

AERIAL MOOSE SURVEY IN THE  
UPPER KOBUK DRAINAGE, ALASKA

Project Report  
November 2002 and March 2003

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## AERIAL MOOSE CENSUS IN THE UPPER KOBUK DRAINAGE, ALASKA

### DATA SUMMARY

Survey Dates: 8-16 November 2002 (sex and age composition survey)

23-26 March 2003 (population estimate survey)

Total area covered by survey: 4001 mi<sup>2</sup> (10,363 km<sup>2</sup>)

Total moose observed: 8-16 November 2002; 61 moose (30 cows, 23 bulls and 8 calves)

23-26 March 2003; 252 moose (226 adults and 26 calves)

March population estimate: 856 (90% confidence interval = 690 - 1022) moose

Estimated total density: 0.21 moose per mi<sup>2</sup> (0.19 adult moose per mi<sup>2</sup>)

(0.08 moose per km<sup>2</sup>; 0.07 adult moose per km<sup>2</sup>)

Estimated ratios: 20 calves:100 cows, 92 bulls:100 cows (November estimates)

### INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) and the National Park Service (NPS) cooperatively attempted to estimate sex and age composition of moose in a 4001 mi<sup>2</sup> (10,363 km<sup>2</sup>) area in the upper Kobuk River drainage during 8-16 November 2002. However, snow conditions were poor, moose were widely scattered and sightability was low. Although this attempt generated estimates of bull:cow and calf:cow ratios, inferences from this data is limited due to a small sample size. During 23 -26 March 2003 we again surveyed moose and estimated the size and the adult:calf composition of the moose population. These population parameters are intended to aid managers in making informed decisions regarding management of moose in this area.

It is often difficult to evaluate the relative health of a moose population based solely on density because it is difficult to evaluate carrying capacity of the habitat. Gasaway et al. (1992) calculated a mean density of 0.38 moose per mi<sup>2</sup> for 20 moose populations in Alaska and the Yukon Territory where predation was thought to be limiting. Mean density of 16 populations within the same general area was 1.7 moose per mi<sup>2</sup> where predation was thought not to be limiting. Ballard et al. (1991) reported a range of 0.13-3.2 moose per mi<sup>2</sup> for 29 moose populations in Alaska.

In addition to densities, bull:cow and calf:cow ratios are often estimated to evaluate the hunting pressure and recruitment in a moose population, respectively. As with density values, values for these ratios depend on a number of factors including population trends, habitat quality and predation pressure. A minimum 20 bulls:100 cows in the fall is often considered adequate to maintain a healthy population. Minimum calf:cow ratios depend on adult mortality rates of the population. Van Ballenberghe and Ballard (1997) reported the proportion of calves in a population can vary between 7% where predation is intense (Van Ballenberghe 1987) and 44% for populations where hunting (and presumably predation) is negligible (Rolley and Keith 1980).

We surveyed moose in the upper Kobuk River drainage during the winter of 2002/2003 because reports from local residents and non-local hunters as well as opportunistic observations by ADF&G and wildlife enforcement personnel indicated moose densities

were low and declining in this area. Although numerous surveys have been conducted in the upper Kobuk River drainage since the late 1950s, sampling methods were inconsistent (Dau et al. 1996). The last and only rigorous, quantitative survey conducted in this area was in 1995 when linear regression was used to analyze data collected in a Gasaway-style survey. Currently, the upper Kobuk census area is 1 of 5 areas in Game Management Unit 23 to be regularly surveyed. The other areas are: middle Noatak drainage, Squirrel drainage, Tagagawik drainage, and northern Seward Peninsula.

Moose are an important subsistence resource for the residents of Kobuk, Shugnak and Ambler. Moose hunting is also an important source of income for hunting guides and transporters in the area and many sport hunters enjoy hunting in this area. In recent years, with the perception of a decline in the moose population, questions have been raised concerning the allocation of moose between local and nonlocal hunters. The issue of subsistence versus sport hunting is controversial throughout the state of Alaska and conflicts will likely intensify as competition increases for limited wildlife resources. Our objective in this study was to update our understanding of the upper Kobuk River moose population.

## **STUDY AREA**

The survey area included an area roughly bound on the West by the Black and Shugnak Rivers (157°25'W), on the East by the Helpmekjack Hills(153°55'W), on the North by crest of the Schwatka Mountains (67°24'N), and to the South by the Kobuk/Koyukuk divide (66°15'N) (Fig. 1). Principal landowners in this area are the State of Alaska, NANA Corporation and the NPS. Vegetation types in this area are: upland shrub, upland spruce/birch/shrub, riparian spruce/willow/cottonwood, tussock tundra, and wet sedge meadows. Alpine areas (above 1500 ft) and large lakes were intentionally excluded from the survey because these areas are not typically utilized by moose.

## **METHODS**

Moose population surveys were conducted in the upper Kobuk river drainage following guidelines outlined by Gasaway et al. (1986) and modified by VerHoef (2001). These survey methods were developed by the ADF&G and are in wide use across the state allowing for comparison of survey areas. The survey area was delineated using a geographical information system (ArcView GIS 3.2, Environmental Systems Research, Inc. [ESRI], Redlands, California) and covered approximately 4001 mi<sup>2</sup> (10,363 km<sup>2</sup>) (Fig. 1). The survey area was divided into a grid of rectangular sample units of 2 degrees latitude and 5 degrees longitude resulting in units of approximately 5.2 mi<sup>2</sup> (13.5 km<sup>2</sup>). There were a total of 763 units within the survey area. All sample units were stratified as high (H) or low (L) moose density based on habitat characteristics and moose observed during stratification flights conducted at the beginning of the survey. Units were considered to be H if they were thought to contain  $\geq 1$  moose. High and low units were randomized for order of sampling selection.

Snow cover in the study area was incomplete during November 2002 raising concerns regarding the likely precision of population estimates due to poor sightability of widely scattered moose. Even so, we decided to attempt a fall survey to estimate population sex

and age composition because bull moose drop their antlers in mid-winter and this would be our only opportunity for evaluating bull:cow and calf:cow ratios. Therefore, we conducted limited stratification flights and surveyed sample units during 8-16 November, 2002.

Two planes participated in the November 2002 survey. A Piper Supercub (ADF&G) surveyed the western portion of the survey area and a Cessna 206 (Arctic Air Alaska), chartered by the NPS surveyed the eastern portion. The Supercub carried 1 observer and the pilot, and the Cessna 206 carried 2 observers and the pilot. Survey planes and observers were based out of Kotzebue, Alaska (ADF&G) and Bettles Alaska (NPS) during the November survey. Moose were categorized as: cow, calf, yearling bull (spike or forked antlers), medium bull (mature bull with antler spread of <50 inches [127 cm]), or large bull (antler spread  $\geq$ 50 [127 cm]).

During the March 2003 survey, 5 planes participated each with a pilot and 1 observer. Four of the planes were Piper Supercubs (ADF&G, Arctic Air Alaska, Arctic Wings, and Northwest Aviation) and the fifth plane was a Bellanca Scout (Arctic Air Alaska). All pilots but one and all observers but one had previous experience in aerial moose surveys. The inexperienced pilot and inexperienced observer were always paired with someone with experience.

The March survey was based out of Dahl Creek (Fig. 1) so that planes and staff would be close to the survey area. Dahl creek has a large airstrip for equipment and fuel delivery, and facilities for personnel. Housing all personnel in one location facilitated survey organization and efficiency. Housing facilities were provided by Max Lyons, Steve Lie, and the Alaska State Troopers. Logistical support while at Dahl Creek was provided by Billy Bernhart and Dean Pungalik.

Survey aircraft used Global Positioning System (GPS) receivers to identify the boundaries of sample units. Search intensity varied with habitat. Greater effort was spent in areas with cover (i.e., forests) than in open habitat. Moose observed were assigned a group number and the coordinates of the group were recorded using the aircraft GPS receivers. Numbers of moose in each group were recorded and each moose was classified as either an adult or calf. Moose population estimates within the survey area were calculated using the software MOOSEPOP (Gasaway et al. 1986, Reed 1989) as well as the Geo-Spatial Population Estimator (GSPE; VerHoef 2001).

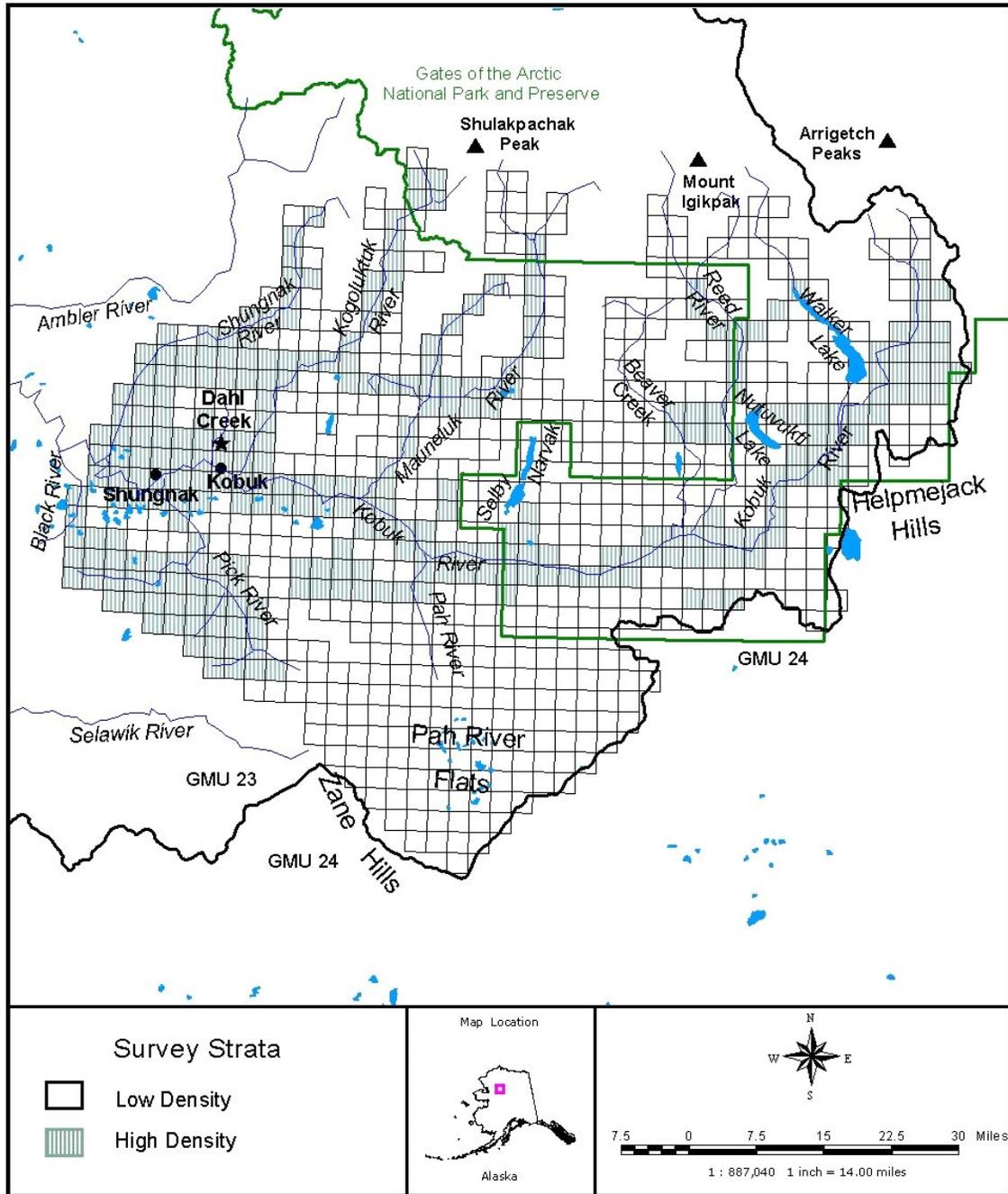


Figure 1. Units delineated for a moose survey on the upper Kobuk River in November 2002 and March 2003. Units were stratified as High if  $\geq 1$  moose was anticipated to be in the unit and Low if no moose were anticipated to be in the unit.

## RESULTS

### November 2002 Survey

#### *Weather and snow conditions*

Snow cover was incomplete and >1 week old during the 8-16 November attempt. Low vegetation was exposed in the eastern portion of the survey units and bare ground was visible in the western portion. Conditions tended to be overcast during the survey but, in general, lighting was adequate. Winds tended to be light and temperatures were moderate (mid-teens °F).

#### *Unit sampling*

Out of 763 total sample units, 35% were classified as H and 65% were classified as L (Table 1). Stratification should be viewed with caution because most sample units were stratified using a desktop approach that was nothing more than our best guess regarding moose distribution. As the primary purpose of the November survey was to examine sex and age ratios, most survey effort was directed at units classified as H. Survey aircraft sampled 17% of all H units and 7% of all L units in the survey area. This constituted 11% of the entire survey area. Crews surveyed 5-13 units a day (Mean [ $\pm$ SE] = 9.3[ $\pm$ 1.12]). Survey times were not kept for all survey units. For those in which times were kept ( $n = 39$ ), survey rates averaged 5.1 minutes per unit (1.03 minutes per mi<sup>2</sup>).

**Table 1.** Summary of the survey area, and the number and size of units sampled during a moose survey conducted from 8-16 November 2002. Units were stratified as H if  $\geq 1$  moose was anticipated to be in the unit and L if no moose were anticipated to be in the unit.

Stratum	# of Units	Area (mi <sup>2</sup> )	# of Units Sampled	Area (mi <sup>2</sup> ) Sampled
High (H)	270	1421.69	45	236.63
Low (L)	493	2579.77	36	187.76
Total	763	4001.4	81	424.39

A total of 61 moose were observed during the November survey. The majority of cows did not have calves (> 70%). In no instance was more than 1 calf observed with a cow during the survey. Mature bulls observed were equally split between medium and large based on antler size. No single-antlered bulls were observed during the survey.

#### *Population composition estimates*

Because the results of data analysis of the November 2002 moose survey using MOOSEPOP and GSPE were similar, we will concentrate reporting on results from the GSPE analysis to facilitate comparison between other survey areas in the state. The estimated calf:cow ratio of 20:100 is comparable to the 19:100 ratio found in the Kobuk River drainage in November of 1995 during a survey that covered a more limited area (Dau et al. 1996). The November 2002 confidence intervals were 6-34 calves per 100 cows, 2-38 calves per 100 cows, and 0-41 calves per 100 cows at the 80%, 90% and 95% confidence intervals, respectively. The estimated bull:cow ratio was 92:100 and is considerably higher than the 1995 estimate of 62:100. The November 2002 confidence

intervals were 45-140 bulls per 100 cows, 31-153 bulls per 100 cows, and 19-165 bulls per 100 cows at the 80%, 90% and 95% confidence intervals, respectively. The 2002 bull:cow ratio is likely bias because a group of 4 bulls was observed in a sample unit classified as L. This result, when extrapolated over all L sample units that were not surveyed, results in an inflated bull:cow ratio. Bias is also suggested because cows have higher survival rates than bulls. This results in more cows than bulls even in un hunted moose populations (Van Ballenberghe and Ballard 1997).

### **March 2003 Survey**

#### *Weather and snow conditions*

Snow cover was complete from 23 - 26 March 2003. Snow depth varied throughout the survey area but in many areas snow reached the belly of moose. No new snow fell during the survey and snow on the ground was > 1 week old. Survey conditions from 23-24 March were good although in some areas thin fog and high overcast occurred. On 25- 26 March clear, bright and sunny conditions prevailed. Winds were light and temperatures were approximately -10 °F.

#### *Unit sampling*

Out of 763 total sample units (Fig. 2), H units comprised 38% ( $n=289$ ; 1512 mi<sup>2</sup>) and L units comprised 62% ( $n=474$ ; 2489 mi<sup>2</sup>) of the total number of units in the survey area. Survey aircraft sampled 34% of all H units in the survey area ( $n=98$ ; 512 mi<sup>2</sup>) and 16% of all L units in the survey area ( $n=74$ ; 388 mi<sup>2</sup>). Twenty two percent of all survey units in the survey area were sampled ( $n=172$ ; 900 mi<sup>2</sup>). Crews sampled 3-18 units a day (Mean [ $\pm$ SE] = 10.5[ $\pm$ 1.11]). Survey times were not kept for all survey units. For those in which times were kept ( $n = 119$ ), Mean ( $\pm$ SE) survey rates were 19.4 ( $\pm$ 0.86) minutes per unit (3.7 [ $\pm$ 0.16] minutes per mi<sup>2</sup>).

A total of 252 moose were observed during the March survey (Table 2). Slightly over 11% of the adult moose observed were accompanied by calves. If we assume 48% of observed adults were bulls (as actually observed during the November attempt), approximately 108 of the moose observed during the March survey were bulls and 118 were cows. This results in a calf:cow ratio of 22:100. If the actual bull:cow ratio was lower than our observed November estimate of 92:100 (and there are indications that this was the case), then this approach underestimates the number of cows and overestimates the calf:cow ratio. Only one cow was observed during the survey with 2 calves. Observed density of all moose in the area surveyed was 0.21 moose per mi<sup>2</sup>. The majority of moose observed were in the western portion of the survey area (Fig. 2).

#### *Population composition estimates*

Results from the GSPE program indicate a total density of moose of 0.21 moose per mi<sup>2</sup> and a density for moose calves of 0.02 calves per mi<sup>2</sup> over the entire survey area (Table 3). Results from MOOSEPOP indicate a total moose density of 0.19 moose per mi<sup>2</sup> and a density of moose calves of 0.02 calves per mi<sup>2</sup>. Moose density estimates from the March 2003 survey were considerably lower than March 1995 estimate of 0.57 moose per mi<sup>2</sup> (Dau et al. 1996). We think this difference is attributable to a decline in the moose population and not an artifact of expanding the census area. The 1995 survey covered a

**Table 2.** Summary of moose observed during a populations survey conducted from 23-26 March 2003 in the upper Kobuk River drainage, Alaska. Units were stratified as H if  $\geq 1$  moose was anticipated to be in the unit and L if no moose were anticipated to be in the unit.

	# of moose observed		Observed density (# moose per mi <sup>2</sup> )		Total observed	Total Density
	H	L	H	L		
Adults	223	3	0.44	0.01	226	0.25
Calves	26	0	0.05	0.00	26	0.03

**Table 3.** Statistics for estimated numbers of moose on the upper Kobuk River drainage during March 2003.

Year	Statistical Pop. estimator	Population estimate	Total ( $\pm$ SE)	80% CI <sup>a</sup> (% of est.) <sup>b</sup>	90% CI <sup>a</sup> (% of est.) <sup>b</sup>	95% CI <sup>a</sup> (% of est.) <sup>b</sup>
2003	GSPE	Total Moose	856 ( $\pm 100.8$ )	727 – 985 (15)	690 – 1022 (19)	658 – 1053 (23)
		Calves	91 ( $\pm 21.7$ )	63 – 119 (30)	56 – 127 (39)	49 – 134 (47)
2003	Moosepop	Total Moose	754 ( $\pm 117.4$ )	603 – 906 (20)	559 – 949 (26)	521 – 987 (31)
		Calves	77 ( $\pm 22.5$ )	48 – 106 (39)	39 – 114 (49)	32 – 121 (58)

<sup>a</sup> Upper and lower bounds of confidence intervals (CI).

<sup>b</sup> The confidence interval expressed as a percentage ( $\pm$ ) of the total estimate.

smaller area (1437 mi<sup>2</sup>; Dau et al. 1996) that was roughly centered in the 2003 survey area. We don't think there was a substantial difference in the proportion of high vs. low quality habitat between the 1995 and 2003 survey areas. In 2003, more moose were observed in the vicinity of Kobuk and Shungnak, an area not included in the 1995 survey area, than anywhere else. If moose are attracted to areas near villages by snow machine trails or low numbers of wolves as local residents suggest, including this area in the 2003 survey should have increased density compared to the 1995 estimate. In fact, the opposite occurred: density was lower in 2003. This makes the lower density observed in 2003 even more striking.

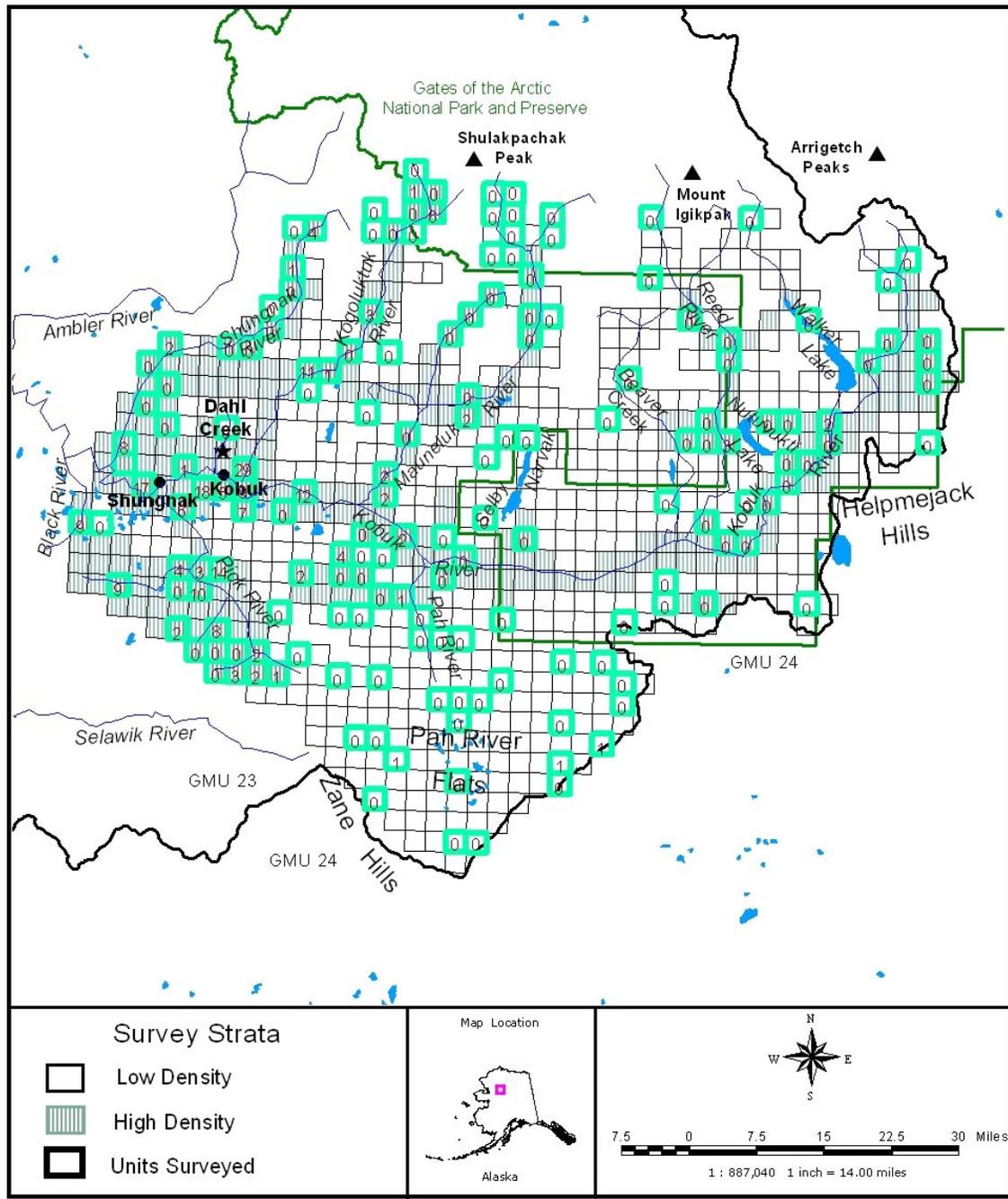


Figure 2. Units delineated for a moose survey on the upper Kobuk River in March 2003. Units were stratified as High if  $\geq 1$  moose was anticipated to be in the unit and Low if no moose were anticipated to be in the unit. Numbers in survey units completed indicate the total number of moose observed in that unit.

## **DISCUSSION**

The accuracy and precision of bull:cow and calf:cow ratios were adversely affected by the low number of moose we observed during November 2002. In addition, poor snow conditions during this time of year may have contributed to the low numbers of moose observed and this problem could be exacerbated if specific age or sex categories had different sightabilities.

Some of the variance associated with the total population size estimates from the March 2003 survey were likely due to the mis-stratification of a number of survey units. Given the low density of moose in the area, this problem is difficult to avoid given the mobility of moose and the difference between high and low moose strata (1 moose). During stratification, a unit was considered H if there were moose tracks within the unit. This definition may have been too liberal and future surveys may want to consider a more rigorous criteria for classifying a unit as a H such as an actual observation of a moose. Additionally, some variance was undoubtedly caused by the clumped distribution of moose within sample units stratified as H. For example, we observed 10-19 moose in 7 sample units and 29 moose in 1 sample unit. In contrast, the large size of the survey area likely improved precision as the larger area minimized the potential for small changes in moose distribution to adversely affect population estimates in the survey area. Although our November estimate of the bull:cow ratio seems unrealistically high, there did not appear to be a biological problem with the proportion of bulls in the population. Even so, densities of bulls may still affect breeding success if bull densities are low enough that not all estrous females can locate bulls (Rausch et al. 1974).

Calf:cow ratios during March of 1995 in the upper Kobuk River drainage (Dau et al. 1996) are similar to those observed in November 2002 (approximately 0.19 calf:cow and 0.21 calf:cow in 1995 and 2002, respectively). The density of calves in the upper Kobuk River drainage however, is considerably different between the 2 years. In March of 1995, there were 0.06 calves per  $\text{mi}^2$  (Dau et al. 1996) and in 2003 there were 0.02 calves per  $\text{mi}^2$ .

The change in density of moose calves from 1995 to 2003 is cause for concern as well as the overall low density of moose in the upper Kobuk River drainage. Moose density dropped from 0.57 moose per  $\text{mi}^2$  in 1995 (Dau et al. 1996) to 0.21 moose per  $\text{mi}^2$  (GSPE estimate) in 2003. Although two population estimates separated by 8 years is insufficient for evaluating population trends, an estimate of 0.21 moose per  $\text{mi}^2$  is extremely low. Similarly, moose density in the upper Koyukuk River drainage (South of Gates of the Arctic National Park and Preserve and adjacent to the area surveyed for this report) was only 0.36 moose per  $\text{mi}^2$  in 1999 (Saperstein 2002). Low moose densities in the Koyukuk River drainage generated enough concern in recent years that the Alaska Department of Fish and Game formed an advisory group to investigate the situation and propose means by which to increase moose numbers (Alaska Department of Fish and Game and the Koyukuk River Moose Hunters' Working Group 2001).

The low density of moose estimated for the survey area is worrisome and indicate the need for a conservative approach to managing moose in the upper Kobuk River drainage.

Moose population numbers are low enough to warrant a reduction in harvest levels to prevent hunting from contributing to this decline.

### RECOMMENDATIONS

1. Repeat the upper Kobuk River drainage in 2-3 years to evaluate population density.
2. Shorten the resident antlerless moose season 6 months (~75%). Change season to read: RESIDENT HUNTERS; 1 moose; however, antlerless moose may be taken only from Nov. 1-Dec. 31; a person may not take a calf or a cow accompanied by a calf (Season Aug. 1 – Dec. 31)
3. Shorten the resident bull season 3 months (~40%). Change season to Sept. 1 – Dec. 31.
4. Establish drawing permit hunts for nonresident hunters throughout the unit to ensure that resident hunters have adequate opportunity to harvest moose for recreation and subsistence.
5. Make federal and state moose hunting regulations consistent throughout the Kobuk River drainage.

### COSTS

The costs of this survey were shared between the National Park Service and the Alaska Department of Fish and Game (Table 4). A considerable portion of the expenses of this survey can be attributed to the cost of having fuel delivered to a remote site. This cost could be reduced by developing a better method for securing fuel at the Dahl Creek airstrip. Flight times to complete the March survey are presented in Table 5.

**Table 4.** Costs of an aerial survey to estimate moose sex and age composition and population level on the upper Kobuk River drainage during November 2002 and March 2003.

	Cost	Item Description
ADF&G	\$1429	3000 kw generator
	\$13	Padlocks (2)
	\$183	Felt tip pens, tape, heat gun, propane, misc.
	\$46	Tarps, tape, misc.
	\$15	Clear contact paper
	\$321	Avgas for stratification
	\$257	Lodging for stratification crew
	\$1452	Airfare for stratification crew
	\$20	Goldstreak
	\$435	Per diem; stratification crew
	\$3026	NW aviation charter (SU surveys)
	\$35	Unleaded gas for generators
	\$135	Airfare: A. Nelson to Dahl Creek-OTZ
	\$150	H. Horner; observer

	\$600	A. Nelson: observer
	\$900	D. Pungalik: wood & water for Dahl Creek
	\$1500	A. Lie; cabin rental
	\$150	V. Karmun; Stratification observer
	\$10667*	TOTAL
NPS	\$10,050	Avgas delivered to Dahl Creek (33 barrels @ 55 gal. Barrel)
	\$2036	Charter (Cessna 206) to evaluate lodging at Dahl Creek
	\$868	Charter (Cessna 206) to transport gear to Dahl Creek
	\$384	1:250 USGS maps
	\$26	Bung wrenches (2)
	\$27	Cam locks for fuel system plumbing
	\$3	Adapter ring for fuel siphon hose
	\$109	Groceries for 3 people for 4 days of work (Nov. survey)
	\$5960	Charter (Cessna 206) for moose composition (Nov. survey)
	\$514	Hose for fueling planes at Dahl Creek
	\$733	Groceries for moose survey (10 people for 7 days)
	\$82	Groceries for moose survey (misc. items)
	\$2330	Charter (Scout) for stratification (March survey)
	\$3991	Charter time (Supercub) March SU survey
	\$2948	Charter time (Cessna 206) gear and personnel to Dahl creek
	\$3807	Charter time (Scout) March SU survey
	\$2554	Charter time (Supercub) March SU survey
	\$1685	Charter time (Cessna 185) gear and personnel to Dahl creek
	\$3000	Max Lyons; Lodging at Dahl Creek (\$500/night)
	\$15	Film development/photographs
	\$41122	TOTAL
	\$51789*	GRAND TOTAL

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\* Costs not included in this estimate are ADF&G flight times and some fuel costs.

**Table 5.** Flight times of survey planes for March survey on the upper Kobuk River, 2003

	Plane	Ferry Time (h)	Survey Time
ADF&G	Stratification		
	C-185	8	11
	PA-18	13.5	15
	Sample unit survey		
	PA-18	4.5	21.4
	PA-18	4.5	13.9
	Misc.		
	PA-18		5.0 (gear to Dahl creek)
	PA-18		8.0 (Check snow conditions prior to survey)
	NPS	Stratification	
Bellanca Scout			13.7 (includes ferry time)
Sample unit survey			
PA-18		9.0	7.8
PA-18		6.17	17.99
Bellanca Scout		5.5	16.83
Misc.			
C-206			7.25 (Check out lodging at Dahl creek)
C-185			6 (gear and personnel transport from FAI to Dahl Creek)
C-206			10.5 (Shuttle gear and personnel from FAI to Dahl Creek)

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