



Yukon Flats National Wildlife Refuge Report – 2007-01

Moose population surveys in the western Yukon Flats including proposed land exchange areas

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ABSTRACT

We conducted moose surveys in the western Yukon Flats in March and November 2006. The surveys were initiated to estimate early winter moose abundance in the traditional 2,269 mi² moose survey area and to estimate early and late winter moose densities in lands proposed for exchange between the Yukon Flats National Wildlife Refuge (Refuge) and Doyon, Limited (Doyon). The March 2006 population estimate for exchange lands in the western Yukon Flats (578 mi² survey area) was 65 moose +/- 33% at the 0.90 confidence level; the mean density estimate was 0.11 moose per mi² +/- 33%, 0.90 confidence level. The November 2006 population estimate for exchange lands surveyed in the eastern and western Yukon Flats (1,108 mi² survey area) was 249 moose +/- 31% at the 0.90 confidence level; the mean density estimate was 0.22 moose per mi² +/- 31%, 0.90 confidence level. Of the land parcels proposed to be received by the Service in the proposed land exchange, approximately 63% include average to high moose densities in early winter and all parcels have low densities of moose in late winter. Parcels proposed to be received by Doyon are characterized by low moose densities in both early and late winter.

The November 2006 population estimate for the traditional 2269 mi² western Yukon Flats survey area was 418 moose +/- 21% at the 0.90 confidence level; the mean density estimate was 0.18 moose per mi² +/- 21%, 0.90 confidence level. We estimated 40% fewer total moose in 2006 compared to 2001 which is a statistically significant decline ($P < 0.02$). The annual rate of decline from 2001 to 2006 is about 8%. Estimated numbers of bulls, cows and calves all follow this declining trend with decreases in 2001, 2005, and 2004 of 18%, 7% and 40%, respectively. The decrease in moose density is likely due to high mortality rates of cow and calf moose as indicated by reported harvest and low numbers of observed calves in moose surveys. Cows comprise a significant portion of moose harvested throughout the Yukon Flats and account for up to 26% of total harvest in the western Yukon Flats. Although bear harvest has significantly increased in the eastern Yukon Flats it has decreased in the western Yukon Flats. Wolf harvest has increased in the western Yukon Flats since 2002. Decreased bear harvest in the western Yukon Flats may be contributing to decreased calf survival. We infer that the moose population in the western Yukon Flats has the capacity to grow quickly based on previous work that documented a high incidence of twinning and good condition of both cow and calf moose. Protection of breeding age cow moose should be the focus for moose management in the Yukon Flats. This objective can be achieved by increased education, outreach and enforcement efforts in partnership with local tribal governments and local residents.

INTRODUCTION

The Refuge is in negotiations with Doyon to consider exchanging approximately 44,515 hectares (110,000 acres, parcel 18 Figure 1) of Refuge lands in the southern Yukon Flats for an equal dollar value of Doyon lands in the region. An Environmental Impact Statement (EIS) is currently being prepared to address concerns related to this proposed action.

Moose surveys are conducted annually in two separate survey areas, one in the eastern Refuge (2,936 mi²) that includes the villages of Fort Yukon and Chalkyitsik, and the other in the western Refuge (2269 mi²) that includes the villages of Stevens Village and Beaver (Figure 1). The Refuge and local village residents conduct the western survey and the Alaska Department of Fish and Game and the Council of Athabascan Tribal Governments conduct the eastern survey. Only 39% of lands involved in the proposed exchange (exchange lands) are included in traditional annual moose survey areas, the majority are not and only anecdotal moose density information is available.

Additional areas were surveyed in March 2006 and November 2006 in an effort to better describe moose use in all exchange lands. The March 2006 survey included exchange lands exclusively. The November 2006 surveys of the eastern and western Yukon Flats included the traditional annual survey areas (and exchange lands therein) and exchange lands outside traditional survey boundaries.

This report summarizes findings of the November 2006 surveys of the western Yukon Flats traditional survey area and the March 2006 exchange lands survey. A comprehensive summary of the traditional eastern Yukon Flats survey area which includes some exchange lands can be found in Stephenson and Thomas 2007.

STUDY AREA

The Refuge area is characterized by mixed forests, dominated by white spruce (*Picea glauca*), black spruce (*Picea mariana*), paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), and balsam poplar (*Populus balsamifera*). Forested areas comprise the majority of the survey area. Shrub communities of alder (*Alnus*) and willow (*Salix spp.*) are most common in riparian sites and surrounding lakes and meadows. Dwarf shrubs such as glandular birch (*Betula glandulosa*), Labrador tea (*Ledum decumbens*), crowberry (*Empetrum nigrum*), and blueberry (*Vaccinium uliginosum*) are common in the uplands. Burned habitats are dispersed throughout the survey areas and include much of the uplands south and west of Beaver and areas north of the Porcupine River.

Western Yukon Flats

The western Yukon Flats traditional study area extends from White Eye (near the lower mouth of Birch Creek), south to Mt. Schwatka, and west to Stevens Village (Figure 1). This survey area is 2,269 square miles. The western Yukon Flats study area was surveyed in November 2006.

Exchange Lands

Moose estimates were calculated separately for exchange lands. Exchange lands occur within both the western and eastern survey areas, and include additional lands outside of these traditional survey areas. Parcels 3, 5, 6, 7, 12 and 13 are within the traditional western Yukon Flats study area, and parcels 8, 9, 10, 11, and 17 are within the traditional eastern Yukon Flats study area. Parcels 1, 2, 4, 14, 15, 18 (the 110,000 acre parcel in upper Beaver Creek), and 19 (Halo lands) occur outside the traditionally surveyed areas (Figure 1). All exchange lands (1,108 mi²) were surveyed in November 2006, and all exchange lands but those in the eastern study area, parcel 13, and the Halo lands were surveyed in March 2006 (total area surveyed = 578 mi²). Population estimates were calculated separately for the exchange lands surveyed in each of these survey periods.

METHODS

Moose population estimation surveys were conducted according to methods outlined in Gasaway et al. 1986 and Ver Hoef 2001. Gasaway methods provide the foundation for modern day geospatial methods. The 2006 publications, "GeoSpatial Population Estimator Software User's Guide" (DeLong 2006), and "GeoSpatial Survey Operations Manual" (Kellie and DeLong 2006) provided guidelines for sample unit design and selection, navigation, and data analysis. Two computer software programs, Moosepop and the GeoSpatial Population Estimator (GSPE) were used to analyze data.

Units were stratified in the western Yukon Flats with a Found Bush hawk by flying one east/west transect through the center of each unit. The stratification aircraft was operated at a ground speed of 130 mph and at a height of about 1,000 feet above ground level (AGL). The pilot and navigator used a Global Positioning System (GPS) to navigate and determine when the aircraft was entering and exiting a unit. Two rear seat observers located moose and tracks. Units that were thought to have one or more moose were stratified high density, the remaining units were stratified low density. Units in the eastern Refuge were stratified based on results of a 1999 stratification. A stratified random sample was selected to determine which units to survey in each survey area.

Two seat utility aircraft were used to survey 5.3 mi² units bounded by two minutes of latitude (north to south) by five minutes of longitude (east to west). Sampling aircraft used GPS to navigate to and within assigned units. Search intensity varied with habitat. The survey protocol required high search intensity in forested habitats (8-10 minutes per square mile) and lower intensity in open habitats or areas with significant water. Survey aircraft generally flew 12 to 15 east/west transects in each unit, about 200 to 300 meters apart, at 200 to 300 feet AGL at 70 knots. However, north to south transects were flown when adjacent north and south units were assigned for survey.

Population estimates were calculated for the traditional western study area for November 2006, for all exchange lands surveyed in November 2006, and for exchange lands surveyed in March 2006.

RESULTS

Stratification

March 2006 Exchange Lands Survey - The stratification of proposed exchange lands in the western Yukon Flats was conducted March 6, 2006. Snow cover was complete over the survey area with snow depths that averaged about 25 inches. The survey time for the stratification was 2 hours and 45 minutes. The average rate of sampling was .7 minutes per mi^2 or 1.5 minutes per unit (Table 1). Thirty-five percent ($n=37$) of the survey area was stratified as high density, the remaining 70 units were judged low density (Figure 2). A total of 16 moose was observed by the stratification crew. The crew also observed numerous wolf tracks in Mud Lakes, on Beaver Creek about 8 miles south of Beaver, on upper Beaver Creek in the uplands, and near Sussaymin Lakes northwest of Stevens Village. Muskrat pushups were present in some areas but not widespread or abundant in the study area.

November 2006 Western Yukon Flats Survey (including Exchange Lands) - The stratification of the western Yukon Flats moose survey area which included some proposed exchange lands, was conducted November 13 to 15, 2006. Snowcover was complete with about 8 inches of snow. Total survey time for all areas was 12 hours and 41 minutes at a rate of 0.23 minutes per mi^2 or 1.2 minutes per sample unit. Thirty-four percent ($n=70$) of the 1,108 mi^2 exchange lands survey area was high density, the remaining 136 units were low density (Figure 3). Twenty-nine percent ($n=122$) of the 2,269 mi^2 western survey area was stratified as high density, the remaining 299 units were low density (Figure 4). The stratification crew observed 133 moose which included seven moose in exchange lands. Discontinuous ground fog hampered stratification on November 15 and prevented completion of 10 sample units in the White Mountains; but these units were stratified later in the week by survey aircraft. A wolf pack including 8 blacks and 2 grays was observed about 5 miles east of Beaver in Mud Lakes. Wolf tracks were observed throughout the survey area including Mud Lakes, Beaver Creek, Hodzana River, Dall River, and Meadow Creek. Muskrat pushups were present but not abundant.

Unit Sampling

March 2006 Exchange Lands Survey - Survey aircraft sampled 42 (39%) of 107 stratified units in four survey days from March 6-12 (Table 2). These included 22 (59%) of the 37 units stratified as high density and 20 (29%) of the 70 units stratified as low density (Figure 2). Crews were able to survey 6 to 10 units daily. Weather was variable (-20° to 5° F) with mostly clear weather. Mean search time was 4.8 minutes per mi^2 for all units in all habitats. A total of 31 moose was observed in sampled units including 2 calves and 29 adults (Table 6). One lynx was observed during surveys.

November 2006 Exchange Lands Survey - On exchange lands we sampled 58 (28%) of the 206 units. These included 29 (41%) of the 70 high density units and 29 (21%) of the 136 low density units (Figure 3). Weather and mean search times were similar to those reported above. We observed 7 moose. Sex and age composition of observed moose is in Table 6.

November 2006 Western Yukon Flats Survey - In six survey days between November 13 to 19 survey aircraft sampled 97 (23%) of 421 units in the western Yukon Flats. These included 65 (53%) of the 122 units stratified as high density and 32 (11%) of the 299 units stratified as low density. Temperatures warmed though the week and ranged from -20 to 0°F. Mean search time was 5.7 minutes per mi². We observed 175 moose (Figure 4). Sex and age composition of observed moose are in Table 6. Additional observations included one gray wolf near Stevens Village, two fox and four lynx. Moose cratering was observed in Mud Lakes and on and adjacent to the Yukon River downstream from Beaver.

Population Status

Because there was no evidence of spatial autocorrelation in the data set, the results between the Moosepop and GSPE analysis programs were nearly identical. The following results are based on GSPE.

March 2006 Exchange Lands Survey - The population estimate for all exchange lands in the 578 mi² survey area was 65 moose +/- 33% at the 0.90 confidence level (range: 44 to 86 moose) (Table 2). Estimates of adults and calves are in Table 5. The density estimates for the high and low strata were 0.19 and 0.07 moose per mi², respectively, with an average of 0.11 moose per mi² +/- 33%, 0.90 confidence level (range: 0.07 to 0.15 moose per mi²). Calves represented 5% of the estimated population. The density estimates for land exchange parcels are included in Table 3.

November 2006 Exchange Lands Survey - The population estimate for all exchange lands in the 1,108 mi² survey area was 249 moose +/- 0.31 at the 0.90 confidence level (range: 172 to 326 moose) (Table 2). Estimated sex and age composition is in Table 5. The density estimates for the high and low strata were 0.64 and 0.13 moose per mi², respectively, with an average of 0.22 moose per mi² +/- 31%, 0.90 confidence level (range: 0.15 to 0.29 moose per mi²). Calves represented 10% of the estimated population. The density estimates for land exchange parcels are included in Table 4.

November 2006 Western Yukon Flats Survey - The population estimate for the 2269 mi² western Yukon Flats survey area was 418 moose +/- 21% at the 0.90 confidence level (range: 330 to 506 moose) (Table 2). Estimated sex and age composition is presented in Table 5. The density estimates for the high and low strata were 0.47 and 0.06 moose per mi², respectively, with an average of 0.18 moose per mi² +/- 21%, 0.90 confidence level (range: 0.14 to 0.22 moose per mi²). Calves represented 12% of the estimated population.

DISCUSSION

Stratification

March 2006 Exchange Lands Survey - We did not correctly stratify 29% of the sample units. Thirty-six percent of units stratified as high density contained no moose and 20% of units stratified as low density contained one or more moose. Since 1999 the proportion of units incorrectly stratified has ranged from 28% to 43% so the 2006 stratification was within previous

ranges. Moose movement in and out of units between stratification and survey partially explain incorrect stratification of some units. Eleven of 16 observed moose were near Beaver Creek in parcel 18. The remaining observed moose were in the Mud Lakes region and lower Beaver Creek, east and west of Beaver Village (parcels 3, 7, and 14).

November 2006 Exchange Lands Survey – We did not correctly stratify 10% of sample units. Twenty-one percent of units stratified as high density contained no moose and 0% of units stratified as low density contained one or more moose. We attribute the low percentage of missed calls in the low density stratum to the ground fog (i.e., we likely overestimated the low density stratum) which hampered stratification on November 15. Six moose were observed in parcels 15, 18, and 19.

November 2006 Western Yukon Flats Survey – We did not correctly stratify 24% of sample units which was a slightly lower percentage than previous surveys since 1999 (mean 29%). Twenty-eight percent of units stratified as high density contained no moose and 16% of units stratified as low density contained one or more moose. As in previous fall surveys moose were dispersed throughout burned areas and highest concentrations occurred in Mud Lakes and adjacent to the Yukon River. We observed 126 moose during the stratification which is the second lowest number of moose observed since the GSPE survey was initiated in 1999 (1999 -152 moose, 2000-78 moose, 2001-159 moose, 2004-189 moose). In 2000, ground fog significantly reduced sightability on two of three stratification survey days.

Unit Sampling

March 2006 Exchange Lands Survey – The observed moose density in 11 exchange parcels that were surveyed (227 mi²) was 0.14 moose mi² which is representative of lower than average moose density in the western Yukon Flats.

November 2006 Exchange Lands Survey – The observed moose density in 17 exchange parcels that were surveyed (312 mi²) was 0.32 moose mi² which is comparable to the 2269 mi² western Yukon Flats survey area moose density of 0.36 mi².

November 2006 Western Yukon Flats Survey - We compared the moose densities observed between 1992, 1996, 1999, 2000, 2001, 2004, and 2006 fall moose population surveys. Although the observed density of 0.36 moose per mi² in 2006 is a 6 percent increase from 2004, it is among the lowest observed densities since 1992 (Table 6). The 2006 observed density of calf moose, 0.04 moose per mi², is of particular interest. The observed calf moose density between 1992 and 2006 (n=9, areas surveyed 104 to 1009 mi²) ranged from 0.04 to 0.16 calf moose per mi² (mean 0.08, n=9). The observed density in 2006 represents a 33% decrease from 2004 and a 50% decrease from the long term 1992 to 2006 mean. Observed densities of cow moose also follow a decreasing trend since 1992 and have decreased 41% since 2001. In comparison observed bull densities have remained stable since 1999.

Population Status

March 2006 Exchange Lands Survey – We compared estimated moose densities between parcels surveyed in late winter (March) and previous late winter surveys conducted in 1999, 2003 and 2004 in the western Yukon Flats. Mean densities for the 1999, 2003, and 2004 surveys were 0.32, 0.23 and 0.28 moose per mi^2 (Table 2). Density estimates for each of the 11 exchange parcels ranged from 0.04 to 0.19 moose per mi^2 with a mean density of 0.11 moose per mi^2 for all exchange lands (Table 3). All parcels from the western Yukon Flats included in the exchange are characteristic of low density moose habitat in late winter.

November 2006 Exchange Lands Survey – We compared estimated moose densities between parcels surveyed in early winter (November) and previous early winter surveys conducted in 1999, 2000, 2001, 2004 and 2006 (Table 2). Mean densities were 0.38, 0.30 and 0.29, 0.23 and 0.18 moose per mi^2 , respectively. The mean density for all early winter exchange lands surveyed in 2006 was 0.22 moose per mi^2 with individual parcels ranging from 0.00 to 0.86 moose per mi^2 (Table 4). The mean density estimate for all exchange lands exceeded the 2006 estimate for all lands in the western Yukon Flats survey area indicating that as a whole the exchange lands likely represent favorable early winter moose habitat. However there is variation between parcels.

Parcels 1, 2 and 6 near Stevens Village are characterized by low moose densities. Parcels 3, 5, 7, and 13 located near Beaver are above average but mostly high density (range 0.27 to 0.86 moose/ mi^2). These lands include Mud Lakes and the Beaver Creek corridor. Parcel 13 included the highest moose densities recorded for all parcels in the survey (0.86 moose/ mi^2). Parcel 12, situated northwest of Beaver on the Hodzana River is low density. Parcels 4, 14, and 15 situated nearest Birch Creek Village include low but primarily high density lands (range 0 to 0.44 moose/ mi^2). Parcel 17, east of Fort Yukon contained average densities of moose. Parcels 8, 9 and 10 on the Porcupine River included the largest aggregate of high density moose habitat (range 0.57 to 0.73 moose/ mi^2 , mean 0.65). Parcel 10 near Chalkyitsik was slightly below average moose density. Both parcels 18 and 19 were characterized by low moose densities in early winter.

In summary, of the parcels proposed to be received by the Service (parcels 1 to 17) approximately 63% include average to high moose densities in early winter and all parcels have low densities in late winter. Parcels proposed to be received by Doyon (parcels 18 and 19) are characterized by low moose densities in both early and late winter.

November 2006 Western Yukon Flats Survey - Population statistics for the 2006 western Yukon Flats survey and previous surveys are included in Tables 2 and 5. We attribute variation in the population estimate to the scattered distribution of the moose population, the presence of predators influencing moose movement, and the small size of the survey units, which increased the number and length of unit boundaries and therefore increased the likelihood that moose would cross unit boundaries. We had numerous instances of moose observed on sample unit boundaries during the survey. All these reasons for variation are common and are experienced in all moose population surveys.

Population trends for the western Yukon Flats have decreased annually since 1999 (Figure 5). We estimated 40% fewer total moose in 2006 compared to 2001 which is a statistically significant decline ($P < 0.02$). The annual rate of decline from 2001 to 2006 is about 8%. Estimated numbers of bulls, cows and calves all follow this declining trend (Figure 6).

The 2006 estimated bull/cow (65/100) and calf/cow (22/100) ratios are within the range of reported ratios since 1999. Unlike 2004 which recorded the lowest yearling bull/cow ratio (5/100), we recorded the highest yearling bull/cow ratio in 2006 (18/100). The abundance of yearling bulls may indicate good recruitment of calves from the previous year due to increased bear harvest and/or adequate over-winter survival.

The Council of Athabascan Tribal Governments, under contract with the U.S. Fish and Wildlife Service (USFWS), has collected the only comprehensive moose and predator harvest information for the Yukon Flats (Table 7). The surveys, conducted for calendar years 2002/2003, 2004/2005, and 2005/2006, include reported subsistence season moose harvest and reported potlatch harvest for villages in and adjacent to the Yukon Flats. Since 2002 the annual harvest of bull moose has ranged from 126 to 228 moose with an increase of 52% between 2004/2005 and 2005/2006. Between 2002 and 2006 the proportion of reported cows harvested from all villages has ranged from 7 to 23 percent depending on how many cows are included in the unreported sex component of the harvest; the harvest of bears has doubled annually; and the harvest of wolves has increased.

There are regional differences in harvest patterns. The villages in the western Yukon Flats (Beaver, Stevens Village, and Birch Creek) report an inverse trend in bull harvest since 2002 with a 26% decrease in bull harvest between 2004/2005 and 2005/2006 compared to the remaining villages (Fort Yukon, Chalkyitsik, Venetie, and Circle) (Table 8). Western Yukon Flats villages also report a slightly higher proportion of cows harvested (range of 16 to 26 percent). The proportion of bears reported harvested by the western Yukon Flats villages (compared to all Yukon Flats villages combined) has declined annually since 2002 (52% - 2002/2003, 33% - 2004/2005, 7% - 2005/2006). However, the proportion of total wolf harvest in the western villages has increased since 2002 (21% - 2002/2003, 24% - 2004/2005, 34% - 2005/2006).

The strength of these harvest surveys is that they are conducted by local residents and are viewed favorably by many local residents so cooperation is generally high. Caution must be taken when making annual reported harvest comparisons due to the variance of households interviewed annually (range: 42 to 88%), the differences between years in the total number of available households within the Yukon Flats villages (range: 408 to 478) which effects available community hunting pressure, and changing environmental factors. For example low water levels in main tributaries (i.e., Porcupine River and Black River) off the Yukon River in 2004 and 2005 severely restricted hunter access which likely decreased moose harvest.

Despite the cautionary notes above, it is apparent that cows comprise a significant portion of moose harvested throughout the Yukon Flats with up to 26% of total reported harvest in the

western Yukon Flats. Bear harvest has significantly increased in the eastern Yukon Flats but has decreased in the western Yukon Flats. Wolf harvest has increased in the western Yukon Flats since 2002 (Table 8).

In summary, it appears that the moose population in the western Yukon Flats has decreased since 1999. The decrease is likely due to high mortality rates of cow and calf moose as indicated by reported harvest and low numbers of observed calves in moose surveys. Decreased bear harvest in the western Yukon Flats may be contributing to decreased calf survival. Because habitat is purportedly high quality and under utilized in the western Yukon Flats and snow depths are not extreme, it is unlikely that habitat or environmental change is responsible for the population decrease.

We infer that the moose population in the western Yukon Flats has the capacity to grow quickly based on previous work that documented a high incidence of twinning and good condition of both cow and calf moose. Protection of breeding age cow moose should be the focus for moose management in the Yukon Flats. This objective can be achieved by increased education, outreach and enforcement efforts in partnership with local tribal governments and local residents.

COSTS

The total costs for the March and November 2006 surveys were \$5,133.00 and \$22,690.00, respectively. See Table 9 for a full listing of expenditures.

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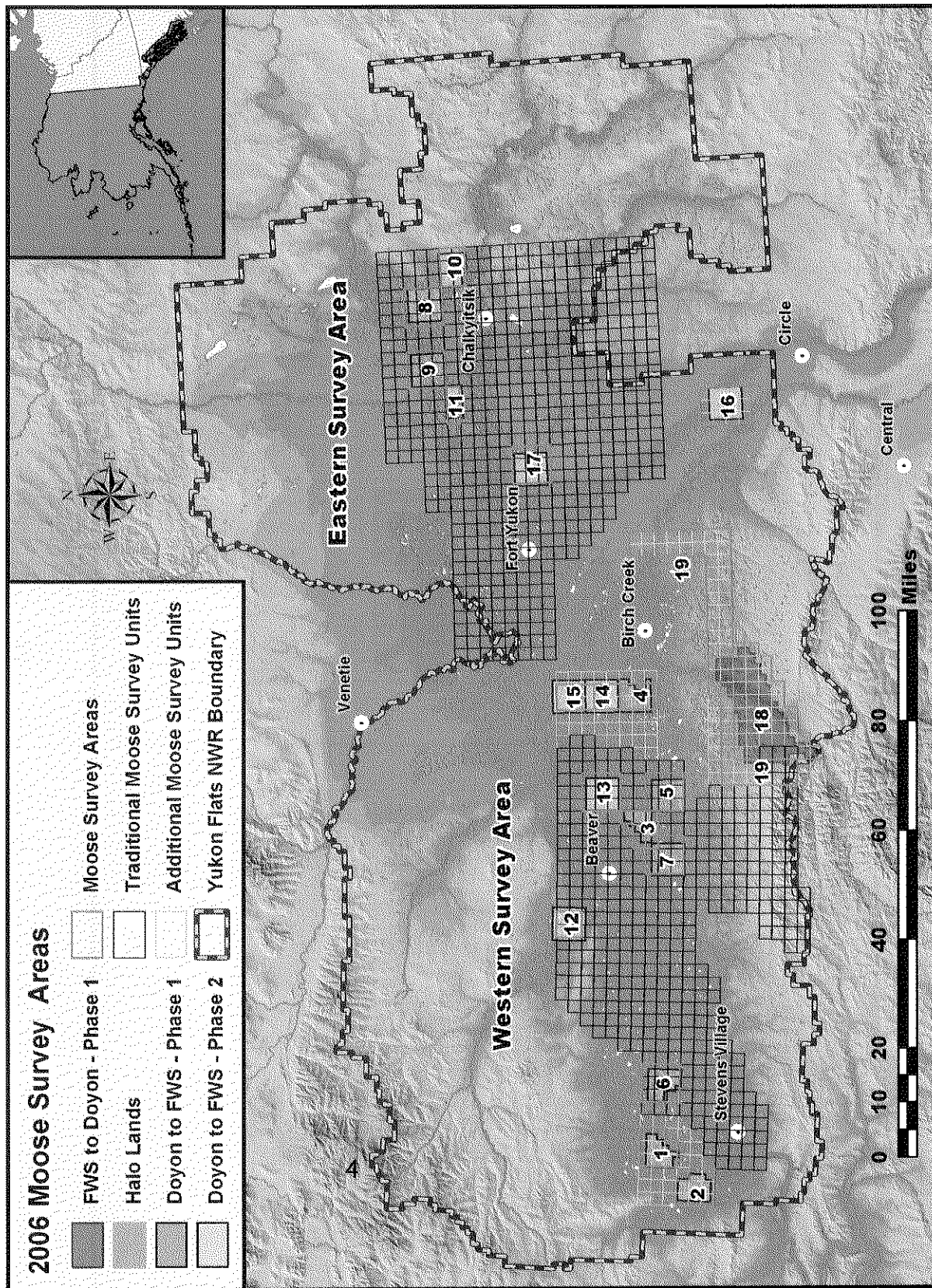


Figure 1: 2006 Moose Survey Areas in Western and Eastern Yukon Flats

Figure 2. Sampling and stratification for the March 2006 Exchange Lands Moose Survey.

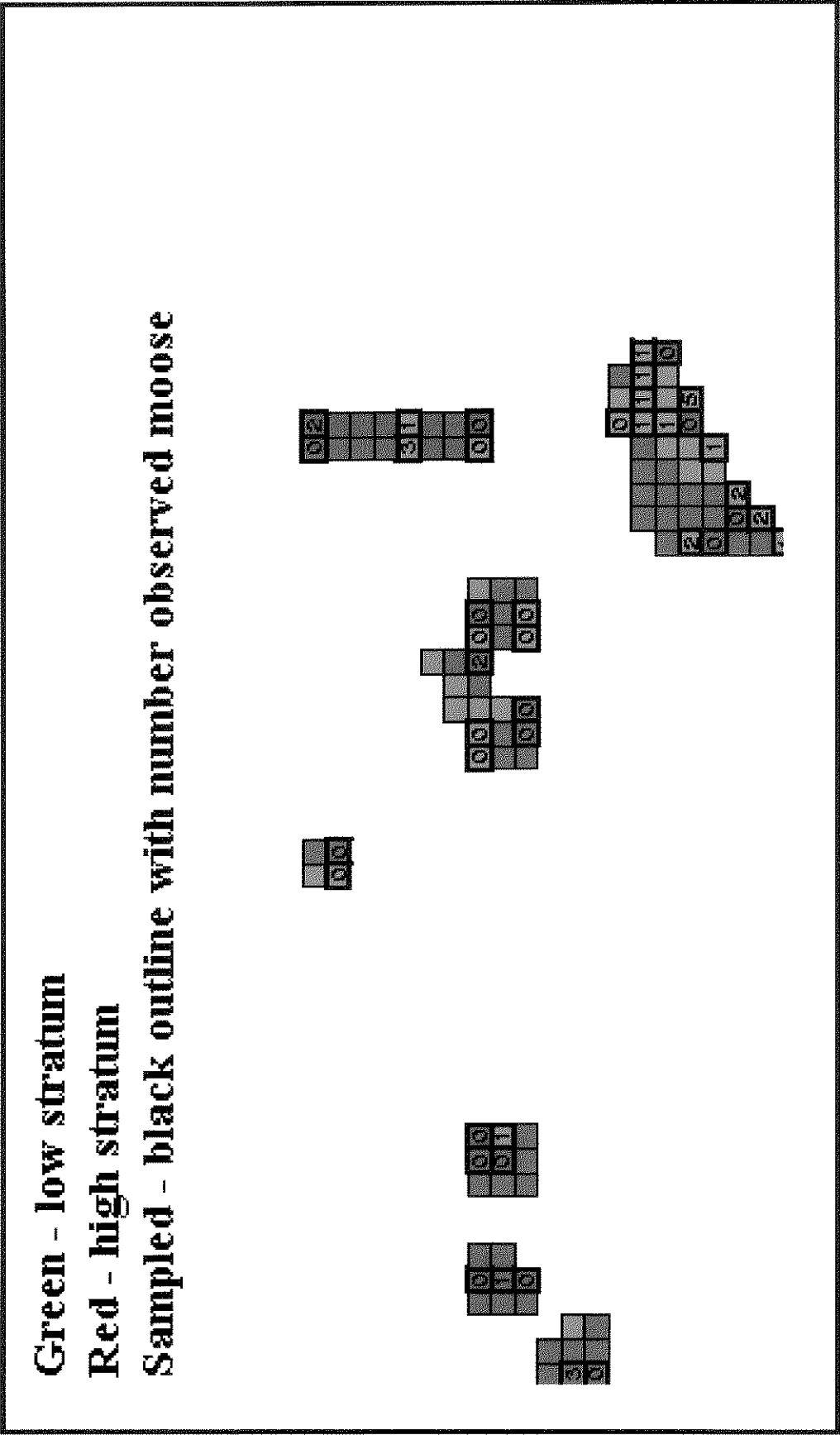


Figure 3. Sampling and stratification for the November 2006 Exchange Lands Moose Survey.

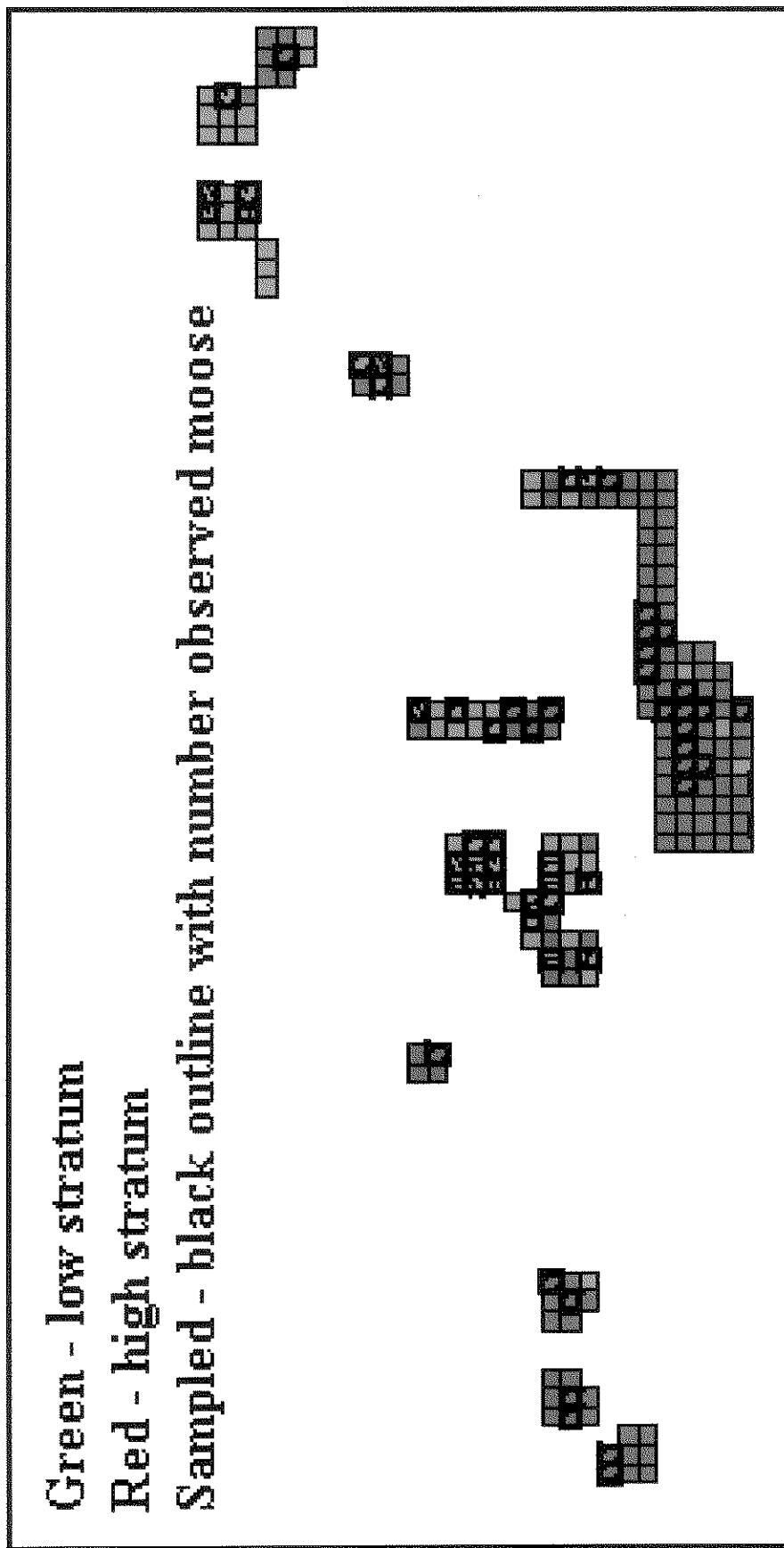


Figure 4. Sampling and stratification for the November 2006 Western Yukon Flats Moose Survey.

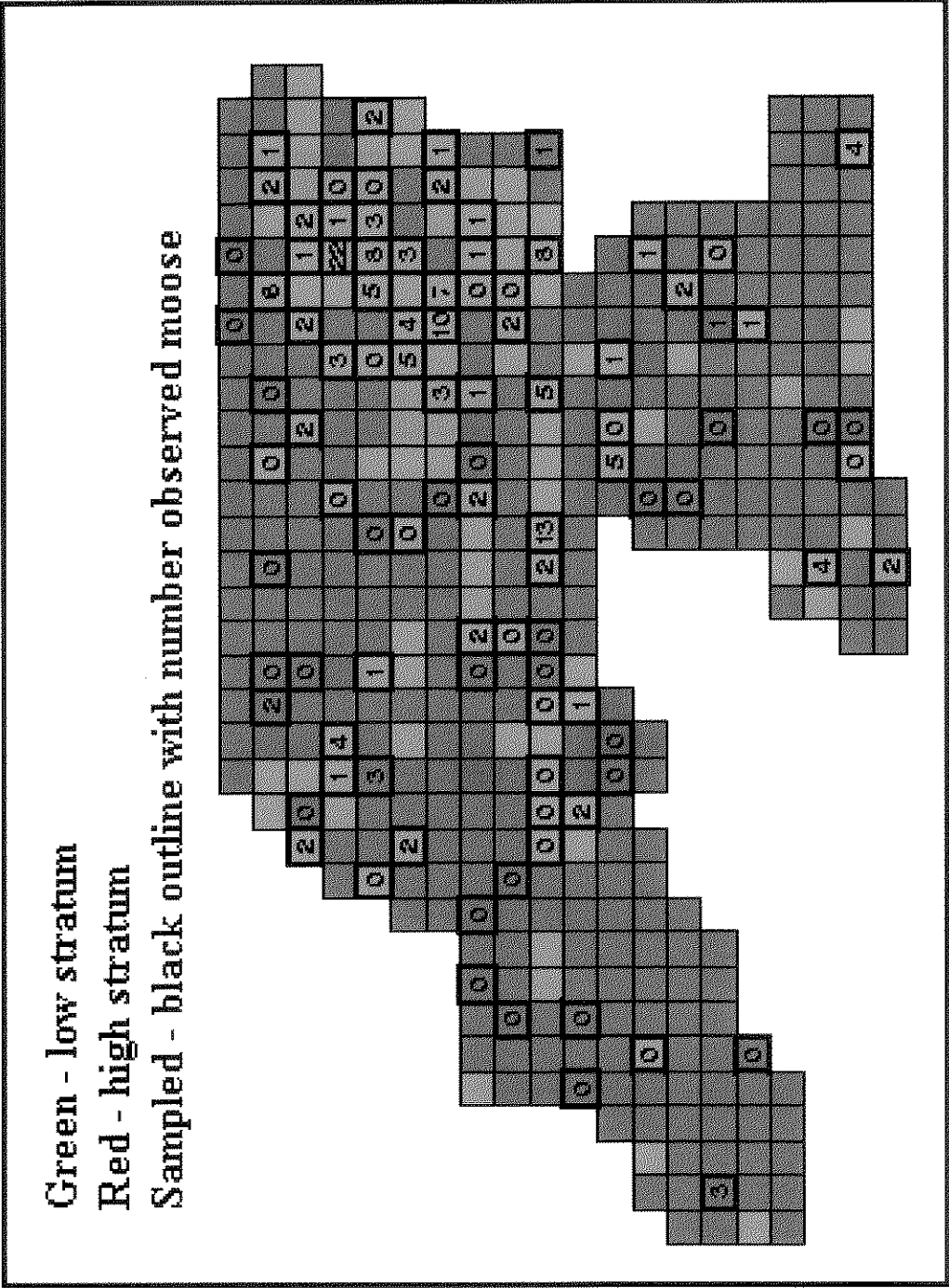


Figure 5. Estimated numbers of moose depicted with range of error (0.90 confidence interval) in the western Yukon Flats, 1999-2006.

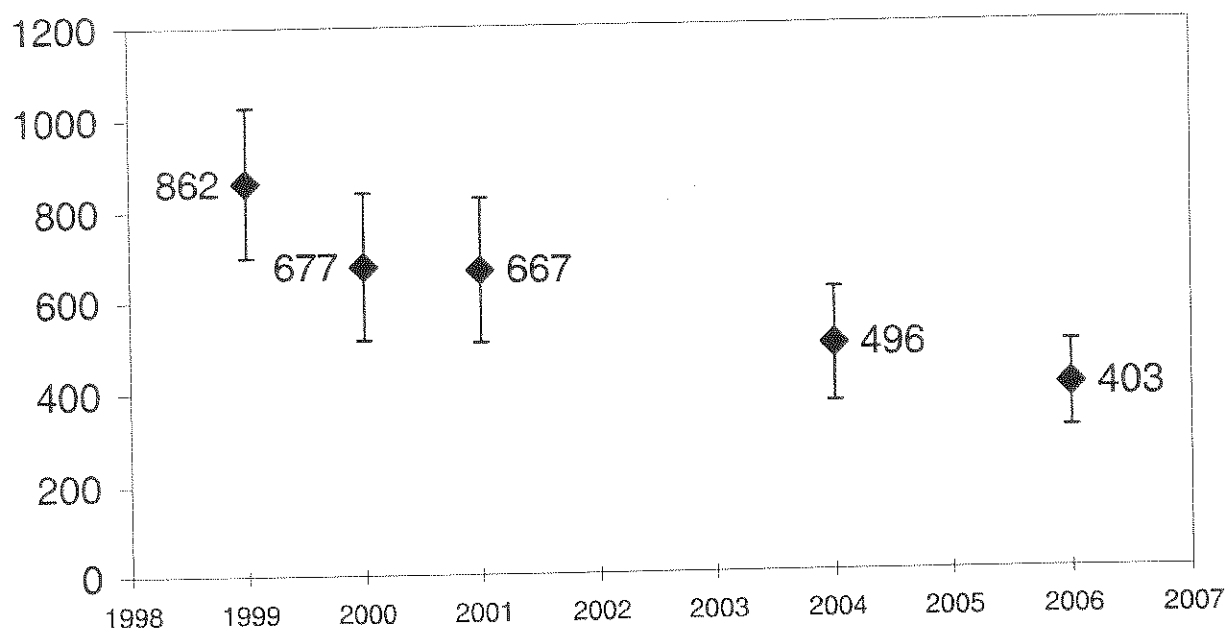


Figure 6. Estimated numbers of calves, bulls, and cows in the western Yukon Flats, 1999-2006.

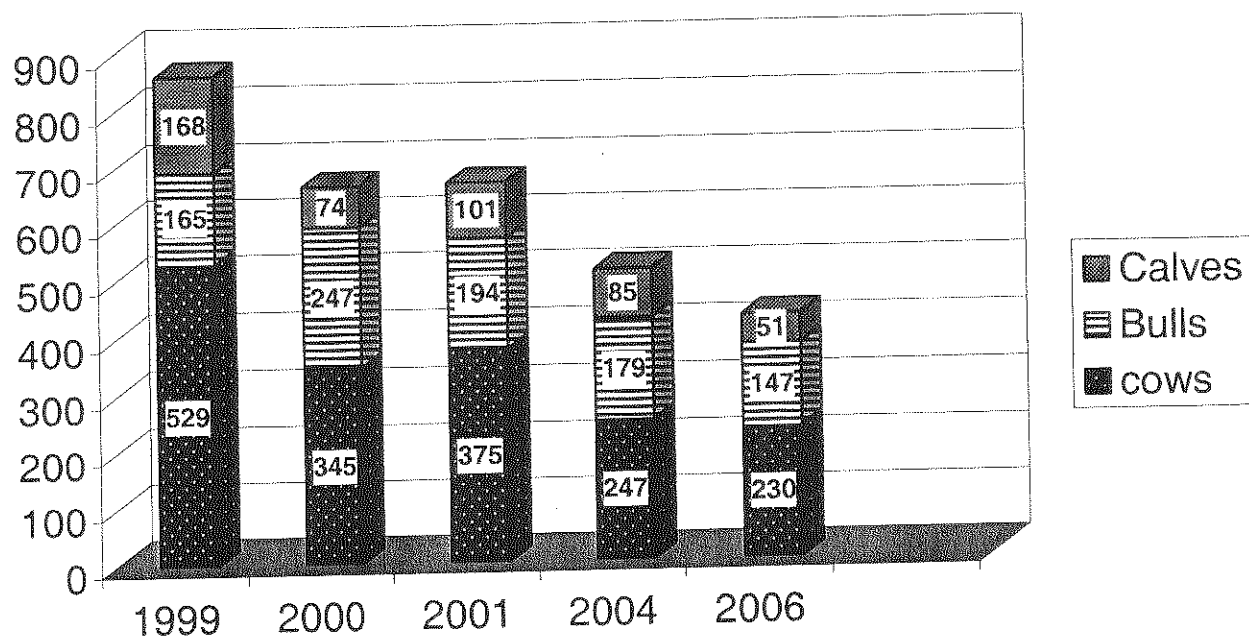


Table 1. Summary of stratifications for moose population estimation surveys on the western Yukon Flats, 1992 to 2006.

Survey Year and Type	Area (mi ²)	Stratified Units (mi ²)			Sampled Units (mi ²)			Total Time Hours/Minutes	Minutes Per Square Mile	Minutes Per Unit
		#High	# Med	#Low	#High	#Med	#Low			
Nov 1992 Stratified Random	4544	26	42	283	26	30	20	--	--	--
		348	515	3682	343	379	286			
Nov 1992 Stratified Random	1532	14	25	80	14	20	3	--	--	--
		184	308	1040	184	247	46			
Nov 1996 ¹ Regression Analysis	1532	37	41	41	9	9	9	12' 53"	0.50	--
		539	516	476	124	122	120			
Mar 1999 GSPE	2269	103	--	318	49	--	47	9' 38"	0.26	1.4
		554	--	1714	264	--	253			
Oct 1999 GSPE	2269	153	--	268	64	--	29	11' 20"	0.30	1.6
		825	--	1444	345	--	156			
Oct 2000 GSPE	2269	183	--	238	69	--	25	12' 24"	0.33	1.7
		987	--	1281	371	--	124			
Nov 2001 GSPE	2269	166	--	255	61	--	37	8' 29"	0.23	1.2
		895	--	1374	334	--	199			
Mar 2003 GSPE	2269	109	--	312	63	--	38	12' 11"	0.32	1.7
		587	--	1682	340	--	206			
Mar 2004 GSPE	2269	102	--	319	51	--	40	9' 52"	0.26	1.4
		548	--	1720	274	--	216			
Nov 2004 GSPE	2269	130	--	291	65	--	28	9' 29"	0.25	1.4
		700	--	1569	350	--	151			
² ar 2006 GSPE Exchange Lands	578	37	--	70	22	--	20	2'41"	0.7	1.5
		200	--	378	119	--	108			
³ Nov 2006 GSPE	2269	122	--	299	65	--	32	12" 41"	0.23	1.2
		656	--	1612	349	--	172			
³ Nov 2006 GSPE Exchange Lands	1,108	70	--	136	29	--	29	Included in above	Included in above	Included in above
		374	--	735	155	--	157			

¹ In 1996 the samples units were not stratified high, medium and low. Number in the high, medium, and low columns indicate the total area and area sampled in the Stevens, Beaver, and Schwatka survey units, respectively.

² Surveys of proposed land exchange areas in the Yukon Flats, Stratification crew: Pilot-Garland Dobson, Navigator-Mark Bertram, Observers-Paul Williams, Craig Edwards

³ Stratification crew: Pilot-Mike Hlnkes, Navigator-Mark Bertram, Observers-Paul Williams, David Hope, Craig Edwards, note that the statistics for the stratification include the Nov 2006 Land Exchange survey which included 1,108 additional survey miles

Table 2. Summary of survey statistics and population and density estimates for moose population surveys on the western Yukon Flats, 1992 to 2006.

Survey Year and Type	Unit Size (mi ²) (# sample units)	Square miles searched (# sample units)	Minutes Searched per square mile	# Moose	Moose per square mile	0.90 Confidence Level	Sightability Correction Factor
Nov 1992 Stratified Random	4544 (351)	1008 (76)		602	0.14	0.22	0.15
Nov 1992 Stratified Random	1531 (119)	575 (43)	5.0	455	0.30	0.33	0.17
Nov 1996 Regression Analysis	1531 (119)	366 (27)	4.7	666	0.44	0.21	0.05
Mar 1999 ¹ GSPE	2269 (421)	517 (96)	5.1	735	0.32	0.21 (0.95CI)	N/A
Oct 1999 GSPE	2269 (421)	501 (93)	6.4	862	0.38	0.19	N/A
Oct 2000 GSPE	2269 (421)	495 (92)	5.5	670	0.30	0.24	N/A
Nov 2001 GSPE	2269 (421)	533 (98)	6.1	667	0.29	0.24	N/A
Mar 2003 ¹ GSPE	2269 (421)	546 (101)	6.2	509	0.23	0.29	N/A
Mar 2004 ¹ GSPE	2269 (421)	490 (91)	6.2	632	0.28	0.20	N/A
Nov 2004 GSPE	2269 (421)	500 (93)	7.3	511	0.23	0.25	N/A
Mar 2006 GSPE Exchange Lands	578 (107)	227 (42)	4.8	65	0.11	0.33	N/A
Nov 2006 GSPE	2269 (421)	522 (97)	5.7	418	0.18	0.21	N/A
Nov 2006 GSPE Exchange Lands	1108 (206)	312 (58)	5.7	249	0.22	0.31	N/A

¹ This survey was conducted in March, all other surveys were conducted in October and November. These data are included to represent late winter density on the western Yukon Flats. Because moose distribution in March and October/November are not comparable, the moose density and population estimates in the March survey will not be compared with October/November surveys to detect change over time.

Table 3. Summary of moose survey statistics including moose population estimates and assessments on proposed land exchange parcels on the Yukon Flats, March 2006.

Exchange parcel # Village Association (Location)	Size(square miles) (# sample units)	Square miles searched (# sample units)	# Moose	Moose per square mile	Late Winter Density Assessment
#1 Stevens T16N, R8W	42.4 (8)	15.9 (3)	3.0	0.07	Low density
#2 Stevens T15N, R9W	42.4 (8)	10.6 (2)	6.0	0.14	Average density
#3 Beaver T17N, R3E	37.1 (7)	5.3 (1)	5	0.13	Average density
#4 Birch Creek T17N, R7E	31.8 (6)	10.6 (2)	2	0.06	Low density
#5 Beaver T16N, R4E	47.7 (9)	21.2 (9)	2	0.04	Low density
#6 Stevens T16N, R6W	47.7 (9)	21.2 (4)	3	0.06	Low density
#7 Beaver T16N, R2E	47.7 (9)	21.2 (4)	2	0.04	Low density
#12 Beaver T19N, R1W	21.2 (4)	10.6 (2)	1	0.05	Low density
#14 Birch Creek T18N, R7E	31.8 (6)	10.6 (2)	6	0.19	High density
#15 Birch Creek T19N, R7E	31.8 (6)	10.6 (2)	4	0.13	Average density
#18 FWS to Doyon	201.4 (38)	78.5 (15)	33	0.16 ^b	Above average density
All Exchange Lands	578 (107)	227 ^a (42)	65	0.11 ^c	Average density

^a minutes searched per mi² = 4.8

^b estimate is +/-28% at the 0.90 confidence level

^c estimate is +/- 33% at the 0.90 confidence level

Table 4. Summary of moose survey statistics including moose population estimates and assessments on proposed land exchange parcels on the Yukon Flats, November 2006.

Exchange parcel # Village Association (Location)	Size (mi ²) (# sample units)	Square miles searched (# sample units)	# Moose	Moose per square mile	Early Winter Density Assessment
#1 Stevens T16N, R8W	42.4 (8)	10.6 (2)	0.03	0.00	Low density
#2 Stevens T15N, R9W	42.4 (8)	10.6 (2)	0.13	0.00	Low density
#3 Beaver T17N, R3E	37.1 (7)	15.9 (3)	24	0.65	High density
#4 Birch Creek T17N, R7E	31.8 (6)	15.9 (3)	0.01	0.00	Low density
#5 Beaver T16N, R4E	47.7 (9)	15.9 (3)	27	0.57	High density
#6 Stevens T16N, R6W	42.4 (8)	10.6 (2)	3	0.07	Low density
#7 Beaver T16N, R2E	47.7 (9)	10.6 (2)	13	0.27	Above average density
#8 Chalkyitsik T23N R19E	47.7 (9)	5.3 (1)	27	0.57	High density
#9 Chalkyitsik T23N R17E	47.7 (9)	21.2 (4)	35	0.73	High density
#10 Chalkyitsik T22N R20E	42.4 (8)	5.3 (1)	7	0.17	Below average density
#11 Chalkyitsik T22N R16E	15.9 (3)	0 (0)	10	0.63	High density
#12 Beaver T19N, R1W	21.2 (4)	5.3 (1)	0.06	0.00	Low density
#13 Beaver T18N, R4E	47.7 (9)	42.4 (8)	41	0.86	High density
#14 Birch Creek T18N, R7E	31.8 (6)	10.6 (2)	14	0.44	High density

Table 4. Continued...Summary of moose survey statistics including moose population estimates and assessments on proposed land exchange parcels on the Yukon Flats, November 2006.

Exchange Parcel # Village Association (Location)	Size (square miles) (# sample units)	Square miles searched (# sample units)	# Moose	Moose per square mile	Early Winter Density Assessment
#15 Birch Creek T19N, R7E	31.8 (6)	10.6 (2)	13	0.41	Above average density
#17 Fort Yukon T20N R14E	31.8 (6)	15.9 (3)	7	0.22	Average density
#18 FWS to Doyon	233.2 (44)	68.9 (13)	18	0.08	Low density
#19 Halo Lands	259.7 (49)	37.1 (7)	14	0.05	Low density
All Exchange Lands	1108 (206)	312 ^a (58)	249	0.22 ^b	Average density

^a minutes searched per mi² = 5.7

^b estimate is +/- 31% at the 0.90 confidence level

Table 5. Summary of estimated sex and age composition for moose population estimation surveys on the western Yukon Flats, 1992 to 2006.

Survey Year Area Size(mi ²)	Total Bulls	Total Cows	Total Calves	Total Moose	Bulls/ 100 Cows	Yr1 Bulls/ 100 Cows	Calves/ 100 Cows	% Bulls	% Cows	% Calves	Moose per square mile
Nov 1992 4544	224	317	78	619	71	12	25	36	51	13	0.14
Nov 1992 1532	134	252	69	455	53	9	28	30	55	15	0.30
Nov 1996 1532	184	340	142	666	54	10	42	28	51	21	0.44
Mar 1999 ¹ 2269	n/a	n/a	64	735	n/a	n/a	n/a	n/a	n/a	9	0.31
Oct 1999 2269	165	529	168	862	31	6	31	19	61	20	0.38
Nov 2000 2269	247	345	74	670	72	10	21	37	52	11	0.30
Nov 2001 2269	194	375	101	668	52	9	27	29	56	15	0.29
Mar 2003 ¹ 2269	n/a	n/a	71	528	n/a	n/a	n/a	n/a	n/a	13	0.23
Mar 2004 ¹ 2269	n/a	n/a	94	632	n/a	n/a	n/a	n/a	n/a	15	0.28
Nov 2004 2269	179	247	85	511	72	5	35	35	48	17	0.23
Mar 2006 ¹ Exchange Lands 578	--	--	3	65	--	--	--	--	--	5	0.11
Nov 2006 2269	147	230	51	418	65	18	22	34	54	12	0.18
Nov 2006 Exchange Lands 1108	89	138	25	249	65	12	18	35	55	10	0.22

¹Survey was conducted in March. All other surveys were conducted in October/November.

Table 7. Reported harvest of moose, wolves, and bears on the Yukon Flats 2002 to 2006^a

Year	Bull moose	Cow moose	Unk sex moose	Total moose	Proportion cow harvest	Wolf	Black bear	Grizzly bear	Unk sex bear	Total bear
2002/2003 ^b	121	33	2	156	21 to 22%	24	32	5	27	64
2004/2005 ^c	97	15	14	126	12 to 23%	50	73	23	24	120
2005/2006 ^d	188	17	23	228	7 to 18%	41	149	37	41	227

^a data from Council of Athabaskan Tribal Governments 2003, 2005, 2006

^b 88% of Yukon Flats households surveyed, Chalkyitsik not surveyed

^c 42% of Yukon Flats households surveyed

^d 50% of Yukon Flats households surveyed

Table 8. Reported harvest of moose, wolves, and bears on the western Yukon Flats^a 2002 to 2006^b

Year	Bull moose	Cow moose	Unk sex moose	Total moose	Proportion cow harvest	Wolf	Black bear	Grizzly bear	Unk sex bear	Total bear
2002/2003 ^b	31	11	0	42	26%	5	6	0	27	33
2004/2005 ^c	35	7	3	45	16 to 22%	12	27	8	4	39
2005/2006 ^d	26	6	0	32	19%	14	17	0	0	17

^a includes Beaver, Stevens Village and Birch Creek

^b data from Council of Athabaskan Tribal Governments 2003, 2005, 2006

Table 9. Expenditures for moose population surveys, western Yukon Flats, 2006.

<i>Spring 2006, Land Exchange Area (578 mi²)</i>	cost
Stratification: 755: 5.8 hours x \$129/hr (all hourly rates are dry)	748.20
Survey: 87S: 27.9 hours x \$88	2,455.20
40HU: 6.9 hours x \$88	607.20
Fuel	1,322.40
Total	5,133.00
 <i>Fall 2006, Land Exchange Area (1,108 mi²) and western Yukon Flats (2,269 mi²)</i>	
Stratification: N796: 16.2 hours x \$148	2,397.60
Survey: N278Z: 32.3 hours x \$88	2,842.40
N788: 27.7 hours x \$88	2,437.60
N13833: 23.1 hours x \$88	2,032.80
N74996: 19.5 hours x \$88	1,716.00
N178BC: 10.3 hours x \$88	906.40
N743: 4.5 hours x \$88	396.00
N792: 1.8 hours x \$88	158.40
Fuel (119.2 x 9 gal/hr x \$5/gal = 5,364, 16.2 x 16 gal/hr x \$5/gal = 1,296)	6,660.00
Food (862.74), Hire Cook (Harry Barber 480.00)	1342.74
Lodging (School: 880.00, Village Council: 920.00)	1,800.00
Total	22,689.94

