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Moose population survey of the western Yukon Flats – November 2008

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1

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ABSTRACT

A moose population survey was conducted on the Yukon Flats National Wildlife Refuge in November 2008. The estimate for the 2,269mi^2 survey area in the western Yukon Flats (Game Management Unit [GMU] 25D) was 490 moose (95% confidence interval; 412-569 moose). Density of moose was 0.22/mi^2. The population was comprised of 251 cows (95% CI; 203-298), 110 calves (83-137), and 127 bulls (100-155). Search time averaged 6.3 minutes/mi^2. The 2008 estimate of total moose was 15% greater than the November 2006 estimate of 417 (311-524). This difference was related to numbers of calves, which were 54% greater than November 2006.

INTRODUCTION

Moose surveys to estimate numbers of moose on the Yukon Flats National Wildlife Refuge are conducted annually in two separate survey 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). The western survey is conducted by the Refuge and local village residents and the eastern survey is conducted by the Alaska Department of Fish and Game (ADF&G) and the Council of Athabascan Tribal Governments. This pattern deviated slightly in fall 2008. As part of a larger black bear research study, the ADF&G planned to survey moose in an area centered around Beaver, Alaska where the western survey occurs. By coordinating the efforts of the ADF&G and USFWS surveys, we were able to include units surveyed by both agencies in a useful complementary manner. This report summarizes results of the November 2008 survey of the western Yukon Flats. Information about the eastern Yukon Flats survey area can be found in Caikoski and Thomas (2007).

OBJECTIVES
1. Estimate numbers of calves, cows, bulls, and total moose in a 2,269mi^2 survey area in the western Refuge.
2. Estimate the ratio of calves/cows and bulls/cows.
3. Determine the trend in numbers of total moose.

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.

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.

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 geospatial methods. The 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 (Gasaway et al. 1986) and the GeoSpatial Population 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 130 knots 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. A stratified random sample was selected to determine which units to survey in each survey area.

Eight tandem seat fixed-wing aircraft (5 Piper Super Cub, 2 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. 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.

RESULTS

Stratification

The stratification of the western Yukon Flats was conducted November 3-5. Stratification included the core survey area of 2269mi^2, in addition to 38 units outside the traditional area that were surveyed for an ADF&G study. Moose count data from those 38 units were not included in estimation of moose numbers. Weather prevented access to a small number of units (n=18) in the hills, which were stratified based on data from previous years. Snow cover was complete over the survey area with snow depths that averaged eight to ten inches. The survey time for the stratification was 10 hours and 44 minutes. The average rate of sampling was 0.26 minutes per mi^2 or 1.4 minutes per unit (Table 1). Thirty-four percent (n=156) of the survey area was stratified as high density, the remaining 303 units were deemed low density (Table 1, Figure 2). A total of 97 moose in the core area were observed by the stratification crew. An additional nine moose were observed in the 38 units outside the core area. Two foxes and 3 packs of wolves (pack sizes=9, 10, 2) were observed.

Unit Sampling

Between 2-6 November and on 8 November survey aircraft sampled 174 (41%) of 421 units in the western Yukon Flats (Table 1). These included 101 (70%) of the 144 units stratified as high density and 73 (26%) of the 277 units stratified as low density (Table 1). Temperatures ranged from 0 to 20° F but were primarily about 10° F. Mean search time was 6.3 minutes per mi^2 (Table 2). We observed 261 moose, including 54 calves, 136 cows, and 71 bulls (Table 3).

Population Status

There was little evidence of spatial autocorrelation in the data set, and therefore, results between the Moosepop and GSPE analysis programs were similar. The following population estimates are based on estimation with the GSPE. The population estimate for the 2,269 mi^2 western Yukon Flats survey area was 490 moose (95% CI; 412-569 moose; Tables 4 and 5). The population was comprised of 251 cows (95% CI; 203-298), 110 calves (83-137), and 127 bulls (100-155; Table 4). Density of moose was 0.22/mi^2. The ratio of calves to cows was 44 calves/100 cows (95% CI; 31-57) and bulls to cows was 51 bulls/100 cows (95% CI; 38-64). The trend in numbers of total moose was negative (Figure 3). Density in the western survey area was generally similar to the eastern survey area (Table 5).

DISCUSSION

Population Status

Numbers of total moose were greater than the most recent fall survey conducted in November 2006. This increase can principally be attributed to calf numbers, which were greater than every survey since 1999. Additionally, the calf/cow ratio, an index of productivity and recruitment, was the highest value recorded since 1992 when surveys of this region began. The increase in calves is encouraging as growing the population of moose in this area is a goal of the Moose Management Plan (ADF&G 2002). To reach this goal, the plan calls for minimizing cow harvest and increasing harvest of predators in order to reduce predation of cows and calves. The results from this survey suggest the plan may be working. The primary source of mortality for calf moose in this system is predation (Bertram and Vivion 2002), and therefore, an increase in calf numbers is suggestive of reduced predation for the 2008 cohort. Should moose from the 2008 cohort survive to become yearlings, we would expect an increase in numbers of yearlings from 2008, where only 3 yearling bulls were observed per 100 cows. Cow moose numbers were slightly higher than those from fall 2006, indicating no net loss of cows the past two years.

This survey benefited from cooperation between the USFWS and the ADF&G. As a result, the precision of the total moose estimate for this survey was greater than those from prior years. This was due to an increase in numbers of survey units sampled (174 vs ≈100 in prior years). However, examination of the relationship between numbers of survey units sampled and precision indicated that the gain in precision was not uniform. In other words, the extra effort and money spent to sample 74 additional units did not result in a similar increase in precision. Continuing to sample 100 survey units is the optimal sample that best balances precision and cost.

Population Trend

The trend (1999-2008) in numbers of total moose continues to be negative. It is difficult to determine a longer term trend as different survey methods were employed prior to 1999. Based on a characterization of moose populations by Boertje et al. (2007), densities of moose in the western Refuge are currently low. This description is consistent with data from surveys conducted in the 1980s by the ADF&G that were used to characterize the population then as low (Gasaway et al. 1992). Therefore, it is likely that numbers of moose in the western Refuge have been relatively stable at a low density since at least the 1980s. Based on metrics of moose health

and productivity, quality habitat in this system does not seem to be limiting (Bertram and Vivion 2002, Boertje et al. 2007). It is most likely that moose are maintained at low densities in this system by predation (Gasaway et al. 1992).

Shortcomings and Future Improvements
Fog and clouds over the hills in the southeastern portion of the survey prevented the stratification of 18 units. Instead, these units were stratified based on previous stratification data. There was a considerable amount of variability in the average time spent surveying a unit (range 25 to 42 minutes). Such variation in search effort undoubtedly led to variation in detection of moose. In the future, pilots and observers should be instructed to make a minimum of 13 passes through a survey unit to ensure adequate search time (about 40 minutes). 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. 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, or double sampling could be used (Kellie and DeLong 2006). Of the two options, double sampling is the cheapest, could be implemented most rapidly, and can be done annually.

ACKNOWLEDGEMENTS

LITERATURE CITED

ADF&G. 2002. Yukon Flats cooperative moose management plan. Alaska Department of Fish and Game. Fairbanks, Alaska, USA 35pp.

Bertram, M.R., and M.T. Vivion. 2002. Moose mortality in eastern interior Alaska. Journal of Wildlife Management. 66:747-756.

Boertje, R.D., K.A. Kellie, C.T. Seaton, M.A. Keech, D.D. Young, B.W. Dale, L.G. Adams, and A.R. Aderman. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. Journal of Wildlife Management. 71:1494-1506.

Caikoski, J.R., and Thomas, B. 2007. Moose population survey eastern Yukon Flats. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. 14pp.

DeLong, RA. 2006. Geospatial population estimator software user's guide. Alaska Department of Fish and Game. Fairbanks, Alaska, USA.

Gasaway, W.C., S.D. DuBois, D.J. Reed, and S.J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biol. Pap. 22 University of Alaska. 108pp.

Gasaway, W.C., R.D. Boertje, D.V. Grangaard, D.G. Kellyhouse, R.O. Stephenson, and D.G. Larsen. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs. No.120.

Kellie, KA and RA DeLong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA.

Ver Hoef, J. M. 2001. Predicting finite populations from spatially correlated data. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association, pp. 93-98.
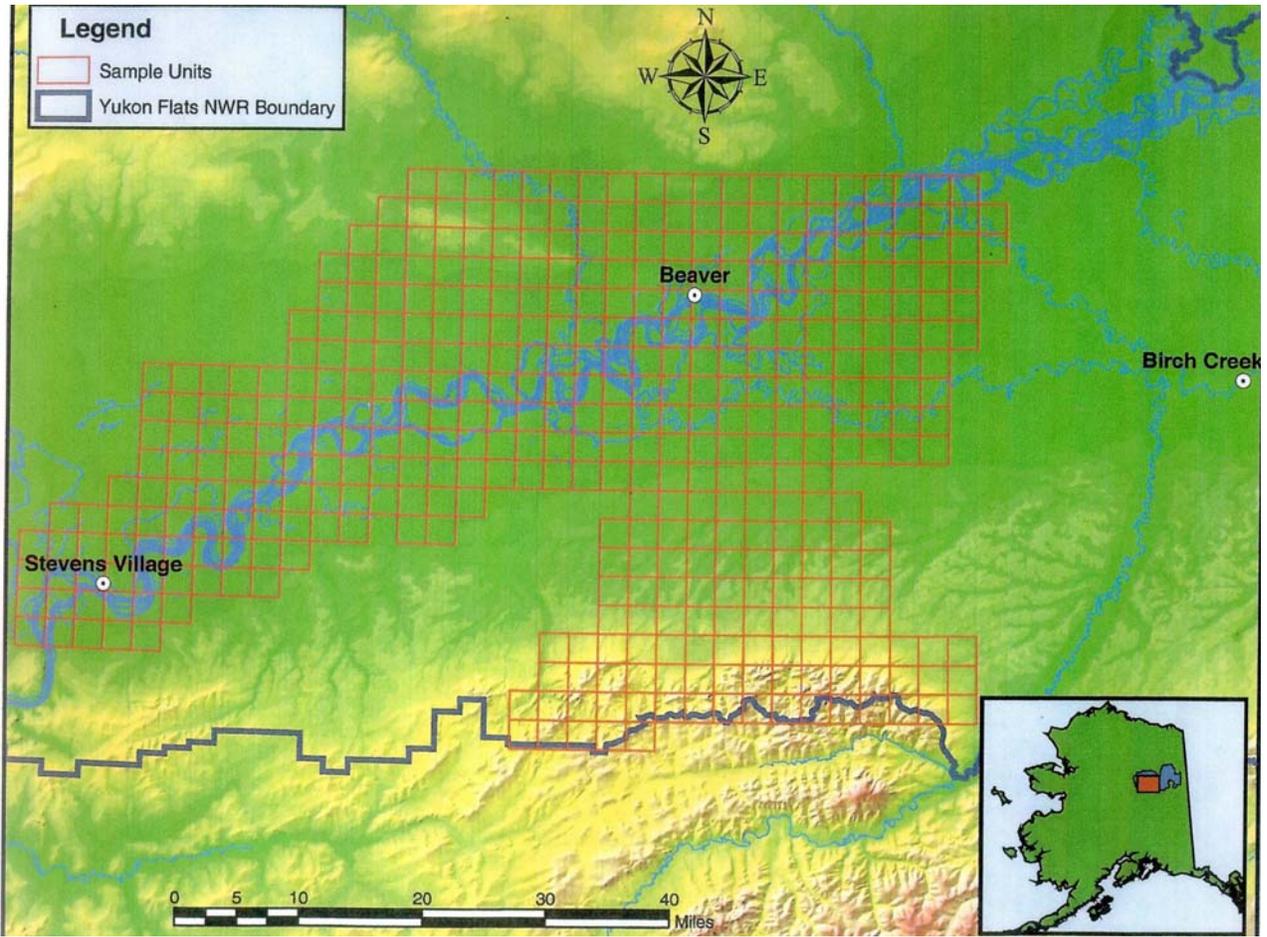
Figure 1. Location of moose survey units in the western Yukon Flats, November 2008.
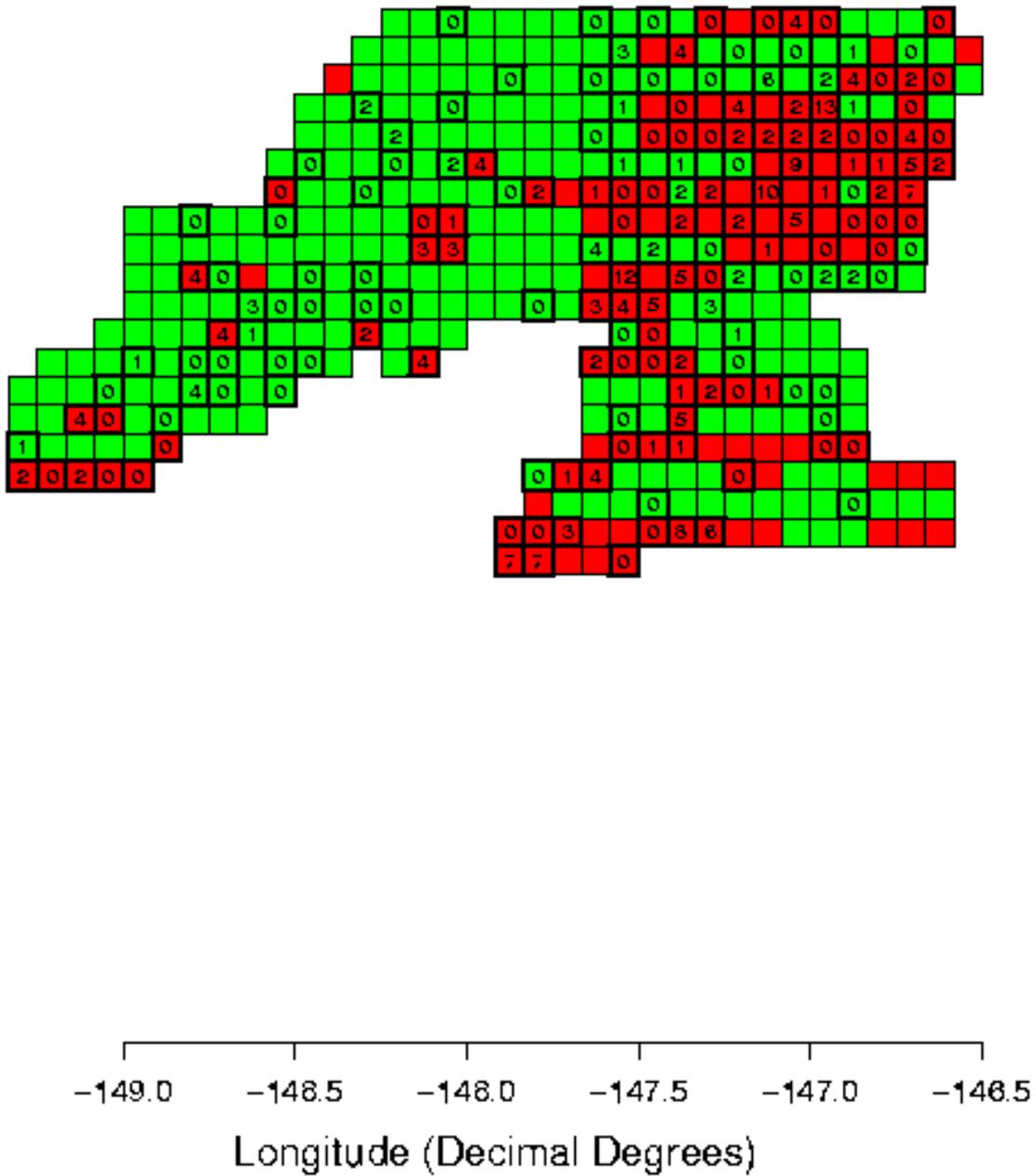
Red= High density
Green=Low density

Figure 2. Stratification (indicated by color of survey unit) and numbers of moose counted in each survey unit for the western Yukon Flats moose survey, November 2008.
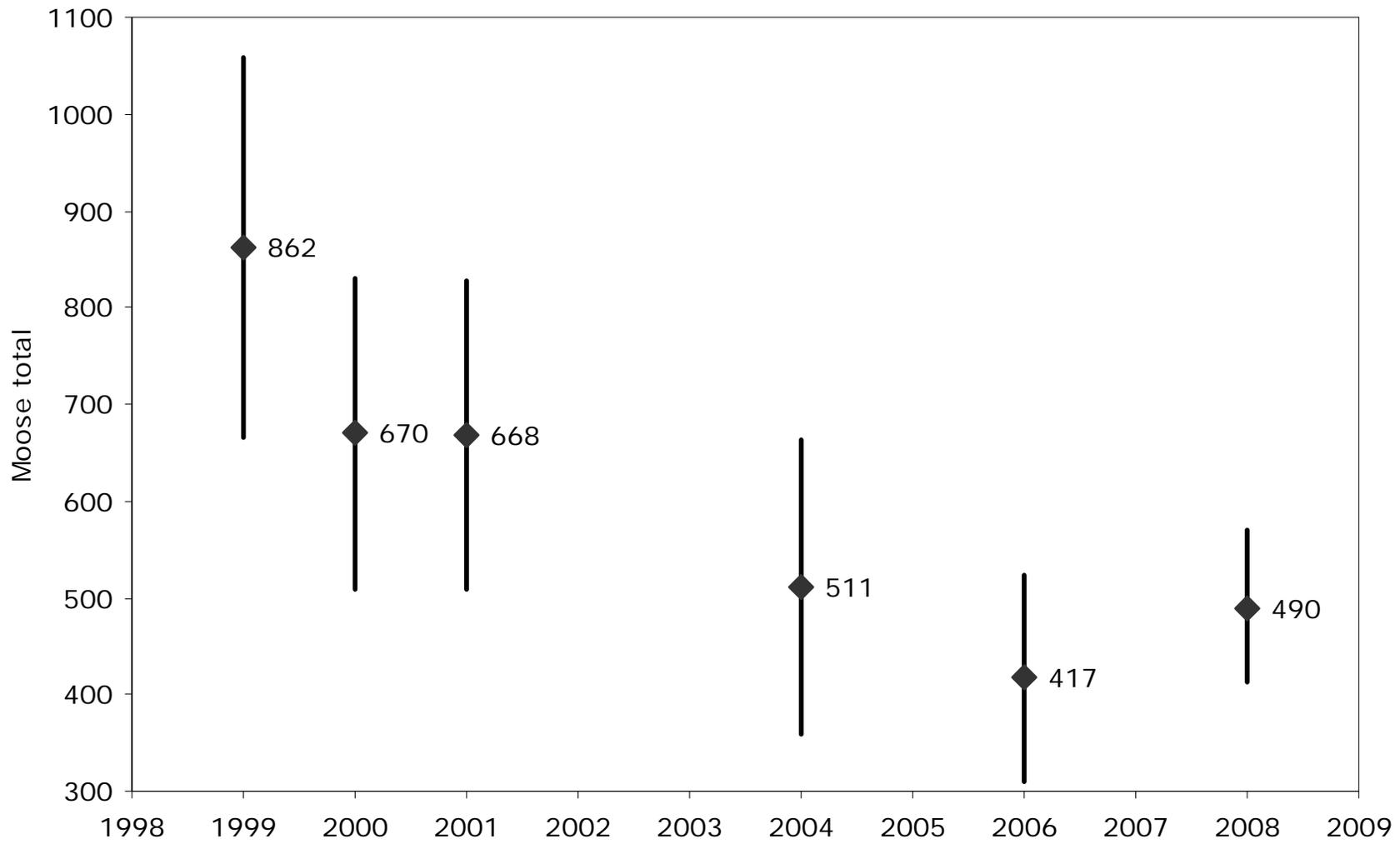
Figure 3. Estimated fall moose total (with 90% confidence interval) for the western Yukon Flats.

Table 1. Summary of stratification and sampled units for moose population estimation surveys in the western Yukon Flats, 1992 to 2008.

Survey Year and Type	Area (mi²)	Stratified Units (mi²)			Sampled Units (mi²)			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			
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[3]	2420	156	--	303	101	--	73	10'44"	0.26	1.4
		839	--	1630	544	--	393			

[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] Stratification crew: Pilot-Mike Hinkes, Navigator-Mark Bertram, Observers- Rob Jess, Craig Edwards, Paul Williams
[3] 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

Table 2. Summary of survey statistics and population and density estimates for moose population surveys in the western Yukon Flats, 1992 to 2008.

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)	546 (101)	6.2	509	0.29	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

[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 observed moose during surveys in the western Yukon Flats, 1983 to 2008.

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 2008, 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]	546	-	-	33	201	-	-	-	-	-	16	0.37
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

[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 2008. 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	528	--	--	--	--	--	13	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

[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)	--	--	78	430	508± 29%	--	--	--	--	--	15	0.22
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

Appendix 1. Reported harvest of moose, wolves, and bears in the Yukon Flats (all villages), 2002 to 2007[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

[a] data from Council of Athabascan Tribal Governments 2003, 2005, 2006, 2007
[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

Appendix 2. Reported harvest of moose, wolves, and bears in the western Yukon Flats (Beaver, Stevens Village, and Birch Creek)[a], 2002 to 2007[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

[a] includes Beaver, Stevens Village and Birch Creek
[b] data from Council of Athabascan Tribal Governments 2003, 2005, 2006, 2007
[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 surveys in the western Yukon Flats, November 2008.

Stratification: N796: 17.3 hours x $155	2,681.50
Survey: 996: 17.1 hours x $97	1,658.70
78Z: 16.0 hours x 97	1,552.00
833: 14.5 hours x $97	1,406.50
48V: 31.72 hours x $189	5,995.08
792: 21 hours x $97	2,037.00
HED: 14.5 hours x $97	1,406.50
Fuel (115hours x 9 gal/hr x $10/gal = 10,350, 17.3 hours x 16 gal/hr x $10/gal = 2,480)	12,830.00
Food	640.00
Lodging (School: 750.00, Village Council: 750.00)	1,500.00
Total	31,707.28