Fort Resolution Moose Census November/December 1995

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Abstract

A moose census was conducted in the Northern Slave River Lowlands from Nov 27 to December 6, 1995. The study area was 5,986.7 km^2, and contained 186 sample units. 241 moose were observed yielding a population estimate of 924 moose (± a 90% confidence interval of 190 moose, or 20.5% of the estimate), and a density of 0.15 moose/km^2.

Population size did not differ significantly ($t_{42} = 0.158$, $p > 0.50$) from a census conducted in 1987/88 (902.2 ± 138 moose). Bull per 100 cow ratio (101.9 bulls per 100 cows) did not differ significantly from 1987/8 (103 bulls per 100 cows, $t_{26} = 0.106$, $p > 0.50$), but calf per 100 cow ratio (32.9 calves per 100 cows) did differ significantly from 1987/88 (71 calves per 100 cows, $t_{33} = 4.072$, $p < 0.01$).

No management activity is deemed to be necessary, given the consistency in population characteristics. The drop in calf per 100 cow ratio perhaps warrants more frequent monitoring of sex/age characteristics. The human harvest of moose in the area will be the subject of future research.

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Introduction

Despite the importance of moose as a food animal in the western NWT, moose censuses have occurred sporadically, with few studies involving re-censusing of set study areas (but see Case unpubl. data, Latour 1992, Bradley et al. 1998). This lack of data on temporal trends makes management difficult, as we have no idea whether populations are increasing or decreasing.

Moose are important to the people of Fort Resolution. While there has been no perceived problem with the moose population, there have been habitat changes in the Slave River Lowlands. Logging has been ongoing in the area for over 50 years, and while forestry can be beneficial to moose populations, excessive logging can eliminate the dense stands of conifers that moose need for winter cover (Stelfox 1974, Potter 1985, Payne et al. 1988, Abaturov and Smirnov 1992, Zablotskaya and Zablotskaya 1992). Also, prescribed burning of willow-choked meadows is being done by the Department of Resources, Wildlife & Economic Development to improve the habitat for bison. Since willows are an important forage plant for moose (Van Ballenberge et al. 1989, Oldemeyer and Regelin 1987), the prescribed burning could decrease the moose's food supply. Lastly, the G.N.W.T. and the community of Fort Resolution have plans to restore the health and size of the bison herd (they currently exist at low density). If the restoration efforts succeed, the resultant large bison population could support a larger wolf population which could in turn increase predation pressure on moose.

In 1987 and 1988 moose censuses were conducted in the Northern Slave River Lowlands study area. The combined population estimate was 902 moose, with a 90% confidence interval of 153 (Graf and Case 1992). The objective of the current study was to estimate the size and structure of the moose population in the Northern Slave River Lowlands study area to compare with the 1988 data.

Methods

An aerial stratified random block survey was conducted using Gasaway et al.'s (1986) technique. The technique entails delineation of a study area, and division of this study area into survey units (SUs). Next is a reconnaissance flight, followed by division of the survey area into strata of similar moose densities. Randomly chosen survey units within each strata are then searched thoroughly for moose. Estimates of population size are calculated for each stratum and combined to give an estimate of total population size. Sampling precision is also calculated for each stratum, then combined to give an estimate of precision for the total population estimate.

Gasaway et al. (1986) recommends that sightability correction factors be calculated for each study area to account for the differences in sightability of moose between different habitats. Sightability correction factors were not calculated for our survey, as estimating sightability is futile when moose densities are less than 0.4 moose/km^2 (Gasaway et al. 1986), as they invariably are in the N.W.T. (Graf 1992). The main purpose of our study was to determine the temporal trend in population size, and this can be done without sightability correction factors if we assume no change in sightability between the two censuses.

Study Area

The North Slave River Lowlands study area and the survey units were established in 1987 by Graf and Case (1992). The study area was 6,648.4 km^2 and 211 SUs in 1988, but we eliminated 25 SUs to save money, making the 1995 study area only 5986.70 km^2 and 186 SUs (Figure 1). The remaining SUs were unchanged. The eliminated SUs were within the Canadian shield to the east, leaving the study area as alluvial plain bounded by the Little Buffalo River to the west and the Taltson River to the east. A detailed description of the area is given in Graf and Case (1992).

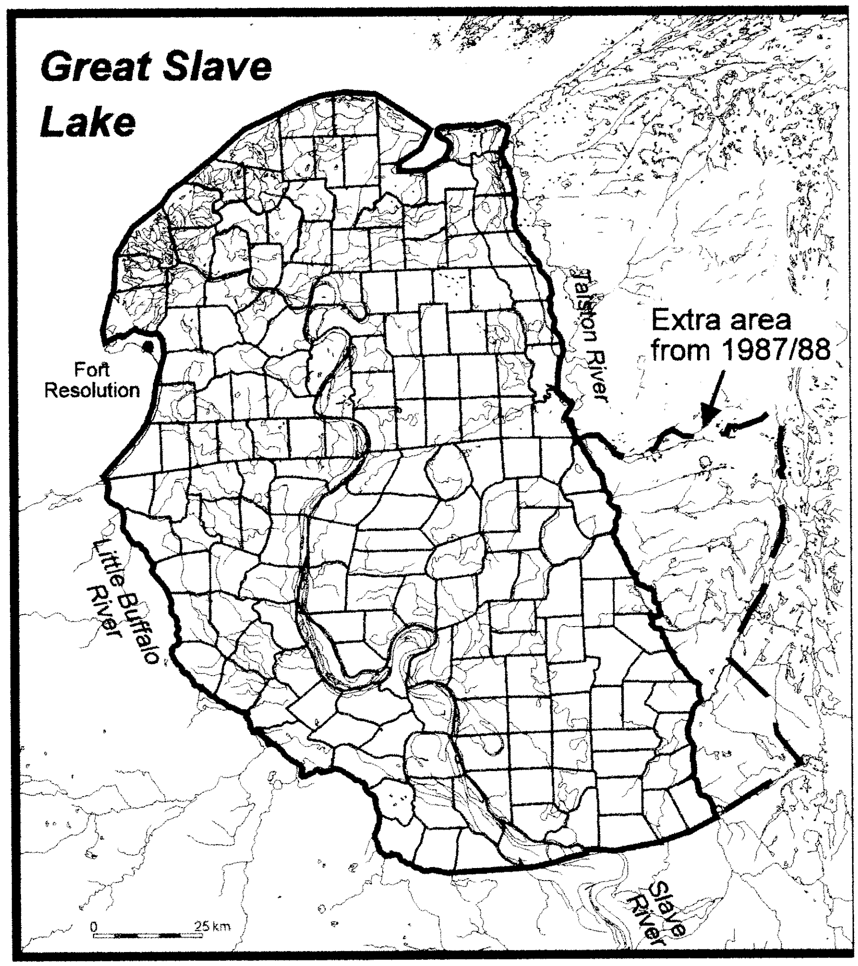

Figure 1. The North Slave River Lowlands study area, with survey unit (SU) boundaries. The dotted line indicates the area surveyed in 1987/88 that was not surveyed in 1995.

Reconnaissance

The reconnaissance survey was flown at 160 km/hr and 125m altitude on November 27, 28, and 29, 1995. A Cessna 185 was the survey plane. Transects were 4 km apart and 1 km wide, resulting in 25% coverage. Navigation was aided by the use of a global positioning (GPS) receiver. A data recorder sat in the co-pilots seat, and was responsible for recording numbers and locations of moose, as well as habitat type at each moose location. We also made notes on habitat within each SU. Locations were recorded on the GPS unit, downloaded to a computer, and displayed on screen to aid in stratification.

Stratification

Each SU was assigned to one of three strata: high, medium, or low. Several criteria were used for stratification: moose and track locations from the reconnaissance flight, moose locations from Graf and Case (1992), and location of 'good' moose habitat (generally willow or willow/prairie habitats) as seen on reconnaissance. Moose and track locations from our own reconnaissance outweighed the other factors, and we tried to avoid having single SUs of one stratum surrounded by SUs of another stratum.

Census

SU searches were conducted from November 30 to December 6. There were two crews searching from Bell 206B helicopters and one crew searching from a Cessna 150 fixed wing plane. In the helicopters there was a navigator/data recorder and two observers in addition to the pilot, while in the Cessna 150 the pilot navigated while the observer counted as well as recorded data. The fixed wing crew was assigned only to SUs that contained mostly open habitats. SUs were searched in random order until the precision of the estimate was deemed acceptable (confidence interval of 20% of the mean, calculated after each day's searching).

Temperature, wind speed, and percent cloud cover were recorded at the beginning of each SU search. Temperature and wind speed were obtained from the aircraft's instruments and cloud cover was estimated visually. Habitat type was recorded at two scales: within 10m and within 250m of each moose sighting.

Data Analysis

Gasaway et al.'s (1986) techniques were used for analysing moose census data. T tests were used to test for significant differences between years for population estimates and sex/age ratios.

Results

Reconnaissance

186 moose were seen on the reconnaissance survey (Figure 2). We used the reconnaissance data to assign 39 SUs to the high stratum, 54 SUs to the medium stratum, and 93 SUs to the low stratum (Figure 3).

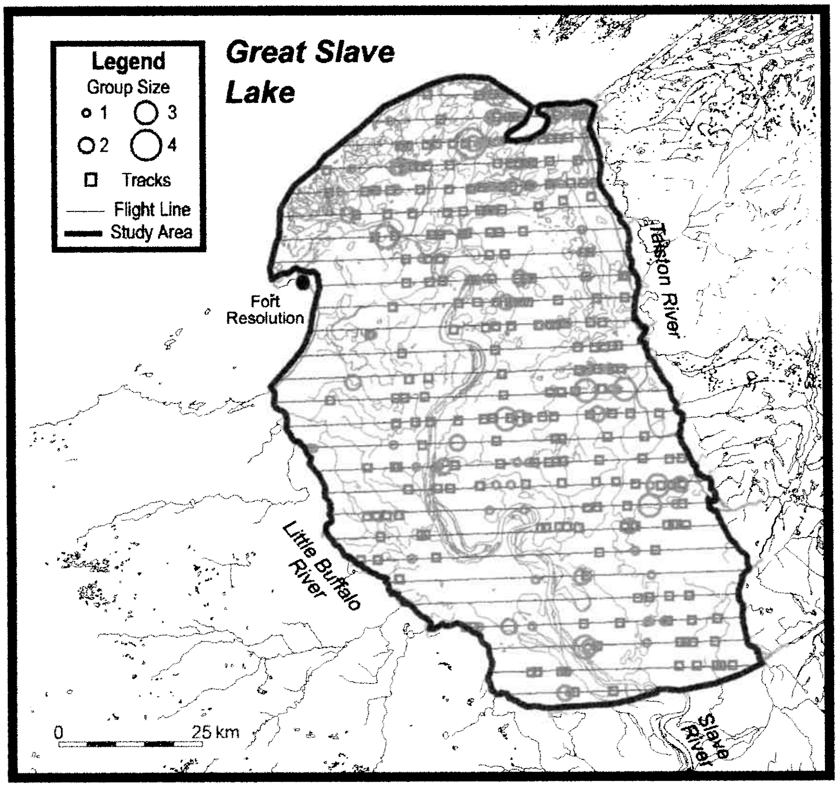

Figure 2. Location of moose and moose tracks seen on reconnaissance flights.

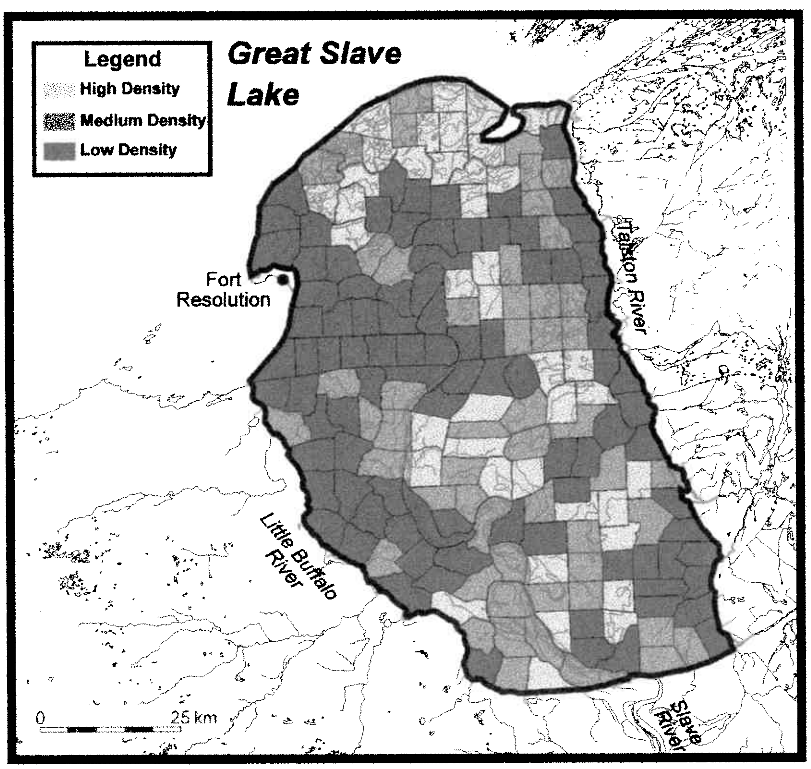

 Figure 3. Strata as delineated by reconnaissance flights.

Population Estimate

We counted 241 moose (Figure 4) and calculated a population size of 923.9 moose, which corresponds to a density of 0.15 moose/km^2. The precision of the census, expressed as a 90% confidence interval, was 189.9, or 20.6% of the estimate. The co-efficient of variation (a second measure of precision) was 12.11 (Table 1).

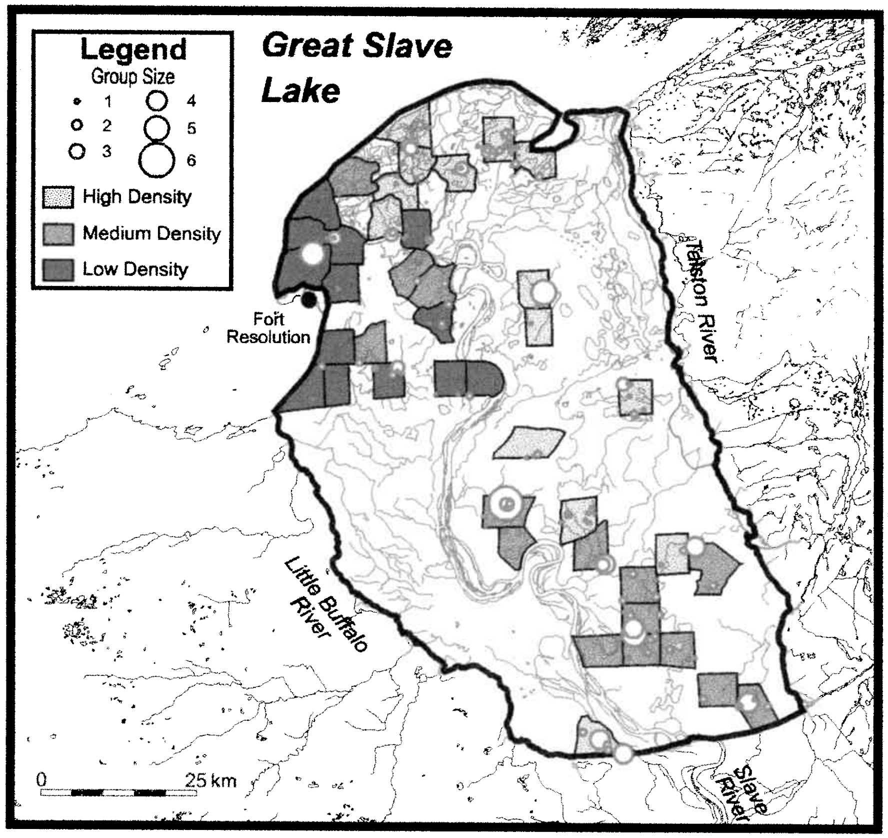

Figure 4. Location of moose seen during SU searches.

Table 1. Moose population size and density for the North Slave River Lowlands study area, 1995.

Strata	High	Medium	Low	Total
Total area (km^2)	1269.30	1792.3	2925.10	5986.70
Area surveyed (km^2)	487.60	472.60	416.10	1376.30
Total SUs	39	54	93	186
#SUs surveyed	15	14	13	42
%SUs surveyed	38	26	14	23
Moose seen	106	93	42	241
Density (/km2)	0.22	0.20	0.10	0.15
Population Estimate	275.9	352.7	295.3	923.9
Variance	1286.65	4579.93	6626.24	12492.82
Degrees of freedom	14	13	12	29
Coefficient of variation				12.11
90% C.I. (% of population estimate)				20.55%

Population Estimates: 1987/88 vs. 1995

There was no significant difference in estimated population size between 1987/88 and 1995 (Table 2). The 1987 and 1988 population estimates and variances were summed to produce a single estimate. Degrees of freedom were calculated according to Gasaway et al. (1986). Also, data from 1987/88 is a subset of the original data, corresponding to the 1995 study area (Figure 1). The slight difference in area of the two study areas is due to differences in measurement method (manual planimeter measurement of topographic maps in 1987/88 vs. GIS software measurement of digitized topographic maps in 1995).

Table 2. Comparison of census results: this study vs. corresponding SUs from Graf and Case (1992).

	1987/88	**1995**
Total Area (km^2)	5876.3	5986.7
Area Surveyed (km^2)	1363.8	1376.3
% of Total Area Surveyed	23	23
Total # SUs	186	186
#SUs Surveyed	43	42
#Moose Seen	278	241
Population Estimate	902.2	923.9
Density	0.15	0.15
Variance	6258.82	12492.82
Degrees of freedom	13	29
90% C.I. (% of population estimate)	15.4	20.6
t test		$t_{42} = 0.158$, $p > 0.50$

Sex and Age Ratios: 1987/88 vs. 1995

The estimated 1995 bull per 100 cow ratio was 102, the calf per 100 cow ratio was 33, the yearling per 100 total bulls ratio was 9 and the twinning rate was 0 (Table 3). No differences could be found in the sex and age ratios between 1987 and 1988 so data from these two years were combined. The only significant difference was in the calf per 100 cow ratios; 1987/88 had over twice 1995's calf per 100 cow ratio (Table 4).

Table 3. Moose population characteristics for the Fort Resolution study area in 1987/88 and 1995.

	Number Seen		
	1987/88	1995	
Total moose	278	241	
Total cows	103	104	
Lone cows	48	72	
Cows w/1 calf	36	32	
Cows w/2 calves	19	0	
Total calves	74	34	
Total bulls	101	103	
Yearling bulls	9	9	
	Ratios		
	1987/88	1995	t test
Bulls per 100 cows (w/yearlings)	103.24 +42%	101.89 + 21%	$t_{26} = 0.106$, $p > 0.50$
Calves per 100 cows (w/yearlings)	**74.48 + 19%**	**32.86 + 31%**	**$t_{33} = 4.072$, $p < 0.01$**
Yearlings per 100 bulls	8.97 + 89%	8.85 + 58%	$t_{27} = 0.022$, $p > 0.50$
Cows w/twins per 100 cows	22.27 + 52%	0	-

Weather: 1987, 1988 & 1995

Cloud cover was extremely variable and no significant difference could be found among years (KW test, $H_2 = 0.57$, $p = 0.75$). Temperature did vary among years ($H_2 = 39.54$, $p < 0.01$); specifically 1987 was warmer than either 1988 or 1995 (Dunn's multiway comparison, $p < 0.05$, Figure 5). Differences in data collection make a statistical comparison of wind speed among years impossible. The median wind speed in 1995 was 9.5 km/hr, while wind was categorized as mostly light or moderate in 1987 and 1988.

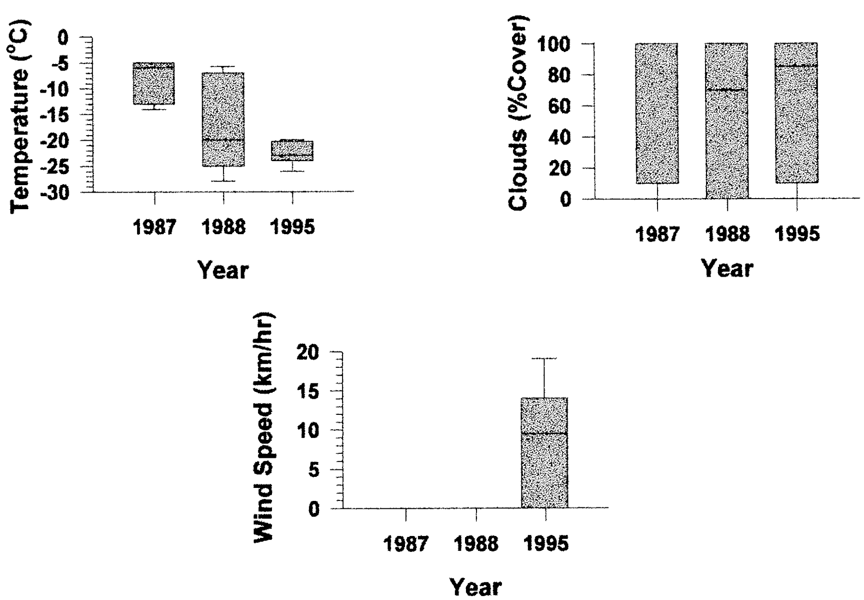

Figure 5. Weather experienced during SU searches. The error bars represent the 10th and 90th percentiles, the boxes are the 25th and 75th percentiles, and the interior lines are the medians.

Habitat

At the fine habitat scale (within 10m of each moose group) 93% of the moose sightings were in relatively 'open' habitats (Figure 6). At the coarse habitat scale (within 250m of each moose group) only 61% of the sightings were in open habitats (Figure 7). When the two scales were considered together (i.e. immediate:general), only 8% of sightings were in 'forested:forested', 31% were in 'open:forested' and 61% were in 'open:open'. There were no moose in 'forested:open' habitats.

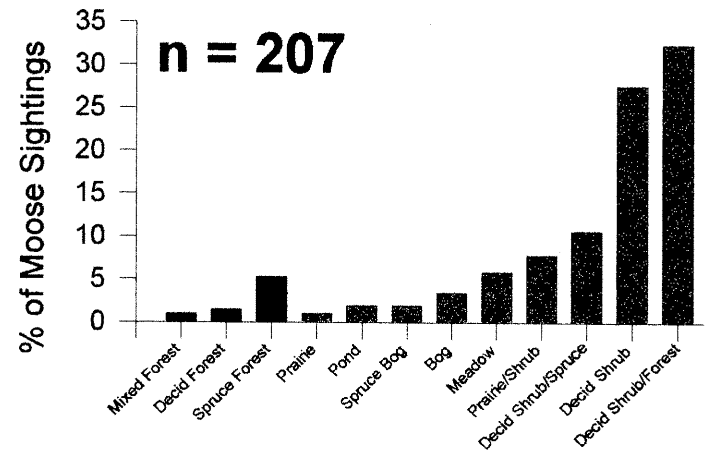

Figure 6. Habitat type within 10m of moose sighting Habitat classes are expressed as percent of total sightings.

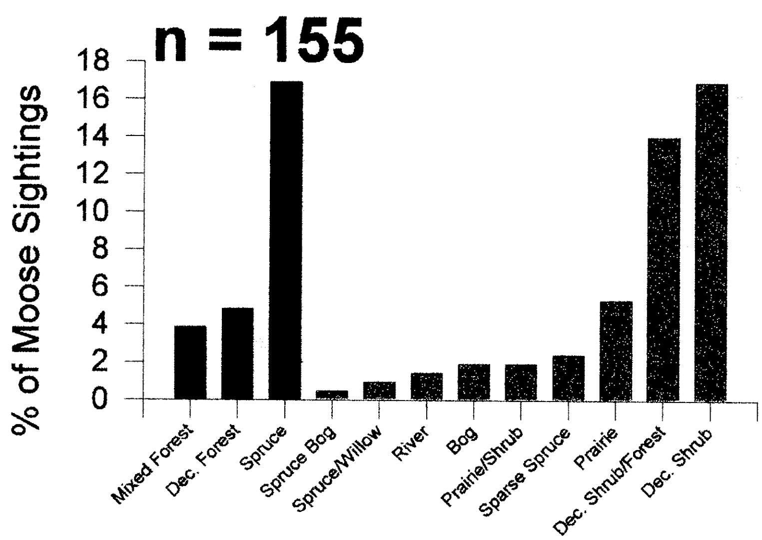

Figure 7. Habitat type within 250m of moose sightings Habitat classes are expressed as percent of total sightings.

Search Effort

We could find no relationship between search effort and number of moose seen per SU for the two helicopter crews in any of the three strata, indicating that our search effort was adequate (Figure 8). For the fixed wing crew, sample sizes within each strata were inadequate for analysis (Figure 9).

Effort was similar between years (1987/88, 1995) for the high ($t_{16} = -0.45$, $p = 0.66$) and medium strata ($t_{11, 22} = 211$, $p = 0.37$). In the low density stratum, the 1987/88 effort was 1.38 minutes/km^2, while in 1995 effort was 1.87 minutes/km^2 ($t_{29} = 4.49$, $p < 0.01$). There was no relationship between moose counted and search effort for the 1987/88 low density stratum (linear regression: $r = 0.38$, $p = 0.11$) so we deem the 0.49 minutes/km^2 difference between years to be inconsequential.

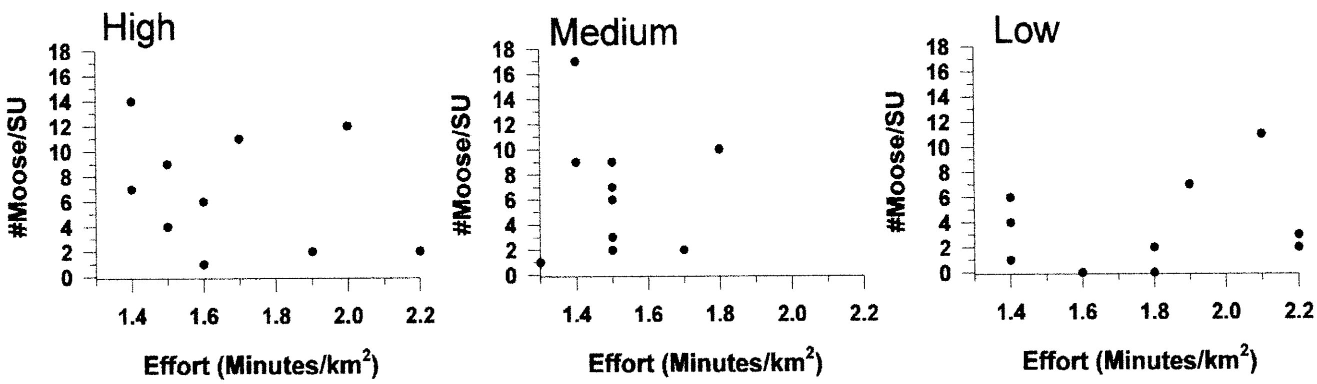

Figure 8. The relationship between search effort and success for the helicopter crews.

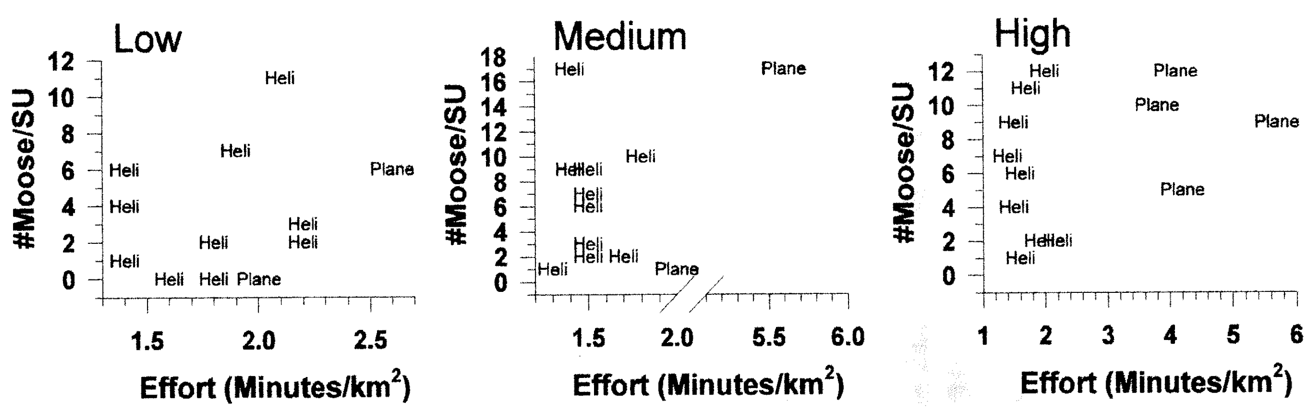

Figure 9. The relationship between search effort and success for the fixed wing and the helicopter crews.

Technique: Fixed Wing vs. Helicopter

Although the sample sizes were too small for statistical testing (the fixed wing did not fly enough SUs in each strata), a subjective examination of the data reveals no difference in search success between the fixed wing and helicopter crews (Figure 9).

Discussion

Possible Sources of Bias

When comparing two or more censuses, it is important to recognise the potential for contrasting conditions to create a bias. Three potential sources of bias were examined: search effort, weather, and technique.

Search effort was not significantly different between the two censuses (1987/88 and 1995) for the high and medium density strata. The significant difference found between the two censuses in the low density strata was small, and the number of moose counted did not correlate with search effort. Search effort was therefore probably adequate in both years.

Severe weather can force moose into cover, making detection difficult. Weather was similar between the two censuses except for temperature; 1987 was warmer than either 1988 or 1995. Since moose were found mostly in open habitats in 1995 (Figures 6 & 7), the colder temperatures had evidently not been severe enough to send the moose into cover. Weather therefore probably did not bias our results.

The only difference in technique between the two censuses was the use of a fixed wing aircraft to search SUs in 1995. Small sample size prevented a statistical comparison of search success between aircraft, but subjectively there appeared to be no difference (Figure 9). An experiment involving double searching of selected SUs with both types of aircraft would provide a more definitive answer to the question of aircraft bias. Although costly, such an experiment could save money in the long term, assuming that a result of no difference was found.

Habitat

The most frequently used habitat for moose was deciduous shrubs. Although habitat availability was not measured, on a subjective basis deciduous shrub habitat appeared to be a relatively minor component of the landscape, indicating that the moose were selecting this habitat. This is evidence of proper timing of the survey; later in winter, moose will tend to move to areas of dense timber, decreasing observability (Gasaway et al. 1986).

Population Density

The 1995 population density of 0.15 moose/km^2 is identical to that reported for 1987/889 in Graf and Case (1992). This density is at the high end of the range for N.W.T. moose, but low compared to other northern areas (Table 4).

Population Characteristics

The 1995 calf per 100 cow ratio of 33 is at the low end of the range reported for moose in the N.W.T. and is significantly lower than the ratio of 74 reported for 1987/88 (Tables 3, 4). This is puzzling, as the population has evidently remained stable over the intervening seven years, and is one of the densest on record for the N.W.T.(Table 4). It is possible that by coincidence, 1995 happened to have an unusually low calf crop. This idea is supported by the identical yearling ratios between the 1987/88 and 1995 censuses (Table 3) indicating that 1994's calf crop was more 'normal'. On the other hand, 1987/88 may be the unusual year; with only two data points and a survey interval of seven years, we can only guess.

Table 4. Population characteristics reported for N.W.T. moose populations. Only block surveys are included.

Location	Year	Density	CV	Calf:100 Cows	Author
Fort Wrigley	1982	0.03	n/a	n/a	Hawley, V. and R. Antoniak, 1983.
Slave River Lowlands	1981	0.04	n/a	n/a	Hawley, V. and R. Antoniak, 1983.
Inuvik	1986	0.05	0.04	44	Stenhouse and Kutney, unpubl. data in Graf, R.
Slave River Lowlands	1980	0.05	n/a	n/a	Hawley, V. and R. Antoniak, 1983.
Slave River Lowlands	1982	0.05	n/a	n/a	Hawley, V. and R. Antoniak, 1983.
Liard Valley	1980	0.06	n/a	n/a	Hawley, V. and R. Antoniak, 1983.
Inuvik	1986	0.06	0.15	25	Jingfors and Kutney, 1989.
Liard Valley	1986	0.07	0.22	100	Case, R., unpubl. data.
Fort Providence	1994	0.08	0.08	32	Bradley, et al 1998.
Liard Valley	1981	0.10	n/a	n/a	Hawley, V. and R. Antoniak, 1983.
Slave River Lowlands	1986	0.11	0.2	64	Graf, R., and R. Case, 1991.
Liard Valley	1985	0.12	0.17	81	Case, R., unpubl data.
Fort Good Hope	1984	0.13	0.1	61	Jingfors, et al, 1987
Liard Valley	1979	0.13	n/a	31	Donaldson and Fleck, 1980
Norman Wells	1984	0.15	0.11	44	Jingfors, et al, 1987.
Norman Wells	1992	0.15	0.19	57	Latour, 1992.
North Slave River Lowlands	**1995**	**0.15**	**0.12**	**33**	**Bradley et al, this study**
Liard Valley	1994	0.16	n/a	32	Bradley et al, unpubl. data
North Slave River Lowlands	1988	0.16	0.10	69	Graf, R., and R. Case, 1992
Norman Wells	1995	0.17	n/a	56	Veitch et al., 1997.
Fort Providence	1991	0.17	0.14	55	Shank, C. 1991. Draft Report.

Conclusions and Recommendations

1) The moose density in the northern Slave River Lowlands has remained stable over the past seven years, and subjectively at least, the people of Fort Resolution have enough moose to meet their needs, so there are no immediate management concerns. With two data points, there is now a better baseline for assessing possible population changes in the future.

2) The potential bias in using fixed wing aircraft in place of helicopters is still unquantified. The next moose census in the N.W.T. should include flying some SUs twice as a sightability experiment.

3) The calf per 100 cow ratio of 33 is quite low, and represents a statistically significant decrease since 1988. The seven year survey interval makes any discussion of trend futile, so we could consider doing yearly sex/age classification flights. The use of the Cessna 150 fixed wing aircraft for these flights would make them financially feasible. To detect a doubling of the calf per cow ratio (ratio out of 1) we would need a variance of about 0.008 (Figure 10). To get an estimate of the number of SUs that would have to searched to achieve a variance of 0.008, calf per cow ratios were calculated from random subsamples taken from our high and medium density strata (4 iterations each at sample sizes 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, and 29, Figure 10). Between 7 and 15 SUs would have to be searched; at $170/hr and 1.5 hrs/SU, this would cost from $2,000 to $4,000.

4)) Although there is no acknowledged standard for census interval in the N.W.T., 7 or 8 years is probably too long. Five years may be a good compromise for a census interval in the absence of any pressing management or conservation concern.

5) Currently, knowledge of the human harvest of moose in the Slave River Lowlands is nil. The Aboriginal Wildlife Harvester's Committee has expressed interest in starting a survey of hunters in Fort Resolution. Such a survey would yield valuable information on one of the causes of mortality in the Slave River Lowlands population. We are hoping to gather data on the 1995/96 harvest in the

spring of 1996.

6) With all of the ongoing habitat changes (logging, prescribed burning), as well as possible future changes, a knowledge of moose habitat use in the Slave River Lowlands would be very valuable to the Aboriginal Wildlife Harvester's Committee and to the Department of Resources, Wildlife & Economic Development. GPS radio collars would provide habitat use data on a scale comparable to that available from landsat remote imagery.

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