MANITOBA'S SECOND EXPERIMENTAL MOOSE HUNT ON HECLA ISLAND

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Abstract: A second controlled moose hunt in the fall of 1979 on Hecla Island in central Manitoba was used as a management tool to reduce the size of the moose population. This season had 3 components, namely a fall archery season for 150 hunters and 2 1-week early winter rifle seasons for 75 hunters each week. Bow hunters harvested 3 moose while 35 were taken in the rifle seasons. Details of examinations carried out for parasites, other anomalies, blood characteristics, reproduction and data relative to live and dressed weights and ages are presented. Appropriate comparisons are made with data collected in 1978 and with similar data from other areas in the province. An economic analysis of the hunt capitalized the value of a moose based on consumptive use as $1,173.10.

Hecla Island Provincial Park, located on Lake Winnipeg, has been considered an anomaly in Manitoba for the past few years because of the high moose density. At the peak of population in 1978, there were about 2.3 moose/sq. km of moose habitat with some areas having up to 5.2 moose/sq. km. A general description of the Island and its moose herd appears in Crichton (1977, a and b). The management strategy has had two goals, namely to reduce the density of moose, while concomitantly to embark on a habitat rejuvenation program. In 1978, the first controlled hunt was held on the Island (Crichton,

1979), however, the magnitude of the habitat program to date has been insignificant.

The mechanics and results of a second controlled hunt in 1979 along with the biological and economic data gathered are contained in this paper.

MATERIALS AND METHODS

License applications for residents only were made available at offices of the Department of Natural Resources throughout the province for the 3 proposed seasons: archery - 150 licenses - September 17th-October 13th inclusive; rifle - 150 licenses (75 for each season) - December 3rd-8th and 10th-15th inclusive. Prospective hunters were asked to select their choice of seasons and submit these applications to the department no later than July 13, 1979.

All archers successful in the draw were forwarded their licenses in the mail and asked to turn in the jaw of any animal they might shoot. The successful rifle applicants were sent their licenses in the mail and asked to report to the check station prior to starting their hunt.

A designated route system used for controlling the use of vehicles, particularly snow machines, was in effect for all seasons (Figure 1) as well as a no-hunting zone to avoid conflict with other park users. Designated routes are a system of trails which allow hunters access into hunting areas. All vehicles are restricted to these routes until an animal is shot, after which they may be taken to the kill site to haul the animal out. Four designated camping sites were available to those hunters desiring to use their own camping

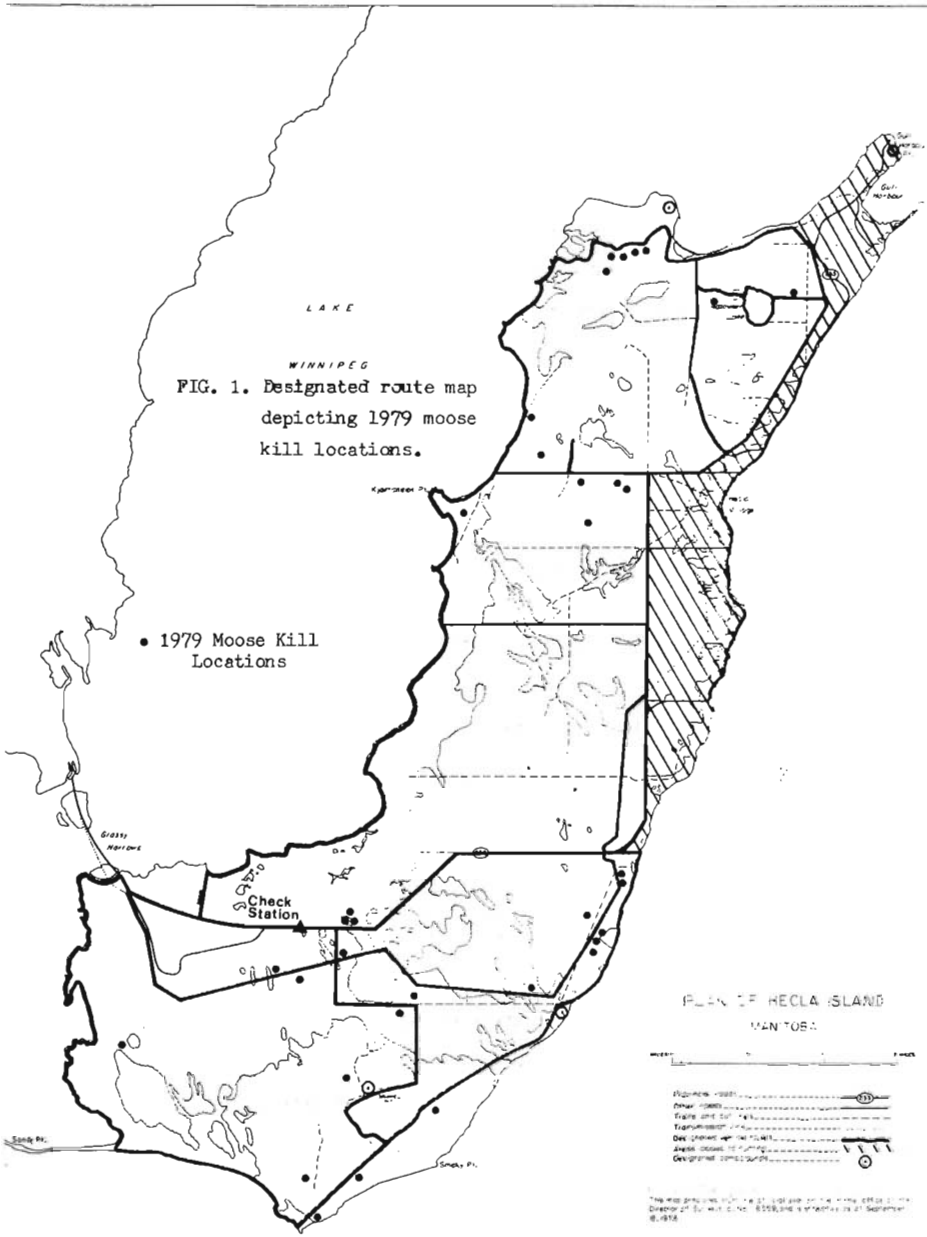

FIG. 1. Designated route map depicting 1979 moose kill locations.

facilities. All designated routes were posted before the seasons and travelled by department staff immediately prior to the winter seasons to determine which ones were passable. This information was in turn passed on to hunters at the check station.

The check station, complete with living accommodations, was set up at the entrance to the Island prior to the first rifle hunt and attended by department staff on a 24-hour basis. All hunters stopped at the station and were given a verbal resume of the requests being made of them along with written instructions, plastic bags for samples, 2 non-heparinized 50 ml conical tubes with positive seal caps for blood and a 7 ml vial containing 10.5 ml of EDTA. Hunters were also made aware of the department's desire to obtain live weights of animals. They were informed that if they contacted staff shortly after shooting a moose, provided it wasn't in an inaccessible area, it would be hauled out using a double-track snow machine. In such cases, staff assisted with the dressing and specimen collection at the check station. Prior to leaving their animal and coming to the check station for assistance, hunters were asked to collect blood samples from the jugular vein and urged to keep them from freezing. In addition, they were asked to note and collect the following if dressing was carried out in the bush: time of death, lungs, heart, liver, kidney and associated fat, female reproductive tract and a gallon of stomach content. Should hunters leave the Island, they were asked to check out at the station and in again upon their return. Staff collected the front portion of the lower jaw, took nasal temperatures, collected 2-3 cc of vitreous humour, removed the metatarsal (cannon) bone, examined each animal for evidence of ticks, when possible obtained live and dressed weights,

assisted hunters with dressing and specimen collection, collected standard big game body measurements (i.e., total length, forehead length, chest and shoulder height, heart girth, neck circumference, hind foot and hind leg) which were made to the nearest centimetre on hanging animals using a steel tape. Weights of moose were taken using a 2,000-pound capacity scale, suspended from a chain hoist, which in turn was attached to a scaffolding under which vehicles could drive. The heart girth of dressed animals was measured by pressing the split sternum together. All antlers were measured using the Boone and Crockett scoring method and a photo taken of each. Once weighed, whole animals were dragged to the marsh area adjacent to the check station where dressing took place and specimens collected. Following this, the animals were reweighed and placed on the hunter's vehicle.

Personnel from Atomic Energy of Canada attended the check station and collected the metacarpal bone from 1 leg, 1 kilogram of flesh from the sternum and about 1 gallon of stomach content. This material is being used by AECL to ascertain the levels of radioactive cesium present in moose.

Ages of all adult animals were determined using the dental cementum technique described by Sergeant and Pimlott (1959).

The kidney fat index (KFI) was determined using the technique of Riney (1955) with the modifications suggested by McGillis (1972).

Serum was extracted from the blood within 2-3 hours of being collected, placed in a storage container and frozen. When samples were suitable, haematocrits were determined. The vitreous humour was filtered through acropor membrane filters held in Gelman easy pressure filter holders within 2-3 hours of being collected and subsequently

frozen. The serum and vitreous humour were analyzed by the Minnesota Department of Natural Resources research laboratory in Grand Rapids, Minnesota using standard techniques.

The various organs and tissues obtained were examined shortly after collection at the check station. Parasites and anomalies were preserved in appropriate fixatives. The heart and liver were returned to hunters desiring them. The sex, weight and crown rump length were taken from all foetuses collected. During the dressing process carried out at the check station, the abdominal cavity was thoroughly searched for filarioids.

Each hunter, upon completion of his/her hunt, was asked to fill out a questionnaire at the check station as to the number of days hunted, success, number of moose seen, number shot at, number of animals wounded and not found and an estimate of their expenditures. Bow hunters were sent a questionnaire and those who did not reply after a second mailing were phoned.

RESULTS

Only 100 of the 150 archery licenses were sold, of which 80 were awarded via the draw and the remaining 20 through a general sale following the draw. The option to hunt was exercised by only 70 hunters, 24 did not hunt and 6 could not be contacted. Relative to the rifle hunt, 680 applicants applied for the 75 licenses allocated for the first week and only 36 for the second week. The remaining licenses for the latter season were allocated by drawing names from those unsuccessful in the draw for the first week.

Archery hunters spent an average of 5.3 days hunting, killed 2 bulls and 1 cow and there were 3.3 moose seen per hunter. This resulted in 1 moose killed per 124 man days and 1 moose wounded.

One hundred thirty-eight of the 150 successful rifle applicants hunted during 1 of the seasons. These individuals spent an average of 4.0 days hunting, saw 1.2 moose/hunter and harvested 20 bulls, 12 cows and 3 calves (Figure 1). This resulted in 1 moose killed per 15.7 days hunted. In addition, 9 moose were wounded, some of which were eventually taken by other hunters. Of the 35 moose harvested, 18 were taken during the first week and 17 the second week.

Hunter expenditures are tabulated in Table 1. The direct cost to the department to run this check station attended by at least 3 staff was $916--this does not include staff salaries as no extra staff were hired for this venture.

Both live and dressed weights were obtained for 15 adult bulls (Table 2) with dressed weights only for the remaining 5. Both weights were obtained for 8 cows (Table 3) and dressed weights only for the other 4. The live weight for those animals on which only dressed weights were available was estimated on the basis of a 30.6% loss for bulls (Table 2) during dressing and 32.5% loss for cows (Table 3). For calves, 1 male had a live weight of 410 pounds and dressed at 260 pounds for a weight loss of 150 (36.6%) pounds while the other had a live weight of 225 pounds and dressed at 140 for a loss of 85 (37.8%) pounds. This latter calf was exceptionally small, alone when shot and likely an orphan. The single female calf weighed 470 pounds live and lost 175 (37.2%) pounds at dressing to weigh 295 pounds. The average percent weight loss for the 3 calves was 37.2.

Table 1. Hunter expenditures - 1979.

Archery season (70 hunters)			
	Cost/hunter	Total cost/hunter	Total expenditure
Local area[1]	$38.37	$ 64.74	$ 2,686.00
Other[2]	$26.37		$ 1,846.00
			$ 4,532.00
License revenue: 100 x $16 = $1,600			
Rifle season (138 hunters)			
Local area	$80.36	$125.63	$11,090.00
Other	$45.27		$ 6,247.00
			$17,337.00
License revenue: 150 x $16 = $2,400			
Cutting and wrapping: 15,829 lbs. x $0.20 = $3,165			
Total hunter expenditure: $29,034			

[1]Riverton, Hecla vicinity.

[2]Other parts of Manitoba.

Table 2. Ages and weights of bull moose - 1979.

Age	Live weight	Dressed weight	Weight loss (%)
1 1/2	675	475	200 (29.6)
1 1/2	650	440	210 (32.3)
1 1/2	684*	475	
1 1/2	610	425	185 (30.3)
2 1/2	733*	509	
3 1/2	950	665	285 (30.0)
3 1/2	840	625	215 (25.6)
4 1/2	920	630	290 (31.5)
4 1/2	840	590	250 (29.8)
4 1/2	1000	670	330 (33.0)
6 1/2	990	680	310 (31.3)
6 1/2	1016*	705	
6 1/2	1060	725	335 (31.6)
7 1/2	970	665	305 (31.4)
7 1/2	1080	745	335 (31.0)
7 1/2	1110*	770	
8 1/2	1015	715	300 (29.6)
9 1/2	1200	835	365 (30.4)
10 1/2	1040	705	335 (32.2)
13 1/2	937*	650	
5.7 ± 3.3	923 ± 170	635 ± 115	283 ± 57 (30.6 ± 1.7)

*Live weight estimated on basis of an average 30.6% loss due to dressing

**Average does not include estimated weights. Number following average is standard deviation

Table 3. Ages and weights of cow moose - 1979.

Age	Live weight	Dressed weight	Weight loss (%)
2 1/2	865*	575	
3 1/2	884*	588	
3 1/2	875	595	280 (32.0)
3 1/2	895	605	290 (32.4)
4 1/2	810	528	282 (34.8)
4 1/2	720	510	210 (29.2)
4 1/2	887*	590	
5 1/2	845	580	265 (31.4)
5 1/2	955	625	330 (34.6)
5 1/2	855	565	290 (33.9)
9 1/2	835	575	260 (31.4)
12 1/2	1015	675	
5.4 ± 2.8	849 ± 68**	584 ± 42	276 ± 34 (32.5 ± 1.9)

*Live weight estimated on basis of an average 32.5% loss due to dressing

**Average does not include estimated weights. Number following average is standard deviation

Figures 2 and 3 depict the relationship between live weight and dressed weight for males and females respectively. The maximum error that can be anticipated using this relationship is 7.4% for males and 4.5% for females. Using this relationship to determine the live weight of the 835 pound bull would have resulted in a weight of 1,208 pounds--the actual weight of this animal (Table 2) was 1,200 pounds. The r and r^2 values for males were 0.9916 and 0.9833 respectively, while those for females were 0.9473 and 0.8973.

The 4 skinned quarters of a 1 1/2 year old bull represented 53.3% of the animal's live weight.

Age data for males and females are given in Tables 2 and 3 with the average age for males being 5.7 $\pm$ 3.3 while that for cows was 5.4 $\pm$ 2.8.

Tables 4 and 5 give the total length, heart girth, shoulder height and chest height for adult males and females respectively.

An inspection of kidney fat indices (Table 6) clearly indicates that those for adult bulls are substantially lower than those for cows. The values for the 2 male calves were 12.5 and 40.0 (smallest calf) and 21.4 for the female calf.

The 3 standard antler measurements are illustrated in Table 7 along with the age of the respective animal. Four of the bulls (ages 7 1/2, 7 1/2, 10 1/2, 13 1/2) had shed their antlers prior to being killed.

Although the blood collected by hunters was not frozen prior to coming to the check station and separation of the serum did occur within 2-3 hours of collection, some haemolysis occurred which influenced some of the results obtained. In very few instances was

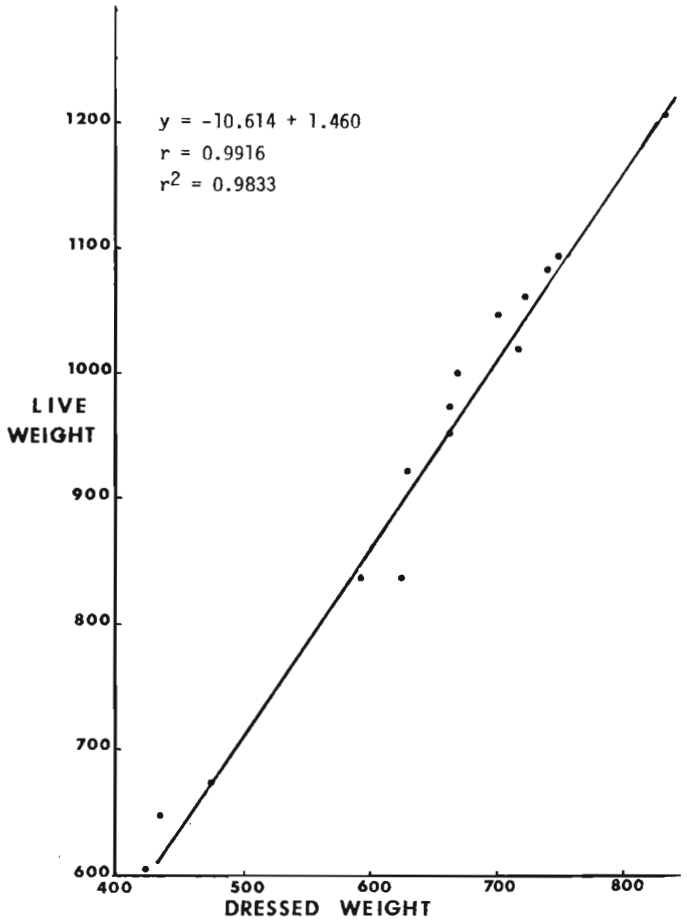

Figure 2. Relationship between live and dressed weight (pounds) of male moose.

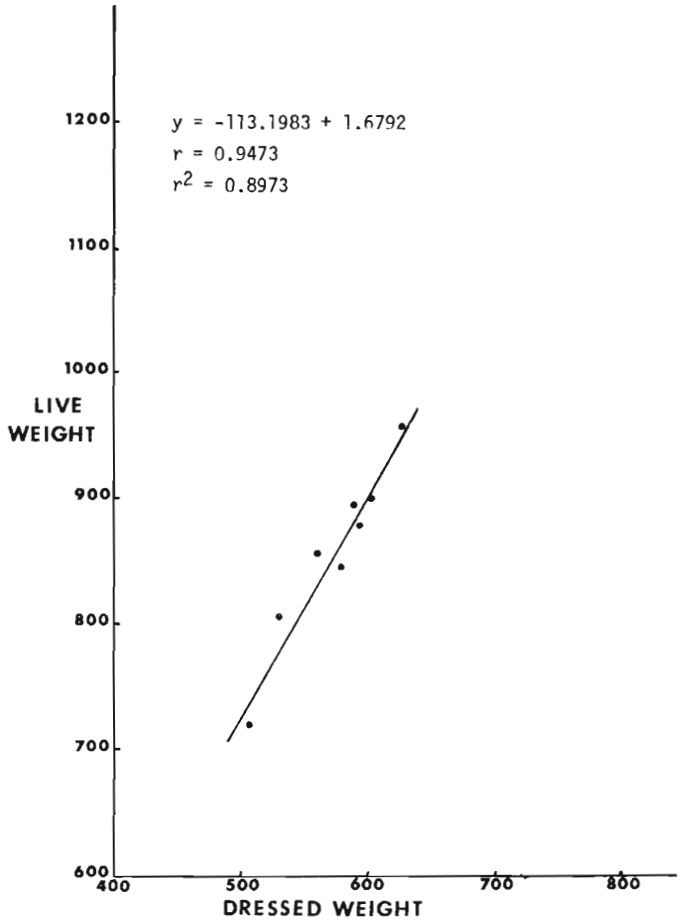

Figure 3. Relationship between live and dressed weight (pounds) of female moose.

Table 4. Morphometric measurements (cm) for adult bulls - 1979.

Age	Total length	Heart girth	Shoulder height	Chest height
1 1/2	245	177	172	99
1 1/2	247	158	163	93
1 1/2	245	171	166	96
1 1/2	250	163	166	95
2 1/2	258	156	152	89
3 1/2	265	187	192	105
3 1/2	265	185	184	111
4 1/2	267	189	181	99
4 1/2	270	178	183	102
4 1/2	269	200	189	104
6 1/2	272	196	186	104
6 1/2	269	189	181	103
6 1/2	285	190	191	104
7 1/2	256	189	181	96
7 1/2	270	203	191	99
7 1/2	270	195	190	96
8 1/2	261	190	179	104
9 1/2	289	207	195	113
10 1/2	275	199	192	113
13 1/2	266	177	182	99
	265 ± 12	185 ± 14	181 ± 12	101 ± 6

NOTE: The number following average is standard deviation.

Table 5. Morphometric measurements (cm) for adult females - 1979.

Age	Total length	Heart girth	Shoulder height	Chest height
2 1/2	264	177	154	80
3 1/2	247	193	170	98
3 1/2	266	188	182	104
3 1/2	273	183	179	94
4 1/2	255	187	177	100
4 1/2	265	170	177	103
4 1/2	277	177	179	103
5 1/2	270	196	168	85
5 1/2	268	181	184	107
5 1/2	267	181	182	105
9 1/2	255	172	166	93
12 1/2	265	178	181	99
	264 ± 8	182 ± 8	175 ± 9	98 ± 8

NOTE: The number following average is standard deviation.

Table 6. Kidney fat index - December, 1979.

Male		Female	
Age	KFI	Age	KFI
1 1/2	42.9	2 1/2*	109.5
1 1/2	40.0	3 1/2*	128.0
1 1/2	33.3	3 1/2*	140.9
1 1/2	17.7	3 1/2*	95.7
2 1/2	15.8	4 1/2*	131.3
3 1/2	25.0	4 1/2	105.3
3 1/2	35.3	4 1/2*	94.4
4 1/2	13.6	5 1/2*	88.2
4 1/2	60.0	5 1/2*	47.8
6 1/2	23.5	5 1/2*	214.0
6 1/2	37.5	9 1/2*	188.2
6 1/2	16.7	12 1/2*	123.8
7 1/2	11.3		122.3 ± 44.6
7 1/2	25.9		
7 1/2	15.6		
8 1/2	15.0		
9 1/2	33.3		
10 1/2	16.7		
13 1/2	25.0		
	26.5 ± 12.7		

*Denotes female pregnant

NOTE: The number following average is standard deviation.

Table 7. Moose age and antler morphology.

Age	Beam	(average)	Width	(average)	Total points	(average)
1 1/2	10.2		61.3		2	
1 1/2	10.5	(10.8)	62.6	(60.4)	7	(4.5)
1 1/2	11.8		61.6		6	
1 1/2	10.8		56.2		3	
2 1/2	14.0	(14.0)	71.7	(71.7)	7	(7)
3 1/2	13.6	(13.6)	88.0	(83.6)	10	(12)
3 1/2	13.6		79.1		14	
4 1/2	15.0		108.6		13	
4 1/2	15.0	(15.3)	91.2	(98.0)	8	(10)
4 1/2	15.9		94.3		9	
6 1/2	17.2		102.2		17	
6 1/2	15.9	(16.8)	111.1	(104.9)	14	(14.7)
6 1/2	17.2		101.3		13	
7 1/2	15.0	(15.0)	113.7	(113.7)	13	(13)
8 1/2	17.8	(17.8)	109.8	(109.8)	17	(17)
9 1/2	18.4	(18.4)	115.6	(115.6)	17	(17)

NOTE: All measurements in cm

the blood collected in the tubes containing the anticoagulant EDTA (Disodium Ethylenediamine Tetraoretate) useable for haemotacrits or blood cell counts as it was generally clotted or diluted. Of the blood parameters obtained, those 3 considered most important in assessing condition are listed in Tables 8 and 9. A t-test for significant differences between the urea-nitrogen, cholesterol and total protein from each year were performed. In 1978, the t-value for urea-nitrogen was 1.08 and the critical t was 2.22; for 1979 the values were 0.19 and 2.12. Similarly, for cholesterol the values in 1978 were 0.55 and 2.21, for 1979, 0.84 and 2.14, while those for total protein were 1.11 and 2.21 in 1978 and 1.23 and 2.12 in 1979. All of the above tests, although not showing significant differences, should be taken as preliminary analyses. The method used to determine the calculated t t and critical t is Cochrane's as outlined in Snedecor and Cochrane (1967: 115). This test is conservative, that is, it will often fail to detect a significant difference which really exists. Continuing analyses will attempt to determine if any multivariate tests show significant difference between groups.

Table 10 lists the parasites found and their prevalence. The hydatid cysts varied in size from 1 cm in the youngest animal to 2.5-6.5 cm in the oldest. The youngest animal had 2 cysts, the 9 1/2 year old had 3 and the oldest had 5. As the heart was the only organ searched for *Taenia krabbei*, the prevalence of this parasite may be higher. Evidence of *Setaria* was found in the tissues of 6 of the 9 animals that were gutted in the bush, thus the fact that staff were not present during the dressing process did not reduce the observed overall prevalence of this parasite. In some cases, in addition to

Table 8. Blood chemistry of male moose.

Age	Urea-nitrogen (gm/dl)	Cholesterol (gm/dl)	Total protein (gm/dl)
1/2	3	85	6.7
1 1/2	2	52	4.4
1 1/2	5	53	5.9
1 1/2	7	69	4.9
1 1/2	40	82	5.9
2 1/2	6	62	6.2
3 1/2	12	63	5.5
3 1/2	13	96	7.5
4 1/2	7	61	6.4
4 1/2	6	93	7.7
4 1/2	8	72	6.5
6 1/2	2	78	6.7
6 1/2	14	62	5.4
7 1/2	9	85	6.4
7 1/2	7	71	6.3
7 1/2	9	85	7.3
8 1/2	7	68	6.6
9 1/2	16	67	5.5
10 1/2	8	61	6.4
13 1/2	9	86	7.2
	9.5 ± 8.1	72 ± 13	6.3 ± 0.9

NOTE: Number following average is standard deviation.

Table 9. Blood chemistry of female moose.

Age	Urea-nitrogen (gm/dl)	Cholesterol (gm/dl)	Total protein (gm/dl)
1/2	5	85	6.9
2 1/2	11	60	6.6
3 1/2	11	63	5.7
3 1/2	7	70	5.8
3 1/2	11	65	6.4
4 1/2	5	64	5.8
4 1/2	14	32	3.7
4 1/2	7	68	6.6
5 1/2	3	54	4.5
5 1/2	5	53	4.9
9 1/2	8	66	6.9
12 1/2	5	69	5.9
	7.7 ± 3.3	62 ± 13	5.8 ± 1.0

NOTE: Number following average is standard deviation.

Table 10. Parasite prevalence in Hecla moose - 1979.

Species	Number infected		Percent infected	
	adult	calves	adult	calves
Echinococcus granulosus	3*	0	9.4	0
Taenia krabbei (heart)	0	0	0	0
Taenia hydatigena	24	1	75.0	33.3
Setaria sp.	19	2	59.4	66.7
Dictyocaulus sp.	1	1	3.1	33.3
Dermacentor albipictus	32	3	100	100

Sample size: 32 adults; 3 calves

*2 cows, 1 bull - ages: 12 1/2, 9 1/2, 3 1/2 (smallest cysts in 3 1/2 year old)

finding live specimens of *Setaria*, calcified specimens were found on the liver, diaphragm and in the connective tissues of the abdominal cavity.

An examination of the uteri revealed that 10 of the 12 adult cows were pregnant for a ratio of 91.7 calves/100 cows. The sex of the foetuses were 5 males and 6 females with the oldest cow having twins. It is interesting to note that the 4 1/2 year old non-pregnant cow, from examination of the uterus, did not appear to have been pregnant in the past. The weight and crown/rump length of the calves found in utero during the 1978 and 1979 hunts are presented in Table 11. T-tests to determine if significant differences existed between the weight of foetuses and crown/rump length were performed and showed no difference (weight: $t = 0.55$ and the critical $t = 2.22$; crown/rump: $t = 0.34$ and the critical $t = 2.22$). As with the blood chemistry analyses, the same test was used and these results should be taken as a preliminary analysis. Continuing analyses will attempt to determine if any multivariate tests show significant differences between years.

DISCUSSION

The relationship between man and moose is a two-way affair with each, over the years, having offered the other a number of benefits. The value of Hecla's moose herd to the park has been recognized for some time; however, if this value is to be realized to its fullest, and because of development on the Island, moose management must be an active affair rather than a do-nothing approach. It is suggested that 3 objectives regarding this management strategy

Table 11. Weight and crown/rump length of foetal calves from the 1978 and 1979 Hecla hunt.

1978			1979		
Sex	Weight (gms)	Crown/rump (cm)	Sex	Weight (gms)	Crown/rump (cm)
F	52.5	12.4	F	59.8	11.7
F[1]	50.6	11.3	F	20.9	9.5
F	26.5	9.1	F	61.7	11.8
F	38.7	10.5	F[4]	79.5	13.1
F	35.2	10.6	F[4]	79.3	12.8
F[2]	27.9	9.8	F	64.3	12.4
F[2]	27.3	9.8	M	68.3	11.7
M	36.0	10.2	M	21.2	8.4
M[1]	54.1	11.5	M	6	6.5
M	25.3	9.2	M	10.2	6.5
M	43.0	10.8	M	25.7	9.4
M	25.5	9.8		45.2 ± 28.3	10.3 ± 2.4
M	38.9	11.0			
M[3]	70.6	11.8			
M[3]	49.9	11.4			
	40.1 ± 13.3	10.6 ± 1.0			

1, 2, 3, 4, = Twins

F - Female; M - Male

be employed: 1) to maintain the moose population at about 200 animals; 2) to provide an opportunity for those visiting the Island to view moose in their natural habitat; and, 3) to provide a limited amount of yearly hunting activity, the extent of which will be determined annually by the size of the herd. The objectives are similar to those outlined by Cumming (1974) for the management of moose in Ontario, namely, 1) protection from suspected overexploitation, 2) development of some regulated use, 3) increase use of an underutilized resource, 4) sustained yield and optimum use of a resource, and 5) recreational and economic benefits to people. Franzmann (1978) suggests further that moose population needs should be considered in total resource planning for forest management units.

The 2 hunts held to date have been designed to offer some Manitobans the opportunity for a high-quality recreational experience while at the same time using this as a tool to reduce the Island's moose herd to a level compatible with the available habitat. It is a well known fact that moose prefer early successional vegetation. The opportunity to develop this type of habitat on portions of Hecla has been compounded by the Island's status as a provincial park. Thus, in order to maintain the population at a level compatible with a habitat that has not been rejuvenated to any extent for over 20 years and ensure the population remains viable, the controlled hunt has been a useful tool. The argument has been advanced that the Island is a natural system and that the moose herd should be left alone. The proponents of this concept fail to realize that as the Island is more intensively developed, fire suppression carried out and as the remaining habitat matures, the ability of the Island to support a

viable moose population and meet the objectives indicated above is greatly diminished. The Department of Natural Resources has adopted a pro-hunting stance and, if managed properly, recreational hunting will not destroy the Island's moose herd, but rather, will assist in maintaining a viable population for all users.

Following the 1978 hunt and a subsequent aerial survey, the moose population was estimated to be about 200 animals. Although the 1978/79 winter was the most severe since 1973/74, there was no evidence found during late winter or early spring to suggest that a significant mortality of moose did occur; thus a decision was made to proceed with another hunt in 1979 recognizing that the 1979 calf crop would hopefully add to the population.

It is estimated from data gathered by the author from field staff that in addition to hunting mortality, about 20-30 moose were removed from the Island's population by poaching, vehicle collisions, migration along the causeway leading to the Island, accidental death (i.e., locked antlers in the case of 2 bulls) and unknown causes. Thus, the present population (post-1979 hunt) is estimated to be about 160-170 animals. Unlike 1978, productivity did not balance the licensed harvest.

There was a high demand (4.8 applicants per license) for the licenses available; however, most (680) applied for the first week with the result that the second week was undersubscribed (36 applicants). The lower success rate (25.4%) over that of 1978 (37.6%) is attributed to the deep snow that blanketed the Island, smaller population and unlike 1978, there was not a "lot of easy moose" to be had in the open marsh areas. The low success for archery was anticipated and the

knowledge gained in 1978 relative to the difficulties of hunting moose via this method undoubtedly contributed to the reduced number of hunters.

Although there were 50 more licenses allocated for the 1979 hunt, the total expenditure by hunters decreased by about $2,000. This was due to fewer archers participating and a reduction in their expenditures (1978 - $123.10/hunter; 1979 - $64.74/hunter). Undoubtedly, this was a reflection of the fact that equipment purchased in 1978 was also used in 1979. This is substantiated by comparing expenditures in the local and non-local areas in both years--local area expenditures in 1979 dropped by about 12%, whereas non-local expenditures dropped by 66%. However, the results do not invalidate the statement (Crichton, 1979) that "moose hunting can result in a significant economic return to those catering to moose hunters." Crichton (1979) computed the capitalized value of a moose on Hecla and found this to be $1,170.53. At today's interest rate of approximately 15% and using the same technique, a capital investment of $193,560 would be required to return a value of $29,034. The post-season population is estimated to be 160-170 animals, thus if 165 is used as a population figure, the capitalized value per moose is $1,173.10, almost identical to that computed following the 1978 hunt (1,170.53). This value was derived using consumptive use data and does not take into account the dollars spent by the non-consumptive users. To measure the dollar value of observing or photographing this stately monarch standing in solitary assuredness or young calves frolicking while the cow feeds on new luxuriant summer growth is next to impossible.

The ages of bulls and cows harvested in 1978 (5.7 ± 2.3 and 5.4 ± 2.8 respectively) were not significantly different from those killed in 1978 (5.7 ± 3.3 and 6.6 ± 4.2). The age structure for moose from Game Hunting Area 26 in the shield country of eastern Manitoba was 4.9 ± 3.0 for bulls and 6.6 ± 4.3 for cows. A comparison of the ages from Hecla and Area 26 showed they were not significantly different (using t-test; for males t = 1.15 and for females t = 0.89). This latter area is heavily hunted and over the past few years licensed hunters, as well as natives, have taken 300-400 moose. Bigelow (1979) found in Game Hunting Areas 18, 18A and 18B in western Manitoba that the mean age structure of a herd that is being harvested at the optimum level (Davies, pers. comm.) was 3.5 for bulls and 5.1 for cows. The calf crop on Hecla in 1979/80 was 51% below that found in 1978/79 and with the present winter being much more severe than 1978/79, it is anticipated that calf survival in 1980 may again be substantially reduced. If such is the case, it seems inevitable that with 2 consecutive years of reduced calf survival, the average age of the population will increase. This, along with maturing habitat, would seem to suggest that the prognosis for average calf crops is not good.

The smaller calf crop in 1979 may have resulted from one of a combination of 2 things: 1) a cold wet spring in which spring green-up was delayed by about 3 weeks; and, 2) nutritionally stressed females at the end of the winter. In utero productivity in 1978/79 (Crichton, 1979) was 100 calves/100 cows, yet in January 1980, the ratio was 20.8 calves/100 cows. This is a loss of 79.2 calves/100 cows over what was observed in utero. The extent of stillborn calves and neonatal mortality is difficult to determine, primarily because

scavengers may utilize the carcass before it is found. However, observations in June and July suggest that most of the calf mortality had occurred by this time. As only 1 or 2 wolves were on the Island in the summer of 1979, they were not considered to be a significant factor acting on the population.

The live and dressed weights of bulls compare very well with those found in 1978, with the average weight loss to dressing in each year being 30.6%. Similarly, with adult cows, both weights are similar with the weight loss in 1978 being 31.0% and 32.5% in 1979. The average weight loss to dressing in calves was 37.2% in 1979 and 38.5% in 1978, suggesting that the weight loss is somewhat greater in calves than in adults. By using the relationship between live and dressed weight depicted in Figures 2 and 3, one can determine the former weight if the latter is known. The ability to estimate live weights of moose within about 7% of the actual value would appear to meet the requirements of most who desire such values. Hunters did not remove large amounts of waste flesh and hide during the dressing process, thus the weight losses indicated are considered to be representative of what occurs. The weights of 11 adult bulls from G.H.A. 26 in 1979 was 767 ± 178 which is greater than that of bulls from Hecla (635 ± 115). One of the bulls from Area 26 dressed out at 1,085 pounds (3 1/2 years old) with another 2 at 960 (7 1/2 years old) and 980 (6 1/2 years old) respectively. Similarly, the average dressed weights of 12 cows from this area was 592 ± 97, very similar to the weights (584 ± 42) from Hecla. Dressed weights for the 2 areas (Hecla and G.H.A. 26) were tested for significant differences using a t-test. For males, the calculated t was 2.51 which is significant (critical t = 2.05, $P < .05$) suggesting that males from Hecla are

lighter than those from Area 26. Similarly, a t-test (t = 1.15) showed there was not a significant weight difference between females from both areas. Franzmann (1978) indicated that the heaviest recorded weights for Alaskan moose were 1,080 pounds for females and 1,310 pounds for males, but indicated that heavier weights have been estimated and undoubtedly exist but lack confirmation. If the weight loss of 31% to dressing applies to bulls from Area 26, the estimated live weight of the bull dressing at 1,085 is 1,572 pounds. Although the small sample size in each age class negates comparing weights, Markgren (1969) indicated that his weight data suggested that the main increase in average dressed and live weight occurs between calf and yearling ages and between 1 and 2 years of age. With females, the growth curve flattens out somewhat; however, that for bulls appears to continue to rise. A perusal of the present data does suggest that the greatest increase in weight occurs in the calf to 2-year-old category.

There are few studies regarding antler development and age, and although sample sizes are small, it is evident that in terms of the beam circumference, width of antlers and number of points that maximum development is occurring in those animals 5 1/2 years of age and greater.

The KFI's of adult females (122.3 $\pm$ 44.6) are significantly greater than those of males (26.5 $\pm$ 12.7) and these values in turn are substantially increased (females 145.6% and males 71.0%) over the corresponding values for 1978 (Crichton, 1979). Until the results of the browse analysis are received, one can only speculate as to the reasons for this. However, it does seem plausible to suggest that it may be one or a combination of the following, namely a reduced

population and/or an excellent growing season producing highly nutritious foods. McGillis (1972) suggested that the low KFI's in 1968 and 1969 in Elk Island National Park were perhaps indicative of a very high moose density. If this is the case, it is not surprising that the KFI's have increased in value as the preseason population in 1978 was 1.6 moose/sq. km, while in 1979 it was about 1.2/sq. km. Nutrition is known to have a strong influence on reproduction and Markgren (1969) suggests that quantity and quality of nutrition are probably relevant to reproduction. Thus, with the cows supporting substantially greater fat reserves in 1979/80 than 1978/79, we might expect greater calf survival in 1980, however, this might be negated by the severity of the present winter. As of mid-February 1980, the severity index was equal to the value following the 1978/79 winter.

The principle that an animal living in an environment best reflects the condition and quality of that environment (Franzmann, 1978) is being used to assess the relative health among moose populations. The methods of measuring nutritional status of moose populations were presented by La Resche, et al. (1974). Blood calcium, phosphorus, total protein, haemoglobin and packed cell volumes are good indicators of the condition status of moose (Franzmann, et al., 1976). Faro and Franzmann (1978) found that low packed cell volume, low protein intake indicated by low blood urea nitrogen and low fatty acid indicated by low cholesterol are indicative of nutritionally stressed moose. With the exception of the BUN's for females, which are substantially lower than those found 1 year ago, the other values are similar to those of 1978. The low BUN value for females is indicative of a lower than average nitrogen

intake at the time of collection. A comparison of the values listed in Tables 8 and 9 with those from Alaska (Franzmann, et al., 1976; Smith and Franzmann, 1979) reveal that the Hecla values are indicative of what was found in Alaska in late winter. Smith and Franzmann (1979) suggest that based on these values, concern is warranted for the physiologic status of the population they worked with when it is exposed to a severe or even normal winter. It is possible then that the calf loss previously discussed has been the result of nutritional factors and with the severity of the present winter, calf survival may not improve in 1980.

A comparison of mean total length and heart girth gives an indication of the size differences between Alaska moose and those from Hecla. The mean total length of the former (Smith and Franzmann, 1979) is about 289 cm, while that for Hecla moose is about 265. Similarly, the heart girth is about 202 cm versus 184 for the moose of Hecla.

The low prevalence of echinococcosis and apparent low prevalence of *T. krabbei* is a reflection of a moose population not predated upon by wolves. The population of the latter in this area has been depressed for a number of years and a high pelt price, along with the proximity of this area to cattle ranches (causing predation problems), dictates that the population will not build up to a level that it will play a role in the population dynamics of moose on Hecla. The presence of what was presumed to be dead calcified *Setaria* were frequently found in the connective tissues and less frequently on the liver. The presence of fibrin on the surface of the liver is common, not only in moose from Hecla, but also those from other areas of

Manitoba. The cause of this is unknown, however, it does appear that those animals infected with *Setaria* also have fibrin on the liver. It has been known for some time that the moose tick does occur on moose in Manitoba (Crichton, unpublished data), however, this represents the first published occurrence of it in Manitoba's moose.

In utero productivity did not differ significantly from that of 1978. Recognition of the role of nutrition in productivity was the basis for attempting some habitat rejuvenation on Hecla which has not been carried out to any extent since the cessation of logging in the mid-1950's. Poor quality trees and the lack of a market for balsam fir in those areas where habitat regeneration is preferred have negated attempts to have local timber operators remove the mature timber. With a large body of water surrounding the Island, the use of controlled fire as a technique to improve the habitat is being carefully considered.

Foetal measurements suggest that breeding lasted from mid-September to late October with most of it occurring in both years in the latter part of September. The calling period in 1978 was at its peak on September 27 and 28 while in 1979 very little vocalization was heard compared to the previous year.

Relative to management, 2 years of conducting this type of controlled hunt have illustrated that it can be done cheaply and that the lottery system (which Manitoba has conducted for a number of years) of allocating licenses and controlling the harvest can be useful and effective. The early winter season, particularly for a rifle season and where the potential for interaction between

consumptive and non-consumptive users exists, is the preferred time period for such an event in Manitoba.

As in 1978, the sample size is small, however, combined with the information gathered in 1978 and data from other parts of Manitoba, it is felt the results are a good indicator of the population's viability and as more data are accumulated, they are serving as the basis upon which comparisons can be made with other areas in Manitoba. A population's well-being is ultimately measured by its production and recruitment of young (Franzmann, 1978) and in this regard the values for Hecla are substantially lower than the average obtained for all others areas in eastern and central Manitoba.

The reaction of many of those participating in the hunt is that they have learned to better appreciate the overall values of recreational hunting rather than measuring their success against bagging an animal. Biologists throughout the country would do well to give more recognition and credence to a different aspect of their job, namely extension. There is no doubt resource agencies will continue to experience problems in financing all programs aimed at moose management, however, improved public awareness of and appreciation for the recreational, commercial and aesthetic values that this stately monarch offers will go a long way to ensuring its rightful place in various ecosystems and the priority of managing it. The efforts extended by departmental staff during the 1978 and 1979 hunts have done much to increase the awareness of people to the values of moose, not only to Hecla Island, but other areas as well and this appreciation by hunters has been made visible in many ways. This can only benefit moose management in Manitoba. Moose cannot be stockpiled

for future use--as the population reaches a balance with the available habitat, the annual surplus resulting from reproduction must be balanced with a comparable mortality, thus the value of recreational hunting to the wildlife manager.

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Table 2. Ages and weights of bull moose - 1979.

Age	Live weight	Dressed weight	Weight loss (%)
1 1/2	675	475	200 (29.6)
1 1/2	650	440	210 (32.3)
1 1/2	684*	475	
1 1/2	610	425	185 (30.3)
2 1/2	733*	509	
3 1/2	950	665	285 (30.0)
3 1/2	840	625	215 (25.6)
4 1/2	920	630	290 (31.5)
4 1/2	840	590	250 (29.8)
4 1/2	1000	670	330 (33.0)
6 1/2	990	680	310 (31.3)
6 1/2	1016*	705	
6 1/2	1060	725	335 (31.6)
7 1/2	970	665	305 (31.4)
7 1/2	1080	745	335 (31.0)
7 1/2	1110*	770	
8 1/2	1015	715	300 (29.6)
9 1/2	1200	835	365 (30.4)
10 1/2	1040	705	335 (32.2)
13 1/2	937*	650	
5.7 ± 3.3	923 ± 170**	635 ± 115	283 ± 57 (30.6 ± 1.7)

*Live weight estimated on basis of an average 30.6% loss due to dressing

**Average does not include estimated weights. Number following average is standard deviation