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1999 AERIAL MOOSE SURVEY ALONG THE YUKON RIVER CORRIDOR,
YUKON-CHARLEY RIVERS NATIONAL PRESERVE, ALASKA

PROJECT REPORT

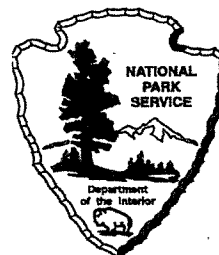
November, 1999

John Burch

Technical Report NPS/AR/NRTR-2002/40



United States Department of the Interior • National Park Service • Alaska Region



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1999 AERIAL MOOSE SURVEY ALONG THE YUKON RIVER CORRIDOR,
YUKON-CHARLEY RIVERS NATIONAL PRESERVE, ALASKA

PROJECT REPORT
November, 1999

JOHN BURCH, U.S. National Park Service, Yukon-Charley Rivers National Preserve & Gates of the Arctic National Park and Preserve, 201 1st Avenue, Fairbanks, Alaska 99701.

DATA SUMMARY:

Survey dates: November 11-18, 1999 (8 days)

Total area: 2,745 mi² (7,110 km²)

Total moose observed: 513 (266 cows, 77 calves [6 sets of twins], 169 bulls, 1 unknown)

Sightability correction factor: 1.18

Search effort: 3.97 minutes/mi² (1.53 minutes/km²)

Population estimate: 979 moose +/-188 (+/-19.19% at 90% CI)
(521 cows, 190 calves, 263 bulls [29spike-fork (yrl) bulls])

Estimated density: 0.36 moose/mi² (0.14 moose/km²)

Estimated sex/age ratios: 36 calves:100 cows, 11 yearlings:100 cows, 51 bulls:100 cows

INTRODUCTION

The National Park Service conducted an aerial moose survey during November 11-18, 1999, in Yukon-Charley Rivers National Preserve (YUCH), Alaska (Figure 1). The purpose of this survey was to estimate the moose population size and sex/age composition for the Yukon River corridor within YUCH. Moose population information is needed by preserve managers for monitoring long-term population trends and to make informed decisions regarding proposed changes to moose hunting regulations for this area.

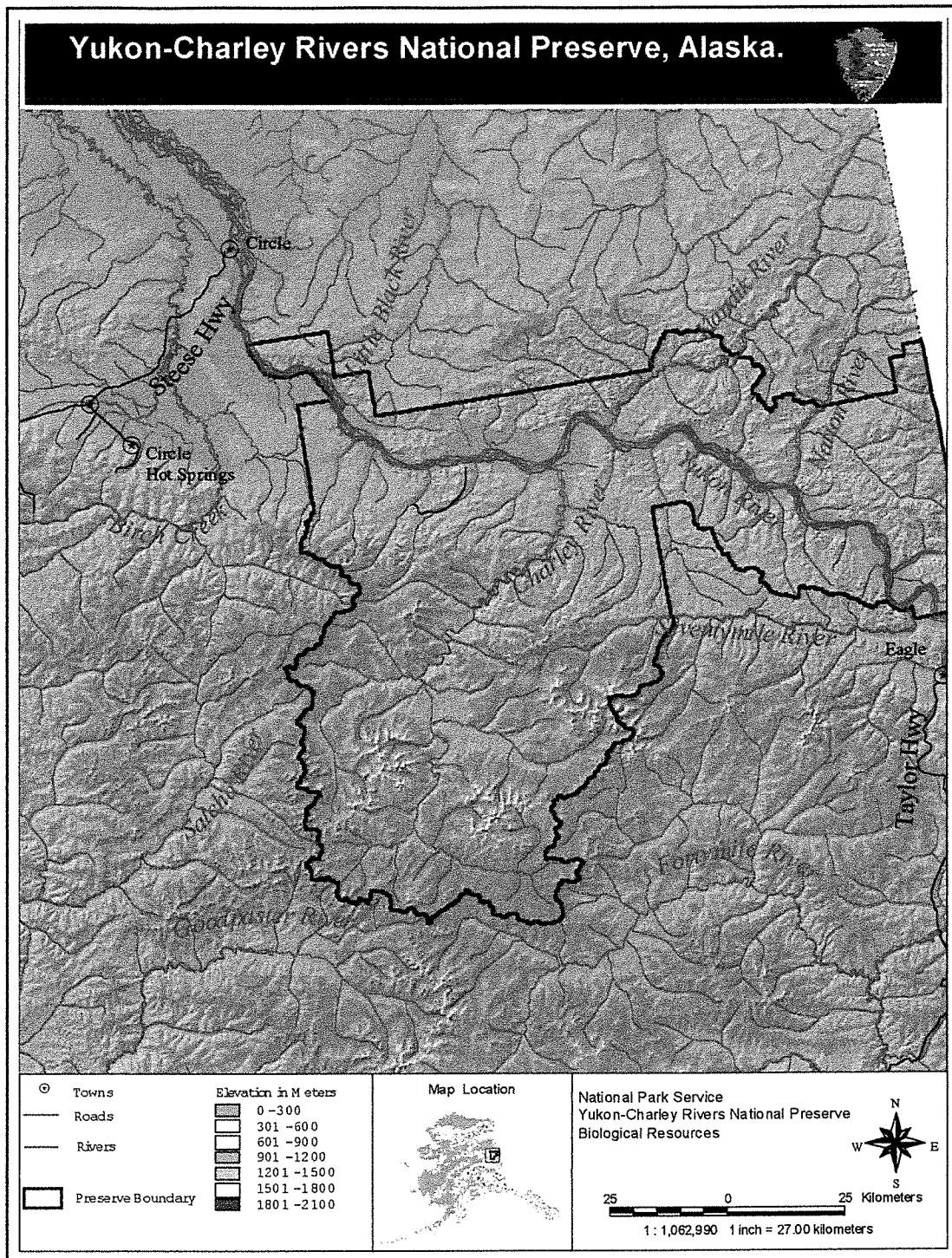


Figure 1. Location of Yukon-Charley Rivers National Preserve (YUCH), Alaska.

Several moose surveys have been conducted within the preserve during the last 25 years. In February 1975, a general survey was conducted along the Yukon River to document winter habitat use (Boertje 1985). During 1982-1987, trend counts were conducted in the Washington Creek area as part of an Alaska Department of Fish and Game (ADF&G) study investigating the role of predation in limiting moose densities in east-central Alaska (Gasaway et al. 1992). In November 1987, a large area along the Yukon River was surveyed between Eagle and Circle within YUCH (Nowlin 1988). A winter, moose habitat-use survey was conducted along the lower Nation River and Hard Luck Creek in March 1991 (Knuckles 1991). The entire Charley River drainage and the Yukon River between Glenn Creek and Woodchopper Creek was surveyed in November 1994 (Demma et al. 1995). The same Yukon River corridor area between Eagle and Circle, surveyed in 1987, was surveyed in 1997 (Burch and Demma 1997) and again during this study. Some of the sampling methodologies used during past surveys varied and were not consistent. Consequently, the results of the older surveys are of limited use in determining long-term moose population changes in YUCH. This survey and the previous 2 surveys all used methods described by Gasaway et al. (1986) and are directly comparable.

In 1998, proposals to change harvest regulations were submitted by local subsistence hunters in Eagle. These proposed changes included a longer fall season and the addition of a March hunting season for qualified federal subsistence users. The longer fall season was adopted, but the March season was not.

In the past, residents of local communities have relied on caribou from the Fortymile Caribou Herd and moose for meat. The harvest limit for Fortymile Caribou Herd caribou was reduced

from 450 to 150 for 1996-2000 as a result of an interagency management plan developed to restore the caribou herd to its former range (ADF&G 1995). The reduction in harvest limits for caribou in the Fortymile Caribou Herd reduced the availability of caribou from this herd for all Alaska residents. Because of this harvest reduction, local residents were more dependent on moose for meat. Recently, residents of Eagle have voiced concerns of having to compete with increasing numbers of non-local hunters for area moose during regular sport hunting seasons. The issue of subsistence vs. sport hunting and rural preference for local wildlife resources is controversial statewide. Resource conflicts of this nature will likely intensify as competition increases for limited wildlife resources in Alaska. Information provided by this survey (and others like it in the future) will assist managers in effectively evaluating future proposals regarding moose hunting and the moose population inhabiting YUCH. Regularly recurring (approximately every 3 years) fall surveys are crucial to monitoring this moose population. Analysis presented here indicate an increase in harvest by both humans and wolves and an increase in the number of people hunting. This increased pressure is on a low density moose population, with low recruitment and a dropping bull:cow ratio. Past surveys indicate a stable population, but it needs to be monitored closely. Another survey in fall 2002 is recommended.

STUDY AREA

The moose survey was conducted along a 30-40 mile (48-64 km) wide corridor of the Yukon River drainage within YUCH, between Eagle and Circle, Alaska (Figure 2). The topography of the area consists mainly of rolling hills and river bluffs. Some isolated rugged terrain occurs on several eroded mountains, with peaks generally under 4000 feet (1200 meters). Vegetation is dominated by black spruce (*Picea mariana*), and several species of deciduous hardwoods

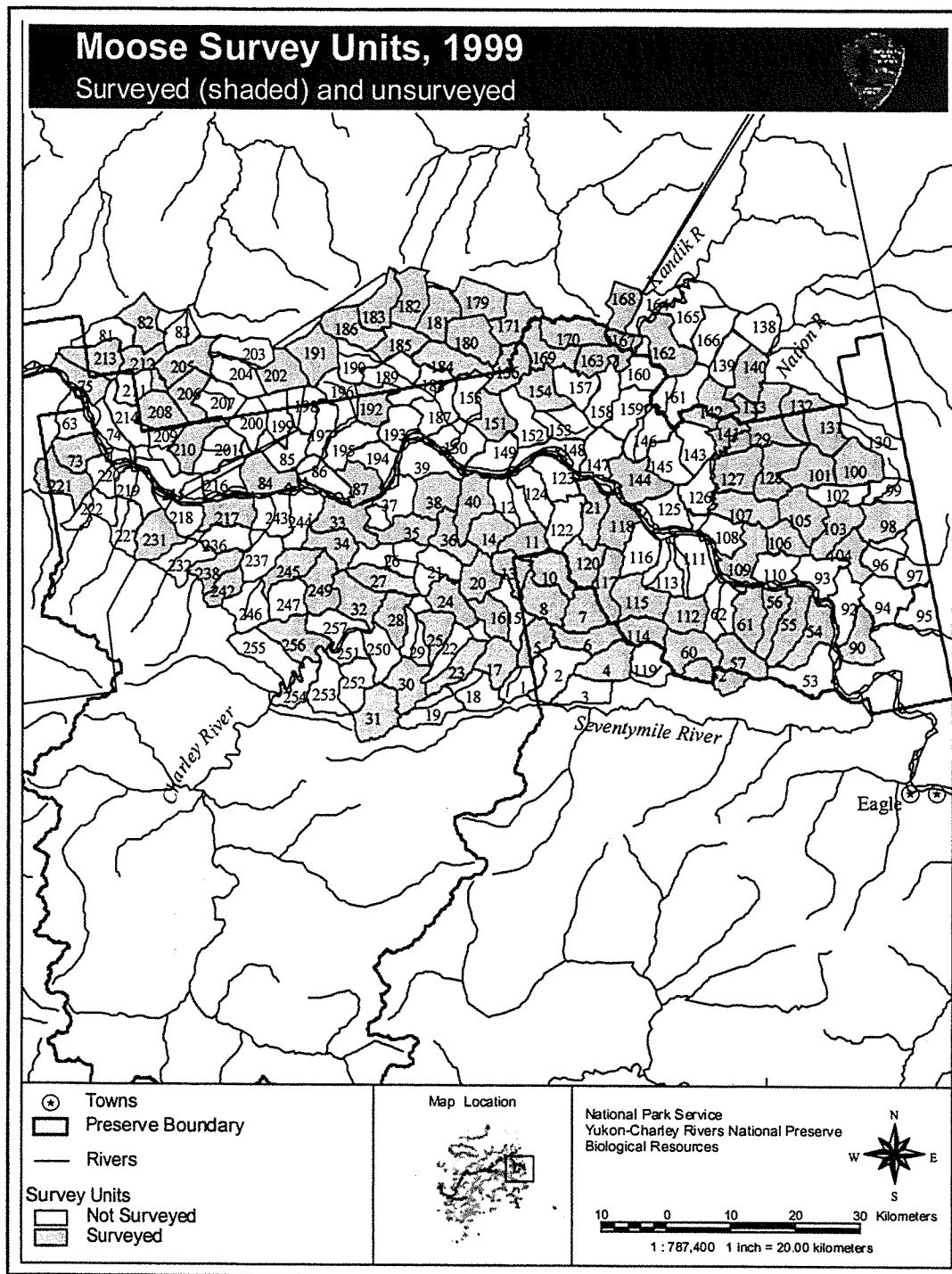


Figure 2. Location of the moose survey area and distribution of survey units. Units shaded gray were surveyed in 1999 in Yukon-Charley Rivers National Preserve, Alaska.

including aspen (*Populus tremuloides*) and birch (*Betula papyrifera*). Ponds, sloughs and large areas of tussock tundra are common in the flats along the Yukon River and lower parts of large tributaries such as the Charley and Kandik rivers. In YUCH's General Management Plan (National Park Service 1985) and an ecological unit mapping report (Swanson 1999) are more thorough descriptions of the vegetation and physiography of the area. Wildfire burns of varying sizes and ages are present throughout the study area (NPS 1985) including the fires from summer 1999 along the Yukon, Nation and Kandik rivers. The preserve's fire management plan (NPS 1999) contains a more in depth review of fire history for the area.

METHODS

The survey used methods described by Gasaway et al. (1986). The study area was comprised of 200 survey units averaging 13.7 mi² and ranging from 7.7-20.0 mi² (35.5 km², range 19.9-51.8 km²). Sample units were stratified into high, medium, or low moose densities based on previous surveys (Nowlin 1988, Demma et al. 1995, Burch and Demma 1997). During the survey, four pilot/observer teams in Piper PA-18 aircraft surveyed sample units at a rate of about 4 minutes per mi² (1.5 minutes/km²). Moose observed were assigned group numbers and mapped on United States Geological Survey (USGS) topographic maps, and latitude and longitude of all groups were recorded utilizing aircraft Global Positioning System (GPS) receivers. Numbers of moose in each group were recorded and sex and age of each moose was determined. Moose were classified as either: cow, calf, yearling bull (spike or forked antlers), medium bull (antler spread > spike/fork, but < 50 inches [127 cm]), and large bull (antler spread ≥ 50 inches [127 cm]).

Moose sightability was estimated by conducting intensive searches, immediately after standard searches. To detect missed moose, 2 mi² (5.18 km²) intensive search plots were randomly selected within sample units. Intensive searches were flown at rates of approximately 12 minutes per mi² (4.6 minutes per km²), roughly 3 times the standard search rate. Intensive searches were conducted in units where 3 or more moose were found during standard searches. The process estimates how many moose were missed at the standard search intensity, and is calculated as a sightability correction factor (SCF). The sightability correction factor is multiplied by the estimate of observable moose to calculate the final population estimate. A total of 30-35 intensive searches was the target number based on recommendations from Dale et al. (1994). Total moose, moose density and sex/age ratios were calculated using the software 'MOOSEPOP' (Gasaway et al. 1986, Reed 1989).

RESULTS AND DISCUSSION

Weather and Snow conditions

Overall, the weather conditions for flying the survey were good to excellent, unlike the conditions of the 1997 survey. There were only occasional times when fog, snowfall, or wind prevented flying in some areas but this did not significantly affect the survey. Snow conditions were optimal throughout the entire survey area with 18 to 24 inches (45 to 60 cm) of fresh snow at the start of the survey and 2-3 light snowfalls of 1 to 2 inches (2-5 cm) during the survey.

Overall, our sightability correction for detecting missed moose was estimated to be 1.18; that is, for every 100 moose observed, 18 moose were missed. Sightability correction estimates during moose surveys in Game Management Unit (GMU) 20A, and other areas of interior Alaska during

the past several years have ranged between 1.1 and 1.2 (Dale 1998, pers. comm.). This indicates that sightability for this survey was within the range of most surveys in interior Alaska.

Standard Survey

One hundred of the 200 survey units were surveyed covering 51% of the study area (Table 1, Figure 2). A total of 90.38 hours (5,423 minutes) of flight time were spent during standard searches for an average of 54.2 minutes per survey unit. Search intensity during standard searches averaged 3.97 minutes per mi^2 (1.53 minutes/ km^2). A total of 513 moose were observed during the survey (266 cows, 77 calves, 169 bulls [21 spike-fork yrlds], and 1 unknown) (Table 1).

Sightability Correction and Population Estimate

Thirty-three sightability correction plots were flown to estimate moose sightability. A total of 12.38 hours (743 minutes) were spent searching the sightability correction plots for an average of 22.5 minutes per plot or 11.25 minutes per mi^2 (4.3 minutes/ km^2). During intensive searches of sightability correction plots, 15 additional moose were found, producing an overall sightability correction factor of 1.18. Applying this sightability correction factor to the observed data generates an overall density of 0.36 moose/ mi^2 (0.14 moose/ km^2) and an estimate of 979 moose in the 2,745 mi^2 (7,110 km^2) study area (+/- 188 moose or +/-19.19%, 90% CI); (Table 2). The composition of the 979 moose was estimated at: 521 cows, 190 calves, 263 bulls (of which 29 were spike/fork [yearling] bulls).

Table 1. November 1999 moose survey results, Yukon-Charley Rivers National Preserve, Alaska

Unit	Date	Strat	Area	yr1 bull	med bull	Lrg bull	cow 0calf	cow 1calf	cow 2calf	lone calf	unknown sex/age	Total	scf plot?	obs std	obs int	std search time	Effort min/mi ²	scf search time
4	11/13/99	MEDIUM	15.01	1	0	0	3	1	0	0	0	6				60	4.00	
5	11/14/99	LOW	11.26	0	0	0	0	0	0	0	0	0				46	4.09	
6	11/13/99	HIGH	12.57	2	1	0	2	1	0	0	0	7	X	3	3	56	4.46	20
7	11/18/99	MEDIUM	13.47	1	1	1	1	0	0	0	0	4				62	4.60	
8	11/13/99	HIGH	14.64	0	3	2	2	0	0	0	0	7	X	2	2	56	3.83	17
10	11/12/99	HIGH	12.75	0	1	2	0	2	0	0	0	7	X	3	3	56	4.39	24
11	11/13/99	MEDIUM	11.87	0	0	0	3	0	0	0	0	3	X	2	2	46	3.88	16
13	11/11/99	HIGH	10.17	0	0	3	3	1	0	0	0	8				60	5.90	
14	11/12/99	HIGH	12.72	1	0	0	4	0	0	0	0	5	X	1	2	53	4.17	20
16	11/12/99	HIGH	10.72	0	0	1	3	0	0	0	0	4	X	0	0	46	4.29	19
17	11/17/99	MEDIUM	13.21	0	1	0	1	0	0	0	0	2				61	4.62	
20	11/11/99	HIGH	13.23	0	0	0	1	0	0	0	0	1				59	4.46	
23	11/17/99	LOW	12.57	1	2	0	1	0	0	0	0	4				60	4.77	
24	11/19/99	MEDIUM	13.09	0	3	0	7	1	0	0	0	12				65	4.97	
25	11/11/99	HIGH	10.97	0	1	0	5	0	0	0	0	6	X	3	6	39	3.56	20
27	11/16/99	MEDIUM	12.75	0	0	0	2	0	0	0	0	2				55	4.31	
28	11/16/99	MEDIUM	12.39	1	0	1	5	1	0	0	0	9	X	2	2	52	4.20	24
30	11/16/99	LOW	15.02	0	0	0	0	0	0	0	0	0				60	3.99	
31	11/17/99	MEDIUM	18.47	0	2	0	6	1	0	0	0	10				85	4.60	
32	11/17/99	MEDIUM	15.93	0	0	0	0	0	0	0	0	0				65	4.08	
33	11/13/99	MEDIUM	17.34	0	0	0	0	0	0	0	0	0				74	4.27	
34	11/17/99	LOW	12.53	0	0	0	1	1	0	0	0	3				58	4.63	
35	11/18/99	MEDIUM	13.48	0	0	0	4	0	0	0	0	4				66	4.90	
36	11/16/99	MEDIUM	11.88	0	0	1	2	2	0	0	0	7	X	2	2	55	4.63	20
38	11/14/99	LOW	16.34	0	0	0	3	0	0	0	0	3	X	0	0	76	4.65	11
40	11/14/99	LOW	15.73	0	0	0	0	2	0	0	0	4	X	0	0	71	4.51	19
52	11/12/99	HIGH	12.02	0	0	0	0	1	0	0	0	2				45	3.74	
54	11/16/99	LOW	15.73	0	0	0	0	1	0	0	0	2				40	2.54	
55	11/12/99	MEDIUM	16.99	0	0	0	0	1	0	0	0	2				38	2.24	
56	11/16/99	LOW	11.60	0	0	0	4	1	0	0	0	6	X	3	3	40	3.45	15
57	11/15/99	HIGH	13.08	2	4	1	6	4	1	0	0	24	X	2	4	65	4.97	24
60	11/15/99	HIGH	16.66	0	3	0	2	1	0	0	0	7	X	1	2	67	4.02	23
61	11/14/99	LOW	14.35	0	0	0	3	2	1	0	0	10				35	2.44	
73	11/18/99	LOW	12.83	0	0	0	0	0	0	0	0	0				47	3.66	
75	11/13/99	MEDIUM	11.15	0	0	2	0	0	0	0	0	2				66	5.92	
82	11/15/99	LOW	13.81	0	0	0	1	1	0	0	0	3	X	1	1	53	3.84	40
84	11/14/99	LOW	15.50	0	0	0	0	0	0	0	0	0				56	3.61	
87	11/14/99	MEDIUM	12.05	0	0	0	0	0	0	0	0	0				45	3.73	
90	11/18/99	LOW	13.70	0	0	0	2	0	0	0	0	2				43	3.14	
98	11/12/99	MEDIUM	17.25	0	0	0	0	0	0	0	0	0				40	2.32	
100	11/12/99	MEDIUM	16.74	0	1	1	1	0	0	0	0	3				35	2.09	
101	11/13/99	MEDIUM	14.46	0	0	0	0	0	0	0	0	0				39	2.70	
103	11/13/99	HIGH	14.68	1	0	1	0	0	0	0	0	2				53	3.61	
104	11/14/99	MEDIUM	10.67	0	0	0	3	1	0	0	0	5	X	0	0	55	5.15	30
105	11/12/99	MEDIUM	16.84	0	0	0	0	1	0	0	0	2				42	2.49	
106	11/14/99	MEDIUM	10.41	5	3	2	6	1	0	0	0	18	X	1	1	68	6.53	20
107	11/16/99	LOW	16.66	0	1	0	1	0	1	0	0	5	X	5	5	42	2.52	20
109	11/18/99	LOW	15.27	0	1	0	0	1	0	0	0	3				33	2.16	
112	11/14/99	HIGH	12.83	0	1	3	5	2	0	0	0	13				55	4.29	
114	11/15/99	MEDIUM	10.80	0	2	6	0	3	0	0	0	14	X	5	5	58	5.37	18
115	11/15/99	LOW	17.21	0	1	0	9	2	1	0	0	17	X	9	9	65	3.78	23
117	11/19/99	MEDIUM	12.48	0	0	0	0	0	0	0	0	0				48	3.85	
118	11/18/99	MEDIUM	13.63	0	1	1	7	2	0	0	0	13				52	3.82	

Table 1 continued.

Unit	Date	Strat	Area	yr1 bull	med bull	Lrg bull	cow 0calf	cow 1calf	cow 2calf	lone calf	unknown sex/age	Total	scf plot?	obs std	obs int	std search time	Effort min/mi ²	scf search time
120	11/12/99	HIGH	13.44	1	2	1	6	0	0	0	0	10	X	7	7	47	3.50	23
121	11/17/99	MEDIUM	12.74	0	1	0	5	0	0	0	0	6				63	4.95	
127	11/13/99	HIGH	16.51	0	1	1	0	1	0	0	0	4	X	0	0	60	3.63	30
128	11/13/99	HIGH	17.77	0	0	0	1	1	0	0	0	3	X	1	3	49	2.76	25
129	11/13/99	HIGH	14.04	0	1	0	5	1	0	0	0	8				47	3.35	
131	11/12/99	MEDIUM	14.13	0	0	0	1	1	0	0	0	3				45	3.18	
132	11/14/99	MEDIUM	13.36	0	0	0	2	0	0	0	0	2				47	3.52	
133	11/18/99	MEDIUM	8.54	0	1	0	0	0	0	0	0	1				42	4.92	
140	11/17/99	LOW	13.91	0	0	0	0	2	0	0	0	4				58	4.17	
141	11/16/99	LOW	11.41	0	0	0	2	0	0	0	0	2				30	2.63	
142	11/18/99	LOW	14.61	0	1	0	1	1	0	0	0	4				30	2.05	
144	11/16/99	LOW	17.81	0	0	0	0	0	0	0	0	0				64	3.59	
151	11/16/99	LOW	13.31	0	0	0	0	0	0	0	0	0				51	3.83	
154	11/17/99	LOW	14.54	0	0	2	2	2	0	0	0	8				46	3.16	
156	11/18/99	MEDIUM	13.82	0	0	0	0	0	0	0	0	0				54	3.91	
162	11/15/99	MEDIUM	19.01	0	0	1	0	1	0	0	0	3	X	0	0	78	4.10	27
163	11/18/99	LOW	16.34	0	1	0	0	0	0	0	0	1				59	3.61	
167	11/15/99	MEDIUM	11.68	0	1	0	0	0	0	0	0	1				51	4.37	
168	11/18/99	MEDIUM	10.67	1	2	1	7	1	0	0	0	13				44	4.12	
170	11/18/99	LOW	15.68	0	2	2	1	2	1	0	0	12				48	3.06	
172	11/15/99	LOW	9.12	0	0	0	0	0	1	0	0	3				41	4.50	
173	11/15/99	MEDIUM	9.56	0	4	6	9	1	0	0	0	21	X	0	0	60	6.28	25
179	11/13/99	HIGH	14.97	0	2	9	4	0	0	1	0	16	X	8	8	60	4.01	24
180	11/17/99	MEDIUM	18.13	1	1	0	1	2	0	0	0	7				75	4.14	
181	11/15/99	MEDIUM	14.22	2	2	1	3	2	0	0	0	12	X	7	7	45	3.16	24
182	11/12/99	HIGH	16.07	1	3	13	11	0	0	0	0	28	X	0	2	65	4.04	24
183	11/12/99	HIGH	13.72	0	1	5	6	0	0	0	0	12	X	3	3	55	4.01	20
184	11/13/99	MEDIUM	15.14	0	0	0	0	0	0	0	0	0				49	3.24	
185	11/13/99	HIGH	11.87	0	1	3	2	2	0	0	0	10	X	4	4	48	4.04	24
186	11/12/99	HIGH	14.82	0	1	2	5	1	0	0	0	10	X	4	4	59	3.98	24
191	11/09/99	HIGH	17.26	0	0	3	3	0	0	0	0	6	X	0	0	73	4.23	24
192	11/14/99	MEDIUM	12.52	0	0	0	0	1	0	0	0	2				52	4.15	
202	11/13/99	MEDIUM	14.61	0	0	1	0	0	0	0	0	1				58	3.97	
205	11/18/99	LOW	16.02	0	1	0	1	0	0	0	0	2				63	3.93	
206	11/18/99	LOW	12.20	0	0	0	0	0	0	0	1	1				45	3.69	
208	11/13/99	MEDIUM	13.90	0	0	0	4	1	0	0	0	6	X	0	4	57	4.10	26
210	11/17/99	LOW	13.87	0	3	0	3	1	0	0	0	8				60	4.33	
212	11/15/99	LOW	11.71	0	0	0	0	0	0	0	0	0				56	4.78	
213	11/18/99	MEDIUM	15.78	0	0	1	1	0	0	0	0	2				58	3.68	
217	11/14/99	LOW	13.76	0	0	0	0	0	0	0	0	0				70	5.09	
221	11/18/99	LOW	16.28	0	0	0	0	0	0	0	0	0				57	3.50	
231	11/13/99	HIGH	15.32	0	1	0	0	0	0	0	0	1				59	3.85	
238	11/14/99	LOW	10.63	0	0	0	0	0	0	0	0	0				44	4.14	
242	11/14/99	MEDIUM	8.05	0	0	0	0	1	0	0	0	2				39	4.84	
245	11/14/99	LOW	13.23	0	0	0	1	0	0	0	0	1				52	3.93	
249	11/18/99	LOW	15.49	0	0	0	0	1	0	0	0	2				60	3.87	
256	11/18/99	MEDIUM	17.75	0	2	0	0	0	0	0	0	2				83	4.68	
Total			1388.83	21	68	80	196	64	6	1	1	513	33	79	94	5423	397.29	743
Average			13.89									5.13				54.23	3.97	22.52

scf = sightability correction factor

Table 2. November 1999, moose survey population estimate, Yukon-Charley Rivers National Preserve, Alaska. Output from MOOSEPOP (Gasaway et al. 1986).

STRATUM	LOW	MED	HIGH	TOTAL
Total no. of survey units	131	45	24	200
Total area (mi ²)	1790.1	622.2	332.9	2745.2
No. of units surveyed	34	42	24	100
Area surveyed (mi ²)	480.0	576.0	332.8	1388.8
No. of moose seen	110	202	201	513
Observed density (moose/mi ²)	0.23	0.35	0.60	0.30
Total Observable (To)	410.2	218.2	201.0	829.5
Variance (Total observable)	5039.5	103.3	0.0	5142.8
Degrees of freedom (To)	33	41	23	34

Sightability correction factor (observable) = (SCFo) = 1.18030

Sampling variance(SCFo) = 0.0075461445

Degrees of freedom (SCFo) = 33

Population estimate after applying sightability correction factor = Total expanded (Te) = 979.0

Sampling variance = V (Te) = 12317.43

Degrees of freedom = df (Te) = 33

80% Confidence Interval around Te = (833.9, 1124.1) is +/- 14.82%

90% Confidence Interval around Te = (791.1, 1166.9) is +/- 19.19%

95% Confidence Interval around Te = (753.2, 1204.8) is +/- 23.07%

Sex and Age Composition

The sex and age composition of the 513 observed moose were as follows: 266 cows, 169 bulls, and 77 calves and 1 unknown. Composition of the observed bulls included 21 yearling bulls (spike-forks), 68 medium bulls, and 80 large bulls. No single-antlered bulls were seen, therefore antler shed did not appear to be a problem.

The estimated sex and age ratios of the population were 36 calves:100 cows, 5.6 spike/fork (yearling bulls):100 cows, and 51 bulls:100 cows. Twinning rates in November 1999 were 2.3

twins:100 cows. During November surveys in 1999, six sets of twins were seen, in 1997, three sets of twins were seen, and in 1994 only a single set of twins was seen.

The total number of yearlings is estimated by doubling the number of yearling bulls, assuming a 50:50 sex ratio. This would make the ratio 11 yearlings:100 cows. However, the yearling component of the population is likely under-represented, because we only classified those bulls with spike or forked antlers as yearlings. Studies conducted by ADF&G indicate that yearling bulls can grow palmated antlers up to 30 inches (76.2 cm), and spike/fork bulls may represent only 40%-60% of the yearling cohort in a given year (Gasaway et al. 1983, Gasaway et al. 1992). Therefore, if we assume that spike/fork bulls represent 60% of the yearling cohort in YUCH, an additional 40% would increase the total number of yearling bulls to 40 and the total number of yearlings to 80. The ratios would increase to over 8 yearling bulls:100 cows, or about 17 total yearlings:100 cows.

Comparisons and Trends

Several moose surveys have been conducted in the past in YUCH (Table 3). However, a variety of study objectives and budget constraints resulted in differing sampling techniques and/or low sample sizes. Comparisons of these data, are difficult and perhaps inappropriate, because comparing these data may result in misleading or erroneous conclusions. The aerial moose survey conducted in November 1997 covered the same area as this survey, using the same methods and sample units and is directly comparable. The survey conducted in 1994 (Demma et al. 1995) overlapped with a 1200 mi² portion of this survey area (Figure 3). As with this current survey, the 1994 and 1997 surveys used techniques based on Gasaway et al.(1986).

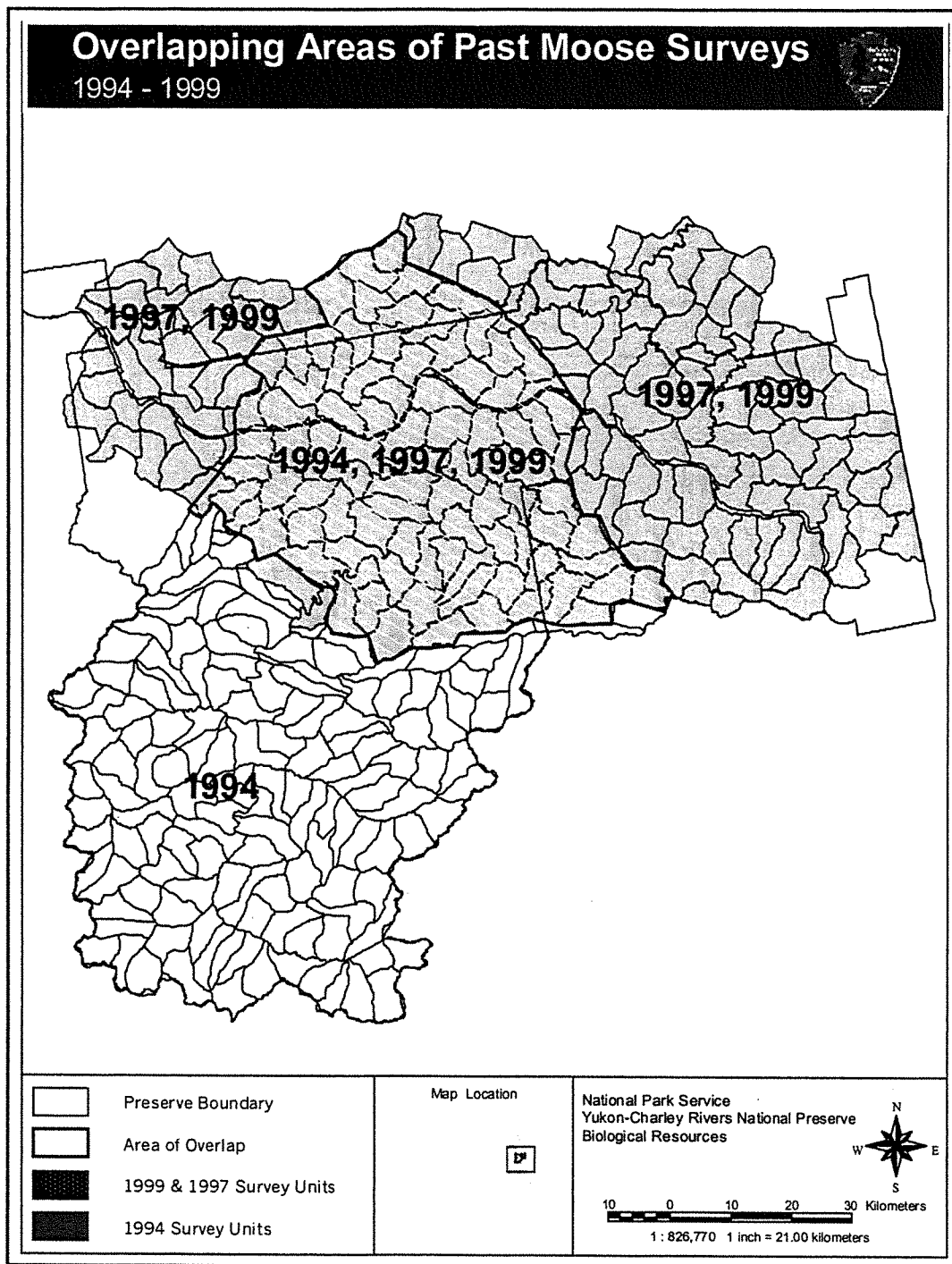


Figure 3. Survey units from 1994, 1997, and 1999 illustrating the area of overlap between these surveys in Yukon-Charley Rivers National Preserve, Alaska.

Table 3. November moose survey data from past years for Yukon-Charley Rivers National Preserve, Alaska. Population estimates for 1987 and 1994 data are not directly comparable to 1997 and 1999. Composition ratios are probably comparable.

Year	Bull:Cow ratio	Calf:Cow ratio	Yrlbull:Cow ratio*	Density moose/mi ²	Population estimate
1987	121	10	14	0.62	1116 (guess)
1994	84	21	7	0.31	735 (+/-166)
1997	60	28	8	0.27	737 (+/-148)
1999	51	36	5	0.36	979 (+/- 188)

* spike fork bulls only, not corrected

The primary differences between the 1994 and 1997 surveys were search intensity and boundaries of the area surveyed (Figure 3). The 1994 survey was conducted at a lower search intensity, as described in Dale et al. (1994). Moose density in the 1200 mi² overlap area was estimated at 0.34 moose/mi² during 1994, 0.23 moose/mi² during 1997, and 0.23 moose/mi² again for this 1999 survey. Assuming a decrease in moose density between 1994 and 1997 in YUCH from these comparisons, however, is inappropriate due to overlapping confidence intervals. Any variation in local moose densities between years could be the result of many variables including immigration and emigration, snow depth, changes in habitat and forage quality (succession of preferred browse species), and harassment by predators. The best use of these data would be as basis for a long-term monitoring program in order to identify trends in YUCH moose densities, and to determine the primary limiting factors of YUCH's moose population.

Age and sex ratios of the moose population in YUCH are typical of other low-density populations in interior Alaska, while densities in YUCH (at 0.36 moose/mi²) appear to be among the lowest reported in the region (Gasaway et al. 1992). In the rest of GMU 20E (of which most

of YUCH is a part) the overall moose density in 1995 was 0.54 with 22 calves and 73 bulls per 100 cows (Gardner 1996). In Denali National Park, Meier et al. (1991) report an overall density of 0.58 moose per square mile and 23 calves, and 81 bulls per 100 cows. In GMUs 25A, 25B, 25D (down the Yukon River from YUCH) moose densities are about 0.6 moose/mi² with 30 calves and 50 bulls per 100 cows (Stephenson 1996). A survey conducted in Yukon Flats National Wildlife Refuge in late October of 1999 reported a similar density of 0.38 moose/mi² and 31 calves and 31 bulls per 100 cows (Bertram and Vivion 1999). This is in contrast with GMU 20A south of Fairbanks where moose densities have been much higher at 2.7 moose/mi² and 52 calves and 35 bulls per 100 cows (Dale 1996).

Harvest

Moose harvest and hunter success from 1983 to 1999 was summarized from ADF&G harvest reports during that period (Table 4 and Figure 4). The area the data covers includes all Uniform Coding Units (UCUs) within the 3 GMU subunits that are completely or partially within YUCH (Figure 5). Moose harvest in YUCH averaged 25 bulls/yr over the 17 year period (range 11-41) and there is a significant trend in moose harvest overall ($R^2 = 0.443$, $F=11.93$, $p=0.004$, $\alpha=0.05$). The mean moose harvest for the first 7 years (17.1) is significantly different from the mean of the last 7 years (32.4; $t=-8.05$, $p=0.0002$, $\alpha=0.05$). These tests indicate a significant increase in the number of moose harvested since 1993. During 1983-1999, an average of 80 hunters (range 41-126) hunted moose in the preserve each year spending an average of about 8 days per hunt. Comparing the mean number of hunters from the first 7 years (54) to the last 7 years (101) indicates a significant increase in the number of people hunting ($t=-6.05$, $p=0.0045$, $\alpha=0.05$). Furthermore, there is also a significant trend in the increase in the number of hunters over the entire 17 years ($R^2=0.70$, $F=34.54$, $p=3.36 \times 10^{-5}$, $\alpha=0.05$).

Table 4. Reported moose harvest, number of hunters, hunter effort and success in Yukon-Charley Rivers National Preserve, Alaska, 1983 to 1999.

Year	Moose Harvested	Number of Hunters	Hunter Days	Hunter Effort (Days/Moose)	Percent Success
1983	21	59	597	28	36
1984	19	46	326	17	41
1985	19	41	399	21	46
1986	13	48	260	20	27
1987	14	57	413	30	25
1988	17	66	464	27	26
1989	17	61	476	28	28
1990	35	81	538	15	43
1991	31	90	747	24	34
1992	12	100	739	62	12
1993	36	93	719	20	39
1994	32	126	926	29	25
1995	33	99	797	24	33
1996	24	94	793	33	26
1997	24	100	851	35	24
1998	37	80	828	22	46
1999	41	116	987	24	35
Total	425	1357	10860	460	547
Mean	25.0	79.8	638.8	27.1	32.2

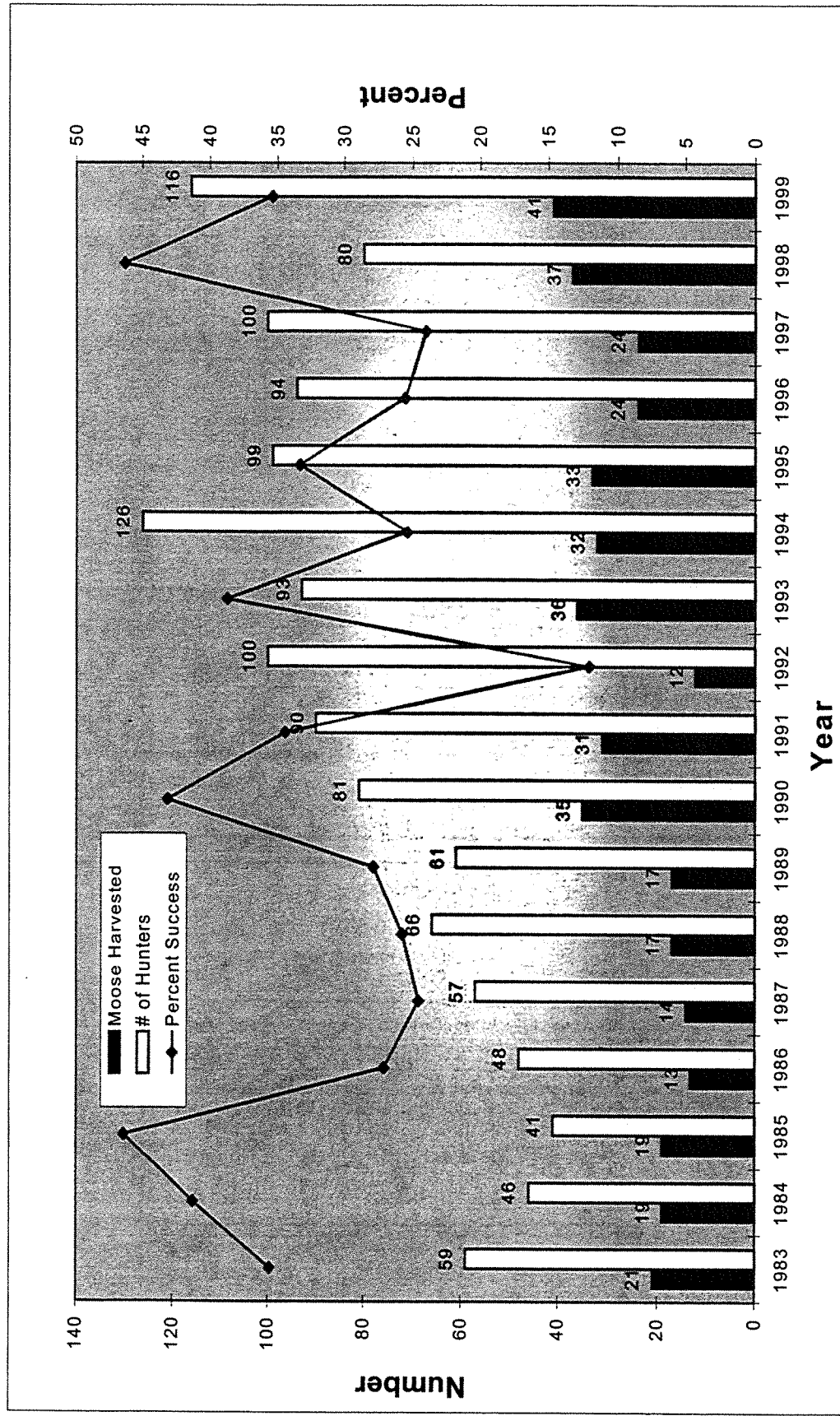


Figure 4. Reported moose harvest, number of hunters, and hunter success in Yukon-Charley Rivers National Preserve, Alaska, 1983-1999 (data gathered from ADF&G harvest reports).

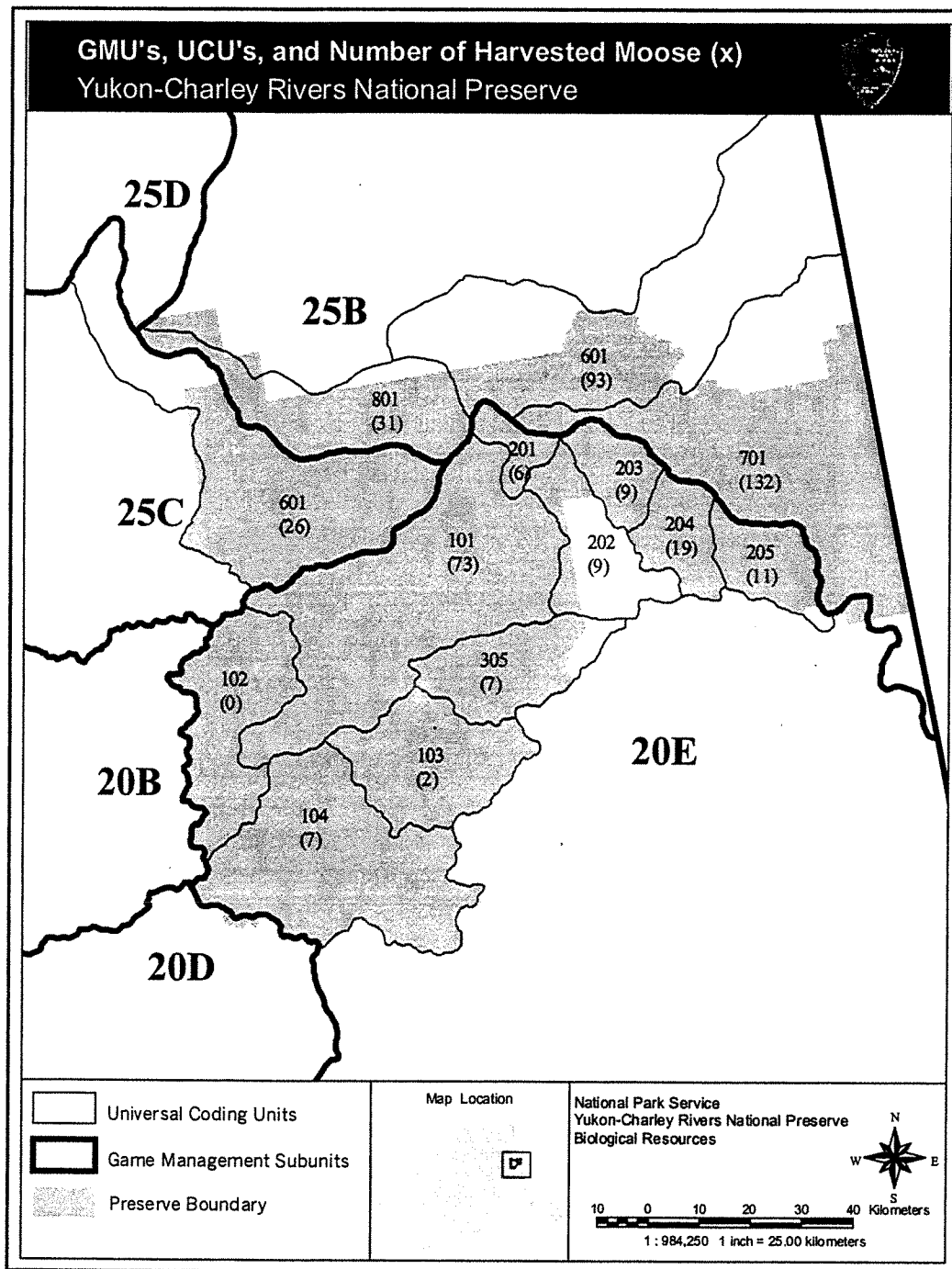


Figure 5. Game management subunits and uniform coding units (UCUs) comprising Yukon-Charley Rivers National Preserve, Alaska. Numbers in parentheses are number of moose reported harvested from 1983-1999 for each UCU.

Reported hunter success rates have averaged 32% (range 12-46%) during this 17 year period. Average hunter success during the first 7 years (32.6) is not significantly different from the last 7 years (32.7; $t=0.829$, $p=0.2171$, $\alpha=0.05$). These data indicate an increase in the number of hunters, but the success rate of hunters has remained about the same. Hunting pressure in the preserve occurs primarily along the main rivers such as the Yukon, Kandik, Nation, and Charley Rivers. Hunters can also access airstrips and remote landing areas within YUCH.

Natural Mortality

We know very little about the natural mortality of moose in YUCH. Nearby studies over past years indicate that bear (both black and brown species) predation on newborn calves is heavy and wolf predation on calves and adults is significant. From 1981-1988 ADF&G intensively studied the moose population in Fortymile drainage south of YUCH where in a study of 33 radiocollared newborn calves, 82% died within 11 months (52% by grizzly bears, 15% by wolves, 3% by black bears, and 12% drowned) (Gasaway et al. 1992). In the same study they found survival rates of adult moose to range from 78% to 93%. In 1998 in Yukon Flats National Wildlife Refuge, preliminary data from a moose calf mortality study found 21 of 29 collared calves killed by bears (predominantly black bears) by early July (Bertram and Vivion 1998). A recent moose study in Denali National Park and Preserve calculated survival rates for cows at 86%, 88%, and 94% for the past 3 years (Layne Adams, USGS/BRD personal communication).

Wolf predation is a common cause of death of adult moose as well as calves in YUCH. An ongoing wolf study in YUCH shows a significant increase in locations of wolves on moose kills from 1997 – 2002 ($R^2 = 0.83$, $p=0.033$) but not prior to 1997 (Table 5).

Table 5. Trend in number of moose kills observed with radiocollared wolf packs.

Year	Total Locations	Moose kills	%Moose kills
1993	192	5	2.6
1994	289	21	7.3
1995	271	17	6.3
1996	118	11	9.3
1997	364	6	1.6
1998	447	8	1.8
1999	355	7	2.0
2000	307	9	2.9
2001	321	16	5.0
2002*	100	10	10.0

* incomplete, only about half the years locations

Distribution of Moose

The location of moose throughout YUCH appears to be concentrated in the greater Yukon Valley. This is illustrated by the distribution of moose groups from the 1999 survey and the distribution of wolf-killed moose from 1993-2001 (Figure 6). The survey locations of moose groups in November make it appear that moose may congregate in the hills on either side of the Yukon. Assuming that most moose are shot near the Yukon River or its major tributaries in September, this could indicate some evidence of moose migrating into the hills in the fall. It is possible some moose may move farther, and the population near the Yukon during the September hunt is higher than indicated by moose surveys in November. The scatter of wolf-killed moose throughout the preserve and beyond, gives some idea of moose distribution outside the surveyed areas (Figure 7).

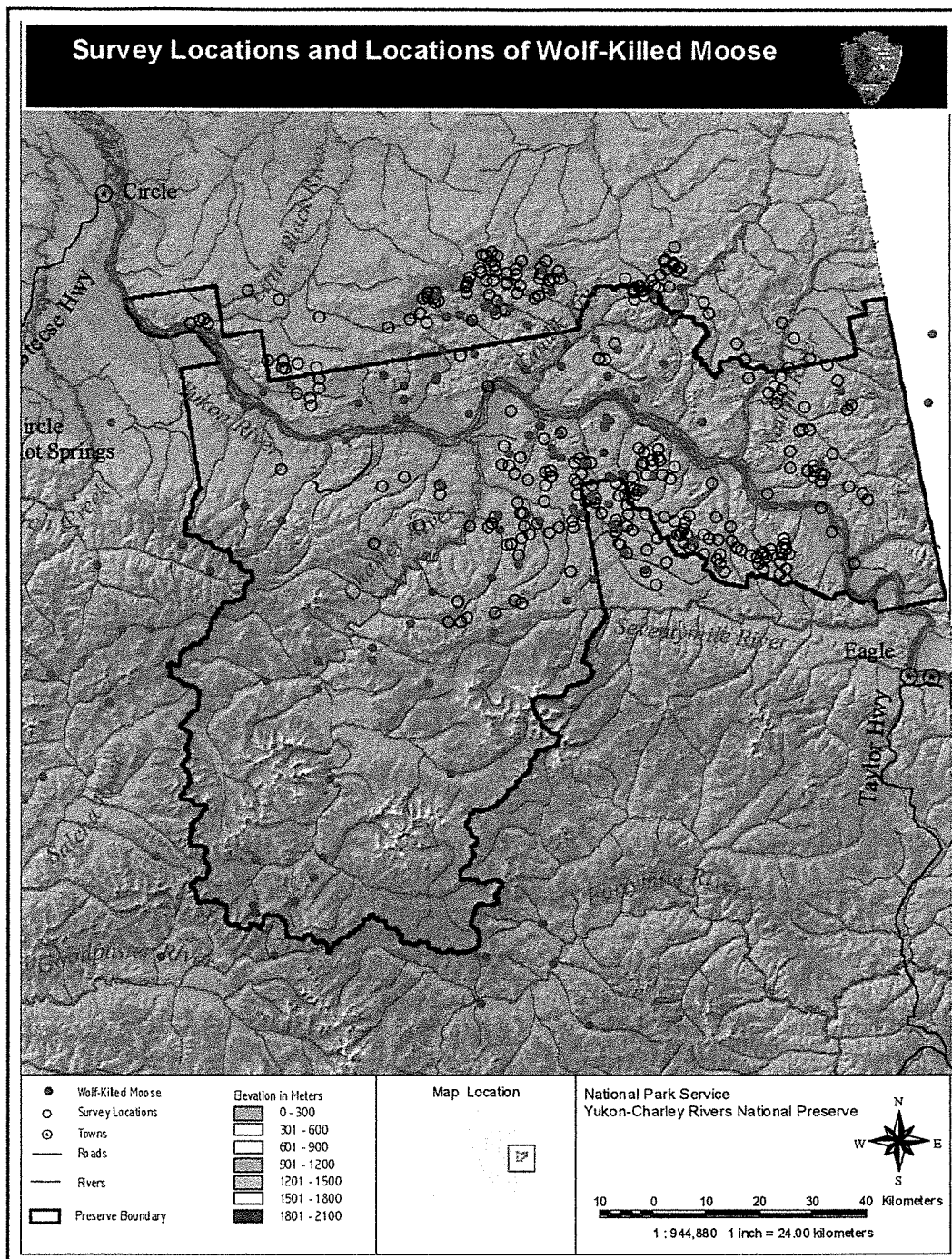


Figure 6. Distribution of moose group locations from 1999 survey (black circles) and the distribution of wolf-killed moose (red dots) from 1993-2001, in Yukon-Charley Rivers National Preserve, Alaska.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

The overall density of 0.36 moose/mi² is among the lowest reported in interior Alaska (Gasaway et al. 1992). The population estimates and sex and age composition of the YUCH moose population appears consistent with that of a stable population. Although the current bull:cow ratio of 51 bulls:100 cows is healthy for a hunted population (Gasaway et al. 1992, Dale 1996, Gardner 1996), the bull:cow ratio in YUCH has decreased significantly during the last 10 years. If the trend continues to 40 bulls:100 cows or lower, some management action or regulatory change may be needed to reduce bull moose harvest in YUCH. Other hunted populations in interior Alaska are managed at 30-40 bulls:100 cows which can be stable or increasing (B. Dale, ADF&G, personal communication).

While the number of hunters has increased since the early 1980s, hunter success rates have remained comparable to the long-term average. A proposal to lengthen the federal subsistence hunting season on bulls and to include any bull, was adopted in 1998, changing the season dates within YUCH. Since 1998 regulations now include August 29-31 making a season that extends from August 20 to September 30 for any bull (a change from one bull with spike-fork antlers from August 20-August 28, and no season from August 29-August 31). A proposed March hunting season was not adopted but may be proposed again in the future. The YUCH moose population could be at the maximum sustainable harvest levels right now. Extending hunting seasons to include a March season and the subsequent additional harvest would have a strong potential to adversely affect YUCH's moose population.

Another problem in managing the moose population in YUCH is our lack of knowledge of moose movements in and adjacent to YUCH. Studies of other moose populations in interior Alaska have documented significant moose movements (Hobgood and Durtsche 1990, Gasaway 1992, Dale and Boertje, ADF&G, unpublished data). Some of these movements are migratory in nature and occur seasonally. Other anecdotal information suggests that snow and other factors may influence the timing and magnitude of movements. These movements may substantially affect the results of surveys, and these November survey results may not be representative of the moose population during the September hunt. Information on the timing and extent of moose movements within and adjacent to YUCH is critical for managers to develop, and implement an appropriate monitoring protocol that will contribute to science-based management decisions.

Available moose population information for YUCH is inadequate for current and future management decision making. I suggest that a long-term monitoring program with consistent and comparable sampling techniques be implemented to track the status of the YUCH moose population. A population survey modeled after Gasaway et al. (1986) should be conducted at least every 3 years, and would cost about \$35,000. The next survey should occur in fall 2002. This monitoring level would provide managers with statistically reliable population estimates and a consistent means to estimate sex and age composition. In addition, a study of moose movements in YUCH would provide valuable information to assist in determining an appropriate population monitoring protocol and allow managers to make informed decisions regarding moose management to maintain healthy populations for future generations.

ACKNOWLEDGMENTS

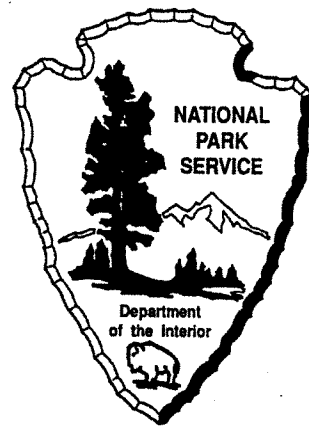
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LITERATURE CITED

- Alaska Department of Fish and Game. 1995. Fortymile Caribou Herd management plan. 21pp.
- Bertram, M. and M. Vivion. 1999. Moose population survey, Western Yukon Flats. USFWS, Yukon Flats National Wildlife Refuge report, Fairbanks, Alaska. 16pp.
- Boertje, R. D. 1985. Letter to Steve Ulvi, National Park Service. April 9, 1985. Alaska Department of Fish and Game. 2pp.
- Burch, J. and N. J. Demma. 1997. 1997 Aerial moose survey along the Yukon River corridor, Yukon-Charley Rivers National Preserve, Alaska. NPS Technical Report NPS/AR/NRTR-98/33. 23pp.
- Demma, N. J., B. W. Dale, and K. B. Fox. 1995. 1994 Aerial moose survey, Yukon-Charley Rivers National Preserve, Alaska. NPS Technical Report NPS/ARRNR/NRTR-95/26. 14pp.
- Dale, B. W. 1996. 1996 moose management report (20A). Alaska Department of Fish and Game report, Fairbanks, Alaska. 15 pp.
- Dale, B. W., L. G. Adams, and W. T. Route. 1994. A relatively inexpensive aerial moose survey technique designed as a replacement for trend surveys or for the use in areas with high sightability. NPS Natural Resources Report AR-94. 15 pp.
- Gardner, C. L. 1996. 1996 Moose management report (20E). Alaska Department of Fish and Game report, Fairbanks AK. 14pp.
- Gasaway, W. C., R. D. Boertje, D. V. Grangaard, D. G. Kelleyhouse, R. O. Stephenson, and D. G. Larson. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monograph 120. 59pp.
- Gasaway, W. C., S. D. Dubois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological Papers, University of Alaska. No. 22. 108pp.

- Gasaway, W. C. R. O. Stephenson, J. L. Davis, P. E. K. Shepherd, and O. E. Burris. 1983. Interrelationships of wolves, prey, and man in interior Alaska. Wildlife Monograph 84. 50 pp.
- Hobgood, W., and B. M. Durtsche. 1990. Ecology of moose in the White Mountains National Recreation Area, Alaska, 1985-88. BLM-Alaska Open File Report. No. 27. 17pp.
- Knuckles, P. 1991. Moose winter habitat survey, Nation River. NPS research and resource management report series 91-02. 4pp.
- Meier, T. J., J. A. Keay, J. C. VanHorn, J. W. Burch. 1991. 1991 Aerial moose survey, Denali National Park and Preserve. National Park Service Natural Resources Survey and Inventory Report AR-91/06. 19pp.
- National Park Service. 1985. Yukon-Charley Rivers National Preserve general management plan. Preserve files, Fairbanks, Alaska. 147pp.
- National Park Service. 1999. Fire management plan for Yukon-Charley Rivers National Preserve, Alaska. Preserve files, Fairbanks, Alaska. 50pp.
- Nowlin, R. 1988. Summary of Yukon-Charley Rivers Preserve moose survey results conducted by ADF&G and NPS during November 1987. Preserve files, Fairbanks, Alaska. 15pp.
- Reed, D. J. 1989. Moosepop program documentation and instructions. Alaska Department of Fish and Game. 15pp.
- Stephenson, R. O. 1996. 1996 Moose management report (25A, 25B, and 25D). Alaska Department of Fish and Game report, Fairbanks, Alaska. 25pp.
- Swanson, D. K. 1999. Ecological units of Yukon-Charley Rivers National Preserve, Alaska. National Park Service report YUCH-99-001, Fairbanks, Alaska. 31pp.





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