a significant increase from a pre-treatment ratio of 0:100 to a post-bear removal ratio of 21.4:100.

Results from a second (post-study) aerial wildlife survey in Winter 2002 also indicated similar moose calf survival ratios to the 2001 data after three additional bears (or 0.18 bears/10km^2) had been removed from the island by Manitoba Conservation Officers in summer 2001. These statistically significant increases in moose calf survivorship relations seem to indicate that the lowered black bear density had an overall positive effect on moose calf survival. An analysis of black bear scats for evidence of moose-calf hair in summer 2000 did not, however, provide a definitive link between black bear predation and moose calf mortality.

The continued (short-term) removal of black bears from the island was one of several wildlife management recommendations offered in order to allow for the re-establishment of a viable moose population on Hecla Island. Park and habitat management recommendations are also part of the final output for this study.

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1. INTRODUCTION

1.0 BACKGROUND

Hecla Island is situated in Manitoba's Interlake region approximately 160 kilometers north of Winnipeg City in the south basin of Lake Winnipeg. The island is approximately 164 km^2 in size and contains a variety of deciduous and mixed forest habitats in addition to extensive areas of treed muskeg (Manitoba Parks Branch 1988). In 1969 the island became part of the provincial park network in Manitoba and was connected to the mainland by a causeway in 1972 (Manitoba Parks Branch 1988).

With the creation of the park, habitat alteration for the most part ceased as a lack of prescribed pasture burning and timber harvesting ensued with the departure of resident families from the island in the late 1960's. It was during the time of park development in the late 1970's and early 1980's that Hecla Island was home to a significant moose (*Alces alces*) population – one of the key natural attractions to the park and a main feature of the park interpretive program.

In addition to the existence of a sizeable wildlife refuge, big game hunting seasons have not been allowed on the island between the periods 1969 to 1978, and 1989 to present. The creation of this 'sanctuary effect ' has allowed substantial increases in both the moose and black bear (*Ursus americanus*) populations, albeit at alternate times. At one point, provincial wildlife biologists were of the opinion that there was an actual over-abundance of moose on the island as the population was estimated at approximately 221 animals in 1978 (Crichton 1979). Since the mid 1980's, however, the population has been on a steady decline (Whaley pers. comm.).

Theoretically, population fluctuations tend to be more extreme for mammals occurring in restrictive areas such as islands (Peterson 1977). In fact, when Goulet (1992) compared Hecla Island with the famous Isle Royale, he found that "the semi-enclosed moose populations of both islands have followed cyclical paths of similar frequency and timing", most likely due to the availability of quality browse and the inherent carrying capacity of the habitats. In his analysis of moose and wolves in the island ecosystem of Isle Royale, Peterson (1977) offered:

> "*Islands may only have a limited number of species, and because of this inherent simplicity, fewer stabilizing mechanisms exist and fluctuations in populations are more likely to occur. Because dispersal is limited, island populations may reach higher densities than mainland populations of the same species. Conclusions drawn from ecological studies on islands must always recognize these unique characteristics.*"

The construction of the Hecla Island causeway, however, has potentially enhanced predator access to the island ecosystem (Crichton pers. comm.). Prior to construction of the causeway, Hecla residents rarely observed black bears on the island (Tomasson pers. comm.). In summer 1999, I had estimated the black bear population to be somewhere between 20 and 30 animals with a noticeably high concentration occurring in close proximity to the island's garbage dump during mid-summer.

An increasing amount of attention has been drawn to the predatory role of bears with regards to moose population dynamics in recent wildlife studies (Gasaway *et al.* 1992; MacCracken *et al.* 1997; Ballard 1991; Schwartz and Franzmann 1991). Since the early 1990's, wildlife biologists have come to appreciate the regulatory effect that bears likely have on moose calf survival. For example, Gasaway *et al.* (1992) found that predation by wolves and bears has a substantial additive mortality component and is the major factor limiting moose populations already at low densities.

A similar bear predation study conducted by Schwartz and Franzmann (1991) found that individual black bears can harvest between 1.4 and 5.3 moose calves per calving season in Alaska. The study concluded that the availability of high quality food (in the form of moose calves) in the spring and early summer months had significant influences on the vigor of black bear populations.

Since moose and gray (timber) wolves (*Canis lupus*) have likely existed sympatrically on Hecla Island for thousands of years, the recent noticeable increase in the black bear population may have had significant unknown impacts on the population dynamics of the moose herd. The Parks and Natural Areas Branch of Manitoba Conservation views a healthy moose herd on Hecla Island as a potential added attraction for increasing recreational use of Hecla/Grindstone Provincial Park. Therefore, enhancing moose viewing and interpretation opportunities by managing potential black bear impacts, as well as supplementing the predator-prey knowledge base for use in future wildlife management decisions on Hecla Island is understood to be most desirable.

1.1 ISSUE

Moose herd composition surveys have been conducted on Hecla Island in most years since 1972 (Table 1) with the highest number of animals (**177**) being counted in 1978 (Figure 1) (Whaley pers. comm. 1997). Prior to the commencement of this project, the most recent aerial census of the moose population was conducted in February 2000 with a total of **25** moose being sighted and sexed. This change in aerial survey data represented an 86% decline since 1978 with 75% of the decline occurring over the latter 10-year period alone.

Of the **25** moose sighted, **13** (52%) were cows and **12** (48%) were bulls (Hagglund pers. comm.). In addition to moose, there were zero white-tailed deer (*Odecoileous virginianus*) and only one timber wolf detected. The most significant finding of the 2000 survey was the detection of ***zero*** moose calves - indicating that herd recruitment was possibly nil and that calf mortality was unusually high since cow-calf pairs were sighted during the spring of 1999, and aerial surveys had traditionally averaged 22.25 calves per year over the previous 29 years (Whaley pers. comm. 1997) (Figure 2). This 29-year average equated to a historical mean calves/100 cows ratio of 46:100.

According to a Manitoba Parks Branch resource inventory of Hecla Island in 1979, there had historically been very few reports of black bears on the island, with the confirmation by park staff of only one bear in 1977 (Manitoba Parks Branch 1979). Today, however, black bears are a common sight on the island with no reliable population estimates (Collins pers. comm.) and no real idea as to their predatory impact on the resident moose population.

TABLE 1: Moose herd composition surveys on Hecla Island: 1971-2000. (revised from: Whaley pers. comm. 1997)

Year	Bulls	Cows	Calves	Unknown	Total	Calves/ 100 Cows	Calves/ 100Adults	Bulls/ 100 Cows
1971/72	22	36	18	-	76	50	31	61.6
1972/73	47	39	24	1	111	61.5	27.6	120.5
1973/74	53	27	29	28	137	-	26.9	-
1974/75	22	18	29	61	130	-	28.7	-
1975/76	61	58	46	2	167	79.3	38.6	105.2
1976/77	32	51	24	-	107	47.1	28.9	62.7
1977/78	35	53	17	-	105	32.1	19.3	66.2
1978/79	52	89	36	-	177	40.4	25.5	58.4
1979/80	51	48	10	-	109	20.8	10.1	106.3
1980/81	25	43	16	-	84	37.2	23.5	58.1
1981/82	No	Survey	-	-	-	-	-	-
1982/83	17	36	19	1	73	52.8	35.9	47.2
1983/84	20	29	17	3	69	56.7	34.7	70
1984/85	45	55	39	2	141	70.9	39	81.8
1985/86	48	63	41	-	152	65.1	36.9	76.2
1986/87	53	36	31	-	120	86.1	34.8	147.2
1987/88	No	Survey	-	-	-	-	-	-
1988/89	37	48	17	-	102	35.4	20	77
1989/90	No	Survey	-	-	-	-	-	-
1990/91	No	Survey	-	-	-	-	-	-
1991/92	22	27	5	-	54	18.5	9.2	81.5
1992/93	28	30	11	-	69	36.6	18.9	93.3
1993/94	25	45	12	-	82	27	17	55
1994/95	No	Survey	-	-	-	-	-	-
1995/96	No	Survey	-	-	-	-	-	-
1996/97	23	32	4	-	59	12	7	72
1997/98	No	Survey	-	-	-	-	-	-
1998/99	No	Survey	-	-	-	-	-	-
1999/2000	**12**	**13**	**0**	**-**	**25**	**0**	**0**	**92**

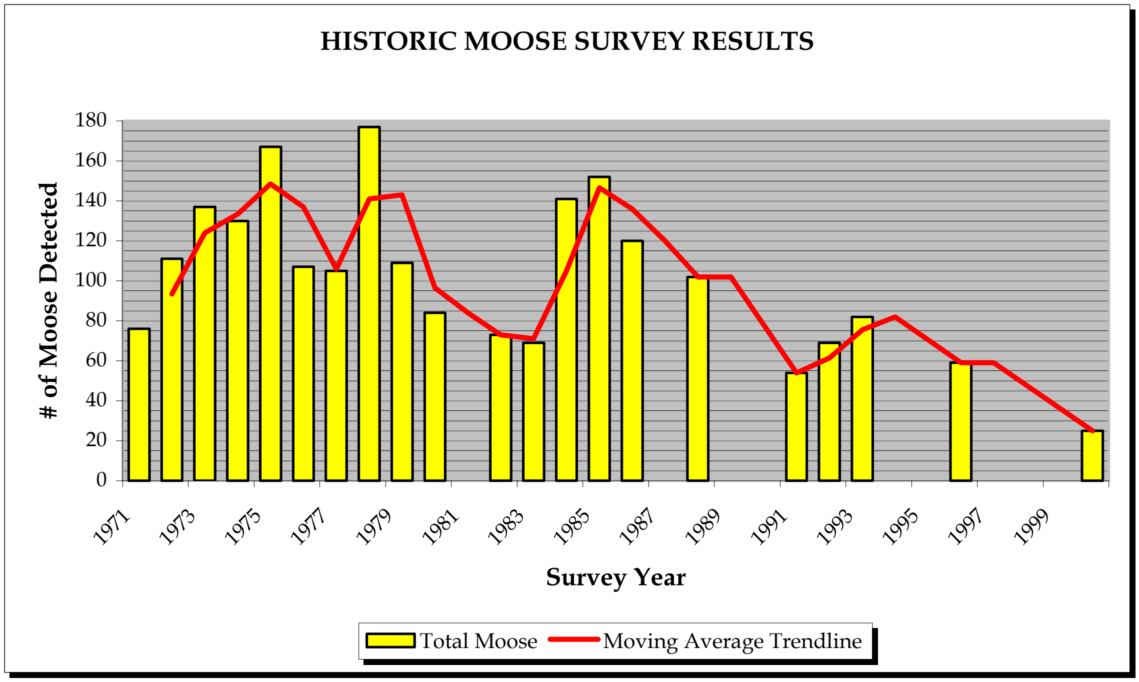


FIGURE 1: Historic aerial survey results showing a stepwise decline in the overall moose population (revised from: Whaley pers. comm. 1997).

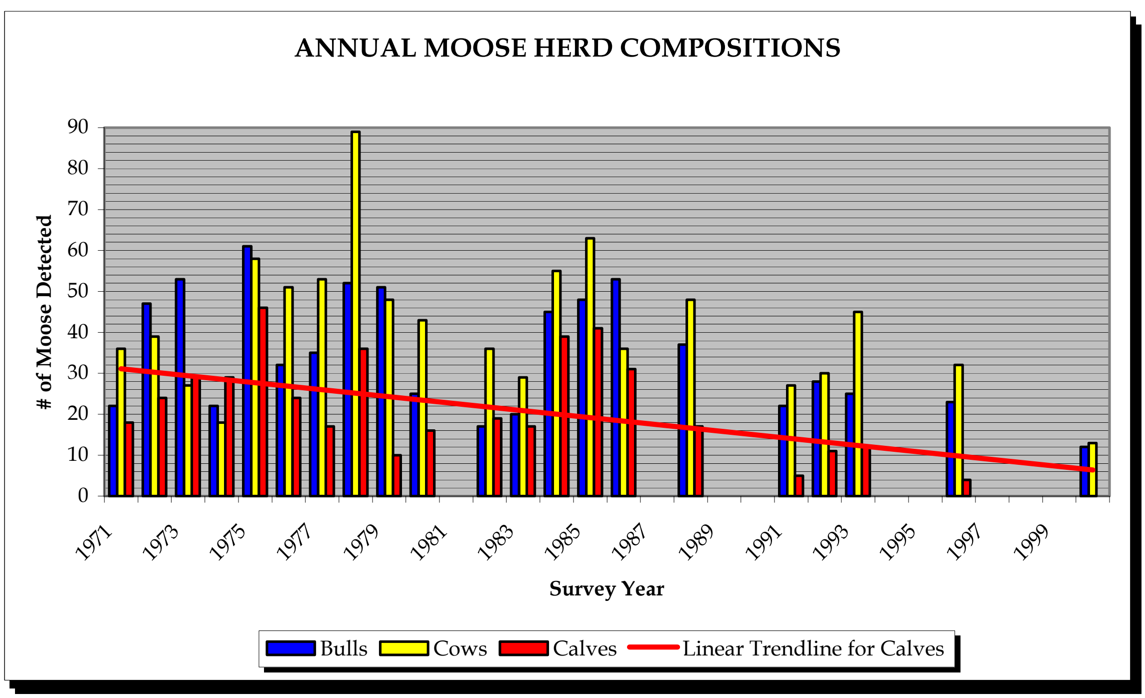


FIGURE 2: Aerial survey results illustrating the downward trend for moose calves. (revised from: Whaley pers. comm. 1997).

1.2 Hypothesis Statement

It was postulated that, in addition to a variety of other human/land development related stresses, increased black bear predation (resulting from a potential influx of bears to the island via the Hecla Island causeway) may play a key role in limiting moose calf survival and thus, limiting the low density moose population on Hecla Island. It was hypothesized, therefore, that a reduced black bear density would enhance the moose calf survival rate over the short term and consequently facilitate an increase in the overall moose herd. This predator-prey relationship was expected to be dependant on black bear density and independent of moose density.

1.3 Project Objectives

The primary objective of the study was to assess the effect of a reduced black bear density on subsequent moose calf survival on Hecla Island, and to formulate park and wildlife management recommendations accordingly. The following list of specific objectives were addressed in order to achieve the assessment:

- To monitor a government-initiated black bear translocation program;
- To detect and assess any changes in moose calf survival - post bear removal;
- To survey alternative big game predator-prey interactions on the island;
- To formulate park management and wildlife management recommendations that are consistent with Manitoba Conservation moose management objectives for Hecla Island.

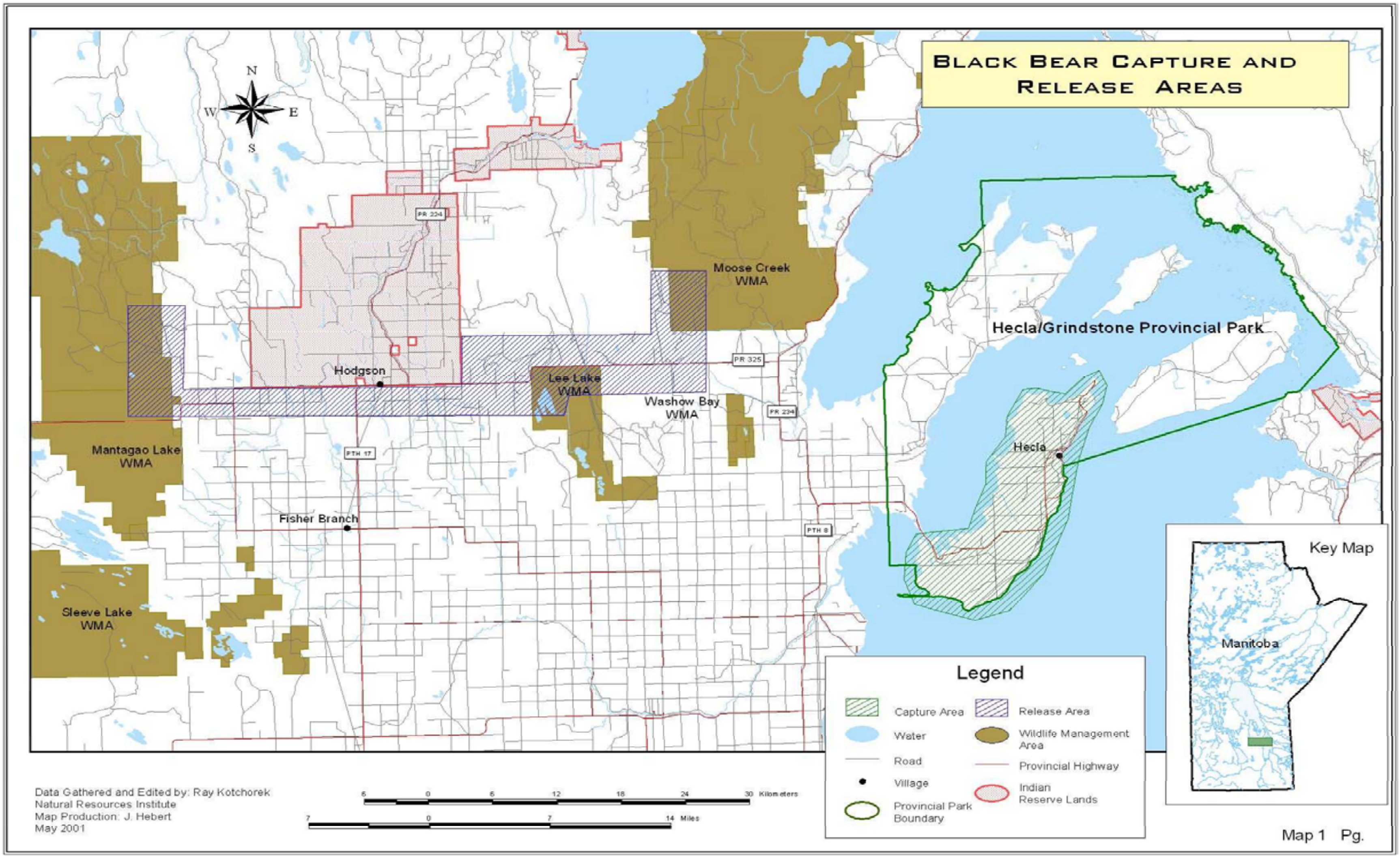
1.4 STUDY PROGRAM

The study program consisted of one field season extending from mid-April 2000 to mid-September 2000. An aerial moose survey of Hecla Island, conducted in late-January 2001 concluded the fieldwork portion of the study. Laboratory work, which consisted of the wolf and bear scat analysis, was completed at the Wildlife Lab at the Manitoba Conservation Wildlife Branch headquarters during the winter of 2000/01. Peripheral data gathering, data analysis and report writing extended from October 2000 to November 2001.

1.5 STUDY AREA

Field activities were contained within the 164 km^2 area of Hecla Island within Hecla/Grindstone Provincial Park, Manitoba, Canada (Map 1). All baiting and trapping efforts were conducted at backcountry sites accessed by all-terrain vehicle (ATV) via the existing ski and snowmobile trail system. The Hecla Island landfill observation and trapping site accessed by truck was the lone exception.

Since abundant precipitation was a major factor throughout the field season, baiting and trapping efforts were concentrated in the drier upland areas of the southeast portion of the island. The release areas for the translocated bears were situated on the mainland west of the island, extending from the Moose Creek Wildlife Management Area west to the Mantagao Lake Wildlife Management Area along Provincial Road 325.



Map 1: Black bear capture and release areas.

1.6 ASSUMPTIONS

It was assumed that, although black bears are known to be excellent swimmers, the noticeable increase in the Hecla black bear population since the mid-1970's has most likely been attributable to enhanced access opportunities via the Hecla Island causeway through Grassy Narrows Marsh. Big game predators, such as black bears and timber wolves, have periodically been observed traveling between the mainland and the island along the causeway since it was constructed in 1972.

It was also assumed that since the Hecla garbage dump (landfill) was scheduled to be decommissioned in the Fall of 2000, the removal of black bears from the island would ultimately benefit the Park, the residents of Hecla Village, and the bears themselves by reducing the number of garbage-conditioned problem bears that may have otherwise ended up being destroyed after the food source disappeared.

Finally, black bear capture and translocation efforts were continued into the month of August since moose calves in other similar jurisdictions typically remain vulnerable to bear predation up to 6 to 8 weeks after birth (Franzmann *et al.* 1980; Stewart *et al.* 1985; Franzmann and Schwartz 1986; Crête and Jolicoeur 1987; Ballard *et al.* 1990; Gasaway *et al*. 1992; Gunson *et al*. 1993).

1.7 LIMITATIONS

The primary goal of the study was to assess whether or not a reduced black bear density would have a positive impact on moose calf survival on Hecla Island. Since total moose calf production on the island could only be estimated at best, the effect of the translocation program was gauged by comparisons of the post bear removal data to prediction intervals based on regression analyses of past winter calves/100 cows and calves/100 adults relations - most importantly, the 0 calves/100 cows ratio from the February 2000 aerial wildlife survey.

Since the resident black bear population was also unknown and only estimated, the total proportion of bears removed from the study area was expressed as X number of bears per 10 km^2 of treatment area. None of the captured bears were tranquilized after capture and no biological data was obtained other than relative size and sex. The number of bears remaining on the island was estimated from relative abundance values acquired from incidental big game sightings and backcountry wildlife observations as well as from relative index values acquired from bait station observations. Although the timber wolf population was estimated with some degree of accuracy by the same methods, the type of effect (i.e. regulating vs. limiting) that current wolf predation may have on moose calf survival was not determined as it was not an objective of the study.

The two main factors that affected the success of the project were: 1) the relatively short treatment period of 18 weeks, and 2) the irregular availability of Manitoba Conservation bear traps to the study. Three (required) traps were made available to the project for a cumulative total of 37 out of 121 total available trapping days (= 31%) during the study period while the remaining 69% of the field season was completed with two traps or less. On several occasions, there were no traps available as a result of problem bear activity in other areas of the Riverton/Hecla district.

Also on several occasions, there were no Manitoba Conservation personnel available to regularly check and re-bait traps during my several short-term absences from the island. These traps were consequently shut down for several days at a time reducing the total trap-days from a possible 252 days to 236 trap-days. The unavailability of traps, in combination with the lost trapping time, most certainly detracted from the success of the trapping efforts with respect to the total number of bears captured and removed from the island.

A third important limitation to the study was the limited access to backcountry areas as a direct result of excessively wet conditions throughout the spring to mid-summer months. Although an ATV was utilized whenever possible, the peaty/boggy nature of the Hecla Island backcountry ski and snowmobile trails did not allow for ATV travel (especially when affected by flooding by the numerous beaver dams). This limited access not only affected the success of the trapping and bait station monitoring efforts, but also effectively hampered the spring to mid-summer collection of bear scats – a critical period for the scat collection. As such, black bear scats were collected relatively late in relation to the moose calving season. Consequently, although some important dietary information was obtained, there was no definitive link made between black bear predation and moose calf mortality by the scat analysis method.

Incidental big game sightings were somewhat of a weakness as sightings by park personnel were inconsistently entered into the big game observation log books (eg. some group observations were entered two and three times by different staff while most observations are believed not to have been entered at all). Also, several of the big game sightings (especially the cougar sightings) proved unreliable as they were reported long after the fact and could not be confirmed by tracks, scats, or in several instances, by questioning of the original observers.

The extended time period between first freeze-up of Lake Winnipeg in late November 2000 (Kosceilney pers. comm.) and the aerial moose survey in late January 2001 possibly allowed for the unrestricted movement of wolves to and from the island. Since several wolves were confirmed to be on the island during the study period, this potential addition of predators may have added to the "predator pit effect" which may have reduced the winter moose calf population to a lower level than would have otherwise been realized in the semi-enclosed system with a fixed number of wolves and fewer black bears.

Finally, relatively small sample sizes for most data collected did not allow for statistically valid tests of significance to be calculated. Keeping this in mind, most inferences and conclusions are purely speculative and are by no means reinforced by classic statistical theory unless explicitly stated as such.

2. LITERATURE REVIEW

2.0 HECLA ISLAND

Hecla Island is one of several large islands in the south basin of Lake Winnipeg – one of the larger freshwater lakes of the world. The island encompasses 163.8 square kilometers, measuring 6.4 km wide by 26.5 km long (Crichton 1977). Recreation and residential development on the island is restricted to the northeastern tip, a sizeable section of the eastern shoreline, and a portion of the northwestern shoreline. Ducks Unlimited (Canada) currently manages Grassy Narrows Marsh - a large marshland project on the island's southwestern section. Prior to construction of the causeway, human access to the island was restricted to small boats, a ferry service and small aircraft. Today, a two-lane paved highway connects the island to the mainland.

The island is situated in a transition zone between the aspen parkland region and the boreal forest region of the Canadian Shield (Manitoba Parks Branch 1988). Most soils on the island consist of fine textured clays with poorly drained areas resulting in extensive marshes, bogs, fens and wet meadows (Manitoba Parks Branch 1988). Much of the central portion of the island exhibits treed muskeg habitat. In upland areas, a variety of deciduous and mixed forest habitats include such tree species as white spruce, balsam fir, tamarack, white birch, aspen, ash, and poplar. The Canada Land Inventory Classification (Woo *et al*. 1977) indicated that approximately two-thirds of the island had a high capability for ungulate production while the remaining one-third had severe limitations. This classification, however, was not specific to moose.

It has been stated that moose habitat on Hecla Island is continually being reduced from both a qualitative and quantitative aspect by forest maturation (due to the suppression of wildfires and a lack of timber harvesting) and extensive human development activities (Crichton 1977). As a result, several recommendations were offered by Weatherill (1970) and Crichton (1977) as to how to offset these losses with habitat manipulation programs that benefit moose. Although most of the recommendations had been tested over the short term in the past, few moose management initiatives have been continued since the late 1980's.

2.0.0 The Hecla Island Ecosystem

Hecla Island has been labeled as "Manitoba's answer to Isle Royale" (Crichton 1977) by virtue of its high-density moose population inhabiting an island within a large freshwater lake. In addition to moose, white-tailed deer and the occasional woodland caribou (*Rangifer tarandus*) currently inhabit the island.

The main (four-legged) predators of ungulates on Hecla Island are timber wolves and black bears. During the winter months, timber wolves are free to roam back and forth between the mainland and the surrounding islands across the winter ice, with their presence during the summer months dictated by their location at ice breakup. Wolves have been recorded as regular residents on the island since the early 1920's with the most recent population estimate of approximately 9 animals in 1999 (Smiley pers. comm.; Bilecki pers. comm.).

Since black bears normally undergo hibernation between November and April, their movement to and from the island is restricted to ice-free periods, when they can either swim or most likely utilize the land-link to the mainland – the Hecla causeway. Moose, on the other hand, have only been observed by some island residents swimming to and from nearby Black Island and wading across the shallow Grassy Narrows Marsh (Crichton 1977) – thus avoiding the vulnerabilities of utilizing the causeway (Crichton pers. comm.).

The most critical component of the habitat requirements of moose on Hecla Island has traditionally been observed to be the food supply (Crichton 1977). Extreme fluctuations in moose populations due to malnutrition are rare, however, with the case of over-browsing on Isle Royale in the 1930's being the most frequently cited (Peterson 1977).

2.0.1 Historic Moose Populations

The high density of moose on Hecla Island in the 1970's was once considered to be a noticeable anomaly in provincial wildlife population statistics. At one point, provincial wildlife biologists were actually of the opinion that there was an over-abundance of moose on the island, possibly endangering their own existence through over-browsing and habitat degradation (Crichton 1979). Although moose population data from aerial surveys had only been available since 1971, it was estimated by the Manitoba Provincial Moose Manager (Crichton 1983) that the habitat carrying capacity for moose on the island during the late 1970's was in the range of 150 animals.

In order to mitigate the negative impacts that the moose herd was having on the island at the time, controlled recreational hunting seasons were allowed for a period of 10 years starting in 1978 and ending in 1988. It was during this time that moose numbers dropped significantly, decreasing every year from 1978 until 1985. The population experienced two more noticeable declines between 1989 and present (after the termination of recreational hunting) due to unknown reasons, creating a step-wise decline as shown in Figure 1 (page 6). Although there are definite gaps in the data as a result of a lack of annual population surveys, the overall trend for the Hecla moose population over the last 23 years has been that of a steady decline.

2.0.2 Historic Predator Populations

Black bears and timber wolves have undoubtedly been regular residents of Hecla Island since pre-settlement times. With the arrival of Icelandic settlers on the island in the late 1800's came a certain amount of subsistence hunting and predator control (Tomasson pers. comm.). Although wolf and bear numbers are unknown for pre-settlement times, the Icelandic settlers of Hecla Island were known to have taken precautionary measures against such animals in defence of their property and livestock as well as for their personal safety. As such, historic predator populations during settlement times were somewhat regulated on the island, albeit to an unknown extent.

In 1969, Hecla Island was designated as a Natural Park under the Manitoba Provincial Park system. The resulting departure of most resident families from the island consequently allowed for predators to go uncontrolled and to re-populate the island throughout the 1970's and 1980's. Although there are no historic population counts to reference, black bears are believed to have been relatively rare with timber wolves being somewhat more common on the island (Tomasson pers. comm.) prior to 1969.

According to Tomasson (pers. comm.) and Crichton (pers. comm.), timber wolves have relied heavily on commercial fish discards at basin holes during the harsh winter months since initial Icelandic settlement. Crichton (pers. comm.) went as far as to suggest that the combination of this dependence on discarded fish and the relatively young age of the average area wolf (due to widespread shooting of wolves in the Interlake ranching area) has likely lead to several generations of wolves that are inexperienced and inefficient at killing moose.

In the late 1980's, there were believed to have been two different wolf packs on Hecla Island – one pack of 7 to 9 animals, and one smaller pack of 3 to 4 animals (Smiley pers. comm.). Most recently, however, there was only one confirmed pack consisting of approximately 7 to 9 animals during the summer of 1999 (Bilecki pers. comm.).

In 1979, Manitoba Parks Branch conducted a resource inventory of Hecla Island wherein no black bears were either sighted nor any sign detected (Manitoba Parks Branch 1979). Two years previous, however, park personnel did detect a set of bear tracks, and a close-range observation by a Park Ranger later confirmed that there was at least one bear present on the island in 1977 (Manitoba Parks Branch 1979). Since 1977, the black bear population has steadily increased on the island - coincidentally after the Hecla Island causeway connected the island to the mainland.

During the 1990's, the inflated bear population on the island forced Natural Resource Officers to take management actions against problem bears in order to protect human safety. Management actions included the translocation and/or destruction of numerous bears. Over a six-year period ranging from 1994-1999, calculations show (from rough annual estimates) that an average of 3.8 bears per year were removed from the island and/or destroyed (data from Todderin, Kowalyk, Melnyk, Smiley - pers. comms.; and the author).

2.0.3 Subsistence and Recreational Moose Hunting

Aboriginal peoples (especially those from the Peguis First Nation and Fisher River First Nation areas) have used the islands of Lake Winnipeg as hunting grounds since long before European settlement in North America. Accordingly, current-day

Aboriginals, who still exercise their Treaty right to hunt, place a significant level of importance on these areas as traditional lands. Although the Treaty Aboriginal harvest of moose on Hecla Island was monitored via routine enforcement patrols and hunter check stations, only rough harvest estimates were ever obtained.

According to numerous memos between Riverton District Conservation Officers and Regional Wildlife Managers over the years, known annual Treaty Aboriginal harvest numbers of moose averaged comparatively low, yet remained relatively constant when compared to the ten years of licensed recreational harvest in the late 1970's and early 1980's. Conversations with residents of the Hollow Water First Nation, however, revealed that actual Treaty Aboriginal harvest of moose on the island during the aforementioned time frame was likely substantially more than even estimated by Conservation Officers.

In 1978, the Manitoba Wildlife Branch introduced recreational moose hunting to Hecla Island. The move was made in order to manage the herd and protect against a potential population crash (as a result of habitat degradation) due to a perceived over-population of animals. Various forms of licensed hunts occurred between 1978 and 1988. Population decreases were immediately evident from aerial survey data in 1979 and continued until 1983. During this period, recreational moose hunting directly accounted for approximately 80% of the decline in the local moose herd. By 1986, hunter success had dwindled substantially and the licensed moose season was terminated at the end of the 1988 season. Since 1988, however, the moose population has been on a steady sharp decline – never fully recovering to pre-recreational hunting levels (Figure 3).

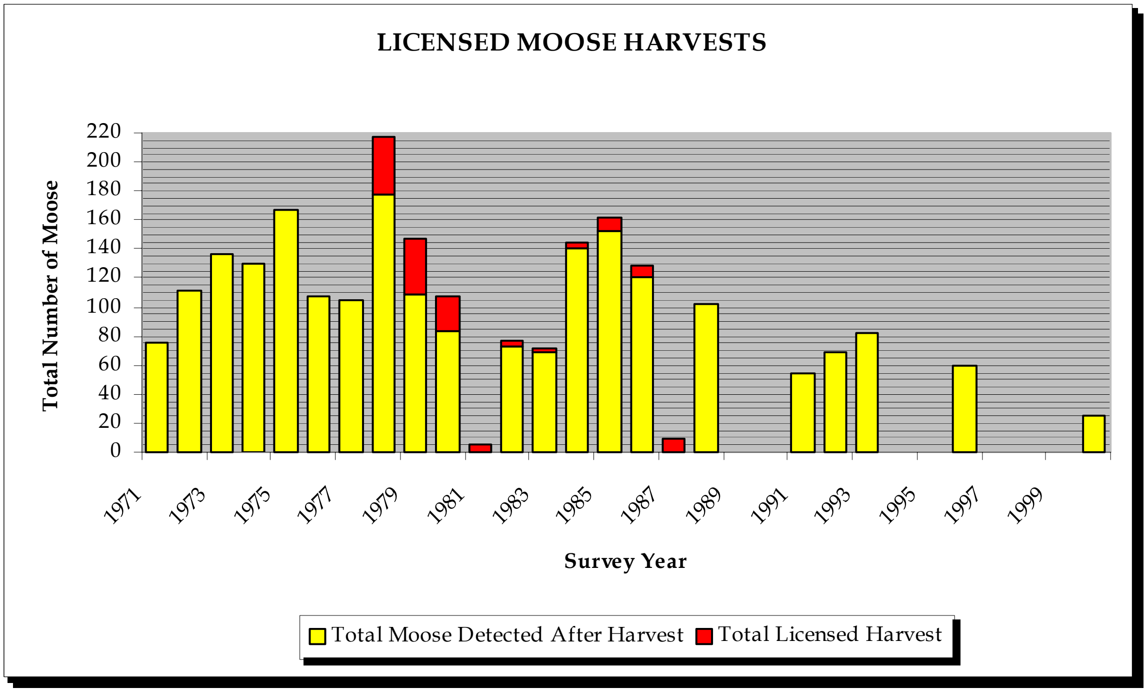


FIGURE 3: Moose population statistics combined with harvest numbers from licensed hunting activities (revised from Whaley pers. comm. 1997).

2.0.4 Park Planning and Development

In 1978, the Hecla Island moose population was at its highest density of an estimated 221 animals (or 1.3 animals/km^2) (Crichton 1979). Park development at that time consisted of the newly constructed Gull Harbour Resort and Conference Center, Hecla Island Golf Course, Gull Harbour Campground, Gull Harbour Marina, and 2 beaches with parking lots and picnic areas - totaling 324 hectares (or 2.0% of the island).

Also developed at that time was the landfill site (approx. 4.05 hectares), the Group Use Site (approx. 4.05 hectares), the maintenance compound/bunkhouse complex (approx. 2.03 hectares), the few remaining houses in Hecla Village (approx. 30.38 hectares) (Hurst pers. comm.), and the two-lane highway (approx. 175.38 hectares) for an additional subtotal of 215.89 hectares or 1.3% of the island. The total developed land area during the peak of the moose population was 539.89 hectares (or 3.3% of the island).

Since 1978, additional park development has included the North Shore Cottage Subdivision (at 30.38 hectares) and the Historic Hecla Village resettlement (Plate 1) (at 131.63 hectares) for a sub-total of 162.01 hectares or 1.0% of the island. When added to the 1978 land area development figure, the total developed land area equals 701.90 hectares or 4.3% of the island.

PLATE 1: Aerial view of Hecla Village.

2.1 MOOSE (*Alces alces*)

2.1.0 Moose Ecology

Gangly and awkward in appearance, moose are the largest members of the deer family *Cervidae* (Gunson *et al.* 1993). Body colour generally appears black but usually varies from dark brown to reddish or grayish brown, with lighter coloured leg stockings. The nose is long and slender and the ears appear similar to those of a mule. Adult female moose, referred to as cows, remain antlerless (Gunson *et al.* 1993) and attain weights averaging 460kgs (Canadian Wildlife Service 1998) while adult male moose, referred to as bulls, have large palmate antlers and may reach weights in excess of 600kgs (Canadian Wildlife Service 1998) (Plate 2).

PLATE 2: Bull moose in Grassy Narrows Marsh, August 2000.

Newborn moose, referred to as calves, are born during the calving season that runs from mid-May thru mid-June in Manitoba. Calves are usually a dark tan colour (Plate 3) while juvenile moose, referred to as yearlings, are normally of the adult colour range. Twin calves are a relatively common occurrence and are indicative of good habitat conditions. The twinning rate for calves on Hecla Island was calculated to be 28% from an 'in utero' moose productivity survey conducted between 1978 and 1986 by Crichton (1988).

Moose can generally live up to 20 years and have home ranges that average 30 km^2 (Burt and Grossenheider 1980). As with most ungulates, moose habitat preferences vary with the changes in the seasons. A variety of habitats from dense coniferous forests to more open aquatic and riparian communities with some cover are typical requirements (Stelfox and Stelfox 1993).

PLATE 3: Cow moose with twin calves at heel (www.ernieroberts.com).

In the summer, moose can be found in open plant communities where forage is abundant, such as riparian areas and clear-cut harvest or burn areas older than 15 years. Aquatic areas tend to be used more frequently and in disproportion to their availability in summer. Winter distribution is limited by the availability of quality woody browse and by such snow conditions as depth, density and hardness (Stelfox and Stelfox 1993).

Typical predators of moose include grizzly bears (*Ursus arctos*), black bears, timber wolves, and to a limited extent, cougars (*Felis concolor*). Since grizzly bears have been extirpated from Manitoba for over a century, and since cougars are relatively rare, moose in Manitoba primarily have black bears and timber wolves to evade. Although some black bears do posses a certain level of hunting instinct and ability, they are still relatively inefficient at locating and killing moose. It is for this reason that black bears are thought to target the somewhat easier to kill newborn moose calves during and immediately following the calving season when high-protein meals are most important. Wolves, on the other hand, tend to target moose mostly during the winter months as they rely on other prey species like beaver (*Castor canadensis*) and white-tailed deer the remainder of the year.

2.1.1 Local Mortality Sources for Moose

Current mortality sources for moose on Hecla Island include timber wolf and black bear predation; unregulated human harvest; limited harvest by Treaty

Aboriginals; winter starvation; exposure due to occasional tick (*Dermacentor albipictus*) infestations; accidents such as drowning (especially for calves); and even the occasional motor vehicle accident. According to the Canadian Food Inspection Agency, brucellosis (a livestock disease that may cause pregnant cow moose to abort their fetuses) was effectively eradicated from Manitoba in 1983 (Thompson pers. comm.) and is therefore not considered to be a factor in declining moose recruitment levels on Hecla Island.

2.1.2 Moose Habitat Studies and Management Initiatives

In the 1970's and 1980's, the moose herd on Hecla Island experienced much attention and public notoriety as the herd was the densest known in the province. During this time, the provincial government was in the process of developing the island into an exclusive natural park with the local moose population being one of the main wildlife attractions for visitors.

Since visitors were naturally drawn to the park by the unparalleled moose viewing opportunities, a plan was put in place to develop an interpretation program that would educate the public about the moose that they had come to see. Key features of the Park Interpretive Program were developed to include such items as: interpretive trails with informational signage through moose habitat; moose viewing towers on the island and in the marsh; and ongoing amphitheater presentations with key guest speakers.

In order to sustain the local moose herd and learn more about it, provincial wildlife managers conducted several studies and developed experiments so that the herd's success could possibly be replicated in other parts of the province through directed management efforts. Studies and management initiatives consisted of the following activities: annual aerial moose surveys to monitor population trends; monitoring of annual snow conditions and depths; monitoring of browse usage to establish carrying capacity; construction of a browse enclosure to monitor the impact of moose, deer and snowshoe hare usage; clear-cut timber harvesting to rejuvenate decadent forest and increase browse production; limited controlled burns to increase browse production; a spring dead moose survey to monitor starvation rates; and ten years of licensed recreational hunting in order to keep the population within its estimated carrying capacity (Crichton 1983).

Although somewhat limited in number, several academic studies were also conducted on the flora and fauna of Hecla Island over the same time frame. The most recent and notable was the study by Goulet (1992) on browse production and utilization by moose in winter.

2.2 Black Bears (*Ursus americanus*)

2.2.0 Black Bear Ecology

Solid and stocky in appearance, the black bear is the second-largest carnivore inhabiting Manitoba. Black bears in Manitoba vary in colour from black to brown (Plate 4), and cinnamon to blonde. Adult male black bears, referred to as boars, can exceed heights at the shoulder of up to 90 cm and usually attain weights in excess of 220kgs (Burt and Grossenheider 1980). Female adult black bears, commonly referred to as sows, are moderately smaller and weigh relatively less than males.

Plate 4: North American black bear (*Ursus americanus*).

Male black bears have relatively large ranges (Powell and Mitchell 1998), which may overlap with as many as 7 to 15 female home ranges (Rogers 1987). Cub litters usually range from 1 to 3 cubs with reproduction occurring every second year (Rogers 1987) since cubs stay with sows for at least one year before being driven off to fend for themselves. Individual home ranges are therefore in high demand, especially on islands, as juvenile dispersal is limited and existing territories often overlap substantially.

Black bears are omnivorous and eat a wide variety of foods, relying most heavily on vegetation – up to 77% in the spring and summer months (Boileau *et al.* 1994). Grasses, tubers, berries, insects, nuts, small mammals and carrion are usual foods (Hatler 1972; Burt and Grossenheider 1980). Accordingly, black bears prefer forested and shrubby areas but also frequent riparian areas, ridge tops, swampy hardwood and coniferous forests, and recently burned areas.

The use of garbage dumps as food sources essentially allows 'dump bears' to extend their growing and fattening period, leading to more rapid growth, earlier maturity and higher reproductive success (Rogers 1987) - possibly as much as doubling reproductive rates (Keay 1995). The use of dumps has also been observed to lead to alterations in natural behaviour (Hastings and Gilbert 1987); foraging habits (Graber and White 1983); physical size; distribution; and even abundance of bears in parks (Harms 1977, 1980; Graber 1982).

Black bears inhabit all areas of Manitoba with the exception of the mixed grass prairie region of the southwest portion of the province. Currently estimated at 25,000 to

30,000 animals, Manitoba's black bear population is managed to maintain a sufficient density that allows for such activities as hunting, photography and biological study to take place while minimizing risks to property and public safety (Manitoba Conservation 2001).

Although black bears have traditionally been considered as opportunists that mainly forage for their food, recent studies have found increasing evidence for the importance of black bear predation on newborn ungulates (Ballard *et al.* 1981; Stewart *et al.* 1985; Franzmann and Schwartz 1986; Crête and Jolicoeur 1987; Ballard *et al.* 1990; Schwartz and Franzmann 1991; Gasaway *et al.* 1992; Gunson *et al.* 1993; Van Ballenberghe and Ballard 1994) with Austin *et al.* (1994) documenting evidence of a black bear actually killing and consuming an adult cow moose in Ontario in 1992.

2.2.1 Local Mortality Sources for Bears

Since there are currently no big game hunting seasons in effect for Hecla Island, black bears do not have any noteworthy mortality sources outside of natural causes and the occasional management actions taken by district Natural Resource Officers to ensure public safety.

2.3 PREDATOR-PREY RELATIONS

2.3.0 Black Bear Predation on Moose Calves

The fact that black bears hunt and kill moose calves is undisputed in the wildlife management community, but the exact extent of such predation is sparsely documented. Increasing evidence suggests that black bear predation is a major mortality factor for moose calves during the first 6 to 8 weeks of life (Stewart *et al.* 1985; Franzmann and Schwartz 1986; Crête and Jolicoeur 1987; Gasaway *et al*. 1992; Gunson *et al.* 1993). Ballard and Larsen (1987) go as far as to suggest "Where black bears are the most numerous predator, they will also be the most significant neonate mortality factor".

It is currently believed that not all bears possess the skills or aptitude for hunting and killing moose calves and that basic predation is a learned behaviour – most likely taught to the cubs by the mother (Rouseau pers. comm.). Interestingly enough though, it is also believed that it is mainly aggressive male black bears that retain this instruction and are therefore likely responsible for most moose calf predation in any given area (Crichton pers. comm.; Rouseau pers. comm.) just as they are responsible for most predatory attacks on humans (Herrero 1985).

Experimental removal of black bears (Stewart *et al.* 1983) and timber wolves (Gasaway *et al.* 1983; Crête and Messier 1984) from study areas have produced immediate increases in moose calf survival rates in various jurisdictions of North America. For example, the removal of 12 black bears from a 90 km^2 study area in Saskatchewan resulted in a same-year 80 calves/100 cows ratio as compared to the control ratio of

40:100 (Stewart *et al.* 1985). Black bear removal did not provide lasting relief from calf losses, however, as calf/cow ratios declined the following year. This decline may have been attributable in part to a subsequent ingress of sub-adult bears to the area as a result of the removal of dominant adults, which may also seem to suggest that moose calf depredation is not limited to specific sex/age classes of bears (Stewart *et al.* 1985).

The same treatment was repeated one year later where a total of 26 black bears were removed from a different study area encompassing 130 km^2. The resulting calf/cow ratios were found to be 87 and 39 calves per 100 mature cows in the removal and non-removal control areas respectively. A similar study conducted in Québec by Crête and Jolicoeur (1987) revealed that moose calf survival was significantly higher in the bear removal area than in the control block in two out of three winters. The fact that improved calf survival seemed proportional to the number of bears removed per area, rather than to the number of bears removed per moose, seemed to indicate that black bear predation is not dependant on moose density but rather on bear density (Stewart *et al.* 1985).

Van Ballenberghe and Ballard (1994) concluded that, when combined with wolf predation, black bear predation on moose in naturally regulated ecosystems "is often limiting and may in fact be regulating". Predation on moose is thought not to be strongly limiting, however, if predators are greatly reduced in number, or if human influence on other ecosystem components is extreme. Under such conditions, moose density can actually rise much higher than in naturally regulated environments containing bears and wolves, consequently making food availability and cover the ultimate limiting factors (Van Ballenberghe and Ballard 1994; Crichton 1977). Since each ecosystem presents its own array of variables, applied research is the key tool used to determine the type of predatory impact (*i.e.* limiting vs. regulating) on any specific ungulate population.

2.3.1 Wolf Predation on Moose Calves

Timber wolves are known as specialist predators (Tremblay *et al.* 2000) that typically prey on beaver and ungulates (Mech 1970; Pimlott 1974; Gunson 1995). During ice-free periods, however, wolves appear to adjust their prey intake according to the availability and vulnerability of prey species (Voigt *et al.* 1976; Potvin *et al.* 1988; Forbes and Theberge 1996).

In his review of wolf feeding habits studies from the 1940's through to the 1960's, Mech (1970) reported that animals the size of beaver or larger consisted of 59 to 96% (percent occurrence) of the food items typically found in wolf scats. Similarly, in their study of summer feeding habits of wolves in Québec, Tremblay *et al.* (2000) reported that species other than moose, caribou and beaver contributed very little to the summer diets of two separate wolf packs. They suggested that the low consumption of smaller prey was a likely result of opportunistic predaceous events as opposed to targeted hunting activities.

Wolves tend to target larger prey species (such as moose) only during the winter months when snow conditions allow them to hunt and kill sick, weakened or injured animals most efficiently. Although young ungulates are sometimes selected by wolves in summer (Pimlott *et al.* 1969; Van Ballenberghe *et al.* 1975; Voigt *et al.* 1976; Fritts and Mech 1981; Messier and Crête 1985), some researchers postulate that wolves tend not to target young moose calves to the same extent as black bears do since alternative food sources are more readily available during this time.

2.3.2 Limiting vs. Regulating

Limiting factors are described by Ballard and Van Ballenberghe (1997) as those factors that ultimately alter the rate of population increase. As such, it can be said that limiting factors include all "additive" mortality sources – external pressures or mortality sources affecting the normal life cycle of an animal. Messier (1991) describes *regulating factors* as subsets of limiting factors wherein they are solely (prey) density dependant – "keeping a prey population within its normal density ranges". Regulating factors are thus, normal "compensatory" mortality sources – mortality sources that the animal is predisposed to during its natural life cycle.

Depending on the relationship between a moose population and the carrying capacity of the specific habitat, predation can be either additive or compensatory

(Ballard 1992). According to Ballard and Van Ballenberghe (1997), however, " The evidence for predation acting as a major limiting factor in many moose populations is strong but the evidence that predation regulates moose populations is debatable".

Although predators are not generally thought to limit ungulate populations (Skogland 1991; Boutin 1992), the addition of a predator to a semi-enclosed system has been argued to: alter population cycles and induce multiple stable states (Walters *et al.* 1981; Messier and Crête 1985; Messier 1991) and even create "predator pits" (Crête and Jolicoeur 1987) – a situation where over-abundant predators hold a select prey population at below K-carrying capacity.

Usually when prey decline in an area as a result of a combination of factors such as severe winter weather, hunting and/or predation, wolf predation may become a limiting factor, especially if bear predation is also prevalent (Gunson 1995). Gasaway *et al.* (1992) go one step further with their statement that "There is increasing evidence to suggest that predation by bears and wolves is the primary factor limiting moose already at low densities where moose are primary prey and where both predators and moose are only lightly harvested".

2.3.3 Diversionary Spring Feeding of Bears and Wolves

In east-central Alaska during the spring of 1985, a wildlife management initiative headed by personnel from the Alaska Department of Fish and Game shed new light on the controversial issue of predator control. In an effort to determine the impact that grizzly bear predation was having on the struggling moose population, biologists attempted to radiocollar grizzly bears in order to follow their movements and study their diets. Although the region also supported wolves, grizzlies were thought to be responsible for killing 17 of 33 (52%) newborn moose calves one year (Savage 1999).

In an attempt to aid collaring efforts, approximately 12,000 kilograms of train-killed ungulate meat was airlifted by helicopter and dropped into remote backcountry areas to be used as bait for the bears. As the study progressed, an obvious anomaly was noticed with the moose population one year later – instead of the previous calf/cow ratio of 1:10, the new ratio was observed to have risen to 1:2 (Savage 1999).

Five years later in 1990, the same team set out to formally test the hypothesis that supplementary feeding of predators such as bears and wolves during the moose calving season actually diverts predators from preying on young moose calves. During this treatment, a total of 26,000kgs of roadkilled meat was airlifted and dropped into a research block during peak calving season. The resulting calf/cow ratio the following winter was observed to be the highest in nine years and almost four times better than anywhere else in the region (Savage 1999).

A variation of the experiment was subsequently repeated by wildlife managers in Alberta in 1998 in order to address spring livestock depredation. The end result was a total of one cow being killed by a grizzly – a number substantially less than the usual double-digit losses in previous years. In all three exercises, diversionary feeding of predators, in order to protect vulnerable prey species (such as moose calves and livestock), showed both positive and immediate results.

2.4 WILDLIFE MANAGEMENT TECHNIQUES

It is suggested by Estes (1996) that there are two basic approaches of analyzing how predators influence ecosystems. One (the inductive approach) is to assemble a list of case studies and search for patterns among them. A second (deductive) approach is to formulate presumptive hypotheses about species of animals that are responsible for some particular function of predation and then test them by conducting studies in which the species is either absent or present. Manipulative experiments in which predators are added or removed from ecosystems, contrasted with un-manipulated controls, usually provide the most compelling evidence of a predator's function, and have been used in a number of past studies to demonstrate keystone predatory roles (Carpenter and Kitchell 1993; Mills *et al.* 1993; Power *et al.* 1996).

2.4.0 Predator Bait Stations

The use of bait stations is a proven method for obtaining wildlife population estimates and is used extensively by the Minnesota Department of Natural Resources for regional bear surveys (Garshelis 1991). The bait station method is normally used in mid to late summer during the transition period between the end of the mating season and the beginning of major berry production (Pitt and Jordan 1996) when foraging becomes the dominant activity (Rogers 1987).

In the study conducted by Pitt and Jordan (1996), bait stations consisted of 0.35 kg of bacon wired at least 2.3 meters high to *Betula* spp. and *Populus* spp. sapplings of 10-20cm diameters. The soft outer bark of these types of trees is the most reliable for the detection of claw marks from curious bears. Another method, employed by Lindzey *et al*. (1977), was a series of bait stations placed at regular intervals, during four periods of four days each between May and October. Small diameter trees were selected where the base of each tree was cleared of debris and the soil was raked to allow for subsequent recognition of tracks. Baits were suspended from the trees 150-170cm above the ground and replaced only if taken. The bait stations were then checked daily. A station was considered visited if at least one bear track was present in the cleared area. No attempt was made to determine if more than one bear had visited each scent station. Relative index values were then calculated for each of the four study periods using the following formula from Linhart and Knowlton (1975):

$$\frac{\text{Total Bear Visits}}{\text{Total Operable Station Nights}} \times 1{,}000 = \text{relative index}$$

Observed index values across the four study periods were comparative and proved useful in monitoring trends in black bear population size. A final note by Lindzey *et al.* (1977), however, indicated that the number of scent stations was limited as a result of area constraints since the study area was located on an island. It was hypothesized that an increase in the number of scent stations would have reduced the inherent variability of the resulting index.

A method somewhat associated with the bait station technique is the use of front-footpad track widths as a predictive indicator of black bear morphometrics (Brooks *et al.* 1998). In particular, the age and body size of bears reliably correlate with width dimensions of the front footpad track. Appropriate models exist for both single-sex and combined sex observations (Brooks *et al.* 1998). This morphometric method, however, was not employed in this study as visual observations were used to distinguish between the various bears.

2.4.1 Black Bear Capture and Translocation

There have been numerous studies conducted where the impact of predator removal on ungulate species have been examined. In most instances, predators such as black bears and timber wolves have been removed from study areas by such extermination methods as: trapping and foot snaring, aerial and ground shooting, and strychnine poisoning (Stewart *et al.* 1985; Crête and Jolicoeur 1987). In one study quoted by Wilton (1983), a total of 73 black bears were captured, tagged and removed from a study area. Three years later, only six of the 73 bears were recaptured inside the study area - one having returned 138 straight-line miles.

The province of Manitoba currently uses culvert traps on trailers constructed of corrugated steel culverts (Schemnitz 1996) to capture, hold and transport black bears and polar bears in all areas of the province. The use of such traps allows for the safe and efficient capture, as well as the safe transport and releasing of both bear species. The traps work on a hinged-door mechanism connected to a baited trigger inside the trap. Once the bear is inside the trap and activates the trigger, the door closes securely behind the animal. The hinged-door system (as opposed to the top-down sliding door system) either captures the bear successfully or not at all with minimal chance of inflicting injury to the animal.

Since the study area for this project consisted of a semi-enclosed island ecosystem, the possibility of bears returning to the island during the relatively short study period seemed relatively remote. It was for this and other conservation reasons that black bears were simply removed from the island and released to mainland sites of similar habitat.

2.4.2 Aerial Wildlife Survey

An aerial survey is the most effective tool for estimating wild ungulate populations over vast areas in remote locations. Most moose survey techniques are based on a method developed in Alaska as reported by Gasaway (1986). This "Alaska" technique involves aerial (helicopter) sampling of randomly selected subunits of a previously (fixed-wing) stratified survey area. The main components include: 1) the survey area; 2) survey units (which are subunits of the survey area); 3) stratification which assigns either a low, medium or high strata to a subunit; 4) the detailed survey of randomly selected subunits to get a total count of moose by sex and age; and 5) an intensive search that provides a correction for animals missed during the initial detailed survey (Lynch 1996). GPS and GIS technologies are used to help improve efficiency as pre-established grids based on lines of latitude are flown as transect lines. (Note: stratification is not required when surveys are conducted over relatively small areas as a population total count is usually more logical and cost effective in such circumstances.)

During the stratification phase, moose are merely observed and their relative locations are recorded. Moose are subsequently aged and sexed during the randomly selected detailed surveys with the use of a low-flying helicopter, which provides the necessary slow speed and maneuverability.

The sex of each moose is determined by such characteristics as: the presence/absence of antlers (Lynch 1996; Whaley pers. comm. 1997); the presence/ absence of a white or gray vulva patch beneath the tail on cows (Lynch 1996; Whaley pers. comm. 1997); the size and appearance of the bell-shaped flap of skin beneath the neck (Crichton pers. comm.); the black (on bulls) vs. the brown (on cows) colouration of the snout (Lynch 1996); and the differences in immediate reaction to the approaching helicopter (eg. bull moose will stand with their hind legs held close together after they rise from their beds before they will run from the aircraft whereas cow moose will simply rise and run for cover) (Crichton pers. comm.). The relative age of each moose is differentiated as adult, yearling or calf, based on the comparative size of each animal as well as the shape of the head. An approximation of the relative age of bull moose is accomplished based on comparative antler size and configuration (Lynch 1996; Whaley pers. comm. 1997).

Although this method is useful for sampling subunits of survey areas and extrapolating total population figures for larger areas, it is important to note that it is not practical for a relatively small area such as an island. As in the case of Hecla Island, a population total count is the most efficient and logical method of determining the moose population, with the methods of flying pre-established transect lines and aging and sexing moose being the same as with the "Alaska" sampling technique.

2.4.3 Wolf Howling Surveys

Wolves typically communicate with each other across distances by howling and barking. Except for high-pitched yapping when pups are present, however, howling almost never includes barking. According to Joslin (1966) howling sessions by single wolves usually last an average of 35 seconds, while sessions by packs usually last longer – approximately 85 seconds on average. In most instances, one wolf is responsible for initiating pack howls with one or more others joining in after several howls (Joslin 1966).

When counting the number of responses during howling surveys, Harrington and Mech (1982) advise that it becomes increasingly difficult to assess the number of individuals if there are more than 3 or 4 wolves howling at the same time. Additionally, Fuller (1988) discovered that response distances are limited as more than 80% of wolf howls are heard at distances of less than 1.5kms and none are usually heard at distances greater than 2.5kms.

Most types of surveys for wolves are usually thought to be inconclusive, especially when known wolf densities are low. The most effective method of locating wolves is thus to initiate track and howling surveys soon after reliable visual sightings are made. Such wolf howling surveys have traditionally been accepted and used to reliably locate wolves and estimate changes in pack numbers (Joslin 1967, Pimlott and Joslin 1968; Theberge and Strickland 1978).

Harrington and Mech (1982) developed simulated wolf howl methodology for both a saturation census and a sampling census. Fuller and Sampson (1988) evaluated this methodology and found it useful for locating packs in small areas, but found that the technique was not practical for surveying large (i.e. province wide) areas due to inherent logistical and statistical constraints.

The following is a list of considerations assimilated by Tucker *et al*. (1990) that must be taken into account when planning a successful howling survey:

1) *Packs are more likely to respond than lone wolves* (Harrington and Mech 1979).

2) *The highest response rates are when pups are at rendezvous sites (July, August and September), and just prior to and during the breeding season (February)* (Harrington and Mech 1979).

3) *One function of howling is to maintain space between packs. Therefore, single wolves or small packs may be intimidated by loud howls close by and are likely to retreat silently rather than respond* (Harrington and Mech 1979).

4) *Avoid howling surveys during precipitation and winds greater than 12 km/hr* (Harrington and Mech 1979).

5) *Wolves respond to human howls better than recordings of wolf howls* (Pimlott 1960; Joslin 1967).

   a. *Wolves are able to detect human howls from at least 10 km* (Harrington and Mech 1979).

   b. *Wolves are more likely to respond when they are at a kill* (Harrington and Mech 1979).

6) *Response rate is highest at dusk and during the night. Phase of the moon and cloud cover has no effect on response rate* (Harrington and Mech 1982).

7) *The majority of howls can be heard by humans 1.5 km and less. Few are heard at over 2.5 km* (Fuller and Sampson 1988).

8) *Wolf packs do not always respond to the first trial, but most respond by the third* (Harrington and Mech 1982).

9) After wolves howl, there is a refractory period of 15 to 20 minutes before they will howl again.

In order to increase the probability of detecting responses, Pimlott and Joslin (1968) suggest that surveys be conducted within the same general area of recent known wolf activity with howling locations being at least 1.5km apart. They also suggest that howling commence at dusk and/or after dark when possible. A trial sequence of five howls should be used to start a survey, alternating "flat" and "breaking" howls with the first trial at a lower volume (Harrington and Mech 1982). Each trial should be repeated three times at about 2-minute intervals. Response rates are usually found to be highest in August, but late July and early September are also good. Since wolves that do not respond one night may respond the next, howling surveys are normally repeated for a minimum of three consecutive nights for optimal success (Tucker *et al.* 1990).

2.4.4 Relative Abundance Calculation

A relative abundance calculation is a simple and inexpensive method of estimating a wildlife population. It can also be used to compare the relative importance or abundance of a particular species with regards to other species present within a delineated study area. According to Dunster and Dunster (1996), a relative abundance value is calculated from the total number of species-specific individuals observed over a certain period of time or in a particular place, divided by the total number of animals observed in that place or specific community of interest. The final value is usually expressed as a percentage since it represents the proportion of each species in relation to the other species that make up the specific community of interest.

2.4.5 Bear and Wolf Scat Analysis

Scat analyses have been widely used to study the diets and predatory behaviour of wide-ranging and secretive predator species (Thompson 1952; Mech 1966; Pimlott *et al.* 1969; Van Ballenberghe *et al.* 1975; Voigt *et al.* 1976). Hair fragments found in predator scat samples are particularly useful as they are quite often the only clue linking a particular prey species to an act of predation.

Two distinct hair types from big game animals that are normally present in scats are the guard hair (i.e. coarse or overhair) and the underhair (i.e. fine hair or fur). The guard hair is the more useful of the two types as gross morphology of this larger hair can usually be examined visually and compared to known samples. Identification characteristics such as pigmentation, length, width and curl (or wave) are often the most telling features (Packer pers. comm.).

Both guard hair and underhair are composed of three distinct keratin layers in cross-section: an external cuticle; a central medulla; and a cortex (Urban 1969). Unique, species-specific scale patterns are visible on the cuticle layer when viewed with a compound microscope. Various techniques for observing scale patterns all include making an imprint of the hair shaft in a soft transparent medium on a glass or acetate slide (Crichton pers. comm.). When the glass slide is viewed with a compound microscope, the scale patterns in the medium are then compared to a key of known mammalian hair samples, facilitating positive species identification.

3. METHODS

3.0 FIELD WORK AND DATA COLLECTION

A variety of different field methods were used in concert to achieve the overall objective of this study. All of the methods are described in this section along with the various project approvals and safety precautions that were taken to ensure the on-going safety of the bears, the public and myself throughout the entire duration of the project.

3.0.0 Permit Acquisition

A Wildlife Scientific Research Permit from the Wildlife Branch of Manitoba Conservation (for the capturing and handling of wildlife) was not required since I was a regular seasonal employee of the Department both prior to and during the fieldwork portion of this project. Accordingly, all animal capturing and handling activities were normal responsibilities of the Seasonal Resource Officer position.

A permit to conduct wildlife research within a provincial park was also not required since most research activities merely involved the monitoring of a (government) wildlife management initiative developed and carried out by Operations Division of Manitoba Conservation, with approval and support granted by Parks and Natural Areas Branch – Winnipeg Headquarters.

3.0.1 Canadian Council on Animal Care Approval

Canadian Council on Animal Care (CCAC) approval was first applied for on March 30, 2000 prior to commencement of the fieldwork portion of the study. I also attended a CCAC course at the University of Manitoba campus on the days of May 18 - 19, 2000. Conditional approval for the project was granted by the Fort Garry Campus Protocol Management and Review Committee on May 2, 2000, with full approval granted on May 23, 2000.

3.0.2 Safety Precautions

While conducting fieldwork activities, I carried a two-way VHF Motorolla radio and, for safety purposes, was in direct radio contact with Manitoba Conservation personnel at all times. The daily use of a 4x4 ATV for accessing backcountry areas also proved to be a valuable safety resource as it ensured against surprise encounters with black bears and provided a safe and reliable mode of retreat from potentially dangerous situations near active bait stations and trap sites.

Although I conducted approximately 90+% of the backcountry fieldwork alone, a firearm was only carried during evening monitoring of backcountry bait stations in addition to all bear handling activities. As per Manitoba Conservation operational guidelines, one of three qualified seasonal Resource Officers from Manitoba Conservation (Hecla District) each provided their valuable assistance in every black bear handling and release situation. Assisting officers were armed with a 12-gauge shotgun loaded with one-ounce lead slugs in order to ensure human safety. The shotgun was also kept ready in all bear handling situations on the slight chance that a bear might have potentially become injured in a trap to the point where the only humane option would have been to destroy it. Ropes were also used in conjunction with the strategic placement of the tow vehicle at release sites in order to facilitate safe and rapid releases.

In order to prevent park visitors from wandering into bait stations or trap sites, existing barricade structures on access roads and trails were always kept closed and secured with padlocks throughout the field season. Additional precautions included the placement of blaze-orange flagging tape and "Danger! – Bear Trap" signs around every bait station and trap site to sufficiently warn park visitors. Highly visible danger signs were also permanent fixtures on both sides of every Manitoba Conservation bear trap utilized for this project.

3.0.3 Bait Station Operation and Monitoring

A total of 13 bait stations were used during the course of the field season. Most bait stations were established along or adjacent to backcountry ski and snowmobile trails accessible only by barricaded roads and trailheads. Once established, all bait stations were monitored for bear sign daily and re-baited as required. Baits typically included highly scented food items such as: skinned beaver carcasses (Plate 5); fish offal and discarded commercial fish by-catch; and road-killed deer. Scent trails were also created on approaches into bait stations with artificial vanilla extract spilled at intervals, as well as with beaver carcasses dragged behind the ATV.

Once bear sign was detected at a bait station, a culvert trap was immediately set up for the following evening (Plate 6). Traps remained set for different periods of time at the various bait stations depending on the level of bear activity observed at the specific site and the activity levels observed at the other bait stations. Monitoring of the bait stations was accomplished by daily visits by myself in order to detect recent bear and wolf sign and to re-bait as necessary.

Relative index values for black bears were derived from evening observations at two separate bait station sites over two periods of three consecutive evenings each. A portable tree stand was utilized at one bait station site and a ½ ton truck was utilized at the Hecla landfill to inventory the different black bears both during (June/July) and after (late August) trapping efforts ceased. Index trends were expected to aid in the remaining bear population estimates as index values were ideally expected to decrease accordingly with increased bear capture and translocation success.

During the wet season, bear tracks observed in muddy areas adjacent to each bait station were used to determine if a site had been visited (Plate 7). Towards the end of summer (during dry conditions), the vegetative layer of the trails on either side of the bait stations/trap sites was raked clear to the soil layer daily in order to record fresh bear and wolf tracks (Plate 8). Other sign indicating the presence of bears at bait stations included any one, or a combination of the following: fresh bear scats; scavenging of baits 3 feet or more above ground level; snapped ¼ inch polyethylene ropes (used to hold beaver carcasses to trees); large vertical claw marks penetrating the outer bark layer of bait trees (Plate 9); large scrapes on the ground (most likely made by dominant male bears staking their territorial right to the bait site/food source - Rousseau pers. comm.); and actual visual sightings (Plate 10).

Plate 5: Typical bait station with skinned beaver carcasses tied to trees approximately three to six feet high.

Plate 6: Typical culvert-type bear trap set along a backcountry snowmobile trail.

PLATE 7: Fresh bear prints visible in soft mud adjacent to a bait station.

PLATE 8: Raked trail areas to detect fresh black bear and timber wolf prints/ activity adjacent to each bait station.

PLATE 9: Bait tree exhibiting claw marks from a black bear.

PLATE 10: Black bear observed approaching culvert trap at Hecla landfill.

3.0.4 Black Bear Capture and Translocation

In early May (before the start of the moose calving season), three bear traps were placed at various locations throughout the Hecla Island study area with the aid of an ATV and a ½ ton pickup truck supplied by Manitoba Conservation. Traps were cleaned and baited regularly, and checked twice daily – morning (between 8am and 10am) and early evening (between 6pm and 9pm).

Traps were baited with several kilograms of meat and/or highly scented foods that were usually consumed in their entirety by every captured bear. Baits used in the traps consisted of the following highly scented food items placed in burlap bags: skinned beaver carcasses, sardines, discarded commercial fish and artificial vanilla extract in early spring; cooked bacon, popcorn, crab apples and artificial vanilla extract during mid-summer; and burnt honey, molasses, marshmallows, used restaurant grease and oats during late summer.

Captured bears were monitored for food and water deprivation and all bears were watered generously both before and after transport to the release sites. Bear traps remained in use from the spring/early summer moose calving season (starting May 2nd) thru to August 30th. Every bear caught was visibly marked with a 7:1 (40%) hydrogenperoxide/hair developer solution applied directly to the fur of the rump and/or rear flank area (for identification of animals that may have returned to the study area during the treatment period). Marking was accomplished by myself standing on top of the bear trap and applying the hair developer solution directly to the fur of each animal (via a small paint roller on an extension handle) as each bear departed from the trap (Plates 11 & 12). The bleached mark on each bear was anticipated to last several weeks until the molting of their winter coats was complete.

PLATE 11: Myself in position to mark a bear as it departs from a trap.

PLATE 12: Example of a black bear (Note: marked with red paint) departing from a Manitoba Conservation culvert trap.

A running total including relative size and sex was kept of all bears captured and removed from the study area. All captured bears were released at mainland areas of similar habitat and low bear densities, pre-selected by the Regional Wildlife Manager of Manitoba Conservation - Interlake Region. These areas included the Moose Creek, Lee Lake and Mantagao Lake Wildlife Management Areas. Due to the territorial nature of black bears, each bear was released at a different location, with each release site being approximately 85km or more from the corresponding capture site on Hecla Island.

Since a main goal of this method was to capture and remove the bears from the study area during and immediately after the critical period that moose calves are vulnerable to black bear predation, a crucial second half to this method included a subsequent big game aerial survey. It was only through such a survey that post-bear removal changes in the moose population could be reliably detected. Although many other mortality sources are known to affect the island moose population, bear removal was intended to show a speculative cause-and-effect relationship between black bear predation and moose calf survival.

3.0.5 Incidental Big Game Sightings

A total of seven 'Big Game Sightings' logbooks were distributed to Hecla/Grindstone Provincial Park staff in order to record all incidental black bear, timber wolf, moose and white tailed deer sightings on the island during the study period. I too kept a personal logbook in which all personal sightings and verbal accounts of big game sightings from park visitors were also recorded. All logbook data was combined and considered in big game relative abundance estimates, included in the final discussion, and used in the formulation of study conclusions and recommendations.

3.0.6 Backcountry Wildlife Observations

Backcountry wildlife patrols were conducted on foot over various parts of Hecla Island throughout the course of the field season. Specific areas targeted included the following trails (including adjoining spurs and preferred big game habitat areas): 1) the Hokanson Point trail; 2) the Kjartanson Point trail; 3) Kirkjubol Road; 4) Christine's Fishing Camp interpretive trail system; 5) the Moose Observation Tower (and surrounding marsh area); and 6) the various trails along the dyke system of Grassy Narrows Marsh (see Map 3, page 70). Big game sign such as tracks (Plates 13, 14 and 15), scrapes, predator scats, black bear territorial marking posts (Plate 16), black bear bite marks and scrapes, ungulate pellet groups, ungulate browsing sign and predator kill sites were all observed, recorded and used to support relative abundance estimates for all big game species known to exist on the island.

PLATE 13: Moose prints in mud along a backcountry trail.

PLATE 14: Deer prints in mud near a natural salt lick.

PLATE 15: Two sets of wolf prints in hardened sand.

PLATE 16: Backcountry hydroelectric pole used as a territorial "bear tree" marking post by black bears.

3.0.7 Predator Scat Collection

During the course of the field season, black bear and timber wolf scats (Plates 17 & 18) were collected for laboratory analysis to determine the presence/absence of ungulate hair – specifically that of moose and moose calves. Most scats were located in backcountry areas in relatively close proximity to the known moose calving area of the southeast section of the island. Samples were collected opportunistically in dry upland areas where black bear and wolf scats were encountered most frequently. Areas of collection included all of the snowmobile trails and the abandoned gravel pit of the southeast section of Hecla Island, as well as the Kjartanson Point trail (and adjoining spurs) and several trails northwest of Hecla Village.

All samples taken were sealed in plastic bags, labeled and frozen for storage. Leather gloves, a particle mask and a small shovel were used to collect all samples in order to guard against the ingestion and possible infection of *Echinococcus granulosus* – a fatal parasitic disease of the lungs and liver in humans. Samples were transported to Winnipeg at the end of the field season and stored in freezers at the Wildlife Branch of Manitoba Conservation.

Since black bears are commonly known to skin prey prior to consuming it, the chances of detecting moose hair in scat samples was understood to be very low. As with self-grooming, however, ingestion of some hair from prey species is ultimately unavoidable. It was expected, therefore, that only 'incidental' hair samples, as well as other resilient body components (such as hoof fragments), would be detectable in the black bear scats if they were actively preying upon moose calves. Thus, this method was expected to be relatively weak in its ability to link black bear predation with moose calf mortality.

PLATE 17: Bear scat found on road in vicinity of Hecla landfill.

PLATE 18: Wolf scat discovered near denning area on southeast portion of island.

3.0.8 Wolf Howling Surveys

Timber wolf howling surveys were conducted in late August and early September at various locations throughout Hecla Island. Howling was conducted at a minimum distance of 1km from PTH #8 in order to avoid causing potential wolf-vehicle collisions. Surveys were initiated at approximately 10:00 pm when weather conditions permitted. Individual wolf vocalizations responding to surveyor howls were anticipated to be discernable and recorded to represent individual animals. Survey results, including results obtained from the Hecla/Grindstone Park Interpretive Program, were supplemented with reported visual sighting information and bait station data in order to estimate the wolf population on the island during the study period.

3.0.9 Aerial Wildlife Survey

An aerial wildlife survey was conducted on Hecla Island by the Wildlife Branch – Interlake Region on January 25th and 26th, 2001 (Appendix 1). Survey funding was provided by Parks and Natural Areas Branch – Interlake Region. The main intent of the survey was to track changes in the total moose population and to assess the number of surviving moose calves after the black bears had been removed from the island ecosystem.

The format of the survey was that of a population total count, precluding a statistically involved estimate, due to the relatively small area of the island. The survey was conducted with a Bell 206 Jet Ranger helicopter (Plate 19) with one pilot, one crew

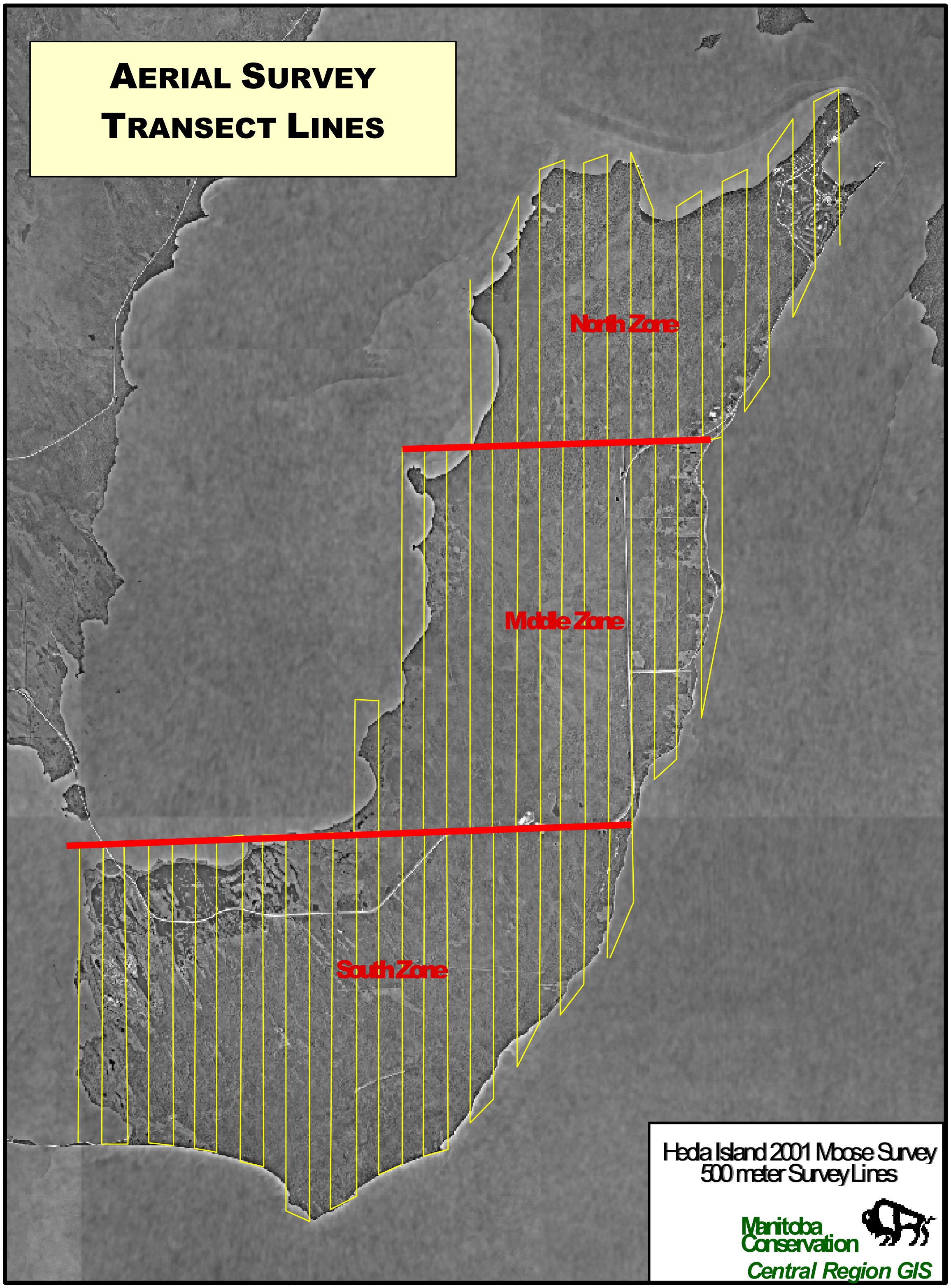
PLATE 19: Helicopter pilot and NRO Brown with Bell 206 Jet Ranger.

leader (Brian Hagglund – Oak Hammock Marsh Manager, Manitoba Conservation – Interlake Region) and two observers (Raymond Kotchorek – Project Leader, NRI; and Greg Brown – Natural Resource Officer IV, Manitoba Conservation – Riverton District). Snow depths were in excess of 25cm and weather conditions were considered adequate both days of the survey producing good viewing conditions.

The island was divided into three zones with each zone systematically searched for moose using 500 metre north–south orientated transect lines superimposed on a base map by GIS software (Map 2), with navigation directed by an on-board GPS unit. Observations were recorded up to approximately 250 meters from both sides of the aircraft along each transect line ensuring complete coverage with minimal overlap.

Flying was conducted at an altitude of 300 to 500 feet above ground level at approximately 100 km/hr when locating animals, and as low as 100 to 200 feet in a hover when sexing animals. All moose observed were counted and sexed (Plates 20 & 21) as per guidelines set out in Lynch (1996). All moose locations were recorded on a hand-held Garmin GPS unit and later mapped by Brian Hagglund of Manitoba Conservation with the use of GIS technology. The base map of Hecla Island was created with ArcView 3.2 GIS software utilizing digital orthophotographs of the island. The software programs used to create the route files (i.e. transect lines) for the GPS and for downloading waypoints were OziExplorer and MapSource 3.03 (Hagglund pers. comm.).

A second post-study aerial wildlife survey was conducted on Hecla Island by Manitoba Wildlife Branch – Interlake Region personnel in January, 2002 (results in Appendix 2).



MAP 2: Transect lines flown in three zones for the 2001 aerial wildlife survey.

PLATE 20: A lone cow moose observed in a black spruce muskeg.

PLATE 21: Two cow moose observed running into an open meadow.

3.0.9.0 Statistical Analysis

Due to the large amount of unrealistic variation in the past aerial survey data ranging from 1971 thru to 1988, it was decided that the best way to perform significance calculations on the data from the 2001 aerial wildlife survey was to base the calculations on prediction intervals. Based on regression analyses, prediction intervals were designed to predict individual population observations for 2001 within a 95% confidence interval. Actual values from the 2001 data were then plotted with the prediction intervals and determinations were made as to whether or not the observed values fell within the predicted ranges. If an observed value were to fall outside the range of a prediction interval then it could be said that the change in population was significant; if it were to fall within the range of a prediction interval, then the change could be said to be insignificant as it fit the range of natural variation.

The baseline data points that were used for all three regression calculations were those from 1988 – the most recent data point from where the data seems to follow a reasonable course (most likely due to the initiation of a standardized survey method around this time). The formula for the 95% prediction interval was as follows:

$$Y_{x*} \pm t_{4,.025} \sqrt{MSE \left(1 + \frac{1}{n} + \frac{\left(x* - \overline{x}\right)^2}{\sum_{i=1} \left(x_i - \overline{x}\right)^2} \right)}$$

where: x* = point at which prediction takes place (here, year = 2000 => x* = 12)

MSE = estimate of σ^2 n = 6 t = 2.776

x_i = 74.833 $\overline{x} = 5.167$

Interpretations:

slope coefficient = average annual change in the rate
intercept = average(predicted) rate at the time origin (year = 1988)

(Murphy pers. comm.)

Using the data from 1988 up to, but not including the 2001 data, the formulas for the fitted regression lines were as follows:

Calves/100 Cows: **y = 37.85 - 3.14 (year - 1988)**

where : 37.85 = represents the average estimated in 1988 according to the slope coefficient
3.14 = represents the decrease in the rate
1988 = year 0

Calves/100 Adults: **y = 21.227 - 1.735 (year - 1988)**

Bulls/100Cows: **y = 75.210 + 0.657 (year - 1988)**

(Murphy pers. comm.)

3.1 LAB WORK

3.1.0 Bear and Wolf Scat Analysis

Black bear and timber wolf scat samples were analyzed for ungulate hair content at the Wildlife Branch lab at Manitoba Conservation Headquarters in Winnipeg during the winter of 2000-2001. As with sample collection, protective measures were taken to guard against accidental ingestion and possible infection of the parasite *Echinococcus granulosis*. A lab coat, particle mask, disposable latex gloves, tongs and forceps, as well as the lab ventilation system, were all used for the entire duration of laboratory activities.

Scat samples were separated by source species and then thawed. Individual samples were broken down into their coarse components with the use of a Tyler Standard Screen Scale (20 mesh sieve), running hot water, lab tongs and forceps. Once a sufficient amount of organic matter had been removed from the sieve, hair samples were individually removed and placed on labeled paper towels in a fume hood for drying.

After a sufficient drying time, all hair strand samples were transferred to glass microscope slides where they were inlaid on a thin transparent layer of Lepage's glue (as per Crichton pers. comm.). Once the glue had set, each hair strand was peeled from the medium with the use of laboratory dissecting instruments. Upon removal from the slides, gross morphology (i.e. length, colour and shape) (Packer pers. comm.) of each hair sample was observed and recorded to aid in species identification.

The glass slides were then viewed with a compound microscope and the hair imprints were analyzed for species-specific scale patterns. All scale patterns were compared to example patterns found in Adorjan and Kolenosky's guide (1969): A Manual for the Identification of Hairs of Selected Ontario Mammals, as well as to known samples of beaver, deer and black bear hair collected during the field season. Although the main objective of this particular method was to determine the presence/absence of moose calf hair in predator scats and establish a link between black bear predation and moose calf mortality, other important dietary information for both wolves and bears resulted from this method.

4. RESULTS

4.0 BLACK BEAR CAPTURE AND TRANSLOCATION

- A total of twelve (12) black bears (0.73 bears/10 km^2) were captured and removed from the study area during the course of the 18-week treatment period (Map 3).

- Of the twelve bears removed, ten (10) were adults, two (2) were sub-adults and there were no (0) cubs of the year. The specific demographic profile was:

  - 5 (large) adult males
  - 1 (medium) adult male
  - 1 sub-adult male
  - 4 (medium) adult females
  - 1 sub-adult female

- None of the adult female bears showed any sign of lactation.

- All captured bears were released to areas of similar habitat and low bear densities as directed by the Regional Wildlife Manager for the Interlake Region (Map 4).

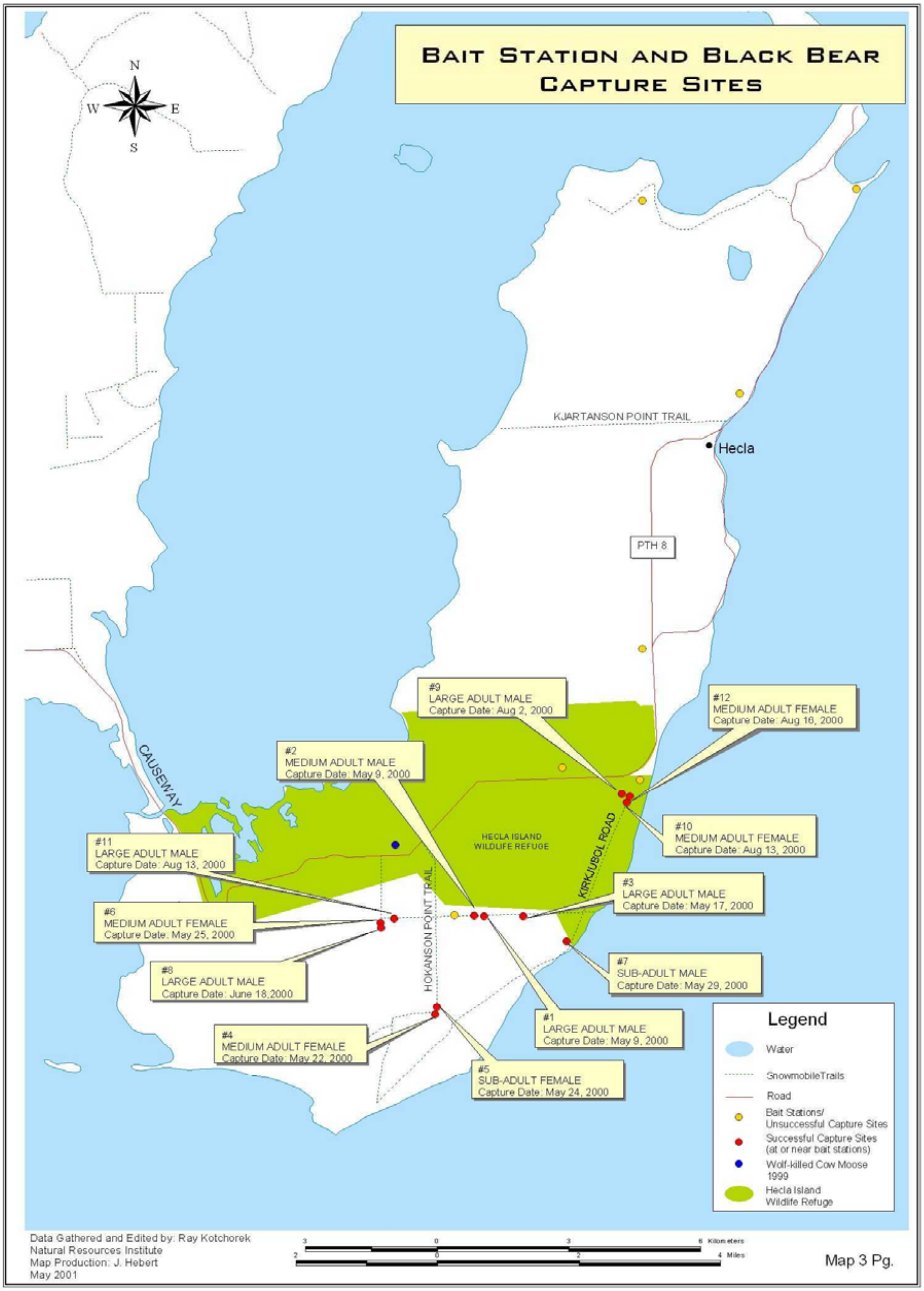
- Three additional bears (sizes and sexes unknown) were removed from the island by Manitoba Conservation Officers during Summer 2001 – 1 year after the Summer 2000 field season.

4.1 BAIT STATION MONITORING

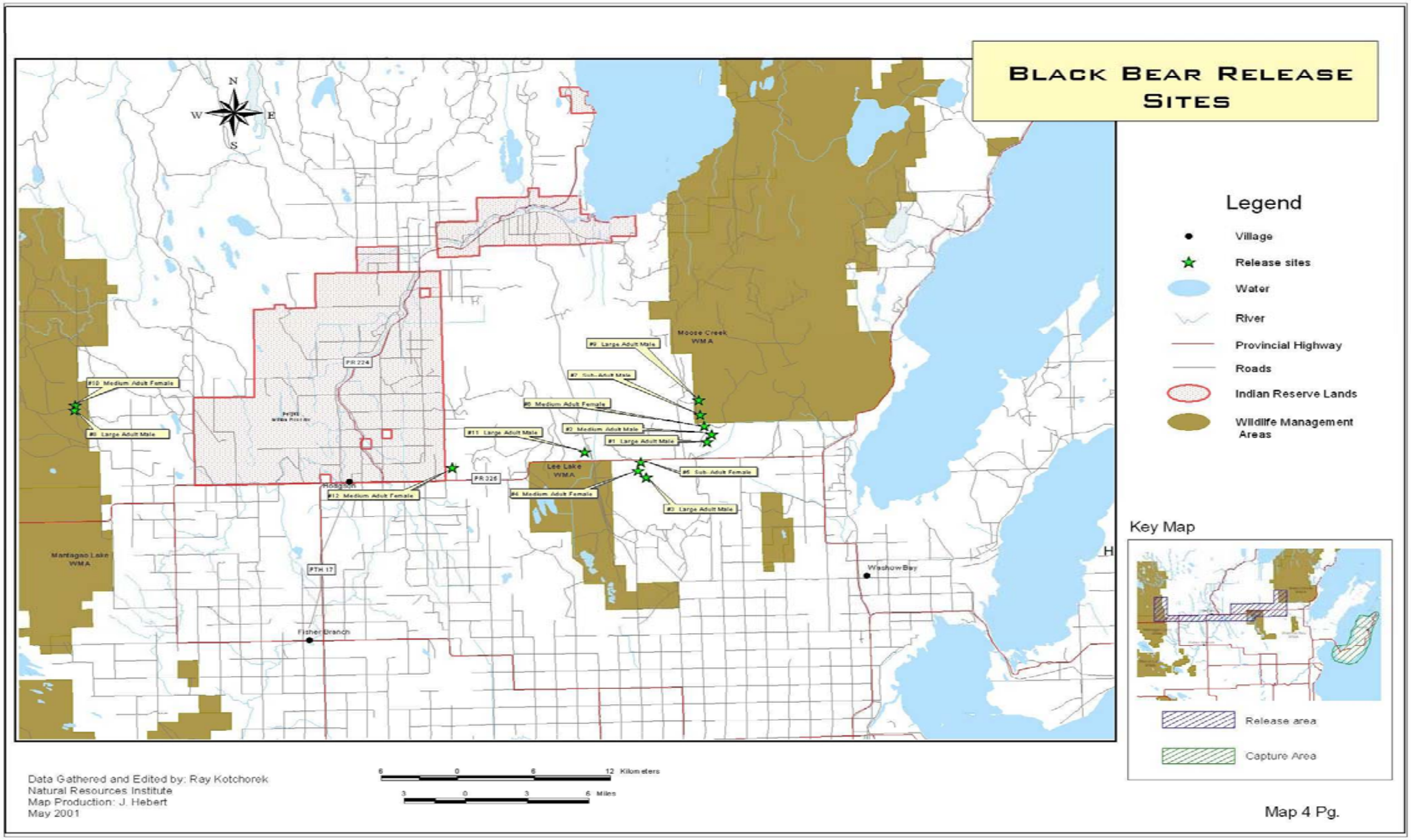
- Bait station monitoring indicated that approximately eight (8) black bears remained on Hecla Island after capture efforts had ceased at the end of the 2000 field season.

- It was estimated that there was likely several more bears in addition to the 8 known animals remaining on the island at the end of the field season in Fall 2000.

- Relative index values for black bears actually increased over time as the animals were removed from the island (Table 2).



Map 3: Bait station and black bear capture sites.



Map 4: Black bear release sites.

TABLE 2: Relative index values for evening black bear observations at two bait stations.

	July 10-12 Observations	August 26-28 Observations	Relative Index Trend (July-Aug)
Backcountry Tree Stand	1	2	
Relative Indices	333	667	100% Increase
	June 22-24 Observations	**August 19-21 Observations**	**Relative Index Trend (June-Aug)**
Hecla Landfill	1	4	
Relative Indices	333	1333	300% Increase

- There were no marked bears either captured or observed at any of the bait stations suggesting that none of the translocated bears returned to the island during the course of the treatment period.

4.2 AERIAL WILDLIFE SURVEY

- A total of 28 moose were observed and sexed in the January 2001 aerial wildlife survey as well as in the January 2002 post-study aerial wildlife survey of the island.

- Of the 28 moose observed in 2001, six (21%) were bulls, 15 (54%) were cows, one (4%) was unidentifiable and six (21%) were calves (Figure 4).

- Of the 28 moose observed in 2002, 13 (46%) were bulls, 10 (36%) were cows and five (18%) were calves (Appendix 3).

- The number of bull moose detected during aerial surveys decreased from 12 animals in 2000 to only 6 animals in 2001 and then increased to 13 animals in 2002.

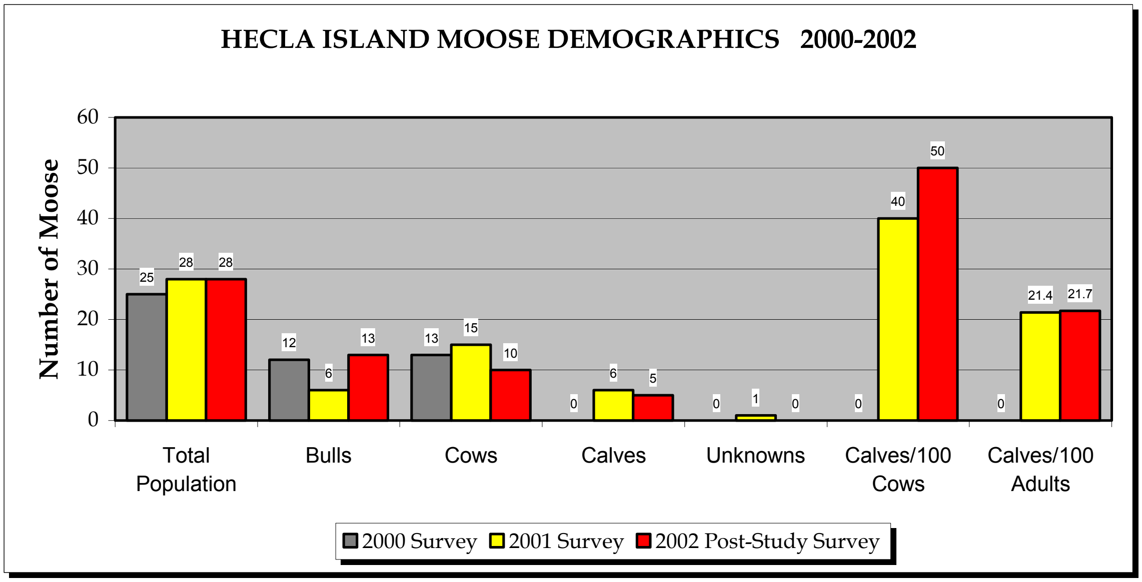
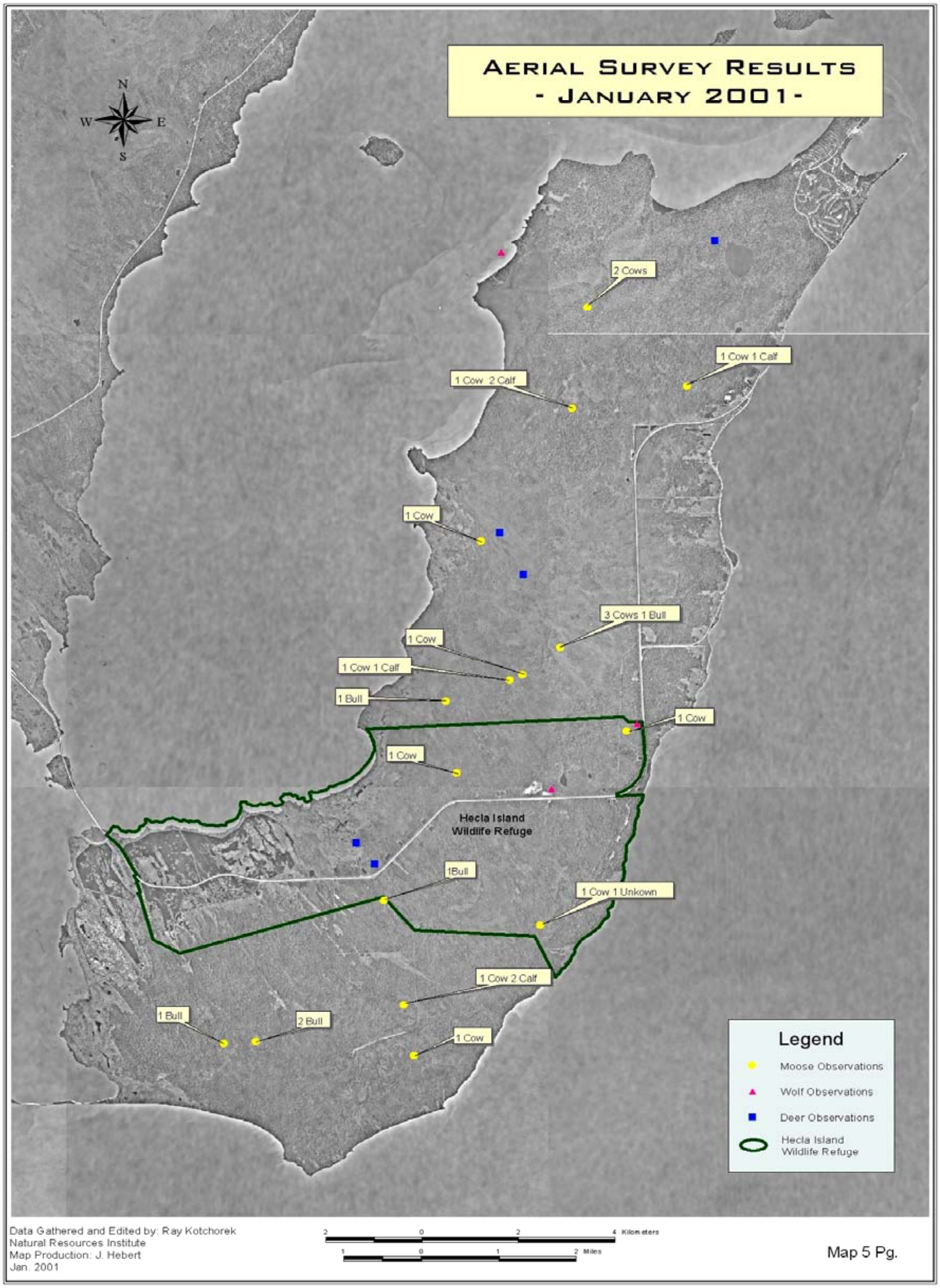


FIGURE 4: Positive increases evident in moose population – post bear removal.

- The number of cow moose detected during aerial surveys increased from 13 animals in 2000 to 15 animals in 2001 and then decreased to 10 animals in 2002.
- Of the 15 cows observed in January 2001, only four (4) were accompanied by calves - including two sets of twins. Accordingly, a total of six (6) calves were detected. A total of 5 calves (including 1 set of twins) were observed during the 2002 survey.
- The calves/100 cows relation increased from a pre-treatment ratio of **0:100** in 2000 to a post-bear removal ratio of **40:100** in 2001 and then increased slightly more to **50:100** in 2002.
- The calves/100 adults relation increased from a pre-treatment ratio of **0:100** in 2000 to a post-bear removal ratio of **21.4:100** in 2001 and then increased slightly more to **21.7:100** in 2002.
- Three (3) timber wolves and ten (10) white-tailed deer were detected during the 2001 survey (Map 5). There were no wolves detected during the 2002 survey.



Map 5: Moose, timber wolf and white-tailed deer observation locations from the 2001 aerial wildlife survey.

4.2.0 Statistical Analysis

Calves/100 Cows: Using 1988 as the baseline year and the equation:

y = 37.85 - 3.14 (year - 1988) as the formula for the fitted regression line, the following numbers were generated:

Tests of significance:

	Estimate	Standard Error	t Statistic	p-Value
Intercept	37.847	5.888	6.427	0.003
Slope	-3.139	0.941	-3.336	0.029

Estimate: 37.85 - 3.14 (12) = 0.177 $\sqrt{MSE}$ = 8.139 (4 degrees of freedom)

$$\text{Standard error: } \sqrt{MSE\left(1+\frac{1}{n}+\frac{(12-\bar{x})^2}{\sum_{i=1}(x_i-\bar{x})^2}\right)} = 8.139\sqrt{1+\frac{1}{6}+\frac{(12-\bar{x})^2}{\sum(x_i-\bar{x})^2}}$$

$$= 8.139\sqrt{1+\frac{1}{6}+\frac{(12-5.167)^2}{74.833}} = 10.891$$

=> the 95% prediction interval for an individual observation (of the calf/100 cow rate)

is: 0.177 $\pm$ 2.776 x 10.891 $\equiv$ **0.177 $\pm$ 30.233** **(observed rate = 40)**

Since the observed rate of 40 calves/100 cows in 2000-2001 is well outside of the prediction interval (Figure 5), a claim can be made that there was a statistically significant increase in the calf/100 cow rate after bear removal (Murphy pers. comm.).

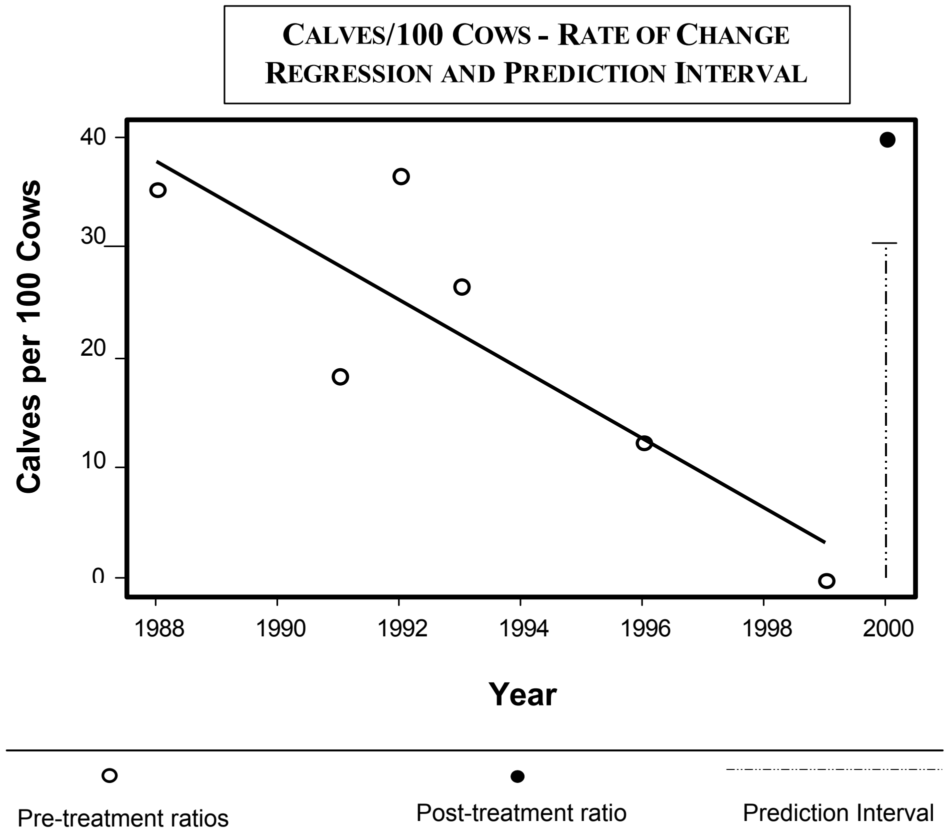


Figure 5: Plot illustrating the significance of the 2000-2001 calves/100 cows data.

<u>**Calves/100 Adults**</u>: Using 1988 as the baseline year and the equation:

y = 21.227 - 1.735 (year - 1988) as the formula for the fitted regression line, the following numbers were generated:

Tests of significance:

	Estimate	Standard Error	t Statistic	p-Value
Intercept	21.227	3.294	6.445	0.003
Slope	-1.735	0.526	-3.296	0.03

=> the 95% prediction interval for an individual observation (of the calf/100 adults rate) is: $0.4096 \pm 2.776 \times 6.0926$ $\equiv$ **0.4096 ± 16.916** **(observed rate = 21.4)**

Since the observed rate of 21.4 calves/100 adults in 2000-2001 is well outside of the prediction interval (Figure 6), a claim can be made that there was a statistically significant increase in the calf/100 adult rate after bear removal (Murphy pers. comm.).

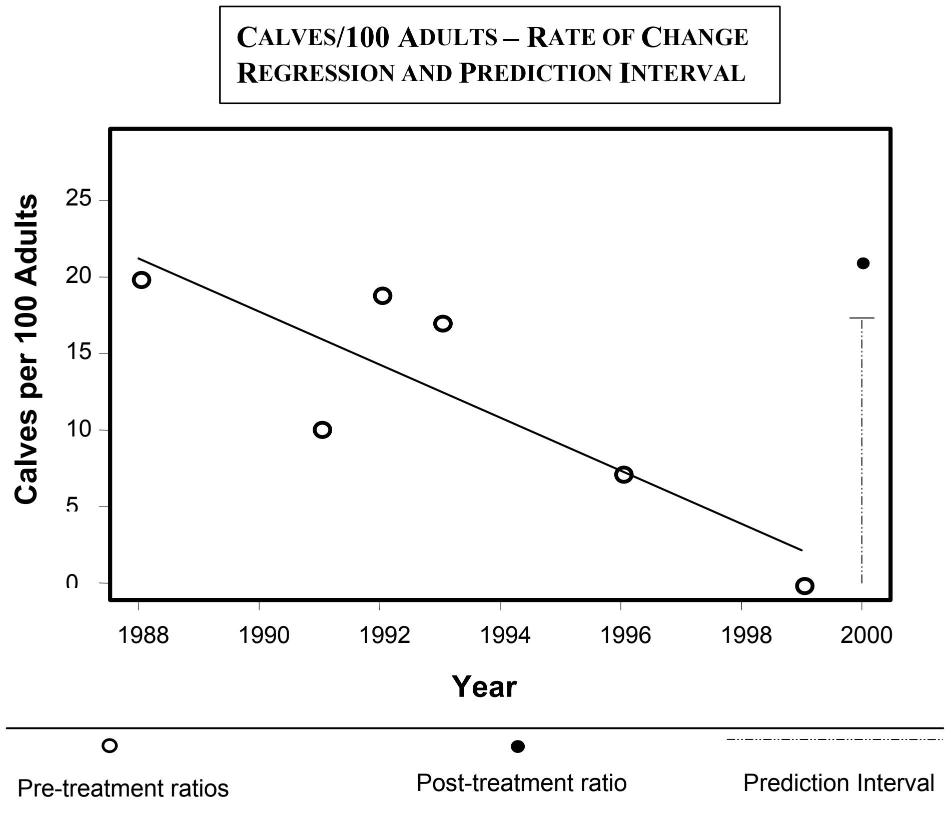


Figure 6: Plot illustrating the significance of the 2000-2001 calves/100 adults data.

<u>**Bulls/100 Cows**</u>**:** Using 1988 as the baseline year and the equation:

y = 75.210 + 0.657 (year - 1988) as the formula for the fitted regression line, the following numbers were generated:

Tests of significance:

	Estimate	Standard Error	t Statistic	p-Value
Intercept	75.2125	11.2051	6.712	0.0026
Slope	0.6568	1.7904	0.367	0.732

=> the 95% prediction interval for an individual observation (of the bulls/100cows rate)

is: 83.09 $\pm$ 2.776 x 20.728 $\equiv$ **83.09 $\pm$ 57.55** **(observed rate = 40)**

Since the observed rate of 40 bulls/100 cows in 2000-2001 is within the prediction interval (Figure 7), it is understood that there was no statistically significant change in the bull/100 cow rate after bear removal (Murphy pers. comm.).

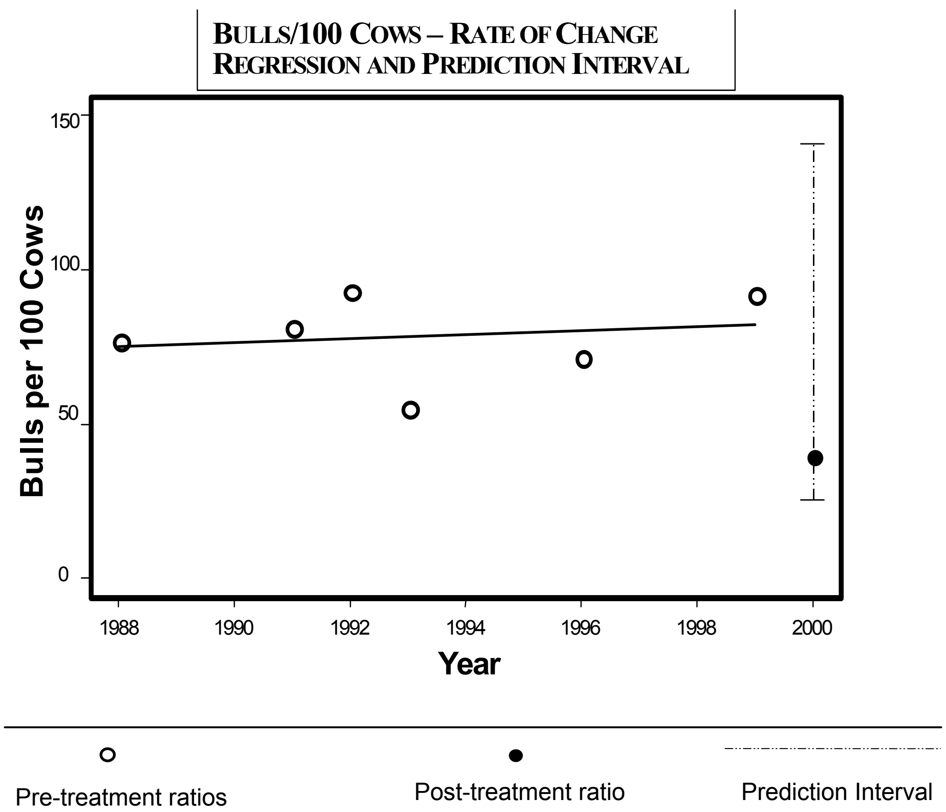


Figure 7: Plot showing no significant change in the 2000-2001 bulls/100 cows data.

4.3 BACKCOUNTRY WILDLIFE OBSERVATIONS

- Animal sign such as tracks, scrapes, predator scats, black bear territorial marking posts, black bear bite marks and scrapes, ungulate pellet groups, ungulate browsing sign, and predator kill sites were all detected and recorded.

- Moose tracks were encountered most frequently out of all big game tracks detected throughout the entire extent of the island.

- Track observations, in combination with visual sightings, indicated that at least six (6) moose calves (including at least one set of twins in the vicinity of the moose-viewing tower) were present on the island during the study period.

- Track observations indicated that several white-tailed deer fawns were present in the spring, with twin fawns being located in two separate areas.

- Although somewhat localized to areas of preferred habitat, ungulate browsing sign, as well as deer and moose pellet groups, was found throughout the island with moose sign being encountered more frequently than deer.

- Although no moose calf kill sites were found, three separate white-tailed deer kill sites were located along the eastern and southeastern portions of the island.

- One wolf-killed cow moose kill site was detected and confirmed by the author (data from 1999) next to the borrow pit adjacent to the moose viewing tower.

- Black bear and timber wolf scats were found throughout the full extent of the island, but were, however, most concentrated on the southeast section.

- Predator scrapes, as well as bite and claw marks were typically detected in close proximity to most active bait stations.

- Several black bear territorial marking posts (or "bear trees") were located along the hydro transmission line south of the Hecla landfill (see Plate 16, page 58).

- Two (2) dead timber wolves were located on the island:
  1) a skull was found on a snowmobile trail on the central portion of the island, and
  2) one whole animal was found frozen on a snowmobile trail during the winter of 1999/2000 (just prior to the 2000 field season).

- Fresh wolf prints discovered in July indicated that several wolf pups were added to the pack during the 2000 field season. The total number of new pups was undetermined however.

- See Incidental Big Game Sightings in Appendix 4.

4.4 WOLF HOWLING SURVEYS

- A total of four separate wolf howling surveys were conducted on the evenings of August 26, 27, 28, and September 01, 2000. There were no wolves heard to respond to surveyor howls on these dates.

- This method did not supplement visual sighting information and consequently did not aid in the summer wolf population estimate.

4.5 BEAR AND WOLF SCAT ANALYSIS

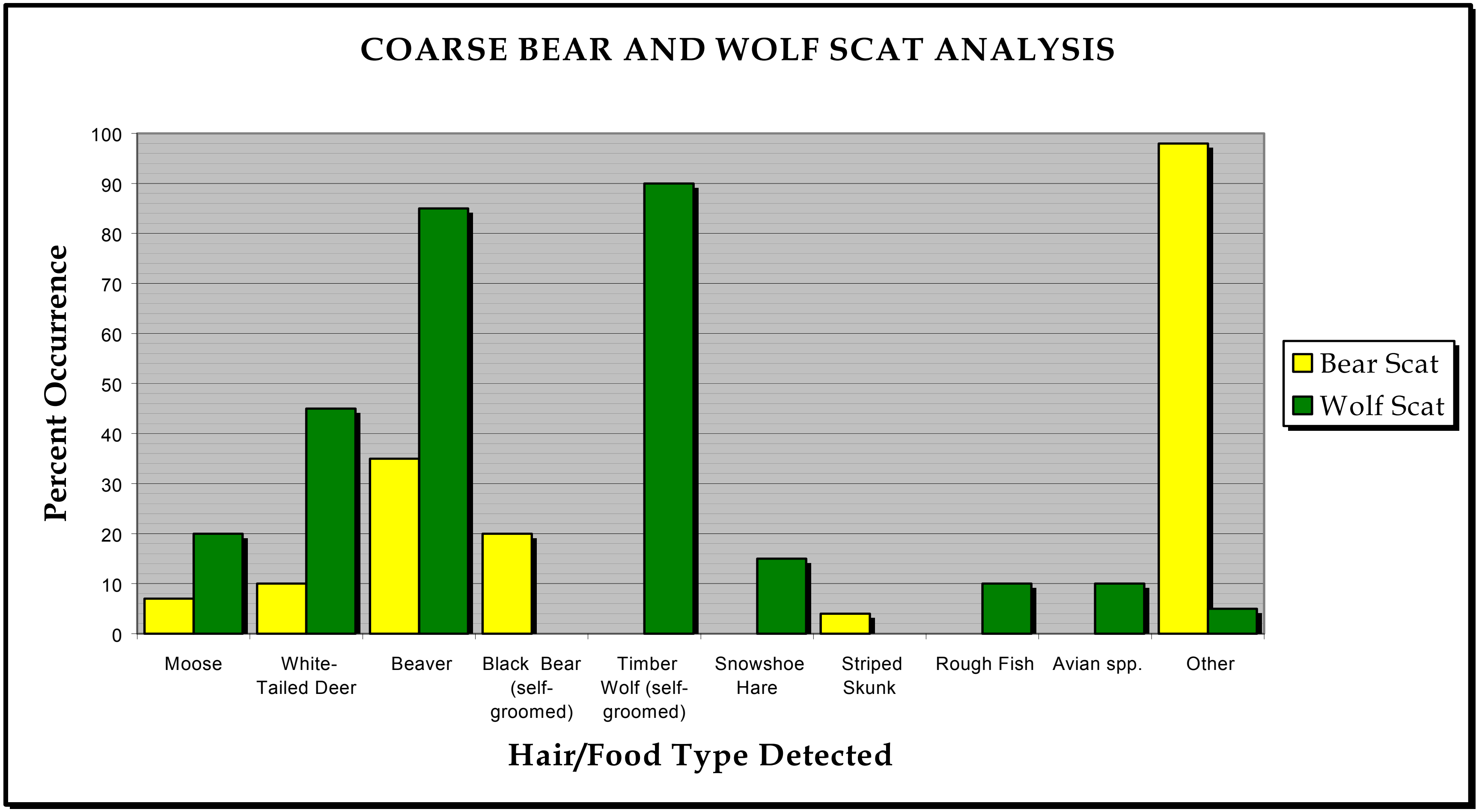
- Moose calf hair was not detected in any of the black bear scats but was detected in two of the wolf scat samples (raw data in Appendix 5).

- Adult moose hair was detected in 7% of black bear scat samples and in 20% of timber wolf scat samples (Figure 8).

- It is believed that moose calf hair was detected in two of the wolf scat samples.

- Beaver hair was detected in 35% of all black bear scat samples and in 85% of all timber wolf scat samples.

- Timber wolf scats were found to contain the widest range of identifiable food types – ranging from deer hair to fish scales/bones and actual recreational fishing line.



NOTE: *All scat samples were collected at least 1 month after the moose calving season had ended.

FIGURE 8: Hair and coarse food-type components detected in black bear and timber wolf scat samples.

4.6 MISCELLANEOUS OBSERVATIONS

- Aerial survey data spanning from 1971 thru to 1987 was found to be statistically invalid and unusable.

- The sharp increase (i.e. a single-year doubling) in the moose population documented in 1983 is biologically unexplainable and unrealistic.

- Recreational moose hunting was found to be directly responsible for approximately 80% of the population decline between 1978 and 1982 – the start of the initial population decline (*according to the aforementioned aerial survey results).

- Although negative effects to translocated black bears were minimized to the highest degree possible, the arbitrary capture and removal of bears implicated and ultimately impacted each and every captured bear for predatory actions that only a probable few were responsible for, and thus proved to be a relatively inefficient method of increasing moose herd recruitment.

- This predator management program was a reactionary response to a dynamic wildlife management issue that could have otherwise been managed proactively.

5. DISCUSSION

5.0 BLACK BEAR CAPTURE AND TRANSLOCATION

Since black bears do not typically venture more than several hundred yards from their winter dens for the first few weeks in the spring, bait stations were set up at strategic locations throughout the island in order to establish exactly where the animals were most concentrated. As all bait stations were monitored daily, black bear activity at each bait site was detected immediately – usually by the following morning. Traps were consequently moved often, as they were set up adjacent to bait stations after significant bear activity was detected.

Three bear traps were set for the first several weeks of the trapping effort at various locations across the island with the first trap being set on May 2nd. Traps remained empty until the first bear was captured on May 9th. During this time (i.e. from late April to mid-May), there were no sightings of any bears nor was any bear sign detected. Starting on May 15th, however, the capture rate increased significantly with a total of six more bears being captured on the dates of May 15, 17, 22, 24, 25, and 29. A subsequent lull in capture success, coinciding with spring green-up, occurred in June with only one bear being captured on June 18th.

Black bear activity at bait stations was noticeably absent in July with no bears being either sighted or captured during the entire month – the tail end of the mating season when natural food sources were abundant. Starting on August 2nd, however, bear sign became more prevalent as the bears began feeding heavily in preparation for winter hibernation. Bears captured in August were trapped on the dates of August 2, 13, 13, and 16. (Note: on August 13th, one bear was captured in the early morning while a second bear was captured during mid-afternoon).

A point of interest was the observation that captured adult male bears out-numbered adult female bears by 6:4. Additionally, two (of the seven in total) male bears were noticeably more aggressive than all of the other ten captured bears. This may be significant in that Crichton (pers. comm.) and Rousseau (pers. comm.) both postulate that it is likely aggressive male bears that are responsible for most neonate depredation.

5.1 BAIT STATION MONITORING

Predator bait stations were established on Hecla Island in late April 2000 and were actively re-baited until early September 2000. An estimated 85 (whole) beaver carcasses, one whole white-tailed deer carcass, 15 tubs of discarded commercial fish remains, approximately fourteen 5-gallon pails of used restaurant grease and approximately 60kgs of domestic crab apples were used as bait at the bait stations.

Black bear estimates via the relative index method at two selected bait station sites did not work as planned since values for bears actually increased at both sites (instead of decreasing as anticipated) after capture efforts had terminated. For this reason, catch per unit effort values actually increased, dis-counting both the exploited population technique of determining the catch per unit effort value for a specific area, and the density extrapolation method of extending the value across the entire study area to derive a total population estimate.

The increases in the index values may simply have been attributable to the changing (i.e. increased) feeding frequency and exposure of bears during late summer and not actually to a rising black bear population. The remaining black bear population was consequently estimated from data gathered through relative abundance calculations, backcountry wildlife observations and bait station observations.

Although the specific effect that spring feeding of predators had on the post-treatment moose calf survival rate was immeasurable and undetermined for this study, the feeding of predators may have played a potentially significant role in diverting predator attention away from moose calves during their first few critical weeks of life. Contrarily, however, the continuous supplemental feeding of predators may also have contributed to the survival of certain animals and thus, to the possible mainenance of key big game predator populations, albeit to an unknown extent.

5.2 AERIAL WILDLIFE SURVEY

A total of 28 moose were detected and sexed during the 2001 aerial wildlife survey – a modest increase from the 25 moose detected during the 2000 survey. This increase, however, did not include the two known mortalities that occurred on the island during and immediately after the summer field season (Appendix 4, page 114).

The overall trend in the moose herd recruitment level showed a positive increase for the first time in seven years. Although somewhat speculative, this immediate increase in the calf population seems to indicate that black bear predation (in combination with various other factors) may actually have a limiting effect on moose calf survival under existing pressures in this island ecosystem. Moose calf survival will, therefore, likely continue to improve with sustained black bear removal and/or diversionary (predator) spring feeding initiatives.

Incidental data gathered prior to and during the aerial moose survey included: 1) the observation of a lone timber wolf giving chase to a white-tailed deer down the center of PTH #8; and 2) the observation by NRO Greg Brown that there seemed to be heavier than normal hunting pressure in the southeastern and southwestern backcountry areas of the island as indicated by ATV tracks in the marsh and meadow areas.

5.3 INCIDENTAL BIG GAME SIGHTINGS

All big game sighting data from the eight logbooks, including my own logbook data, was combined to derive relative abundance values for each big game species (Table 3, Appendix 4). An analysis of the data compiled from park staff and visitors indicated that white-tailed deer were most abundant on Hecla Island in 2000. These observations were only factored in as rough estimates, however, since it was noticed that most deer sightings were generally made in the same localized areas – possibly indicating that the same few deer may have repeatedly been observed in the same locations only at different times. This consideration was taken into account when the total deer population was estimated.

Moose observations were reported more frequently towards the latter part of summer with most observations occurring along or adjacent to PTH #8. Cow moose with single calves were observed at various locations, with a set of twin calves observed on several occasions within the vicinity of the moose-viewing tower. An additional pair of twin calves was also located on the north section of the island via ongoing track detection.

During the summer of 1999, a lone cow woodland caribou had been observed several times by park staff on Hecla Island. After repeated sightings, quite a lot of interest was generated as to whether it was alone or if others accompanied it. Several subsequent sightings during the 2000 field season by park staff, Gull Harbour Resort Hotel staff, and myself, however, all indicated identical physical characteristics suggesting that the same animal was observed in all instances.

In late May, an adult black bear with a single cub was reported to have been observed by a park visitor on the north end of the island adjacent to the Gull Harbour Marina. This was the only reported sighting of a black bear cub on Hecla Island during the entire field season - possibly indicating an overabundance of male bears since aggressive males may kill cubs-of-the-year in order to mate with subsequently receptive females. Additional sightings were mainly of bears observed crossing PTH #8 with relatively few sightings occurring in populated areas.

During the early morning hours of June 6th, Mr. Todd Thompson – a local commercial fisherman observed a single (large) black bear on the mainland approach to the Hecla Island causeway. The bear was also observed by a park visitor sometime later in the same general area. Although neither individual stopped to watch the movements of the animal, both individuals indicated that the bear seemed intent on using the causeway to gain access to Hecla Island. It is unknown if the bear had any markings on its coat since it was observed at approximately 200 yards in the early morning dawn. It is therefore unknown if the bear was a previously translocated animal actually returning to the island, or if it was a roaming mainland bear just passing through the area.

Although timber wolves were observed on the island quite frequently in 1999, relatively few sightings were recorded during the field season of 2000. All wolf sightings were of individual animals (as opposed to the pack of 7 animals sighted in 1999). Wolf sign and sightings were generally concentrated along the Hecla causeway as well as the dyke system of Grassy Narrows Marsh.

One wolf (a dark-gray adult) was repeatedly observed by park staff in the vicinity of the park gate, and was actually observed by park employee Erica Bardarson on the mainland approach to the causeway on May 27th. After several months of very few timber wolf sightings, a conversation with Mr. Doug Bjornson - a local beaver trapper, revealed that he had observed a pack of five wolves cross PTH #8 in single-file on the northern portion of the island sometime in early Spring 2000. Since this was the only group sighting confirmed on the island during the ice-free period of 2000, the total wolf population was believed not to have been any greater than five animals.

Several unconfirmed cougar sightings were also related to me during the summer months of 2000 - one sighting by a Green Team worker for the park and one sighting by a guest at the Gull Harbour Resort Hotel. All sighting information was anecdotal, however, as all reports were acquired long after the fact through second-hand personal communications with no physical evidence later detected.

A personal communication with Mr. Darren Martinson - a local commercial fisherman, revealed a confident sighting of a "large brown cat with a 3-foot long tail walking on the beach by Edison's camp" during the summer of 1999. Mr. Wayne Spring, a park employee and a local trapper, also offered his account of what he believed were cougar tracks in the same general area during the winter of 1999-2000. Several other sightings were rumoured to have been made by park visitors to the staff at the Gull Harbour Campground office in 1999, however, no such sightings were either recorded or confirmed. There was no evidence of a cougar found during field activities for this project.

5.4 BACKCOUNTRY WILDLIFE OBSERVATIONS

During backcountry wildlife patrols, it was observed that a new snowmobile trail (extending approximately half of the entire length of the island) had been created with bulldozers by park staff during the winter of 2000. The resulting slash was left in-situ as it was all pushed to one side of the trail - effectively segmenting important moose habitat by creating a physical barrier for cow and calf moose, while at the same time creating new hunting corridors for wolves in future winters (Plate 22).

PLATE 22: A physical barrier to wildlife movement that effectively segments important moose habitat while creating new hunting corridors for wolves.

The development of this new trail system in the Hecla Island backcountry essentially counter-acts most moose habitat initiatives and population management efforts that have been undertaken to date. If ecosystem based management is the theoretical ideal which most Manitoba provincial parks strive to achieve, then management frameworks should be developed wherein ecosystem goals are weighted evenly (if not more so) against such park and resource development activities. Such management frameworks will undoubtedly have to be specific to each provincial park as every park has its own unique array of wildlife issues and development prospects, and since a broad-based blanket policy would not likely deal effectively with such situations.

5.5 Wolf Howling Surveys

It is believed that wolf howling surveys were unsuccessful for at least two reasons. First and foremost, it is known that howling surveys are naturally less successful when local wolf densities are low – as was the case for the Hecla Island population. Secondly, although most environmental conditions were adequate for surveys to be conducted, wind conditions on most nights were less than ideal – possibly masking responding wolf howls that would have otherwise been detected.

5.6 Bear and Wolf Scat Analysis

The scat analysis method proved inconclusive – most likely for the following two reasons: 1) scats were collected relatively late with respect to the moose calving season and associated moose calf vulnerability; and 2) black bears typically remove the hide from their prey prior to consuming it, therefore ingesting little if any hair.

While no moose calf hair was detected in any of the black bear scat samples, moose calf hair was detected in two timber wolf scat samples. Thus, although the results of the scat analysis method seemed to establish a greater link between moose calf mortality and timber wolf predation, results from the black bear translocation program did establish a speculative positive response between increased moose calf survivorship and a lowered black bear density.

Finally, the analysis of hair fragments in scat samples revealed that beavers are a key prey species and an important food source for both black bears and timber wolves on the island. (Note: beavers were still very plentiful at the end of the field season, especially in backcountry areas, even after a local trapper had removed approx. 85 animals from the island under the Manitoba Highways problem beaver control program.)

5.7 IMPLICATIONS FOR PARK AND WILDLIFE MANAGEMENT

This study examined the probability that black bear predation has negatively affected moose calf survival on Hecla Island as a likely result of increased predator presence on the island - circumstantially linked to the development of the Hecla Island causeway. As can be determined from the previously stated findings, significant increases in the post-bear removal moose calf survival statistics do seem to suggest that black bear predation (via a largely unregulated black bear population) has been a likely factor in reduced moose calf survival and, thus, in reduced moose herd recruitment levels on the island.

Important to note, however, is the drastic reduction in the creation and renewal of vital moose habitat that has coincided with the increase in predator presence over the last three decades or so. Since the turn of the century, Icelandic settlers actively harvested the island's trees for lumber and burned the meadows for pasture annually. These activities provided copious amounts of prime moose habitat that was continuously revitalized. When the island was given provincial park status, however, all essential moose habitat-producing activities were discontinued and replaced by infrastructure development that depleted available wildlife habitat and de-emphasized forest renewal processes. When combined with increased predator presence, this overall decline in the quantity and quality of moose habitat has likely had a strong deleterious effect on the local moose population.

Since it is highly unlikely that this island ecosystem will ever return to pre-development (and pre-causeway) conditions, it is imperative that wildlife habitat creation/revitalization programs be established and that big game predator populations be both vigilantly monitored and proactively managed if a viable moose population is to remain on Hecla Island.

6. CONCLUSIONS AND RECOMMENDATIONS

6.0 CONCLUSIONS

As a result of the black bear translocation program, a total of 12 (0.73 bears/10km^2) were physically removed from Hecla Island in Summer 2000. Results from the aerial wildlife survey conducted several months after bear removal in January 2001 indicated a significant increase in the moose calf population as well as a slight increase in the overall moose population when compared to data from the previous year. Similar findings were also realized from a second post-study aerial wildlife survey conducted in January 2002.

The statistically significant increases in moose calf survivorship relations seem to suggest that black bear predation most likely did have a limiting effect on moose calf survival, and thus, likely had a deleterious impact on the overall moose population on the island prior to this study taking effect. The analysis of black bear scats did not, however, provide a definitive link between black bear predation and moose calf mortality - consequently causing the findings of the study to be relatively speculative. Incidental big game observations and backcountry wildlife patrols did indicate, though, that white-tailed deer (which are easier to kill and therefore preferentially targeted by timber wolves) were relatively abundant – suggesting that the limited wolf population had little need to prey on the more resilient moose and, thus, did not likely contribute in any substantial way to the decline of the overall moose population.

In conclusion, although not every mortality source for moose was examined in this study, direct human stresses on moose as well as land development stresses on moose habitat were found to have substantial negative impacts on the moose population of Hecla Island - probably even more so than likely black bear predation on newborn calves.

6.1 RECOMMENDATIONS

- The results of this study should serve as benchmark data for future provincial park management decisions and wildlife management initiatives on Hecla Island.

- Black bear translocation efforts should continue for at least several more seasons **only if** a sustainable moose herd is deemed to be the highest wildlife priority for Hecla Island.

- Habitat management is key to sustaining any wildlife population. Integrated forest management and habitat management prescriptions (such as prescribed burning and aspen/birch harvesting - both in strategic areas and on sufficient scales) should be undertaken/continued on a regular basis in order to rejuvenate moose habitat and enhance essential ungulate recruitment conditions.

- Although ecosystem-based management should ultimately take priority, keystone predator species such as black bears and timber wolves should be managed proactively so as to avoid potential predator-pit situations (i.e. especially those situations that can be associated with resource/land development activities).

- A management framework should be established for Hecla/Grindstone Provincial Park wherein ecosystem based management is weighted evenly (if not more so) against new resource/park development initiatives.

- Wildlife impact studies should be conducted prior to any backcountry (and front country) developments such as new snowmobile trails - especially when potentially negative impacts to wildlife and wildlife habitat are foreseeable.

- Prudent clearing practices and proper protocol must be planned, followed and supervised in all backcountry development in provincial parks in order to mitigate all foreseeable impacts to wildlife and wildlife habitat.

- Any future black bear translocation initiatives should be vigilantly monitored and adaptively managed according to population goals and/or significant trends in monitored big game prey populations.

- A very limited and closely monitored spring-bear hunting season may take the place of future translocation efforts.

- Future translocated black bears should be sedated and marked with permanent ear tags in order to establish if and when bears may in fact return to the island.

- Biological data should be recorded and an inventory kept for all black bears removed from Hecla Island.

- Attempts should be made to maintain an inventory of the remaining black bear population on the island.

- Detailed records should be kept by every Manitoba Conservation district office (especially those in provincial parks) concerning the trapping, translocation and/or disposition of black bears in order to aid and support population estimates used in the management of black bears.

- Manitoba Conservation bear traps should be standardized in order to prevent injury to bears: 1) all traps should be inspected for damage on a regular basis; 2) all traps should be regularly maintained and kept in optimal working condition; 3) all bait hooks should be changed from the hanging metal hooks to a metal t-bar design; 4) all seasonal staff should get proper training re: bear trap set-up and protocol at the start of each season BEFORE they are required to set a trap in a hasty manner; 5) all NROs should be briefed about black bear ecology and instructed to translocate bears a sufficient distance from the capture/ problem area; 6) all seasonal staff should be briefed on proper protocol around bear traps and trap sites; 7) all traps should pass a bear safety inspection prior to being put into service (eg. there should be no holes in the trap large enough for a bear to reach out with a paw or to force its head out through and the bars on the front and rear of the traps should be sufficiently close so as not to allow a bear to bite and pull at the (horizontal) bars with its teeth.)

- Black bear trapping paraphernalia should be standardized and made available to every Manitoba Conservation district office as kits to ensure proper apparatus and baiting methods are followed by department staff.

- Human foods should not be used as baits in traps so as to avoid habituation and/or conditioning bears to human food sources. Black bear baits should ideally consist of natural bear foods normally available to area bears and should change accordingly with the changes in seasons (eg. high protein sources such as beaver meat and fish in spring; honey and apples in mid-summer (Woroniuk pers. comm.); and highly fatty foods such as mast in late summer/early fall (Herrero 1985)).

- Big game aerial surveys should be consistently funded and conducted at a minimum of every two years in order to properly monitor and track big game population trends on Hecla Island.

- The use of modern GIS and GPS technology should be encouraged and used in all future aerial wildlife surveys.

- The Hecla Interpretive Program should endeavor to ask for public assistance in documenting sightings of moose calves. All sightings should be recorded in a logbook and detailed records kept such as singles or twins, locations, time of year, etc… to aid in monitoring efforts and future moose management initiatives.

- The Hecla Interpretive Program should be re-focused with respect to its role in educating the public about moose, moose management, generating public interest and providing moose viewing opportunities for the public.

- The Hecla Interpretive Program should attempt to estimate and keep track of annual timber wolf populations as part of its operational plan in order to gauge predator presence on the island (eg. wolf howls, track counts, logbook records of sightings etc…).

- Wildlife habitat studies should be supported to the fullest extent in order to optimize resource management prescriptions and to take full advantage of an increasingly rare study opportunity - a substantial semi-enclosed island ecosystem with a significant (un-hunted) wildlife population.

- Research concerning diversionary spring feeding strategies for predators should be supported and/or actively pursued.

- Research concerning local moose population dynamics should be supported and/or actively pursued.

7. LITERATURE CITED

ADORJAN, A. and G. KOLENOSKY. 1969. A Manual for the Identification of Hairs of Selected Ontario Mammals. Research Branch, Ont. Dept. Lands For., Reser. Rep. (Wildl.) no. 90. 64pp.

AUSTIN, M., M. OBBARD and G. KOLENOSKY. 1994. Evidence for a Black Bear, *Ursus americanus*, killing an Adult Moose, *Alces alces*. Cdn. Field Naturalist 108: 236-238.

BALLARD, W. 1991. Population Dynamics of Moose in Southcentral Alaska. Wildl. Monogr. 114: 1-49. Supplement to J. of Wildl. Mgmt. 55(1), January 1991.

BALLARD, W. 1992. Bear predation on moose: A Review of recent North American studies and their management implications. Alces (Suppl.) 1: 1-15.

BALLARD, W., T. SPRAKER, and K. TAYLOR. 1981. Causes of Neonatal Moose Calf Mortality in South Central Alaska. J. Wildl. Manage. 45(2): 335-342.

BALLARD, W. and D. LARSEN. 1987. Implications of predator-prey relationships to moose management. Swed. Wildl. Res. (Suppl.) 1: 581-602.

BALLARD, W., S. MILLER, and J. WHITMAN. 1990. Brown and Black Bear Predation on Moose in Southcentral Alaska. Alces 26: 1-18.

BALLARD, W. and V. VAN BALLENBERGHE. 1997. Predator/Prey Relationships. *In*: Ecology and Management of the North American Moose. A. FRANZMANN and C. SCHWARTZ, Ed. R. MCCABE. Smithsonian Institution Press, Washington, D.C.

BOILEAU, F., M. CRÊTE, and J. HUOT. 1994. Food Habits of the Black Bear, *Ursus americanus*, and Habitat Use in Gaspesie Park, Eastern Québec. Cdn. Field Naturalist. 108: 162-168.

BOOKHOUT, T. 1996. Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, Bethsda, Maryland. Fifth ed. 740pp.

BOUTIN, S. 1992. Predation and moose population dynamics: A critique. J. Wildl. Manage. 56: 116-127.

BROOKS, R., R. MCROBERTS and L. ROGERS. 1998. Predictive Relationships Between Age and Front-foot Pad Width of Northeastern Minnesota Black Bears, *Ursus americanus*. Cdn. Field Naturalist. 112: 82-85.

BURT, W. and R. GROSSENHEIDER. 1980. Peterson Field Guides – Mammals. Third Ed. Houghton Mifflin Company, Boston. 289pp.

CANADIAN WILDLIFE SERVICE. 1998. Hinterland Who's Who - Moose. Canadian Wildlife Service, Environment Canada pamphlet. 3pp.

CARPENTER, S. and J. KITCHELL. 1993. The trophic cascade in lakes. Cambridge Univ. Press, New York, N.Y. 385pp.

CRÊTE, M. and F. MESSIER. 1984. Evaluation of indices of gray wolf density in hardwood-conifer forests of southwestern Québec. *In*: Impact of Wolf and Black Bear Removal on Cow:Calf Ratio and Moose Density in Southwestern Québec. M. CRÊTE and H. JOLICOEUR, Alces.

CRÊTE, M. and H. JOLICOEUR. 1987. Impact of Wolf and Black Bear Removal on Cow:Calf Ratio and Moose Density in Southwestern Québec. Alces 23: 61-87.

CRICHTON, V. 1977. The Moose of Hecla Island. Unpubl. Manuscript Report. Manitoba Department of Renewable Resources & Transportation Services. :55pp.

CRICHTON,V. 1979. An Experimental Moose Hunt on Hecla Island, Manitoba. Alces.

CRICHTON, V. 1983. Hecla Island Moose management – A Brief Summary. Unpubl. Manuscript Report. Manitoba Department of Natural Resources. 16pp.

CRICHTON, V. 1988. In Utero Productivity of Moose in Manitoba. Alces 24: 143-149.

DUNSTER, J. and K. DUNSTER. 1996. Dictionary of Natural Resource Management. UBC Press, Vancouver. 363pp.

ESTES, J. 1996. Predators and Ecosystem Management. Wildlife Society Bulletin 24(3): 390-396.

FORBES, G., and J. THEBERGE. 1996. Response by wolves to prey variation in Central Ontario. Can. J. Zool. 74: 1511-1520.

FRANZMANN, A., and C. SCHWARTZ. 1986. Black Bear Predation of Moose Calves in Highly Productive Versus Marginal Moose Habitats on the Kenai Peninsula, Alaska. Alces 22: 139-153.

FRANZMANN, A., C. SCHWARTZ and R. PETERSON. 1980. Moose calf mortality in summer on the Kenai Peninsula, Alaska. J. Wildl. Manage. 44: 764-768.

FRANZMANN, A. and C. SCHWARTZ. 1997. Ecology and Management of the North American Moose. Ed. R. McCabe. Smithsonian Institution Press, Washington, D.C. 733 pp.

FRITTS, S. and D. MECH. 1981. Dynamics, movements and feeding ecology of a newly protected wolf population in northwestern Minnesota. Wildl. Monogr. 80: 1-79.

FULLER, T. 1988. Wolf population dynamics in northcentral Minnesota. Ph.D. Thesis, Univ. Wisconsin, Madison. 147pp.

FULLER, T. and B. SAMPSON. 1988. Evaluation of a simulated howling survey for wolves. J. Wildl. Manage. 52(2): 60-63.

GASAWAY, W., R. STEPHENSON, J. DAVIS, P. SHEPHERD, and O. BURRIS. 1983. Interrelationships of wolves, prey, and man in interior Alaska. Wildl. Monogr. 50pp.

GASAWAY, W. 1986. Estimating moose population parameters from aerial surveys. Biol. Pap. 22. Univ. Alaska – Fairbanks. 108pp.

GASAWAY,W., R. BOERTJE, D. GRANGAARD, D. KELLEYHOUSE, R. STEPHENSON and D. LARSEN. 1992. The Role of Predation in Limiting Moose at Low Densities in Alaska and Yukon and Implications for Conservation. Wildl. Monogr. 120: 1-59. Supplement to J. of Wildl. Mgmt. 56(1), January 1992.

GARSHELIS, D. 1991. Monitoring effects of harvest on black bear populations in North America: a review and evaluation of techniques. Proceedings of the 10th Eastern Workshop on Black Bear Management and Research, Bismarck, Arkansas Press, Fayetteville. :120-144.

GOULET,G. 1992. An Assessment of Winter Habitat for Moose on Hecla Island with Emphasis on Browse Production and Browse Utilization. Master's Practicum, Natural Resources Institute, University of Manitoba. 210pp.

GRABER, D. 1982. Black Bear Food Habits in Yosemite National Park. *In*: Bears - Their Biology and Management. Ed. C. Meslowe ; Int.. Conf. Bear Res. Manage. 5: 1-10, 1983.

GRABER, D. and M. WHITE. 1983. Black bear food habits in Yosemite National Park. *In*: Bears – Their Biology and Management. Ed. C. Meslowe ; Int.. Conf. Bear Res. Manage. 5: 1-10.

GUNSON, J., M. JALKOTZY, L. CARBYN and L. ROY. 1993. Predation. *In*: Hoofed Mammals of Alberta. ED. J.B. STELFOX, 1993. Lone Pine Publishing, Edmonton, Alberta. :69-80.

GUNSON, J. 1995. Wolves in Alberta; their characteristics, history, prey relationships and management. Alberta Environment pamphlet. 24pp.

HARMS, D. 1977. Black bear management in Yosemite National Park. Proceedings of the Western Association of State Game and Fish Commissioners. 57: 159-181.

HARMS, D. 1980. Black bear management in Yosemite National Park. Int.. Conf. Bear Res. Manage. 4: 205-212.

HARRINGTON, F. and D. MECH. 1979. Wolf howling and its role in territorial maintenance. Behaviour. 68: 207-249.

HARRINGTON, F. and D. MECH. 1982. An analysis of howling response parameters useful for wolf pack censusing. J. Wildl. Manage. 46(3): 686-693.

HASTINGS, B. and B. GILBERT. 1987. Extent of human-bear interactions in the backcountry of Yosemite National Park. California Fish and Game. 73: 188-191.

HATLER, D. 1972. Food Habits of Black Bears in Interior Alaska. Cdn. Field Naturalist. 86: 17-31.

HERRERO, S. 1985. Bear Attacks; Their Causes and Avoidance. Hurtig Publishers, Edmonton, Alberta. 287pp.

JOSLIN, P. 1966. Summer activities of two timber wolf (*Canis lupus*) packs in Algonquin Park. M.S. Thesis. Univ. Toronto, Ontario. 99pp.

JOSLIN, P. 1967. Movements and home sites of timber wolves in Algonquin Park. Amer. Zool. 7: 279-288.

KEAY, J. 1995. Black Bear Reproductive Rates in Yosemite National Park. California Fish and Game 81(3): 122-131.

LINDZEY, F., S. THOMPSON and J. HODGES. 1977. Scent Station Index of Black Bear Abundance. J. Wildl. Manage. 41(1): 151-153.

LINHART, S. and F. KNOWLTON. 1975. Determining the Relative Abundance of Coyotes by Scent Station Lines. Wild. Soc. Bull. 3(3): 119-124.

LYNCH, G. 1996. Northern Moose Program – Moose Survey Field Manual. Alberta Natural Resources Service, Alberta Environmental Protection. 52pp.

MACCRACKEN, J., V. VAN BALLENBERGHE, and J. PEEK. 1997. Habitat Relationships of Moose on the Copper River Delta in Coastal South-Central Alaska. Wildl. Monogr. 136: 1-52. Supplement to J. of Wildl. Mgmt., 61(4), October 1997.

MANITOBA PARKS BRANCH. 1979. Hecla Island Resource Inventory. Parks Branch, Natural Resources Division, Manitoba Department of Mines, Natural Resources and Environment, June 1979.

MANITOBA CONSERVATION. 2001. Wildlife Branch webpage – *http.//www.gov.mb.ca/natres/wildlife/managing/fs_black_bear.html*

MANITOBA PARKS BRANCH. 1988. Hecla Grindstone Provincial Parks Management Plan. Manitoba Natural Resources, Parks Branch. 100pp.

MECH, D. 1966. The Wolves of Isle Royale. U.S. Nat. Park Serv. Fauna Ser. no. 7. 210pp.

MECH, D., 1970. The wolf: the ecology and behaviour of an endangered species. The Natural History Press, Garden City, N.Y. 384pp.

MECH, D. 1982. Wolves (radio-tracking). Pages 227-228. *In*: D. Davis, (Ed.) CRC Handbook of census methods for terrestrial vertebrates. CRC Press Inc., Boca Raton, FL.

MESSIER, F. and M. CRÊTE. 1985. Moose-wolf dynamics and the natural regulation of moose populations. Oecologia. 65: 503-512.

MESSIER, F. 1991. The significance of limiting and regulating factors on the demography of moose and white-tailed deer. J. Anim. Ecol. 60: 377-393.

MILLS, L., M. SOULÉ, and D. DOAK. 1993. The keystone species concept in ecology and conservation. Bioscience. 43: 219-224.

PETERSON, R. 1977. Wolf Ecology and Prey Relationships on Isle Royale. U.S. Nat. Park Serv. Scientific Monograph Series (11), Washington, D.C. 210 pp.

PIMLOTT, D. 1974. The ecology of the wolf in North America. Pages 280-285 *In: M.* Fox, (ed.). The wild canids: their systematics, behavioural ecology and evolution. Van Nostrand-Reinhold, New York, N.Y. 508pp.

PIMLOTT, D., J. SHANNON, and G. KOLENOSKY. 1969. The ecology of the timber wolf in Algonquin Provincial Park. Ont. Dept. Lands For., Reser. Rep. (Wildl.) no. 87. 92pp.

PIMLOTT, D. 1960. The use of tape-recorded howls to locate timber wolves. 22nd Midwest Wildl. Congr. 15pp.

PIMLOTT, D. and P. JOSLIN. 1968. The status and distribution of the red wolf. Trans. N. Amer. Wildl. and Nat. Resour. Conf. 33: 373-389.

PITT, W. and P. JORDAN. 1996. Influence of Campsites on Black Bear Habitat Use and Potential Impact on Caribou Restoration. Restoration Ecology 4(4): 423-426.

POTVIN, F., H. JOLICOEUR and J. HUOT. 1988. Wolf diet and prey selectivity during two periods for deer in Québec: decline versus expansion. Can. J. Zool. 66: 1274-1279.

POWELL, R. and M. MITCHELL. 1998. Topographical Constraints and Home Range Quality. Ecography 21: 337-341.

POWER, M., D. TILMAN, J. ESTES, B. MENGE, W. BOND, L. MILLS, G. DAILY, J. CASTILLA, J. LUBCHENCO, and R. PAINE. 1996. Challenges in quest for keystones. *In*: Predators and Ecosystem Management. J. ESTES, Wildlife Society Bulletin.

ROGERS, L. 1987. Effects of Food Supply and Kinship on Social Behaviour, Movements, and Population Growth of Black Bears in Northeastern Minnesota. Wildl. Monogr. 97: 1-72 - Supplement to J. of Wildl. Manage. 51(2), April 1987.

SAVAGE, C. 1999. Saving moose by feeding bears. Can. Geographic, May/June, 1999.

SCHEMNITZ, S. 1996. Capturing and Handling Wild Animals. *In* : Research and Management Techniques for Wildlife and Habitats. Ed. T. BOOKHOUT, The Wildlife Society, Bethsda, Maryland. Fifth ed. :106-124.

SCHWARTZ, C, and A. FRANZMANN. 1991. Interrelationship of Black Bears to Moose and Forest Succession in the Northern Coniferous Forest. Wildl. Monogr. 113: 1-58 – Supplement to J. of Wildl. Mgmt. 55(1), January 1991.

SKOGLAND, T. 1991. What are the effects of predators on large ungulate populations? Oikos. 61: 401-411.

STELFOX, J.B. 1993. Hoofed Mammals of Alberta. (Ed.) Lone Pine Publishing, Edmonton, Alberta. 241pp.

STELFOX, J.B. and J.G. STELFOX. 1993. Distribution. *In*: Hoofed Mammals of Alberta. J.B. STELFOX (ED.). Lone Pine Publishing, Edmonton, Alberta. :45-61.

STEWART, R., E. KOWAL, R. BEAULIEU and T. ROCK. 1985. The Impact of Black Bear Removal on Moose Calf Survival in East-Central Saskatchewan. Alces 21: 403-417.

THEBERGE, J. and D. STRICKLAND. 1978. Changes in wolf numbers, Algonquin Provincial Park, Ontario. Can. Field-Nat. 92: 395-398.

THOMPSON, D. 1952. Travel range, and food habits of timber wolves in Wisconsin. J. Mammal. 33: 429-452.

TREMBLAY, J., H. JOLICOEUR, and R. LEMIEUX. 2000. Summer Food Habits of Gray Wolves in the Boreal Forest of the Lac Jacques-Cartier Highlands, Québec: A Note. Alces – In Press, Spring 2002.

TUCKER, P., D. DAVIS, and R. REAM. 1990. Wolves; Identification, Documentation, Population Monitoring and Conservation Considerations. Northern Rockies Natural Resource Center of the National Wildlife Federation, Missoula, MT.

URBAN. 1969. Food Habits of Mink in the Turtle Mountain Area of Manitoba. Master of Science Thesis, University of Manitoba.

VAN BALLENBERGHE, V., A. ERIKSON and D. BYMAN. 1975. Ecology of the timber wolf in northeastern Minnesota. Wildl. Monogr. 43: 1-43.

VAN BALLENBERGHE, V. and W. BALLARD. 1994. Limitation and regulation of moose populations: the role of predation. Cdn J. of Zool. 72 (7): 2071-2077.

VOIGT, D., G. KOLENOSKY, and D. PIMLOTT. 1976. Changes in summer foods of wolves in central Ontario. J. Wildl. Manage. 40(4): 663-668.

WALTERS, C., M. STOCKER, and G. HABER. 1981. Simulation and optimization models for a wolf-ungulate system. *In*: Dynamics of large mammal populations. Ed. C. Fowler and T. Smith. John Wiley and Sons, New York. 317-337.

WEATHERILL, R. 1970. Tentative moose management plan for Hecla Island Provincial Park. Manitoba Department of Mines, Resources and Environmental Management.

WILTON, M. 1983. Black Bear Predation on Young Cervids – A Summary. Alces 19: 136-146.

WOO, V., G. MILLS, H. VELDHUIS and D. FORRESTER. 1977. A guide to biophysical land classification, Hecla-Carroll Lake, 62P-52M, Manitoba, July 1977. Northern Resource Information Program, Canada-Manitoba Soil Survey and Department of Renewable Resources and Transportation Services. Technical Report No. 77-3. 32pp.

8. PERSONAL COMMUNICATIONS

BARDARSON, E. Hecla/Grindstone Provincial Park seasonal employee.

BILECKI, L. Park Interpreter (retired), Hecla/Grindstone Provincial Park. Manitoba Conservation. February 17, 2000.

BJORNSON, D. Gull Harbour Resort Hotel employee and local beaver trapper.

COLLINS, G. Regional Wildlife Manager, Interlake Region, Manitoba Conservation. February 16, 2000.

CRICHTON, V. Wildlife Biologist – Forest Wildlife Specialist, Wildlife Branch, Manitoba Conservation. February, 2000.

HAGGLUND, B. Regional Wildlife Technician, Manitoba Conservation - Central Region.

HURST, R. Landscape Architect and Acting Head of Design and Development, Manitoba Conservation – Parks and Natural Areas Branch, Winnipeg, Manitoba.

KOSCEILNY, V. Natural Resource Officer, Manitoba Conservation - Riverton District.

KOWALYK, C. Natural Resource Officer, Manitoba Conservation - West Hawk Lake District.

MARTINSON, D. Hecla Island area commercial fisherman.

MELNYK, R. Park Patrol Captain, Manitoba Conservation - West Hawk Lake District.

MURPHY, D. Principal Consultant, Statistical Advisory Service, University of Manitoba.

PACKER, T. Forensic Biologist, Alberta Sustainable Resource Development, Fish and Wildlife Division, Edmonton Headquarters.

ROUSEAU, P. Senior Park Warden, Parks Canada - Riding Mountain National Park.

SMILEY, D. Natural Resource Officer, Manitoba Conservation - Hecla District.

SPRING, W. Hecla/Grindstone Provincial Park employee and area trapper.

THOMPSON, T. Hecla Island area commercial fisherman.

TODDERIN, W. Natural Resource Officer, Manitoba Conservation - Lynn Lake District.

TOMASSON, D. Long time Hecla Island resident. March 2000.

THOMPSON, B. Regional Veterinarian Specialist, Animal Health Division, Canadian Food Inspection Agency, Winnipeg, Manitoba.

WHALEY, K. Regional Wildlife Manager, Manitoba Conservation - Northwest Region, February 2000.

WHALEY, K. 1997. Moose Population Survey Hecla Island: Central Region, December 1996. Manitoba Natural Resources Manuscript Report No. 97-01W. 9pp.

WORONIUK, R. Natural Resource Officer/District Supervisor, Manitoba Conservation – Hecla/Riverton Districts.

9. APPENDICES

PRELIMINARY HECLA ISLAND AERIAL MOOSE SURVEY REPORT - 2001

SPECIES: Moose **SURVEY DATE(S)** January 25 & 26, 2001

GHA(S): 21A (Hecla Island) **CONTRACT #:**

DATE LAST FLOWN: February 2000 **AIRCRAFT TYPE:** Bell 206

CREW CHIEF: Brian Hagglund **Pilot:** Dave Tomlin

NAVIGATOR: Brian Hagglund

OBSERVERS: Greg Brown, Ray Kotchorek

TYPE OF SURVEY: Population Total Count

SURVEY METHOD: Transects

OBSERVER POSITIONING: Both Sides

SURVEY OBJECTIVES:
To establish a population estimate for the Hecla Island moose herd. This information will be utilized to determine management prescriptions. The north west area of Grindstone Point, and Deer Island were also flown with remaining time for comparison to Hecla Island data.

CHARTER RATE: $531 (dry) **FUEL:** 4.5 drums
PILOT EXPENSES: $158.72 . **TOTAL POSITIONING HOURS**: 0.9 hrs
TOTAL SURVEY HOURS: 8.1 hrs **TOTAL FLYING HOURS**: 9.0 hrs
TOTAL SURVEY COSTS: $4,937.72

GENERAL INTERPRETATION OF SURVEY RESULTS:
A total of 28 moose were observed during the survey of Hecla Island. Of the 28 moose observed 15 (54%) were cows, 6 were bulls (21%), 6 calves (21%) and 1 unknown (4%). Of the 15 cows observed, only 4 were observed with calves (2 sets of twins). As well during a one (1) hour survey of the North West portion of Grindstone Point 41 moose were observed; 25 cows, 9 calves, 6 bulls and 1 unknown. A total of 10 moose (8 Cows and 2 Bulls) were observed during the survey of Deer Island.

Results of this survey indicate a slight increase in population of moose on Hecla Island when compared to the 2000 survey. Previous surveys suggested that low herd recruitment has been a condition of this herd for at least four years. The 2001 survey corroborates this low recruitment condition, however, it is encouraging to see the increase in calves from zero in the 2000 survey.

GENERAL IMPRESSIONS OF SURVEY CONDITIONS

Weather conditions during the survey were generally adequate. Bright sun with turbulent wind provided less than optimal viewability for approximately half of the survey. High overcast during the other half of the survey provided optimal viewability. Snow conditions were good and fresh tracks could be observed relatively easily.

ABSTRACT

An aerial survey to determine the moose population in Hecla Island Provincial Park was undertaken on January 25th and 26th 2001. The island was divided into three (3) zones with each zone systematically searched for moose using 500 Metre north–south orientated transects. Observations were recorded from both sides of the aircraft (observing distance ≈250m). All flight lines and observations were stored into a hand held Global Positioning System (GPS) for input into the Regional Geographic Information System (GIS). A total of 28 moose were observed during the survey, a slight increase from the 2000 count of 25 animals Of the 28 moose observed 15 (54%) were cows, 6 were bulls (21%), 6 calves (21%) and 1 unknown (4%). Of the 15 cows observed, only 4 were observed with calves (2 sets of twins).

Based on the survey data, the population remains low and herd recruitment seems to be improving.

ACKNOWLEDGEMENTS

I would like to thank several people for their participation in the planning and delivery of the Hecla Island Moose Survey. Hank Hreisteinko, Wildlife Branch Big Game Technician assisted in the logistical planning of the survey. Regional Manitoba Conservation staff, Gene Collins, Don Jacobs, and Dave Roberts for providing logistical assistance. I would especially like to thank observers Greg Brown and volunteer Ray Kotchorek. In addition I would like to thank all Riverton district staff for their logistical assistance with fuel, radio communication, accommodations and hospitality.
Most importantly thank you to Parks Branch for funding the survey.

RECOMMENDATIONS

1. The results of this survey should be used for assessing management prescriptions.

2. The Bear removal program should be continued on Hecla Island during 2001 / 2002.

3. An appropriate study should be designed and implemented to determine the dynamics of the Hecla Island moose population.

4. Use of a hand held GPS unit for recording observation locations and storing transect coordinates for navigation should continue to be used in future surveys.

5. There needs to be additional management prescriptions to improve recruitment and habitat conditions on Hecla Island; Aspen and birch harvesting should be conducted in strategic locations, shear blading of willow should be performed in order to rejuvenate habitat for moose. All prescriptions should be implemented in the Wildlife Refuge where possible.

6. In order to monitor the moose population, the survey should be repeated in January – Feb. 2002.

Date prepared: February 5, 2001 Prepared by: Brian Hagglund

CC:	Sid Roback	Don Jacobs
	Gene Collins	Randy Woroniuk
	Tony Merkl	Rick Hurst
	Doug Pastuck	Brian Knudsen
	Hank Hristienko	Raymond Kotchorek

PRELIMINARY HECLA ISLAND AERIAL MOOSE SURVEY REPORT - 2002

SPECIES: Moose **SURVEY DATE(S)** January 30 & 31, 2002

GHA(S): 21A (Hecla Island) **CONTRACT #:**

DATE LAST FLOWN: January 2001 **AIRCRAFT TYPE:** Bell 206

CREW CHIEF: Brian Hagglund **Pilot:** Bob Longley

NAVIGATOR: Brian Hagglund

OBSERVERS: Greg Brown, Hank Hristienko, Dave Blanchard

TYPE OF SURVEY: Population Total Count

SURVEY METHOD: Transects

OBSERVER POSITIONING: Both Sides

SURVEY OBJECTIVES:
To establish a population estimate for the Hecla Island moose herd. This information will be utilized to determine management prescriptions. The north west area of Grindstone Point, and Deer Island were also flown with remaining time for comparison to Hecla Island data.

CHARTER RATE: $517 (dry)
PILOT EXPENSES:
TOTAL SURVEY HOURS: 8.1 hrs
TOTAL SURVEY COSTS: $4,978
FUEL: 4.0 drums
TOTAL POSITIONING HOURS: 0.9 hrs
TOTAL FLYING HOURS: 9.0 hrs

GENERAL INTERPRETATION OF SURVEY RESULTS:
A total of 28 moose were observed during the survey of Hecla Island. Of the 28 moose observed (Figure 1) 10 (36%) were cows, 13 were bulls (46%), and 5 were calves (18%). Of the 10 cows observed, only 4 were observed with calves (1 set of twins). As well during a one (1) hour survey of the North West portion of Grindstone Point 24 moose were observed; 12 cows, 7 bulls, and 5 calves. A total of 15 moose (9 bulls, 2 cows, 1 calf and 2 unknown) were observed during the survey of Deer Island.

Results of this survey indicate a stable population of moose on Hecla Island when compared to the 2000 survey. Previous surveys suggested that low herd recruitment has been a condition of this herd for at least four years. The 2002 survey corroborates this low recruitment condition, however, it is encouraging to see the increase in calves from zero in the 2000 survey.

GENERAL IMPRESSIONS OF SURVEY CONDITIONS
Weather conditions during the survey were generally adequate. Bright sun with turbulent wind provided less than optimal viewability for approximately half of the survey. High overcast during the other half of the survey provided optimal viewability. Snow conditions were good and fresh tracks could be observed relatively easily.

ABSTRACT

An aerial survey to determine the moose population in Hecla Island Provincial Park was undertaken on January 30th and 31th 2001. The island was divided into three (3) zones with each zone systematically searched for moose using 500 Metre north–south orientated transects. Observations were recorded from both sides of the aircraft (observing distance ≈250m). All flight lines and observations were stored into a hand held Global Positioning System (GPS) for input into the Regional Geographic Information System (GIS). A total of 28 moose were observed during the survey, the same number observed during the 2001 survey. Of the 28 moose observed 10 (36%) were cows, 13 were bulls (46%), and 5 were calves (18%). Of the 10 cows observed, only 4 were observed with calves (1 set of twins).

Based on the survey data, the population remains low and herd recruitment seems to be improving.

ACKNOWLEDGEMENTS

I would like to thank several people for their participation in the planning and delivery of the Hecla Island Moose Survey. Hank Hreisteinko, Wildlife Branch Big Game Technician assisted in the logistical planning of the survey as well as acted as a survey observer. Regional Manitoba Conservation staff, Gene Collins, Don Jacobs, and Dave Roberts for providing logistical assistance. I would especially like to thank observers Greg Brown and Dave Blanchard. In addition I would like to thank all Riverton district staff for their logistical assistance with fuel, radio communication, accommodations and hospitality.

Most importantly thank you to Parks Branch for funding the survey.

RECOMMENDATIONS

7. The results of this survey should be used for assessing management prescriptions.

8. An appropriate study should be designed and implemented to determine the dynamics of the Hecla Island moose population.

9. Use of a hand held GPS unit for recording observation locations and storing transect coordinates for navigation should continue to be used in future surveys.

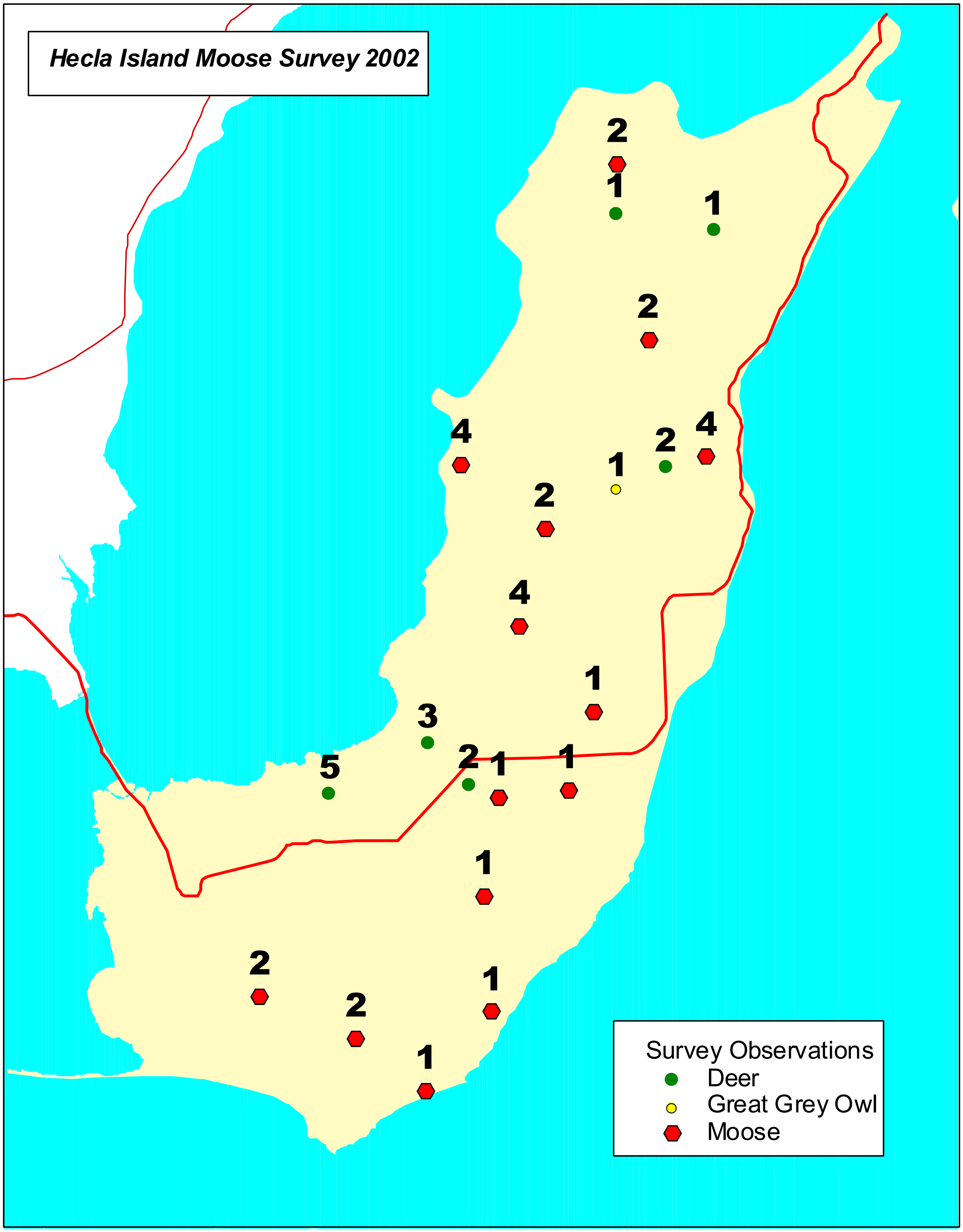
10. There needs to be additional management prescriptions to improve recruitment and habitat conditions on Hecla Island; Aspen and birch harvesting should be conducted in strategic locations, shear blading of willow should be performed in order to rejuvenate habitat for moose. All prescriptions should be implemented in the Wildlife Refuge where possible.

11. In order to monitor the moose population, the survey should be repeated in every second year. Next survey should be scheduled for January 2004.

Date prepared: May 17, 2002 Prepared by: Brian Hagglund

CC:	Sid Roback	Don Jacobs
	Gene Collins	Randy Woroniuk
	Tony Merkl	Rick Hurst
	Doug Pastuck	Brian Knudsen
	Hank Hristienko	Raymond Kotchorek

Figure 1 Location of Observations 2002 Hecla Moose Survey



AERIAL MOOSE SURVEY DATA FOR HECLA ISLAND 1971-2002

Year	Bulls	Cows	Calves	Unknown	Total	Calves/ 100 Cows	Calves/ 100 Adults	Bulls/ 100 Cows
1971/72	22	36	18	-	76	50	31	61.6
1972/73	47	39	24	1	111	61.5	27.6	120.5
1973/74	53	27	29	28	137	-	26.9	-
1974/75	22	18	29	61	130	-	28.7	-
1975/76	61	58	46	2	167	79.3	38.6	105.2
1976/77	32	51	24	-	107	47.1	28.9	62.7
1977/78	35	53	17	-	105	32.1	19.3	66.2
1978/79	52	89	36	-	177	40.4	25.5	58.4
1979/80	51	48	10	-	109	20.8	10.1	106.3
1980/81	25	43	16	-	84	37.2	23.5	58.1
1981/82	No	Survey	-	-	-	-	-	-
1982/83	17	36	19	1	73	52.8	35.9	47.2
1983/84	20	29	17	3	69	56.7	34.7	70
1984/85	45	55	39	2	141	70.9	39	81.8
1985/86	48	63	41	-	152	65.1	36.9	76.2
1986/87	53	36	31	-	120	86.1	34.8	147.2
1987/88	No	Survey	-	-	-	-	-	-
1988/89	37	48	17	-	102	35.4	20	77
1989/90	No	Survey	-	-	-	-	-	-
1990/91	No	Survey	-	-	-	-	-	-
1991/92	22	27	5	-	54	18.5	9.2	81.5
1992/93	28	30	11	-	69	36.6	18.9	93.3
1993/94	25	45	12	-	82	27	17	55
1994/95	No	Survey	-	-	-	-	-	-
1995/96	No	Survey	-	-	-	-	-	-
1996/97	23	32	4	-	59	12	7	72
1997/98	No	Survey	-	-	-	-	-	-
1998/99	No	Survey	-	-	-	-	-	-
1999/2000	12	13	0	-	25	0	0	92
2000/2001	6	15	6	1	28	40	21.4	40
2001/2002	13	10	5	-	28	50	21.7	130

INCIDENTAL BIG GAME SIGHTINGS - 2000

- Black bear sightings were relatively rare during the first few weeks of the field season.
- Black bear sightings became increasingly numerous throughout the frequently traveled portions of the island as the field season progressed.
- One (large) bear was observed approaching (and possibly accessing) the Hecla Island causeway from the mainland approach.
- A total of only four (4) timber wolf sightings were made by the author throughout the entire field season.
- All wolf sightings were of individual animals and not of whole or partial packs as observed in previous years.
- The total number of wolves present on the island during the summer of 2000 was known to be at least five (5) animals.
- Wolves were observed on and along the Hecla Island causeway on several different occassions throughout the field season.
- White-tailed deer sightings were most prevalent representing 38% of the big game sightings (Table 3). Moose were the second most frequently observed big game species at 33% while black bears were observed 20% of the time.
- White-tailed deer were observed on and along the Hecla Island causeway numerous times throughout the field season.
- The white-tailed deer population was estimated at approximately 20 animals.

TABLE 3: Relative abundance percentages for all big game animals observed on Hecla Island during the 2000 field season.

	Total Big Game Sightings	Moose	White-Tailed Deer	Woodland Caribou	Black Bears	Timber Wolves
Individuals Sighted	225	74	85	8	44	14
Relative Abundance Values		33%	38%	3%	20%	6%

- A cow moose was observed immediately after giving birth to a calf in Grassy Narrows Marsh on the morning of May 10th.

- The cow moose and newborn calf were observed to remain in the same general area of the marsh for approximately 5 days after the birth - most likely for predator evasion purposes.

- Numerous sightings of one (1) lone cow woodland caribou confirmed the presence of this species on the island.

- The cow caribou was not detected during the 2001 aerial survey.

- Incidental moose mortality during the study period included:
  1) one yearling cow being struck and killed by a vehicle on August 22nd; and
  2) the entrails of one (1) mature bull found by district Natural Resource Officers along a side-road sometime later in the Fall – most likely the result of lawful Treaty Aboriginal hunting activities.

Wildlife Laboratory

Black Bear and Timber Wolf Scat Analysis

Sample #	Sample Month	Species	Contents / Hair Type
1	May	Wolf	Moose and Wolf
2	May	Wolf	Moose
3	June	Wolf	Moose
4	July	Wolf	Beaver, Hare and Wolf
5	July	Black Bear	- No Hair Detected -
6	July	Black Bear	- No Hair Detected -
7	July	Wolf	White-tailed Deer and Beaver Fish Scales, Fish Bones and Recreational Fishing Line
8	July	Black Bear	- No Hair Detected -
9	July	Black Bear	Unidentifiable hair fragments
10	July	Black Bear	- No Hair Detected -
11	July	Black Bear	Unidentifiable hair fragments
12	July	Black Bear	- No Hair Detected -
13	August	Wolf	Moose Calf
14	August	Black Bear	Black Bear
15	August	Black Bear	Black Bear
16	August	Wolf	Beaver and Deer fawn
17	August	Black Bear	- No Hair Detected -
18	August	Black Bear	Beaver and Unidentifiable hair fragments
19	August	Black Bear	- No Hair Detected -
20	August	Wolf	White-tailed Deer
21	August	Wolf (pup)	Beaver and Wolf
22	August	Black Bear	Striped Skunk (attached to exterior of sample)
23	August	Black Bear	- No Hair Detected -
24	August	Wolf	Moose
25	September	Wolf	Beaver, Wolf and White-tailed deer

Page 1

Wildlife Laboratory

Black Bear and Timber Wolf Scat Analysis

Sample #	Sample Month	Species	Contents / Hair Type
26	Late August	Wolf	Beaver, Fish scales and Fish bones
27	" "	Wolf	Beaver and Wolf
28	" "	Wolf	Beaver, Wolf and White-tailed Deer
29	Collected in August Unknown Deposit Dates	Wolf	- No Hair Detected -
30	" "	Wolf	Wolf and White-tailed Deer
31	" "	Wolf	Wolf
32	" "	Wolf	Moose Calf and Wolf
33	" "	Wolf	Beaver and Wolf
34	" "	Wolf	Beaver and Wolf
35	" "	Wolf	Wolf
36	" "	Wolf	White-tailed Deer and Wolf
37	" "	Wolf	Beaver
38	" "	Wolf	Beaver and Wolf
39	" "	Wolf	- No Hair Detected -
40	" "	Wolf	Beaver
41	" "	Wolf	- No Hair Detected -
42	" "	Wolf	White-tailed Deer and Wolf
43	" "	Wolf	White-tailed Deer
44	" "	Wolf	Beaver and Wolf
45	" "	Wolf	Beaver and Wolf
46	" "	Wolf	Beaver and Wolf
47	" "	Wolf	- No Hair Detected -
48	" "	Wolf	Beaver and Wolf
49	" "	Wolf	Beaver and Wolf
50	" "	Wolf	Beaver and Wolf
51	" "	Wolf	Beaver and Wolf

All samples identified with:
A Manual for the Identification of Hairs of Selected Ontario Mammals
A.S. Adorjan and G.B. Kolenosky, Research Branch, Ontario Department of Lands and Forests, Research Report (Wildlife) No. 90
September 1969, 64 pp.

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