MOOSE AND CARIBOU SURVEY
CARMACKS WEST-CASINO TRAIL
LATE-WINTER 2011

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Environment

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TR-13-02

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Summary

- We used fixed-wing aircraft to conduct a late-winter survey of moose and caribou in the area northwest of Carmacks, in the range of the Klaza caribou herd and west to the proposed Casino mine, on 2-9 March 2011. The main purpose of this survey was to map the distribution and late-winter habitats of moose and caribou in this area.
- We flew over the entire survey area and spent about 0.42 minutes per km^2 searching for moose. We found a total of 311 moose, of which 291 were adults, 1 was a yearling bull, 13 were calves, and 6 were of unknown age and sex. We also mapped all observations of fresh moose tracks.
- Moose were widely distributed across the survey area. Most were seen in willow-rich habitats in recently burned areas, open forest, and along creeks; some were seen in the main Yukon River valley. The biggest concentrations of moose were in the northern part of the survey area, in the hills west of Minto and in the Hayes Creek area mostly in areas burned in the mid-1990s, and in open spruce and creek valleys on hills in the headwaters of the Klotassin River, Dip Creek, and Coffee Creek.
- Of moose seen in the survey 4% were calves. Although this may be negatively biased because of lower sightability of cows with calves, it is still low compared to other late-winter surveys, so recruitment appears to have been low this year in this area.
- We saw 125 caribou in 13 groups and mapped all observations of fresh caribou tracks.
- Caribou were concentrated in open and closed spruce forest habitats in 2 main areas, the lower Hayes Creek and Selwyn River valleys, and the headwaters of the Klotassin River.
- The proposed upgrading and extension of the Freegold Road runs through concentrated moose wintering habitat in creek valleys, and through one of the 2 main wintering concentrations of the Klaza woodland caribou herd.

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Introduction

This report summarises the results of the late-winter survey of moose and caribou in the area northwest of Carmacks around the proposed extension of the Freegold Road (see Map 1), conducted 2-9 March 2011. The main purpose of the survey was to map the distribution and late-winter habitats of moose and caribou in this area, which is experiencing high levels of mineral exploration and the proposed development of several new mines and associated all-season access roads.

Previous Surveys

Environment Yukon has previously conducted several moose surveys in areas that substantially overlap with this survey area (see Map 2). We conducted early-winter censuses in the area immediately northwest of Carmacks in 2007 (this same survey was attempted in 2003 but was cancelled due to poor weather and snow conditions; results in O'Donoghue et al. 2008a and O'Donoghue et al. 2008b), and further west in 1987 along the "Casino Trail" which was proposed to reach the same mining claims as the present potential Freegold Road extension (results in Markel and Larsen 1988). We also mapped late-winter distribution of moose along the Yukon River valley between Carmacks and Minto in March 2007 (results in O'Donoghue 2013).

The Klaza woodland caribou herd, which inhabits this area, was last counted in 1996 and fall counts to monitor herd composition were last done in 2003; radio-collared animals were monitored in the late 1980s and 1990s (results in Farnell et al. (1991) and in Fish and Wildlife Branch file reports).

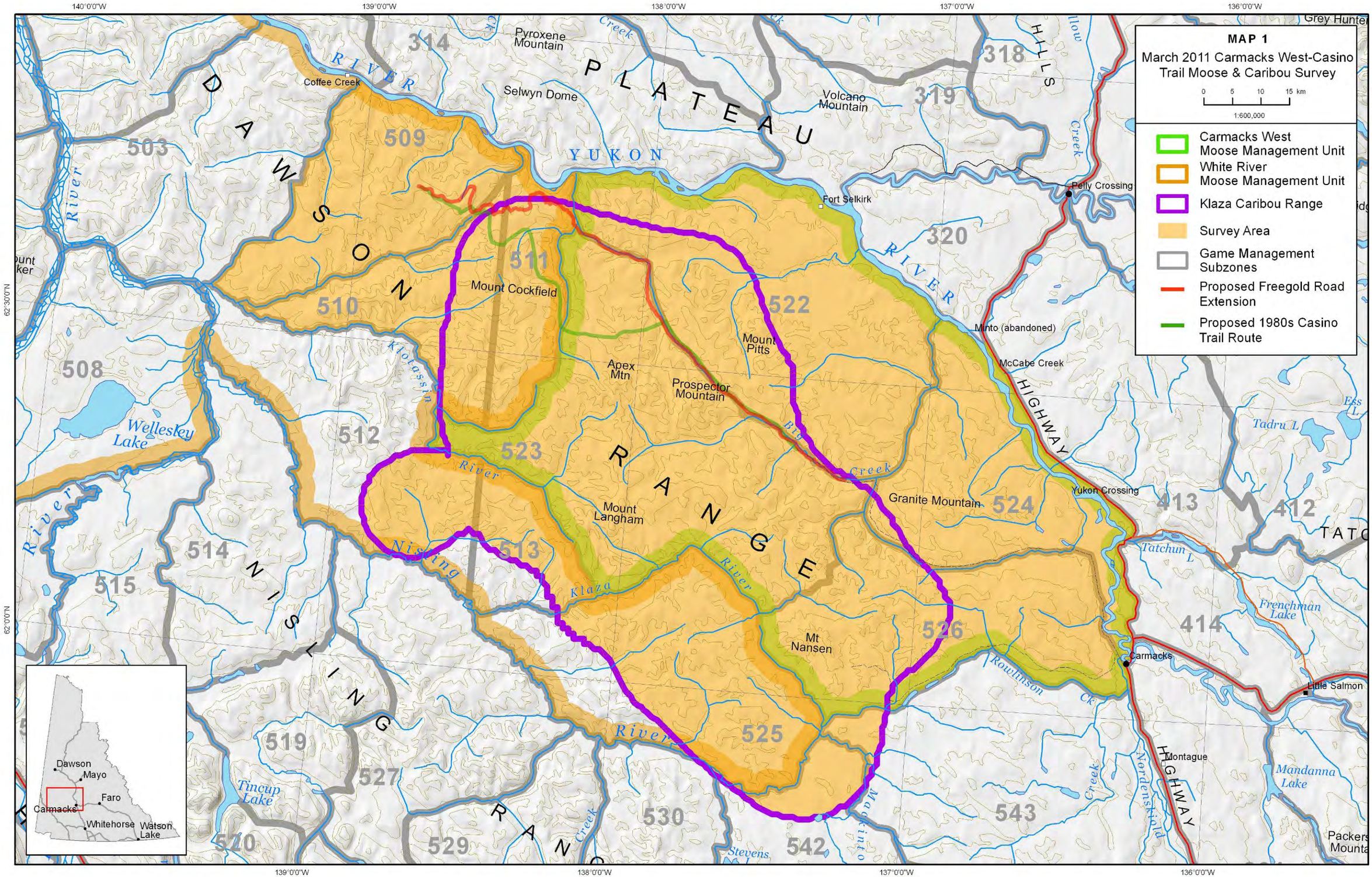
Community Involvement

This survey was conducted largely because of the high level of mining exploration and development in this area, and as a result of concerns expressed by residents of the Carmacks area about cumulative effects on wildlife during planning sessions for developing the *Community-based Fish and Wildlife Work Plan for the Little Salmon/Carmacks First Nation Traditional Territory, 2012-2017*. Mapping seasonally important habitats in this area has also been recommended at annual Northern Tutchone May Gatherings. Selkirk First Nation co-funded this survey, and Little Salmon/Carmacks First Nation provided staff to help conduct it.

Study Area

The survey area boundaries were delineated to cover

- the Carmacks West Moose Management Unit (Game Management Subzones 5-22, 5-23, 5-24, and 5-26);
- the range of the Klaza caribou herd (extending the area to include parts of Game Management Subzones 5-12, 5-13, 5-25, 5-42, and 5-43); and
- Game Management Subzones (5-09, 5-10, and 5-11) in the west along the potential Freegold Road extension (see Map 1).


MAP 1
March 2011 Carmacks West-Casino Trail Moose & Caribou Survey
0 5 10 15 km
1:600,000
Carmacks West Moose Management Unit
White River Moose Management Unit
Klaza Caribou Range
Survey Area
Game Management Subzones
Proposed Freegold Road Extension
Proposed 1980s Casino Trail Route
140°0'0"W
139°0'0"W
138°0'0"W
137°0'0"W
136°0'0"W
63°0'0"N
62°30'0"N
62°0'0"N
DAWSON
NISLING
RANGE
PLATEAU
YUKON
RIVER
HILLS
HIGHWAY
Coffee Creek
Pyroxene Mountain
Selwyn Dome
Volcano Mountain
Grey Hunter
Pelly Crossing
Fort Selkirk
Minto (abandoned)
McCabe Creek
Yukon Crossing
Tatchun L
Frenchman Lake
Carmacks
Little Salmon
Montague
Mandanna Lake
Tadru L
Ess L
Mount Cockfield
Mount Pitts
Apex Mtn
Prospector Mountain
Mount Langham
Granite Mountain
Mt Nansen
Rowlinson Ck
Nordenskold Creek
Wellesley Lake
Tincup Lake
Stevens
Macmillan
Packers Mountain
Klaza River
Nisling River
Dawson
Mayo
Faro
Carmacks
Whitehorse
Watson Lake
314
318
319
320
503
509
510
511
512
513
514
515
519
522
523
524
525
526
527
529
530
542
543
412
413
414
508

MAP 2

Previous Moose Surveys
Carmacks West-Casino Trail

0 5 10 15 km
1:600,000

- 2011 Survey Area
- 1987 Survey Area
- 2003 & 2007 Survey Area
- 2007 Habitat Survey Area
- Proposed Freegold Road Extension
- Proposed 1980s Casino Trail Route

140°0'0"W 139°0'0"W 138°0'0"W 137°0'0"W 136°0'0"W

63°0'0"N 62°30'0"N

DAWSON RANGE
PLATEAU
NISLING RANGE
HIGHWAY
HILLS
RIVER
YUKON
River
Creek
Lake
Coffee Creek
Pyroxene Mountain
Selwyn Dome
Volcano Mountain
Pelly Crossing
Fort Selkirk
Mount Cockfield
Mount Pitts
Apex Mtn
Prospector Mountain
Minto (abandoned)
McCabe Creek
Granite Mountain
Yukon Crossing
Tatchun L
Frenchman Lake
Carmacks
Little Salmon
Montague
Mandanna Lake
Packers Mountain
Mt Nansen
Wellesley Lake
Tincup Lake
Stevens L
Ess L
Tadru L
Diamant Lake
Nisling
Klaza
Big
Rowlinson Ck
Nordenskiold
Mackintosh
Klaane
Tatchun
Little

The goal was to cover moose and caribou populations likely to be affected by increased use and extension of the Freegold Road associated with mining activity. The survey area was about 11,402 km².

The study area consists mostly of rolling hills and plateaus, dissected by numerous creeks, in the drainages of the Klotassin, Klaza, Nisling, and Yukon rivers. Much of the area is forest-covered with black and white spruce, aspen, and lesser amounts of lodgepole pine and paper birch; balsam poplar also grows along the Yukon River. Forest cover varies from dense mature white spruce and poplar in the main river valleys, to dense younger spruce in many lowlands, to more open mixed spruce and aspen on slopes. Many of the creek valleys are lined with wide shrubby willow flats. Willow and dwarf birch shrub habitats, alpine tundra, and unvegetated rocky areas typify the higher plateaus and peaks of the Dawson Range, which runs northwest-southeast through the survey area.

There are old and more recent burns throughout the study area (see Map 3), and these vary in quality as moose habitat. The most recent large fires were a 252 km² 2010 burn south of the Klaza River, a 408 km² 2009 burn and a 178 km² 1996 burn near Mackintosh Creek in the southern part of the survey area, a 160 km² 2004 burn south of Big Creek; a total of about 985 km² in 1994-1995 fires in the northeast part of the survey area; and a 153 km² 1995 burn at the headwaters of the Klotassin River.

The survey area has abundant roads, trails, and cut lines associated with past and present mining activities throughout most of the area. The Freegold Road, the road to Mount Nansen, and their spurs are all regularly used by miners, hunters, and others.

Methods

We used a survey method called "intensive stratification", which gives us good information about the distribution and areas of concentration of moose and caribou over the whole survey area. The technique involved the following steps:

1. The survey area was divided into uniform rectangular blocks 15-16 km² in size. We used the same survey blocks as those used in the 2003 and 2007 surveys for the eastern part of the survey area.
2. Observers in fixed-wing aircraft flew over all the blocks, making about 4 passes through each block and classifying (or "stratifying") 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 the same as the "stratification" part of a full moose census survey, except that we covered the area at about 4 times the intensity to get more complete information.
3. We counted and recorded a GPS location of each moose, caribou, or group of animals we saw. We classified all moose seen by age

(adult or calf) when possible, but did not put as much effort into this as we do during censuses when we are making estimates of population composition. Except for cows with calves, we did not try to determine the sex of moose. We did not attempt to classify caribou seen by age and sex. For this survey, we also recorded a GPS location for each sighting of fresh moose or caribou tracks, in order to supplement our data from animal observations.

Weather and Snow Conditions

Weather and snow conditions for this survey were good. Temperatures ranged from -39°C to -8°C, with most days starting out in the -30s and warming into the minus teens. Skies were mostly clear with some localised haze. On the third to last day of the survey, skies clouded over in the afternoon and about 1 cm of snow fell overnight, but the weather cleared out in the morning. Winds were light on most days, although there were brisk winds causing some turbulence in the mountains on 3 days. Light conditions were mostly bright and snow coverage was complete, so visibility was good for spotting moose, caribou, and their tracks.

Results and Discussion

Coverage

It took us about 79.4 hours to count moose and caribou in the 712 blocks in our survey area, for a search intensity of 0.42 minutes per km². This was slightly lower than our target search intensity of 0.5 minutes per km², and corresponded with flying through each block about 4 times and circling animals when needed to verify sightings. We needed an additional 19.2 hours to ferry between the survey area and fuel supplies in Carmacks, Minto, and Pelly Crossing. The time devoted to ferrying was about 20% of the total flight time.

Observations of Moose

We counted a total of 311 moose; 291 of them were adults, one was a yearling bull, 13 were calves, and 6 were of unknown age and sex (see Table 1). We spent 4,762 minutes (79.4 hours) searching the survey blocks for moose, so we saw an average of 0.07 moose per minute of survey time. In addition to moose seen, we also noted fresh moose tracks at 827 locations.

Table 1. Observations of moose during the March 2011 Carmacks West-Casino Trail survey.

	Number Observed	Percentage of Moose Observed
Unknown Adults	278	89
Adult Cows	13	4
Yearling Bull	1	<1
Calves	13	4
Unknown Age and Sex	6	2

MAP 3
Carmacks West-Casino Fire History

0 5 10 15 km

1:600,000

Survey Area

Fire History

- 1946 - 1949
- 1950 - 1959
- 1960 - 1969
- 1970 - 1979
- 1980 - 1989
- 1990 - 1999
- 2000 - 2009

140°0'0"W 139°0'0"W 138°0'0"W 137°0'0"W 136°0'0"W

63°0'0"N 62°30'0"N 62°0'0"N

Pyroxene Mountain
Coffee Creek
Selwyn Dome
Volcano Mountain
Pelly Crossing
Fort Selkirk
Mount Cockfield
Minto (abandoned)
McCabe Creek
Mount Pitts
Apex Mtn
Prospector Mountain
Wellesley Lake
Granite Mountain
Yukon Crossing
Tatchun L
French Man Lake
Carmacks
Little Salmon
Mt Nansen
Montague
Mandanna Lake
Packers Mountain
Tincup Lake
Stevens L

DAWSON PLATEAU

NISLING RANGE

RANGE

HIGHWAY

HIGHWAY

TATCHUN HILL

River

Creek

Klotassin

Big Creek

Nisling River

Klaza River

Kluane River

Roulinson Ck

Nordenskiold Creek

Mandanna Lake

MAP 4

Moose Observations
Carmacks West-Casino Trail

0 5 10 15 km

1:600,000

Survey Area

Unclassified Adults
- 1 - 2
- 3 - 4
- 5 - 7

Cows with Calves
- 1 Calf

Moose Tracks

Proposed Freegold Road Extension

140°0'0"W 139°0'0"W 138°0'0"W 137°0'0"W 136°0'0"W

62°30'0"N 62°0'0"N

DAWSON RANGE
PLATEAU
NISLING RANGE
TATCHUN HILLS
YUKON RIVER
HIGHWAY
Pyroxene Mountain
Coffee Creek
Selwyn Dome
Volcano Mountain
Diamain Lake
Pelly Crossing
Fort Selkirk
Hayes Creek
Mount Cockfield
Dip Creek
Klotassin
Mount Pitts
Apex Mtn
Prospector Mountain
Minto (abandoned)
McCabe Creek
Tatlmain Lake
Ess L
Tadru L
Wellesley Lake
Big Creek
Granite Mountain
Yukon Crossing
Tatchun L
Frenchman Lake
Nisling River
Klaza River
Mt Nansen
Carmacks
Rowlinson Ck
Little Salmon
Montague
Nordenskiold Creek
Mandanna Lake
Packers Mountain
Kluane River
Tincup Lake
Stevens L
Mackintosh Creek
Claire Lake

Distribution of Moose

Moose were widely distributed in the survey area (see Map 4). The biggest concentrations of moose were in the northeastern and north-central parts of the survey area in the Big Creek valley and in areas burned in the 1990s and 1980s; and in the northwest in unburned open spruce, creeks valleys and subalpine willows at the headwaters of the Klotassin River, Dip Creek, Coffee Creek, and south of the Yukon River. Smaller concentrations were seen in the area burned in 1995 between the Klotassin and Nisling rivers and in the 1996 burned area along Mackintosh Creek.

Moose were mostly in habitats—open ridges, along creeks, and in old burns—with abundant willow growth. We saw some moose and tracks in the main valley of the Yukon River where there was abundant willow in sloughs. We saw few moose or tracks of moose in areas burned since 2000 or with dense lowland black spruce, except where associated with willows along creeks in those habitats. Sightability of moose was undoubtedly better in more open habitats but we did not see evidence from tracks that we were missing any concentrations of moose in the dense spruce and aspen forests that had little shrub cover.

Moose typically concentrate in river valleys in the central Yukon during winters of deep snow, moving down from their preferred early-winter subalpine habitats when snow depths get too deep as the winter progresses (Fraser et al. 2001, O'Donoghue 2005). Snowfall was above normal in the Carmacks area during the winter of 2010-2011 (Yukon Department of Environment 2011), with snow depths 60-74 cm at nearby snow stations at the beginning of March. This is approaching levels that could negatively affect movements of moose (above 70 cm; Peek 1997), but we still saw most moose away from the main river valley. Distribution of willows likely affected habitat use by moose in this area in late winter 2011 more than did snow depths.

The Freegold Road and its proposed extension cut through areas of concentrated moose wintering habitat along Big and Hayes creeks. The area between the northwest end of the proposed Freegold Road extension and the Yukon River, where the proposed Casino mine will be built, is also a wintering area for moose, consistent with findings in file reports by consultants working for Western Copper.

Ages and Sex of Moose

We classified most of the moose we saw by age, but we cannot translate these observations directly into estimates of the composition of the moose population in the study area. Stratification surveys such as this are aimed mostly at determining the distribution of moose in the survey area. The data are valuable for mapping important habitats and also for dividing up the survey blocks covering the area into "strata" or categories of high and

low expected densities of moose for future surveys.

The observed proportions of moose of different ages that we saw were likely biased compared to those of the actual population. Previous surveys have shown that cow moose, particularly cows with calves, tend to space themselves away from other moose more than bulls do, so that there is a higher proportion of cows in low-density survey blocks than there is in high-density blocks. Low-density blocks also typically have lower sightability, because forest canopies are, on average, denser. As a result of these differences in sightability, we likely miss seeing more cows and calves than we do bulls when we search over all habitats with the same intensity, so our observations will be biased. Census surveys, in which survey blocks are searched very intensively and counts are corrected for sightability, are more appropriate for estimating population composition than are intensive stratification surveys.

The age classifications observed in this survey can be compared directly with the results from similar late-winter surveys in the future. Our observed composition index was 4% calves in the population. Although likely biased low, 4% calves is low compared to that found in other late-winter surveys elsewhere in the Yukon (average 12% calves observed), so it is likely that survival of calves to 10 months of age was low in this area during the previous year.

Identification of High and Low-Density Blocks

We divided the survey blocks into 4 categories of expected moose density, for use in future surveys of the survey area. We classified 116 (16%) of the 712 survey blocks as high, 175 (25%) as medium, 255 (36%) as low, and 166 (23%) as very low expected abundance of moose (see Map 5), based on our observations from the air. Most of the blocks with higher expected numbers of moose were located in the burns where we observed the highest numbers of moose in this survey, in open hilly areas, and in areas with dense willows along creeks.

Observations and Distribution of Caribou

We counted a total of 125 caribou in 13 groups. In addition to caribou seen, we also noted fresh caribou tracks at 163 locations.

Caribou were unevenly distributed in the survey area (see Map 6). The biggest concentrations of caribou were in the areas around Hayes Creek and the headwaters of the Klotassin River. There was a smaller concentration seen near Big Creek. The Hayes Creek area was also the most important wintering area for the Klaza caribou herd in the late 1980s (Farnell et al. 1991). The Klotassin River area was used more lightly in the 1980s. The increased use of the Klotassin River area may be related to fires that burned some of the Hayes Creek wintering area in the early to mid-1990s.

MAP 5

Survey Block Stratification
Carmacks West-Casino Trail

0 5 10 15 km

1:600,000

Survey Area

Expected Number of Moose

- Very Low
- Low
- Medium
- High

140°0'0"W 139°0'0"W 138°0'0"W 137°0'0"W 136°0'0"W

63°30'0"N 63°0'0"N 62°30'0"N 62°0'0"N

Pyroxene Mountain
Selwyn Dome
Volcano Mountain
Coffee Creek
Fort Selkirk
Pelly Crossing
Mount Baker
Mount Cockfield
Minto (abandoned)
McCabe Creek
Mount Pitts
Apex Mtn
Prospector Mountain
Wellesley Lake
Granite Mountain
Yukon Crossing
Tatchun L
Frenchman Lake
Mt. Nansen
Carmacks
Little Salmon
Montague
Tadru L
Tatlmain Lake
Mandanna Lake
Tincup Lake
Stevens L
Ess L

DAWSON RANGE
PLATEAU
NISLING RANGE
HIGHWAY
YUKON
RIVER
Creek
River
Hills
TATC
Packers Mounta

MAP 6

Caribou Observations
Carmacks West-Casino Trail

0 5 10 15 km

1:600,000

Survey Area

Klaza Caribou Range

Caribou Sightings
- 1 - 5
- 6 - 10
- 11-20

Caribou Tracks

Proposed Freegold Road Extension

Proposed 1980s Casino Trail Route

140°0'0"W 139°0'0"W 138°0'0"W 137°0'0"W 136°0'0"W

63°0'0"N 62°30'0"N 62°0'0"N

DAWSON RANGE

NISLING RANGE

PLATEAU

HILLS

TATCHUN HILLS

YUKON RIVER

HIGHWAY

Pyroxene Mountain
Coffee Creek
Selwyn Dome
Volcano Mountain
Grey Hunter Peak
Diamain Lake
Pelly Crossing
Fort Selkirk
Hayes Creek
Mount Cockfield
Mount Pitts
Apex Mtn
Prospector Mountain
Big Creek
Granite Mountain
Minto (abandoned)
McCabe Creek
Yukon Crossing
Tadru L
Ess L
Ck
Klotassin River
Wellesley Lake
Nisling River
Klaza River
Mt Nansen
Tatchun L
Frenchman Lake
Carmacks
Little Salmon
Little Sal
Rowlinson Ck
Montague
Nordenskiold Creek
Mandanna Lake
Claire Lake
Packers Mountain
Kluane River
Tincup Lake
Stevens L
Mackintosh Creek

Caribou seen along Rowlinson Creek in the southeastern part of the survey area were likely part of the Aishihik herd which has historically wintered in this area.

We saw most caribou in unburned, open-canopy spruce forest and sparsely treed open plateaus in hilly terrain. These open coniferous habitat types provide wintering caribou with adequate supplies of lichens, their principal winter food, and typically have snow characteristics suitable for caribou cratering to get at the food. Snow depths less than 60 cm are considered best for caribou feeding and depths greater than 74 cm may inhibit caribou movements. Snow accumulation in the Carmacks area during the winter of 2010-2011 winter was therefore at levels that could limit feeding and movements by caribou.

The proposed extension of the Freegold Road would bisect the Hayes Creek wintering habitat of the Klaza caribou herd as well as cut through caribou wintering habitat used along Big Creek.

Other Wildlife Sightings

During the survey, we also recorded sightings of other notable observations of wildlife besides moose and caribou. We saw a total of 17 sheep, a group of 5 nursery sheep (ewes and yearlings) on ridges north of Mount Nansen and a group of 12 to the west (on Mount Langham). We saw two groups of bison with 18 animals along the Nisling River. There was a mule deer buck on the open west-facing ridges overlooking the Yukon River just north of Yukon Crossing. We also spotted 6 groups of wolves totalling 24 animals, and 1 coyote.

Conclusions and Recommendations

- Habitat with abundant willows in hilly terrain, along creeks, and in recent burns supported the highest densities of moose in this area in late winter 2011. The biggest concentrations of moose were in the 1994-1995 burns in the hills west of Minto and the Hayes Creek area, and in the creek valleys and open spruce on hills in the headwaters of the Klotassin River, Dip Creek, and Coffee Creek.
- Recruitment of moose appears to have been low in this area during 2010-2011.
- Woodland caribou of the Klaza herd were concentrated in two main areas, near Hayes Creek and in the headwaters of the Klotassin River
- The proposed upgrading and extension of the Freegold Road cuts through wintering concentrations of moose along Big Creek, Hayes Creek, and Dip Creek, and through the Klaza caribou wintering range near Hayes Creek and Big Creek.
- Alternative routing of the Freegold Road extension, including the original proposed Casino Trail route, should be evaluated to minimise potential negative impacts on moose and, especially, Klaza caribou.
- We should gather a second year of baseline data on moose and caribou distribution in this area to examine the amount of variation among years

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