DOES FIRST NATION'S HUNTING IMPACT MOOSE PRODUCTIVITY IN ALBERTA?

Gerry M. Lynch

4158 Petty Creek Road, Alberton, MT 59820, USA

ABSTRACT: Wildlife biologists and members of the hunting public in Alberta voiced concerns that unregulated hunting by First Nations' hunters was detrimental to some moose populations. Moose population dynamics were examined in 3 study areas where First Nations hunting occurred. Provincially licensed sport hunters were only allowed to harvest antlered moose in all 3 areas, but numbers of permits were unlimited. Moose populations in some management areas were characterized by strongly biased sex ratios in favor of females, high mean age of the female cohort, and reduced reproductive performance. In Wildlife Management Unit (WMU) 358, where hunting by First Nations' hunters was considered "heavy", the sex ratio was not strongly biased, moose numbers were sustained at a higher level, and both pregnancy and twinning rates were higher than in the other areas. Contrary to the fears of wildlife managers and sport hunters, moose hunting by First Nations' hunters in WMU 358 did not appear to be detrimental, but may have actually enhanced moose productivity. The moose harvest there probably resembled a selective harvest system where females as well as males were included. Wildlife managers in Alberta may wish to consider the benefits of selective harvest for other areas that are currently managed under a non-selective male-only harvest strategy.

ALCES VOL. 42: 25-31 (2006)

Key words: age structure, *Alces alces*, First Nations hunting, moose harvest, Native hunting, productivity, selective harvest, sex ratio

---

In many jurisdictions across North America, the moose (*Alces alces*) resource is shared by Indigenous People (First Nations people in Canada, Native Americans in the United States), who are exercising their treaty hunting rights, and sport hunters licensed to harvest a moose. Conflicts between these two groups have been known to occur and wildlife managers must consider the harvest by both when formulating the annual hunting regulations. An annual telephone questionnaire in Alberta (Lynch and Birkholz 2000) provided reasonable estimates of the annual harvest by licensed sport hunters, but the take by First Nations' hunters was never documented. In response to the uncertainty concerning the total harvest of moose each year, those who set hunting regulations adopted a conservative approach by forbidding the removal of any females by sport hunters and later by limiting numbers of bull moose permits. The stated goal of moose management in Alberta was to increase moose numbers in most wildlife management units (WMUs).

History has shown that unregulated hunting can profoundly impact wildlife populations by reducing animal numbers or by altering population characteristics, including age structures of population cohorts and sex ratios. In Alberta, the Northern Moose Management Program (NMMP) enabled biologists to examine moose population characteristics over a large portion of northern moose range. Three study areas (WMUs 346, 350, and 358) allowed a comparison of the characteristics of moose populations in an area considered to be heavily utilized by First Nations' hunters (WMU 358) and 2 other areas where First Nations hunting was not considered to be significant. The purpose of this paper was to

examine the impact of unregulated hunting by First Nations' hunters on the moose population in WMU 358, an area considered by moose biologists to have been heavily hunted by that group for many years.

STUDY AREA

The 3 study areas were typical boreal forest, covered by mosaics of open muskeg and forests dominated by mixed and pure stands of white spruce (*Picea glauca*), black spruce (*P. mariana*), aspen (*Populus tremuloides*), and lodgepole pine (*Pinus contorta*). Locally important tree species were tamarack (*Larix laricina*), white birch (*Betula papyrifera*), balsam poplar (*P. balsamifera*), and jack pine (*P. banksiana*). Shrub communities were dominated by species of alder (*Alnus* spp.) and willow (*Salix* spp.), depending on drainage. Plant species in all areas were influenced by fire history and some were impacted by clear-cut logging or oil and gas exploration.

The 3 study areas were located in west-central Alberta, roughly north of highway 16 and south of the Peace River. WMU 358 was situated on the Alberta-British Columbia boundary. Some poaching and hunting by First Nations' hunters occurred in all areas, but First Nations hunting in WMU 358 was feared to be excessive. Hunting by licensed sport hunters was considered heavy in all areas, except in WMU 350, a semi-wilderness area with limited hunter access. Moose in all areas were preyed upon by gray wolves (*Canis lupus*), black bears (*Ursus americanus*), and grizzly bears (*U. arctos*), but grizzlies were only occasional visitors to WMU 358. All areas were influenced by agriculture (except WMU 350), logging, and the petrochemical industry. The areas of WMUs 346, 350, and 358 were 5,205 km^2, 6,253 km^2, and 2,886 km^2, respectively.

METHODS

Moose surveys were conducted using the stratified random block method of Gasaway et al. (1986). Cessna 180 and 185 fixed-wing aircraft were used for the pre-survey activity. Randomly selected survey blocks were flown using Robertson 44 and Bell Jet Ranger helicopters. Survey blocks were flown in a WMU until confidence limits on population means reached 20 % or less. A Global Positioning System (GPS) and Geographic Information System (GIS) helped with the logistics of surveying large geographical areas (Lynch and Shumaker 1995).

Helicopter Wildlife Management was the company contracted to captured female moose by net gun from a Hughes 500 helicopter. An additional 24 females were darted from a Robertson 44 helicopter and immobilized with carfentanil citrate and xylazine. Captured moose were ear-tagged, measured, fitted with a radio-collar, and a tooth was extracted for aging. Moose transmitters were in the 150-megahertz frequency range and included a mortality switch that doubled the pulse rate when a mortality occurred.

Moose incisor bars were collected from hunter-killed moose for aging. All teeth were sectioned and aged according to the technique first described by Sergeant and Pimlott (1959).

Radio-collared moose were found once per week from a fixed-wing aircraft to determine their location and status (dead or alive). When a transmitter was found to be in "mortality mode", a helicopter was dispatched to the site immediately so the cause of death could be determined.

Each spring a helicopter was used to relocate newborn calves belonging to radio-collared females. Three flights in each study area ensured that newborns were found before they were lost to early calf mortality.

Moose population parameters were compared between the 3 study areas to try to detect any adverse effects related to the unregulated hunting by First Nations' hunters in WMU 358. Moose densities, adult sex ratios, calf production and survival, adult survival, and twinning

rates were examined for discrepancies.

Hunting pressure (success and effort) by licensed sport hunters was measured by the annual telephone questionnaire. Hunting pressure by First Nations' hunters was not measured, but was subjectively classified as "light", "moderate", or "heavy" in the 3 study areas. This classification was based on observations by Fish and Wildlife Division officers and biologists as well as reports from landowners, oil field personnel, and other private individuals in the field.

RESULTS

Moose surveys were flown in the 3 study areas every year during the 5 years of the NMMP (Table 1). In WMU 346, the population mean ranged from 2,308 (1997-98) to 3,369 (1996-97). The low count in 1997-98 was not considered accurate and was attributed to poor survey conditions in that WMU, when warm winds suddenly melted most of the snow cover. Excluding 1997-98, population means in WMU 346 ranged from 2,669 to 3,369. Bulls per 100 cows ranged from 9 in 1993-94 to 21 in 1996-97. Increasing bull:cow ratios were in response to changes to the hunting regulations beginning in 1994 that reduced the harvest of antlered moose by sport hunters. Calves per 100 cows ranged from 31 to 46 at the time of the surveys, about 6 months after birth.

The estimated moose population means in WMU 350 ranged from 2,701 (1994-95) to 3,593 (1996-97). The lower mean in 1994-95 was attributed to a greater harvest of bulls that year when hunting pressure shifted to WMU 350 from adjacent areas where the general hunting season format (unlimited over-the-counter license sales) was changed to a limited entry draw. This effect also showed itself in the lower bull:cow ratio that year (10 bulls per 100 cows) in the post hunting season population. Other than 1994-95, bulls per 100 cows ranged from 23 to 29 in WMU 350. Calves per 100 cows at the time of the surveys ranged

Table 1. Five years of aerial survey results from WMUs 346, 350, and 358 in northern Alberta.

WMU	Year	Population	95% C.L.	Per 100 Cows		Density	
		Mean	+/- %	Bulls	Calves	/100 km^2	/mi^2
346	93/94	3,118	16	9	42	65	1.7
	94/95	2,792	19	15	45	54	1.4
	95/96	2,669	15	20	31	51	1.3
	96/97	3,369	18	21	42	65	1.7
	97/98	2,308	11	17	46	44	1.2
350	93/94	2,952	19	23	45	51	1.3
	94/95	2,701	16	10	32	45	1.2
	95/96	3,557	20	25	39	57	1.5
	96/97	3,593	19	25	35	57	1.5
	97/98	3,204	14	29	32	51	1.3
358	93/94	1,328	15	20	42	46	1.2
	94/95	2,478	15	22	56	86	2.2
	95/96	2,682	18	30	46	93	2.4
	96/97	2,842	15	28	50	98	2.6
	97/98	2,552	11	24	56	88	2.3

Table 2. Numbers of female moose captured and sources of their mortality during the 5-year term of the NMMP in northern Alberta.

WMU	Collared	Source of Mortality				
	n	Predation	Birthing	Winter	Shot	Totals
346	34	1 (14%)	0	0	6 (86%)	7 (21%)
350	36	6 (55%)	1 (9%)	1 (9%)	3 (27%)	11 (31%)
358	44	0	0	1 (5%)	20 (95%)	21 (48%)
Totals	114	7 (18%)	1 (3%)	2 (6%)	29 (74%)	39 (34%)

from a low of 32 to a high of 45.

In WMU 358, the population mean ranged from 1,328 in 1993-94 to a high of 2,842 in 1996-97. In 1994-95 the mean was 2,478, 80% higher than the previous year's count. This discrepancy caused us to question the accuracy of our survey technique, so the moose survey in WMU 358 was replicated 2 months later in February 1995 in order to check the technique. The second survey resulted in a mean of 2,429, only 49 less than the first population estimate. These results confirmed the legitimacy of the survey technique. The low numbers in 1993-94 were attributed to movement of moose out of WMU 358 into adjacent agricultural areas in response to deep snow. Movements of moose into adjacent areas during winter were later confirmed by radio telemetry in WMU 358. Future moose surveys in all areas were scheduled for completion by the end of December, before moose were driven out of a survey area or into heavy cover by deep snow (Lynch and Shumaker 1995). Bulls per 100 cows in WMU 358 ranged from 20 to 28 during the 5-year period, and calves per 100 cows at survey time ranged from 42 to 56.

Sources of mortality of radio-collared moose were identified (Table 2). Thirty-four percent (n = 39) died during the course of the project. Six of 7 deaths in WMU 346 were due to being shot and 1 to predation. In WMU 350, the wilderness area, a total of 11 radio-collared moose died during the study. Fifty-five percent (n = 6) was attributed to predation by gray wolves. One died giving birth, 1 died from winter-related causes, and 3 were shot. In WMU 358, where hunting by First Nations' hunters was common, 21 of 44 cow moose died. Ninety-five percent of those that died were shot (n = 20). The only other death in WMU 358 was related to severe winter conditions.

Over the term of the study, 224 cumulative annual adult radio-collared females were eligible to bear calves (Table 3). Of these, 176 (79%) produced litters. Percent cows bearing calves was about the same in WMUs 346 and 350 (74% and 73%, respectively), but in WMU 358, the area heavily used by First Nations' hunters, 73 of 85 (87%) of eligible radio-collared cows produced calves (Table 3).

In spring of each year a helicopter was used to obtain a "visual" on each radio-collared cow moose in order to determine whether it had a calf or calves. Initially, a single flight in June was used, but it soon became apparent that calves were being lost to early mortality factors and were therefore not included in calving statistics. Beginning in 1996, 3 flights were used each year to obtain a more accurate assessment of calf production. Table 4 examines reproductive performance of radio-collared females during 1996 and 1997, when the extra helicopter flights were used. In

Table 3. Reproductive performance of radio-collared moose as determined at time of parturition during spring of 1996 and 1997 in northern Alberta.

WMU	Eligible Cows	Litters	%
346	78	58	74
350	62	45	73
358	85	73	87
Overall	224	176	79

Table 4. Twinning rates among radio-collared moose and observed[1] during 5 years of aerial surveys in northern Alberta.

WMU	Radio-Collared Females			Aerial Surveys				
	n litters	*n* twins	%	*n* cows	Single Calf	Twins	% Calving	% Twinning
346	38	6	16	886	317	15	37.5	4.5
350	28	2	7	1,185	413	18	36.4	4.2
358	39	10	26	1,457	608	49	45.1	7.5

[1]Calving and twinning rates determined by telemetry occurred at birth. Rates determined from aerial surveys occurred approximately 6 months after birth.

WMU 346, there were 38 litters that included 6 sets of twins (16% of litters). In WMU 350, 28 litters included 2 sets of twins (7%), and in WMU 358, where First Nations' hunters were active, there were 39 litters that included 10 sets of twins (26%).

Percent twins observed during the winter aerial surveys were 4.5, 4.2, and 7.5 in WMUs 346, 350, and 358, respectively (Table 4). The lower figures during winter aerial surveys were attributed to calf mortality during the first 6 months of life.

Annual survival rates of radio-collared cows in WMUs 346, 350, and 358 were 0.928, 0.863, and 0.751, respectively (Table 5). Calf annual survival rates were 0.745, 0.575, and 0.614, respectively.

DISCUSSION

Moose surveys were flown each year of the NMMP in WMUs where cow and calf moose mortality studies were underway or where moose hunting regulations were changed from a general season format to a limited entry draw in order to reduce the bull harvest and restore less biased adult sex ratios.

Table 5. Annual survival rates calculated of radio-collared female moose and calves of radio-collared females in northern Alberta.

WMU	Females		Calves		
	Survival	Mortality	% Died	Survival	Mortality
346	0.928	0.072	14.9	0.745	0.255
350	0.863	0.137	28.2	0.575	0.425
358	0.751	0.249	25.2	0.614	0.386

We were particularly interested in population trends in WMU 358, where many believed that moose were being over-hunted by First Nations' hunters. There was no significant change in population means in any of the 3 study areas during the 5 years of the project. Numbers in WMU 358 actually suggested a trend toward increasing, not decreasing moose numbers. Moose densities in WMU 358 sustained themselves at 50-75 % higher levels compared to the other 2 study areas, in spite of removal of many female moose by First Nations' hunters.

Numbers of bulls per 100 cows more than doubled in WMU 346 in response to hunting season changes that curtailed the antlered moose harvest by licensed sport hunters. In 1993, prior to the regulations change, approximately 64 % of available bulls were shot each year. By 1996 this rate had dropped to 24 % and the sex ratio had gone from 9 to 21 bulls per 100 cows in the post hunting season population.

In WMU 350, the wilderness area, the bull: cow ratio declined dramatically in 1994 when approximately 64 % of bulls were removed that season by licensed hunters. The spike in hunting pressure that year was attributed to movement of hunters into WMU 350 from adjacent areas where a limited entry draw had been initiated. The following year, in 1995, WMU 350 was included with adjacent areas limited by a draw for antlered moose permits. This reduced the bull harvest in subsequent years and led to a recovery in the ratio of bulls

to cows. The ratio of bulls to cows in the post hunting season population appeared to be highly sensitive to hunting pressure.

In WMU 358, licensed moose hunters removed 39, 25, 27, and 31% of available bulls between 1994 and 1997, respectively. In addition, an unknown number of bulls were harvested by First Nations' hunters and poachers. In spite of the heavy antlered harvest, post hunting season numbers of bulls per 100 cows in WMU 358 were 22, 30, 28, and 24, respectively, during the same period. It was apparent that removal of antlerless moose by First Nations' hunters helped to offset the loss of bulls to hunting, thus preventing the bull: cow ratio from becoming severely skewed.

The causes of mortality of radio-collared females in the 3 study areas were not unexpected. The greatest level of mortality occurred in WMU 358, where First Nations' hunters, and possibly poachers, removed 46 % of radio-collared females. This was reflected in the annual survival rates calculated for the 3 areas. WMU 358 had the lowest female moose survival rate (0.751), compared to 0.928 and 0.863 in WMUs 346 and 350, respectively.

We were able to age 1,206 incisor bars from hunter killed male moose and a sample of female moose from WMU 346. The females were harvested as part of a special hunting season to obtain reproductive tracts. The mean ages of bulls in WMUs 346 and 358 were 2.5 and 2.7 years, respectively. In WMU 350, where hunting pressure was less, the mean age of males was 3.5 years. WMU 350 also had the lowest percentage of yearlings in the harvest, 32.4%, compared to 50.0% in WMU 346 and 49.7% in WMU 358. Bull moose annual mortality rates in WMUs 346, 350, and 358 were 49.9%, 33.7%, and 46.2%, respectively. These results were not unexpected and they were in agreement with perceived levels of hunting pressure.

The mean age of females in WMU 346, where hunting by First Nations' hunters was minimal, was 7.2 years. We suspected that the female cohort in WMU 350 was also old, while that in WMU 358 was younger, due to the harvest of females there by First Nations' hunters. However, we did not have age data from female moose in those 2 areas. Studies of reproductive performance of our radio-collared females suggested that older females might have been less productive than younger, prime-aged animals. Seven radio-collared females demonstrated a pattern of alternate year breeding. All were 9 years old or older. All other adult females produced a litter annually. We thought that a younger female cohort in WMU 358, the area used by First Nations' hunters, would be more productive than the old female cohorts in WMUs 346 and 350.

Calf mortality during the first 6 months was a factor in reducing the numbers of twins observed during the winter moose surveys. Calf survival seemed highest in WMU 346 where there were fewer predators and less hunting by First Nations' hunters. The lowest calf survival rate was in WMU 350 where both bear species and wolves were abundant. In WMU 358, calves were hunted by First Nations' hunters.

These observations were made as subsets of the larger NMMP. Other factors that were beyond the scope of the NMMP, such as local climatic events and range quality and condition, were probably relevant factors not considered here. These data were considered observational and not cause and effect.

The harvest of cows and calves by First Nations' hunters in WMU 358 was thought to resemble a selective harvest system of management, except that numbers of cows and calves harvested could not be regulated. Under this regime, and despite the fact that comparisons between the 3 study areas may not have been significant statistically (due to our sample sizes) when compared to other areas studied, the moose population in the area "heavily" hunted by First Nations' hunters had some of the highest bull:cow ratios, had the greatest population density, had the highest ratio of

calves to cows, had the highest pregnancy rate among radio-collared cows, and had the highest twinning rate recorded. This does not mean that unregulated either sex moose hunting would automatically benefit all moose populations, nor does it mean that unregulated hunting by First Nations' hunters is not detrimental to some other moose populations. It does suggest that moose managers in Alberta should abandon their non-selective male-only management strategy for moose and opt for a selective harvest system that includes limited cow harvest and increased opportunity to harvest calves. Far northern WMUs, where moose populations are currently limited by predation, should continue to be managed for a male-only harvest, as prescribed by Van Ballenberge and Dart (1982).

ACKNOWLEDGEMENTS

This project was paid for by the Government of Alberta, Alberta Sustainable Development, Fish and Wildlife Division, and by hunters through the Alberta Conservation Association.

REFERENCES

GASAWAY, W. C., S. D. DUBOIS, D. J. REED, and S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper Number 22. University of Alaska, Fairbanks, Alaska, USA.

LYNCH, G. M., and S. BIRKHOLZ. 2000. A telephone questionnaire to assess moose harvest. Alces 36:105-109.

_____, and G. E. SHUMAKER. 1995. GPS and GIS assisted moose surveys. Alces 31:145-151.

SERGEANT, D. E., and D. H. PIMLOTT. 1959. Age determination in moose from sectioned incisor teeth. Journal of Wildlife Management 23:315-321.

VAN BALLENBERGE, V., and J. DART. 1982. Harvest yields from moose populations subject to wolf and bear predation. Alces 18:258-275.