MOOSE SURVEY

NISUTLIN SOUTH

EARLY-WINTER 2010

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Summary

- We conducted an early-winter survey of moose in the Nisutlin South area north of Teslin on November 27 – 28, and December 1 – 5, 2010. The main purposes of this survey were to estimate abundance, distribution, age and sex composition, and population trend of the local moose population.
- We attempted to count all moose in survey blocks covering about 26% of the area, and found a total of 405 moose, of which 100 were adult bulls, 225 were adult and yearling cows, 11 were yearling bulls, 67 were calves, and 2 were not classified to age or sex.
- We estimate that there were 1,352 ± 18% moose in the total survey area, which was equal to a density of about 248 moose per 1,000 km^2 of total area. This is above the Yukon-wide average of about 155 moose per 1,000 km^2 of total area.
- We did not detect a change in moose abundance in the Nisutlin South comparison area since 1994.
- We detected a consistent declining trend in the number of adult bulls per 100 adult cows in the Nisutlin South comparison area between 1986 and 2010.
- We estimated that there were about 36 calves and 6 yearlings for every 100 adult cows in the Nisutlin South comparison area. This suggests that survival of calves was good for calves born in 2010, but low for calves born in 2009.
- We estimated that there were about 48 adult bulls for every 100 adult cows in the Nisutlin South comparison area. While this is considered sufficient to ensure that all cows are bred during the rut, it was below the Yukon average of 65 adult bulls per 100 adult cows.
- Moose harvest reported by licensed hunters in the Nisutlin South comparison area appeared to be within the allowable range set out in the Yukon moose management guidelines. First Nation harvest is not included in this estimate.
- Complete harvest information is required to ensure this moose population is managed within sustainable limits.

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Introduction

This report summarizes the results of the early-winter survey of moose in the Nisutlin South survey area conducted on November 27 – 28, and December 1 – 5, 2010 (see Figure 1). The main purposes of this survey were to estimate abundance, distribution, age and sex composition, and to determine population trend of the area's moose population.

Previous Surveys

We have an extensive history of moose population and monitoring surveys in the Nisutlin region. Early-winter intensive population or census surveys have been conducted in all or most of the entire study area west of the Morley and Wolf rivers (see Figure 2) in 1986 (Jingfors and Markel 1987), 1994 (Ward et al. 1997), and 2003 (Environment Yukon 2009).

Other less intensive surveys include moose reconnaissance surveys in the lower Nisutlin River floodplain (Hoefs 1974*a*, 1974*b*, 1976; Lortie 1974) and 2 late-winter range assessment surveys in the Nisutlin River valley in 1979 (Larsen 1980) and 1991 (Loewen and Larsen 1991). An early-winter trend survey was conducted in the high ground north of Deadman Creek in 1989 (Larsen and Ward 1990) and 6 surveys were done in the Fish Lake trend area in the Thirtymile Range from 1989 to 1994 (Larsen and Ward 1990, 1991; Smits et al. 1992, Smits et al. 1993, Smits and Bakica 1994; unpublished data).

Trend surveys were intended to provide information on relative abundance and age and sex composition to help predict and understand trends in moose numbers.

As part of a moose monitoring program in the Teslin Tlingit Traditional Territory, 3 early-winter composition surveys were flown in the central and southwest portion of the study area in December 2004, 2005, and 2007 (Florkiewicz 2004, 2005, and 2008). These surveys were done to obtain moose age and sex composition data to monitor the health of the population following the 2003 census survey. Two late-winter recruitment surveys were also flown in 2003 (Florkiewicz 2003) and 2004 (unpublished data) to determine if enough calves were surviving to maintain a stable population.

Finally, a 3-year (2008 to 2010) study of moose habitat use and movement patterns was undertaken by a graduate student of University of Northern British Columbia with the support and participation of the Teslin Tlingit Council and their staff. The purpose of the study was to gain a better understanding of moose habitat use and movement patterns using GPS radio-collared moose and local and traditional knowledge and to look at the effect of access through different habitat types on moose harvest and predation rates. Once completed, information from this project will contribute to land use planning and development impact assessment in the Teslin Tlingit Council's Traditional Territory.

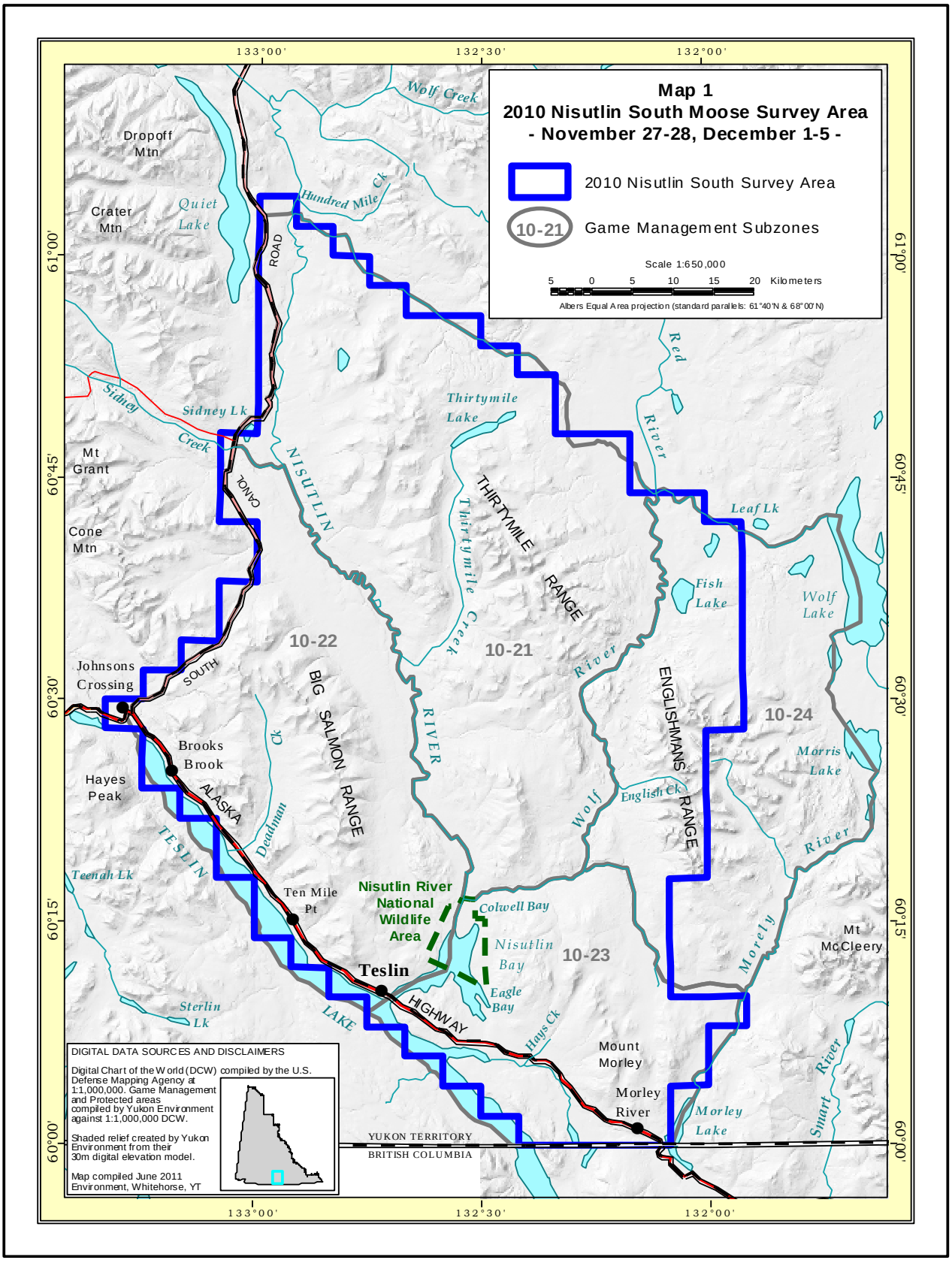

Figure 1. 2010 Nisutlin South moose survey area.

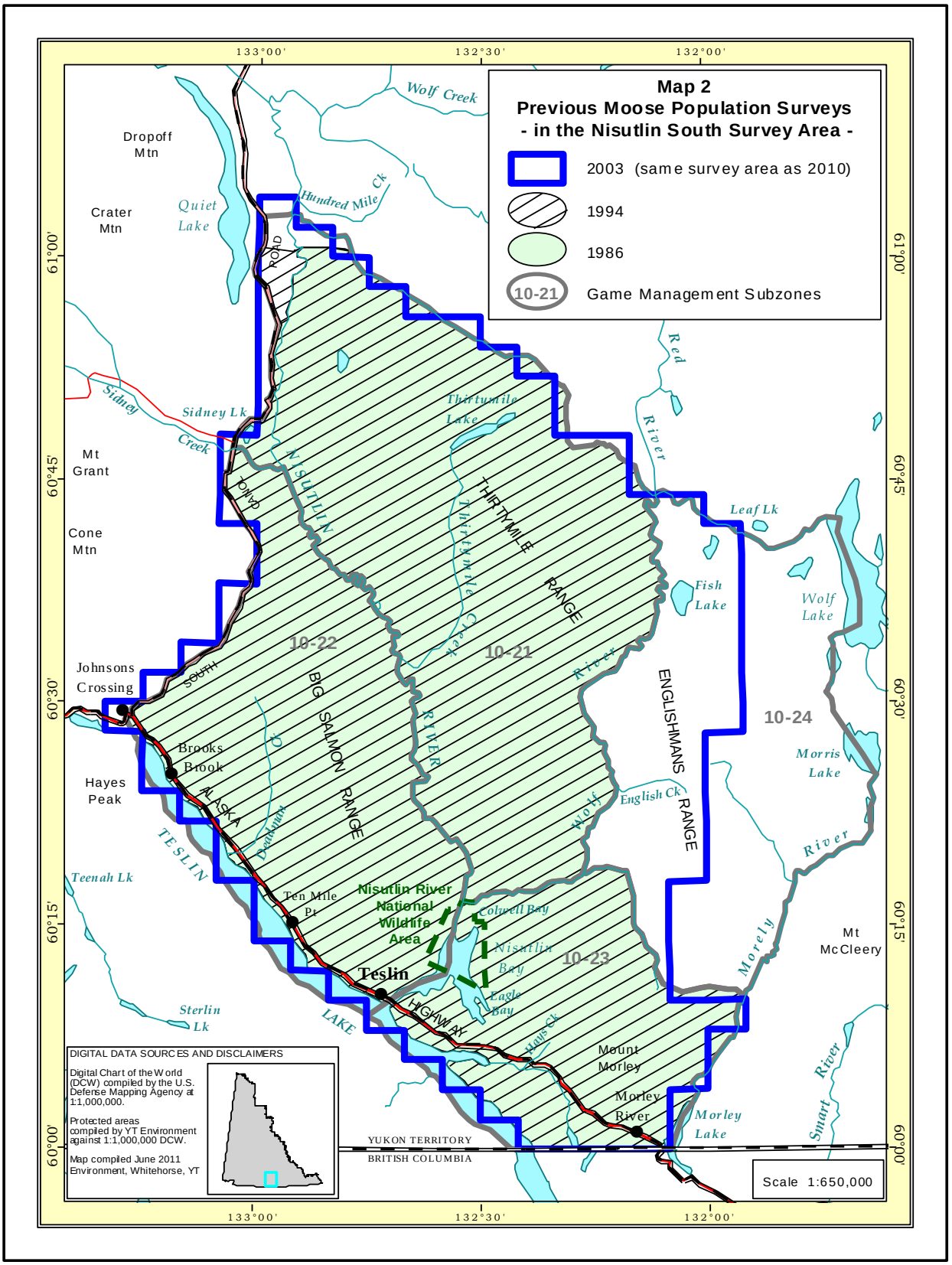

Figure 2. Previous moose population surveys in the Nisutlin South survey area.

Community Involvement

Moose have been a key part of First Nation peoples' subsistence lifestyle for generations and today are the most widely hunted game species by both First Nation and non-First Nation hunters.

Reflecting their interest in moose management, Teslin community members have participated as observers in the current and past moose surveys in the area.

Teslin community members have expressed concerns about high hunting pressure and moose harvest along the Nisutlin River and want to ensure that moose populations and hunting opportunities are maintained for future generations. Community members were also concerned about possible increases in harvest associated with upgraded access to the Red Mountain mine, which is adjacent to this survey area. Although recent surveys have shown a stable or slowly increasing moose population and stable numbers of bulls in the Nisutlin South survey area (Environment Yukon 2009), the community expressed concerns about a lack of bulls available to hunters along accessible corridors in some years.

In summer 2010, Teslin Tlingit Council asked their members to voluntarily restrict their moose harvest to one moose per household in the Game Management Subzones 10-21, 10-22, and 10-23 and to refrain from harvesting moose between October and January.

Moose harvest management discussions between Teslin Tlingit Council and Environment Yukon are ongoing. Both parties are mutually interested in developing a collaborative harvest management plan that ensures moose populations and hunting opportunities remain sustainable into the future.

Study Area

The Nisutlin South survey area covers about 5,460 km^2, and includes Game Management Subzones (GMSs) 10-21 to 10-23 and the west half of GMS 10-24 (Figure 1). The western part of GMS 10-24 was added in 2003 to evaluate possible concentrations outside of the original survey area.

The survey boundary followed the British Columbia border at Morley Lake to Teslin Lake and northwest to Johnsons Crossing; and then north along the South Canol Road to Quiet Lake. It then followed the river drainage at Hundred Mile Creek southeast to the Wolf River and Leaf Lake area, and south along the Englishmans Range back to Morley Lake.

Most of the study area (about 5,046 km^2) is considered suitable moose habitat. Approximately 8% of the area is large water bodies (0.5 km^2 or more in size) and land at or greater than 1,524 m (5,000 feet) in elevation, although moose are sometimes observed at higher elevations.

The survey area lies almost entirely within the Yukon Southern Lakes ecoregion, except for the small portion in the southwest which is within the Big Salmon mountain range, part of the Pelly Mountains ecoregion (Yukon Ecoregions Working Group 2004). The major geographic features within the survey area are the Big Salmon, Thirtymile, and Englishmans mountain ranges, and the Nisutlin River valley.

The climate of the survey area is generally dry, falling within the rain shadow of the St. Elias-Coast Mountains. Temperature extremes are not as great as in the Yukon interior valleys, due to the higher elevations of valley floors in this ecoregion. Winds are common in valleys with southeast to northwest orientation due to their proximity to storm centers in the Gulf of Alaska (Yukon Ecoregions Working Group 2004).

High elevation slopes are dominated by willow (*Salix sp.*) and shrub birch. Lower elevations are often composed of mixed woodland, but dominated by pine (*Pinus contorta*), white spruce (*Picea glauca*) and black spruce (*Picea mariana*). Forest fires have produced some localized patches of stands dominated by willow and pine. Seasonal flooding of the Nisutlin River also creates early successional habitat along the banks of the river (Yukon Ecoregions Working Group 2004).

Relatively few forest fires have been recorded in the study area since 1946; mapped information prior to 1946 is not available (Figure 3).

Most fires occurred along the South Canol Road or Alaska Highway during the 1950s. More recent small fires, covering a total of about 21 km^2, occurred near the Nisutlin River in 1992 and 2004; north of Thirtymile Lake in 1999; and at the southeast end of Fish Lake in 2010.

Methods

We have adapted a relatively new technique to survey moose developed by the Alaska Department of Fish and Game (Kellie and DeLong 2006). The field sampling is similar to those used in the stratified random block method (Gasaway et al. 1986) we used in earlier surveys, except that we count moose in rectangular rather than irregularly shaped survey units. The technique consists of 6 steps:

1. The survey area is divided into uniform rectangular blocks about 17 km^2 in size.
2. Observers in fixed-wing aircraft quickly fly over all the blocks, and classify (or "stratify") them 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" part of the survey.
3. We combine these categories of blocks into high or low "strata", and then randomly select a sample of blocks in each stratum for our census. We typically select a higher proportion of the high blocks than the low blocks to survey.

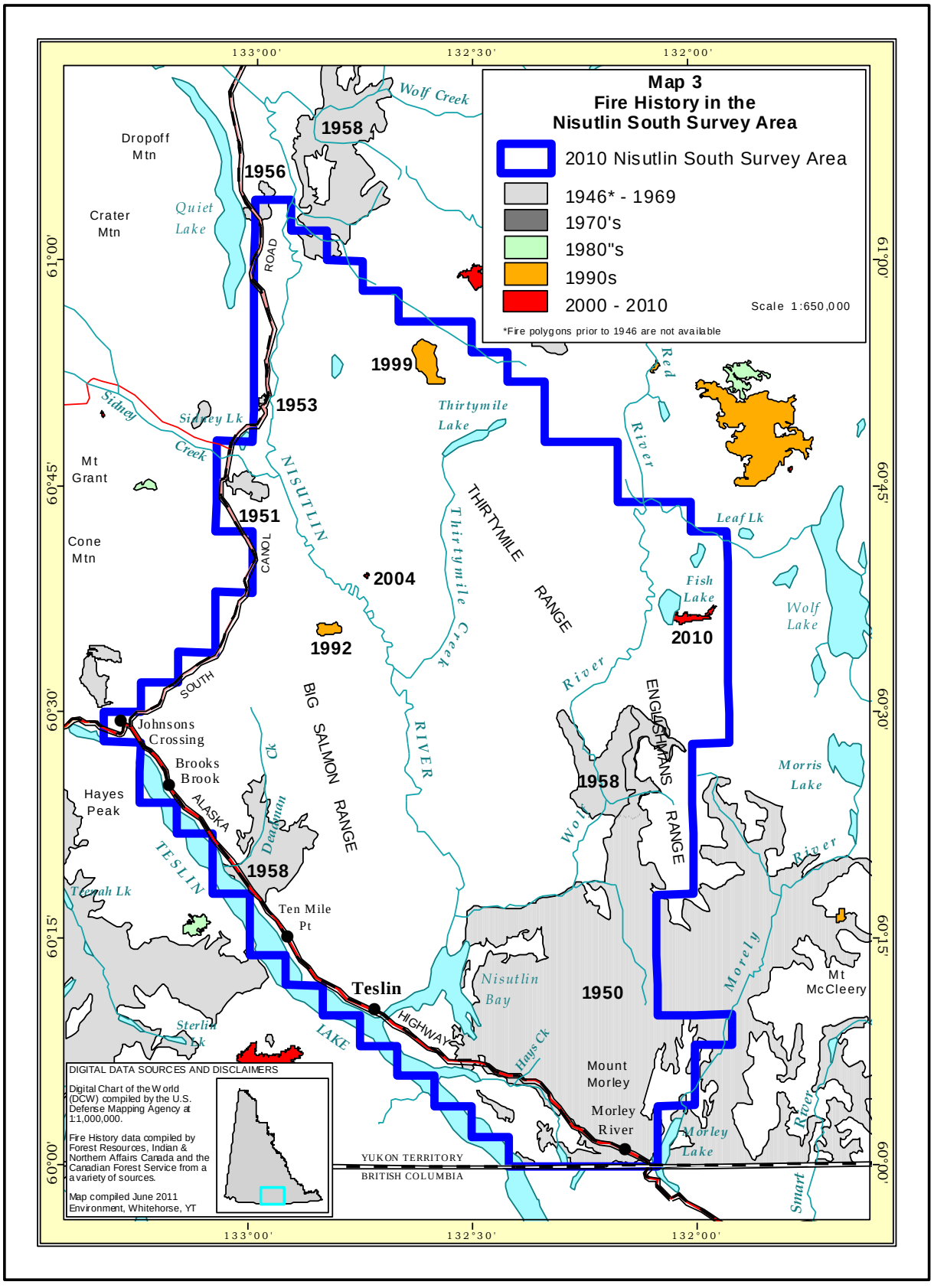

Figure 3. Fire history in the Nisutlin South survey area

4. Using helicopters, we try to count every moose within the selected blocks (the "census" part of the survey) at a search intensity of about 2 minutes per km^2. We classify all moose 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 by assuming it equals the number of yearling bulls we saw.
5. We repeat our counts at double the search intensity in a portion (about 25%) of some of our selected survey blocks to estimate the number of moose that we missed at our regular search intensity. We use these double counts to develop a "sightability correction factor" to correct the census results for moose that we overlooked.
6. We use computer programs to estimate the total number of moose by age and sex in the entire survey area. We base the estimate on the numbers of moose counted in the blocks during the census. The sightability correction factor is applied to the total number within each stratum to account for moose that we miss (Becker and Reed 1990). Generally, the more blocks that are searched during the census part of the survey, the more precise and reliable is the resulting population estimate.

This technique has the advantage of being easier operationally to fly, is more flexible for small area estimation, and provides good population estimates, often with greater precision than the stratified random block method. Currently, the only drawback of this method is the inability to estimate confidence intervals (CI) for ratio estimates (e.g. number of bulls/100 cows) that are calculated using data corrected with the sightability correction factor.

When appropriate, we use weighted linear regression analysis to detect trends in population parameters across years. This analysis takes into account the confidence intervals associated with individual surveys. In addition, population parameters from successive surveys are evaluated using pairwise comparison tests.

In the harvest section of this report, total moose abundance in each Game Management Subzone (see Table 4) is estimated by multiplying the average estimated moose density in the high and low stratum blocks by the number of high and low stratum blocks per Game Management Subzone respectively. This is a change from older reports where survey area wide moose density was applied to each Game Management Subzone.

Weather and Snow Conditions

In general, early-winter moose surveys are conducted in late October or early November. In 2010, poor snow and weather conditions delayed the survey until late November.

Weather conditions were variable during the survey period. Temperatures were moderate, ranging from -25°C to 0°C, and winds were mainly light to calm at the start and mid-point of the survey, with a few days of strong winds at the end of November and during the last few days of the survey. We were able to fly on all but 2 days due to a snow storm in late November, although 2 days were cut short as a result of snow and visibility problems related to low ceilings, fog, and icing conditions. Light conditions were mainly flat on most days with a few sunny breaks in early December.

Snow depth was intermediate (greater than 15 cm) and coverage was complete. Light-to-heavy snow fell the first week of the survey which helped crews track and sight moose. Snowpack conditions in the study area between October 2010 and February 2011 were generally normal, with an above normal snowpack in the north end, and below normal snowpack to the south around Teslin and Morley Lake (Yukon Department of Environment 2011).

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Results and Discussion

Results for the entire 2010 survey area (GMS 10-21 through 10-24) and the Nisutlin South comparison area (GMS 10-21 through 10-23) are presented separately in the following sections.

ENTIRE 2010 SURVEY AREA (GMS 10-21, 10-22, 10-23, and the west half of 10-24)

Stratification (Identification of High and Low Moose Density Blocks)

We used the strata classification data from the 2003 early-winter population survey to designate high and low strata blocks for the entire study area (see Figure 4).

We assigned 79 (25%) of the 321 survey blocks as having high expected moose abundance and 242 (75%) as having low expected abundance of moose (Figure 4). Most of the blocks with expected high moose abundance were in the subalpine areas west of Thirtymile Lake, in the Thirtymile, Englishmans, and Big Salmon ranges (north and east of Deadman Creek), and the Mount Morley area in the south.

Coverage

We surveyed 82 of the 321 blocks, or about 26% of the total area (see Figure 5). This included 37 of 79 (46.8%) blocks expected to contain relatively high numbers of moose and 45 of 242 (18.6%) blocks expected to contain few or no moose.

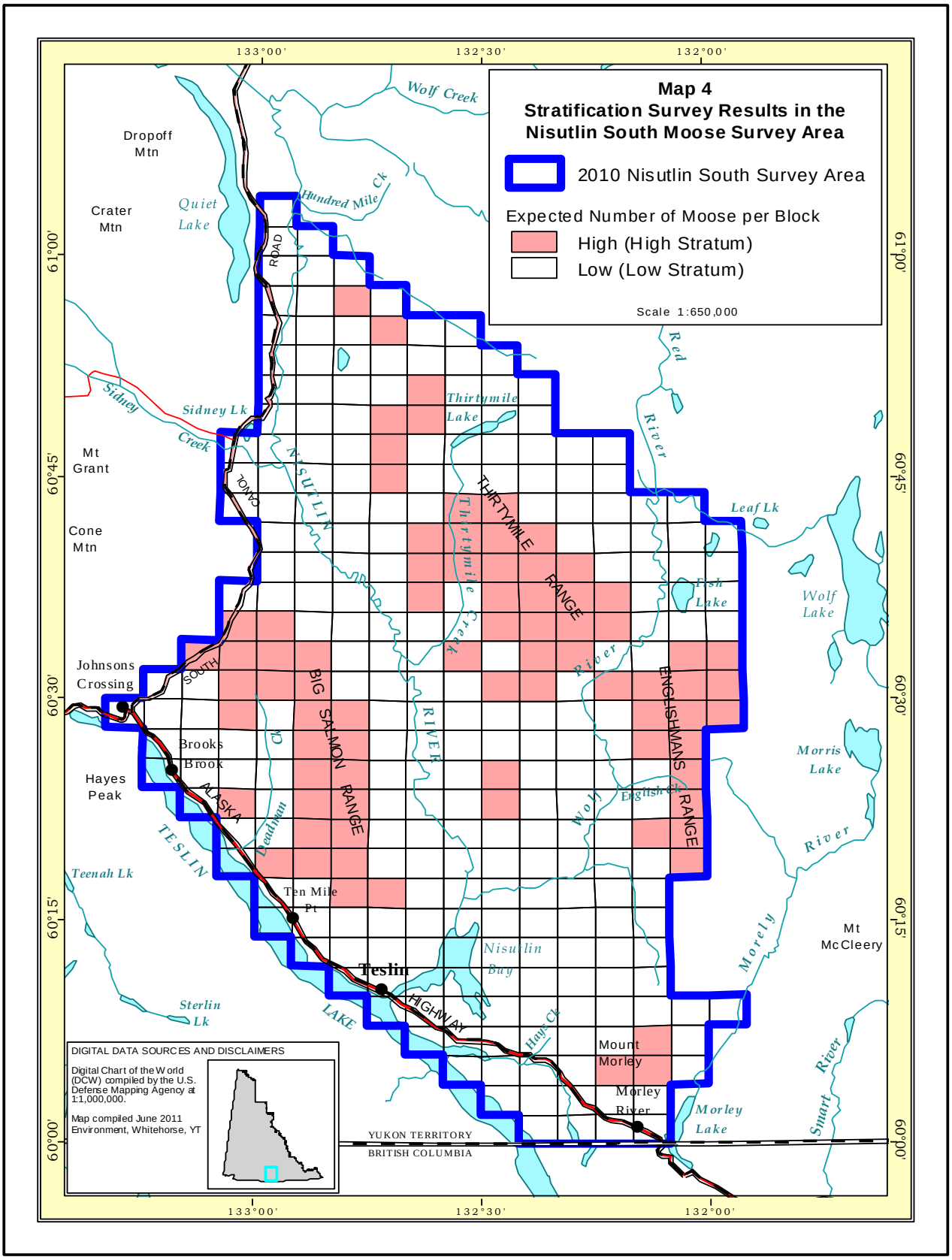

Figure 4. Stratification survey results in the Nisutlin South moose survey area.

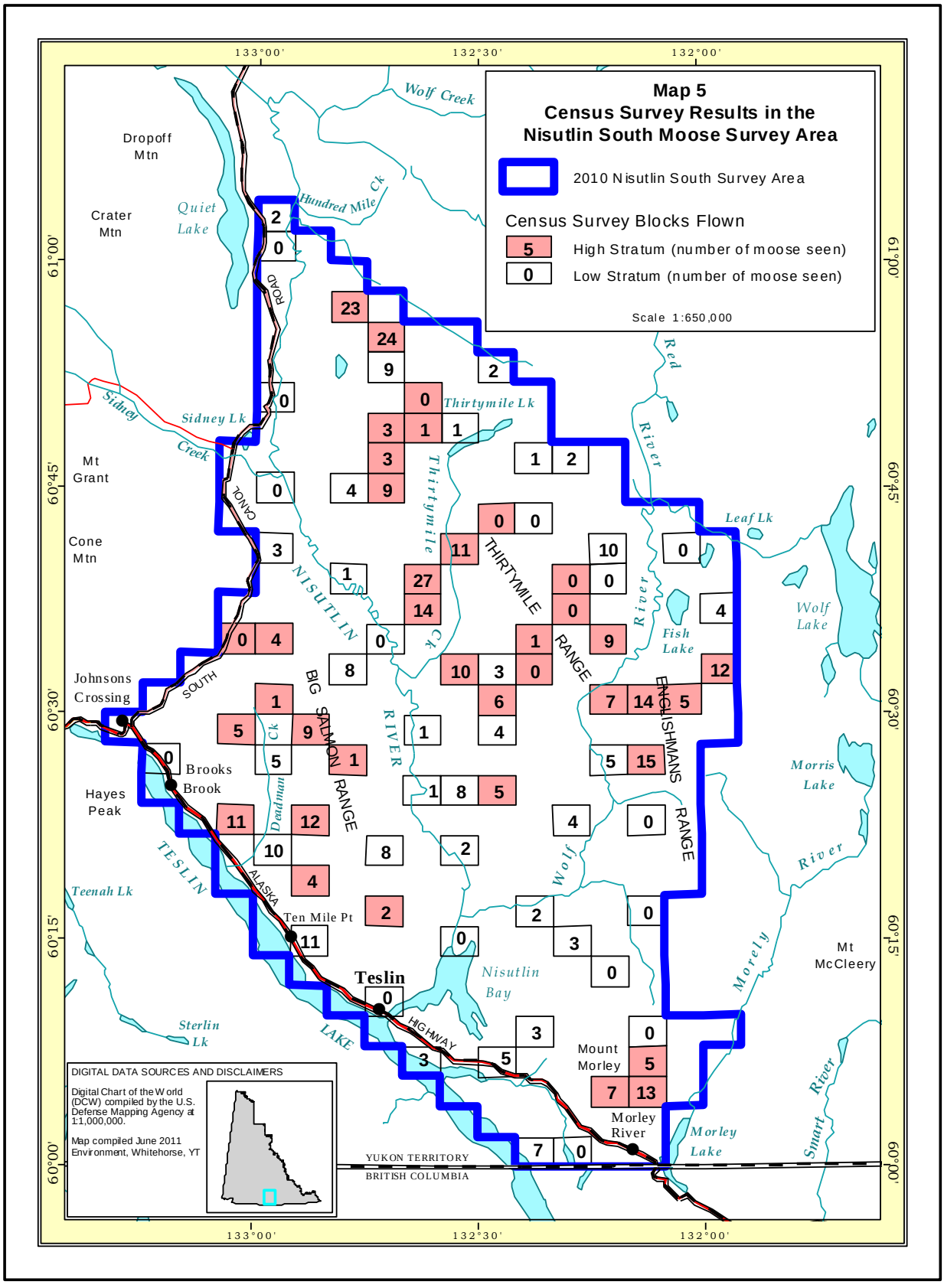

Figure 5. Census survey results in the Nisutlin South moose survey area.

It took 45.4 hours to count moose in these blocks, for a total search intensity of 1.95 minutes per km², very close to our target search intensity of 2 minutes per km². Survey intensity was somewhat lower in the high-abundance blocks (1.93 minutes per km²) than in the low-abundance blocks (1.97 minutes per km²). We used an additional 6.2 hours to re-count survey blocks to calculate our sightability correction factor.

Another 20.5 hours of helicopter time was used in ferrying between survey blocks, to a remote fuel cache near Sidney Lake on the South Canol Road, and back and forth to Teslin.

Total flight time (survey and ferry time combined) was 72.1 hours.

Observations of Moose

We counted a total of 405 moose: 100 adult bulls, 225 adult and yearling cows, 11 yearling bulls, 67 calves and 2 unclassified moose (Table 1). We saw an average of 434 moose for every 1,000 km² in the high-abundance blocks, and 172 moose per 1,000 km² in the low blocks.

Table 1. Observations of moose during the November-December 2010 survey in the Nisutlin South survey area.

	High Blocks	Low Blocks	Total
Number of Blocks Counted	37	45	82
Number of Adult Bulls Observed	70	30	100
Number of Adult and Yearling Cows Observed*	155	70	225
Number of Yearling Bulls Observed	9	2	11
Number of Calves Observed	38	29	67
Number of Unknown Age/Sex	1	1	2
Total Moose Observed	273	132	405

*Adult and yearling cows cannot always be reliably distinguished from the air, so they are counted together. Assuming an equal number of males and females are born with similar survival in their first year, the number of yearling cows and bulls observed should be approximately equal. It follows that the total number of yearling bulls should be similar to the number of yearling cows. We therefore estimate the total number of adult cows in the survey area by subtracting the number of yearling bulls observed from the total number of cows counted. Similarly, we estimate the total number of yearlings by doubling the number of observed yearling bulls. The estimate of adult cow and total yearling in the population are presented in Table 2.

Distribution and Abundance of Moose

In early winter, shrub-dominated communities and subalpine willow flats and creek draws with abundant willows generally have good numbers of moose in them. In this survey, most of the moose we saw were concentrated in and around high elevation subalpine habitats of the Thirtymile, Englishmans, and Big Salmon mountain ranges and Mount Morley area, with few moose seen in the valley bottoms (Figure 5). Some moose, however, were found mid-slope between the high ground and the Nisutlin River in the north end and Thirtymile Creek area, and between the Big Salmon range and Teslin Lake. Given the later timing of the survey, this movement of moose down slope was likely in response to increased snow in the high ground.

In general, the distribution of moose is consistent with the previous early winter surveys conducted for this area (Environment Yukon 2009).

We estimate that there were 1,352 ± 18% moose in the entire 2010 Nisutlin South survey area (Table 2). This includes a sightability correction factor of about 2% in the high blocks, and 10% in the low blocks for moose missed during the census portion of the survey. Therefore, we estimate that there were 248 moose per 1,000 km² of total area, or 268 moose per 1,000 km² of suitable moose habitat (Table 2). This is higher than the Yukon-wide average of 155 moose per 1,000 km² of total area, and higher than the average density of 211 moose per 1,000 km² of moose habitat, based on the most recent early-winter survey data from throughout Yukon.

Table 2. Estimated abundance of moose in the Nisutlin South survey area in November-December 2010.

Estimated Abundance	Best Estimate ± 90% Confidence Interval (%)*	90% Confidence Interval (Range)*
Estimated Total Number of Moose**	1352 ± 18%	1115-1588
Adult Bulls	338 ± 18%	276-399
Adult Cows	711 ± 19%	575-848
Yearlings	54 ± 57%	23-85
Calves	249 ± 28%	180-317
Unknown Age/Sex	8 ± 122%	0-18
Density of Moose (per 1,000 km^2)		
Total Area (5460.1 km^2)	248	
Moose Habitat Only (5045.7 km^2)***	268	

* A "90% confidence interval" means that, based on our survey results, we are 90% sure that the true number lies within this range of numbers. Our best estimate is in the middle of this range.

** Estimated numbers provided are based on a Not Pooled "sightability correction factor" or SCF. In this survey, a SCF of 1.024 was applied to the High stratum and an SCF of 1.103 was applied to the Low stratum to correct the estimate of moose abundance for animals that were missed by the survey crews (see step 5 of methods section for a description of how the SCF is calculated).

*** Suitable moose habitat is considered all areas at elevations lower than 1,524 m (5,000 ft), excluding water bodies 0.5 km^2 or greater in size.

Ages and Sex of Moose

Age and sex ratio results for the entire 2010 Nisutlin south survey area were not substantially different than those calculated for the smaller Nisutlin South comparison area discussed below.

NISUTLIN SOUTH COMPARISON AREA (GMS 10-21 TO 10-23)

Population Status and Trend: 1986 to 2010

We estimate that there were 1,024 ± 17% moose in the Nisutlin South comparison area in 2010 (Figure 6, Table 3). This represents an average density of 220 moose per 1,000 km2 of total area, or 233 moose per 1,000 km2 of suitable moose habitat.

Between 1985 and 2010, we detected an increasing trend in the number of moose in the area (Figure 7, Model x^2=16.9, df=3, p<0.001). A sharp increase in moose numbers occurred between 1986 and 1994 when the population went from 558 to 882 moose (P<0.002: 2 tailed t Test). This represented a population increase of more than 50 percent, for an average annual population growth rate of 5.9 percent.

The increase in moose abundance is likely due to a combination of a relatively low natural mortality rate and high recruitment between years (Ward et al. 1997). Since 1994, we did not detect a change in the population (p>0.1).

Population Composition and Sex Ratios

We detected a consistent decreasing trend in the bull:cow ratio between 1986 when there were 88 bulls per 100 cows and 2010 when we estimated 48 bulls per 100 cows (Figure 8, Model x^2=6.81, 3 df, p=0.009).

The adult bull:cow ratio in the Nisutlin South comparison area was above the 30 adult bulls per 100 adult cows minimum identified in the Yukon moose management guidelines (Environment Yukon in prep.), but the long-term downward trend in the proportion of adult bulls is cause for some concern. A low adult bull:cow ratio can be an indicator of excessive harvest which can lead to a decline in overall moose abundance.

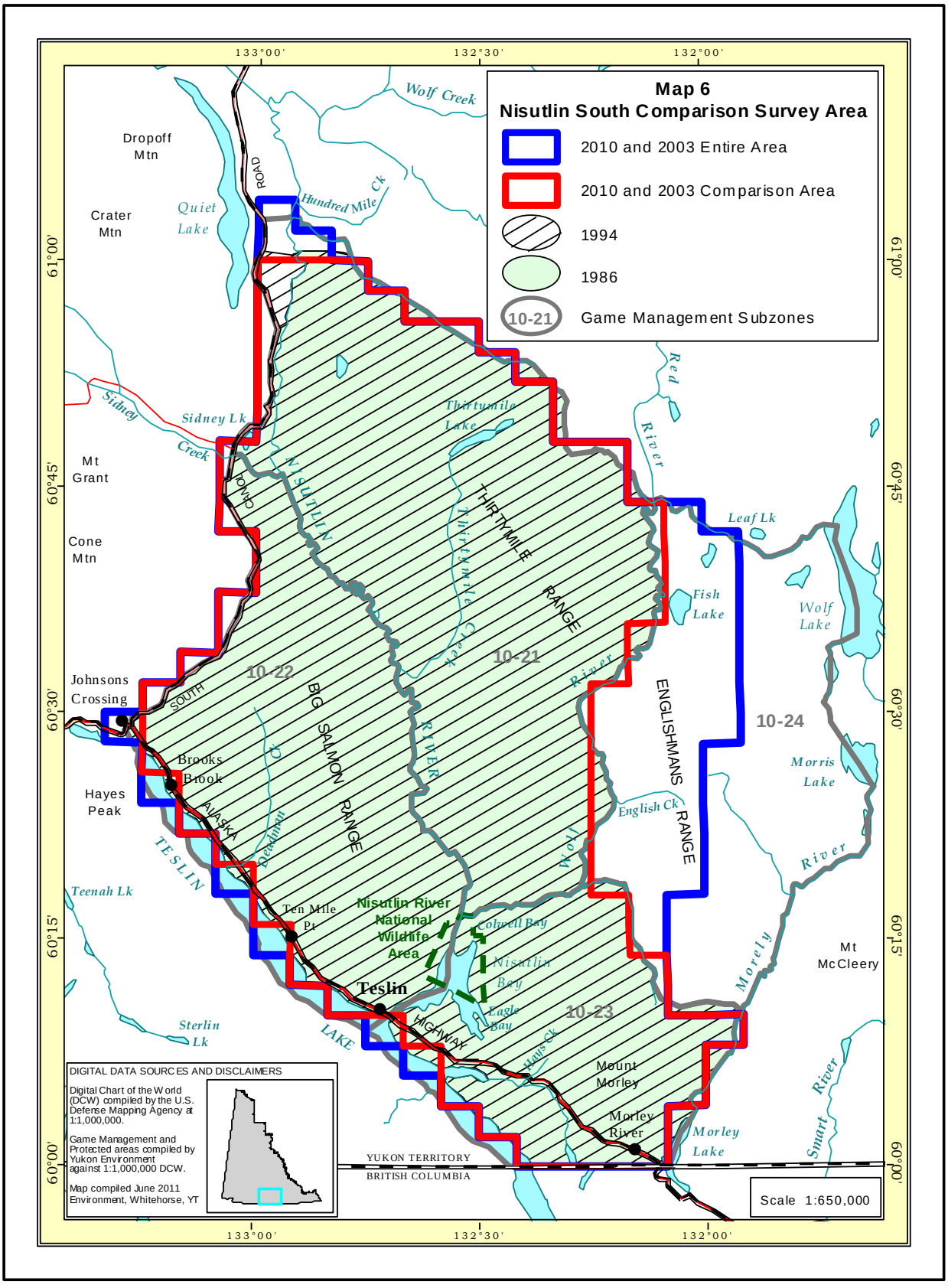

Figure 6. Nisutlin South comparison survey area

Table 3. Results of the 1986, 1994, 2003 and 2010 early-winter moose population surveys of the Nisutlin South comparison area.

	Game Management Subzone 10-21 to 10-23 Comparison Area			
Survey Year	**2010**	**2003**	**1994**	**1986**
Survey Method	Geospatial[2]	Geospatial[2]	Stratified Random Block	Stratified Random Block
Estimated Abundance[1] (90% Confidence Range)[3]				
Total Moose	1024 ± 17% (854-1194)	881 ± 21% (696-1066)	882 ± 15% (751-1014)	558 ± 19% (452-665)
Adult Bulls (≥ 30 months)	257 ± 18% (211-303)	207 ± 29% (147-268)	273 ± 21% (216-330)	180 ± 31% (125-236)
Adult Cows (≥ 30 months)	535 ± 19% (435-634)	393 ± 27% (288-498)	357 ± 17% (295-419)	205 ± 25% (153-256)
Yearlings (Approx. 18 months)[4]	48 ± 48% (25-71)	118 ± 41% (70-166)	67 ± 39% (41-93)	73 ± 43% (42-105)
Calves (≤ 12 months)	195 ± 26% (145-245)	173 ± 29% (122-224)	185 ± 19% (149-221)	99 ± 33% (66-132)
Unknown age/sex	7 ± 110% (0-14)	3 ± 116% (0-6)	1 ± 0% (1)	1 ± 49% (1-2)
Estimated Population Ratios[1] (90% Confidence Range)[3]				
% Adult Bulls	25 ± 24% (19-31%)	23 ± 30% (16-30%)	31 ± 15% (26-35%)	32 ± 20% (26-39%)
% Adult Cows	52 ± 13% (45-59%)	44 ± 26% (33-56%)	40 ± 8% (37-44%)	37 ± 19% (30-44%)
% Yearlings	5 ± 47% (2-7%)	13 ± 44% (8-19%)	8 ± 36% (5-10%)	13 ± 40% (8-18%)
% Calves	19 ± 22% (15-23%)	20 ± 33% (13-26%)	21 ± 13% (18-24%)	18 ± 28% (13-23%)
% Unknown Age/Sex	1 ± 112% (0-1%)	<1%	<1%	<1%
Adult Bulls per 100 Adult Cows	48 ± 26% (36-60)	52 ± 34% (34-70)	76 ± 21% (60-93)	88 ± 36% (56-120)
Yearlings per 100 Adult Cows	9 ± 50% (4-13)	30 ± 47% (16-44)	19 ± 40% (11-26)	36 ± 56% (16-56)
Yearlings per 100 Adult Moose	6 ± 47% (3-8)	17 ± 43% (10-24)	10 ± 36% (6-13)	16 ± 37% (10-22)
Calves per 100 Adult Cows	36 ± 23% (28-45)	44 ± 37% (28-61)	52 ± 14% (44-59)	48 ± 27% (35-62)
% of Cow-Calf Groups with Twins[5]	3 ± 131% (0-6)	13 ± 58% (6-21)	12 ± 54% (5-18)	Not avail. (Ob. ratio= 12%)
Density of Moose (per 1,000 km^2)[1]				
Total Area	220	189	194	Not avail.
Moose Habitat only[6]	233	201	203	131
Total Area (km^2)	4660.6	4660.6	4537.8	Not avail.
Habitable Area (km^2)[6]	4387.0	4387.0	4337.5	4269.6

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

[2] For Geospatial data, the difference between total estimated numbers of moose and the sum of adults, yearling, calf and unknown numbers is because individual age/sex classes are unlikely to exhibit the same spatial correlation as that found in the sum of all observed moose in sampled units. The two sums may differ as a result.

[3] This means that we are 90% sure that the true number of moose in the area lies within the range of moose numbers given in the brackets.

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

[5] Twinning Rate = the number of cows with 2 calves divided by the total number of cows with calves. It represents what percentage of cows that had calves, had twins.

[6] Suitable moose habitat is considered all areas at elevations lower than 1,524 m (5,000 ft), excluding water bodies 0.5 km^2 or greater in size.

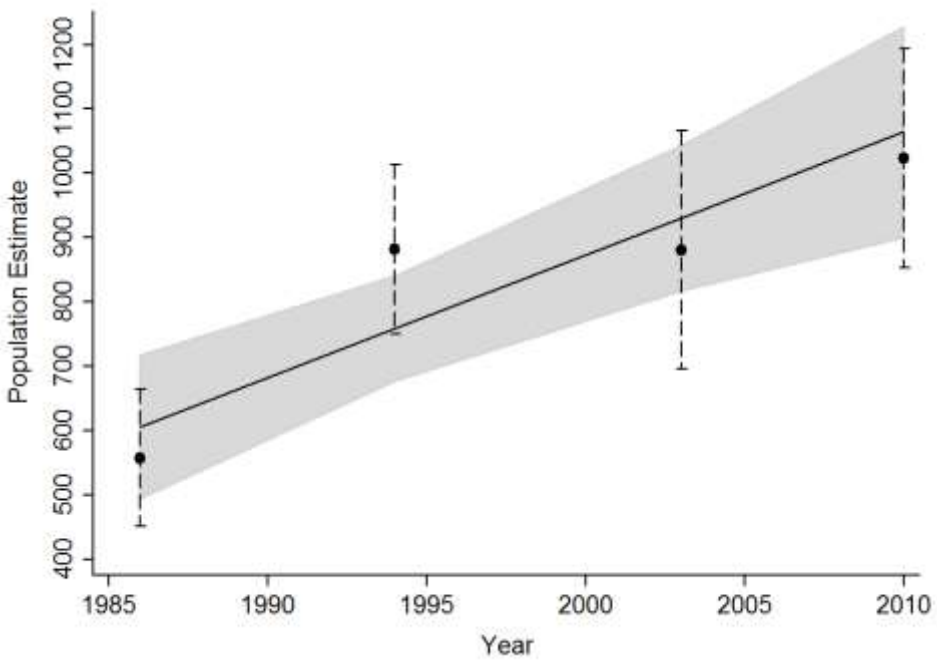

Figure 7. Estimated abundance from moose surveys in the Nisutlin South comparison area 1986 – 2010. Estimate (dots) with 90% confidence intervals (vertical error bars) and variance-weighted least-squares regression trend line with 95% confidence interval (shaded area) (Model $R^2 = 0.83$).

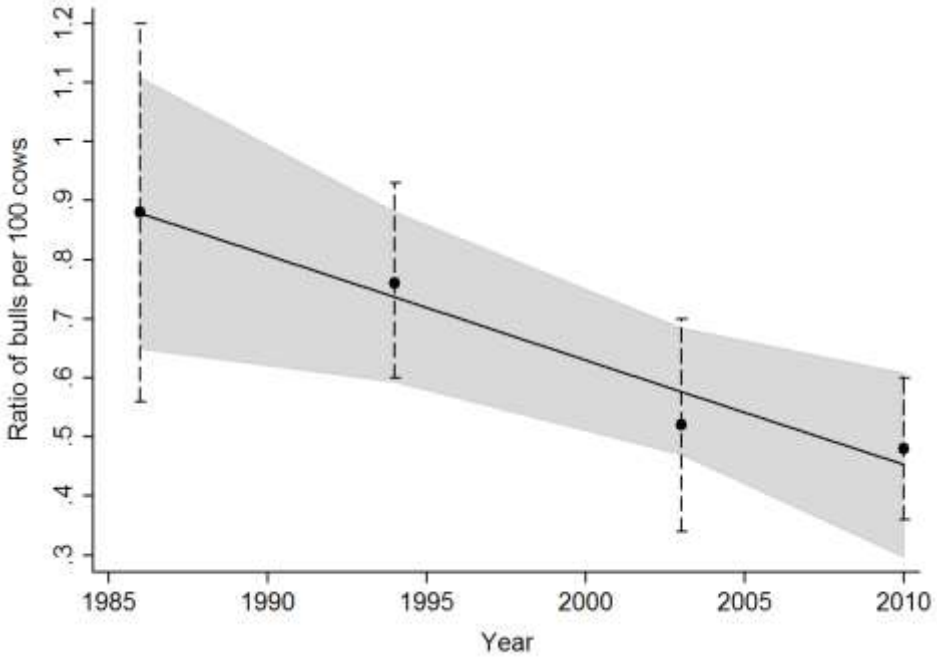

Figure 8. Estimated ratio of bulls per 100 cows from moose surveys in the Nisutlin South comparison area 1986 – 2010.
Estimates (dots) with 90% confidence intervals (vertical error bars) and variance-weighted least-squares regression trend line with 95% confidence interval (shaded area) (Model $R^2 = 0.96$).

Age Ratios and Recruitment

Wildlife managers use the number of calves per 100 adult cows and the number of yearlings per 100 adult moose to measure recruitment. Recruitment is defined as the addition of new individuals into the breeding population. If recruitment (the number of calves and yearlings being added to the population) is greater than mortality (the number of adults dying) then the population will grow. Conversely, if recruitment is lower than adult mortality the population will decline.

In the 2010 Nisutlin South comparison area, there were 36 calves per 100 adult cows (Table 3), which was above the Yukon average of 34 calves per 100 adult cows and above the minimum 25 calves per 100 adult cows needed to maintain a stable moose population.

Yearling recruitment was low in 2010 (6 yearlings per 100 adult moose) and below the 8 to 15 yearlings per 100 adult moose normally associated with stable to increasing moose populations.

Recruitment levels recorded during the 1986, 1994, and 2003 surveys were generally good to above average (range of 44 to 52 calves per 100 adult cows and 10 to 17 yearlings per 100 adults; Table 3). In general, about 25 calves per 100 adult cows and 8 to 15 yearlings per 100 adult moose are considered sufficient to maintain stable moose populations in areas with typical mortality rates (Environment Yukon in prep.).

Less Intensive Moose Survey Data: 1989 to 2007

As noted in the *Previous Surveys* section, a number of low-intensity trend, composition, and recruitment surveys were conducted in the Nisutlin South area between 1989 and 2007. These less intensive surveys, however, have proven to be not effective for monitoring moose abundance or population trend in the area. Different survey methods, incomplete and/or inconsistent geographic coverage, annual shifts in moose distribution, and small sample sizes limited our ability to use these surveys to make comparisons or interpret any changes over time.

Harvest

The 5-year average (2006 to 2010) total reported annual harvest in the Nisutlin South comparison area was about 18 moose per year (Table 4). This represents an estimated average annual harvest rate of about 1.5% of the total 1,191 moose estimated for this area (Table 4). The total estimated moose given in Table 4 is higher than the 2010 total moose reported in Table 3 because the moose density estimates in Table 4 incorporated the sightability correction factor for moose missed during the survey.

The reported harvest numbers do not include harvest by First Nations' hunters. In the absence of this information, we generally assume that First Nation harvest is about equal to that of licensed resident non-First Nation hunters.

If we make this assumption, then the total estimated average annual harvest increases to about 2.7% of the estimated moose population. If the unreported harvest added is also bulls, then this is still below the annual allowable harvest rates of 3% to 4% that we generally set for stable moose populations of average density (Environment Yukon in prep.). Harvest, however, was not uniformly distributed. In GMS 10-21 the harvest rate was only 1.7%, but it approached the 4% maximum allowable limit in GMS 10-22 (3.5%) and GMS 10-23 (3.6%).

The reported moose harvest by licensed hunters in the Nisutlin South comparison area has been variable (Figure 9). The annual reported harvest peaked at about 30 moose in 1980, exceeding 5% of the 1986 moose population estimate. More recently, the annual reported moose harvest by licensed hunters has remained below the 3% to 4% annual allowable harvest rate. Harvest has varied from as low as 8 moose in 1993 (less than 1% of the 1994 estimated moose population; Table 3) to 25 moose in 2007 (between 2.4% and 2.8% of the 2010 and 2003 respective moose population estimates; Table 3). Since 2007 there has been a downward trend in reported moose harvest in the area (Figure 7).

Other Wildlife Sightings

In addition to the 405 moose we counted during the survey, we also saw 113 moose that were either in the blocks that were not selected or just outside the survey boundary.

Other species recorded during the survey included a total of 35 wolves in 4 possible packs. One pack of 4 wolves was found in the north end of the study area west of Thirtymile Lake. Two packs (12 and 11 wolves each) were located on the Wolf River near English Creek and at the south end of the Nisutlin River north of Nisutlin Bay respectively. Another pack of 8 wolves was seen in the south end of the survey area between Eagle Bay and Hays Creek. One dead wolf was observed on the Nisutlin River north of the mouth of Thirtymile Creek. A wolf population survey that encompassed the Nisutlin South survey area was conducted in February 2011 (Baer 2011). The wolf survey found 14 resident packs with an estimated total late-winter population of 98 wolves. Wolf density, average pack size and pack density observed in the Nisutlin Wolf Lake survey area in 2011 are slightly higher than Yukon averages (Baer 2011).

Other observations during the survey included 25 caribou which were mostly concentrated in the northeast; 10 thinhorn sheep, 1 wolverine, and 1 gyrfalcon. One merlin was spotted in the Nisutlin River area northwest of the mouth of Thirtymile Creek and 2 owls were sighted just south of the Wolf River northeast of Colwell Bay. GPS locations for these last two groups were not recorded.

Table 4. Average annual (2006-2010) reported moose Harvest[1] and allowable harvest summary for the 2010 Nisutlin South comparison area.

GMS	GMS Area (km^2)	Estimated Density[3] (moose/ 1000 km^2)	Total Estimated number of Moose	Average Resident Harvest	Average Non-Resident Harvest	Average (Special Guided) Harvest	Average Reported Harvest[1] (2006-2010)	Current Harvest Rate (% of total population)	2% Allowable Annual Harvest	3% Allowable Annual Harvest	4% Allowable Annual Harvest
10-21	2329.6	250	582.4	3.4	3.0	0.2	6.6	1.1	11.6	17.5	23.3
10-22	1527.6	265	404.8	7.0	0.2	0.0	7.2	1.8	8.1	12.1	16.2
10-23	991.7	205	203.3	3.6	0.2	0.0	3.8	1.9	4.1	6.1	8.1
Total	**4848.9**	**245.5**	**1190.5**	**14.0**	**3.4**	**0.2**	**17.6**	**1.5**	**23.8**	**35.7**	**47.6**

[1] Does not include harvest by First Nations' members.

[2] The 2010 Nisutlin South entire survey area includes the west half of GMS 10-24. GMS 10-24 data was excluded from the table because only part of the study area overlaps this GMS (see Figure 1), and we don't know if or how much of the harvest in GMS 10-24 occurs in the survey area.

[3] Based on 2010 Nisutlin South Moosepop SCF Not Pooled moose survey results.

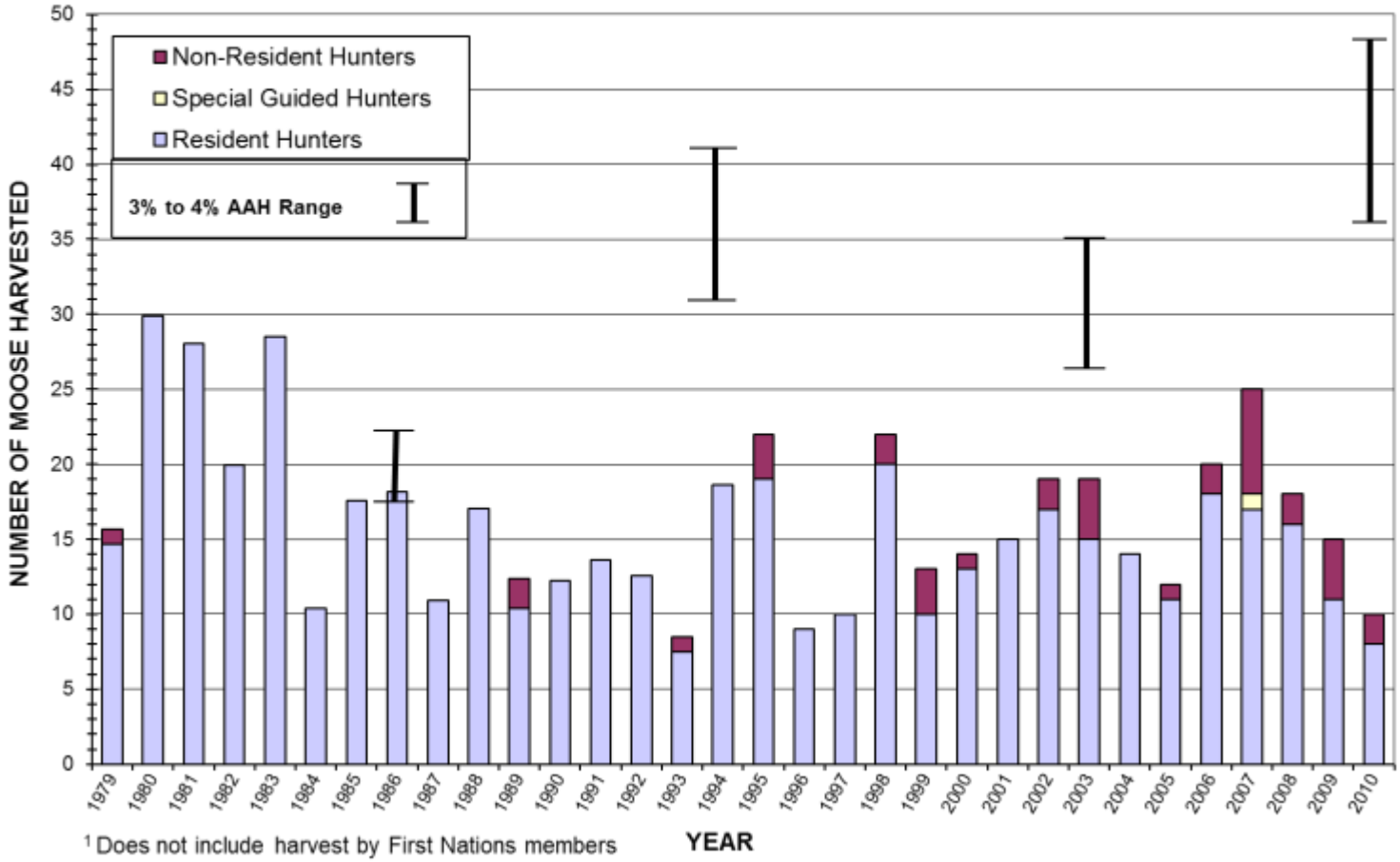

Figure 9. Annual Reported Moose Harvest (1979-2010) in the Nisutlin South comparison area.

Conclusions and Recommendations

- We estimate that there were about 1352 moose in the entire Nisutlin South survey area, for an average density of about 248 moose per 1,000 km^2 of total area. This was above the Yukon-wide average. We did not detect a change in the population since 1994.
- We detected a declining trend in the bull:cow ratio between 1986 and 2010 in the Nisutlin South comparison area.
- The ratio of adult bulls to adult cows in the Nisutlin South comparison area was below the estimated Yukon-wide average but was above the minimum number considered sufficient to ensure that adult cows are bred during the rut.
- Survival of calves appears to have been good in the Nisutlin South comparison area during the summer and fall of 2010, but low for calves born in 2009. Overall calf and yearling recruitment suggested a stable moose population.

  Reported moose harvest by licensed hunters in the Nisutlin South comparison area appears to be within normal allowable harvest limits set out in the Yukon moose management guidelines. This does not include harvest by First Nations' hunters.
- The declining adult bull to adult cow ratio in the area, however, may be an indication that the total harvest is high, raising concerns about the long term welfare of the area moose population.
- Complete harvest information is required to ensure this moose population is managed within sustainable limits.

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