# MOOSE SURVEY

# MAYO MOOSE MANAGEMENT UNIT

## EARLY-WINTER 2011

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## Yukon Department of Environment
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## TR-12-32


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## Summary

- We conducted an early-winter survey of moose in the area northeast of Mayo on 2-7 November 2011, using helicopters. The main purpose of this survey was to estimate the abundance, distribution, and population composition of the moose population.
- We counted all moose in survey blocks covering about 23% of the entire area, and found a total of 260 moose, of which 60 were adult bulls, 137 were adult and yearling cows, 15 were yearling bulls, and 48 were calves.
- We calculated a population estimate of 816 ± 27% moose for the area, which is equal to a density of about 163 per 1,000 $km^2$ over the whole area, or 173 per 1,000 $km^2$ in suitable moose habitat. This is about 77% of the estimated density of 225 moose per 1,000 $km^2$ in suitable moose habitat calculated from the last survey in 2006 in the same area.
- Based on current and past survey results, moose abundance in the Mayo Moose Management Unit has remained stable or declined slowly since 2006.
- We estimated that there were about 40 calves and 20 yearlings for every 100 adult cows in the survey area. This suggests that survival of calves and young moose was fairly good during 2010 and 2011.
- We estimated that there were about 41 bulls for every 100 cows in the survey area, which is a relatively low sex ratio and similar to that estimated in 2006.
- Harvest of moose in this area appears to be near the maximum sustainable level.

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# Introduction

This report summarises the results of the early-winter survey of moose in a part of the Mayo Moose Management Unit (see Map 1), conducted on November 2-7, 2011. The main purpose of this survey was to estimate abundance, distribution, and population composition of the local moose population.

### *Previous Surveys*

The Yukon Fish and Wildlife Branch has monitored populations of moose in the Mayo area since the mid-1970s, using a variety of methods and survey areas. We conducted early-winter surveys in different survey areas (see Map 2) in 1988 (results in Larsen et al. 1989; a small part of this area was also re-surveyed in late winter 1989), 1993 (results in Ward and Larsen 1994), and 1998 (results in Yukon Fish and Wildlife Branch file reports). In 2006, we conducted an early-winter survey of moose in the same survey area as this year's (results in Ward et al. 2006). Early winter is the best time of year to estimate abundance of moose because of their concentration in high-altitude open habitats. Bull moose still have antlers at this time of year, so early-winter surveys also allow us to estimate the proportion of bulls in the population.

We conducted late-winter surveys to measure recruitment of calves in a large area around Mayo (see Map 2) each year from 1993 to 1999 and in 2003 (results in Ward and Larsen 1994, 1995; Sinnott and O'Donoghue 2003, and Yukon Fish and Wildlife Branch file reports).

We also measured recruitment of moose at the end of winter in the same area as this year's survey in 2001, 2002, and 2004 (results in Fraser et al. 2001, O'Donoghue and Sinnott 2003, and Yukon Fish and Wildlife Branch file reports).

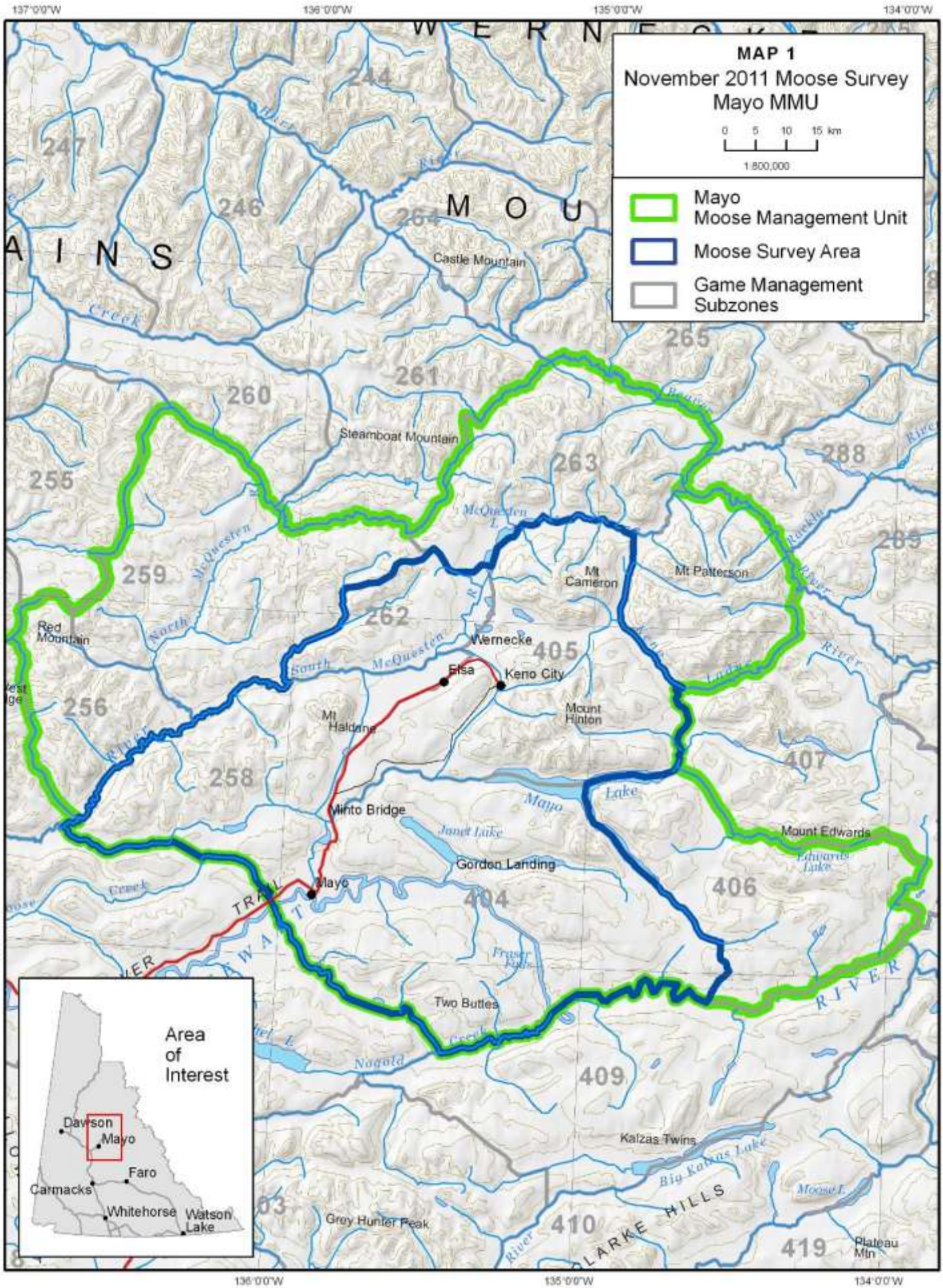
Finally, we have worked with local residents to conduct ground-based monitoring of composition of the Mayo-area moose population each fall since 2001.

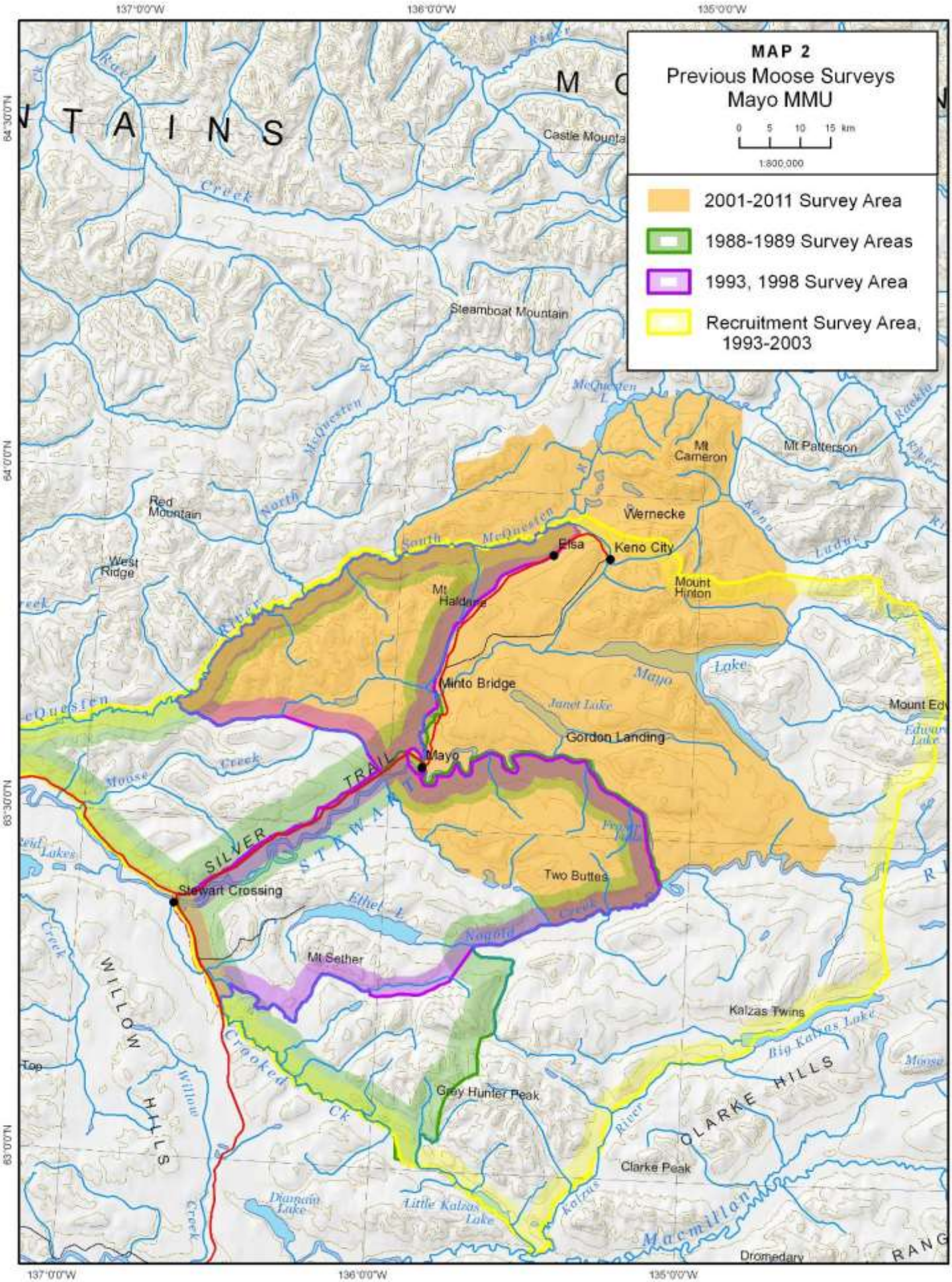
### *Community Involvement*

Residents of the Mayo area have consistently placed a high priority on monitoring the health of the local moose population. This survey was recommended in the *Community-based Fish and Wildlife Management Work Plan for the Na-Cho Nyäk Dun Traditional Territory* for 2008-2013, which was developed cooperatively by the Mayo District Renewable Resources Council, the First Nation of Na-Cho Nyäk Dun, and Environment Yukon.

# Study Area

The Mayo survey area was re-located in 2001 to conform to the boundaries of Yukon Moose Management Units. These Moose Management Units were developed to help us more consistently monitor and manage moose in all areas throughout Yukon. We plan to monitor the health of moose populations in priority moose management units using both aerial and ground-based surveys.


MAP 1
November 2011 Moose Survey
Mayo MMU
0 5 10 15 km
1:800,000
Mayo
Moose Management Unit
Moose Survey Area
Game Management
Subzones
137°0'0"W
136°0'0"W
135°0'0"W
134°0'0"W
64°30'0"N
64°0'0"N
63°30'0"N
Castle Mountain
Steamboat Mountain
Mt Cameron
Mt Patterson
Red Mountain
Wernecke
Elsa
Keno City
Mt Haldane
Mount Hinton
Minto Bridge
Janet Lake
Gordon Landing
Mayo
Mount Edwards
Two Buttles
Kalzas Twins
Grey Hunter Peak
Plateau Mtn
Area of Interest
Dawson
Mayo
Faro
Carmacks
Whitehorse
Watson Lake


MAP 2
Previous Moose Surveys
Mayo MMU
0 5 10 15 km
1:600,000
2001-2011 Survey Area
1988-1989 Survey Areas
1993, 1998 Survey Area
Recruitment Survey Area, 1993-2003
137°0'0"W
136°0'0"W
135°0'0"W
64°30'0"N
64°0'0"N
63°30'0"N
63°0'0"N
Steamboat Mountain
Mt Cameron
Mt Patterson
Wernecke
Elsa
Keno City
Mount Hinton
Red Mountain
West Ridge
Mt Haldane
Minto Bridge
Janet Lake
Gordon Landing
Mayo
Mount Edwards
Stewart Crossing
Two Buttes
Mt Sether
Kalzas Twins
Grey Hunter Peak
Clarke Peak
Dromedary
SILVER TRAIL
STEWART
WILLOW HILLS
CLARKE HILLS
Moose Creek
Crooked Ck
Willow Creek
Ethel L
Nogold Creek
Big Kalzas Lake
Little Kalzas Lake
Diamain Lake
McQuesten River
North McQuesten River
South McQuesten River
Mayo Lake
Macmillan RANGE

The Mayo Moose Management Unit is about 9,659 km², and includes Game Management Subzones (GMS) 2-56, 2-58, 2-59, 2-62, 2-63, 4-04, 4-05 and 4-06 (see Map 1). The survey area within the Mayo Moose Management Unit is about 5,014 km². The border runs northeast along the McQuesten and South McQuesten rivers to McQuesten Lake. From there, it roughly extends south along the Keno Ladue River to Mayo Lake and then to the Stewart River. The Stewart River and Nogold Creek form the southeast boundary. The southwest boundary runs along Francis and Talbot creeks northwest to Mayo, and back to the McQuesten River.

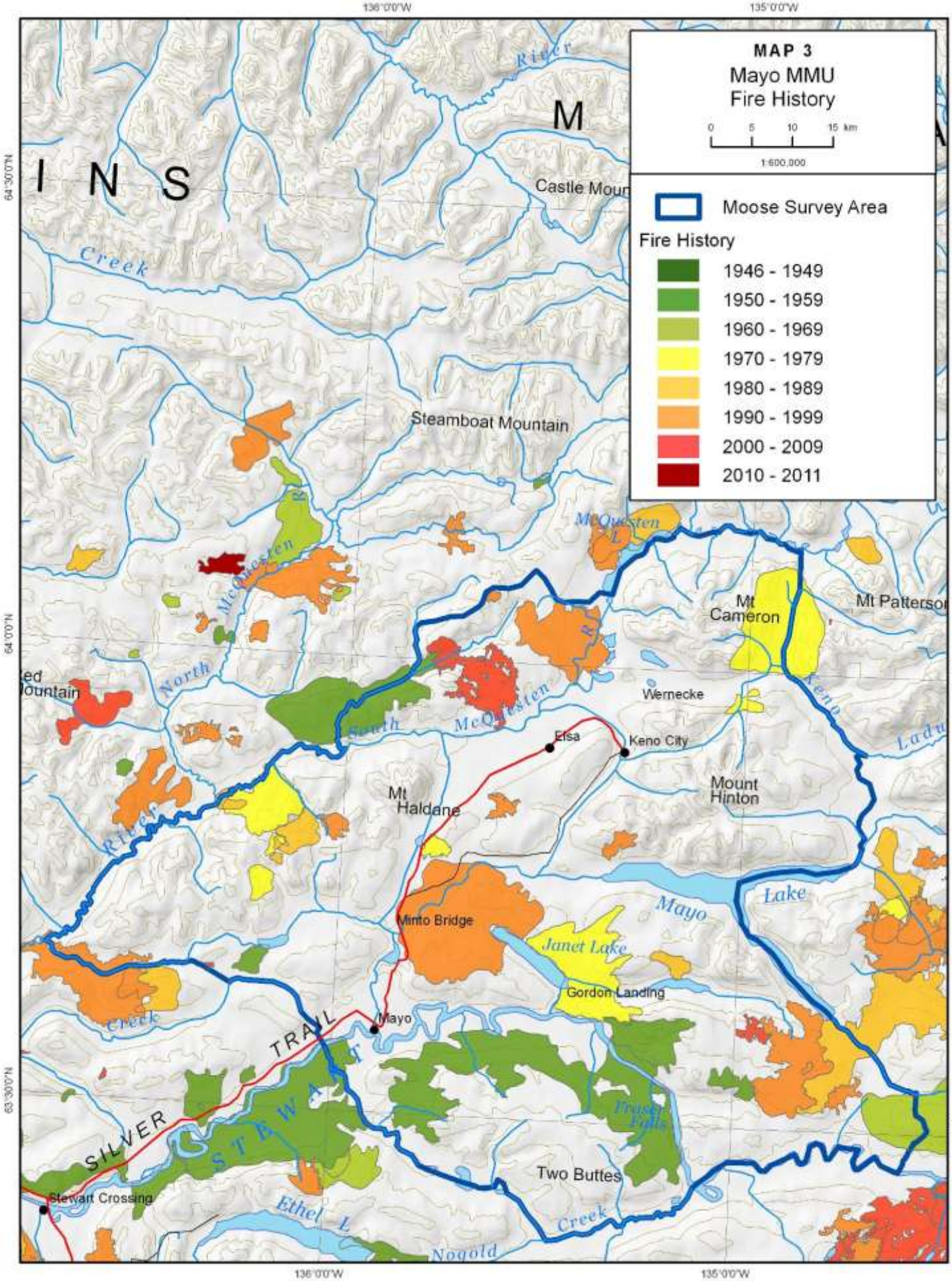
Most of the study area (about 4,717 km²) is considered suitable moose habitat, except for approximately 6% of the area, which includes large water bodies (0.5 km² or more in size) and land over 1,524 m (5,000 feet) in elevation. The study area consists mostly of rolling hills and plateaus, dissected by numerous creeks, in the drainages of the Stewart and South McQuesten Rivers. Most of the area is forest-covered with black and white spruce, lodgepole pine, aspen, and paper birch. Willow and dwarf birch shrub habitats, alpine tundra, and unvegetated rocky areas typify the higher plateaus, scattered throughout the study area, and the mountainous area in the northeastern corner (the Keno area) of the survey area. Old and recent forest fires have occurred throughout the study area (see Map 3).

The most recent large fires were a 55 km² burn northwest of Elsa in 2005, a 71 km² burn southwest of McQuesten lake in 1998, a 73 km² burn at the south arm of Mayo Lake in 1994, and a 183 km² burn north and west of Janet Lake in 1990.

## 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 involves 6 steps:

1. The survey area is divided into uniform rectangular blocks about 15 km² (2' latitude x 5' longitude) 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.
3. We combine these categories of blocks into high and low “strata”, and then randomly select a sample of each stratum for our census. We typically select a higher proportion of the high blocks than the low blocks to survey.


MAP 3
Mayo MMU
Fire History
0 5 10 15 km
1:600,000
Moose Survey Area
Fire History
1946 - 1949
1950 - 1959
1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - 2009
2010 - 2011
136°0'0"W
135°0'0"W
64°30'0"N
64°0'0"N
63°30'0"N
Steamboat Mountain
Mt Cameron
Mt Patterson
Wernecke
Elsa
Keno City
Mount Hinton
Mt Haldane
Minto Bridge
Janet Lake
Gordon Landing
Mayo
Lake
Two Buttes
Stewart Crossing
SILVER TRAIL
Ethel L
Nogold
Creek
River

4. We try to count every moose within the selected blocks (the "census" part of our survey) using helicopters, at a search intensity of about 2 minutes per km$^2$. 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 by assuming it equals the number of yearling bulls we saw.
5. We repeat our counts at double the search intensity in a portion of our survey blocks to estimate the number of moose that we missed at our regular search intensity. We use these double counts to develop "sightability correction factors" for the high and low blocks to correct the census results for moose that we overlooked.
6. We use a computer program (Gasaway et al. 1986) to estimate the total number of moose by age and sex in the entire survey area based on the numbers of moose counted in the blocks during the census, the distribution of these blocks; how we classified the blocks we didn't count, and the sightability corrections (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.

## Weather and Snow Conditions

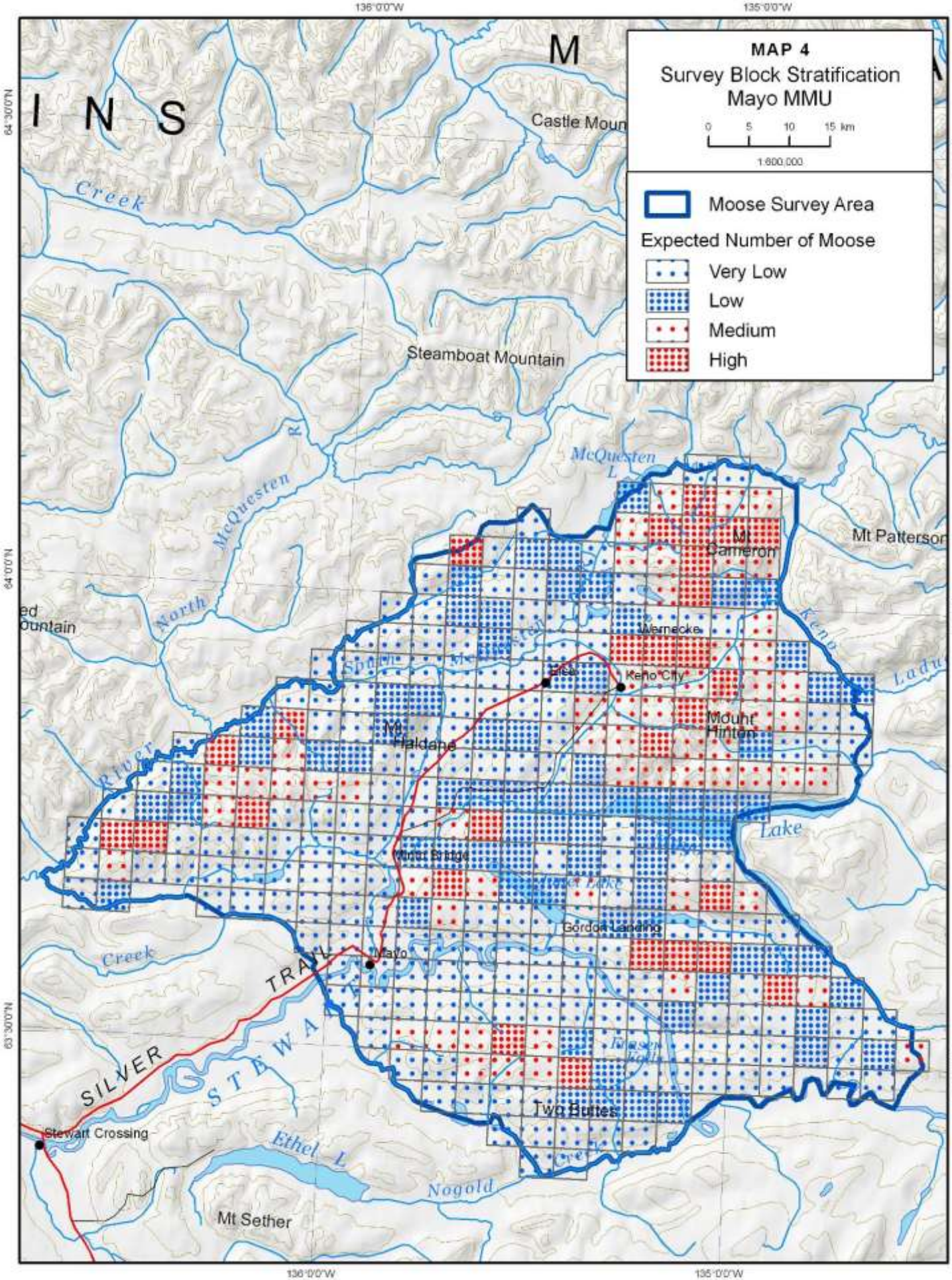
Weather conditions were variable for this survey. Temperatures ranged from -25°C to -7°C. Skies were clear on one day, mostly cloudy on 3 days, and cloudy on 2 days; we had light snow on 3 days and ground fog on another, but we were able to work around the weather and complete the census in 6 consecutive days. Low-lying clouds prevented us from getting into one survey block on the last day of the survey. Winds were mostly calm or light on 4 of the days and moderate on 2 days. Light conditions ranged from flat to bright and snow coverage was complete, so visibility was generally good for spotting moose.

## Results and Discussion

### *Identification of High and Low-Density Blocks*

We used the results of our 2006 stratification survey to classify the survey blocks by expected density of moose. We modified the classification of several survey blocks based on the 2006 census counts.

We classified 28 (8%) of the 328 survey blocks as high, 59 (18%) as medium, 75 (23%) as low, and 166 (51%) as very low expected abundance of moose (see Map 4), based on our observations from the air.


MAP 4
Survey Block Stratification
Mayo MMU
0 5 10 15 km
1:600,000
Moose Survey Area
Expected Number of Moose
Very Low
Low
Medium
High
136°0'0"W
135°0'0"W
64°30'0"N
64°0'0"N
63°30'0"N
Steamboat Mountain
McQuesten L
McQuesten R
North
Mt Patterson
Mt Cameron
Wernecke
Keno City
Mount Hinton
Mt Haldane
Lake
Gordon Landing
Mayo
TRAIL
SILVER
STEWART
Stewart Crossing
Ethel L
Nogold
Mt Sether
Two Buttes

Most of the blocks with higher expected numbers of moose were located in the mountainous area in the northeastern part of the survey area and on subalpine ridges scattered elsewhere in the area. For the purpose of selecting blocks for the census, we grouped the 87 blocks expected to have high and medium numbers of moose into a High stratum, and the 241 blocks with low and very low expected numbers of moose into the Low stratum.

### *Coverage*

We counted moose in 77 of the 328 blocks, or about 23% of the total area (see Map 5). We initially randomly selected 60 blocks to survey—36 from the High stratum and 24 from the Low stratum. After completing the count in these blocks, however, the precision of our population estimate was still fairly low, so we selected and continued to survey more blocks—in all, 44 High and 33 Low-stratum blocks were selected—to get a more precise estimate. It took us about 40.4 hours to count moose in these blocks, for a search intensity of 2.06 minutes per km². Survey intensity was about the same in low-abundance (2.11 minutes per km²) and high-abundance (2.03 minutes per km²) blocks. We needed an additional 8.0 hours to re-count portions of 30 survey blocks (at an intensity of 4.22 minutes per km²) to calculate our sightability correction factors. Another 21.4 hours were used in ferrying between survey blocks, to a fuel cache at Keno City, and back and forth to Mayo.

### *Observations of Moose*

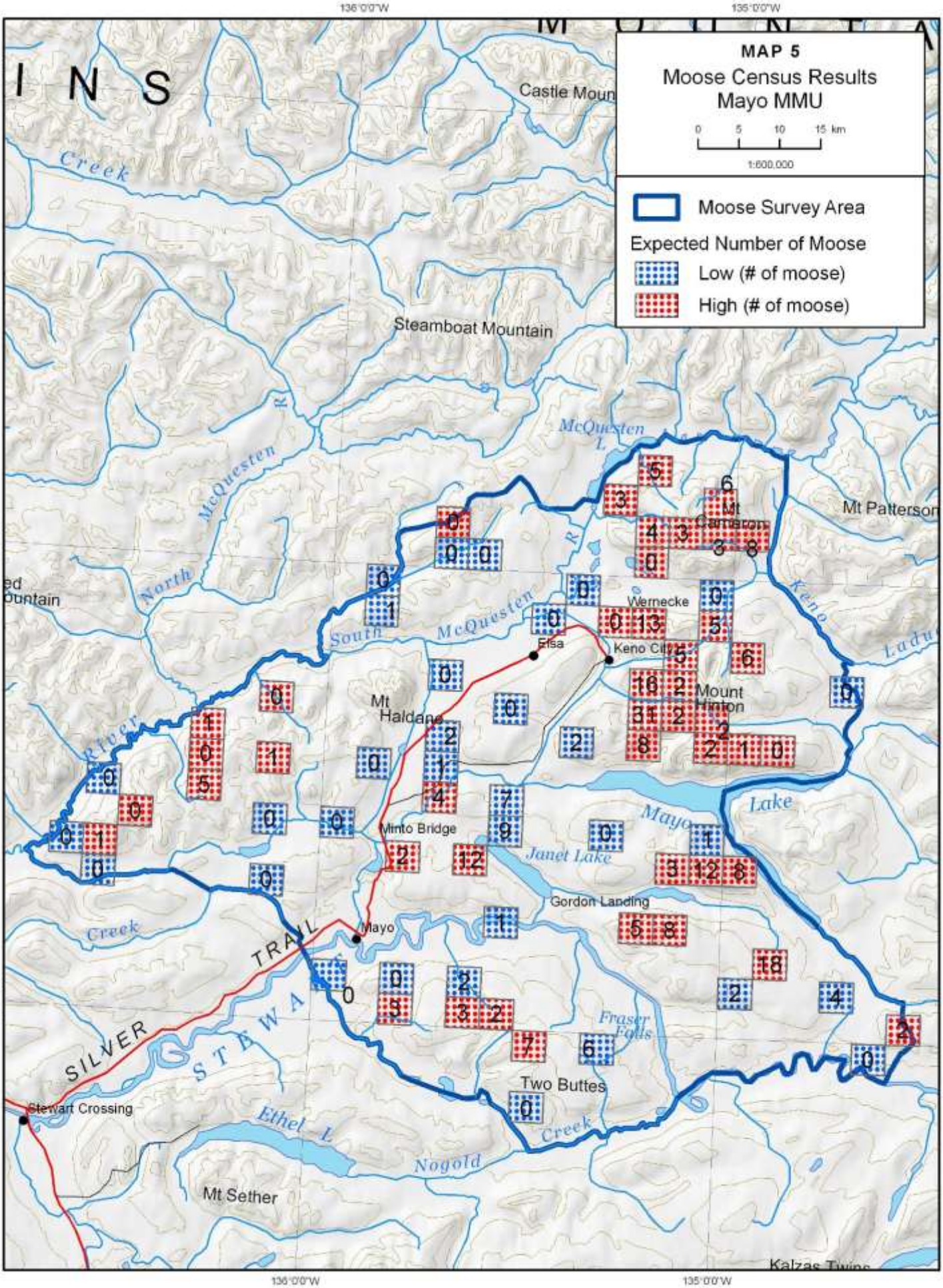
We counted a total of 260 moose, 60 of them adult bulls, 137 adult and yearling cows, 15 yearling bulls, and 48 calves (see Table 1). We observed an average of 331 moose for every 1,000 km² in the high-abundance blocks, and 75 moose per 1,000 km² in the low blocks.

### *Distribution and Abundance of Moose*

Moose were widely distributed in the survey area (see Maps 5 and 6), and we found them in a variety of habitats. As expected for the early winter, subalpine willow flats and creek draws with abundant willows generally had good numbers of moose in them. We saw few moose in forested lowlands and lower-elevation slopes.

The estimated number of moose in the whole survey area, based on our census counts, was 819 ± 27% (see Table 2). This includes corrections for moose missed during the census of about 15% in the high blocks and 12% in the low blocks, as calculated from our repeated searches of selected areas at double our usual search intensity.

The estimated density of moose in the survey area was 163 per 1,000 km², or 173 per 1,000 km² of suitable moose habitat (see Table 2). This was higher than the Yukon-wide average of 157 moose per 1,000 km², but only 77% of the density found in the 2006 survey (see Table 3) Because of the statistical uncertainty in the population estimates, the calculated change in the moose population between 2006 and 2011 was not statistically significant (at the P = 0.10 level), but the decline in moose abundance may be real biologically.


MAP 5
Moose Census Results
Mayo MMU
0 5 10 15 km
1:600,000
Moose Survey Area
Expected Number of Moose
Low (# of moose)
High (# of moose)
136°0'0"W
135°0'0"W
64°30'0"N
64°0'0"N
63°30'0"N
Castle Mountain
Steamboat Mountain
McQuesten L.
North McQuesten R.
South McQuesten River
Mt Patterson
Mt Cameron
Wernecke
Keno City
Elsa
Mt Haldane
Mount Hinton
Keno Ladue
Minto Bridge
Janet Lake
Mayo Lake
Gordon Landing
Mayo
SILVER TRAIL
STEWART
Fraser Falls
Two Buttes
Stewart Crossing
Ethel L.
Nogold Creek
Mt Sether
Kalzas Twins

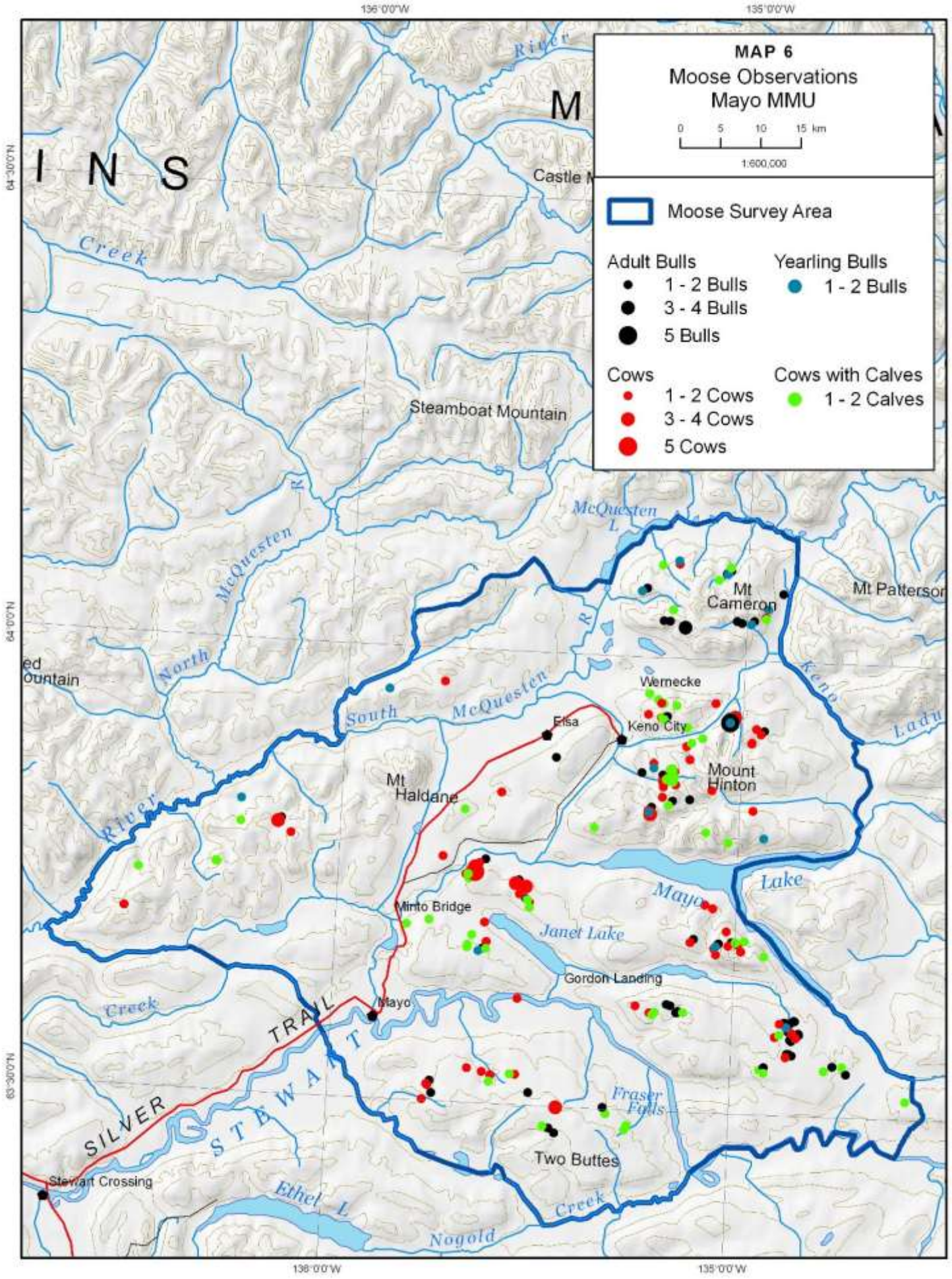

MAP 6
Moose Observations
Mayo MMU
0 5 10 15 km
1:600,000
Moose Survey Area
Adult Bulls
1 - 2 Bulls
3 - 4 Bulls
5 Bulls
Yearling Bulls
1 - 2 Bulls
Cows
1 - 2 Cows
3 - 4 Cows
5 Cows
Cows with Calves
1 - 2 Calves
136°0'0"W
135°0'0"W
64°30'0"N
64°0'0"N
63°30'0"N
Steamboat Mountain
McQuesten L
McQuesten R
North McQuesten River
South McQuesten River
Mt Cameron
Mt Patterson
Wernecke
Keno City
Elsa
Mount Hinton
Mt Haldane
Mayo Lake
Janet Lake
Minto Bridge
Gordon Landing
Mayo
SILVER TRAIL
STEWART
Fraser Falls
Two Buttes
Stewart Crossing
Ethel L
Nogold Creek

**Table 1.** Observations of moose during the November 2011 survey in the Mayo Moose Management Unit.

| | High Blocks | Low Blocks | Total |
|---|---|---|---|
| Number of blocks counted | 44 | 33 | 77 |
| Number of adult bulls observed | 55 | 5 | 60 |
| Number of adult and yearling cows observed* | 114 | 23 | 137 |
| Number of yearling bulls observed | 14 | 1 | 15 |
| Number of calves observed | 39 | 9 | 48 |

* Adult and yearling cows cannot always be reliably distinguished from the air, so they are counted together. Assuming that equal numbers of males and females are born and that they survive about equally well until they're yearlings, the number of yearling cows in these totals should be about the same as the number of yearling bulls observed during the survey. We used this assumption to estimate the total number of yearlings in the survey area presented in Table 2.

**Table 2**. Estimated abundance of moose in the Mayo Moose Management Unit survey area in November 2011.

| | ***Best Estimate ± 90% Confidence Interval**** | **Estimates within 90% Confidence Interval*** |
|---|---|---|
| Estimated total number of moose | 816 ± 27% | 599 – 1,034 |
| Adult bulls | 166 ± 35% | 107 – 225 |
| Adult cows | 408 ± 32% | 278 – 538 |
| Yearlings | 80 ± 43% | 46 – 115 |
| Calves | 162 ± 37% | 103 – 222 |
| Density of moose (per 1,000 $km^2$) | | |
| Entire area | 163 | |
| Moose habitat only** | 173 | |

* 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 near the middle of this range.

** 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.

**Table 3**. Comparison of the results of the 2006 and 2011 surveys of moose in the Mayo Moose Management Unit.

| | 2006 | 2011 |
|---|---|---|
| Estimated Abundance | | |
| Number of moose (± 90% Confidence Interval*) | 1,061 ± 21% | 816 ± 27% |
| Density (per 1,000 $km^2$ suitable habitat) | 225 | 173 |
| Estimated composition (± 90% Confidence Interval*) | | |
| Adult bulls | 225 ± 28% | 166 ± 35% |
| Adult cows | 571 ± 23% | 408 ± 32% |
| Yearlings | 52 ± 45% | 80 ± 43% |
| Calves | 213 ± 34% | 162 ± 37% |

* 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, and that our best estimate is near the middle of this range.

### *Ages and Sex of Moose*

Calf survival to the early winter was good in 2011 in the survey area. Based on our survey results, there were an estimated 40 calves for every 100 adult cows (see Table 4). In general, about 25–30 calves per100 adult cows are considered necessary for maintaining stable moose populations in areas with typical mortality rates. Calves made up an estimated 20% of the population in 2011, but only one percent of cow-calf groups contained twins.

The estimated percentage of yearlings in the population in the survey area – 10% – was also healthy (see Table 4).

There were an estimated 20 yearlings per 100 cows, or about 12 per 100 adults. Depending on mortality rates, about 10–20 yearlings per 100 adults are required for maintaining stable populations (Yukon Fish and Wildlife Branch 1996).

Survival of moose calves is typically variable among years, but ground-based monitoring and our late-winter recruitment surveys suggest that the long-term average in the Mayo area has been adequate for sustaining moose populations (O'Donoghue and Sinnott 2003).

We estimate that there were 41 adult bulls for every 100 adult cows in the survey area (see Table 4). This is considerably lower than the Yukon-wide average of 64 bulls per 100 cows in areas that have been surveyed, but still above the minimum level of 30 bulls per 100 cows needed to ensure most cows are bred (Yukon Fish and Wildlife Branch 1996).

We estimated a similar low number of bulls (39 for every 100 cows) in 2006. Relatively high harvest rates in the Mayo Moose Management Unit are the most likely reason for the low percentage of bulls seen during this survey.

### *Harvest*

The reported harvest of moose by licensed hunters in the Mayo Moose Management Unit during the previous 5 years for which we have complete records (2007 to 2011), averaged about 27 moose per year (see graph below). This does not include harvest data from First Nation hunters, which are reported annually at Northern Tutchone May Gatherings. First Nation harvest rates are similar to those of licensed resident hunters in much of the central Yukon.

Using our latest estimates of moose density, we estimated that the annual harvest (including First Nation harvest) was about 3% of the total moose population in the Mayo Moose Management Unit. This is near the recommended maximum allowable harvest rate of 3–4% for this area. The low percentage of bulls that we observed during the 2011 survey provides further evidence that harvest in this area was likely high. Neither the harvest rate nor the percentage of bulls in the population were at levels at which we would consider harvest restrictions mandatory (although restrictions could be considered as a precautionary measure). The data suggest however, that harvest was high, and that we need to closely monitor both harvest and the moose population in this area to ensure that the population remains healthy.

### *Other Wildlife Sightings*

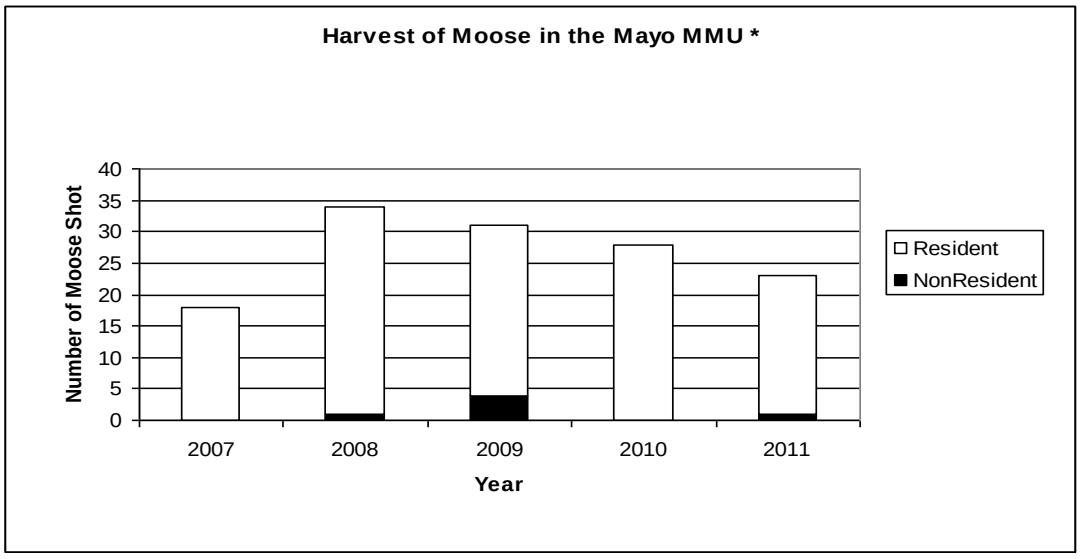
In addition to the 260 moose we counted during the 2011 survey, we also observed 74 moose outside of the blocks that were surveyed.

During the survey, we also recorded other notable observations of wildlife besides moose. We saw one pack of 8 wolves in the southeast part of the survey area and a pair of wolves near Elsa. We also saw a wolverine near the road to Mayo Lake and a red fox on the Mayo River near Minto Bridge.

**Table 4**. Estimated composition of the moose population in the Mayo Moose Management Unit survey area in November 2011.

| | ***Best Estimate*** | **Estimates within 90% Confidence Interval*** |
|---|---|---|
| Adult bulls | 20% | 16 – 25% |
| Adult cows | 50% | 44 – 56% |
| Yearlings | 10% | 5 – 14% |
| Calves | 20% | 15 – 25% |
| | | |
| Bulls per 100 adult cows | 41 | 28 – 54 |
| Yearlings per 100 adult cows | 20 | 9 – 30 |
| Calves per 100 adult cows | 40 | 28 – 52 |
| % of cow-calf groups with twins | 1% | 0 – 3% |

* 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, and that our best estimate is near the middle of this range.



## Conclusions and Recommendations

- We estimate that there were about 816 moose in the survey area in the Mayo Moose Management Area. The estimated density was about 173 moose per 1,000 $km^2$ of suitable habitat, which is slightly higher than the Yukon-wide average. Based on the 2011 survey, the population appears to have been stable or slowly declining since 2006.
- There was good survival of calves in this area during the summer and fall of 2011. Survival of calves born in 2010 (yearlings in this survey) was also quite good. Long-term recruitment appears adequate to maintain moose numbers in the Mayo Moose Management Unit.
- The number of bulls in the survey area, compared to the number of cows, was low in this survey. This likely reflects the relatively high harvest rates in the area.
- Harvest of moose in the Mayo Moose Management Unit is close to the maximum recommended allowable rate.
- We should continue discussions with the First Nation and Renewable Resources Council about options for managing harvest in this area to ensure that it does not exceed sustainable levels.
- We should continue to closely monitor the status and harvest of the moose population in the Mayo Moose Management Unit.

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