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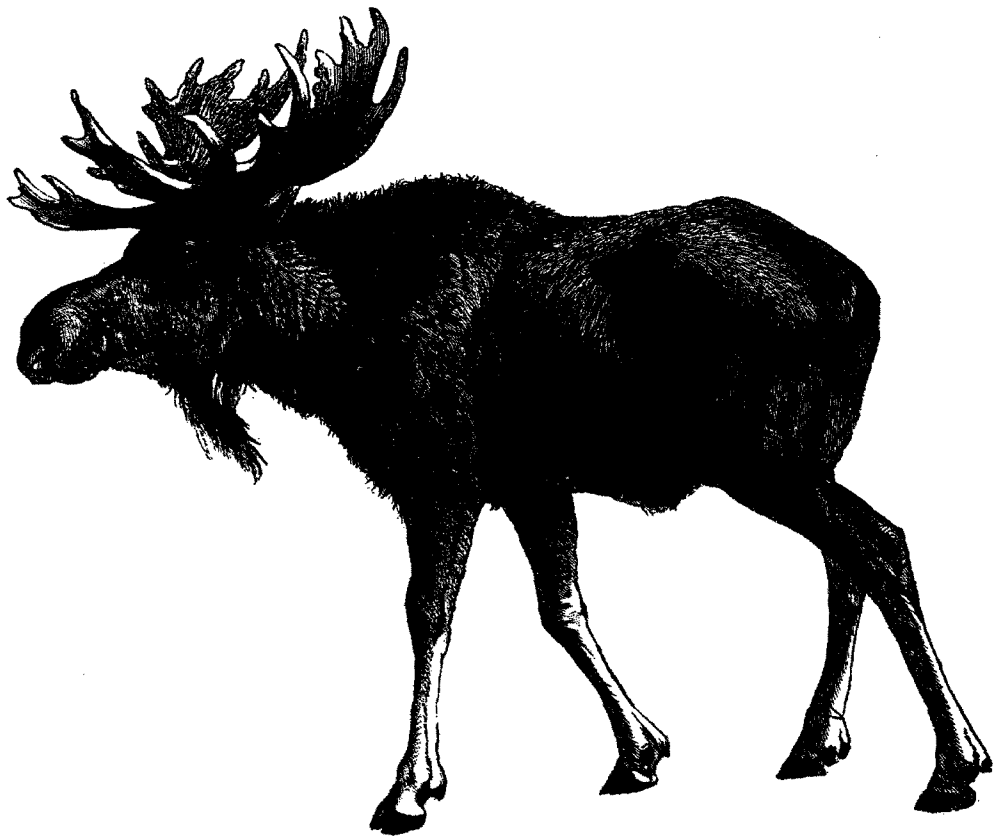
Moose Population Parameters and Distribution in the Squirrel River, Alaska, November 1992

A. E. Morkill and J. Dau



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INTRODUCTION

Moose expanded their distribution into northwestern Alaska during the mid-20th century. Accounts by village elders indicate that moose were rarely seen in the Kobuk River valley prior to 1930, but they were reportedly more numerous by the 1950s (Anderson et al. 1977). Moose are second to caribou as an important subsistence source of red meat used by residents of inland villages in Game Management Unit (GMU) 23, which includes the area with all streams draining into Kotzebue Sound. Most locals regard moose as a form of insurance against a potential distribution change or population decline of caribou (Anderson et al. 1977). In addition, moose are one of the principal big game species sought by non-local Alaskan resident and non-resident sport hunters in GMU 23.

Moose populations have steadily increased in GMU 23; however, declining bull:cow ratios in some portions of the Unit during recent years have caused concern among state and federal biologists. Trend counts in the Noatak River drainage indicate that bull:cow ratios have declined from 56 in 1987 to 31 bulls/100 cows in 1990 (Alaska Dept. Fish & Game 1991). Declining bull:cow ratios are thought to be primarily the result of increased sport harvest of trophy bulls.

The demand for trophy bull moose hunting in GMU 23 continues to increase. Bull moose represented 91.6% of the reported moose harvest in GMU 23 from 1983-1991 (data from ADF&G harvest database). Bulls with antlers larger than 50" constituted 62% of the bull harvest from 1985-1989 (ADF&G 1990). Non-local (living outside of GMU 23) Alaskan residents and non-residents harvested the majority of moose in GMU 23 from 1982-1992, accounting for 68% of the total reported harvest (Table 1). Although the actual harvest of moose by local hunters exceeds the reported harvest, the trend in the reported harvest indicates an increasing proportion of non-local sport hunters.

The Bureau of Land Management's (BLM) Kobuk District manages approximately 1 million acres of public land in the Squirrel River drainage, located within GMU 23 (Figure 1). Sport and subsistence harvest of moose occurs in the Squirrel River drainage, as does other big game hunting, fishing, and recreational river floating (Robinson 1987). Moose harvested in the Squirrel River drainage accounted for 5.4% of the reported harvest for GMU 23 in 1983-1991 (data from ADF&G harvest database).

BLM currently administers 8 Special Recreation Permits (SRP) for registered guides and outfitters in the area. BLM is also responsible for the cooperative management of subsistence resources on

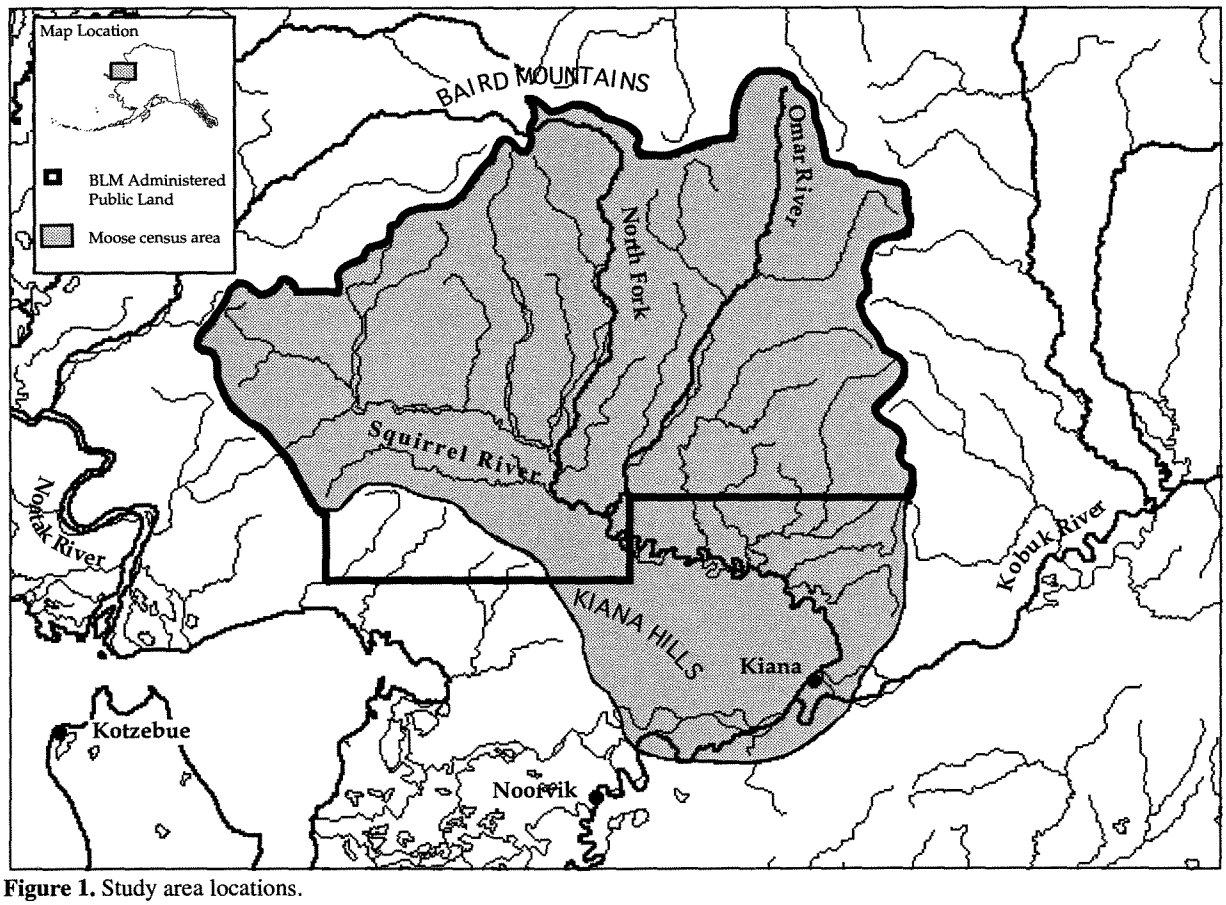

Figure 1. Study area locations.

Table 1. Reported GMU23 moose harvest taken by GMU23 resident, non-local Alaskan resident, and non-resident hunters (data from ADF&G Harvest Summary Reports).

HARVEST YEAR	GMU23 RESIDENT/ (%)	ALASKA RESIDENT/ (%)	NON-RESIDENT/ (%)
1982-1983	141/(53)	81/(30)	45/(17)
1983-1984	152/(50)	115/(38)	39/(13)
1984-1985	137/(40)	127/(37	81/(23)
1985-1986	72/(32)	98/(44)	53/(24)
1986-1987	106/(39)	99/(36)	69/(25)
1987-1988	101/(29)	104/(30)	142/(41)
1988-1989	59/(18)	114/(36)	147/(46)
1989-1990	81/(22)	117/(32)	167/(46)
1990-1991	69/(21)	117/(35)	150/(45)
1991-1992	79/(23)	121/(35)	131/(35)
TOTAL	**997/(32)**	**1093/(35)**	**1024/(33)**

public lands under authority of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, and under the Federal Subsistence Management Program initiated in July 1990. BLM-Kobuk District's management objectives for the Squirrel River include maintaining natural and healthy fish and wildlife populations and their habitats, and minimizing conflicts between subsistence activities and recreation uses (BLM 1991).

Increased demand for trophy moose and the increase of guide and air transport services that provide hunting opportunities in the Squirrel River has become a concern in relation to BLM's SRP issuance and subsistence management responsibilities. Access to the Squirrel River drainage is relatively easy by air or snowmachine from Kotzebue, a large community with year-round commercial airline service. Hunters accessing GMU 23 by aircraft accounted for 69% of the Unit's total reported moose harvest during 1990-91 (ADF&G 1992). In the Squirrel River drainage, the majority of successful moose hunters in 1989-1991 reportedly used registered guides (48.9%) or transport services (17.8%) (Appendix A). It should be noted, however, that these data are incomplete. The reported harvest of moose by residents of GMU 23 may be as low as 10-25% of the actual harvest (ADF&G 1990). Also, some hunters who report taking a moose fail to report the drainage in which they hunted.

BLM-Kobuk District and ADF&G initiated a cooperative effort to conduct a moose census in the Squirrel River in November 1992 to obtain baseline moose population data which would allow the agencies to address concerns related to declining bull:cow ratios and increased sport hunting. Objectives were to: 1) estimate population size, 2) estimate age and sex composition, and 3) determine the relative distribution and density of moose in the Squirrel River census area. Estimates of moose population parameters will contribute to the overall knowledge of moose population dynamics in GMU 23, and provide essential data for managing moose for subsistence and sport harvest.

The authors would like to acknowledge other participants who assisted in the survey: R. Jandt, BLM; L. Ayres, J. Coady, R. Delong, S. Machida, R. Nelson, and J. VerHoef, ADF&G; H. Michaelbrink, University of Alaska Coop. Ext. Service, Nome; M. Reardon, U.S. Fish and Wildlife Service, Selawik National Wildlife Refuge; B. Lentsch, Tamarac Air Ltd.; J. Rood, Northwestern Aviation; and D. Henley, Office of Aircraft Services. A Cooperative Agreement (No. 1422L953-A3-0004) between BLM-Kobuk District and ADF&G documented each agency's contributions to the census.

STUDY AREA

The moose census was conducted primarily in the Squirrel River drainage, situated about 60 miles east of Kotzebue in northwestern Alaska (Figure 1). The Squirrel River drainage is bounded by the Baird Mountains to the north, Kallarichuk Hills to the east, and Kiana Hills to the south. The census area also included the Kiana Hills and portions of the lower Kobuk River near Kiana, a village located at the confluence of the Squirrel and Kobuk Rivers. BLM currently manages the majority of the Squirrel River drainage, while the remainder of the census area included Native-selected lands managed by USFWS-Selawik NWR, and Native-conveyed land. Elevations ranged from 10 feet above sea level along the Kobuk River to 2,500 feet

in the Baird Mountains. Vegetation complexes classified by Craighead et al. (1988) for the area are summarized as follows: Tussock and shrub tundra represented the most widespread complexes found primarily on mountain slopes and well-drained sites at lower elevations. These were characterized by either an absence of trees or sparsely scattered black spruce *(Picea mariana)*, a shrub layer of primarily willow (*Salix spp.*) and alder (*Alnus crispa*), and low ground cover dominated by cotton grass (*Eriophorum spp.*), birch (*Betula nana*), blueberry (*Vaccinium uliginosum*) and sedges (*Carex spp.*). Alpine tundra and shrubland occurred at higher elevations, primarily consisting of sedges, *Dryas spp.*, and lichen, and the shrubland included dense thickets of willow and alder. Upland spruce complexes were dominated by white spruce (*Picea glauca*) on well-drained slopes, or mixed white and black spruce on lower, more gentle and poorly drained slopes, interspersed with willow. The Kobuk and Squirrel River bottomlands included forests consisting of almost entirely white spruce with an understory of alder and willow, and river floodplains dominated by tall willow. Old, overgrown river channels along the Kobuk River consisted of bands of spruce alternating with strips of willow-sedge marsh.

METHODS

A stratified random sampling design known as the Gasaway Method was used for estimating moose population parameters (Gasaway et al. 1986). The census area encompassed 1,440 mi^2 of the Squirrel River drainage and a portion of the Kobuk River and Kiana Hills. Alpine and scree slopes above approximately 2,000 feet were eliminated from the census area. One hundred and twenty-seven sample units (SU) were delineated, ranging 7.2 -17.4 mi^2 ($\bar{x}$ = 11.4 mi^2) in size. Gasaway et al. (1986) recommended SUs ranging in size from 9-15 mi^2 to minimize variation in the population estimate, which increases as SU size increases.

The census area was initially stratified based on differing moose densities (eg. low, medium, high). Moose densities were determined by recording number of moose and moose tracks observed, and the relative density of spruce cover recorded during a preliminary aerial survey over the entire census area at an average flight intensity of 1 min/mi^2. Subsequently, a simple random sample of SUs was selected from each stratum and surveyed at a flight intensity of 4-6 minutes/mi^2. In addition, a randomly-designated 2-3mi^2 area within each selected SU was intensively surveyed at 12 minutes/mi^2 to obtain a Sightability Correction Factor (SCF).

Moose were recorded as yearling (spike/fork), medium (31-50"), and large (>50") bulls, cows, and cows with calves. Field data were entered daily into the ADF&G's Moose Population Estimation Survey Software Program (MOOSEPOP) to optimally allocate survey effort and obtain population parameter estimates (Delong and Reed, unpubl. report). By determining an optimal allocation of survey effort each day, we attempted to achieve a recommended precision level of >90% confidence interval (CI) with ±25% of the population estimate (Gasaway et al. 1986).

RESULTS

Stratification and Standard Survey

The moose census was conducted during 3-14 November 1992. Snow cover was complete with some low vegetation visible, and temperatures ranged 10-25° F. Clear to partly cloudy weather conditions prevailed, except for five days during which high winds, snow and poor visibility grounded the survey effort. Stratification was completed in three consecutive days using a Cessna 185 aircraft with a team of one pilot, one navigator, and two observers. The census was completed in six days using as many as five Supercub aircraft per day, each with a pilot and an observer. Costs for planning and implementing the moose census are summarized in Appendix B.

Approximately 628 mi^2 was stratified as low density (56 SUs), 580 mi^2 as medium density (51 SUs), and 232 mi^2 as high density (20 SUs). Thirty-two SUs (11 low, 14 medium, 7 high strata) were randomly selected for the standard survey effort, and SCFs were obtained for 30 SUs.

Population Estimate

A total of 346 moose were counted in the 32 surveyed SUs, with 41 observed in low strata, 129 in medium strata, and 176 in high strata (Appendix C). The population estimate was 1,372 moose ±23.4% at the 90% CI (V_e = 35,596.04, df = 23). Densities within each stratum were 0.3 moose/mi^2, 0.8 moose/mi^2, and 2.1 moose/mi^2 for the low, medium, and high strata, respectively (Appendix D). Overall moose density in the census area was 0.95 moose/mi^2.

Age and Sex Composition

Of the total number of moose observed during the standard survey, 78 bulls, 205 cows, and 63 calves were identified. Twenty-eight percent (58)

of cows were observed with calves, including 5 pairs of twins. Calves represented 18% of the total number of moose observed. Ratios of 32 calves:100 cows and 37 bulls:100 cows were estimated from the census data. The total number of bulls included 28 yearlings, 26 medium-sized adults, and 24 large adults.

Distribution

Moose observed during the November census were primarily concentrated along the south side of the Kiana Hills and along the Kobuk River near Kiana. Moose were otherwise scattered throughout the census area, with higher numbers in the hilly terrain in the upper Squirrel and Omar Rivers. Most moose were observed in dense spruce stands or willows in upper stream valleys. Moose densities were lowest in the Squirrel River valley where habitat was primarily open tussock tundra.

DISCUSSION

Census data indicated that as many as 1,050-1,700 moose inhabited the Squirrel River-Kiana census area in November, 1992. We caution that this population estimate may be somewhat inflated because those SUs that certainly contained no moose were not randomly selected for survey. Moose were observed in all but one of the low density SUs that were randomly selected for survey.

Comparable moose population estimates for the Squirrel River drainage are lacking prior to 1992. In 1985, a Gasaway census was attempted in the Squirrel River drainage; however, the population estimate was 395 moose ± 120% at the 90% CI (12 SUs). The poor precision was attributed to movements of moose between areas, which caused moose numbers to change within SUs from that expected based on stratification (Larsen et al. 1986). The 1985 census also did not include the south side of the Kiana Hills and Kobuk River, where high densities of moose were observed in 1992. Moose movement between SUs during the 1992 census was believed to be minimal because most SUs were counted soon after being stratified, and because counts in all but two SUs fell within the expected strata. Those two SUs were surveyed last, following two days of snow and wind which may have induced moose movements.

The 1992 ratio of 37 bulls:100 cows in the Squirrel River represented a 35% decline from 57 bulls:100 cows estimated in 1985 (ADF&G 1988), a trend similar to that indicated in the Noatak River drainage. Calf:cow ratios increased from 20 calves in 1985 (Larsen et al. 1986) to 32 calves:100 cows in 1992.

Current ADF&G moose population objectives for GMU 23 include maintaining a minimum of 40 bulls:100 cows to ensure healthy populations (ADF&G 1991). Moose hunting regulations have been changed in recent years to manage for >40 bulls:100 cows and to reduce overall moose mortality by limiting non-resident hunters to taking only antler-size restricted bulls during a 3-week open season. Previously, non-residents were able to harvest either sex during a 7-month open season. State and federal hunting regulations allow resident subsistence and sport hunters to take one moose during 1 August-31 March (excluding cows with calves). In addition, various land management agencies have evaluated options for managing access by registered guides and air transport operators to public lands to in turn manage the harvest of wildlife populations. However, while restricting access and harvest may benefit the target moose population, it could displace hunters to other areas. The subsequent impact of controlled use areas on other wildlife populations and users must be considered.

Results of the November 1992 moose census have provided BLM and ADF&G with essential information for 1) developing management goals for BLM public lands in the Squirrel River drainage, 2) monitoring cumulative impacts of BLM's SRP program and other resource uses, 3) providing baseline data for input into ADF&G's proposed GMU 23 moose management plan, 4) providing input to the State Board of Game and Federal Subsistence Board on sport and subsistence moose harvest regulations, and 5) identifying potential habitat inventory needs and priorities.

MANAGEMENT IMPLICATIONS

As the primary land manager in the Squirrel River drainage, BLM must make management decisions based on the best available information, and in turn must rely on cooperative efforts with ADF&G and other agencies to obtain wildlife population data. BLM's mandated responsibilities related to wildlife management include managing subsistence resources on federal land, issuing permits for guides and outfitters on public lands, and providing for other land use activities while minimizing significant impacts to wildlife.

Currently, the Squirrel River is being considered for inclusion in the Wild and Scenic River System. Until a final decision is made, BLM is charged with the responsibility of maintaining the area's outstanding recreation, fishery, wildlife, and scenic values within the study withdrawal (BLM 1991). BLM-Kobuk District has begun developing an Integrated Activity Plan for the Squirrel River, and

one main issue is public access and it's potential impact on fish and wildlife resources. In addition, recent land selections by the State of Alaska in the Squirrel River drainage (pursuant to the Alaska Statehood Act of 1959 and ANILCA 1980) may affect BLM and ADF&G management actions by further dividing public lands among various land managers and potentially introducing additional resource conflicts and activities that impact wildlife. We recommend that the Squirrel River census area be cooperatively surveyed approximately every 5 years to monitor moose population trends in relation to harvest trends and management decisions.

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Appendix A. Summary of commercial services used by successful and unsuccessful moose hunters that reportedly hunted in the Squirrel River drainage, 1989-1991[1]

COMMERCIAL SERVICES USED	SUCCESSFUL HUNTERS (% of total)	UNSUCCESSFUL HUNTERS (% of total)
None	6 (13.3)	4 (11.8)
Transport	8 (17.8)	8 (23.5)
Non-guided	5 (11.1)	6 (17.6)
Registered Guide	22 (48.9)	7 (20.6)
Lodge/Camp[2]	-	-
Other	0	0
Service Not Reported	3 (6.7)	9 (26.5)
Non-guided/Guided[3]	1 (2.2)	0
TOTAL	**45**	**34**

[1]Data from ADF&G harvest report database
[2]Lodge/camp was reported twice in combination with transport service
[3]One hunter reported using both non-guided and registered guide services

Appendix B. Approximate project costs for Squirrel River moose census, November 1992.

AIRCRAFT COSTS		**TOTAL**
Stratification Flights:		
C-185[1]	22 hrs @ $108/hr	$2,300.00
Survey Flights:		
PA-12	22 hrs @ $80/hr	$1,760.00
PA-18[1]	35 hrs @ $80/hr	$2,800.00
Contract PA-18	19 hrs @$166/hr + OAS%	$3,200.00
Contract PA-18[1]	29 hrs @ $124/hr	$3,600.00
OAS PA-18	3 hrs @ $63/hr	$110.00
100LL AV Gas	1090 gal @ ~$2.40/gal	$2,600.00
TCP Fuel Treatment		$60.00
Plane space rental and	C-185 = 5 nights @$55/night	$275.00
electrical hookup	PA-12 & PA-18 = 5 nights each @$25/night	$250.00
SUPPLIES & MISC.		
Topographic maps:	16-1:63s x 8 copies each @$2.50/map	$320.00
	2-1:250s x 5 copies each @$4.00/map	$40.00
Long distance phone calls		$200.00
FOOD & LODGING[2]		$1,700.00
TRAVEL COSTS		
Roundtrip airfare Fairbanks to Kotzebue for 5 personnel		$3,200.00
Roundtrip airfare Nome to Kotzebue for 3 personnel		$660.00
ESTIMATED PROJECT COSTS		$23,075.00
PERSONNEL DAYS		
BLM 2 personnel[3]	37.0 days	
ADF&G 7 personnel[3]	73.0 days	
FWS 1 personnel	1.0 day	
UAF 1 personnel	8.0 days	
OAS 1 personnel	4.0 days	

NOTES:
[1] Aircraft costs include ferry of C-185 and PA-12 from Nome and contract PA-18 from Fairbanks.
[2] Food and lodging costs were less than planned because several personnel received free accomodations and did not claim daily meal allowances. Such costs must be fully estimated for future censuses.
[3] Personnel days include preparing project proposal and Cooperative Agreement, project coordination and implementation, data analysis, and preparing and reviewing final report.

Appendix C. Moose observed during survey of 32 SUs (sample units) in the Squirrel River census, November 1992.

SU#	AREA	STRATA	DATE	YBULL	MBULL	LBULL	COW/0	COW/1	COW/2	TOTAL OBSERVED
2	10.54	low	11/10/92	1			4			5
4	11.2	low	11/4/92	1	1		4			6
40	10.76	low	11/9/92		1		1	1		4
50	13.19	low	11/5/92		2		1			3
52	10.96	low	11/5/92					1		2
69	14.95	low	11/4/92				2	1	2	10
81	13.29	low	11/5/92		1	1				2
107	13.88	low	11/9/92							0
111	11.74	low	11/5/92				2	1		4
113	9.25	low	11/10/92					1		2
117	10.83	low	11/9/92				1	1		3
7	14.24	medium	11/5/92	1	5	1	5	2		16
8	13.42	medium	11/4/92				3			3
17	10.78	medium	11/5/92		1		2			3
18	12.04	medium	11/5/92	1			1			2
23	13.87	medium	11/4/92				2			2
28	9.29	medium	11/5/92				8			8
66	9.69	medium	11/5/92		2		3	4		13
80	8.93	medium	11/10/92	1			2	1		5
83	10.1	medium	11/5/92		2	3	3	1		10
97	12.16	medium	11/9/92				1			1
112	11.45	medium	11/4/92					1		2
114	9.35	medium	11/10/92	2			7	5		19
120	13.81	medium	11/14/92	3	1	5	13	9		40
122	13.62	medium	11/5/92				1	2		5
12	13.28	high	11/4/92	2	1	1	9	1		15
25	8.94	high	11/9/92	4		3	13	4	1	31
31	10.19	high	11/9/92	3	3	1	18	4		33
64	11.7	high	11/14/92		2		4	1		8
123	14.49	high	11/10/92	3	1	1	7	7		26
125	9.58	high	11/9/92	2	1	2	8	1	1	18
126	17.35	high	11/9/92	4	2	6	22	4	1	45
Totals				28	26	24	147	106	15	346

Appendix D. Summary of moose survey data by strata for the Squirrel River census area, November 1992.

Parameters	Strata			Total
	Low	Med	High	
Number	56	51	20	127
Area (mi^2)	628.28	579.98	232.60	1440.86
Number surveyed	11	14	7	32
Area surveyed (mi^2)	130.59	162.75	85.53	378.87
No. moose observed	41	129	176	346
Density (moose/mi^2)	0.31	0.79	2.06	0.95
Total est. moose (T_0)	197.3	459.7	478.6	
$V(T_0)$	1344.95	14116.72	4587.42	
T_0DF	10	13	6	
SCF_0	1.47	1.24	1.07	
$V(SCF_0)$	0.0926	0.0099	0.0014	
SCF_0DF	9	12	6	

Total Estimate(T_e)= 1372.4
80% CI around T_e =1124 - 1621 (±18.13%)
90% CI around T_e = 1049 - 1696 (±23.56%)
95% CI around T_e = 982 - 1763 (±28.44%)

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