

**NISUTLIN SOUTH MOOSE MANAGEMENT AREA
EARLY-WINTER MOOSE SURVEY
NOVEMBER 25 – DECEMBER 7, 2003**



Yukon
Environment

2009

**NISUTLIN SOUTH MOOSE MANAGEMENT AREA
EARLY-WINTER MOOSE SURVEY
NOVEMBER 25 – DECEMBER 7, 2003**

**Fish and Wildlife Branch
SR-09-04
Yukon Department of Environment**

© 2009 Yukon Department of Environment

Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5A
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721, Fax (867) 393-6263
E-mail: environmentyukon@gov.yk.ca

Suggested citation:

ENVIRONMENT YUKON. 2009. Nisutlin South Moose Management area early-winter moose survey.
Yukon Fish and Wildlife Branch Report SR-09-04, Whitehorse, Yukon, Canada.

SUMMARY

- ❖ An early-winter census survey of the Nisutlin South moose population was done 19 November to 7 December 2003. The purpose of this survey was to estimate moose abundance, distribution and demographic parameters of moose in the area.
- ❖ The Nisutlin South survey area is an important hunting area for the Teslin Tlingit First Nation and licensed hunters. Concern has grown in recent years about the potential over-harvest of moose in the area because of access.
- ❖ Two population censuses were done prior to the 2003 census – 1986 and 1994. Several other types of surveys have been performed within certain parts of the area during 1974, 1976, and 1989 to 1994.
- ❖ The historical survey area included GMA 10-21, 10-22 and 10-23, and was 4387 km². The 2003 survey area size was increased to include the western part of GMA 10-24 and was 5460 km².
- ❖ The census covered 62 sample units, which corresponds to approximately 20 percent of the survey area (1055 km²). Within the surveyed sample units 299 moose were observed: 92 bulls, 157 cows, 49 calves and 1 unclassified moose.
- ❖ The total population estimate for the 2003 survey area was 1103 (90%CI: 888-1318), which corresponds to a density of 219 moose per 1000 km² of habitable terrain.
- ❖ Moose were concentrated in and around the sub-alpine zones of the three mountain ranges within the survey area.
- ❖ There are an estimated 43 calves per 100 cows and 27 yearlings per 100 cows.
- ❖ The sex ratio was estimated to be 56 bulls per 100 cows.
- ❖ Licensed harvest has decreased from the 1980s, and has averaged below 15 moose per since 1990.

1. INTRODUCTION

The objective of this report is to summarize the results of the Nisutlin South moose population census survey which was completed in 2003. Note that this report is written in 2009, so some details of the survey have been lost along with the memory of the observers. Furthermore, because more recent licensed harvest information is available, we present licensed harvest data from 1979 to 2008.

The census survey was originally planned for the early-winter 2002, but due to unsuitable snow conditions the survey was delayed one year. The 2003 survey was completed because some issues arose in the region and the most current population data was outdated (10 years old). The issues that initiated the survey were:

- 1) To fulfill a commitment made to the outfitter of Outfitting Area 19, as part of their outfitter quota negotiations.
- 2) The Teslin Tlingit Council (TTC) harvest management strategy, including access permits for FN and non-FN hunters, is reliant upon a good assessment of the local moose population. TTC is discussing some very sensitive issues within their FN, such as cow harvest practices, and many of the decisions will hinge on the assessment of the total population and the distribution of harvesting opportunities.
- 3) Within the fish and wildlife plan the concerns of note were that the heavy use of accessible corridors within the traditional territory could be adversely influencing local moose numbers. The specific concern was that declining moose density in a neighbouring area, Whitehorse, would mean that hunters would travel to the Nisutlin area for hunting opportunities.

1.1. Previous Surveys

The Nisutlin South survey area is one of the fortunate areas in Yukon that has had relatively extensive and regular moose surveying. Previous population census surveys in the area were completed in 1986 and 1994. Other surveys conducted in the area, though not population census surveys, include moose reconnaissance surveys in 1974 (February and December) and 1976; and trend surveys of the Big Salmon mountain range (1989) and Fish Lake area (1989 to 1994). Though the data collected during these other surveys are not compatible with the population census survey data they will be included as supplementary information where appropriate.

1.2. Study Area

The Nisutlin South survey area was expanded for 2003. The expansion of the survey area approximately doubled the size of the 2003 area compared to previous population census surveys of the area. However, a complete census survey was only done for the area consistent to previous surveys (but see end of next paragraph).

The 2003 Nisutlin South survey area is located in southern Yukon. The southern end of the South Canol Highway bisects the survey area. It includes much of the Nisutlin River Valley and the southern part of the Big Salmon mountain range. The survey area is approximately east of Teslin Lake and Teslin River from the British Columbia-Yukon border to Livingstone Crossing; south of the Livingstone Trail and Big Salmon Lake; and west of Morley River and Englishmans Range (Map 1). The full survey area includes Game Management Sub-zones 8-11, 8-24, 8-25, 8-

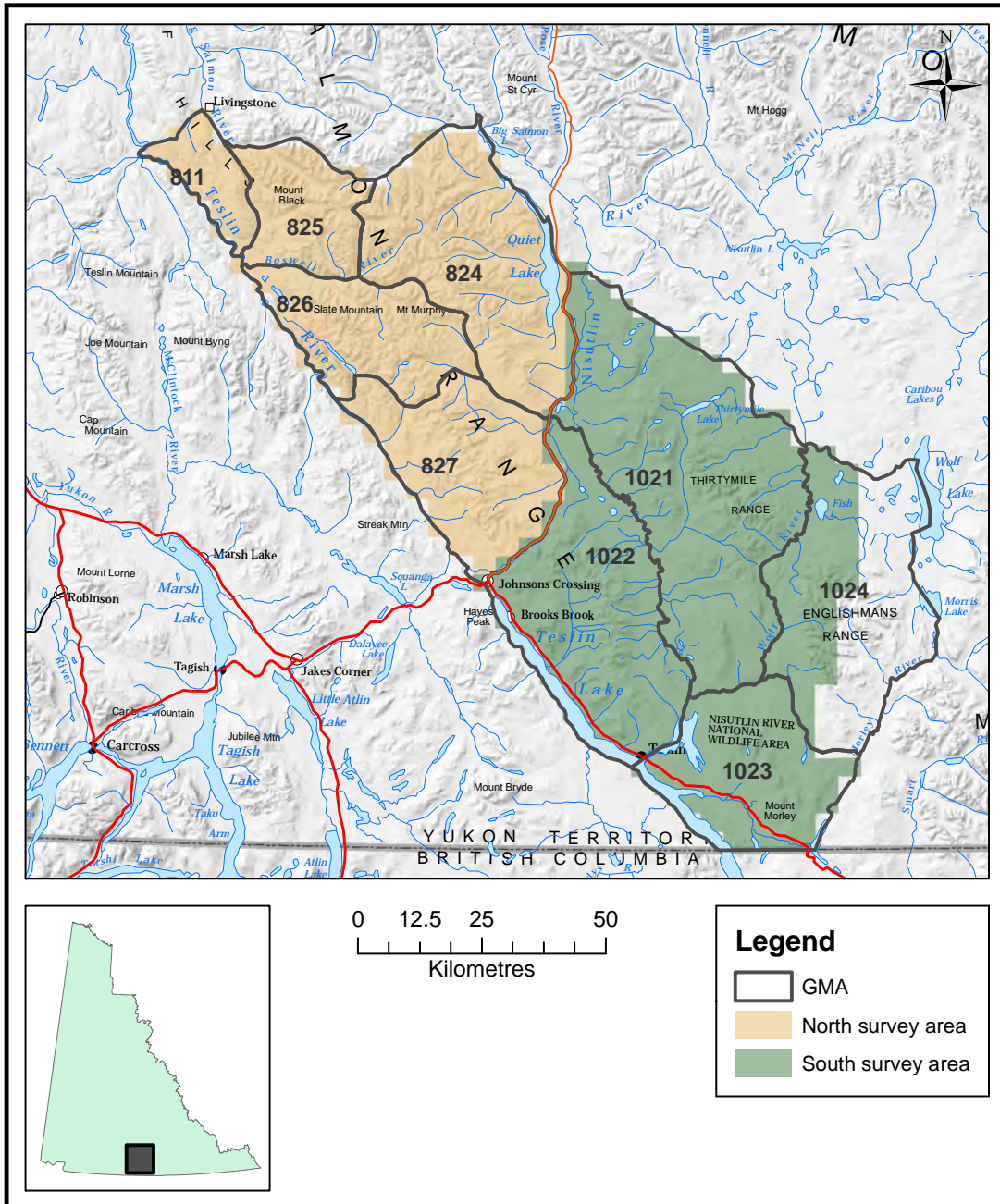
26, 8-27, 10-21, 10-22, 10-23, and the west half of 10-24. The survey area was expanded for the 2003 survey to include the west half of 10-24.

The northern portion of the survey area (Map 1) is mostly within the Pelly Mountains ecoregion (Yukon Ecoregions Working Group 2004). The major geographic feature within the survey area is the Big Salmon mountain range. Because the Big Salmon mountain range is the principal geographic feature, much of the area is above tree line. The high elevation slopes are dominated by shrub birch, while lower elevation dominated by white spruce (*Picea glauca*) (Yukon Ecoregions Working Group 2004). The area experiences relatively heavy precipitation compared to other areas within Yukon.

The entire southern portion of the survey area (Map 1) is almost entirely within the Southern Lakes ecoregion, though a small portion of the Pelly Mountains ecoregion penetrates the northwest corner where the Big Salmon mountain range enters the area. The major geographic features within the survey area are the Big Salmon, Thirty Mile, and Englishmans mountain ranges, and the Nisutlin River valley. High elevation slopes are dominated by willow (*Salix sp.*) and shrubs birch. Lower elevations are often composed of mixed woodland, but dominated by pine (*Pinus contorta*), white spruce (*P. glauca*) and black spruce (*Picea mariana*) (Yukon Ecoregions Working Group 2004). Forest fires have produced some localized patches of sub-climax stands dominated by willow and pine. Also, the dynamic fluvial processes of the Nisutlin River cause seasonal disturbances which provide a steady amount of early successional habitat along the banks of the river.

Nisutlin South Moose Census Survey Area

November 25 to December 7, 2003



Map 1: Nisutlin South moose population census survey area – November 25 to December 7, 2003. Population census was only completed for the south survey area (green). Game management sub-zones included in the survey area are shown.

2. METHODS

We have adopted a relatively new survey technique, developed by Jay Ver Hoef with the Alaska Department of Fish and Game to survey moose (Kellie and DeLong 2006). Field sampling portions of this new geospatial technique are similar to those used in the stratified block method (Gasaway et al. 1986) used prior to 1999, except that we count moose in square rather than irregular shaped survey blocks. This new technique employs more current population estimation procedures.

The new technique involves six steps:

- 1) The survey area is divided into uniform rectangular blocks about 17 km² in size.
- 2) Observers in fixed-wing aircraft fly over all the blocks, and classify (or “stratify”) each block as having either high, medium, low, or very low expected moose abundance, based on local knowledge, number of moose seen, tracks, and habitat. This is called the “stratification” portion of the survey.
- 3) We combine these categories of blocks into high and low “strata”, and then randomly select a sample of each stratum for inclusion in the following steps.
- 4) We try to count every moose within the selected blocks (the “census” part of the survey) using helicopters at a search intensity of about 2 minutes per km². We classify all moose seen by age (adult, yearling, or calf) and sex. Yearling cows are often difficult to distinguish from adults, so we classify all cows as adults, and later estimate the number of yearling cows that were present among the older cows based on the number of yearling bulls we saw.
- 5) To estimate the number of moose that we missed during step 4, we re-fly a portion of some of our selected survey blocks using double the search intensity (about 4 minutes per km²). This information is used to develop a “sightability correction factor” to be incorporated into our population estimate.
- 6) We use computer programs to estimate the total number of moose in each age and sex category in the entire survey area based on the numbers of moose counted in the blocks during the census. The “sightability correction factor” is applied to the total number to account for moose that we overlooked.

Generally, the more blocks that are searched during the census portion of the survey (step 4), the more precise and reliable the resulting population estimate.

The geospatial technique has the advantage of being operationally easier to fly. It is flexible for small area estimation and provides good population estimates often with greater precision than the stratified random block method. However, the stratified random block technique allows us to determine a sightability correction factor to our estimated population data which allows accounting for moose that were missed during the survey. The population estimation technique reported depends on the difference in precision of the population estimate and if a sightability correction factor is calculated during the survey.

2.1. Stratification (identification of high and low density blocks)

The total survey area is 9550.3 km², including 8049.7 km² of habitable area. Habitable area is terrain that is not large waterbodies (>0.5 km²) or above 1525 metres elevation (5000 feet). The survey area was flown to stratify the north and south portions of the area November 19, 20, 21, 29, and December 7 and 10. Three aircraft were used for the stratification survey: Super Cub, Cessna 206, and Found Bush Hawk. A total of 20.7 hours were used to complete the

stratification. The north portion is 4090 km² and includes 3004 km² of habitable area. Within the north portion 244 sample units were stratified. The south portion is 5460 km² and includes 5046 km² of habitable area. Within the south portion 321 sample units were stratified. The complete survey area is composed of 565 sample units.

The stratification survey of the southern 321 sample units resulted in categorizing 77 (24%) as high density moose blocks and 244 (76%) as low density blocks (Map 2). The stratification survey of the northern 244 sample units resulted in categorizing 103 (42%) as high density units and 141 (58%) as low density units (Map 2). The majority of the estimated high density moose sample units were located in the higher elevation habitat along and around the mountain ranges within each of the survey areas (Map 2; Map 3).

2.2. Census Coverage

The census survey was only done for the southern portion of the survey area. A fixed wing aircraft, a Super Cub, was used for the census survey. The 2003 Nisutlin South census survey area was conducted during 7 work days between November 25 and 7 December. The census covered a total of 62 sample units, which included 27 high density sample units and 35 low density sample units. The 62 survey sample units cover 1055 km² and represent 19.3 percent of the total survey area.

2.3. Weather and snow conditions

Weather was variable and changed considerably during the survey. There were blizzard conditions and flurries between November 28 and December 4 which meant that surveying could not be done during those days.

Table 1: Summary of temperature and weather conditions during sampling days for the 2003 Nisutlin South census survey.

Date	Temperature	Weather conditions
November 25	-19°C to -20°C	Cloudy
November 26	-16°C to -22°C	Snow
November 27	-16°C to -18°C	Cloud, snow
November 28	-19°C	Cloud
December 4	-16°C to -21°C	Cloud
December 6	-12°C to -21°C	Cloud, snow
December 7	-12°C to -17°C	Mainly clear

3. RESULTS AND DISCUSSION

All population parameter estimates are presented with 90% confidence intervals. For the remainder of the text only the south portion of the survey area will be discussed.

3.1. Observations of Moose

During the census, 299 moose were observed within the census sample units, including 92 bulls, 157 cows and 49 calves (Table 1). About 83 percent of moose recorded were observed in the high density sample units.

Table 2: Observations of moose during the 2003 Nisutlin South census survey (November/December 2003).

Category	High blocks	Low blocks	Total
Bulls (adult)	65	11	76
Bulls (young)	12	4	16
Cows	135	22	157
Unknown	1	0	1
Calves	34	15	49
Total	247	52	299

3.2. Distribution and Abundance

Moose were unevenly distributed within the Nisutlin South Survey area. The stratification survey indicates that moose were concentrated in and around the high elevation sub-alpine habitats of the Thirtymile, Englishmans, and Big Salmon mountain ranges with few moose observed in valley bottoms. The distribution of moose is consistent with the previous early winter surveys conducted for this area (Ward et al. 1998).

The estimated total number of moose in the survey area is 1103 moose (90% CI: 888-1318). The estimated density within suitable habitat is 219 moose per 1000 km² and the moose density over the entire area is 202 moose per 1000 km². The calculated density is considered within the range of average moose density within Yukon (Yukon Fish and Wildlife Branch 1996).

3.3. Age and Sex

Calves and yearlings made up an estimated 19 and 12 percent of the total population, respectively. Calf survival to early winter was estimated at 43 calves per 100 cows (90% CI: 28-58). Recruitment of the previous year's calves was estimated to be 27 yearlings per 100 cows (90% CI: 15-40). Both suggest a population that is stable or growing.

Adult bulls and cows represent an estimated 25 and 44 percent of the total population, respectively. The sex ratio was estimated to be 56 bulls per 100 cows (90% CI: 34-70), which may be indicative of a sustainable harvest.

Table 3: Estimated population parameters of the moose population in the Nisutlin South moose survey area in November and December 2003 (5460 km²).

	Population Parameters	Estimates	Confidence interval (90%)
Estimated Abundance	Total Moose	1103	19.46% (888-1318)
	Density (moose/1000 km ² of Habitat)	219	na
	Density (moose/1000 km ² of Total Area)	202	na
Estimated Composition	Mature bulls (> 30 months)	278	25.32% (208-348)
	Mature cows (> 30 months)	492	24.82% (370-615)
	Yearlings (Approx. 18 months) ⁵	135	41% (80-190)
	Calves (< 12 months)	210	28.01% (151-269)
	Unknown	3	122.73% (0-7)
Estimated Population Ratios	Mature bulls per 100 mature cows	56	30.54% (39-73)
	Yearlings per 100 mature cows	27	46.40% (15-40)
	Calves per 100 mature cows	43	34.82% (28-58)
Estimated Population Composition	Mature Bulls: percent of total population	25%	26.26% (18-32)
	Mature Cows: percent of total population	44%	24.21% (33-55)
	Yearlings: percent of total population	12%	43.62% (7-17)
	Calves: percent of total population	19%	31.73% (13-25)
	Unknown	<1%	na
Twinning Rate		12%	59.08% (5-19)

3.4. POPULATION STATUS: 1986, 1994 AND 2003

For comparison, the area of the 2003 census survey was reduced so that it is consistent with previous surveys. To make areas consistent all data collected in GMA 10-24 was removed and data was reanalyzed. The reduced data is reported in Table 4.

Population Estimates

The moose population in the Nisutlin South survey area seems to be stable between 1994 and 2003 – the 2003 estimated population size, 881 (90%CI: 696-1066), is nearly identical to the 1994 estimate, 882 (90%CI: 751-1014). Both of the most recent surveys (1994 and 2003) indicate that the population may have increased by more than 50 percent since the 1986 estimate (Figure 1).

Sex Ratios

Sex ratios, the number of bulls per 100 cows, are often biased slightly towards fewer males than females (a smaller sex ratio). Animal populations exposed to unnatural mortality, due to hunting of bulls, show an even greater trend towards smaller sex ratios. In Yukon, wildlife managers can use sex ratios as an indicator of excessive harvest pressure on moose populations; when sex ratios are low a population might be experiencing an unsustainable harvest. A sex ratio less than 30 bulls per 100 cows is considered a potential problem population (Moose Management Guidelines, 1996).

The sex ratio seems to be declining steadily since the 1986 estimate (Figure 2). As of 2003 the sex ratio estimate of 52 is still not below the 30 bulls per 100 cows threshold, but if the decreasing trend continues the sex ratio may be a concern in the near future. Previous surveys of the area, 1973 to 1975, indicate an average sex ratio of 70 bulls per 100 cows.

Recruitment

Recruitment is defined as the addition of new individuals to a population. Moose recruitment is limited by predation of calves by grizzly bears and wolves. Recruitment data is prone to large amounts of variation, so predicting long-term trends is problematic without data collected during consecutive years. The two indices of recruitment reported here – the number of calves per 100 cows and number of yearlings per 100 cows – provide two years of recruitment information for interpretation. Both indices of recruitment indicate that recruitment is not a problem for the Nisutlin South moose population (Figure 3).

Table 4: Comparison of Nisutlin South Moose Survey (No SCF) Results from the 1986, 1994 and 2003 surveys (Game Management Subzones 1021-1023 Comparison Area, 4387 km²)¹. Confidence intervals are reported a plus or minus a percentage and as a range of values.

POPULATION PARAMETERS	1986 ³	1994 ³	2003 ²
Survey Technique/Analysis	SRB/MoosePop	SRB/MoosePop	Geo-Spatial
<i>Estimated Abundance</i>			
Total Moose ⁴	558 ±19% (452-665)	882 ±15% (751-1014)	881 ±21% (696-1066)
Density (moose/1000 km ² of habitat)	131	203	201
Density (moose/1000 km ² of total area)	NA	194	189
<i>Estimated Composition³</i>			
Mature Bulls (> 30 months)	180 ±31% (125-236)	273 ±21% (216-330)	207 ±29% (147-268)
Mature Cows (> 30 months)	205 ±25% (153-256)	357 ±17% (295-419)	393 ±27% (288-498)
Yearlings (approx. 18 months) ⁵	73 ±43% (42-105)	67 ±39% (41-93)	118 ±41% (70-166)
Calves (< 12 months)	99 ±33% (66-132)	185 ±19% (149-221)	173 ±29% (122-224)
Unknown	1 ±49% (1-2)	1 ±0% (1)	3 ±116% (0-6)
<i>Estimated Population Ratios⁴</i>			
Mature Bulls per 100 Mature Cows	88 ±36% (56-120)	76 ±21% (60-93)	52 ±34% (34-70)
Yearlings per 100 Mature Cows	36 ±56% (16-56)	19 ±40% (11-26)	30 ±47% (16-44)
Calves per 100 Mature Cows	48 ±27% (35-62)	52 ±14% (44-59)	44 ±37% (28-61)
Mature bulls: percent of total population	32 ±20% (26-39)	31 ±15% (26-35)	23 ±30% (16-30)
Mature cows: percent of total population	37 ±19% (30-44)	40 ±8% (37-44)	44 ±26% (33-56)
Yearlings: percent of total population	13 ±40% (8-18)	8 ±36% (5-10)	13 ±44% (8-19)
Calves: percent of total population	18 ±28% (13-23)	21 ±13% (18-24)	20 ±33% (13-26)
Unknown	<1 ±54% (0)	<1 ±15% (0)	<1 ±118% (0)
Twining rate (%) ⁶	Est. value not avail.	12 ±54% (5-18)	13 ±58% (1-21)
	(Note: Obs.ratio=12)		

¹ To allow for comparison across years, no sightability correction factor is included in estimates provided.

² Used Geo-spatial no scf results for the 2003 Nisutlin South comparison area. Any differences between the total estimated moose abundance and the sum of the estimated composition numbers for the 2003 subset results is due to the geo-spatial estimation methods used.

³ Used Moosepop no scf results for the 1994 and 1986 Nisutlin South comparison areas

⁴ While not technically correct, for explanation purposes the 90% Confidence Interval may be interpreted as the range of values that is 90% certain to encompass the true population parameter.

⁵ To account for yearling cows that cannot be identified from the air, the total number of yearlings is assumed to equal 2x estimated number of yearling bulls in the population.

⁶ Twining Rate = the number of cows with 2 calves divided by the total number of cows with calves.

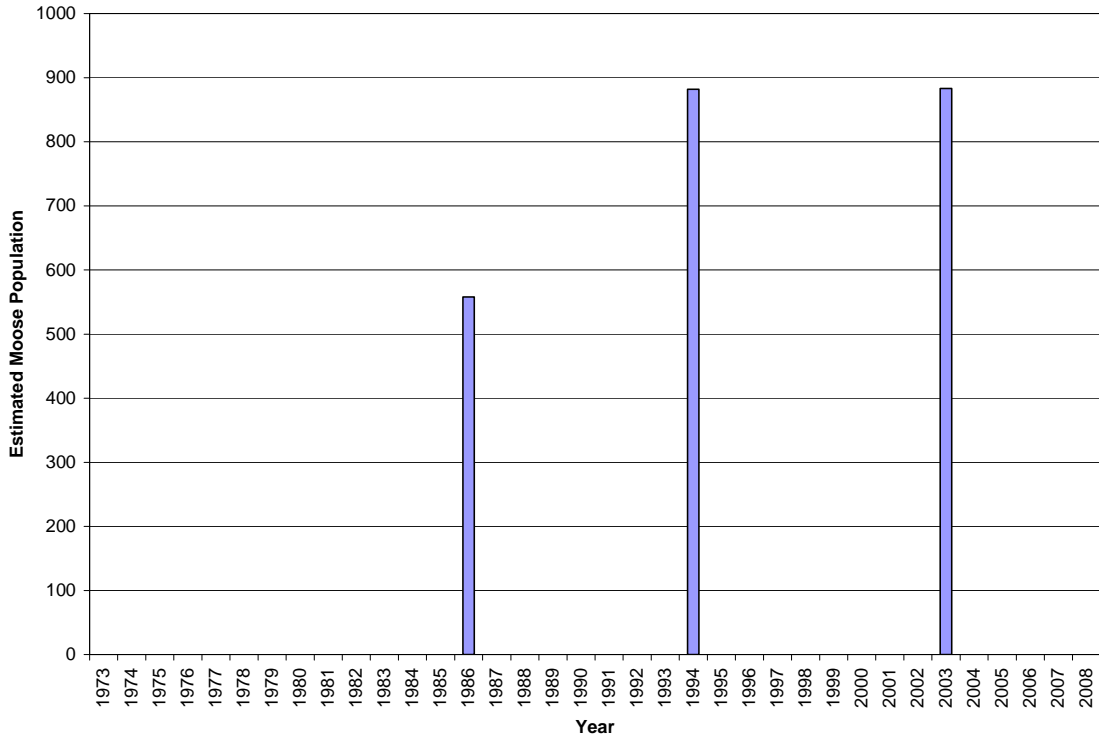


Figure 1: Estimated population size for Nisutlin South survey area from population census surveys.

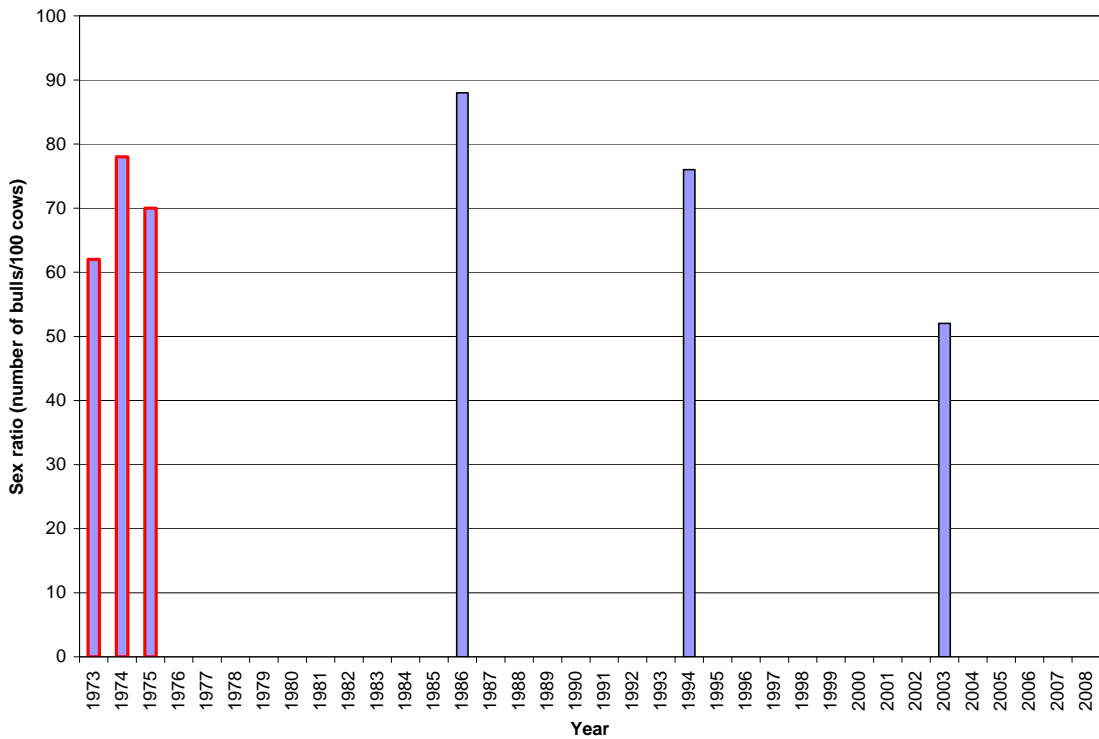


Figure 2: Estimated sex ratio (number of bulls per 100 cows) within the Nisutlin South survey area. The bars outlined in red indicate data collect during non-census surveys; therefore, the information is not directly comparable, but provides some historical data for consideration. The 1973 and 1975 surveys were

conducted during February 1974 and January 1975, respectively; however, the data correspond to the previous year’s moose sex ratio so are reported as 1973 and 1975.

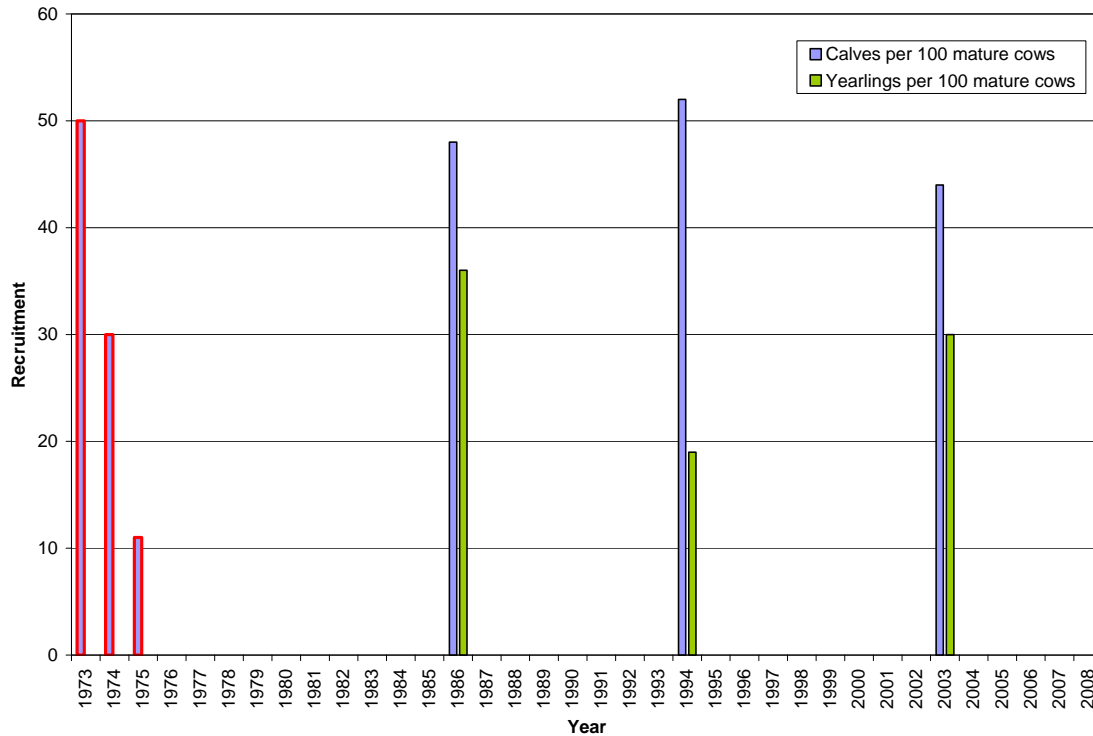


Figure 3: Estimated recruitment indices within the Nisutlin South survey area, 1973 to 2008. Recruitment is reported as number of calves per 100 cows (blue) and number of yearlings per 100 cows (green). The bars outlined in red indicate data collect during non-census surveys; therefore, the information is not directly comparable, but provides some historical data for consideration. The 1973 and 1975 surveys were conducted during February 1974 and January 1975, respectively; however, the data correspond to the previous year’s moose recruitment so are reported as 1973 and 1975.

3.5. Licensed Harvest

Licensed harvest in the Nisutlin South census survey area has been variable during the 30 year period where harvest data is available (Figure 4). Licensed harvest has averaged 15.84 moose per year (range: 8 to 30) between 1979 and 2008.

When licensed harvest is grouped by decade a trend becomes more apparent (Figure 5). Between 1979 and 1988 the average annual licensed harvest was 19.5 moose per year (3.50 percent of the total estimated population), which is significantly greater than licensed harvest during the following two decades (ANOVA: $F_{2,27}=4.121$, $p=0.027$). During the 1989 to 1998 and 1999 to 2008 periods the average annual licensed harvest has remained about the same at 13.3 (1.51 percent of the total estimated population) and 14.7 (1.67 percent of the total estimated population) moose per year, respectively. The annual allowable harvest (AAH) presented in Figure 4 indicates a harvest rate of 4 and 2 percent of the population. AAH was calculated using the estimated moose population from population census surveys..

Note that the reported harvest does not include unlicensed subsistence harvest. Government of Yukon biologists estimate unlicensed subsistence harvest to be as large as the licensed harvest.

Therefore, if the unlicensed harvest is close to the licensed harvest the total allowable harvest almost definitely exceeded.

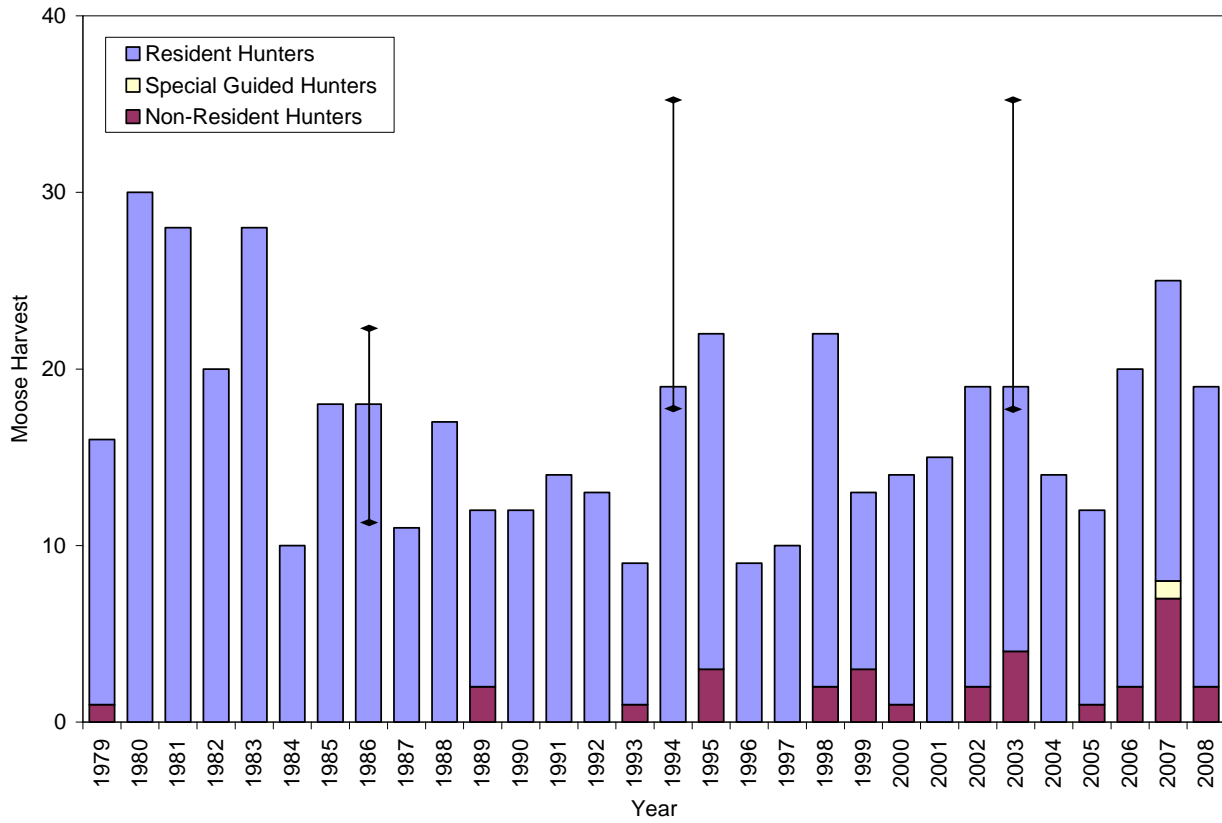


Figure 4: Total licensed moose harvest in the Nisutlin South census survey area, 1979 to 2008. GMAs included are 10-21, 10-22 and 10-23. Vertical black bars indicate the AAH within the 2 to 4 percent range. The top of the bar indicates the 4 percent AAH and the bottom of the line indicates the 2 percent AAH.

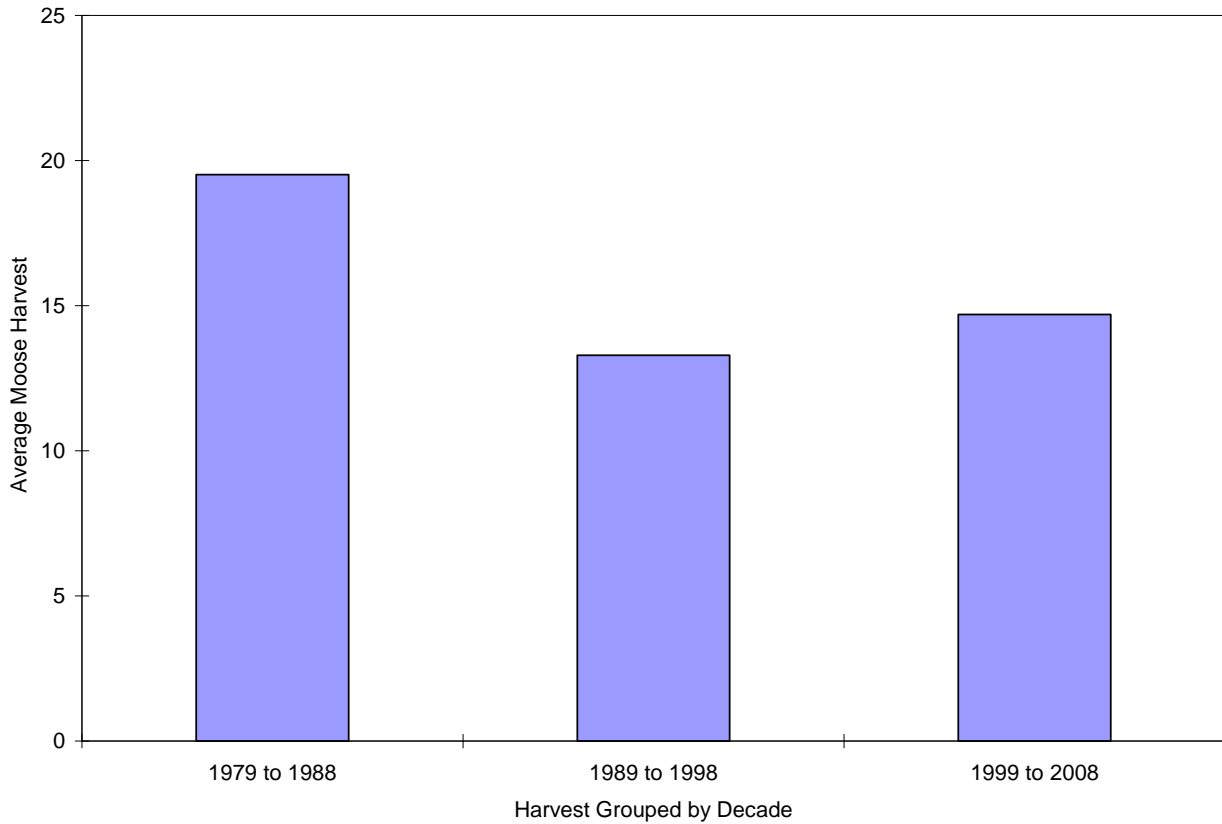


Figure 5: Average licensed harvest (blue bar) and the annual allowable harvest rate (black line) grouped into 10-year periods in the Nisutlin South census survey area, 1979 to 2008. Annual allowable harvest rate is 2 percent of the population estimate from a census survey conducted during the decade. GMAs included are 10-21, 10-22 and 10-23.

Table 5: Average annual reported moose harvest, 2004 to 2008, and the estimated allowable annual harvest (AAH) for Nisutlin South moose survey area for Game Management Areas (GMA) 10-21, 10-22 and 10-23¹. Reported totals are weighted by GMA. Differences in values reported in this table compared to other data reported within this document are because more of more current population projections.

GMA	Area (Km ²)	Density (moose/1000km ²)	Total moose in GMA	Average resident kill	Average non-resident kill	Average non-resident kill (Special guided)	Average kill (2004-2008)	Current harvest rate (% of total pop)	2% AAH	3% AAH	4% AAH	5% AAH
10-21	2329.6	189	440.3	4.4	2.2	0.2	6.8	1.5	8.8	13.2	17.6	22.0
10-22	1527.6	212	323.9	6.4	0.0	0.0	6.4	2.0	6.5	9.7	13.0	16.2
10-23	991.7	112	111.1	4.6	0.2	0.0	4.8	4.3	2.2	3.3	4.4	5.6
Total	4848.9	181	875.3	15.4	2.4	0.2	18	2.2	17.5	26.2	35	43.8

¹ Does not include unregulated subsistence harvest.

CONCLUSIONS AND RECOMMENDATIONS

2003 Status

- ❖ The estimated total number of moose in the Nisutlin South survey area is 1103 moose. The estimated density is 219 moose per 1000 km² of suitable habitat, which is considered within the range of average moose density within Yukon (Yukon Fish and Wildlife Branch 1996).
- ❖ The 2003 recruitment suggests a population that is stable or growing.
- ❖ The sex ratio is smaller than natural – an indication of hunting pressure – but it is not below the 30 bulls/100 cows threshold (Yukon Fish and Wildlife Branch 1996).

Population Trend

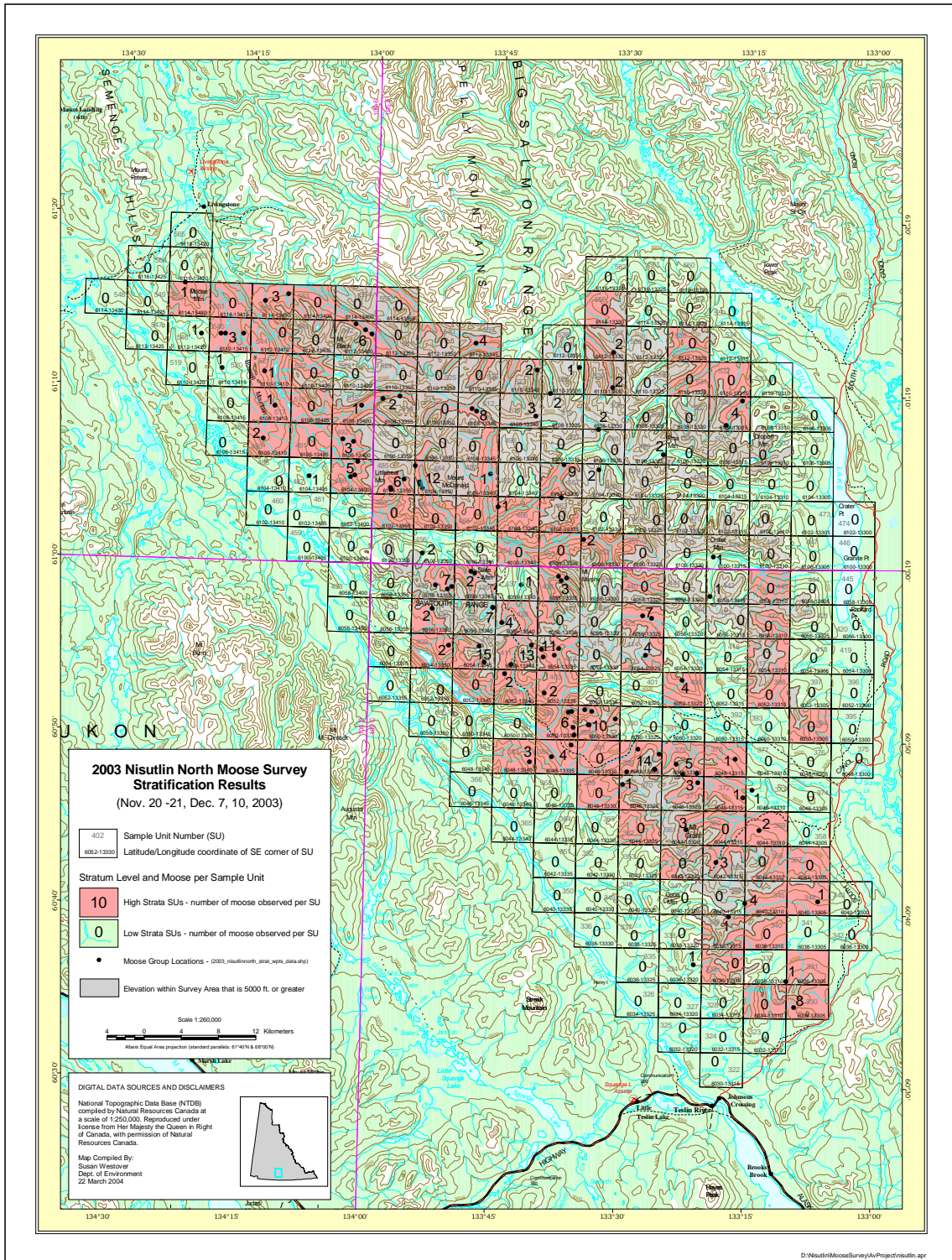
- ❖ The moose population has increased from the 1986 population estimate, but has remained unchanged from the 1994 population estimate.
- ❖ Estimated numbers of calves and yearlings for all survey years suggests adequate recruitment.
- ❖ Sex ratios have continuously decreased since the 1986 estimate. As of 2003 the sex ratio was still considered acceptable, but if the decreasing trend continues it may indicate an unsustainable harvest.

Harvest

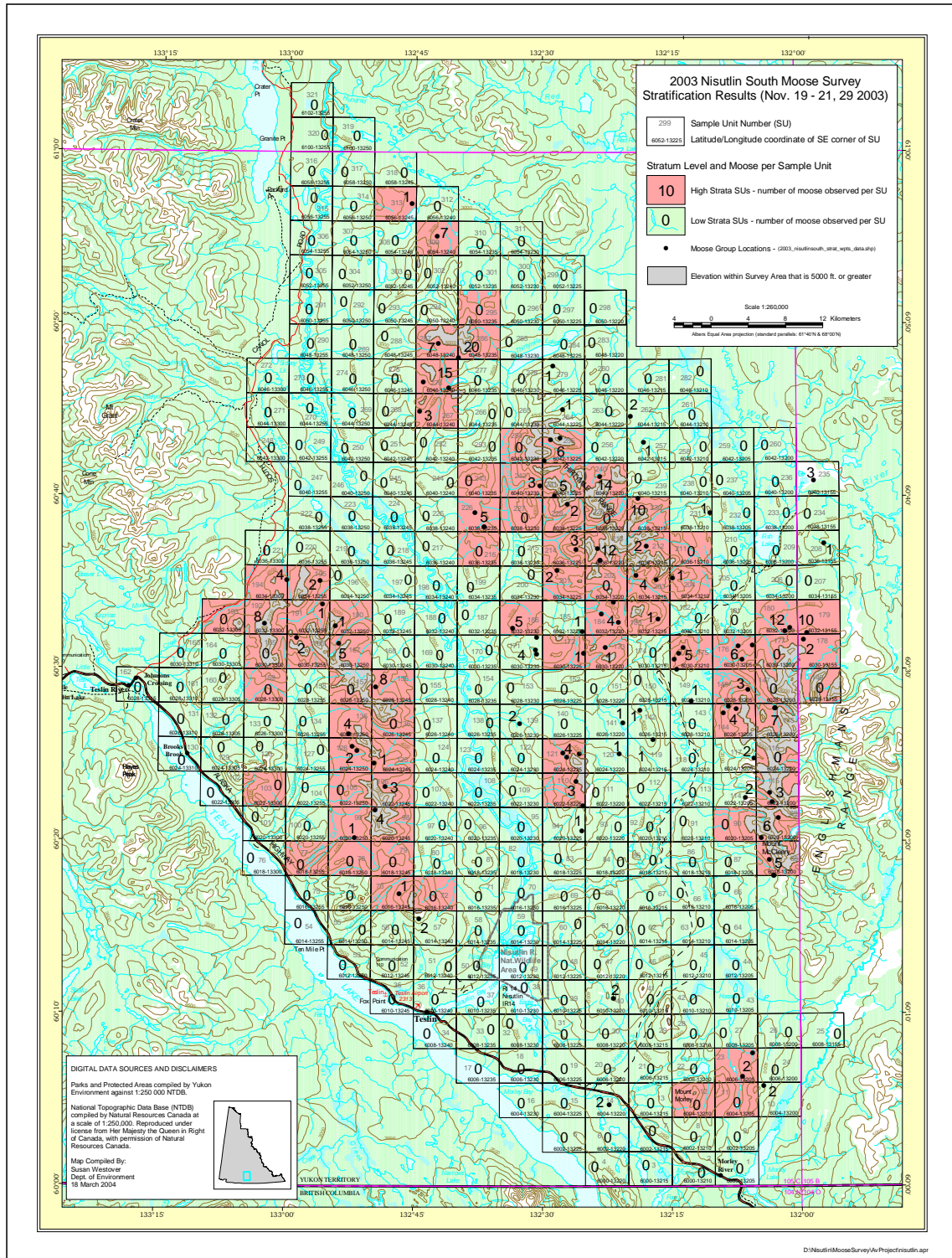
- ❖ Licensed harvest within 10-21, 10-22 and 10-23 GMA has averaged about 16 moose per year, but has been variable (8 to 30 moose).
- ❖ Licensed harvest was slightly higher during the 1980s than the last twenty years.
- ❖ Current licensed harvest is within the normal range of annual allowable harvest rates.
- ❖ Unknown harvest rates of unlicensed subsistence harvesters could put the annual harvest rate near or above the upper range of annual allowable harvest rates.

Literature Cited

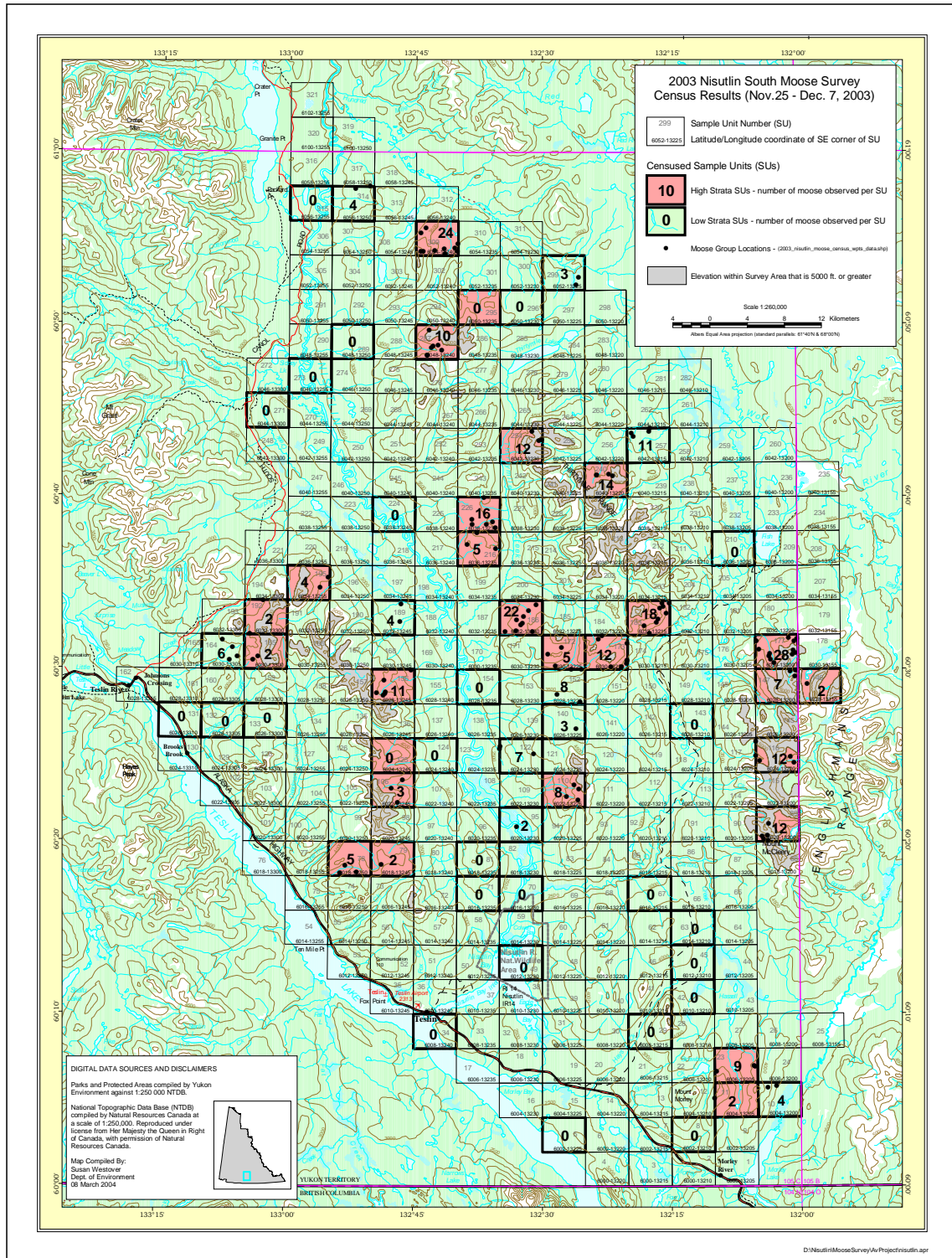
- Gasaway, W. C., S. D. DuBois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological paper 22, University of Alaska, Fairbanks. 108pp.
- Kellie, K.A. and R.A. DeLong. 2006. Geospatial Survey Operations Manual. Division of Wildlife Conservation, Alaska Department of Fish and Game. Fairbanks, Alaska, USA. 55 pp.
- Ward, R.M.P., B. McLean, S. Westover, R. Florkiewicz, and B.G. Slough. 1998. In prep: Moose population characteristics in the Nisutlin, Mount Lorne, Whitehorse South, Aishihik, Big Salmon, Mayo, Liard, Finlayson Lake and Dawson areas; 1994-95. Department of Renewable Resources, Government of Yukon. 64pp.
- Yukon Ecoregions Working Group. 2004. Pelly Mountains Ecoregion; Yukon Southern Lakes Ecoregion. In: Ecoregions of the Yukon Territory: Biophysical properties of Yukon Landscapes. Edited by C.A.S Smith, J.C. Meikle, and C.F. Roots. Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia. p. 207-225.
- Yukon Fish and Wildlife Branch. 1996. Moose management guidelines. Yukon Fish & Wildlife Branch, Yukon Renewable Resources, Whitehorse, Yukon. 12pp.



Map 2: Stratification survey of the northern portion of the Nisutlin South survey area (4090 km²). The area was stratified into high density (red) and low density (not red) moose habitat. Values within each of the sample units indicate the number of moose observed within each unit.



Map 3: Stratification survey of the southern portion of the Nisutlin South survey area (5460 km²). The area was stratified into high density (red) and low density (not red) moose habitat. Values within each of the sample units indicate the number of moose observed within each unit.



Map 4: Census of southern portion of the Nisutlin South survey area (5460 km²). Bolded sample units indicate the units within the survey area that were sampled (N=62). The values within each of the sample units indicate the number of moose observed within each unit.