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Moose population survey of the western Yukon Flats – March 2013

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ABSTRACT

A moose population survey was conducted on the Yukon Flats National Wildlife Refuge in March 2013. Moose were counted in 101 of 421-5.3 mi^2 units, of which 68 were stratified high moose density and 33 low density. The estimate for the 2,269 mi^2 survey area in the western Yukon Flats (Alaska Game Management Unit [GMU] 25D) was 460 total observable moose (95% CI; 345-575). Density of moose was 0.20/mi^2 or 0.08/km^2. The population was comprised of 364 adults (95% CI; 269-458) and 103 calves (63-143). Search time averaged 6.3 minutes/mi^2. The number of calves was high relative to other spring surveys, but the reasons for this are not known. There was no detectable trend in spring numbers of total observable moose. Moose on the Yukon Flats continue to persist at low densities, which has been documented for >50 years. Continued conservative management of harvest is recommended.

INTRODUCTION

Moose (*Alces alces*) are an important food resource and the Yukon Flats National Wildlife Refuge (NWR) is legally mandated to provide the opportunity for continued subsistence use by local residents. Fall and spring aerial population surveys are conducted in order to provide managers with data on moose numbers, and during fall surveys, measures of recruitment and productivity can be obtained. These data are used in making harvest decisions and contribute to our understanding on the quantity and quality of an important wildlife resource.

Surveys on the Yukon Flats NWR are conducted in two separate areas, one in the eastern Refuge (2,936 mi^2) that includes the villages of Fort Yukon and Chalkyitsik, and the other in the western Refuge (2,269 mi^2) that includes the villages of Stevens Village and Beaver (Figure 1). This report summarizes results of the March 2013 survey of the western Yukon Flats. Information about the most recent eastern Yukon Flats survey area can be found in Caikoski and Thomas (2007).

OBJECTIVES

1. Estimate numbers of calves and total moose in a 2,269mi^2 survey area in the western Refuge.
2. Estimate the % calves.

STUDY AREA

The study 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.

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). The survey area is 2,269 square miles.

METHODS

Moose population estimation surveys were conducted according to methods outlined in Gasaway et al. (1986) and Ver Hoef (2001). Gasaway et al. (1986) methods provide the foundation for geospatial methods. The publications, “GeoSpatial Population Estimator Software User’s Guide” (DeLong 2006), and “GeoSpatial Survey Operations Manual” (Kellie and DeLong 2006) provide guidelines for sample unit design and selection, navigation, and data analysis. Two

computer software programs, Moosepop (stratified random estimator; Gasaway et al. 1986) and the GeoSpatial Population Estimator (spatial estimator; GSPE) were used to analyze data.

Units were stratified in the western Yukon Flats with a Found Bush Hawk flying one east/west transect through the center of each unit. The stratification aircraft was operated at a ground speed of 110 knots and at a height of about 700 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, and remaining units were stratified low density. A stratified random sample was selected to determine which units to survey in each survey area.

Three tandem seat fixed-wing aircraft (1 Piper Super Cub, 1 Aviat Husky, 1 Bellanca Scout) were used to survey 5.3 mi^2 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 (usually the Yukon River). 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 or because of strong easterly or westerly winds. Because this survey was conducted in March, we were not able to discern bulls from cows, and counts consisted of adults and calves.

RESULTS

Stratification

Forty-three percent (n=181) of the survey area was stratified as high density, the remaining 240 units were low density (Table 1, Figure 2). Seventy-one moose were observed during the stratification. Although no wolves were observed during the stratification, tracks were observed north of Beaver along the Hodzana and Yukon Rivers, and approximately 6 miles south of Twin Lakes. Hare tracks were evident throughout the survey area. One set of wolverine tracks were observed. Muskrat pushups and lynx tracks were low to moderate.

Unit Sampling

Between 11-17 March, survey aircraft sampled 101 (24%) of 421 units in the western Yukon Flats (Table 1). These included 68 (38%) of the 181 units stratified as high density and 33 (14%) of the 240 units stratified as low density (Table 1). Temperatures ranged from -20 to 20° F but were primarily about 10° F. Snow cover was complete in the survey area; it had been several weeks since the last significant snowfall, as evidenced by the high number of observed tracks. Wind was generally moderate during the survey, but operations were shut down for 2 consecutive days beginning on day 4 due to high winds ranging from 30-40 knots. Mean search time was 6.3 minutes per mi^2 (Table 2). Pilots and observers counted 160 moose, including 37 calves (Table 3).

Population Status

There was some evidence of spatial autocorrelation in the high density strata. The stratified random estimator (Moosepop) had an estimate of total observable moose that was 485 (95% CI; 364-606) in the 2,269 mi^2 study area, and the estimator that modeled spatial autocorrelation (GSPE) had an estimate of 460 (95% CI; 345-575; Tables 4 and 5, Figure 3). The following population estimates are based on estimation with the spatial estimator (GSPE). The estimated population was comprised of 364 adults (95% CI; 269-458) and 103 calves (63-143; Tables 4 and 5). Density of total moose was $0.20/mi^2$. There was no trend in numbers of total observable moose, as the slope of the relationship between observable moose and year was not different from 0 (Figure 3). Density in the western survey area was generally similar to the eastern survey area (Table 5).

DISCUSSION

Moose in the western Yukon Flats NWR (Alaska GMU 25D) continue to occur at low densities. The spring count of 460 resulted in a moose density of $0.20/mi^2$ or $0.08/km^2$. As yield of moose in such a system is correspondingly low (Hayes et al. 2003, Boertje et al. 2009), continued conservative management of harvest is recommended. Moose across the Yukon Flats continue to persist at low densities, which has been documented for >50 years (Bentley 1961, Gasaway et al. 1992, Caikoski 2010, this survey).

Spring counts of total observable moose should not be compared with fall counts. More moose may be missed in spring (Gasaway et al. 1978) because long, dark shadows that obscure observations are common. Moose may also move less, often bedded in patches of willow where they are more difficult to see. Moose distribution may also be different in late winter (e.g., moose move toward the Yukon River), and some moose have died during the winter (Lake et al. 2011). When looking at the spring estimates of total observable moose in 1999, 2003, 2004, 2008, and 2013, it is tempting to conclude a population decline (Figure 3). However, there is no trend, as the slope of the line cannot be statistically differentiated from 0 (Figure 3). Therefore, it is erroneous to conclude a decline or trend in total observable moose.

Increased numbers of calves were observed relative to other spring surveys. This result is suggestive of increased survival during summer 2012 and winter 2012-2013. It is not clear what factors contributed to this, as neither monitoring of calf survival with VHF transmitters (Bertram and Vivion 2002), winter wolf kill rates (Lake et al. 2011), or habitat/environmental factors (Seaton et al. 2011) were investigated during 2012 and 2013. Nevertheless, if survival of this calf cohort continues, an increased number of yearling bulls could be expected for the upcoming hunting season.

Although moose occur at low densities throughout, hunter success is highly variable across the Yukon Flats (Stevens and Maracle 2012). Villages with households that successfully harvested a moose during 2010-2011 ranged from 5-97%, with an average of 22% (Stevens and Maracle 2012). Some villages reported a longer amount of time to harvest a moose (14.4 days), while others reported a shorter amount of time (1.05 days), with an average of 7.7 days (Stevens and

Maracle 2012). Similar data on hunter success are also available for the Tanana Flats (Alaska GMU 20A) where moose occur at some of the highest densities in North America (2.5-3.1/mi^2) - a more than 13-fold difference from the Yukon Flats, providing an interesting comparison. Hunter success on the Tanana Flats ranged from 24-35% among 2001-2009, with an average of 30%, and the number of days to harvest a moose was relatively constant at 6 days during 2002-2011 (Young 2010, 2012 ADF&G testimony to the Alaska Board of Game). Therefore, despite a 13-fold greater moose density, hunters on the Tanana Flats were successful only 8% more than those on the Yukon Flats, and spent only 2 fewer days to harvest a moose. Factors contributing to hunter success and time to successfully harvest a moose are unknown, and would make an interesting study. Such an analysis could investigate things like access, hunter effort, experience with hunting in the area, hunter density, moose density, etc.

During the survey, seismic activity around Stevens Village was evident. At least 5 helicopters were sling loading equipment to the north daily, and this traffic prevented us from counting moose in 2 survey units. Multiple, lengthy (>1 mile) snowshoe tracks with evidence of nearby helicopter landings were observed, and trees were marked with flagging along snowshoe tracks. An ice road to Stevens Village from the Yukon River bridge was observed.

Little evidence of snowmachine tracks around Stevens Village and Beaver was observed, which is suggestive of limited trapping and moose hunting activity in the weeks prior to the survey. On law enforcement patrols this winter, limited activity was also observed; low furbearer numbers likely contributed to this.

Shortcomings and Future Improvements

The decision to conduct a spring survey was made after 2 consecutive fall surveys were canceled (2011, 2012) due to inadequate snow conditions for viewing moose from the air. Fall surveys are preferred for several reasons, including that cows can be discerned from bulls, which allows indices of productivity and recruitment to be obtained (% cows, yearling bull/cow, calf/cow, bull/cow), in addition to the moose counts. Spring surveys provide only a count of adult and calf moose. When deciding whether to conduct a fall or spring survey, it is useful to be aware of data differences and limitations.

This survey does not estimate detection of moose and instead assumes that detection is constant across years. If this assumption is not met, interpretation of annual variation in moose numbers is more difficult. In addition, estimates of moose numbers would increase if adjusted for detection. The detectability of moose on this survey is a question that should be investigated in the future. A mark-recapture estimate of detection could be obtained with collared moose.

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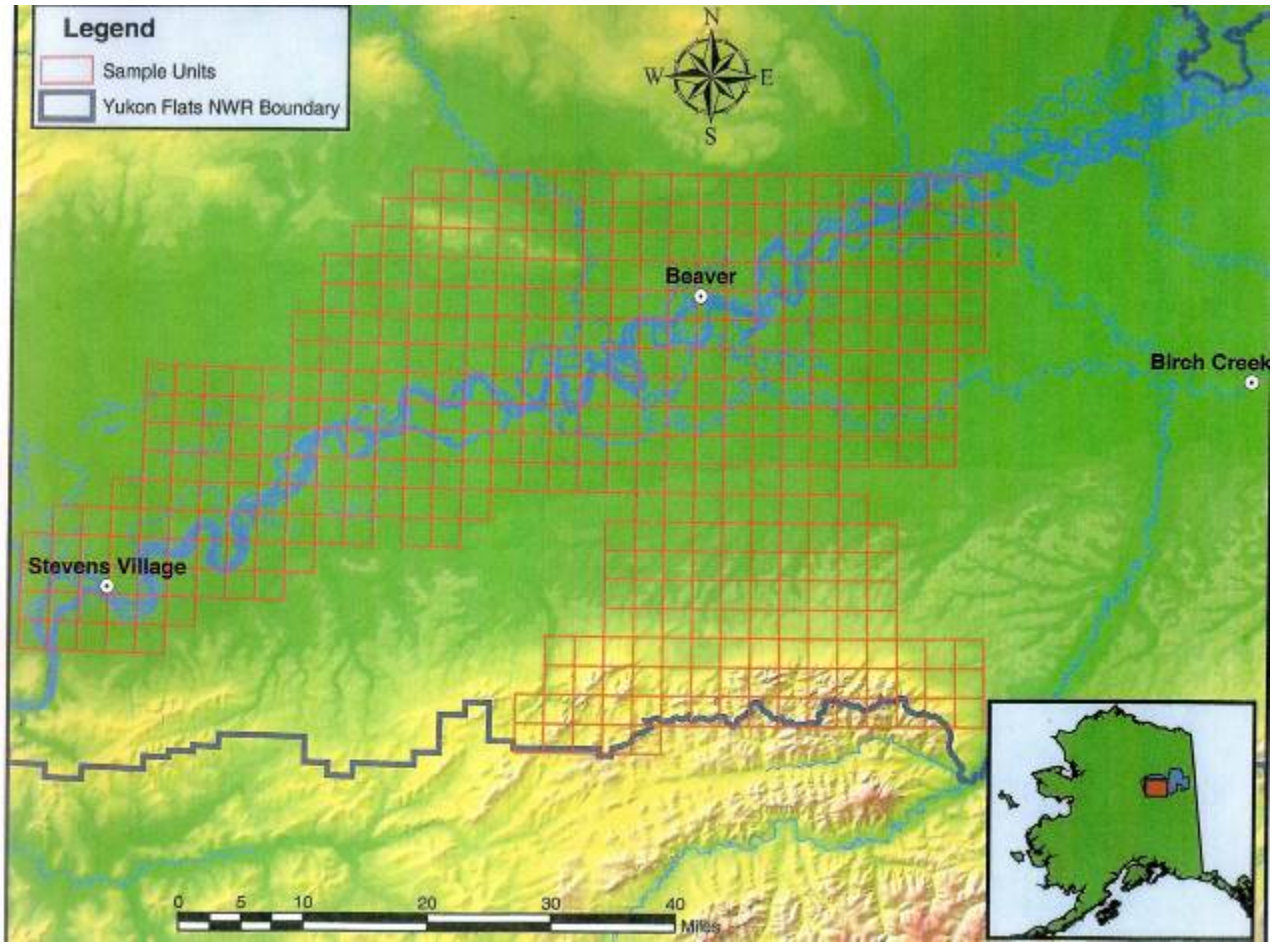

Figure 1. Location of moose survey units in the western Yukon Flats, March 2013.

Red= High density
Green=Low density
# =Moose count

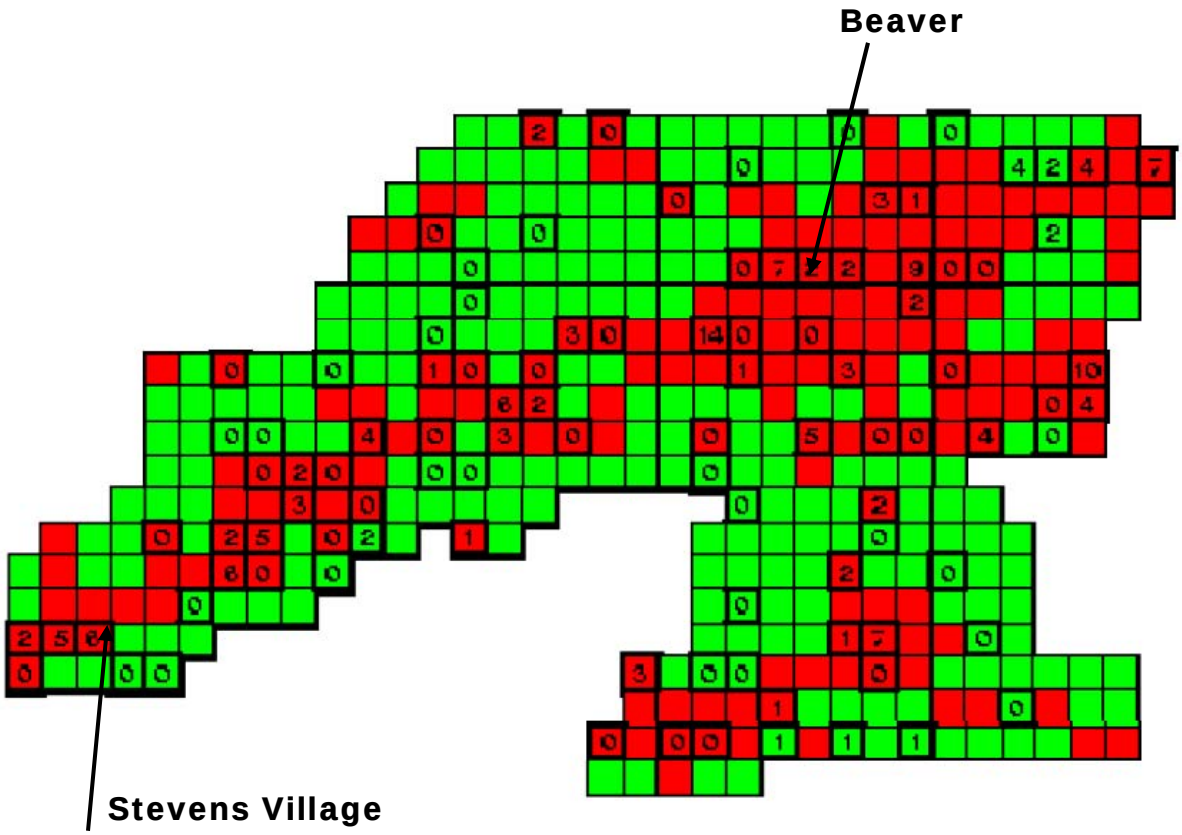

Figure 2. Stratification (indicated by color of survey unit) and numbers of moose counted in each of 101 survey units for the western Yukon Flats moose survey, March 2013.

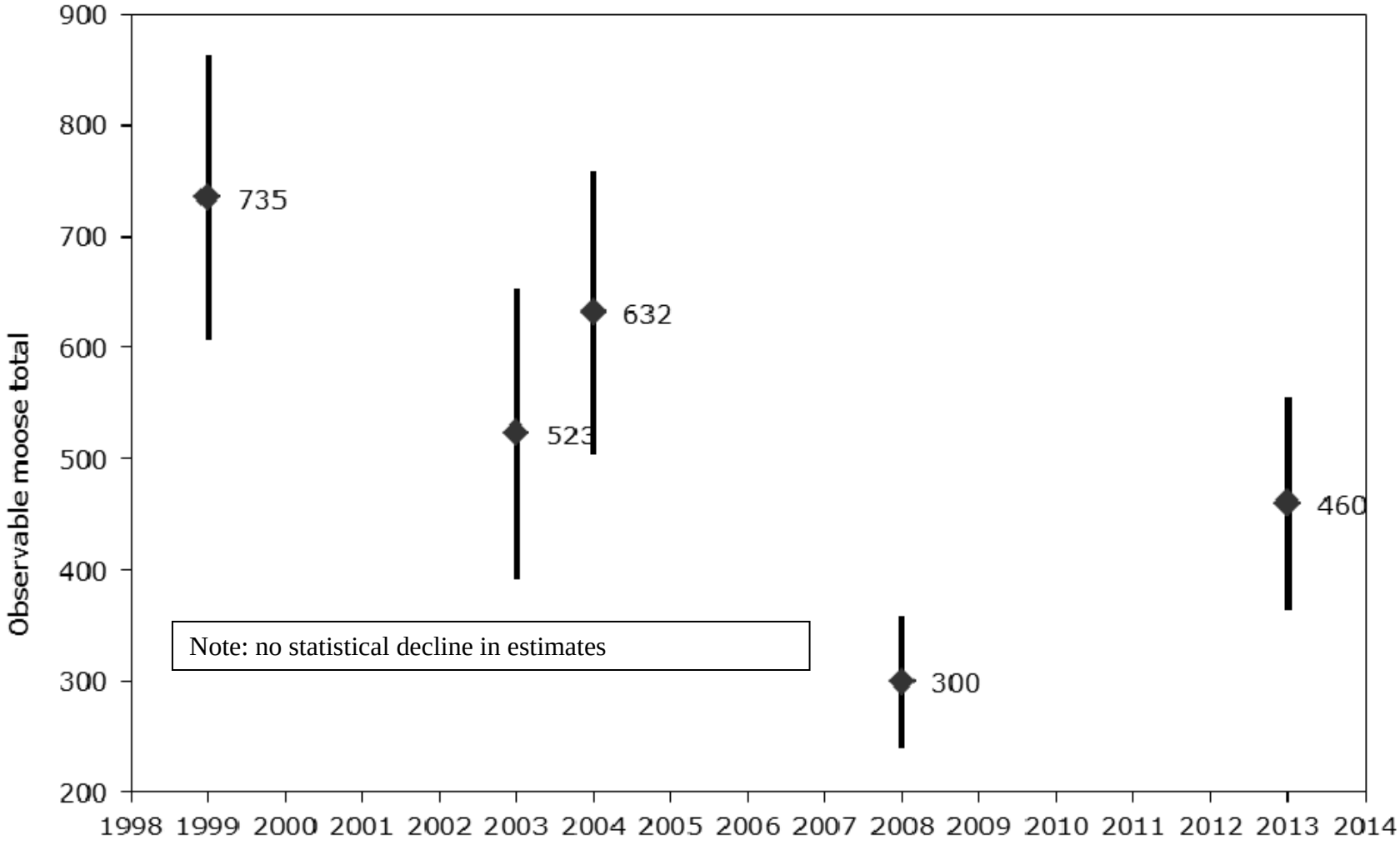

Figure 3. Estimated observable spring moose total (with 90% confidence interval) for the western Yukon Flats.

Table 1. Summary of stratification and sampled units for moose population estimation surveys in the western Yukon Flats, 1992 to 2013.

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	264	--	194			
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			
Mar 2006 GSPE Exchange Lands	578	37	--	70	22	--	20	2'41"	0.27	1.5
		200	--	378	119	--	108			
Nov 2006 GSPE	2269	122	--	299	65	--	32	12' 41"	0.23	1.2
		656	--	1612	349	--	172			
Nov 2006 GSPE Exchange Lands	1,108	70	--	136	29	--	29	Included in above	Included in above	Included in above
		374	--	735	155	--	157			
Mar 2008 GSPE	2269	118	-	303	73	-	38	9'15"	0.24	1.3
		635	-	1634	393	-	205			
Nov 2008 GSPE[2]	2420	156	--	303	101	--	73	10'44"	0.26	1.4
		839	--	1630	544	--	393			

Table 1. Summary of stratification and sampled units for moose population estimation surveys in the western Yukon Flats, 1992 to 2013, continued.

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 2010 GSPE[3]	2269	175	--	246	63	--	33	N/A	N/A	N/A
Mar 2013 GSPE		943	--	1326	339	--	178			
	2269	181	--	240	68	--	33	9'52"	0.26	1.4
		975	--	1294	367	--	178			

[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]Includes 38 units stratified for ADF&G BIMMA. These units are outside the survey area and data from these units are not included as part of the 2008 survey. Information from these units was not included in the sampled units column
[3]From desktop stratification of prior data. See methods for detailed description.

Table 2. Summary of survey statistics and population and density estimates for moose population surveys in the western Yukon Flats, 1992 to 2013

Survey Year and Type	Unit Size (mi^2) (# sample units)	Square miles searched (# sample units)	Minutes Searched per square mile	# Moose	0.90 Confidence Level (#Moose)	Density ($moose/mi^2$)	Sightability Correction Factor
Nov 1992 Stratified Random	4544 (351)	1008 (76)		602	0.22	0.14	0.15
Nov 1992 Stratified Random	1531 (119)	575 (43)	5.0	455	0.33	0.30	0.17
Nov 1996 Regression Analysis	1531 (119)	366 (27)	4.7	666	0.21	0.44	0.05
Mar 1999[1] GSPE	2269 (421)	517 (96)	5.1	735	0.21 (0.95CI)	0.32	N/A
Oct 1999 GSPE	2269 (421)	501 (93)	6.4	862	0.19	0.38	N/A
Oct 2000 GSPE	2269 (421)	495 (92)	5.5	670	0.24	0.30	N/A
Nov 2001 GSPE	2269 (421)	533 (98)	6.1	667	0.24	0.29	N/A
Mar 2003[1] GSPE	2269 (421)	544 (101)	6.2	523	0.25	0.23	N/A
Mar 2004[1] GSPE	2269 421)	490 (91)	6.2	632	0.20	0.28	N/A
Nov 2004 GSPE	2269 421)	500 (93)	7.3	511	0.25	0.23	N/A
Mar 2006[1] GSPE Exchange Lands	578 (107)	227 (42)	4.8	65	0.33	0.11	N/A
Nov 2006 GSPE	2269 (421)	522 (97)	5.7	418	0.21	0.18	N/A
Nov 2006 GSPE Exchange Lands	1108 (206)	312 (58)	5.7	249	0.31	0.22	N/A
Mar 2008 GSPE[1]	2269 (421)	597 (111)	6.5	300	0.20	0.13	N/A
Nov 2008 GSPE	2269 (421)	936 (174)	6.3	490	0.13	0.22	N/A
Nov 2010 GSPE	2269 (421)	517 (96)	6.5	440	0.28	0.19	N/A

Table 2. Summary of survey statistics and population and density estimates for moose population surveys in the western Yukon Flats, 1992 to 2013, continued.

Survey Year and Type	Unit Size (mi^2) (# sample units)	Square miles searched (# sample units)	Minutes Searched per square mile	# Moose	0.90 Confidence Level (#Moose)	Density ($moose/mi^2$)	Sightability Correction Factor
Mar 2013 GSPE[1]	2269 (421)	544 (101)	6.3	460	0.21	0.20	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.

Table 3. Summary of observed moose during surveys in the western Yukon Flats, 1983 to 2013.

Survey Year	Area Size (mi^2)	Total Bulls	Total Cows	Total Calves	Total Moose	Bulls/ 100 Cows	Yrl Bulls/ 100 Cows	Calves/ 100 Cows	% Bulls	% Cows	% Calves	Moose per mi^2
1983[a]	119	13	15	13	41	87	27	87	32	37	31	0.34
1984[a]	56	1	1	1	3	100	100	0	33	33	34	0.05
1985[a]	140	20	20	10	50	100	40	50	40	40	20	0.36
1986[a]	233	52	70	19	141	74	21	27	37	50	13	0.61
1987[a]	170	36	51	13	100	71	8	25	36	.1	13	0.59
1988[a]	174	38	45	13	96	84	18	29	40	47	13	0.55
1989	no survey in western Yukon Flats											
1990[a]	53	7	16	4	27	44	12	25	26	59	15	0.51
1991[a]	237	48	49	15	112	98	8	31	43	44	13	0.47
1992[b]	109	19	27	5	51	70	11	19	37	53	10	0.47
1992[c]	1009	154	191	48	393	81	15	25	39	49	12	0.39
1992[d]	476	117	150	39	306	78	13	26	38	49	13	0.64
1993[e]	170	29	57	17	103	51	14	30	28	55	17	0.61
1994	104	30	26	9	65	115	23	35	46	40	14	0.63
1995	no survey in western Yukon Flats											
1996[f]	366	105	168	57	330	54	11	34	32	51	17	0.90
1997	no survey in western Yukon Flats											
1998	no survey in western Yukon Flats											
1999[g]	517	n/a	n/a	26	248	n/a	n/a	n/a	n/a	n/a	10	0.48

Table 3. Summary of observed moose during surveys in the western Yukon Flats, 1983 to 2013, continued...

Survey Year	Area (mi^2)	Total Bulls	Total Cows	Total Calves	Total Moose	Bulls/ 100 Cows	Yrl Bulls/ 100 Cows	Calves/ 100 Cows	% Bulls	% Cows	% Calves	Moose (mi^2)
1999	501	52	161	56	269	32	6	35	19	60	21	0.50
2000	495	75	117	28	220	64	7	24	34	53	13	0.44
2001	533	69	154	49	272	45	9	32	25	57	18	0.51
2002	no survey in western Yukon Flats											
2003[g]	544	-	-	33	234	-	-	-	-	-	14	0.43
2004[g]	572[h]	-	-	34	243	-	-	-	-	-	14	0.43
2004	500	59	80	29	168	74	8	36	35	48	17	0.34
2005	Survey initiated but cancelled due to inadequate snow cover											
2006[gi]	227	-	-	2	31	-	-	-	-	-	1	0.14
2006	522	64	90	21	175	71	12	23	37	51	12	0.36
2006[i]	312	38	55	8	101	69	13	15	38	54	8	0.32
2008[g]	597	-	-	16	145						11	0.24
2008	936	71	136	54	261	52	2	40	27	52	21	0.28
2010	517	30	76	22	128	39	4	29	24	59	17	0.25
2013[g]	544	-	-	37	160	-	-	-	-	-	23	0.29

[a] includes the Meadow Creek, Mud Lakes, and Schwatka trend units
[b] includes trend units within 4,500 mi^2 survey area
[c] data from the 1992 4,500 mi2 Gasaway survey
[d] data is a 1,500 mi^2 area within the 1992 4,500 mi^2 survey area, ie, comparable to the 1996 survey area
[e] includes only the Meadow Creek and Mud Lakes trend areas
[f] data from the 1996 regression estimator survey of 1500 mi^2
[g] data from Spring GSPE survey
[h] note that we dropped 17 plots from calculations for the estimate because they were biased but they are included here for observed moose
[i] includes proposed land exchange areas

Table 4. Summary of estimated sex and age composition for moose population estimation surveys in the western Yukon Flats, 1992 to 2013. Numbers in parentheses represent 95% confidence intervals.

Survey Year Area Size(mi^2)	Total Bulls	Total Cows	Total Calves	Total Moose	Bulls/ 100 Cows	Yrl 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	--	--	64	735	--	--	--	--	--	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	--	--	71	523	--	--	--	--	--	14	0.23
Mar 2004[1] 2269	--	--	94	632	--	--	--	--	--	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
Mar 2008[1] 2269	--	--	34	300	--	--	--	--	--	11	0.13
Nov 2008 2269	127 (100-155)	251 (203-298)	110 (83-137)	490 (412-569)	51 (38-64)	3 (-0.15 - 5)	44 (31-57)	26	51	22	0.22
Nov 2010 2269	93 (49-137)	265 (170-361)	85 (45-125)	440 (294-587)	35 (14-56)	5 (0-9)	32 (13-51)	21	60	19	0.19

Table 4. Summary of estimated sex and age composition for moose population estimation surveys in the western Yukon Flats, 1992 to 2013, continued. Numbers in parentheses represent 95% confidence intervals.

Survey Year Area Size(mi^2)	Total Bulls	Total Cows	Total Calves	Total Moose	Bulls/ 100 Cows	Yrl Bulls/ 100 Cows	Calves/ 100 Cows	% Bulls	% Cows	% Calves	Moose per square mile
Mar 2013[1] 2269	--	--	103 (63-143)	460 (345-575)	--	--	--	--	--	22	0.20

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

Table 5 Estimated moose population composition from surveys of eastern and western Yukon Flats (GMU 25D), in addition to Venetie and Birch Creek.

Survey period and area (mi²)	Total bulls	Total cows	Total calves	Total adults	Total moose (90% CI)	Bulls: 100 Cows	Yrlg Bulls: 100 Cows	Calves: 100 Cows	% Bulls	% Cows	% Calves	Moose per mi²
Eastern 25D												
Fall 1995 (1534)	199	369	136	568	704±33%	54	8	37	28	52	19	0.46
Fall 1997 (1534)	208	372	45	580	625±36%	56	16	12	33	60	7	0.40
Fall 1999 (2936)	218	381	223	599	829±20%	57	24	59	26	46	27	0.28
Fall 2000 (2936)	252	319	156	571	726±25%	79	19	49	35	44	21	0.25
Fall 2001 (2936)	208	217	93	425	514±27%	95	17	43	40	42	18	0.18
March 2004 (2936)			66	316	382±20%						21	0.13
Fall 2004 (2936)	170	394	203	564	773±17%	43	10	51	22	51	26	0.26
Fall 2005 (2936)	337	419	243	761	1008±20%	80	22	58	34	42	24	0.34
Fall 2006 (2936)	243	407	151	650	799±17%	60	12	37	30	51	19	0.27
Fall 2007 (2936)	189	286	111	477	585±23%	64	15	39	32	50	19	0.20
Venetie Survey												
Fall 2004 (2858)	192	257	105	449	551±60%	75	24	41	37	46	19	0.19
Fall 2005 (2858)	94	213	123	293	423±32%	44	4	58	22	49	29	0.15
Birch Ck., Survey												
Fall 2006 (3630)	219	401	117	620	732±33%	55	8	29	30	55	16	0.20
Western 25D												
Fall 1992 (4544)	224	317	78	541	619±21	71	12	25	36	51	13	0.14
Fall 1992 (1531)	134	252	69	386	455±33%	53	9	28	30	55	15	0.30
Fall 1996 (1531)	184	340	142	524	666±21%	54	10	42	28	51	21	0.44
March 1999 (2296)	--	--	64	671	735±17%	--	--	--	--		9	0.31
Fall 1999 (2269)	165	529	168	694	862±19%	31	6	31	19	61	20	0.38
Fall 2000 (2269)	247	346	75	593	670±24%	71	12	22	37	52	11	0.30
Fall 2001 (2269)	193	375	100	568	668±24%	52		27	29	56	15	0.29
March 2003 (2269)	--	--	71	430	523± 25%	--	--	--	--	--	14	0.23
March 2004 (2269)			94	538	632±20%						15	0.28
Fall 2004 (2269)	179	247	85	426	511±25%	72	5	34	35	48	17	0.23
Fall 2006 (2269)	147	230	51	381	417±21%	65	18	22	35	55	12	0.18
March 2008 (2269)			34	266	300±20%	--	--	--	--	--	11	0.13
Fall 2008 (2269)	127	251	110	379	490±13%	51	3	44	26	51	22	0.22
Fall 2010 (2269)	93	265	85	356	440±28%	35	5	32	21	60	19	0.19
March 2013 (2269)	--	--	103	364	460±21%	--	--	--	--	--	22	0.20

Appendix 1. Reported harvest of moose, wolves, and bears in the Yukon Flats (all villages), 2002 to 2011[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
2006/2007[e]	76	2	16	94	2 to 19%	38	78	17	0	95
2007/2008[e]	75	2	0	77	3%	30	68	22	0	90
2008/2009[f]	Unk	Unk	Unk	104		45	26	2		28
2009/2010	121.5	2.0	0	123.5	2%	19.7	49.0	15.6		64.6
2010/2011	93.1	0	2.4	95.5	0%	12.6	19.8	3.9	0	23.7

[a] data from Council of Athabascan Tribal Governments 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011
[b] 88% of Yukon Flats households surveyed, Chalkyitsik not surveyed
[c] 42% of Yukon Flats households surveyed
[d] 50% of Yukon Flats households surveyed
[e] all Yukon Flats households surveyed except only a subsample taken from Fort Yukon
[f] Alaska Department of Fish and Game Subsistence Division 2010

Appendix 2. Reported harvest of moose, wolves, and bears in the western Yukon Flats (Beaver, Stevens Village, and Birch Creek)[a], 2002 to 2011[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
2006/2007[e]	11	1	5	17	6 to 35%	3	8	3	0	11
2007/2008[e]	9	0	0	9	0%	10	13	2	0	15
2008/2009[b]	8.8	0	0	8.8	0%	0	9.1	0		9.1
2009/2010[b]	18.4	0	0	18.4	0%	0	9.4	2		11.4
2010/2011[b]	12.8	0	0	12.8	0%	1.2	2.5	2.7		5.2

[a] includes Beaver, Stevens Village and Birch Creek
[b] data from Council of Athabascan Tribal Governments 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011
[c] 42% of Yukon Flats households surveyed
[d] 50% of Yukon Flats households surveyed
[e] all Yukon Flats households surveyed except only a subsample taken from Fort Yukon

Appendix 3. Expenditures for moose population survey in the western Yukon Flats, March 2013.

Survey: N796 ($190/hour x 14 hours)	2,622.00
N792 ($125/hour x 33 hours)	4,112.00
N178BC ($125/hour x 35 hours)	4,325.00
N13833 ($125/hour x 28 hours)	3,450.00
Survey Fuel: 96 hours x 9 gal/hr x $9[1]/gal	7,776.00
14 hours x 16 gal/hr x $9[1]/gal	2,016.00
Food	0
Lodging	0
Total	24,301.00

[1] Best guesstimate since it was a mix of fuel from Fairbanks and Beaver and Scoter Lake