

NATIONAL PARK SERVICE

ALASKA REGION

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1986 AERIAL MOOSE CENSUS - DENALI NATIONAL PARK AND PRESERVE

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INTRODUCTION

An aerial moose census was conducted on 18 to 26 November 1986, in the portion of Denali National Park north of the Alaska Range. The Preserve area was not surveyed. The area surveyed was divided into five major regions, and a stratified random sampling technique (Gasaway et al., 1986) was used to estimate moose numbers in each.

Stratification flights were flown by pilot Jim Okonek and observers Layne Adams, John Dalle-Molle, Jane Dale, Allen Peck, Brian Swift, Ralph Tingey, Jim Trumbull and Joe Van Horn. Survey pilots were Jim Cline, Don Glaser, J. W. Musgrove, and Jim Ortman, with observers John Burch, Bruce Dale, Tom Meier, Brad Shults, and Joe Van Horn.

Conditions for the survey were excellent, as a widespread snowfall was followed by ten days of good flying weather, during which the census was conducted.

METHODS

Five areas of the park were identified as warranting separate consideration, based on topography, vegetation, and previous history of moose surveys. These were the East End (road corridor and drainages west to Sable Pass), the Stampede area (northeast

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corner of the park), the Kantishna Hills, the mountain slope west of the Muldrow Glacier, and the forested flatlands in the northwestern part of the park. Each of these areas was in turn subdivided into individual counting units averaging 16 square miles in area (Fig. 1). Wherever possible, counting unit boundaries were those used by Singer (1984).

Census methods and statistical analyses used follow Gasaway et al. (1986). Stratification into areas of high, medium or low moose density was based on animals seen during overflights with a Cessna 185 aircraft and three observers. Counting units were randomly chosen within each area and stratum, and surveyed with Piper Supercubs at an average search intensity of 4.5 minutes per square mile. In most of the survey units, a randomly selected two-square-mile block was immediately re-surveyed at a higher intensity (15 minutes per square mile), in order to assess moose sightability on the original survey. A sightability correction factor was generated and applied to all five census areas. Moose seen were classified as large bulls (greater than 50" antler spread), medium bulls, yearling bulls, cows or calves. Bull:cow and cow:calf ratios were calculated for each of the five survey areas.

RESULTS

Counts were performed in 53 survey units, making up 842 of the 3871 square miles in the five census areas. ^{22% of Area} Intensive sightability checks were performed in 29 of the survey units. Where 79 moose had been seen in the basic census, 95 were seen in the intensive searches. There was no significant decrease in sightability over the ten-day period of the survey, as weather and snow conditions remained favorable. Assuming that virtually all of the moose present were seen on the intensive survey, we were seeing about 83 percent of the moose in our initial search. A sightability correction factor of 1.2 was applied to the data. Singer (1984) estimated a sightability correction factor of 1.15-1.23, based on four checks.

An overall estimate of 1900 moose ($\pm 20\%$, 90% Confidence Interval) was obtained for the five census areas combined, representing an average density of 0.491 moose per square mile. This estimate is for the entire park north of the Alaska Range, but does not include preserve areas. It was estimated that there were 1664-1864 moose in this same area in 1984 (Singer, 1984; Dubois, 1985). The five areas surveyed in 1986 show large differences in moose density estimates and sex and age ratios (Table I). These areas will be discussed individually.

Eastern Park

The eastern portion of the park continues to have by far the highest moose density of areas surveyed. A density of 1.4 moose per square mile was estimated for this area, or a total of 416 moose ($\pm 36\%$, 90% CI). Many moose surveys have been conducted in this area, but the variety of methods and areas covered make the results difficult to compare (Haber, 1977; Troyer, 1974-1981; Van Ballenberghe, 1982-1986; Singer, 1984). The most recent census of this entire area was in 1984, when Singer (1984) counted 281 moose, for a sightability-corrected estimate of 337. This value lies well within the confidence limits on our 1986 estimate, so no increase in moose density can be documented over this period. The calf:cow ratio of 18 calves per 100 cows does not suggest an expanding population. Van Ballenberghe (1986) flew a helicopter survey of moose in a portion of the eastern park in September 1986. He classified 133 moose, with 29 bulls per 100 cows and 9.4 calves per 100 cows. The present survey would estimate 142 moose for the same area, with 52 bulls and 18 calves per 100 cows. The two surveys were performed two months apart, and differential migration of the various classes of moose following the rut and the onset of winter may account for the differences in population structure.

Stampede Area

This area lies in the northeastern corner of the park, including the so-called "Wolf Townships" along the Stampede Road, which are not included in the park. Moose density was estimated at 0.275 per square mile, or 204 moose overall ($\pm 36\%$, 90% CI). Singer (1984) estimated 223 moose in a portion of this area (274 after applying a sightability correction factor). The 1986 estimate for that same portion would be 130 moose. It is possible that there has been a decrease in moose in this part of the park. The calf:cow ratio of 16 calves per 100 cows is the lowest from the areas surveyed. Singer (1984) observed only 9 calves per 100 cows. Striking differences in moose density appear in various parts of the Stampede area, with large areas being nearly devoid of moose. The observed density of moose in the low-density stratum, which makes up two-thirds of the Stampede area, was only 0.02 moose per square mile. Much of this area is open tundra not suitable for moose habitat. If there is significant migration of moose between the East End and Stampede areas, then timing of surveys may affect the population structure and density of moose obtained, and it may be valuable to examine combined estimates for these two areas.

Kantishna Hills

The Kantishna Hills area continues to support a moderate density of moose estimated at 0.69 per square mile (424 moose $\pm 29\%$, 90% CI). Singer (1984) estimated 290 in the southern part of the

hills in 1984; our figures would estimate 271 in the same area. The calf:cow ratio was high, with 28 calves observed per 100 cows in the present survey, and 26 per 100 in Singer (1984).

Mckinley Slope

This area, stretching from the Muldrow Glacier west to the Swift Fork River along the north face of the Alaska Range, appears to harbor a rapidly expanding moose population, now estimated at 623 or 0.721 per square mile ($\pm 47\%$, 90% CI). The area was more lightly surveyed than those farther east, and confidence limits are wide, but even the lower limit represents an increase over Singer's (1984) figures. Where Singer estimated 225 moose in 1984 (277, corrected for sightability), the present survey estimates 573 (90% CI 304-842). Troyer (1974) counted 134 moose in this area ten years earlier. High calf:cow ratios of 27:100 (present survey), 33:100 (Singer, 1984) and 56:100 (Troyer, 1974) fit an increasing population. The striking preponderance of bulls found in this survey (192 bulls:100 cows), and also found by Singer (1984) (156 bulls:100 cows), and Troyer (1974) (144 bulls:100 cows) is more difficult to explain. This entire area lies on a slope, and seasonal migration to higher or lower elevations may change moose densities and demography.

Northwestern Flats

This large (1350 square mile) area was too lightly sampled to give a precise estimate of moose numbers. The population

estimate is 233 moose ($\pm 85\%$, 90% CI), or 0.173 moose per square mile, the lowest density of the areas surveyed. DuBois (1985) estimated a density of 0.06 moose per square mile over most of this area. In the present survey, the same sightability correction factor was applied here as in the less forested areas, which may have yielded a low estimate. Only 21 moose were seen on the survey, so the ratios of 50 calves per 100 cows and 25 bulls per 100 cows cannot be taken too seriously, but the relative scarcity of bulls, and their prevalence on the Slope area, suggests that there may be an interchange of animals between these two areas.

DISCUSSION

Several trends in moose numbers are apparent in the park, and these warrant further survey efforts. It is likely that moose have increased in the Slope area, and decreased in the Stampede area, but in each case migration to and from adjacent areas may confuse the issue. The large number of surveys conducted in the east end of the park and the difficulty of comparing their results make it hard to ascribe trends to the moose population there. It would be desirable to perform repeated surveys by the method used here, which is a standard technique in Alaska and allows confidence limits to be calculated. Finally, a more intensive survey is needed in the northwestern part of the park, to at least establish a baseline for moose density there. It is

to be hoped that weather and funds will again allow an extensive moose census in Denali.

ACKNOWLEDGEMENTS

Layne Adams, John Dalle-Molle, and Bruce Dale (USNPS), and L. David Mech (USFWS) were instrumental in planning the survey. I thank Dale Hagstrom (ADF&G) for advice on census techniques and data analysis, and for the use of a computer to check calculations. The above-mentioned pilots and observers worked long hours to make the survey possible.

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Table I: Results of 1986 Moose Census, Denali National Park and Preserve

REGION	STRATUM	TOTAL		AREA		SURVEY TIME (MIN)	BULLS			COWS			TOTAL MOOSE OBS	OBS. CALVES BULLS			CORRECTED			
		AREA		SURVEYED			BULLS			# CALVES				DENS.	PER	PER	EST	DENSITY		
		UNITS	MI ²	UNITS	MI ²		YR	MED	IG	0	1	2		CALF	PER 100	100	POP	90% CI	MOOSE	
															MI ²	COWS	COWS	T	±	±%
East	H	13	214.2	6	95.7									1.33						
	M	3	43.6	3	43.6									0.96						
	L	4	43.3	3	35.7									0.42						
	total	20	301.1	12	175.0	853	10	27	13	95	19	0	1	184	18	44	416 ± 149	36%		1.382
Stampede	H	10	171.6	4	64.5									0.54						
	M	5	83.5	3	51.0									0.78						
	L	32	485.7	3	44.3									0.02						
	total	47	740.8	10	159.8	731	1	17	7	38	5	1	0	76	16	57	204 ± 73	36%		0.275
Kantishna Hills	H	11	188.5	4	66.7									0.56						
	M	17	285.8	5	90.5									0.71						
	L	10	139.5	3	47.9									0.31						
	total	38	613.8	12	205.1	968	2	36	10	41	9	3	0	116	28	91	424 ± 123	29%		0.691
McKinley Slope	H	8	162.1	3	54.5									0.99						
	M	13	266.9	3	52.6									0.88						
	L	23	435.5	4	64.7									0.28						
	total	44	864.5	10	171.8	695	13	37	21	28	8	1	0	118	27	192	623 ± 292	47%		0.721
Northwest Flats	H	0	0	0	0									---						
	M	6	80.8	2	25.9									0.27						
	L	77	1269.6	7	104.3									0.13						
	total	83	1350.4	9	130.2	521	0	3	0	7	4	1	0	21	50	25	233 ± 197	85%		0.173
Totals	H	42	736.4	17	281.4															
	M	44	760.6	16	263.6															
	L	146	2373.6	20	296.9															
	total	232	3870.6	53	841.9	3768	26	120	51	209	45	6	1	515	22	76	1900 ± 372	20%		0.491

Table II: Raw Data, 1986 Denali National Park Moose Survey

SURVEY	RANDOM	DENSITY	AREA	COWS							LONE	TOTAL	SEARCH		OBSERVED	OBS	DATE	
				BULLS			W/#CALVES			TIME			EFFORT	DENSITY				
				Y	M	L	0	1	2									BEFORE
UNIT	REGION	ORDER	STRATUM	MI ²							CALF	MOOSE		MIN	MIN/MI ²			
14-1	East	13	L 3	14.1								0	-	-	96	6.8	0.00	TM 11/24
H 14-5	"	9	M 2	15.5		8		15	2			27	5	5	83	5.4	1.74	TM 11/24
M 14-7	"	2	L 3	6.4				7	4			15	4	5	51	8.0	2.34	TM 11/19
15-1	"	7	H 1	12.6	1	2		11	3			20	8	8	80	6.3	1.59	TM 11/21
15-2	"	5	H 1	14.8	1	4	10	21	3			42	20	20	67	4.5	2.84	TM 11/21
15-3	"	6	H 1	10.5		2	1	9	3	1		19	4	7	54	5.1	1.81	TM 11/21
15-4	"	3	H 1	19.0	2	7	1	9	1			21	5	7	65	3.4	1.11	TM 11/18
16-1	"	11	M 2	14.0		2		8	2			14	0	0	95	6.8	1.00	JB 11/22
L 16-2	"	8	H 1	13.8				1				1	-	-	50	3.6	0.07	JB 11/22
L 17-2	"	1	M 2	14.1				1				1	-	-	46	3.3	0.07	TM 11/19
17-3	"	4	L 3	15.2								0	-	-	58	3.8	0.00	TM 11/19
17-4	"	10	H 1	25.0	6	2	1	13	1			24	2	2	108	4.3	0.96	BD 11/21
8-1	Stamp	6	L	15.6		1						1	-	-	60	3.8	0.06	JV 11/20
M 8-7	"	22	H	13.6		2		5	2			11	2	2	72	5.3	0.81	JB 11/26
10-1	"	4	L	17.6								0	-	-	51	2.9	0.00	TM 11/20
H 10-3	"	16	M	18.6		10	4	12	1			28	11	11	109	5.9	1.51	JB 11/22
11-1	"	1	L	11.1								0	0	0	40	3.6	0.00	JV 11/19
M 11-3	"	5	H	14.8			1	7				8	0	0	63	4.3	0.54	JV 11/19
11-5	"	2	M	18.6		2		5		1		10	-	-	90	4.8	0.54	JV 11/20
M 11-13	"	3	H	17.0	1	2	1	1	1			7	0	0	60	3.5	0.41	JV 11/19
11-14	"	20	M	13.8				2				2	2	3	63	4.6	0.14	JB 11/21
M 11-25	"	10	H	19.1			1	6	1			9	1	1	123	6.4	0.47	JB 11/21

Table II: Raw Data, 1986 Denali National Park Moose Survey

				COWS								SEARCH		SEARCH					
SURVEY		RANDOM DENSITY		AREA	BULLS			W/#CALVES			LONE	TOTAL	INTENSIVE		TIME	EFFORT	OBSERVED		
UNIT	REGION	ORDER	STRATUM	MI ²	Y	M	L	0	1	2	CALF	MOOSE	BEFORE	AFTER	MIN	MIN/MI ²	DENSITY	OBS	DATE
12-4	Kant	10	H	17.1		2		4	2			10	0	0	75	4.4	0.58	BS	11/23
12-5	"	2	H	16.1		9		2	1	1		16	-	-	73	4.5	0.99	TM	11/22
12-15	"	3	M	25.0		7	1	7				15	3	6	115	4.6	0.60	TM	11/22
12-18	"	18	H	18.3		1						1	-	-	112	6.1	0.05	JB	11/26
12-21	"	6	H	15.2	1	1	1	5	1			10	2	3	44	2.9	0.66	TM	11/23
12-24	"	4	L	13.9								0	0	0	44	3.2	0.00	BD	11/19
12-27	"	5	M	20.2		6	1	2	2			13	-	-	125	6.2	0.64	JB	11/23
12-29	"	8	M	13.5		5		1				6	0	2	64	4.7	0.44	JB	11/23
12-31	"	1	M	16.4	1	2		9	2			16	-	-	84	5.1	0.98	BS	11/22
12-32	"	13	L	18.4		1	2	6	1	1		14	6	8	82	4.5	0.76	BD	11/23
12-34	"	9	M	15.4		1	5	5		1		14	0	1	82	5.3	0.91	BD	11/23
12-36	"	7	L	15.6		1						1	-	-	68	4.4	0.06	BD	11/23
1-1	Slope	9	H	15.9	3	13	7	8	2			35	-	-	79	5.0	2.20	BD	11/22
1-13	"	5	L	19.0				1	1			3	0	0	87	4.6	0.16	TM	11/18
2-1	"	8	H	13.7	1	4	4	4				13	0	0	68	5.0	0.95	BD	11/21
3-5	"	2	L	10.7				1				1	-	-	58	5.4	0.09	BD	11/19
4-2	"	14	M	24.1	8	8	3	6	2			29	2	2	100	4.1	1.20	BS	11/23
6-3	"	3	M	13.0		2	4	5				11	-	-	59	4.5	0.85	BD	11/18
6-4	"	4	L	16.2								0	-	-	52	3.2	0.00	BD	11/18
6-7	"	6	M	15.5		1		1	2			6	-	-	40	2.6	0.39	TM	11/20
7-2	"	1	L	18.8	1	6		2	1	1		14	0	0	92	4.9	0.74	TM	11/20
8-5	"	10	H	24.9		3	3					6	2	2	60	2.4	0.24	TM	11/23

Table II: Raw Data, 1986 Denali National Park Moose Survey

SURVEY	RANDOM	DENSITY	AREA	BULLS			COWS			LONE	TOTAL	INTENSIVE		SEARCH	SEARCH	OBSERVED	OBS	DATE
				Y	M	L	W	#	CALVES			BEFORE	AFTER					
UNIT	REGION	ORDER	STRATUM	MI ²			0	1	2	CALF	MOOSE			MIN	MIN/MI ²	DENSITY		
3-7	Flats	6	L	14.9		3			1		5	-	-	56	3.8	0.34	BD	11/24
18-5	"	5	L	11.2				1			1	-	-	63	5.6	0.09	JB	11/24
18-21	"	4	L	15.7							0	-	-	62	3.9	0.00	JB	11/24
18-22	"	2	L	18.5							0	-	-	70	3.8	0.00	JB	11/24
19-6	"	37	M	11.4					1		3	-	-	40	3.5	0.26	BD	11/24
M 20-12	"	1	L	1.6			2	2			6	-	-	45	3.9	0.52	BD	11/24
20-17	"	10	M	14.5			2	1			4	-	-	50	3.4	0.28	JV	11/24
20-19	"	7	L	18.1			2				2	0	0	70	3.9	0.11	JV	11/24
20-20	"	3	L	14.3							0	0	0	65	4.5	0.00	JV	11/24

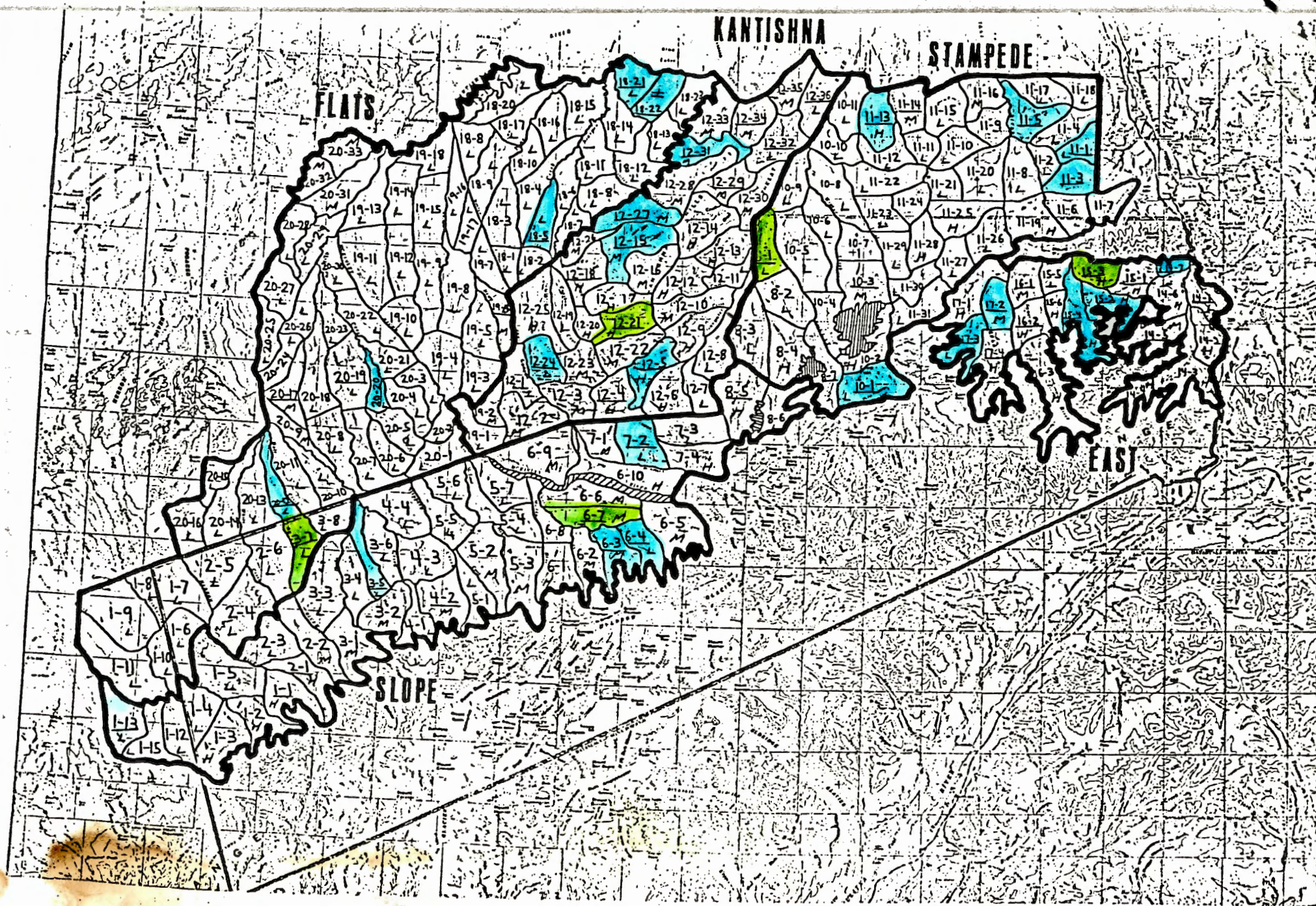


FIGURE I. DENALI NATIONAL PARK MOOSE SURVEY UNITS

Showing stratification (high, medium or low moose density) according to 1986 stratification.

Underlined units were surveyed in 1986 census.