MOOSE SURVEY
M'CLINTOCK AREA
EARLY-WINTER 2011

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Summary

- We conducted an early-winter moose survey in the M'Clintock area east of Whitehorse from November 15 to 26, 2011. The purpose of this survey was to estimate numbers, distribution, and age and sex composition, and to determine potential population trends.
- We attempted to count all moose in survey blocks covering about 24% of the area, and found a total of 431 moose: 145 adult bulls, 211 adult and yearling cows, 31 yearling bulls, and 44 calves.
- We estimated that there were 1,405 ± 20% moose for the total survey area, which is equal to a density of about 280 moose per 1,000 km^2 of total area. This figure is above the Yukon-wide average of about 157 moose per 1,000 km^2 of total area.
- Within the Game Management Subzones surveyed in both 1999 and 2011, we did not find any significant change in moose numbers. Current numbers, recruitment (the number of young that survive to adult), and harvest data suggest a stable population.
- We estimated there were about 27 calves and 33 yearlings for every 100 adult cows in 2011. This ratio suggests that survival of calves was good during the summer and fall of 2011, and very good in the summer and fall of 2010.
- We estimated that there were about 90 adult bulls for every 100 adult cows in 2011. This figure is well above the current Yukon average of 64 adult bulls per 100 adult cows, calculated from other areas surveyed.
- The reported moose harvest by licensed hunters in the 2011 M'Clintock survey area seems to be within the allowable range set out in the Yukon Moose Management Guidelines.

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Introduction

This report summarizes the results of the early-winter survey of moose in the M'Clintock area, conducted 15 – 26 November, 2011. The purposes of this survey were to:

- estimate numbers (abundance);
- determine distribution, or where the moose were found;
- examine age and sex composition; and
- determine population trends.

Previous Surveys

Few previous moose surveys have been done in the M'Clintock area. One early-winter population census was done in 1999 (Yukon Fish and Wildlife Branch 2000), but it covered only Game Management Subzones 8-12, 8-15, 8-16, and 8-17 (Figure 1).

A late-winter survey was carried out in the entire M'Clintock area in 2010 (O'Donovan et al. 2011). That survey mapped moose distribution and identified potentially important habitats during the critical late-winter season.

Community Involvement

Moose have been a key part of the subsistence of First Nation peoples for generations. Today, moose is the game species most widely hunted by both First Nation and non-First Nation hunters.

In recent years, people have become concerned about the numbers of moose being harvested from the M'Clintock area. The southern portion of the study area is easy to reach and is near Whitehorse. Conservation officers are also concerned and have reported that off-road vehicle trails are providing new entry points to moose habitat.

This moose survey will provide important information for the Southern Lakes Wildlife Coordinating Committee, who are interested in the recovery of Southern Lakes moose populations. It may also help in developing management plans for that recovery.

Study Area

The 2011 M'Clintock survey area covered about 5,011 km^2, and included Game Management Subzones 8-12 to 8-17 (Figure 2). The survey boundary was the Alaska Highway from Johnson's Crossing west to Whitehorse, north along the North Klondike Highway to the south end of Lake Laberge, northeast to Thomas Lake and the Teslin River, and then south along the Teslin River to Johnson's Crossing.

Most of the study area is considered suitable moose habitat except for roughly 4% that includes large water bodies (0.5 km^2 or more in size) and land above 1,676 m (5,500 feet) in altitude.

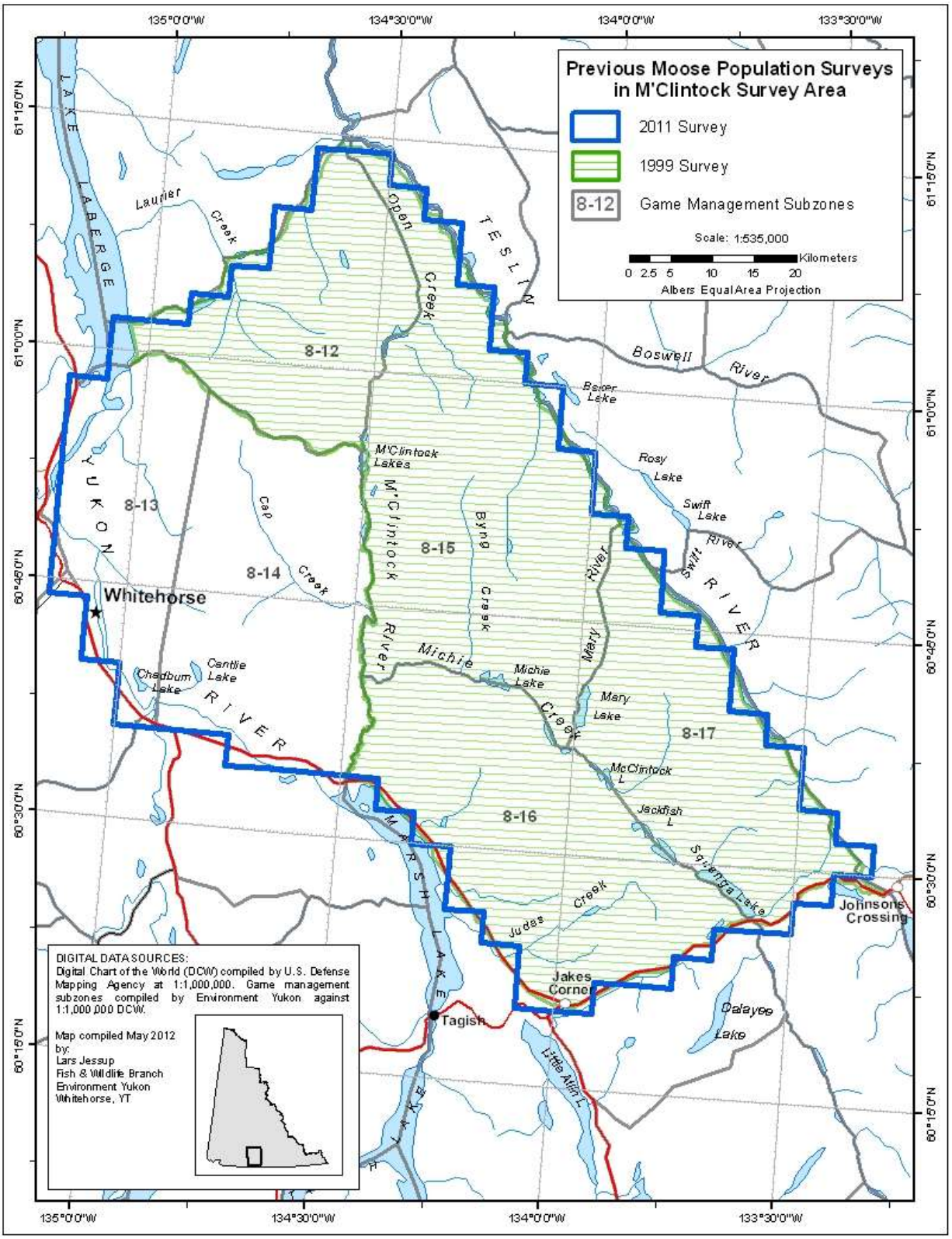

Figure 1. Location of previous moose population surveys in the M'Clintock area.

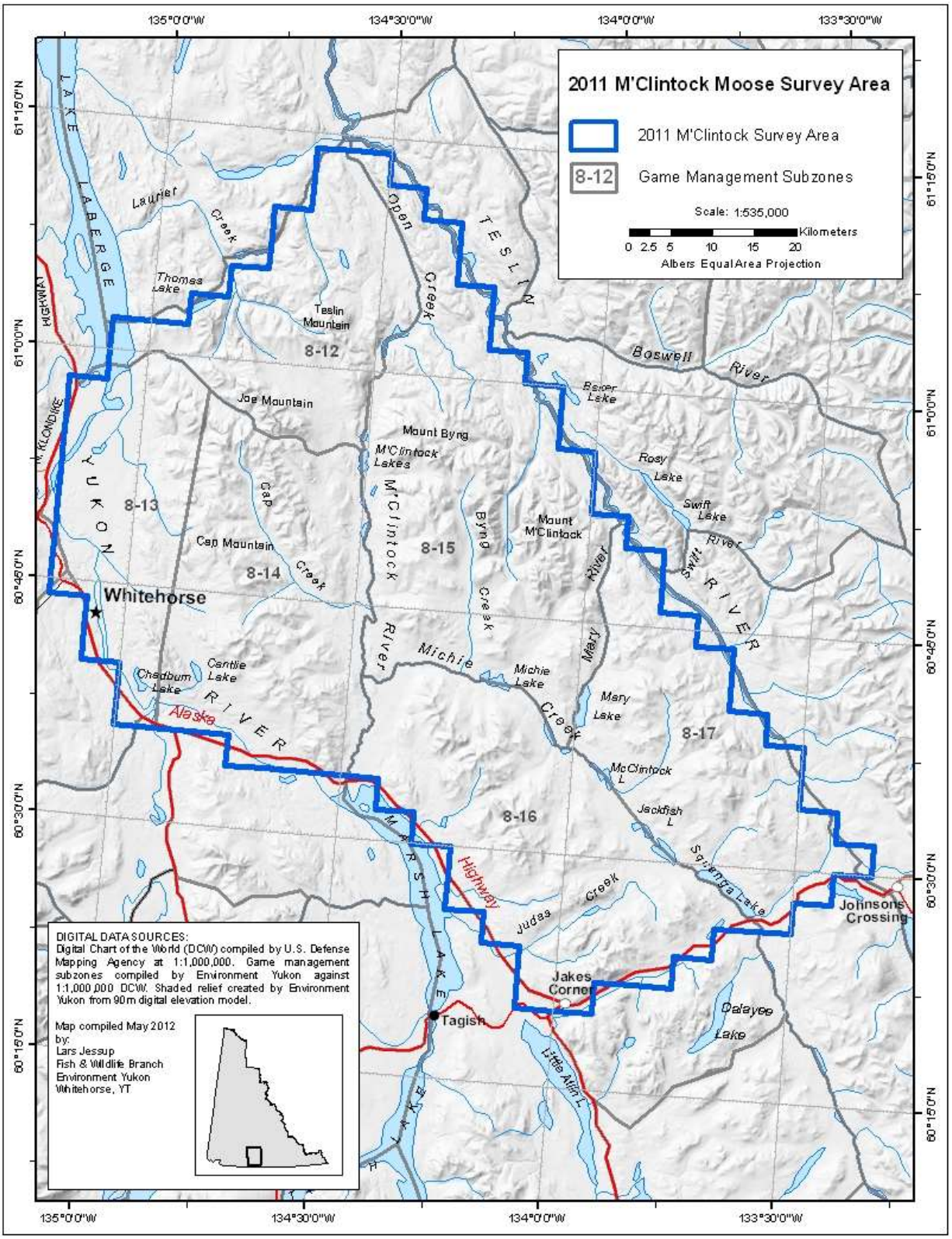

Figure 2. Location of 2011 M'Clintock moose survey, showing Game Management Subzones.

The survey area lies entirely within the Yukon Southern Lakes ecoregion (Yukon Ecoregions Working Group 2004). Major geographic features within the survey area include the M'Clintock River and Michie Creek valleys. The northern portion of the survey area is more mountainous, dominated by Cap, Joe, Teslin, Byng, and M'Clintock mountains.

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

Much of the area is covered with black and white spruce, aspen, and lodgepole pine. Forest cover varies from dense mature white spruce and aspen in the main river and creek valleys, to dense black spruce in many lowlands, to more open scrubby spruce on slopes. Shrub habitats, including willow and dwarf birch, and alpine tundra are typical of the alpine transition zone on the higher slopes and plateaus. There are scattered wetlands throughout the study area, especially in the M'Clintock river valley as well as in the nearby Michie-Byng valleys. Forest fires have produced some localized patches of willow and pine (Yukon Ecoregions Working Group 2004).

The fire history in the survey area from 1946 to present is shown in Figure 3. Two small fires totalling about 50 km^2 burned just north of Jackfish Lake in 1999 and 2002. Another 59 km^2 burned along the northeast margin of the survey area as part of a 183-km^2 fire in 2009. Other forest fire activity in the survey area was from the 1940s or 1950s and was very limited.

Methods

We have adopted 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 the way we conducted our moose surveys in the past, 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 fly over all the blocks quickly, 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.

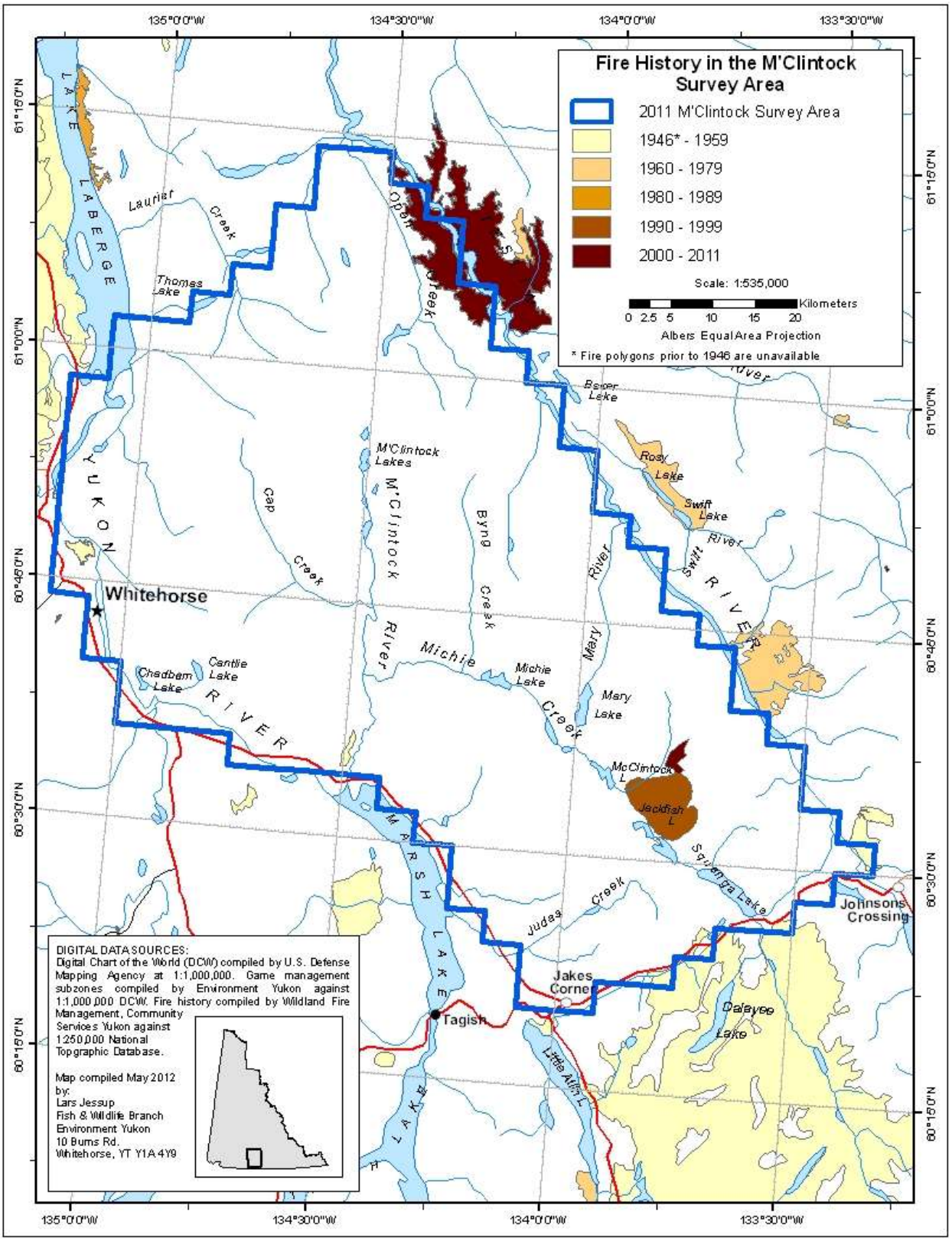

Figure 3. Fire history in 2011 M'Clintock survey area from 1946 to present.

3. We combine these categories of blocks into high and 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.
4. Using helicopters, we try to count every moose within the selected blocks (the "census" part of our 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 they are counted together.
5. We repeat our counts at double the search intensity in about 25% 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).

Weather and Snow Conditions

Weather conditions were relatively consistent for this survey. During the stratification part of the survey, temperatures ranged from -15°C to -30°C. During the census part of the survey, temperatures ranged from -10°C to -26°C.

Winds were light to moderate for most of the survey and did not generally affect flying conditions. Weather was generally favourable, except for 3 days during the stratification survey. During the census, clouds prevented crews from flying low-lying areas for a short time each morning.

There was good snow coverage for animal tracking during both parts of the survey.

Results and Discussion

For the 2011 survey, the 1999 survey area was expanded by the inclusion of Game Management Subzones 8-13 and 8-14. We first present the results for the entire 2011 survey area. Then, to make comparisons with the 1999 survey, we present results for the "M'Clintock comparison area" encompassing those Game Management Subzones (8-12, 8-15, 8-16, and 8-17) that were surveyed in both 1999 and 2011.

2011 M'Clintock Survey Area (Game Management Subzones 8-12 to 8-17)

Identification of High and Low Moose Density Blocks

We reclassified the entire survey area for expected numbers of moose (including the area surveyed in 1999). Out of the 297 survey blocks, we classified 101 (34%) of the 297 survey blocks as high, and 196 (66%) as low (Figure 4).

Coverage

During our census, we surveyed 71 of the 297 blocks, or about 24% of the total area (see Figure 5). This included 42 blocks with high expected numbers of moose and 29 blocks with low expected numbers.

It took 39.2 hours to count moose in these blocks, for a search intensity of 1.96 minutes per km². Survey intensity was higher in the high-abundance blocks (2.08 minutes per km²) than in the low-abundance blocks (1.80 minutes per km²). We used an additional 8.3 hours to recount moose in about 25% of the survey blocks so that we could calculate our sightability correction factor. Another 20.7 hours of helicopter time were used in ferrying between survey blocks, to a remote fuel cache near Squanga Lake, and back and forth to Whitehorse. Total flight time (survey and ferry time combined) was 68.1 hours.

Observations of Moose

We counted a total of 431 moose: 145 adult bulls, 211 adult and yearling cows, 31 yearling bulls, and 44 calves (Table 1).

We observed an average of 531 moose for every 1,000 km² in the high-abundance blocks, and 113 moose per 1,000 km² in the low blocks.

Most moose were seen in and around high elevation sub-alpine bowls and ridges, with the highest concentrations on Teslin Mountain, Mount Byng, Cap Mountain, and Streak Mountain (Figure 5). Relatively few moose were seen in the lower valley bottoms, but some moose were seen in mid-elevation burns or meadows. In early winter, shrubby areas in burns, sub-alpine willow flats, and creek draws provide abundant forage and moose tend to concentrate in these areas.

Moose Abundance and Density

The estimated number of moose in the entire 2011 survey area, based on our census counts, was 1,405 ± 20% moose (Table 2). This figure includes a sightability correction factor of about 13% in the high blocks for moose missed during the census portion of the survey. Sightability was 100% in the low blocks, so no correction factor was applied there.

The estimated density of moose in the survey area was 280 per 1,000 km², or 291 moose per 1,000 km² of suitable moose habitat. This figure is higher than the Yukon-wide average of about 157 moose per 1,000 km². It is also higher than the average density of 209 moose per 1,000 km² of suitable habitat, based on the most recent early-winter surveys throughout Yukon.

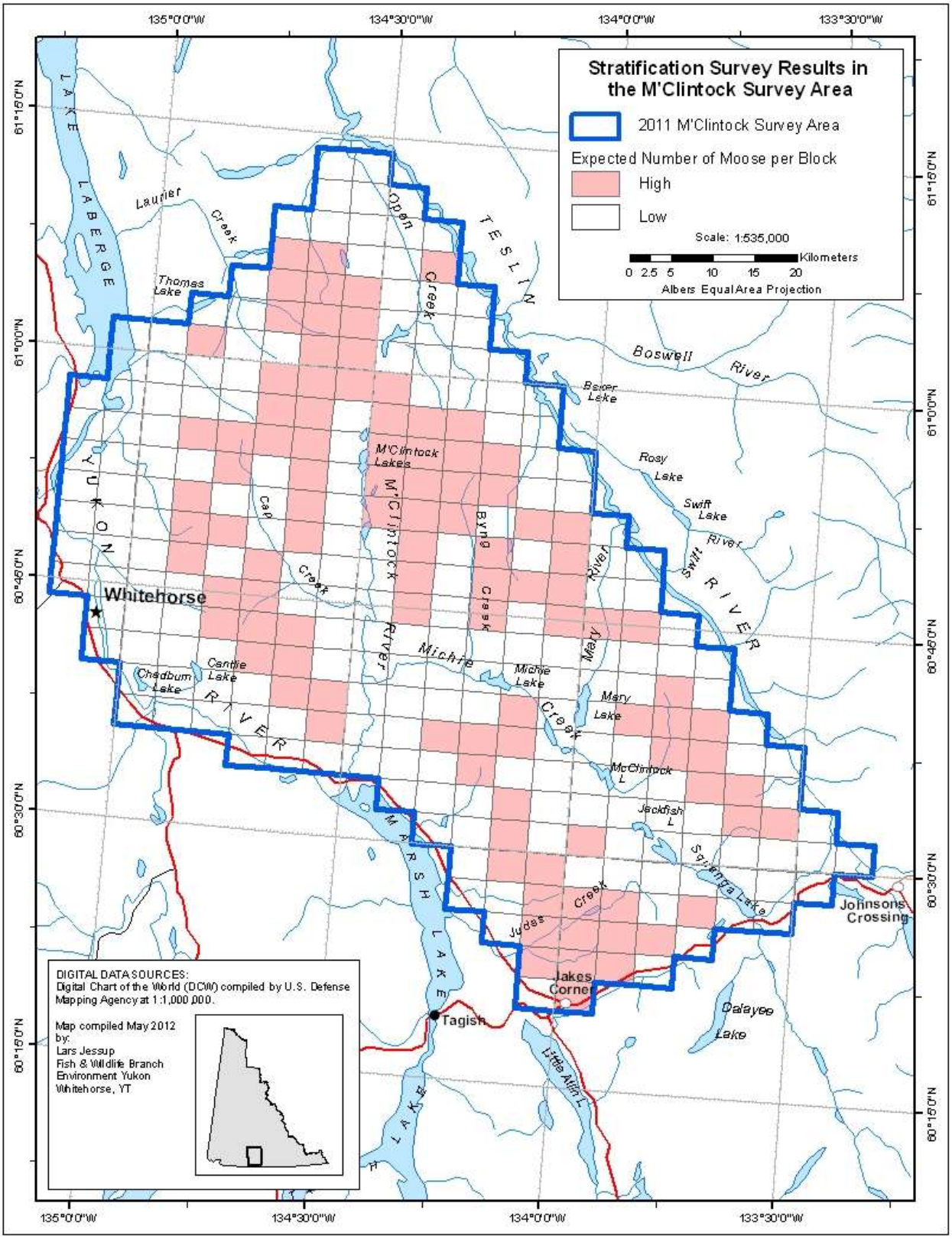

Figure 4. Stratification survey results, 2011 M'Clintock survey area.

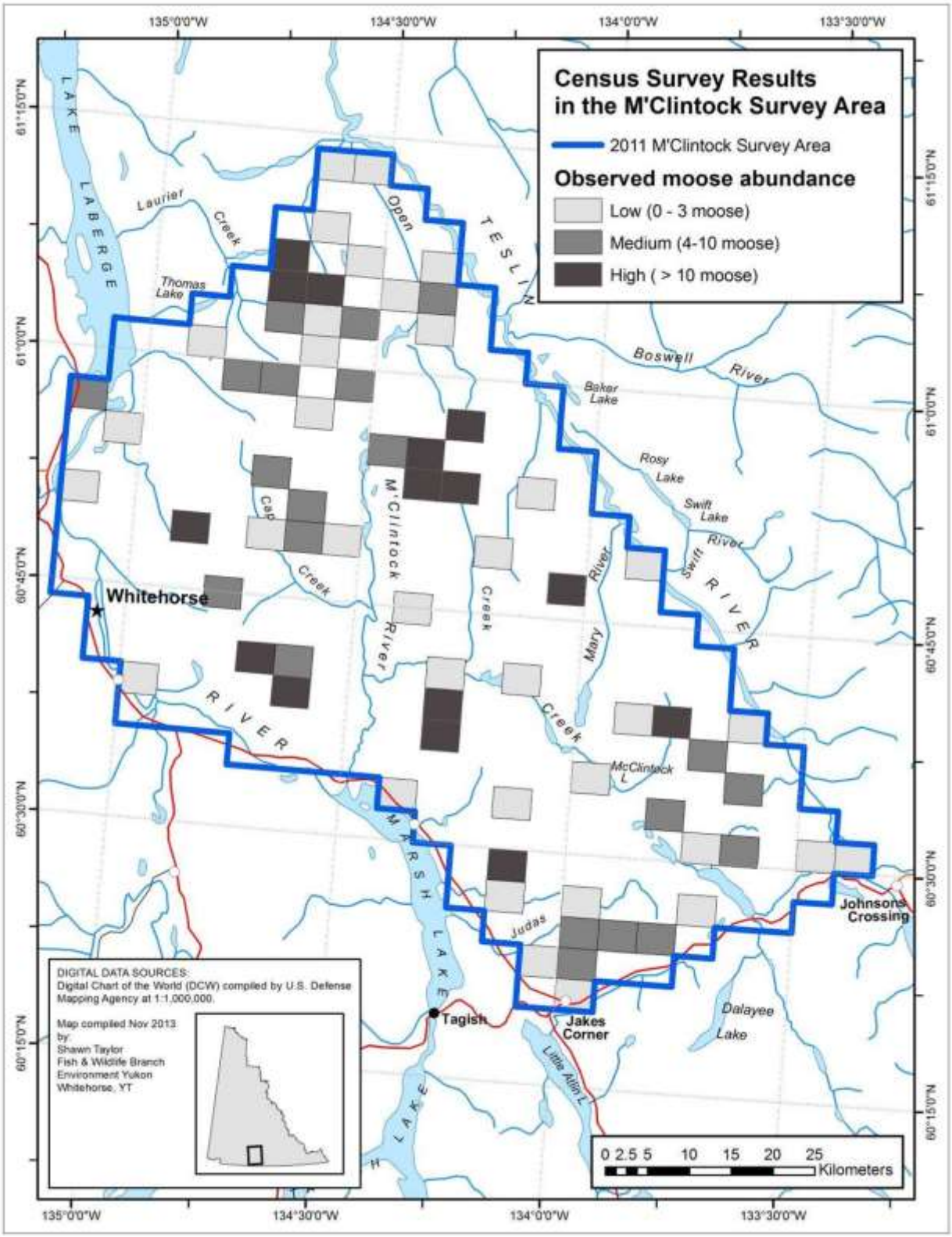

Figure 5. 2011 M'Clintock moose population survey results.

Table 1. Observations of moose during the November 2011 survey in the M'Clintock survey area.

	High Blocks	Low Blocks	Total
Number of blocks counted	42	29	71
Number of adult bulls observed	118	27	145
Number of adult and yearling cows observed[1]	192	19	211
Number of yearling bulls observed	29	2	31
Number of calves observed	37	7	44
Number of unknown age/sex	-	-	-
Total moose observed	**376**	**55**	**431**

[1] 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 below.

Table 2. Estimated abundance of moose in the M'Clintock survey area in November 2011.

	Best Estimate ± 90% Confidence Interval (%)[1]	90% Confidence Interval (Range) [1]
Estimated total number of moose[2]	1405 ± 20%	1127-1683
Adult bulls	504 ± 28%	364-645
Adult cows	560 ± 22%	437-683
Yearlings [3]	197 ± 35%	128-266
Calves	160 ± 30%	112-208

[1] 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.

[2] Estimated numbers provided were obtained using geospatial software and are based on a Not Pooled "sightability correction factor" or SCF. In this survey, a SCF of 1.134 was applied to the High stratum and an SCF of 1.000 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).

[3] 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.

Sex and Age Ratios

Wildlife managers use sex and age ratios to assess the health of wildlife populations. For example, low numbers of adult bulls compared to adult cows could indicate that licensed harvest is too high. The numbers of calves and yearlings are used to measure recruitment, or the number of young that survive to enter the adult population. Low numbers indicate poor survival, and recruitment to the adult population will be low in those years. If annual recruitment is outweighed by adult mortality, populations will decline.

We estimated that there were 90 bulls per 100 adult cows in the M'Clintock survey area in 2011, which is well above the Yukon average of 65 bulls per 100 adult cows. The Yukon moose management guidelines recommend that at least 30 adult bulls per 100 adult cows are required to ensure that all cows are bred during the rut (Yukon Fish and Wildlife Branch, in preparation).

In the 2011 M'Clintock survey area, calf survival to early winter was good with a calf/cow ratio of 27 calves per 100 cows (Table 3). We estimated a yearling/cow ratio of 33 yearlings per 100cows, which indicates that survival was excellent in 2010.

Of the cow-calf groups we observed, 9% had twins. In general, a calf/cow ratio of about 25 calves per 100 cows and a yearling/cow ratio of about 8-15 yearlings per 100 cows are considered necessary to maintain stable moose populations in areas with typical mortality rates (Environment Yukon, in preparation).

M'Clintock Comparison Area (Game Management Subzones 8-12, 8-15, 8-16, and 8-17)

Population Abundance

In the M'Clintock comparison area the numbers of moose, the recruitment rate (the number of calves still alive at the time of the survey), and the harvest data all indicated that the population was stable since 1999. The mean estimated moose population size increased about 15%, from 798 moose in 1999 to 921 moose in 2011, but this increase was not statistically significant ($P>0.1$: Z-test).

Average moose density in the comparison area was 256 moose per 1,000 km^2 of total area, or 264 moose per 1,000 km^2 of suitable moose habitat. This was a higher figure than the Yukon-wide average of 157 moose per 1,000 km^2 of total area. It was also higher than the Yukon-wide average density of 209 moose per 1,000 km^2 of moose habitat.

Results also suggested that there has been relatively good recruitment of calves into the adult population since the last survey.

Table 3. Estimated age and sex ratios in the M'Clintock survey area in November 2011.

	Estimated Population Ratios [1]	
Adult bulls per 100 adult cows	90 ± 27%	66 - 114
Yearlings per 100 adult cows	33 ± 45%	18 - 48
Yearlings per 100 adults	13 ± 36%	8 - 18
Calves per 100 adult cows	27 ± 24%	20 - 33
% of cow-calf groups with twins	9% ± 104%	0 - 18%

[1] Ratio results with the sightability correction factor confidence interval calculated using the Gasaway (1986) methodology implemented in the program Moosepop.

Sex and Age Ratios

The estimated numbers of adult bulls and adult cows in the comparison area has gone up since 1999 (Table 4). The adult bull/cow ratio has also risen to 92 adult bulls per 100 adult cows in 2011 compared to 77 adult bulls per 100 adult cows in 1999. The ratio in both years was well above the minimum level of 30 bulls per 100 cows identified in the Yukon moose management guidelines (Yukon Fish and Wildlife Branch, *in preparation*).

Calf survival was good in the 2011 M'Clintock comparison area, although slightly lower in 2011 than in 1999, with a calf/cow ratio of 31 calves per 100 cows compared to 40 calves per 100 cows (see Table 4). Yearling survival was excellent, with 35 yearlings per 100 cows, although also lower than in the 54 calves per 100 cows seen in 1999. Of the cow-calf groups we observed in the comparison area, 15% had twins in 2011, slightly more than during the 1999 survey (5%).

Harvest

We generally set an annual allowable harvest rate of between 3% and 4% for stable moose populations of average density (Environment Yukon, *in preparation*). Harvest rates above 5% of the total moose population can carry an unacceptably high risk of population decline (Gasaway et al. 1992; Environment Yukon, *In preparation*).

The 5-year average (2007 to 2011) total reported annual harvest in the 2011 M'Clintock survey area was about 21 moose per year, or about 1.5% of the total 1,392 moose estimated for GMSs 8-12 to 8-17 (Table 5). However, it does not include moose harvested by First Nation hunters, which we generally assume to be about equal to harvest by licensed resident hunters. If we add this assumed First Nation harvest, the average annual harvest rate increases to about 3.0% of the estimated moose population.

The total harvest is likely within the 3-4% annual allowable harvest for the M'Clintock survey area. However, we do not know the number of cow moose being harvested, which can have a greater impact on moose populations than the harvest of bulls.

Table 4. Comparison of identical areas from the 1999 and 2011 M'Clintock moose population surveys (Game Management Subzones 8-12, 8-15, 8-16, and 8-17).

Survey Year	1999	2011
Estimated abundance[1] (90% confidence range)[2]		
Total moose[3]	798 ± 15% (681-914)	921 ± 20% (740-1102)
Adult bulls (≥ 30 months)	230 ± 26% (171-289)	336 ± 27% (245-427)
Adult cows (≥ 30 months)	294 ± 22% (228-360)	366 ± 22% (287-446)
Yearlings (approx. 18 months)[4]	158 ± 49% (81-235)	129 ± 37% (82-177)
Calves (≥ 12 months)	118 ± 25% (88-147)	112 ± 28% (80-143)
Unknown age/sex	4 ± 80% (1-7)	-
Estimated population ratios[1] (90% confidence range)[2]		
% Adult bulls	28% ± 28% (20-36%)	36% ± 16% (30-42%)
% Adult cows	37% ± 25% (28-46%)	40% ± 17% (33-47%)
% Yearlings	20% ± 51% (10-30%)	14% ± 34% (9-18%)
% Calves	15% ± 29% (11-19%)	12% ± 23% (10-15%)
% Unknown age/sex	<1 ± 82% (0-1%)	-
Adult bulls per 100 adult cows[5]	77 ± 32% (52-102)	92 ± 27% (67-116)
Yearlings per 100 adult cows	54 ± 54% (25-82)	35 ± 40% (21-49)
Yearlings per 100 adults	23 ± 51% (11-35)	16 ± 33% (10-21)
Calves per 100 adult cows	40 ± 34% (27-54)	31 ± 26% (23-39)
% of cow-calf groups with twins[6]	5% ± 124% (0-11%)	15% ± 57% (6-24%)
Density of moose (per 1,000 km^2)		
Total area	222	256
Moose habitat only[7]	236	264
Total area (km^2)	3594.8 km^2	3594.8 km^2
Habitable area (km^2)	3374.0 km^2	3488.8 km^2

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

[2] 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.

[3] 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.

[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 Ratio results with the sightability correction factor confidence interval calculated using the Gasaway (1986) methodology implemented in the program Moosepop

[6] 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.

[7] Suitable moose habitat was considered to be all elevations lower than 1,524 m (5,000ft) in 1999 and updated to ~1,676 m (5,500 ft.) in 2011, excluding all water bodies 0.5 km2 or greater in size. Note: Moose seen above 5,000 ft. during the 1999 survey changed our assessment of habitable area to elevations lower than 5,500 ft. in 2011.

Table 5. Average annual reported moose harvest and allowable harvest summary for the 2011 M'Clintock survey area.

GMS	GMS Area (km^2)	Estimated Density[1] (moose/ 1000 km^2)	Total Estimated number of Moose[2]	Average Resident Harvest	Average Non-Resident Harvest	Average (Special Guided) Harvest	Average Reported Harvest[3] (2007-2011)	Current Harvest Rate (% of total population)	2% Allowable Annual Harvest	3% Allowable Annual Harvest	4% Allowable Annual Harvest
8-12	648	330	214	2	0	0.2	2.2	0.8%	4	6	9
8-13	551	140	77	1	0	0	1	1.0%	2	2	3
8-14	864	300	259	1	0	0	1	0.4%	5	8	10
8-15	1221	305	372	9	0	0	9	2.3%	7	11	15
8-16	968	300	290	4	0	0	4	1.2%	6	9	12
8-17	745	240	179	5	0	0	5	2.7%	4	5	7
Total	**4997**	**279**	**1392**	**21**	**0**	**0.2**	**21.2**	**1.6%**	**28**	**42**	**56**

[1] Based on 2011 M'Clintock Moosepop SCF Not Pooled moose survey results.

[2] This number is based on the GMS area multiplied by the density of moose. It differs slightly from the population estimate for the entire survey area (1405 moose) because the total survey area is slightly different from the area of the GMS used to calculate the density estimate.

[3] Does not include First Nations harvest.

When we examined individual Game Management Subzones, the estimated average harvest of moose, adjusted for First Nation harvest, was within allowable limits in GMS 8-12, 8-13, 8-14, and 8-16. However, the harvest was above the 4% annual allowable limit in GMS 8-15 (4.6%) and 8-17 (5.4%).

We have recorded available harvest data for licensed hunters in the M'Clintock survey area since 1979. Over this time, the reported annual moose harvest has varied, but has not trended up or down (see Figure 6) and average moose harvest has been 21 moose per year since 1979. The annual harvest peaked at about 32 moose in 1984 and was as low as 10 moose in 1986.

In 1999, when the population was first censused, licensed harvest in the M'Clintock comparison area was 21 moose, or 2.6% of the estimated population of 798 moose (Table 4). With the potential First Nation harvest, the annual allowable harvest was probably higher than sustainable levels in 1999. In 2011, licensed harvest in this area was 19 moose, or 1.8% of the estimated population of 921 moose. Total harvest, including that of First Nations, was probably below the recommended maximum sustainable harvest rate for this area.

Despite the general finding of a sustainable and relatively constant harvest, a cautious management approach should be taken in this area. This region lies in close proximity to a large population of resident hunters in Whitehorse, and proliferation of off-road vehicle trails is leading to increased access into the region.

Other Wildlife Sightings

Besides the 431 moose we counted during the 2011 survey, we also saw 50 moose outside the surveyed blocks or just outside the survey boundary, for a total of 481 moose.

We also recorded a total of 14 wolves in 2 packs, located in the north end of the study area. We sighted one pack of 6 wolves east of the south end of Lake Laberge and northwest of Joe Mountain. We saw a second pack of 8 wolves in the 2009 burn (see Map 3) west of the Teslin River near its junction with the Indian River.

We observed 233 caribou during the survey, belonging to the Laberge and Carcross caribou herds. They were concentrated near the headwaters of Laurier Creek, to the east of Whitehorse, and in the southeast towards Squanga Lake. We also recorded 43 mule deer, 9 thinhorn sheep, 1 red fox, 5 porcupine, about 30 grouse, and about 412 ptarmigan, including 74 white-tailed ptarmigan.

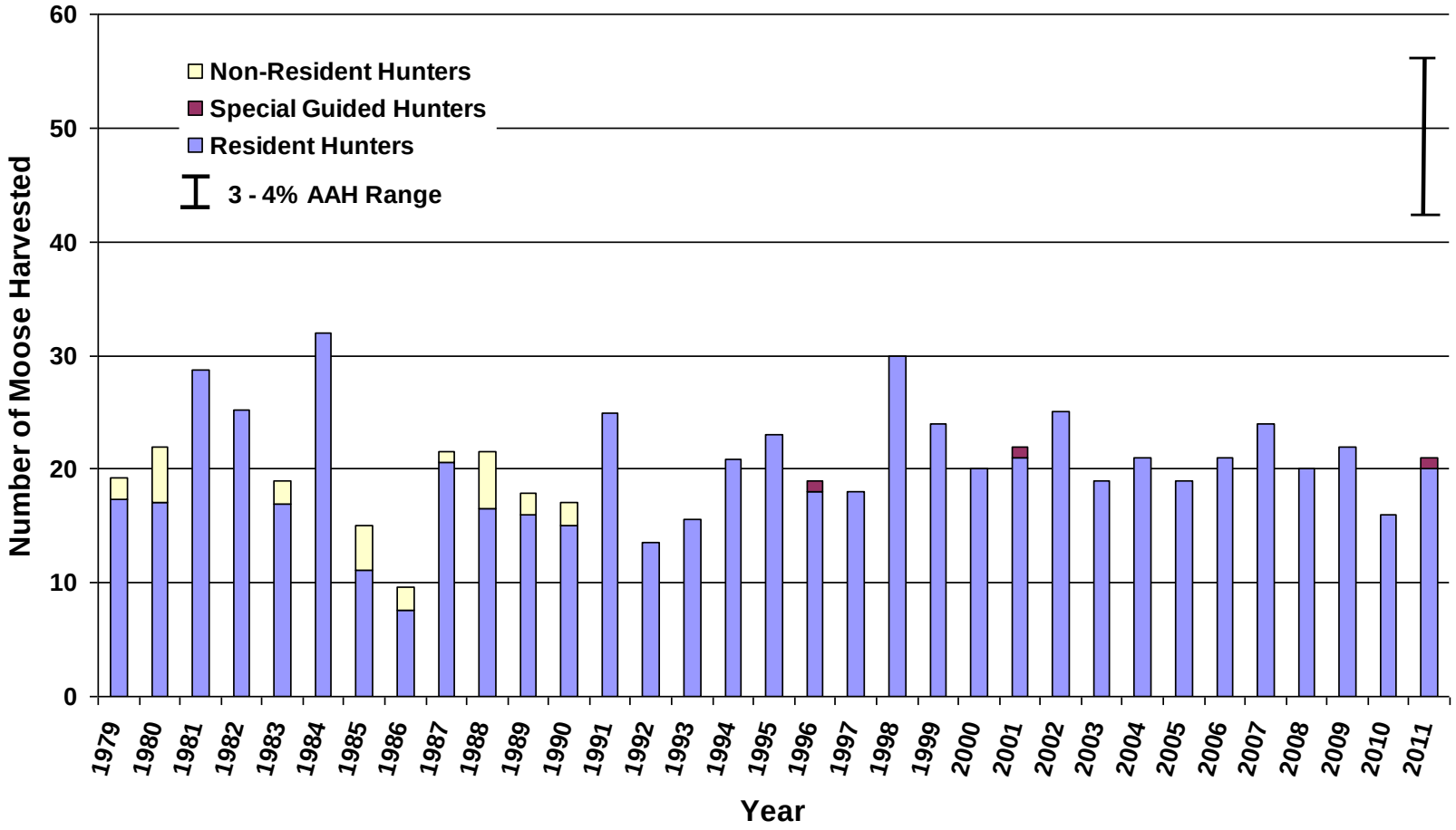

Figure 6. Annual reported moose harvest (not including First Nation harvest) from 1979–2011 in the 2011 M'Clintock survey area (GMSs 8-12 to 8-17).

The 3-4% annual allowable harvest (AAH) range is based on an estimated 1,392 moose in these Game Management Subzones.

Conclusions and Recommendations

- We estimate that there were about 1,405 moose in the entire 2011 M'Clintock survey area. The average density was about 280 moose per 1,000 km^2 of total area. This figure is above the Yukon-wide average.
- The moose population in the M'Clintock comparison area has been stable or slowly increasing since the previous survey in 1999.
- Survival of calves appears to have been very good in 2010 and good in 2011. Overall, calf and yearling recruitment suggested a stable to increasing moose population.
- The ratio of adult bulls to adult cows was very high and above the estimated Yukon-wide average. It was also well above the minimum level needed to make sure that all adult cows are bred. Present harvest levels seem to be within normal annual allowable limits (less than 3% to 4% of the total estimated moose population). However, the harvest may be above sustainable limits in some areas (Game Management Subzones 8-15 and 8-17).
- We recommend a cautious management approach; the region is very near the city of Whitehorse and a large number of resident hunters. Hunting pressure could easily increase to unsustainable levels.

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