Copper Fox Metals Inc.

SCHAFT CREEK PROJECT
2012 Winter Moose Population and Distribution Survey

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2012 WINTER MOOSE POPULATION AND DISTRIBUTION SURVEY

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Executive Summary

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Copper Fox Metals has begun work on the development of a copper-gold-molybdenum-silver mine within the Schaft Creek watershed of the Skeena Region in northwest British Columbia, approximately 140 km southwest of Dease Lake. Moose (*Alces americanus*) are a highly valued economic resource and are of great cultural significance within the region. In March 2012, winter moose population and distribution surveys were conducted in the regional study area surrounding the Schaft Creek Mine infrastructure. The primary objectives were to establish a moose population estimate, determine if any change in the population has occurred since the initial inventory in 2006, and to determine moose distribution patterns in areas potentially affected by development for the project.

Survey data from many areas in the Skeena region suggest a possible decline in the moose population over the past six years. Data collected during the recent survey were compared with earlier survey results, and were used to determine local population status relative to regional trends. Other factors that may influence the moose population within the RSA were identified, which will aid in the development of an effective monitoring and mitigation plan that takes into consideration the apparent decline of moose in the region.

Aerial surveys were conducted from March 7, 2012 to March 9, 2012 within the Schaft Creek and Mess Creek watersheds. The flights covered 15 survey blocks with identifiable moose winter range habitat. Survey effort was focused on areas below 1100 m elevation with low snowpack that might not limit moose mobility. Each observation included information on age, sex, activity, habitat rating, percent cover, and location. A total of 71 individuals in 51 groups of moose were observed during the survey. The number of sightings were corrected for sightability using Aerial Survey software. The corrected data resulted in a population estimate of 112 individuals, a sex ratio of 72 bulls per 100 cows, and a productivity rate of 4 calves per 100 cows. Population density of moose in study area based on uncorrected data was calculated as 0.13/km^2 for the total area, and 0.15/km^2 for capable habitat. When corrections for sightability were applied, moose density was calculated at 0.20/km^2 for the total area, and 0.24/km^2 for areas of capable habitat.

The population estimate in 2012 (112 ± 22) was substantially lower than 2006 (314 ± 35). Productivity appears to be declining, with 4 calves per 100 cows (± 3 at 90% C.I.) in 2012 compared to 31 calves (± 8 at 90% C.I.) per 100 cows in 2006, while sex ratio is relatively constant with 72 adult males (± 28 at 90% CI) per 100 females in 2012 compared to 93 males (± 16 at 90% C.I.) per 100 females in 2006.

Winter conditions within the study area were considered average and no extreme snowfalls had occurred. No human or natural habitat degradation was apparent in areas that were previously identified as high value habitats for moose, nor was there any apparent avoidance of preferred habitat. A total of 11 wolves were observed in the 560 km^2 RSA during the survey, resulting in a wolf density of 19.6 / 1,000 km^2. A wolf density of 4 / 1,000 km^2 has been suggested as the limit for sustaining ungulate populations in the region. It can be speculated, therefore, that predation is an important contributor to the extremely low calf : cow ratios and population decline in the study area.

Acknowledgements

Acknowledgements

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Glossary and Abbreviations

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Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

BAFA	Boreal Alti Fescue Alpine
BWBS	Boreal white and black spruce
SBS	Sub-boreal spruce
BCH	British Columbia Hydro
BEC	Biogeoclimatic Ecosystem Classification
BIAA	Bell Irving Alternate Alignment
ESSF	Engelmann Spruce Sub-alpine Fir
FN	First Nation
HSR	Habitat Suitability Rating
ICH	Interior Cedar Hemlock
MoE	Ministry of Environment
MWLAP	Ministry of Water, Land and Air Protection
MoFLNRO	Ministry of Natural Resource Operations
RIC	Resource Inventory Committee
RISC	Resource Information Standards Committee
SRB	Stratified Random Block
SU	Survey Unit
UWR	Ungulate Winter Range
WMU	Wildlife Management Unit

1. Introduction

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1.1 OVERVIEW

Copper Fox Metals Inc. (Copper Fox) has begun an initiative to develop a copper-gold-molybdenum-silver project within the Schaft Creek watershed, approximately 140 km southwest of Dease Lake in north-western British Columbia. There is currently no access by land to the proposed development. The proposed road access route follows Mess Creek from the transportation corridor developed by the Galore Creek project to the south.

Moose (*Alces americanus*) are an important economic and cultural resource in the Skeena Region surrounding the Schaft Creek and Mess Creek watersheds. Moose are traditionally harvested by the Tahltan First Nations (Tahltan), and recreationally by resident and nonresident hunters (BC MSRM 2000). As part of initial baseline data collection in 2006 and 2007, a substantial effort was directed at inventorying moose and identifying suitable habitat in a regional study area (RSA) delineated to include area potentially impacted by the development. The results of the inventory are detailed in RTEC (2007).

Recent surveys in the Skeena Region (Demarchi 2011) combined with anecdotal information from knowledgeable locals, guide outfitters, and First Nations, all suggest that the population of moose may be declining in the region. In light of this information, and given the initial baseline surveys were conducted six years earlier, it was necessary to re-evaluate population status so that current information can be incorporated into the environmental impact assessment. Identifying a change in population levels during the six years may be indicative of natural variability in population fluctuations, and inform the preparation of a monitoring and mitigation plan for the development.

In addition to assessing the current moose population in the Schaft Creek Project (the Project) area, identification of natural factors that may be influencing the population was also desirable. Characterizing potential factors such as predation, habitat quality, or weather variation, would also assist an environmental effects assessment of the Project by potentially providing an index of the relative contribution of natural and human-caused impacts to population trend.

1.2 OBJECTIVES

The objectives of the 2012 winter survey were to:

- Determine moose winter population within an area potentially influenced by the Project;
- Identify distribution of wintering moose relative to the Regional Study Area (RSA);
- Identify other factors, such as habitat conditions, that may influence the moose population within the RSA; and
- Relate observations to regional information on moose population status.

1.3 REGIONAL INFORMATION ON MOOSE AND FACTORS INFLUENCING POPULATION

The moose resource is important in the Skeena Region and substantial effort has been directed at regional inventories and understanding regional habitat use. Less effort has been directed at determining the influence of environmental and human factors on the population dynamics including predation, habitat changes, weather influence, harvest or other human mortality. Currently the moose population in British Columbia is listed as secure with the majority of that population residing in the central and sub-boreal interior, the northern boreal mountains and the boreal plains of northeast British Columbia (Blood 2000). While the population is reported to be stable, multiyear population estimates for the Skeena region, derived from independent studies for the Nass River watershed including the Nass Wildlife Area (NWA) located in the area of New Aiyansh and Meziadan approximately 150km south of the Schaft RSA, report a decline in population numbers from 2001 to 2011, from 2,080 +/- 17% to 883 +/- 25% respectively (Demarchi and Shultze 2011). On a local level, previous survey results for the Schaft Creek area report a total of 314 (+/- 35 at 90% CI) moose within the Schaft and Mess Creek watersheds (RTEC 2007).

Other indicators of concern for regional population have been identified. Within the NWA, Demarchi (2011) calculated that calf to cow ratios in 2011 were the lowest observed during five surveys which began in 1994. Ratios for the total area and the NWA in 2011 were similar, being slightly higher (more calves per hundred cows) in the NWA. The mean ratio declined substantially in the entire area since 2007, but only slightly (and insignificantly) in the NWA over the same period. The wide confidence interval around the calf to cow ratio in the NWA in 2011 makes it difficult to know whether the ratio actually declined or not, but a decline seems plausible in light of population results presented. Bull to cow ratios increased significantly from 2001 to 2007 in the entire area, with the increase in bull to cow ratio in the NWA from 2001 to 2007 being particularly notable. In 2011, it was apparent that the mean bull to cow ratios in the entire area had declined significantly but not in the NWA. Wolf sightings in 2011 (37 wolves in nine packs) were the highest recorded since surveying began in 1994.

It is acknowledged that within the Skeena Region, including the Schaft Creek RSA, the area has only supported moose in recent times. Demarchi (2000) suggested that the presence of moose in the Nass watershed may be a relatively recent phenomenon that began in the 20th century as he evidences with the observation that traditional Nisga'a language does not have a word for the species. Pollard et al (2001) provided a detail summary of the occurrence of moose in the Prince Rupert Forest District and suggested that moose (*andersonii* subspecies) moved west from the Alberta Plateau Ecoregion into north-western British Columbia over the last 200 years. He cited Petticrew and Munro (1979) as suggesting that Mackenzie recorded moose in the Peace River valley in 1793, but did not observe any west of the Rocky Mountains on his exploration. Pollard et al (2001) cited LeResche et al (1974) who stated that moose were first identified at the mouth of the Stikine River in the 1830s and later confirmed in the 1870s.

There are a number of influences on moose populations that can act at local or regional scales. Human harvest, habitat quality and seasonal weather conditions, predation and disease, and other human influences have all been important factors associated with the status of moose populations.

1.3.1 Harvest

In a healthy population the suggested bull to cow ratio as outlined in the Harvest Management Strategy for British Columbia (BC MoE n.d.) is not to be reduced to a ratio any less than 30 bulls per 100 cows or 50 bulls per 100 cows for low density populations (Demarchi 2000; Hatter 2009). Bull to cow ratios vary within the region with numbers of 31 bulls to 100 cows to 73 bulls per 100 cows observed. Surveys done in the Level Mountain and Spatsizi areas near the Schaft RSA report a ratio of 68 bulls per 100 cows (+/- 18) and a cow calf ratio of 33 to 100 (+/- 8) as being in the mid-range of those reported for most northern populations. The reported cow calf ratio was above the 30 calves to 100 cows that is consistent with recruitment levels necessary to balance typical reported adult mortality rates (Marshall and Steventon 1990).

Harvest hunting pressure has affected northern populations of moose for several decades now. In the southern Skeena over harvest of moose was suspected in the early 1980's. This led to the implementation of restrictive regulations in 1981 and set allowable annual harvest limits (Van Drimmelen 1987). A high bull to cow ratio in the northern Level Mountain area of the Skeena region suggested that hunting pressure is light and does not contribute greatly to the moose population (Marshall and Steventon 1990). However, this high bull to cow ratio, as discovered in recent studies, was indicative of a high harvest rate of cow moose which, despite restrictions put in place in 2007, has not rectified the problem and moose population numbers continue to decline although the drop has not been statistically significant between 2007 and 2011 (Demarchi and Schultze 2011). Prior to this, Demarchi (2000) also presented results of a moose radio collaring study in which 58% of all moose mortalities were from hunter kills. Recently released government information reports a 70% decrease in moose within a 5,000 km^2 area in the Skeena Region between 1997 and 2011 which has resulted in specified management actions by both the British Columbia government and local first Nations groups to recover moose population numbers. The population decline has also prompted the development of other harvest management plans such as that of Hatter (2009). Hatters' presentation to the Guide Outfitters Association of BC (GOABC) on moose management suggested that an objective of maintaining bull to cow ratio of 30 bulls to 100 cows post hunt was key for hunted herds. It was suggested by Hatter that sustainability of harvest was density dependent, and he presented a calculation for sustained yield based on post hunt moose density (Hatter 2009).

The first strategy applied in the NWA of the south Skeena Region, applied in 2007, was to implement restrictions to licensed hunting through Guide Outfitters and limited entry hunts. Subsequent to this, there was complete closure of limited licensed moose hunting within this area for 2012/13, lowered total allowable harvest and annual Nisg̲a'a harvest allocations (as per treaty agreement), and bull only harvest (MFLNRO 2011).

During the 2011 season the regulated moose open hunting season within in the provincial Wildlife Management Unit (WMU) 6-21 (which lies within the Schaft Creek RSA) ran from August 20 to October 31 and was limited to 1 bull moose only. Recent changes to the British Columbia hunting regulations (BC MFNRLO 2012) now prohibits all open season moose hunting within 400 m of Highway 37 from Meziadin Junction to the Yukon border between September 25 and October 10. No limited entry hunting opportunities for Moose exist within the Schaft Creek RSA. However, 97 and 98 available shared hunts exist within neighboring WMU's 6-19 and 6-20 respectively. These draws are for bull moose only, with the season running from August 15 to October 15 (for WMU 6-20) and September 1 to October 15 (for WMU 6-19). No cow season exists for resident hunters or nonresident hunters.

First Nation (Tahltan) harvest may also have an influence on the moose population. No estimate of Tahltan harvest or location of harvest effort is publically available.

1.3.2 Habitat

Habitat conditions and habitat availability contribute greatly to moose population dynamics and numbers. Generally preferred habitat includes areas with flatter topography in highly productive vegetated sites. A more in depth discussion of moose habitat is provided in RTEC (2010) a summary of which is provided in the following paragraphs.

Moose are highly dependent upon riparian areas throughout the entire year. In south eastern Alaska and Stikine River regions, moose populations selected river-terraced spruce dominated stands in close proximity to waterways (Doerr 1983). When this habitat is not available moose also show preference for young seral stage open shrub dominated habitats, logging roads and clear cuts as they often have a higher vegetation productivity rate and create habitat edges that produce more forage (Serrouya and D'Eon 2002). When highly suitable habitat such as that produced by clear-cuts ceases to exist, populations may suffer as forage becomes less available. In clear-cuts between the ages of 25 to

30 years, high value browse is replaced by second growth conifers and important moose browse may be eliminated by succession (Alaback 1981 as cited in Doerr 1983).

Habitat quality is key to sustaining moose populations, and winter range is often identified as most critical. Capable winter range topography within this region is defined as those areas with <60% slope and below 1,050 meters during high snowpack conditions while optimal winter range is defined as those areas having less than 47% slope and below 988 meters elevation (RTEC 2007). The suitability of winter range is further influenced by the availability of rooted forage such as willow, red osier dogwood, aspen, birch and other woody browse juxtaposed with conifer vegetation providing cover. In the Skeena region, including the RSA, winter range is key to moose survival and requires a combination of cover and forage in area with lower snow depths (< 1 m for more than 60 days). In the Schaft RSA over 21,000 hectares of the two most highly suitable classes of winter habitat existed during the 2007 habitat inventory (RTEC 2010). Table 1.3.1 displays the calculated area available. This habitat was distributed along lower elevation areas associated with the Schaft Creek and Mess Creek drainages. Winter snowpack conditions and predation by wolves seem to coincide with one another as snowpack limits the mobility of moose therefore making it easier for wolves to attack and kill individuals. Habitat providing other function such as spring and summer range, calving areas or areas where moose may congregate to rut are also important.

Table 1.3-1. Area of Moose Habitat – Late Winter

Habitat Suitability Rating	Area (ha)	% Habitat in RSA
High	4,669	1
Moderately High	16,947	5
Moderate	62,773	20
Low	14,869	5
Very Low	7,172	2
Nil	206,070	66

Availability to suitable habitat of appropriate spatial organization greatly influences the status of a moose population and therefore certain ideal habitat conditions are desired. In addition to having areas providing various habitat function close together in a land base, areas of connectivity with sufficient mature cover form effective movement corridors and allow for easy migration between seasonal ranges (Demarchi 2000). Mineral licks and wallows are also believed to be important for ungulates including moose. Rea et al. (2004) compiled literature and reviewed the importance of mineral licks or mud licks to moose and suggested that their form is different than used by other ungulates (e.g., mountain goat) as they are generally associated with wet seeps and muddy springs with many worn trails. They are believed to supplement nutritional requirements of moose, soils that aid digestion and provide a source of water and an area for social interactions. Mineral licks may be used by moose during spring and late winter as well as other times of year.

Habitat for moose is afforded some administrative protection. British Columbia identifies a “mineral lick” or “wallow” as a wildlife habitat feature. Such features are protected to different degrees on a regional basis at the discretion of the local environmental authorities (Government of British Columbia 2004). The Forest and Range Practices Act Government Actions Regulations (BC Reg 582/2004 section 11-1) identifies that the Minister responsible for the Wildlife Act may identify as a wildlife habitat feature a significant mineral lick or wallow, however no legal definition or description for these features is provided. Moose winter range may be designated as an ungulate winter range (UWR) unit under the BC Forest and Ranges Practices Act (FRPA), which can limit development activities in the unit.

1.3.3 Predation

It has been suggested in several studies that predation is likely the greatest limiting factor to moose population in northern British Columbia (Marshall and Steventon 1990). Within the wolf population of south central Alaska moose accounted for as much as 70% of wolves' diets (Ballard 1987). Demarchi (2011) noted that during the most recent survey (2011) of his multiyear surveys produced the greatest number of wolf observations. This coincided with an extreme decrease in moose numbers in the NWA and also with the lowest cow to calf ratios reported during the 5 separate surveys conducted between 1994 and 2007 (Demarchi 2011). It is likely that the observation of more wolves suggests increased predation correlating with the decline in population. In populations of moose which have experienced high levels of predation, a low cow to calf ratio is apparent. RTEC (2007) reports a ratio of 31 calves per 100 cows in a population that is expected to have been susceptible to predation. Results from other studies conducted in the Yukon show a higher number of calves, yearlings, and older adults being killed by wolves (Hayes et al. 2000). Several other species may also prey upon moose in the Skeena Region including: black bear, grizzly bear, wolverine, and cougar.

In northern BC, wolves are the greatest predator of moose. The wolf-moose dynamic is so important that manipulating it can be used as a conservation tool for managing other ungulate species such as mountain caribou. Wilson (2009) suggested using the Fuller (1989) static equation for moose and wolf management to aid mountain caribou recovery in BC. The equation used allows moose sustainability in an area to be estimated from factors such as wolf density. Fullers (1989) equation drew from Keith's (1983) equation to yield the moose density required to support a given wolf density and hunting intensity:

$$U = \frac{S}{(\lambda_p - 1)} + \frac{K \cdot W}{1000(\lambda_p - 1)}$$

Based on the following parameters:

- *W* (wolves/1,000 km^2): < 6.5, 3 and < 1.5;
- *λp* (intrinsic rate of increase of moose population): 1.24 (Keith 1983);
- *S* (hunter kill/km^2): set to 0 because densities are based on winter survey estimates conducted after the hunting season;
- *K* (annual moose kill/wolf): 12, averaging estimates from Keith (1983) and Hayes et al. (2000).

This equation results in target densities for moose of < 300 and < 50 moose/1,000 km^2 for densities of < 6.5 and < 1.5 wolves/1,000 km^2, respectively.

Other species such as grizzly bear, black bear, and wolverine are important predators on moose in the northwest of BC. Wolverine were found by Krebbs et al (2007) to concentrate on areas associated with moose winter range for carrion or to prey on moose. Other research suggests that grizzly bear are a much more active predator of moose. In the Mt. Edziza and Spatsizi plateau grizzly population, ungulates (likely moose) make up half of bear diets (Rescan 2006). Black bears are also known to prey upon newborn moose calves (Blood 2000), and stalking of moose by black bear during calving period has been observed in the region by Rescan staff.

1.3.4 Other Human Influence on Moose

Several human related activities that occur within the region may negatively affect the moose population. Activities including mining and logging and their associated infrastructure such as road building causes habitats to become fragmented (Yazvenko et al. 2000). Fragmented habitat areas reduce moose mobility and access to seasonal habitat areas. Vegetation removal done to increase sightability for drivers along roadsides creates foraging habitat for moose leading to mortalities resulting from vehicle strikes (Rea 2003). Industrial development may also negatively affect populations from disturbance or habitat degradation. Forest development may impact moose, although initial harvesting of forested areas produces moose browse, overharvesting of forested areas reduces cover which is important for heat regulation, protection from poor weather conditions such as blizzards, and also protection from humans (BC Ministry of Environment Lands and Parks (MELP) 2000). Regional activities requiring the use of helicopters for accessing exploration camps may also present negative effects. In addition to inducing a “startle reflex” in ungulates which may result in injury leading to death, low flying aircrafts may also create changes in movements. Andersen et al. (1996) reported a substantial increase in moose home range sizes when low level aircraft activity was present, although these did return to their normal size once activity ceased. No reports directly evaluating helicopter disturbance on moose could be found.

2. Methods

2. Methods

2.1 STUDY AREA

The Project is located in mountainous terrain in northwestern British Columbia (Latitude: 130° 58' 48.9", Longitude: 57° 22' 4.2"), approximately 1,000 km northwest of Vancouver (Figure 2.1-1). The area is located 80 km southwest of Telegraph Creek, and approximately 76 kilometers west of the Stewart-Cassiar highway (Highway 37). The mineral claims of interest are situated near the headwaters of Schaft Creek - a tributary of Mess Creek, which flows into the Stikine River downstream of Telegraph Creek. The entire study area is within wildlife management unit (WMU) 6-21.

The Project is within an area transitional between interior and coastal ecosystems of British Columbia, and is characterized by cool summers and cold humid winters. Elevations in the Project area range from 500 m to greater than 2,000 m above sea level. Mean annual precipitation is 640 mm, which is approximately 84% greater than that recorded at Telegraph Creek. Temperatures are strongly influenced by the Coast Mountains, and may range from above 20ºC in the summer to below -20ºC in the winter.

While the area is relatively pristine, past exploration has occurred within the upper basin of the Schaft Creek drainage. The mineral claims are within the Telegraph Creek Community Watershed identified in the Cassiar Iskut-Stikine Land and Resource Management Plan (CIS LRMP) area (BC MSRM 2000).

The wildlife regional study area (RSA) encompassed both the Schaft Creek and Mess Creek drainage basins to their headwaters and beyond the height of land to More Creek (Figure 2.1-2). Mess Creek forms an effective ecological boundary within the Project area. Geomorphology to the west of Mess Creek consists of rugged coastal mountains while the east contains expansive high elevation plateaus.

The area is characterized by the Northern Boreal Mountain ecoprovince, and the Yukon-Stikine Highlands and Northern Mountains and Plateaus ecoregions (Luttermerding et al. 1990). Ecosections within the study area include the Tahltan Highlands and Southern Boreal Plateau. Biogeoclimatic ecosystem classification (BEC) units within the study area include Englemann Spruce- Subalpine Fir (ESSF), Spruce Willow Birch (SWB), Boreal White and Black Spruce (BWBS), and Interior Cedar Hemlock (ICH). Boreal Altai Fescue Alpine (BAFA), formerly Alpine Tundra (AT), is present at higher elevations.

2.2 AERIAL SURVEY

The survey was conducted by helicopter between March 7 and 9, 2012. The survey adhered to conditions outlined in Ministry of Forest Lands and Natural Resource Operations (MoFLNRO) permit SM 12-76651 and Parks Use Permit (PUP) 105994. The same study area and protocols that were used in 2006 (RTEC 2007) were repeated in this survey, including the same helicopter pilot, aircraft and navigator.

The study area was limited to areas containing capable moose habitat, broadly defined as areas under 1,100 m elevation and < 60% slope. Moose occupancy is typically limited by snow depth. Above 1,100 m snow depths can exceed 1.5 m, which can significantly limit moose movements. The same 15 survey blocks that were previously flown in 2006 were flown again for the 2012 winter moose inventory (Figure 2.2-1).

The aerial survey protocol adhered to RISC standards (MSRM 2002), including the use of a Bell 206 helicopter with bubble observation windows staffed with two observers and a navigator. The average flight speed was approximately 100 km/hour; however, this rate changed with conditions: faster over open areas with good sightability, and slower over closed forest with poor sightability. Flight lines were

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Schaft Creek Project Location Map

FIGURE 2.1-1

RTEC Rescan

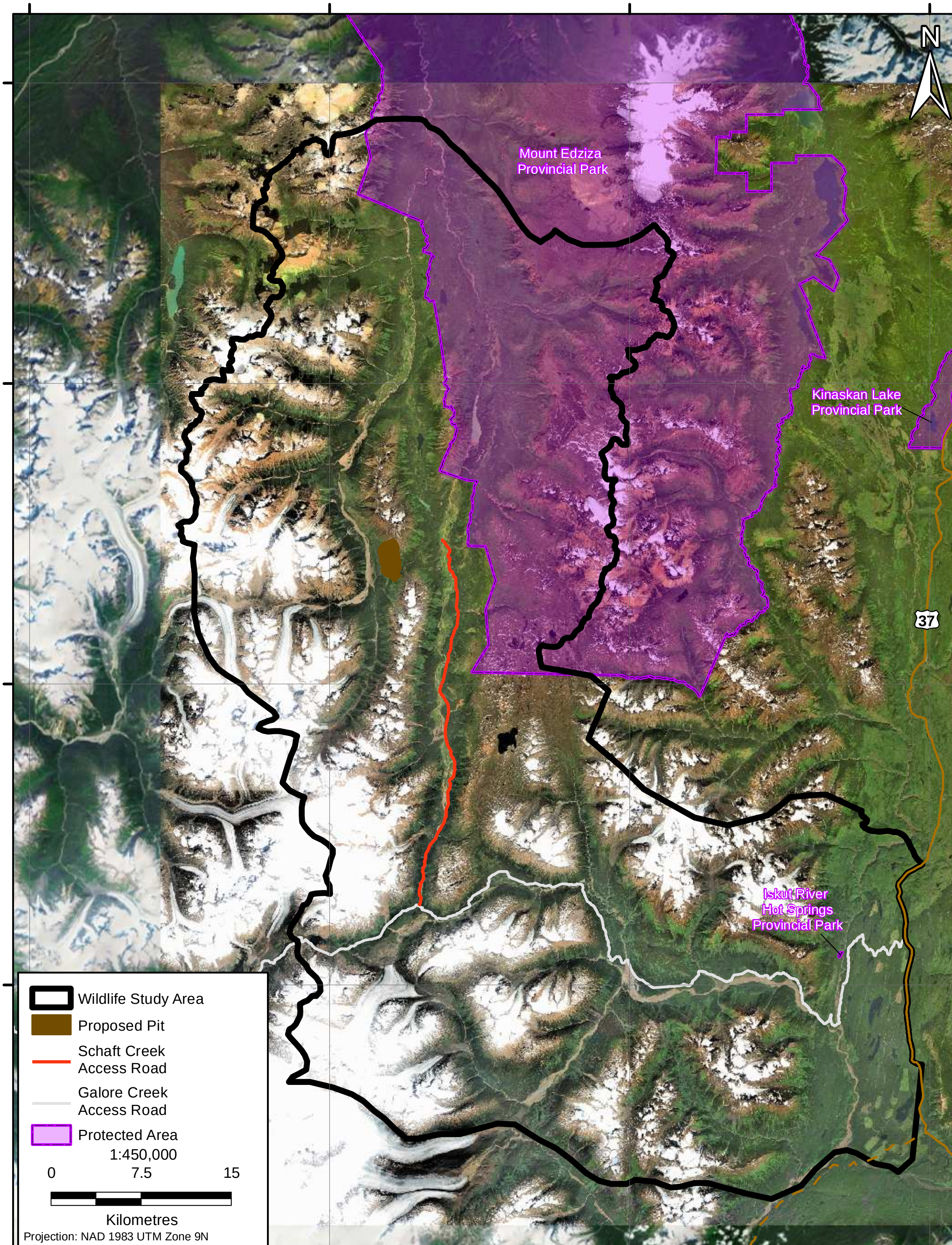

FIGURE 2.1-2

Schaft Creek Wildlife Study Area

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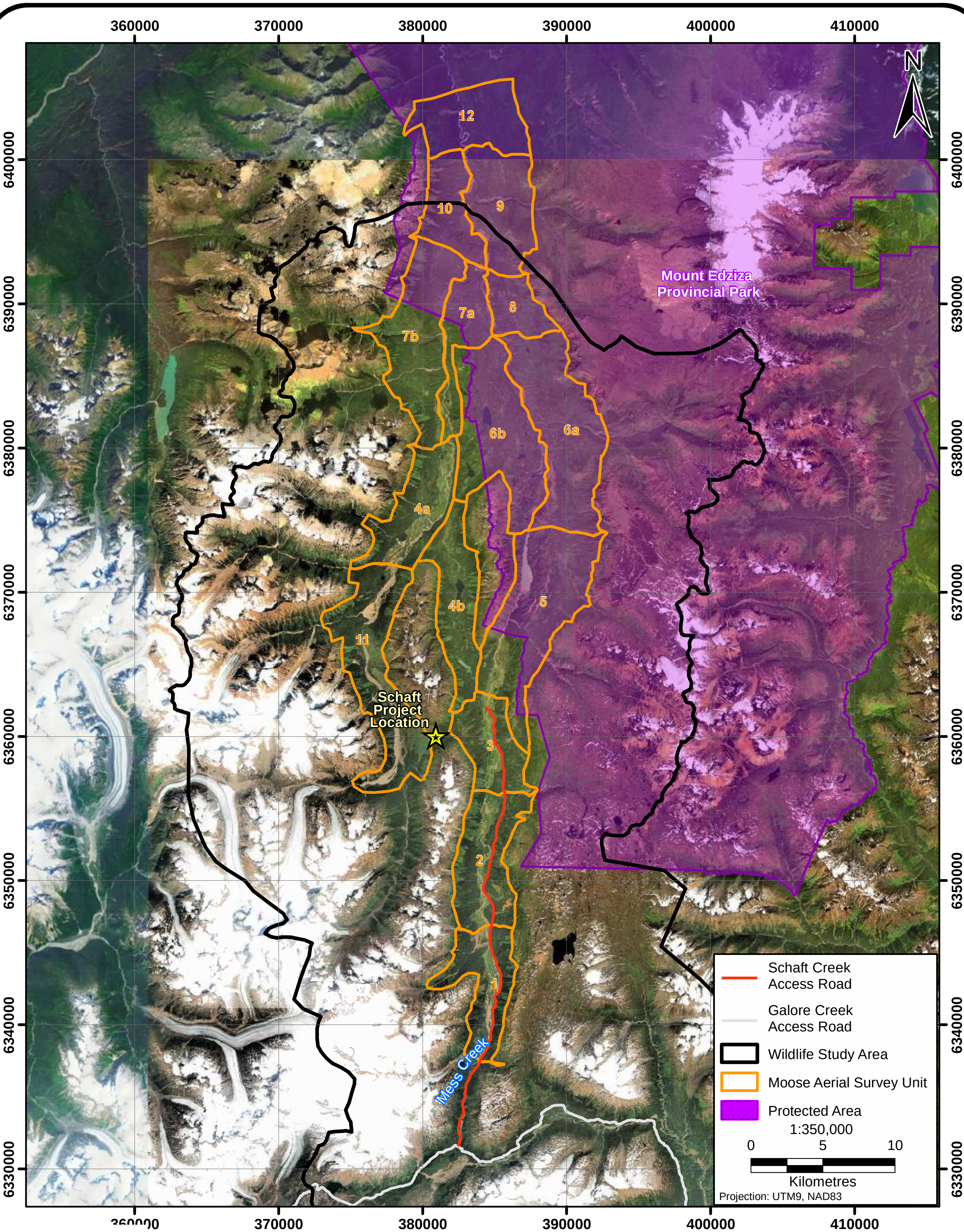

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Survey Units for Inventory during March 2012

Figure 2.2-1

RTEC Rescan

spaced at approximately 500 m, depending on ground cover and topography. Surveys were conducted when daytime high temperatures were expected to be below freezing and the snow cover was complete. Moose were recorded as calves or adults (including yearlings) and adults were classified as bulls or cows based on the presence of a vulva patch.

For each observation, oblique cover (within a 9 to 10 m radius) was estimated as percent vegetative cover (or screening cover) around an individual (or the first animal seen in a group) following standard procedures (Anderson and Lindsey 1996; Unsworth et al. 1998; Quayle et al. 2001). Moose locations were recorded using a hand-held Garmin 76 GPS with an external antenna. Depredated moose and incidental wolf observations were also recorded during the survey, and effort to identify possible impacts to habitat condition and broadly evaluate habitat quality was included with the survey.

2.3 ANALYSIS

Surveys followed a total count approach, and a sightability correction was applied to each moose observation using the program AERIAL SURVEY (Unsworth et al. 1998). Detection probabilities were determined using sightability data from a model generated for British Columbia (Quayle et al. 2001). The sightability correction and detection probabilities were applied to the moose observations to generate a true population estimate, and provide an estimate of variance. Density estimates were calculated for the RSA using the total area of delineated survey units and the capable area within the survey units. Errors are presented as standard deviation (SD). Confidence intervals (CI) are presented at 90%.

3. Results

3. Results

3.1 MOOSE WINTER INVENTORY RESULTS

Temperatures during the survey ranged between -2°C and 2°C under overcast conditions. Snow cover was 100%. Consistent temperatures resulting from the overcast conditions suggest moose were not likely to seek forest cover for thermal relief; however, predator avoidance may have increased moose use of more densely covered areas. Appendix 1 includes the survey details and information on each observation. The helicopter survey flight lines are illustrated in Appendix 2. The survey took 13.0 hours (781 minutes) of flight time to complete and an average of 45.9 ± 28.9 minutes per survey block (range 12 minutes to 123 minutes per block).

A total of 71 moose in 51 groups (average 1.4 ± 1.0 moose per group) were observed within 9 of the 15 survey blocks (Table 3.1-1; Figure 3.1-1). Moose density was calculated as 0.13/km^2 for the total area and 0.15/km^2 for the area containing capable habitat in the RSA. Vegetation cover can have a substantial influence on the ability of observers to detect moose. Areas of higher cover produce higher sightability corrections and lower detection probabilities that result in greater variances associated with a population estimate. Applying corrections for sightability bias in the program AERIAL SURVEY, moose density was calculated as 0.20/km^2 for the total area and 0.24/km^2 for the capable area.

Table 3.1-1. Summary of Moose Observations in Schaft Creek Study Area, March 2012

Parameter	Observed Data Total Count	Sightability Corrected Data*		
		Total Count	Variance (SE^2)	90% Confidence Interval*
Bulls	32	45	37	10
Cow	36	62	130	19
Calves	2	3	1	2
Unknown	1	3	4	3
Totals	**71**	**112**	**185**	**22**

** Corrections for sightability and estimates of variance were derived using the program Aerial Survey (Unsworth et al. 1998) with the B.C. moose model (Quayle, MacHutchon, and Jury 2001). 90% confidence intervals can be calculated by 1.65*√(variance).*

Moose densities across the 15 survey blocks (including 4 subunits) ranged between 0 and 0.34/km^2 (0.10 ± 0.13) based on the total area of the survey blocks, and between 0 and 0.39/km^2 (0.11 ± 0.14) based on capable habitat within those blocks (Appendix 3). The highest density was observed in survey block 6a.

The observed sex ratio was 89 bulls per 100 cows. After applying a sightability correction, the sex ratio was estimated to be 72 ± 28 bulls per 100 cows.

Observed productivity was 6 calves per 100 cows. The sightability correction resulted in an estimated productivity of 4 ± 3 calves per 100 cows. Natality was determined by calculating the number of calves per 100 adults. Observed natality was 3 calves per 100 adults.

3.1.1 Wallows and Mineral Licks

Mineral licks used by moose are generally characterized by well-worn trails leading to wet muddy springs or seepage areas that contain dense track concentrations (Rea et al. 2004). Mineral licks can either be wet or dry. While dry licks are most often associated with use by mountain goat and Stone's sheep, wet licks are used by moose. Wet (mineral) licks are usually associated with groundwater springs and develop into muddy clearings used mainly by elk (Cervus elaphus) and moose. Licks may function as sources of: (1) nutritionally important elements that are deficient in forage plants, (2) nutritional elements that become deficient during the transition to spring forage change, (3) clays and carbonates to buffer against intestinal disorders associated with spring forage change, and/or (4) combinations of the above (Parker and Ayotte 2004).

Wallows are a feature associated with moose use and may be attributed to rutting behaviour in the fall by bulls (e.g., a rutting pit or scrape where a moose urinates, paws and creates a muddy pit; Geist 1963). These features are typically produced new each season. Wallows may also indicate annual activity where moose of any sex exploit a wet area by pawing or manipulating the ground to access a resource such as the elements available from a mineral spring.

A mineral spring was located in survey block 5a on the west bank of the Mess River (Plate 3.1-1a). It appeared to be a thermal spring, but there was no evidence of recent use. A series of wallows were also observed in block 5a with some evidence of recent use including tracks, melted snow and muddied appearance (Plate 3.1-1b) suggesting this area is being used as a mineral lick. The wallows are on the east side of Mess Creek, near a former trapper cabin. Both of these wildlife habitat features had been noted during past wildlife inventory for baseline, no additional features of this nature were identified.

3.1.2 Incidental Wildlife Observations

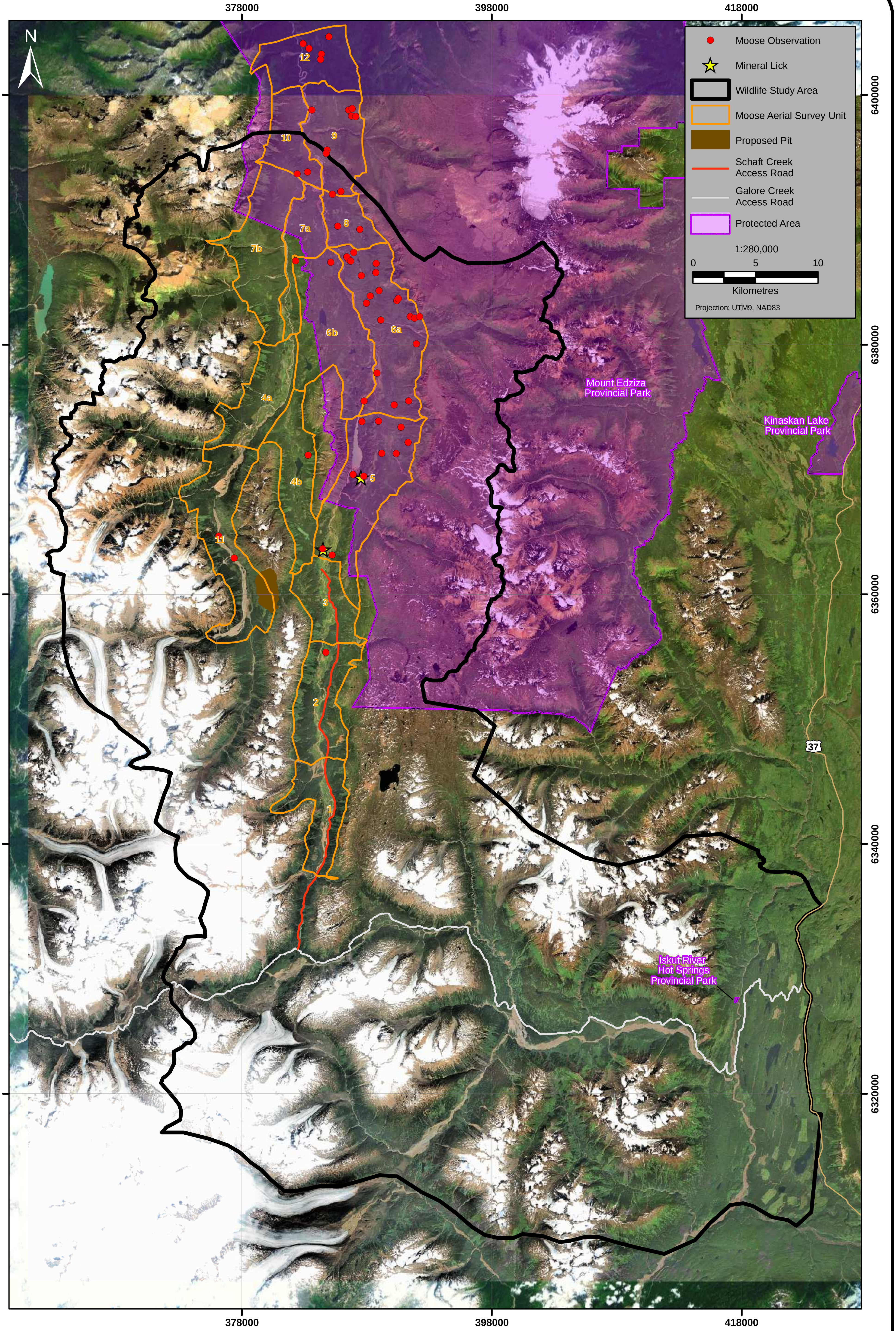
The location of incidental wildlife and other important observations are illustrated in Figure 3.1-2. Eagle nests were observed in survey blocks 2 and 5a. Wolverine tracks were observed blocks 1 and 10. A total of five wolf-killed moose were observed in blocks 1, 3 (2 kills), 4a, and 7a. A total of 11 wolves were observed, including a pack of 4 in block 5a, a pair in block 6b, and a pack of five wolves in block 9.

3.2 COMPARISON TO 2006

Survey effort was similar between 2006 and 2012. While 2012 was conducted later in the winter and conditions were slightly warmer, both surveys were conducted with snow cover at 100% and under overcast skies that provide a flat light beneficial to detecting moose under forest canopies. Sightability correction factors in 2006 (1.426) and 2012 (1.577) suggest that moose were under cover slightly more during the 2012 survey. Flight time in 2012 (13 hours) was comparable to 2006 (14.6 hours), especially considering that more moose were observed in the previous survey and extra time is required to classify them by age and sex. Flight lines and area of coverage were also nearly identical between the two surveys.

Substantially fewer moose (112 ± 22) were observed in the RSA during the March 2012 survey than in 2006 (314 ± 35). Table 3.2-1 presents the results from 2006 (from RTEC 2007). Following sightability correction, productivity was also substantially lower (4 ± 3 calves per 100 cows) in 2012 than in 2006 (31 ± 8 calves per 100 cows). There was no substantial difference in observed sex ratio in 2012 (72 ± 28 bulls per 100 cows) compared to 2006 (93 ± 16 bulls per 100 cows).

Comparisons of results by survey block between the two survey years were made (Table 3.2-2). While there was a consistent decline across a majority of the survey blocks from 2006 to 2012, block 6, particularly 6a, supported a sizeable increase in the relative number of moose in the RSA. This suggests the possible importance of this area for sustaining moose. The high concentration of moose in block 6 indicates that there may have been substantial movements from surrounding areas into capable habitat in this block with no subsequent emigration, or habitat conditions of this block promoted higher moose survival.

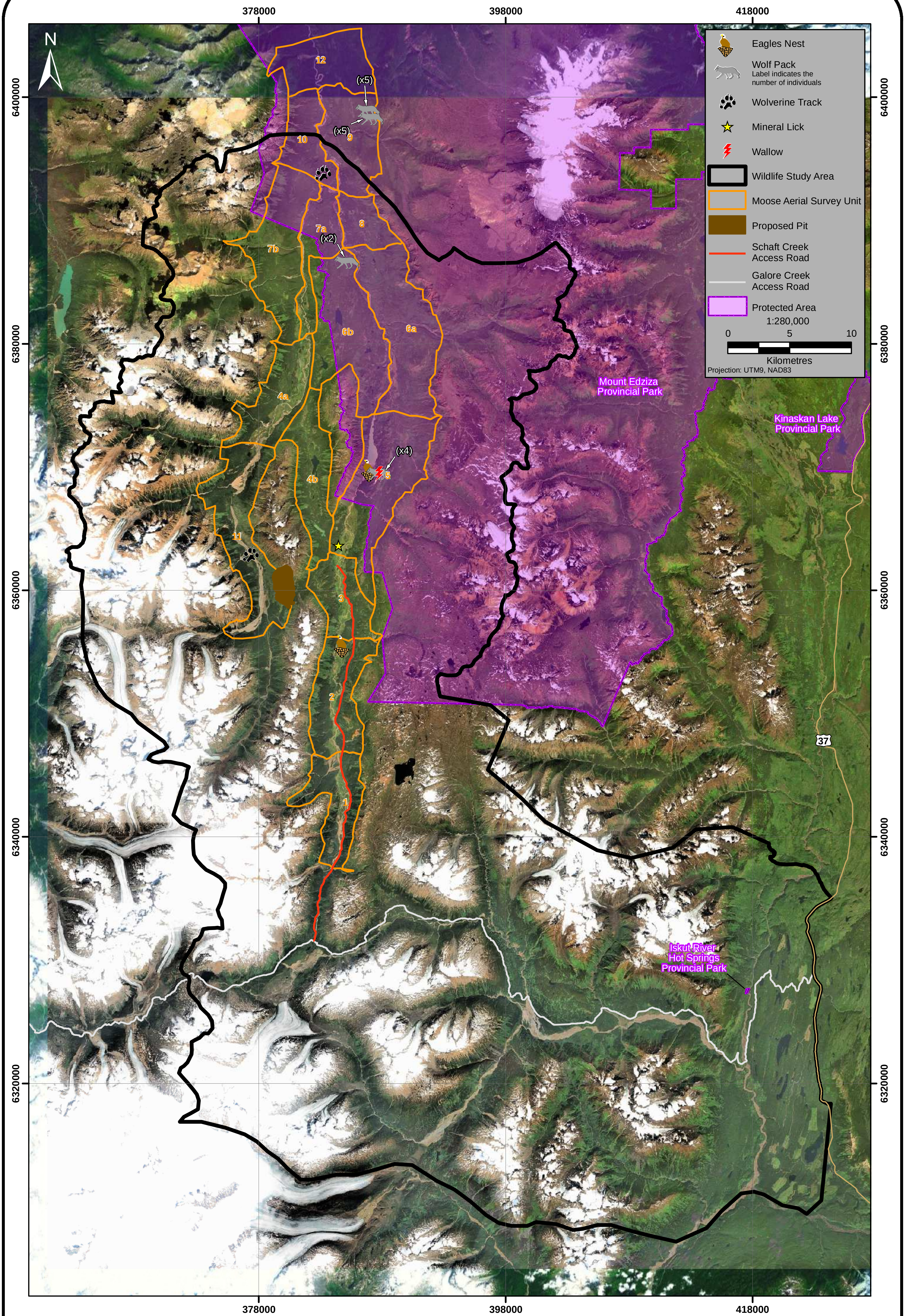


copper FOX metals inc.

Location of Moose Observations March 7 to 9, 2012

FIGURE 3.1-1

RTEC Rescan



copper FOX metals inc.

Incidental Observations, Wallows, and Mineral Licks

FIGURE 3.1-2

RTEC Rescan™

Plate 3.1-1a. Mineral spring located in survey block 5a.

Plate 3.1-1b. A series of wallows observed in a wet area in block 5a.

Table 3.2-1. Summary of Moose Observations in Schaft Creek Study Area, 2006

Parameter	Observed Data Total Count	Sightability Corrected Data*		
		Total Count	Variance (SE^2)	90% Confidence Interval*
Bulls	85	112	90	16
Cow	94	122	50	12
Calves	26	37	26	8
Unknown	14	43	182	22
Totals	**219**	**314**	**453**	**35**

** Correction for sightability and estimates of variance were derived using the program Aerial Survey (Unsworth et al. 1998) with the B.C. moose model (Quayle, MacHutchon, and Jury 2001). 90% confidence intervals can be calculated by 1.65*√(variance).*

Table 3.2-2. Differences in Population Distribution between Survey Years

Survey Unit	2006 Percent of Total Population Estimate[a]	2012 Percent of Total Population Estimate[a]	Change in Population Distribution 2012 minus 2006
1	0.0%	0.0%	0.0%
2	1.4%	0.0%	-1.4%
3	0.5%	0.0%	-0.5%
4a	2.3%	0.0%	-2.3%
4b	0.0%	1.4%	1.4%
5	23.1%	9.9%	-13.3%
6 (a and b)[b]	15.7%	54.9%	39.2%
7a	6.9%	0.0%	-6.9%
7b	4.6%	0.0%	-4.6%
8	10.2%	5.6%	-4.6%
9	13.0%	15.5%	2.5%
10	4.6%	2.8%	-1.8%
11	8.3%	2.8%	-5.5%
12	11.6%	7.0%	-4.5%

[a] *based on sightability corrected population*
[b] *2012 survey split 6a and 6b, 37 moose were observe in 6a while 2 were observed in 6b*

Predation was not observed during the 2006 survey, but was observed in 2012. A total of 11 wolves from 3 packs were recorded, along with 5 kills. The increase in wolf observations in the RSA is consistent with the Nass Wildlife Area where 37 wolves in nine packs were recorded, the highest wolf numbers since surveys of that area began in 1994 (Demarchi 2011).

3.2.1 Habitat Quality

Suitable late winter habitat for moose was modelled in 2007 (RTEC 2010). Approximately 26% of the total RSA was assigned a Habitat Suitability Rating (HSR) of High, Moderately High, or Moderate. All three of these suitability classes were distributed through the surveyed area. Changes in habitat suitability may influence sustainability of moose and current conditions were noted during the inventory. Areas such as the mid-level floodplain adjacent to Mess Creek (survey blocks 3 and 5), the older burn on the upper Schaft Creek (survey block 11), and they dry open aspen stands on the east side of Mess Creek (survey blocks 5, 6a, 8, 9) all continue to sustain high and moderately high suitable moose winter range. There were no apparent impacts associated with industrial development, habitat degradation (e.g., mountain pine beetle infestation), or vegetation succession that may have degraded habitat quality since 2006. The high number of moose observations in survey block 6a was associated with the BWBS and SBS BEC zones on dry, shrub, or open aspen stands, vegetation types that were rated as High or Moderately High for late winter moose habitat suitability (RTEC 2010). There were areas within the RSA containing high suitability habitat where evidence of moose activity was very light or absent. Habitat quality has not significantly changed since the 2006 survey, and suitable moose winter range does not appear to be limiting in the RSA.

4. Discussion and Conclusions

4. Discussion and Conclusions

The results of this survey suggest that there has been a decline in the moose population in the RSA from 314 to 112 moose over the past six years. Productivity of moose in the Schaft Creek RSA is very low compared to other areas in the region (Table 4.1-1), and is well below what is considered to be sustainable for population growth (Demarchi 2011). Similarly, productivity in the NWA in 2011 was the lowest since surveys began in 1994 (Demarchi 2011).

Table 4.1-1. Comparison of Moose Population Characteristics within North-Western British Columbia

Population Characteristic	Schaft Creek RSA	NTL North Section[a]	NTL South Section[a]	Schaft/Mess Creeks[b]	NWA and NWA Outside Area[c]
Adjusted Population	112	380*	122*	314	321
Productivity (calves/100 cows)	3	57	33	31	39
Sex Ratio (bulls/100 cows)	72	110	32	93	51

**Numbers are totals extrapolated from SRB*
[a] Rescan 2009[b]RTEC (2007)
[c] Demarchi 2011

By contrast, the sex ratio has remained relatively stable since 2006, and is well above the suggested sustainable level of 30 bulls per 100 cows (Demarchi 2000, Hatter 2009) which is identified as a post hunting season minimum standard for managing moose harvest in BC (BC MoELP 1996). The Schaft Creek sex ratio is also much higher than other accessible populations exposed to significantly higher hunting pressures, such as the southern NTL area (Table 4.1-1). In the absence of any significant human-caused mortality in the area or changes to habitat quality, these demographic parameters suggest a potentially significant impact of predation on the Schaft Creek moose population.

No evidence of human activity was observed in the RSA during the survey. It is expected that some harvest does occur in the RSA during fall on guided hunts, and some resident harvest may also occur. Access to the area is difficult and the best hunting locations along Mess and Schaft Creeks where moose may concentrate during the rut are far from areas where hunters would access the area. There is no road access to the area, and there are no substantial trails that could enable access from Telegraph Creek or other communities for hunting.

There were no extreme winter weather conditions in 2012 that might have negatively influenced moose survival (e.g., extremely deep snow), and habitat conditions appeared similar to those mapped in 2006. In the absence of site specific meteorological data, there was no anecdotal information to suggest that exceptionally severe winter conditions occurred in any winter since 2006. A substantial area of suitable winter habitat exists in the RSA, and there were no observations of over-browsing or other conditions that might suggest moose numbers were exceeding biological carrying capacity during ground surveys conducted in 2006 and 2007 for wildlife habitat value (RTEC 2010). There was no expansion of industrial or recreational development in the RSA since 2006 that might result in direct habitat loss or modification. There is likely ongoing indirect disturbance from nearby exploration activities which began prior to 2006, including disturbance from aircraft, which occurs from spring to fall.

It should be noted that the RSA is connected to an extensive area of suitable winter habitat extending beyond Telegraph Creek and along the Stikine River. There are no barriers to prevent moose and wolves from moving out of the RSA for tens of kilometers, and some of the observed declines may be due to emigration from the study area; however, concentrations of moose in survey block 6a suggests this may not have been the case.

An apparent increase in the number of wolves in the study area in 2012 is consistent with observations in other areas of the region, such as within the NWA, where the number of wolves was the highest recorded over 17 years of surveying (Demarchi 2011). Information from local residents also suggests that there is an increase in the number of wolves in areas around Dease Lake. Based on the relationship between ungulate density and predator density derived by Fullers (1989), current moose density in the area is well below what can sustain apparent wolf numbers. Wolf density in the area was estimated to be 19.6 / 1,000 km^2, nearly five times the estimated sustainable rate of 4 wolves per 1,000 km^2.

Based on current habitat conditions in the RSA, wolf predation appears to be a primary contributor to the observed decline in moose numbers in the RSA over the last six years. The decline may have been further exacerbated by additional factors, such as habitat degradation, human harvest of cows and calves, predation from other carnivores, and disturbance from industry, but evidence of these causes was not prominent. It is also unclear how current predator/prey dynamics is influencing other ungulates in the RSA. There is anecdotal information from local sources suggesting caribou, mountain goat, and Stone’s sheep populations in and near the RSA may have declined in recent years as well.

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Appendix 1

Schaft Moose Survey Data

Appendix 1a. Schaft Moose Survey Summary Data

SU	DATE	SURVEY AREA	PILOT	NAVIGATOR	OBSERVERS	TEMP (celsius)	% CLOUD COVER	WIND	LIGHTING	START TIME	FUEL BREAK	RE-START TIME	END TIME	TIME ELAPSED (minutes)
1	7-Mar-12	Mess (Upper)	B.Oestreich	S.Freeman	M.Louie, D.Bate	2	100	20 S	flat	14:15			14:27	12
2	7-Mar-12	Mess (Upper)	B.Oestreich	S.Freeman	M.Louie, D.Bate	2	100	20 S	flat	13:47			14:15	28
3	7-Mar-12	Mess (Upper)	B.Oestreich	S.Freeman	M.Louie, D.Bate	-1	100	20 S	flat	13:24			13:47	23
8	8-Mar-12	Mess (Mid)	B.Oestreich	S.Freeman	M.Waite, D.Bate	1	100	20 S	flat	11:35	11:38	12:15	12:40	28
9	9-Mar-12	Mess (Mid)	B.Oestreich	S.Freeman	M.Louie, D.Bate	-2	100	35 SE	flat	10:48			12:00	72
10	9-Mar-12	Mess (Mid)	B.Oestreich	S.Freeman	M.Louie, D.Bate	-2	100	36 SE	flat	12:00	12:18	12:55	13:20	43
11	7-Mar-12	Schaft camp	B.Oestreich	S.Freeman	M.Louie, D.Bate	1	100	35 S	flat	10:15			11:20	65
12	9-Mar-12	Mess (Mid)	B.Oestreich	S.Freeman	M.Louie, D.Bate	-2	95	35 SE	flat	13:23			14:14	51
4A	7-Mar-12	Schaft camp	B.Oestreich	S.Freeman	M.Louie, D.Bate	0	100	20 S	flat	11:20			11:53	33
4B	7-Mar-12	Skeeter Lake	B.Oestreich	S.Freeman	M.Louie, D.Bate	0	100	20 S	flat	11:53	12:19	13:17	13:24	33
5A	7-Mar-12	Mess Lake	B.Oestreich	S.Freeman	M.Louie, D.Bate	0	100	20 S	flat	14:33			15:58	85
5B	8-Mar-12	Mess Lake	B.Oestreich	S.Freeman	M.Waite, D.Bate	1	100	35 SE	flat	9:16			9:32	16
6A	8-Mar-12	Mess Lake	B.Oestreich	S.Freeman	M.Waite, D.Bate	1	100	20 S	flat	9:32			11:35	123
6B	8-Mar-12	Mess Lake	B.Oestreich	S.Freeman	M.Waite, D.Bate	2	100	20 S	flat	12:40			13:50	70
7A	8-Mar-12	Schaft (Lower)	B.Oestreich	S.Freeman	M.Waite, D.Bate	2	100	20 S	flat	13:50			14:15	25
7B1	8-Mar-12	Schaft (Lower)	B.Oestreich	S.Freeman	M.Waite, D.Bate	2	100	20 S	flat	14:15			14:57	42
7B2	9-Mar-12	Schaft (Lower)	B.Oestreich	S.Freeman	M.Waite, D.Bate	-2	100	35 SE	flat	10:16			10:48	32

Appendix 1b. Schaft Moose Survey Observation Data

DATE	SU	LAT	LONG	Y_PROJ	X_PROJ	GPS WPT	BULLS	LONE COWS	COW & 1 CALF	UNK SEX/AGE	ACTIVITY	TOTAL	% COVER	COMMENTS
7-Mar-12	11	57.4	-131.0	6362944	377388	1	1				sd	1	35	1 m snow @ 950 elev. Wolverine tracks.
7-Mar-12	11	57.4	-131.1	6364689	376137	2	1				ld	1	25	
7-Mar-12	4B	57.5	-130.9	6371158	383279	3	1				sd	1	10	
7-Mar-12	2	57.3	-130.9	6355372	384702	4								WPT eagle nest. NO MOOSE.
7-Mar-12	5A	57.5	-130.9	6369627	386888	5								WPT eagle nest. NO MOOSE.
7-Mar-12	5A	57.4	-130.9	6363659	384443	6								WPT mineral spring. NO MOOSE.
7-Mar-12	5A	57.4	-130.9	6363179	385192	7	1				ld	1	15	
7-Mar-12	5A	57.5	-130.9	6369471	387749	8								WPT wallow - some use. FOUR wolves. NO MOOSE.
7-Mar-12	5A	57.5	-130.9	6373853	387585	9		1			sd	1	30	
7-Mar-12	5A	57.5	-130.9	6373880	388913	10	1				sd	1	45	
7-Mar-12	5A	57.5	-130.8	6371322	389177	11		1			ld	1	45	
8-Mar-12	5B	57.5	-130.8	6371307	390349	12	1				ld	1	20	
8-Mar-12	5B	57.5	-130.8	6373419	390725	13	1				sd	1	30	
8-Mar-12	5B	57.5	-130.8	6372189	391298	14	1				sd	1	20	
8-Mar-12	6A	57.6	-130.8	6380078	391959	15	1				ld	1	20	
8-Mar-12	6A	57.5	-130.8	6375498	391341	16	2				sd	2	35	
8-Mar-12	6A	57.5	-130.8	6375202	390188	17	1				sd	1	30	
8-Mar-12	6A	57.5	-130.9	6377741	388797	18		2			ld	2	25	
8-Mar-12	6A	57.5	-130.9	6375500	387758	19			1		ld	2	40	
8-Mar-12	6A	57.6	-130.9	6386845	386538	20		1			ld	1	25	
8-Mar-12	6A	57.6	-130.9	6387066	386393	21	1				wk	1	30	
8-Mar-12	6A	57.6	-130.9	6383365	387942	22		1			ld	1	30	
8-Mar-12	6A	57.6	-130.9	6386726	386700	23		1			ld	1	25	
8-Mar-12	6A	57.6	-130.9	6387426	386934	24		4			ld	4	25	
8-Mar-12	6A	57.6	-130.9	6383939	388261	25		1			ld	1	25	
8-Mar-12	6A	57.6	-130.9	6382027	389101	26			1		rn	2	35	
8-Mar-12	6A	57.6	-130.9	6385567	387556	27		1			ld	1	10	
8-Mar-12	6A	57.6	-130.9	6384361	388980	28	1				sd	1	25	
8-Mar-12	6A	57.6	-130.9	6385821	388720	29	1				sd	1	35	
8-Mar-12	6A	57.6	-130.9	6386558	388737	30		2			sd	2	30	
8-Mar-12	6A	57.6	-130.8	6383564	390386	31		2			ld	2	30	
8-Mar-12	6A	57.6	-130.8	6382270	391455	32		2			sd	2	25	
8-Mar-12	6A	57.6	-130.8	6383727	390523	33	1				ld	1	25	
8-Mar-12	6A	57.6	-130.8	6382160	391809	34	5	2			rn/ld	7	25	
8-Mar-12	6A	57.6	-130.8	6382287	392209	35	1				sd	1	15	
8-Mar-12	8	57.7	-130.9	6392314	385905	36		1			sd	1	50	
8-Mar-12	8	57.6	-130.9	6389268	387428	37		1			sd	1	30	
8-Mar-12	8	57.7	-130.9	6392107	385234	38	1				sd	1	30	
8-Mar-12	8	57.6	-130.9	6389536	385657	39	1				sd	1	50	
8-Mar-12	6B	57.6	-130.9	6386651	385104	40	1				sd	1	35	Pack of wolves - 2 observed
8-Mar-12	6B	57.6	-131.0	6386769	382283	41				1	sd	1	60	Possibly a bull.
9-Mar-12	9	57.7	-130.9	6395636	384809	42		1			ld	1	10	
9-Mar-12	9	57.7	-130.9	6395379	384736	43		1			ld	1	30	
9-Mar-12	9	57.7	-131.0	6398837	383596	44		2			ld	2	50	
9-Mar-12	9	57.7	-130.9	6398819	386517	45	1	1			sd	2	30	
9-Mar-12	9	57.7	-130.9	6398346	386755	46		1			sd	1	45	
9-Mar-12	9	57.7	-130.9	6398956	386817	47	3				ld	3	40	Pack of wolves - 5 at least near WPTs 47 & 48
9-Mar-12	9	57.7	-130.9	6398298	387098	48		1			sd	1	20	Pack of wolves - 5 at least near WPTs 47 & 48
9-Mar-12	10	57.7	-131.0	6393868	383237	49		1			ld	1	60	Wolverine tracks.
9-Mar-12	10	57.7	-131.0	6393699	382409	50		1			ld	1	70	
9-Mar-12	12	57.8	-130.9	6404703	384929	51		1			sd	1	15	
9-Mar-12	12	57.8	-130.9	6403306	384340	52		1			ld	1	25	
9-Mar-12	12	57.8	-130.9	6402883	384282	53	1				sd	1	50	
9-Mar-12	12	57.8	-131.0	6403767	383360	54	1				sd	1	15	
9-Mar-12	12	57.8	-131.0	6404143	382871	55	1				ld	1	35	

Notes:

WPT - GPS waypoint

SD - standing

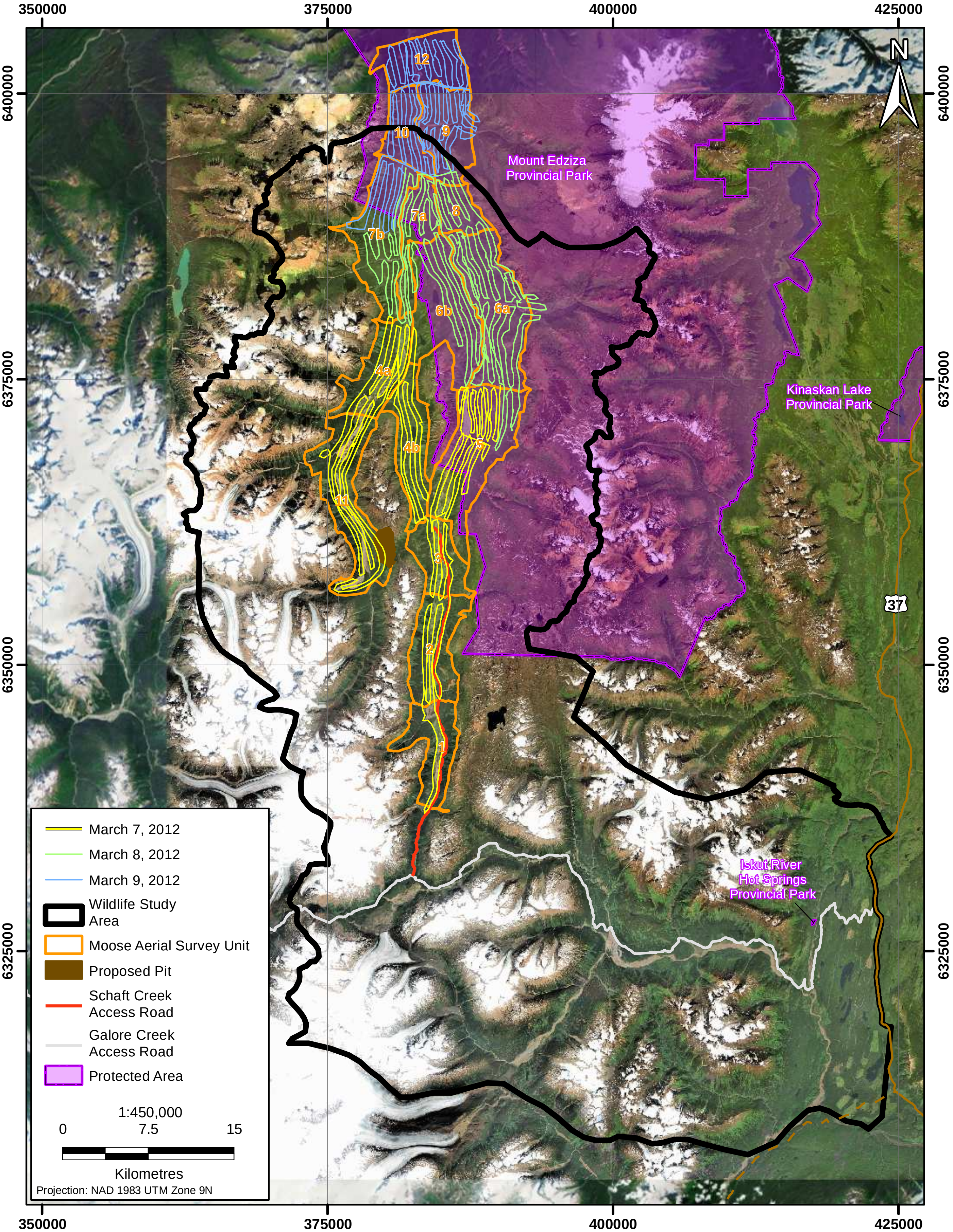
LD - lying down

RN-running

WK- Walking

Appendix 2

Helicopter Flight Lines



Appendix 2

Helicopter Flight Lines

copper FOX metals inc.

RTEC

Rescan™

Appendix 3
Moose Population Densities

Appendix 3. Moose Population Densities

		Total Study Area		Capable Habitat*		
Survey Unit	Moose Observations	Area (km^2)	Density ($moose/km^2$)	Area (km^2)	Density ($moose/km^2$)	Proportion of Capable Habitat within each SU (%)
1	0	29.3	0.00	19.4	0.00	66.21
2	0	36.5	0.00	26.2	0.00	71.78
3	0	24.9	0.00	18.8	0.00	75.50
4A	0	32.6	0.00	28.8	0.00	88.34
4B	1	32.1	0.03	25.9	0.04	80.69
5	7	62.2	0.11	47.5	0.15	76.37
6	39	113.5	0.34	99.9	0.39	88.02
7A	0	22.8	0.00	22.3	0.00	97.81
7B	0	48.3	0.00	42.7	0.00	88.41
8	4	15.2	0.26	13.7	0.29	90.13
9	11	34.6	0.32	29.9	0.37	86.42
10	2	22	0.09	20	0.10	90.91
11	2	54.1	0.04	42.4	0.05	78.37
12	5	31.4	0.16	24.9	0.20	79.30
Total	71	559.50	0.13	462.40	0.15	82.65
Total (corrected for sightability)	112	559.50	0.20	462.40	0.24	82.65

**Capable habitat is defined as <1,050 m elevation and <60% slope*