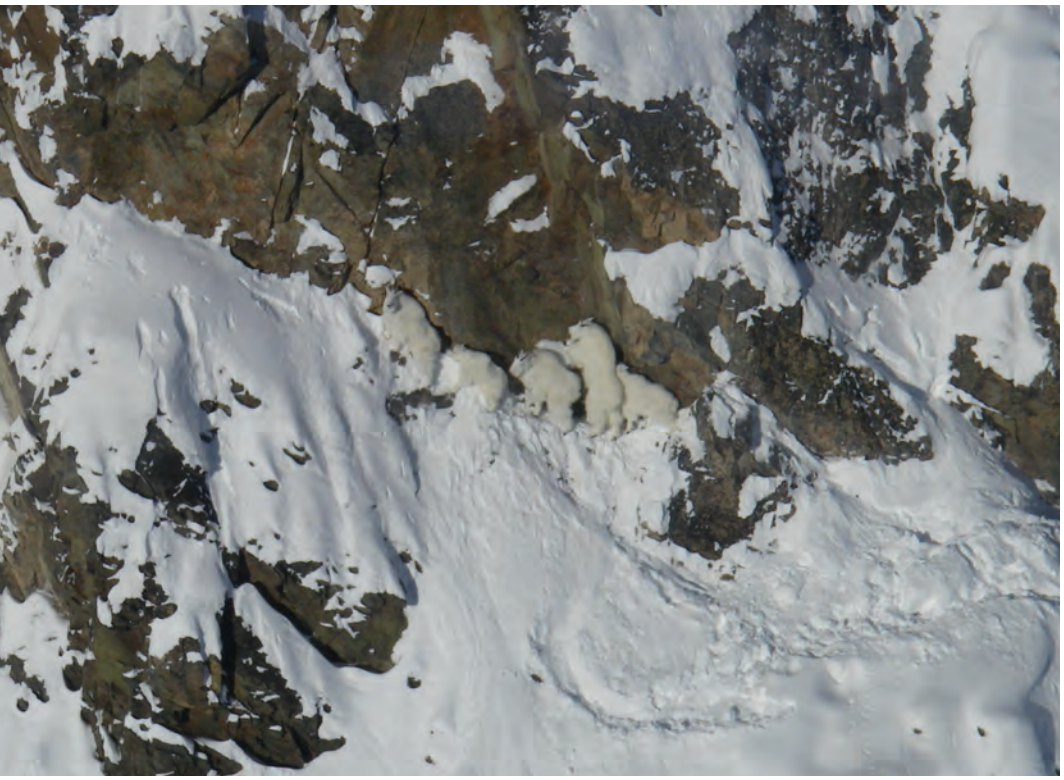
Copper Fox Metals Inc.

Schaft Creek Project: Mountain Ungulate Baseline, 2006 and 2008



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September 2010

SCHAFT CREEK PROJECT:
Mountain Ungulate Baseline, 2006 and 2008

September 2010
Project #1039-001-07

Prepared for:

Copper Fox Metals Inc.

Prepared by:

Rescan™ Tahltan Environmental Consultants
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Citation: Rescan™ Tahltan Environmental Consultants (RTEC). 2010. *Schaft Creek Project: Mountain Ungulate Baseline, 2006 and 2008*. Prepared for Copper Fox Metals Inc. September 2010.

Executive Summary

copper FOX metals inc.

RTEC Keepers of the Land

Executive Summary

Copper Fox is a Canadian mineral exploration and development company focused on developing the Schaft Creek deposit located in northwestern British Columbia. The deposit is situated within the upper source regions of Schaft Creek, which drains northerly into Mess Creek and onwards into the Stikine River. The Schaft Creek Project (the Project) is located within the traditional territory of the Tahltan Nation. The Project entered the British Columbia Environmental Assessment (EA) process in August 2006. This report presents the results of investigations into the distribution and habitat use of mountain goat (*Oreamnos americanus*), Stone's sheep (*Ovis dalli stonei*), and northern caribou (*Rangifer tarandus* population 15), in the area surrounding the Project. Surveys were conducted for these species in summer and winter, 2006 and 2008, in the area surrounding the proposed mine and access road development and recorded baseline information on the local population, distribution, herd composition, and habitat use.

Surveys in both 2006 and 2008 confirmed the presence of goat, sheep, and caribou within the wildlife study area. Winter surveys were conducted during March, 2006, and February and March, 2008: summer surveys were conducted during July, 2006, and August, 2008. Mountain goats are far more abundant in the area than are sheep or caribou; very few sheep were recorded on surveys and caribou were very rare.

A total of 154 sightings of goats were recorded during the surveys in both years. At least one goat was recorded in each of the fifteen survey units (SU) that were surveyed in either year except two: SU G1 and G12. In 2006, a total of 92 goats were counted over 8 SUs in the winter and 132 were counted over 9 SUs in the summer (6 SUs were surveyed both in the winter and summer). In 2008, a total of 106 goats were counted over 8 SUs in the winter and 22 were counted over 4 SUs in the summer (two SUs were surveyed both in the winter and summer). The ratio of kids to adults varied across the seasons, from 10 kids per 100 adults in summer 2008, 12 kids per 100 adults in summer 2006, and 23 kids per 100 adults in both the winter of 2006 and 2008. The average capable habitat density of goats was approximately 0.18 goat/km^2 for both seasons (winter and summer). Capable habitat refers to the area including and within 500 m of suitable escape terrain (rocky, barren areas with slopes of 40 to 70°). Half of all goats were seen alone (49% of goat sightings). The remaining sightings were split between observations of nursery groups (24%) and non-nursery groups (27%).

Goats were generally at higher elevations and closer to escape terrain during the summer than in the winter. No discernable differences in the aspect of goat sightings were apparent across the seasons: for the most part goats were observed on all aspects except northerly ones in the winter and summer. There was a statistical difference in the slope of goat sightings between winter and summer, where goats were on slightly steeper slopes in the winter than in the summer. There were no differences among topographic features between SUs of the wildlife study area and between different group composition categories (single goats, nursery groups, and non-nursery groups). Only goats in SU G8 and G9 were at lower elevations than could have been predicted during the summer, differing from the elevations of goat sightings in all other SUs. In many cases however, there were low sample sizes per SU for analysis, which reduces the ability of tests to reveal meaningful and statistical differences in data.

A total of 35 Stone's sheep were observed in two of the fifteen SUs during surveys in 2006 and 2008. Ewes accounted for the majority (66%) of sheep observed. Lambs were only observed during the summer; the ratio of lambs to ewes was 44 lambs per 100 ewes. Density estimations based on capable habitat was the lowest in summer 2008 at 0.05 sheep/km^2 (SU G1), slightly higher in winter 2008 at 0.15 sheep/km^2 (SU G10), and the highest during summer 2006 at 0.27 sheep/km^2 (SU G10). Roughly equal detections of single sheep, nursery groups, and non-nursery groups were recorded.

Most sheep were observed on southwest facing mountain faces with slopes between 30 to 50°, and within 100 m of escape terrain. Occupied areas spanned a wide elevation range, but the majority of sheep (75%) were observed between 1,426 and 1,683 m in the winter and between 1,702 and 2,026 m in the summer. As few sheep sightings were recorded, little can be concluded from the analysis of spatial distribution.

A total of three caribou were observed in the eastern portion of the study area during the summer survey in 2006. No caribou were observed on any of the three other surveys in 2006 and 2008. The results suggest that caribou from the Mount Edziza sub-population can be expected to occasionally use habitat in the eastern wildlife study area. Areas outside of the study area to the north support larger tracts of higher value habitat for caribou.

Several species and/or species sign (e.g., tracks) were incidentally recorded during aerial surveys. Grizzly bear and grizzly bear sign were observed during summer surveys, which included observations of a lone bear, females with cubs, and a probable den site. Other mammals observed included a gray wolf and tracks of fisher and red fox. Golden eagles were observed during both summer surveys, totalling nine individuals. Other birds observed included a blue grouse and a ptarmigan species.

Acknowledgements

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Acknowledgements

This report was prepared for Copper Fox Metals Inc. by Rescan Tahltan Environmental Consultants. The report was written by Julia Shewan (B.Sc.) with writing and editing support from Greg Sharam (Ph.D) and Brandie Harding (B.Sc, M.Sc. Candidate). Fieldwork was conducted in 2006 and 2008 by Shaun Freeman (B.Sc., R.P.Bio.) with assistance from Nicola Freeman (M.Sc., R.P.Bio.), Odelia Dennis (RTEC), Dennis Quock (RTEC), Kyle Quock (RTEC), Natasha Seymour (RTEC), and Bev Searle-Freeman (Rescan).

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SCHAFT CREEK PROJECT: MOUNTAIN UNGULATE BASELINE, 2006 AND 2008

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1. Schaft Creek Project

1.1 PROJECT SUMMARY

Copper Fox Metals Inc. (Copper Fox) is a Canadian mineral exploration and development company focused on developing the Schaft Creek deposit located in north-western British Columbia, approximately 60 km south of the village of Telegraph Creek (Figure 1.1-1). The Schaft Creek deposit was discovered in 1957 and has since been investigated by prospecting, geological mapping, geophysical surveys as well as diamond and percussion drilling. The deposit is situated within the upper source regions of Schaft Creek, which drains northerly into Mess Creek and onwards into the Stikine River. The Stikine River is an international river that crosses the US/Canadian border near Wrangell, Alaska. The Schaft Creek deposit is a polymetallic (copper-gold-silver-molybdenum) deposit located in the Liard District of north-western British Columbia (Latitude 57° 22′ 42″; Longitude 130°, 58′ 48.9″). The property is comprised of 40 mineral claims covering an area totalling approximately 20,932 ha within the Cassiar Iskut-Stikine Land and Resource Management Plan (Figure 1.1-2).

The Schaft Creek Project (the Project) is located within the traditional territory of the Tahltan Nation. Copper Fox has been in discussions with the Tahltan Central Council (TCC) and the Tahltan Heritage Resources Environmental Assessment Team (THREAT) since initiating exploration activities in 2005. Copper Fox will continue to work together with the Tahltan Nation as work on the Schaft Creek Project continues.

The Schaft Creek Project entered the British Columbia EA process in August 2006. Although a formal federal decision has not yet been made, the Project will likely require federal approval as per the *Canadian Environmental Assessment Act*. Copper Fox has targeted the third quarter 2010 for submission of their Schaft Creek EA Application.

The current mine plan would see ore mined from an open pit at a rate of 100,000 tonnes per day. The mine plan includes 812 million tonnes of Measured and Indicated Mineable resources providing for an estimated 23 year mine life. The Project is estimated to generate up to 2,100 jobs during the construction phase and approximately 700 permanent jobs during mine operations.

The deposit will be mined with large truck/shovel operations and typical drill and blast techniques. The ore will be crushed, milled and filtered on site to produce separate copper and molybdenum concentrates. The Process Plant will include a typical comminution circuit (Semi-Autogenous Mill, Ball Mill and Pebble Crusher) followed by a flotation circuit and a copper circuit with thickener, filtration and concentrate loadout and transportation. The Process Plant includes a designated molybdenum circuit with thickener, filtration, drying and bagging. A tailings thickener and water reclaim system will be used to recycle process water. The circuit will have a design capacity of 108,700 tonnes per day and a nominal capacity of 100,000 tonnes per day (36,000,000 tonnes per year). Approximately 293,000 tonnes of concentrates will be produced each year, which will be transported via truck to the port of Stewart, BC, for onward shipping to markets.

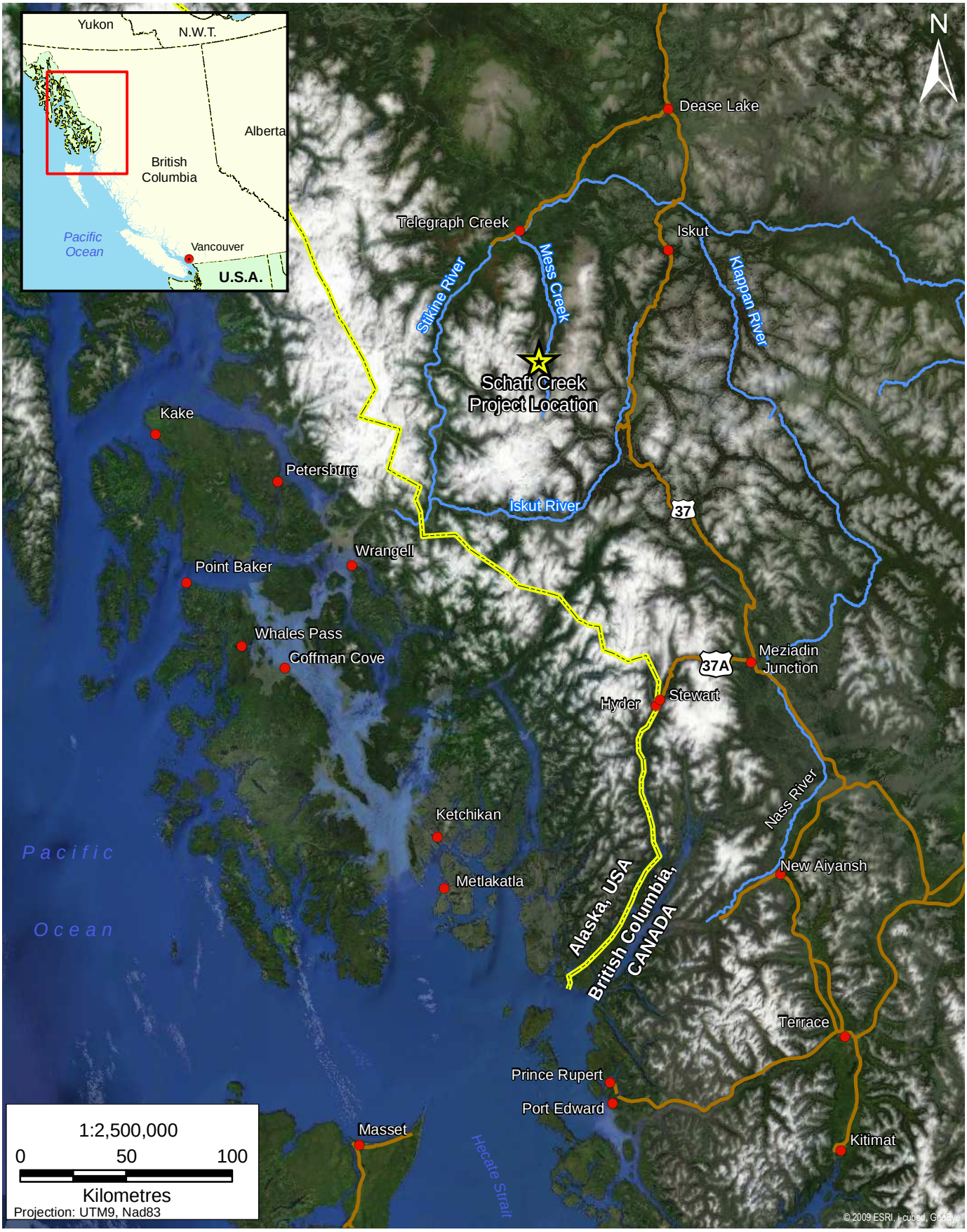
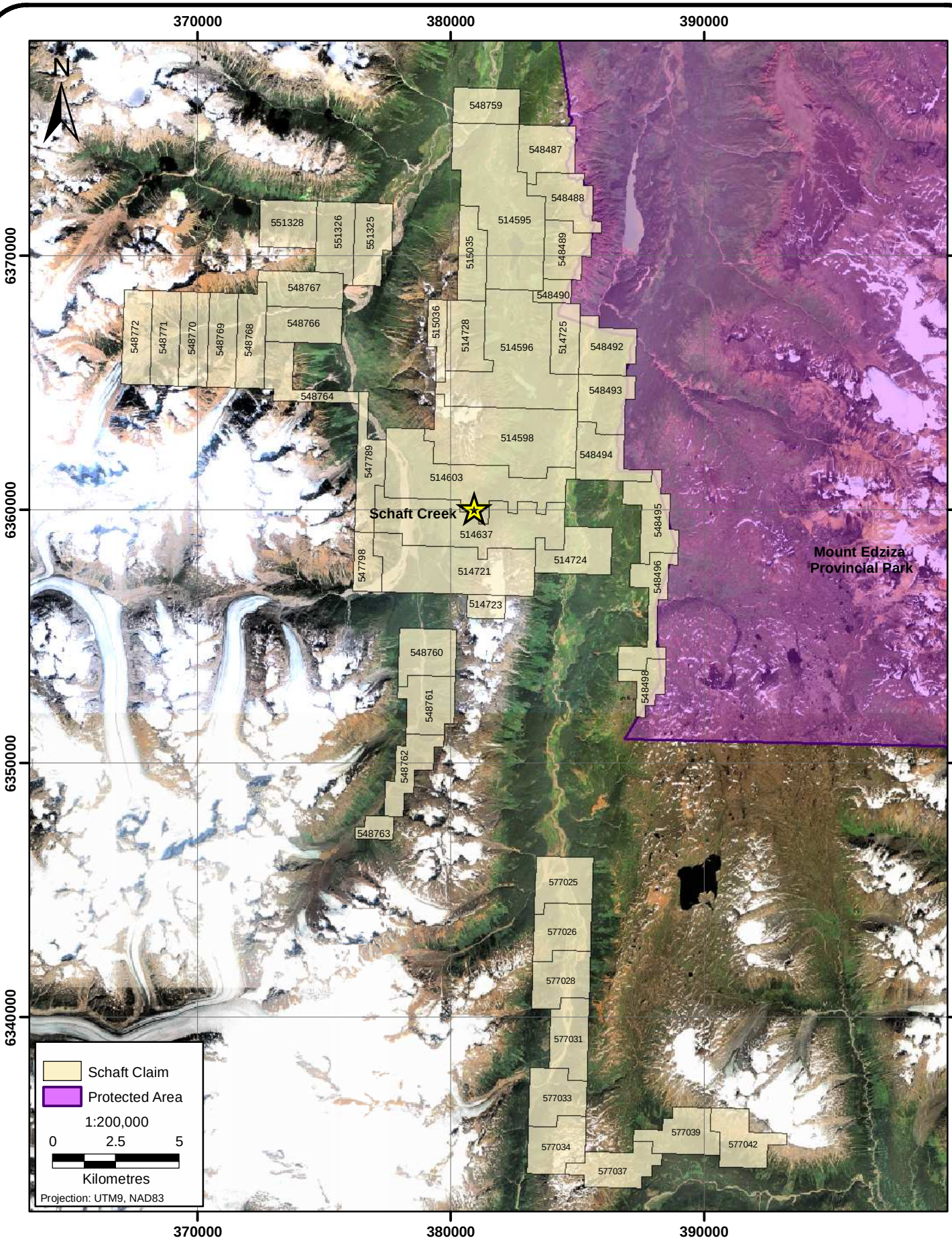


FIGURE 1.1-1

Location Map for Schaft Creek Project



Schaft Creek Project Mineral Claims

FIGURE 1.1-2

Copper Fox will construct an access road to the mine site (Schaft Creek Access Road; Schaft Road) to the 65.1 kilometre point (65.1km) of the Galore Creek Access Road (Galore Road). The Schaft Road will cover a distance of 39.5 km from the Galore Road to the Schaft mine site (Figure 1.1-3). Both the Galore and Schaft roads will be gravel roads with six metre wide driving surface. Pullouts and radio controls will be used to manage two-way traffic on the road. The Schaft Road will be a private road used to service the Schaft Creek mine.

The Galore Road is a fully permitted multi-use road; B.C. MOF Special Use Permit (S24637). The Galore Road is being constructed by Galore Creek Mining Corporation. Currently, Galore Creek Mining is only planning to construct the Galore Road to 40 km while they review the current Galore Creek Project for which the road was to service. Copper Fox will engage Galore Creek Mining with respect to the completion of the Galore Road, and if necessary, arrange to transfer the MOF Special Use Permit to Copper Fox as the Schaft Creek Project advances.

The Galore Road connects to Highway 37 near Bob Quinn Lake. The total road distance from the Schaft mine site to Highway 37 is 105 km. The majority of the 39.5 km Schaft Road is within the Mess Creek watershed. In order to avoid geohazards along the Mess Creek valley, the Schaft Road will cross Mess Creek twice (Figure 1.1-3). Mess Creek is considered navigable per Transportation Canada criteria.

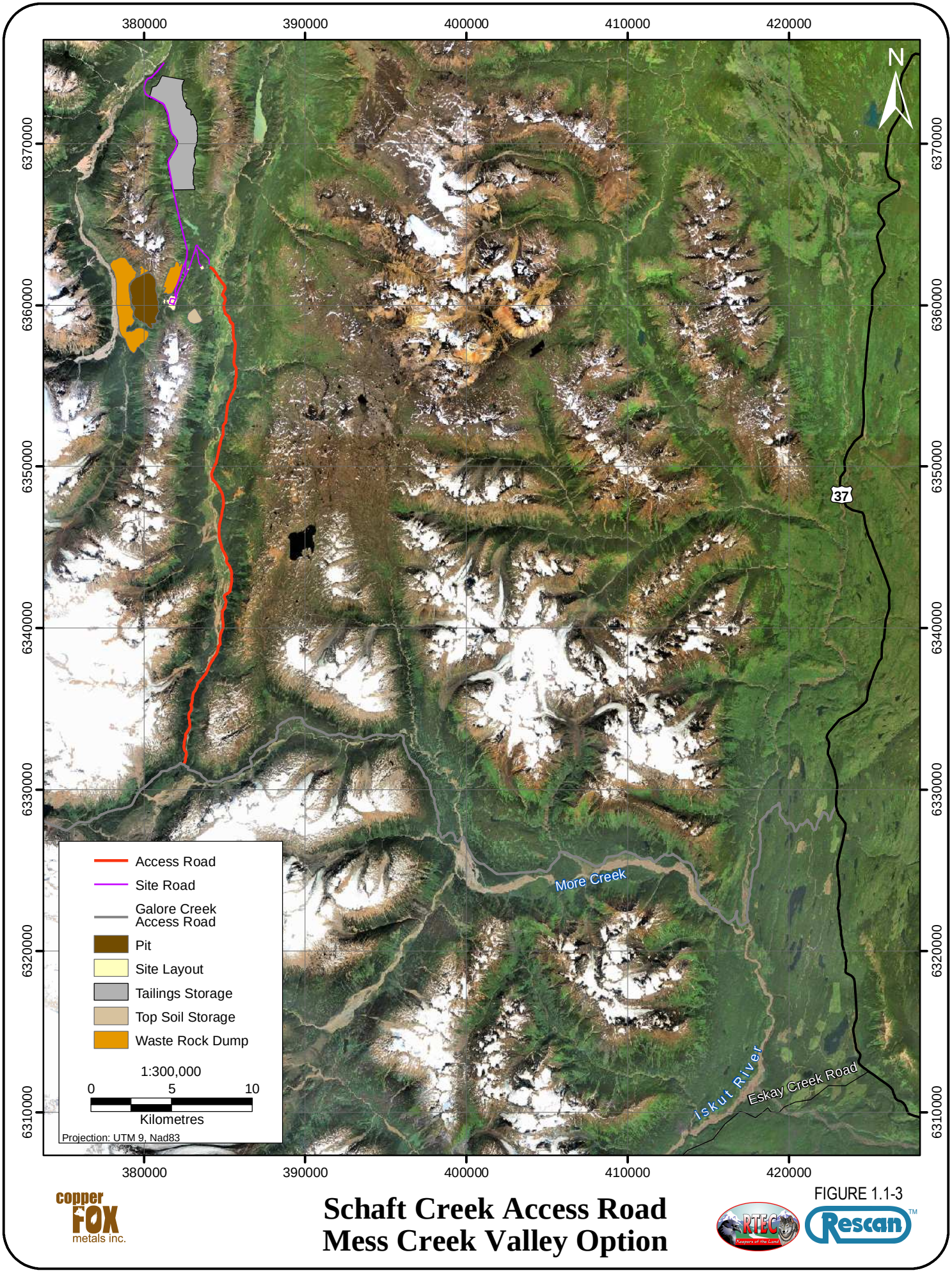
After crossing Mess Creek at the north end of the Schaft Road (32.5 km), the route rises up the side of Mount LaCasse crossing Shift Creek (10 m bridge) and Big B Creek (10 m bridge). The route terminates at Snipe Lake (39.5 km). Conventional 30-tonne trucks will be used to transport concentrate from the mine site to the Bob Quinn area along the Schaft and Galore roads. From Bob Quinn to Stewart, convention B-train commercial truck haulage can then be utilized along Highway 37 and 37A. There will be 30 concentrate trucks along this route over a 24 hour period, seven days per week.

Electrical power to the mine site will be provided via a 138 kV transmission line, extending from Bob Quinn Lake to the Project along the proposed corridor for the Galore and Schaft roads. The proposed transmission line assumes that electrical power will be supplied from British Columba Transmission Corporation's (BCTC) proposed new 287 kV Northwest Transmission Line from a point near Bob Quinn Lake.

The Schaft Pit will encompass an area of 4.9 km^2 at the end of the mine life (Figure 1.1-4). The Pit will extend 330 m below the current elevation (520 masl). An ore stockpile and crusher will be located between the Pit and Schaft Creek. Crushed ore will be conveyed to the Plant site on the saddle just east of the Pit. Tailings from the Process Plant will be piped to the Skeeter Tailings Storage Facility (TSF) as a slurry (55% solids).

Over the life of the mine the Project will generate over 812 million tonnes of tailings, which will be managed in the Skeeter TSF. The TSF will not span the low relief watershed divide between Skeeter and Start watersheds. The Skeeter TSF will require three embankments to contain the tailings generated over the life of the mine (Figure 1.1-5). Based on average climatic conditions, the TSF will have a positive water balance. Discharge from the TSF will be to Skeeter Creek.

The Project will generate an estimated 1,547 million tonnes of waste rock. Waste rock dumps are proposed around the perimeter of the Schaft Pit, with the majority of the material being placed on the east side of Schaft Creek (Figure 1.1-4). The current plan assumes the waste rock will be non-acid generating and will not leach metals at or near neutral pH. The plan is subject to change as work progresses on the metal leaching and acid rock drainage program.



Schaft Creek Access Road
Mess Creek Valley Option

FIGURE 1.1-3

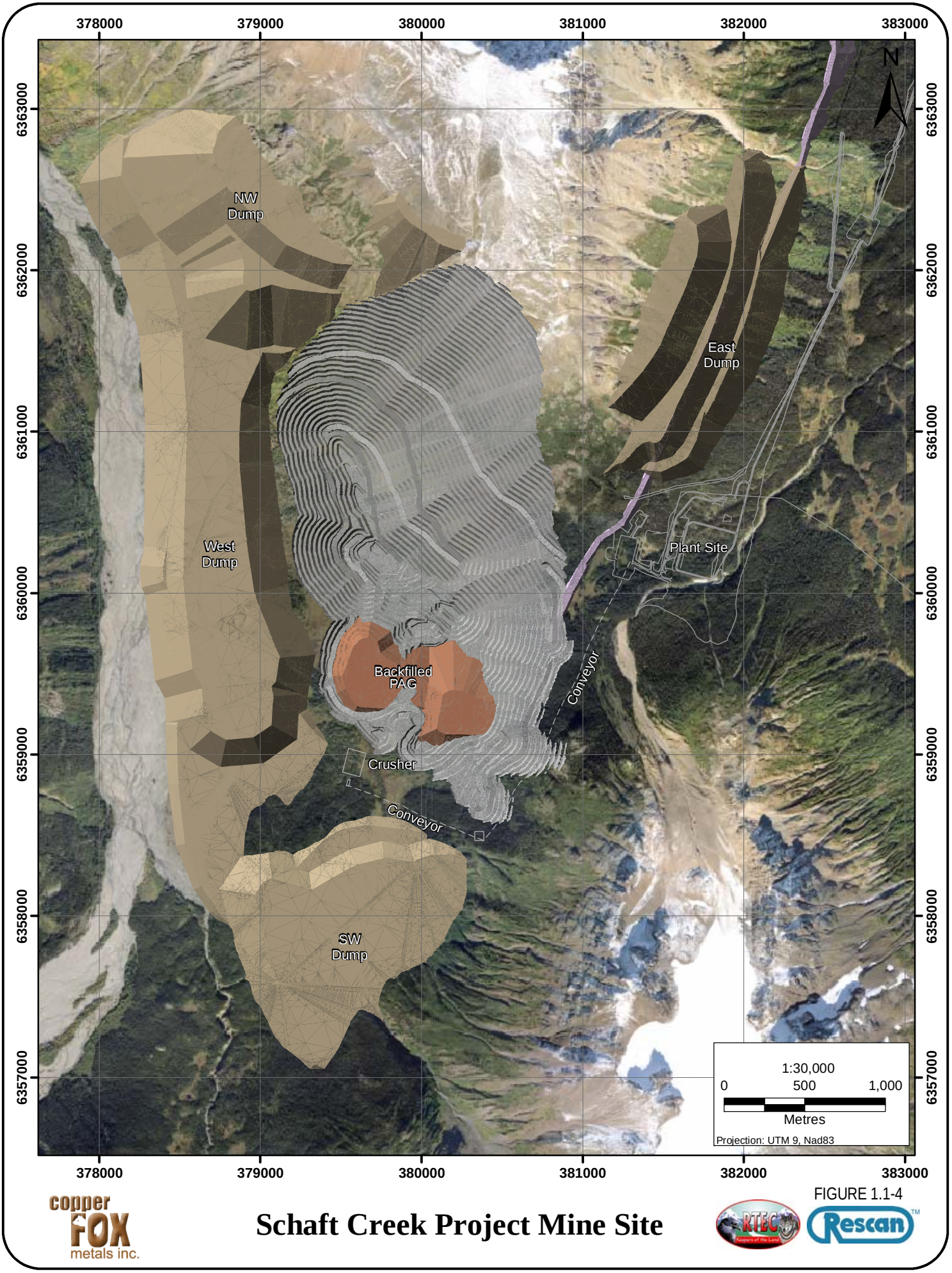
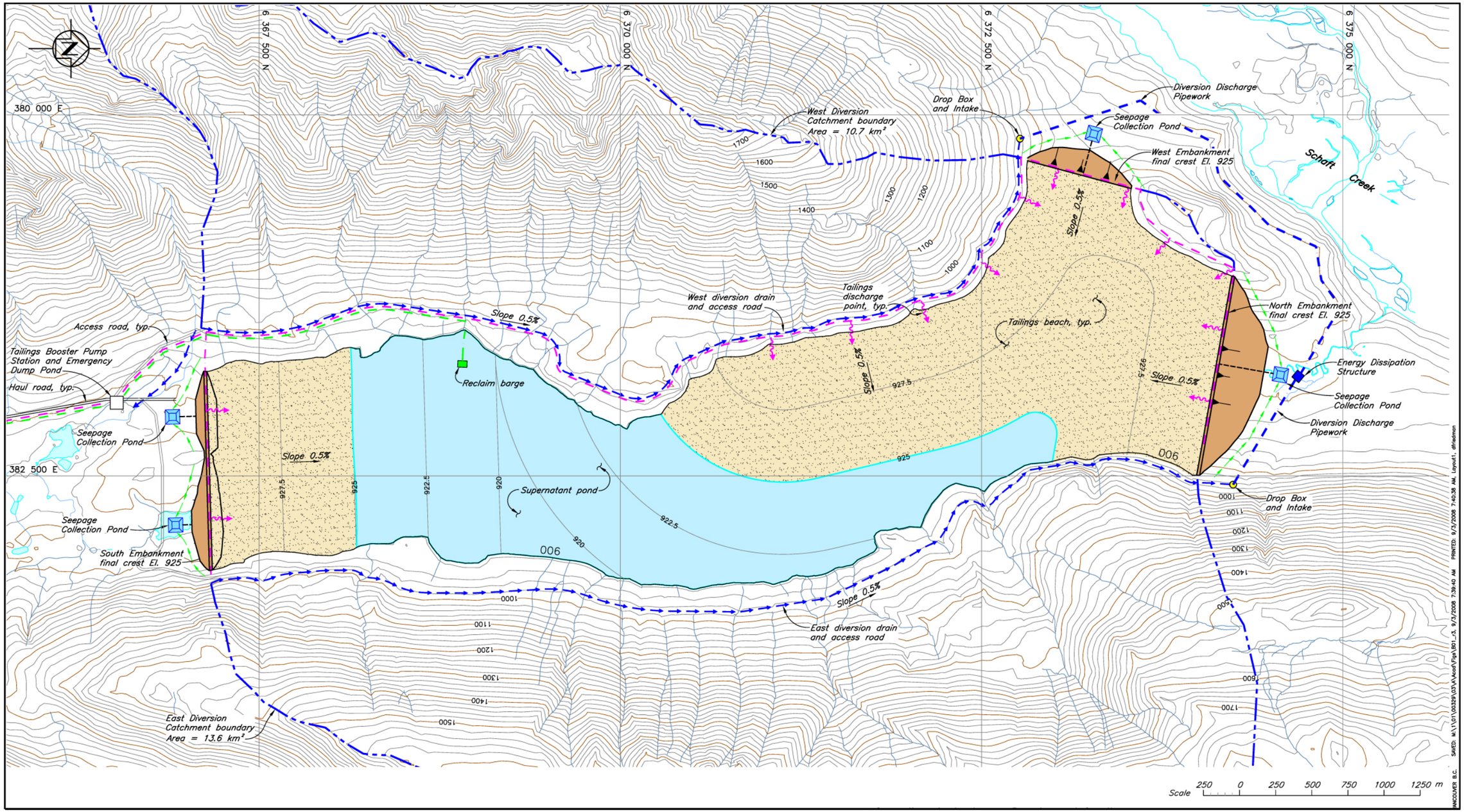


FIGURE 1.1-4

Schaft Creek Project Mine Site



Source: Knight Piésold Consulting

Note: This layout represents the tailings storage facility in the final years of operation prior to closure. Several years before the end of operations and closure, the tailings deposition pattern will be modified to relocate the supernatant pond towards the north of the facility, where a permanent spillway will be constructed in the west abutment of the North Embankment.

FIGURE 1.1-5

Schaft Creek Project - Skeeter Tailings Storage Facility

The Project will be a fly-in, fly-out operation, and a new airfield capable of handling a Boeing 737 will be constructed to the east of the Pit. The preliminary design includes a 1,600 m compacted gravel landing strip, terminal building, fuelling facilities, small maintenance facility and control and lighting systems.

A permanent camp will be constructed to support approximately 700 employees. Other facilities include a truck shop, warehouse, administration, maintenance laboratory, explosive storage, water treatment facilities and potable water storage.

2. Mountain Ungulates

2. Mountain Ungulates

2.1 INTRODUCTION

In BC, mountain ungulates receive particular conservation focus from both the government and public and private stakeholders. Mountain ungulates tend to be important economic and social resources for traditional harvest by First Nations and recreational harvest for resident and non-resident hunters, in addition to having important biological roles within ecosystems.

Three mountain ungulate species, mountain goat (*Oreamus americanus*), Stone's sheep (*Ovis dalli stonei*) and northern caribou (*Rangifer tarandus* population 15), were selected as focal species for baseline study for the Schaft Creek Project. Mountain goat and Stone's sheep are both yellow-listed in the province, a classification indicating the species welfare is not of immediate conservation concern (BC CDC 2010a, b). Northern caribou are on the BC blue list and are also an Identified Wildlife element under the Identified Wildlife Management Strategy (IWMS) (BC CDC 2010c). Northern caribou are also listed as species of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC [COSEWIC 2002b]) and are present as a species of special concern on Schedule 1 of the *Species at Risk Act* (SARA) (2002). All of these species are protected under the provincial *Wildlife Act* (1996), whereby harvesting activities by resident and non-resident hunters are regulated by hunting licenses.

Research has identified a common limiting factor among many of the ungulate species across the province: limited availability of capable winter habitat and associated species' sensitivity to climatic conditions during the winter. The BC Ministry of Environment (MoE) identifies ungulate winter range (UWR), defined as the areas that are necessary for the winter survival of ungulate species. UWR and associated objectives are mandated under the authority of Sections 9(2) and 12(1) of the *Government Actions Regulation* (BC Reg. 582/2004b) and *Forest and Range Practices Act* (Section 149.1; 2004a). Winter range is an important component of the species' seasonal habitat. Important goat and sheep winter range habitat characteristics are suitable escape terrain, forage, and cover. Escape terrain includes steep cliffs, rocky outcrops, and talus slopes where animals can escape from predators. Important northern caribou winter habitat includes mature and old growth forests that provide snow interception and an adequate supply of terrestrial and arboreal lichens and high elevation windswept slopes where terrestrial lichens can be accessed. At this time, no approved UWR for mountain goat, Stone's sheep, or northern caribou has been delineated in the immediate vicinity of Project: the closest approved UWR is that mapped for mountain goats to the south in the northern Nass timber supply area (TSA) (UWR #u-6-002; BC MOE 2008).

While no UWR occurs in the Project area, important areas and habitat for all three focal species has been identified through land management. Land and Resource Management Plans (LRMP) are sub-regional, integrated resource plans that establish the framework for land use and resource management objectives and strategies, and provide a basis for detailed management planning. The Schaft Creek Project lies entirely within the Cassiar Iskut-Stikine (CIS) LRMP area (BC ILMB 2000). The CIS LRMP identifies goat, sheep, and caribou as requiring increased management consideration to maintain viable populations and habitats, and undertook measures to identify high value habitat for all three species and natal (kidding/lambing) habitat for mountain goat and Stone's sheep within the plan area. Under wildlife management objective 5 and 7, high value habitat is identified as interim winter range for these species within the plan area, until such time these areas are designated as

approved UWR by the province (BC ILMB 2000). Additionally, specific strategies are outlined under wildlife management objectives 4 through 7 to maintain and minimize disturbance to interim winter range and natal habitat (BC ILMB 2000).

The following section provides an overview of the mountain ungulate baseline study initiated in 2006 and continued in 2008. Within this section can be found a description the aerial survey protocol used to evaluate the population and distribution of mountain ungulates within the study area (Section 2.4). In addition, the analysis and results of survey effort over the two year baseline study, which is common to each of the focal species, is included (Section 2.5). More information on mountain goat, Stone's sheep, and northern caribou, including a species background, detailed methodology for the analysis of field data, and the discussion of species specific population characteristics and spatial distribution, can be found in Section 3, Section 4, and Section 5, respectively. Incidental observations of other wildlife are also reported (Section 6).

2.2 STUDY AREA

In 2006, the Project wildlife study area was delineated, covering approximately 3,131 km^2 (Figure 2.2-1). A portion (556 km^2) of the study area overlaps Mount Edziza Provincial Park. The study area lies within the Northern Boreal Mountain ecoprovince, including both the Yukon-Stikine Highlands ecoregion, Tahltan Highlands ecosection, and the Northern Mountains and Plateaus ecoregion, Southern Boreal Plateau ecosection (Luttermerding et al. 1990). The biogeoclimatic ecosystem classification (BEC) system categorizes the study area into BAFA (boreal altai fescue alpine), multiple subzones of the ESSF (Engelmann spruce-subalpine fir), SWB (spruce willow birch), BWBS (boreal white and black spruce) and the ICH (interior cedar hemlock). There is pronounced transition in the ecology of the study area from east to west. The eastern study area is characterized by expansive high elevation plateaus while the west is more representative of rugged coastal mountainous terrain, with Mess Creek forming the effective border between these two geomorphologies (Plate 2.2-1).

Eastern Study Area (Mount Edziza Provincial Park)

Western Study Area (Above Schaft Creek)

Plate 2.2-1. Geomorphologies of the Wildlife Study Area.

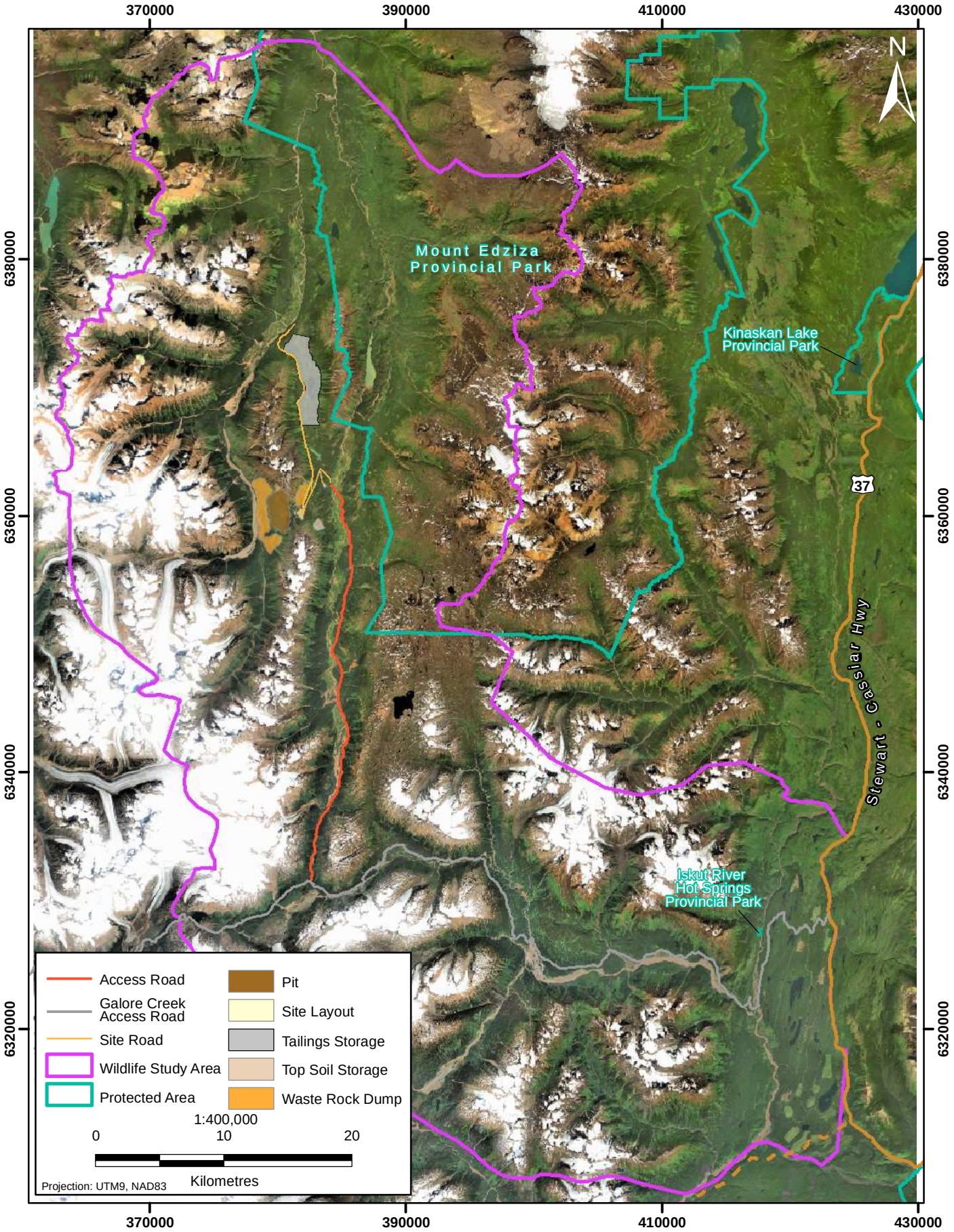


FIGURE 2.2-1

Schaft Creek Wildlife Study Area

For mountain ungulate surveys, the wildlife study area was partitioned into 15 survey units (SUs) near the development and along the transportation corridor, covering approximately 1,718 km^2 of the study area (Figure 2.2-2). Each SU encompassed suitable habitat that could be used by mountain ungulates during the summer and winter. SUs were delineated using topographic features that could limit the movement of mountain ungulates between units, e.g., low elevation valleys separating mountain ranges. Low elevation valleys would be unfavourable habitat for mountain ungulates, such as mountain goats, as goats are more vulnerable to predation in the absence of escape terrain. Thus, lower elevations represent a movement restriction for mountain goats. Delineating survey units in this way aids in reducing inter-unit movement within the survey period and increases the independence of each unit, which provides a fairly accurate population estimate for mountain ungulates within an area.

2.3 OBJECTIVES

The overall objective of this study was to collect baseline information on mountain ungulate (i.e., mountain goat, Stone's sheep, and northern caribou) distributions within the study area. A wildlife population is a group of organisms of the same species occupying a particular space at a particular time (RIC 1998). The specific objectives of this study were to:

- establish a baseline estimate of the seasonal population size and herd composition of mountain ungulates within the wildlife study area;
- establish baseline information on the distribution of mountain ungulates within the study area;
- assess habitat within the study area for occupancy by mountain ungulates; and
- identify characteristics of occupied winter and summer habitat.

2.4 MOUNTAIN UNGULATE AERIAL SURVEYS, 2006 AND 2008

To assess the seasonal abundance and distribution of mountain ungulates within the study area, aerial surveys were flown during the winter and summer of 2006. Surveys were flown during the winter of 2006 on March 6, 13, and 31, covering seven of the fifteen SUs (Table 2.4-1; Appendix 1). During the summer of 2006, surveys were conducted within nine of the fifteen SUs from July 17 – 19 (Table 2.4-1; Appendix 1). Six SUs were surveyed in both the winter and summer of 2006: SU G4, G5b, G6a, G6b, G6c, and G8 (Table 2.4-1).

At the request of BC MOE Skeena regional biologists, additional surveys were completed in winter and summer of 2008. Surveys were focused within SUs not covered in 2006; however, several SUs were resurveyed to control for seasonal differences between years (SUs G4, G6b, and G6c). On February 8, 2008, surveys were conducted in three SUs, but surveys were suspended until March 19 due to poor weather. Winter surveys were completed on March 19 and 20 and covered four SUs. During the summer, surveys were flown in four SUs on August 2 and 3. In 2008, two SUs, SU G2 and G3, were surveyed both in the winter and summer: SU G3 was also surveyed in summer 2006 (Table 2.4-1). SUs G1, G7, and G12 were the only areas not surveyed twice across the two year baseline study (Table 2.4-1).

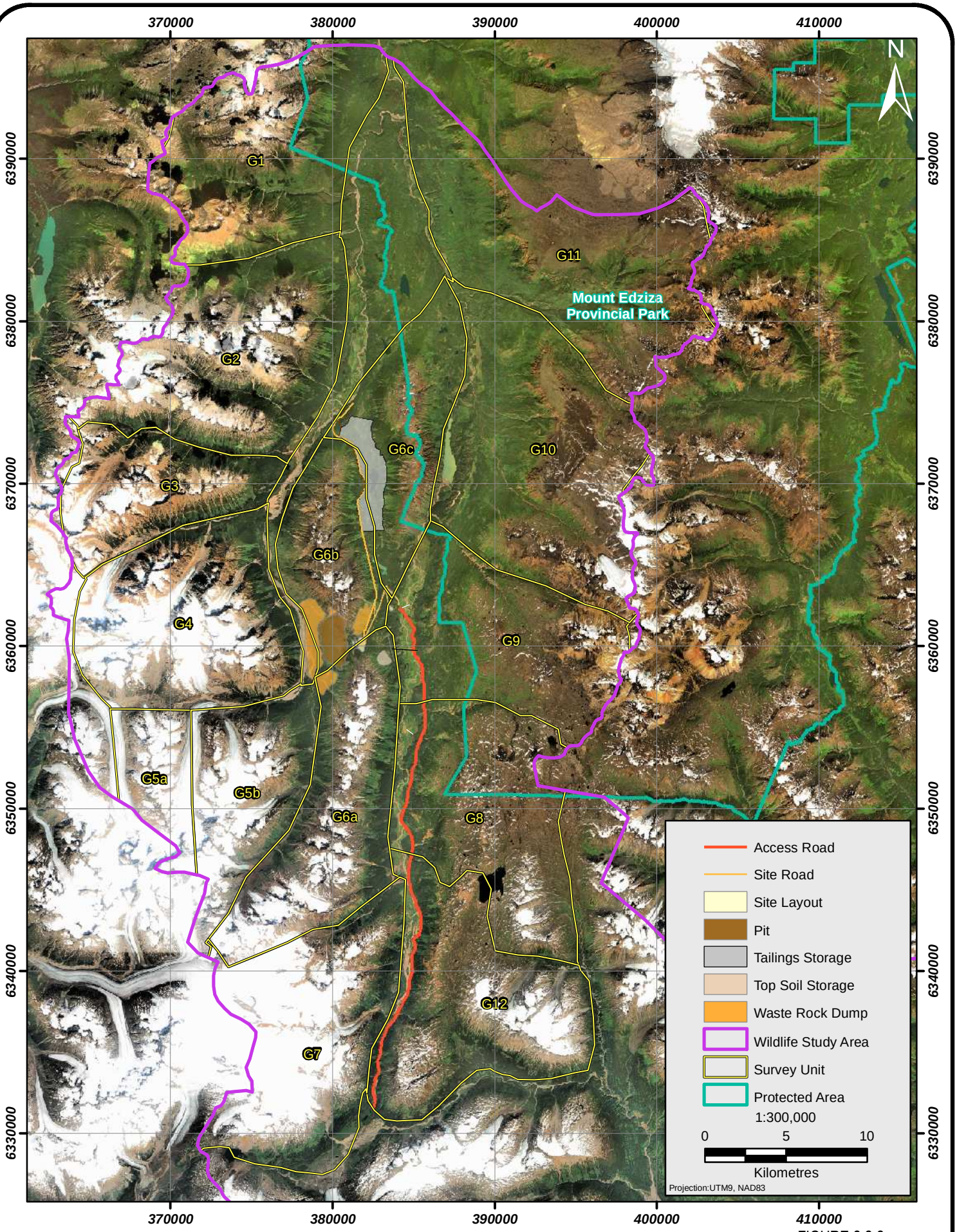


FIGURE 2.2-2

Mountain Ungulate Survey Units

Table 2.4-1. Survey Units Flown in 2006 and 2008

Survey Unit	Winter 2006	Summer 2006	Winter 2008	Summer 2008
G1				√
G2			√	√
G3		√	√	√
G4	√	√	√	
G5a				
G5b	√	√		
G6a	√	√		
G6b	√	√	√	
G6c	√	√	√	
G7				√
G8	√	√		
G9		√	√	
G10		√	√	
G11				
G12	√			

The methods used to inventory mountain ungulates adhered to the aerial survey protocol as described by the Resource Information Standards Committee of BC (RIC 2002). This included the use of a Bell 206 helicopter with two observers, a pilot, and a navigator. The helicopter maintained an average speed of approximately 100 km/hour. Helicopter speed changed with wildlife sightability - faster over open areas where sightability was good and slower over areas where visibility was obscured by vegetation cover. Survey effort was predominately directed in areas above the treeline due to difficulty in observing animals under closed canopy forest. For mountain goats and Stone sheep, effort was primarily directed around escape terrain while relatively flatter topography was surveyed for northern caribou. Flight lines followed topographic contours or identifiable features and were spaced at intervals of approximately 200 m. Flight paths were recorded using a hand-held Garmin GPS 76 unit with an external antenna.

Each sighting of goat, sheep, or caribou was geo-referenced and the number of animals was counted. Goats were classified as adults or kids, Stone's sheep were classified as rams, ewes, or lambs, and caribou were classified as bulls, cows, or calves (RIC 2002). Animals that could not be aged or sexed with confidence were recorded as unidentified. For each observation, the dominant vegetation cover type and habitat suitability rating (HSR) were recorded, based on the presence of topographic and vegetative features used for habitat suitability modelling in the region. A HSR of one represented the most suitable habitat based on provincial benchmarks, while a HSR of six represented habitat devoid of habitat features that could be used by mountain ungulates. Incidental observations of all other wildlife species were recorded during aerial surveys and were geo-referenced wherever possible.

2.5 AERIAL SURVEY EFFORT, 2006 AND 2008

The calculation of survey effort, represented as a ratio of time to area, allows for an assessment of the survey intensity. Survey effort was determined in three ways: as the ratio of survey time to total area within each SU, the ratio of survey time to the area surveyed within each SU (referred to as census area), and as the ratio of survey time to the amount of capable goat and sheep habitat within each SU. The total area for each SU included the whole area within the boundaries of the survey unit (Appendix 1). Census area included the area covered by helicopter flight lines, with a maximum extent of 500 m above and below the horizontal position of flight line on the slope. Capable habitat was

calculated as the area of suitable escape terrain and all area within 500 m of the escape terrain within each SU. Escape terrain was identified using the Digital Elevation Model (DEM) with 1:20,000 Terrain Resource Inventory Mapping (TRIM) data; defined as rocky, barren areas that have a slope of 40° to 70°. Maps of survey flightlines, census areas, and capable habitat areas are included in Appendix 2.

Winter surveys were conducted over six days (three days each year) during February and March, 2006 and 2008 (Section 2.4). A total of 11.5 hours of survey time was directed at 732 km^2 of habitat (total area) in seven SUs in 2006 and 9.4 hours over 736 km^2 of habitat in seven SUs during 2008 (Appendix 1). Average winter survey effort ranged from 0.76 ± 0.12 and 0.97 ± 0.13 (based on total area) (Table 2.5-1).

Table 2.5-1. Summary of Survey Effort by Total Area, Census Area, and Area of Capable Habitat, 2006 and 2008

	Survey Effort (min/km^2 ± SE[1])			
Focal Area	**Winter 2006**	**Summer 2006**	**Winter 2008**	**Summer 2008**
Total Area				
Range within SUs	0.19 –1.20	0.40 –1.01	0.25 – 1.12	0.32 – 1.15
Average	0.97 ± 0.13	0.55 ± 0.07	0.76 ± 0.12	0.72 ± 0.20
Census Area				
Range within SUs	0.43 – 1.78	0.56 – 1.20	1.21 – 1.54	1.28 – 2.23
Average	1.36 ± 0.17	0.84 ± 0.07	1.38 ± 0.04	1.78 ± 0.20
Capable Habitat				
Range within SUs	0.31 – 3.88	0.65 – 3.52	0.61 – 1.32	0.48 – 1.53
Average	1.89 ± 0.48	0.95 ± 0.29	1.08 ± 0.13	0.94 ± 0.24

Summer surveys were conducted over the course of five days: three days in July, 2006, and two days in August, 2008 (Section 2.4). Approximately 976 km^2 of habitat across nine SUs (total area) was surveyed over a period of 10.1 hours in 2006: 5.7 hours were used in 2008 to survey approximately 448 km^2 of habitat within four SUs (Appendix 1). Average summer survey effort ranged from 0.55 ± 0. 0.7 to 0.72 ± 0.20 (based on total area) (Table 2.5-1).

[1] ± Standard Error (SE). All subsequent variation (±) is reported in standard error unless otherwise stated.

3. Mountain Goat

3. Mountain Goat

3.1 BACKGROUND INFORMATION

The total number of mountain goats in British Columbia was estimated at approximately 50,000 individuals in 2000 (Blood 2000a; Côté and Festa-Bianchet 2003), of which approximately 16,000 to 35,000 occur within the Skeena Region (BC ILMB 2009). Mountain goats are widely distributed throughout the province and can be found in most major mountain ranges except those on coastal islands (e.g., Vancouver and Queen Charlotte Islands) (Blood 2000a). While suitable habitat for mountain goats is found throughout the province, mountain goat are most numerous in northern BC, although the southern Rocky Mountain and Coast Mountain ranges support substantial populations (Blood 2000a; Demarchi, Johnson, and Searing 2000).

The Cassiar Iskut-Stikine LRMP has mapped high value winter habitat (i.e., interim winter range) and natal (kidding) habitat within the plan area, some of which are located within the wildlife study area (Section 2.2; BC ILMB 2000). Interim winter range and kidding habitat were considered during delineation of survey units: high value winter and kidding habitat occurs to the east within Mount Edziza Provincial Park (e.g., southern Big Raven Plateau [SU G11], Kitsu Plateau [SU G10], Spectrum Range [SU G9]), as well as on several ridges around the development area including the southwestern slopes of Mount LaCasse (SU G6b) and the adjacent northeast facing slope across Schaft Creek (SU G4), the isolated mountain bounded between Skeeter Lake and Mess Lake (SU G6c), and other southeastern slopes on the west side of Schaft Creek (SU G2 and SU G3).

Mountain goats are vulnerable to overharvest and are sensitive to disturbances from human activities (e.g., Foster and Rahs 1983; Hutchins and Stevens 1981; Varley 1998), and are particularly sensitive to helicopter over-flights (Côté 1996; Goldstein et al. 2005). Mountain goats have demonstrated some habituation to noise and human disturbance; however, goats may temporarily restrict their use of previously occupied areas (National Park Service 1994). To reduce disturbance to mountain goats in BC, the Ministry of Environment (2006) set guidelines prohibiting helicopter activity within a minimum distance of 1.5 km of goat habitat throughout the year, and larger buffers (i.e., beyond 1.5 km) are recommended during the kidding season (May to July).

3.2 DATA ANALYSIS METHODOLOGY

3.2.1 Population Characteristics

The total number of mountain goats observed, group size and composition, kid-to-adult ratios, and density were calculated. Group size included a total count of animals seen at each sighting. Group composition included three categories; single (solitary goat), nursery group (kids present), and non-nursery groups (no kids present).

Density was calculated for mountain goats for each survey unit by dividing the number of animals observed by the total area, census area, and the area of capable habitat of each (See Section 2.5 for definitions of total, census, and capable areas). Survey estimates were not adjusted for sightability, as no suitable model exists for establishing sightability for mountain goats in BC (RIC 2002; Ayotte 2005).

3.2.2 Spatial Distribution

Spatial survey data were examined for evidence that mountain goats were selecting particular topographic features, including elevation, slope, aspect, and distance to escape terrain. Aspect is reported in the observed aspect or aspect bearing (°). For analytical purposes, the aspect bearing was separated into the cardinal directions (e.g., N, NE, E), which included a range of degrees shown in Plate 3.2-1. Sightings (e.g., categorical [single, nursery group, or non-nursery group] or pooled) provided the basis for analysis: the topographical features at goat sightings were derived from DEM with 1:20,000 TRIM data.

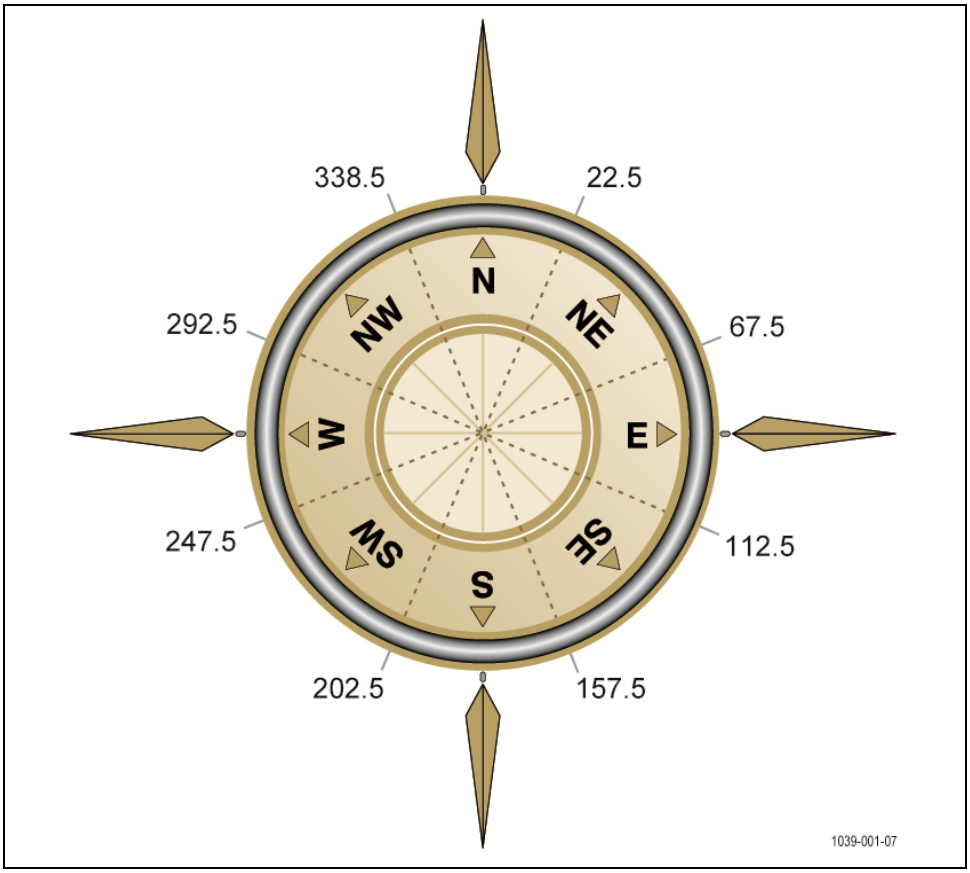


Plate 3.2-1. Definitions for Cardinal Aspects.321

The spatial data associated with each sighting except aspect were compared using Analysis of Variance (ANOVA), to test whether there were differences in habitat selection among SUs, seasons, and years. Aspect is recorded as circular data bounded between 0° and 359°; an ANOVA could not be performed on this data type. Circular data analyses were preformed instead using the Watson's U Test. The null hypothesis (H_0) that there were no differences in the topographic features associated with goat sightings among SUs, seasons, and years. Significant results were indicated by a P value of less than 0.05 (alpha value). Where data did not meet the assumptions of ANOVAs, non parametric tests were used (e.g., Kruskal-Wallis Analysis of Variance on Ranks). In the case of significant results, pairwise comparisons were conducted with a Tukey HSD test for normal data or the Dunn's method for non-normal data. Tests were conducted using JMP v.6, SigmaStat v3.1, and Oriana 3. Analyses were performed on both pooled sighting data (no group composition category) and group composition category data. For aspect, tests were limited to pooled sighting data between seasons and years.

Boxplots were also used to visually describe the spread in the sighting data, using six descriptive percentile summaries: the 5th percentile (representing 5% of all data points), 25th percentile or the lower quartile (representing 25% of data points), the mean (arithmetic mean [$\overline{X}$], representing the average of all data points), median (representing the middle or 50% of all data points), 75th percentile or upper quartile (representing 75% of data points), and the 95th percentile (representing 95% of all data points). For aspect, the mean represented the mean direction, which was calculated in Oriana 3.

3.3 RESULTS

3.3.1 Population Characteristics

3.3.1.1 Summary

Over the two year baseline study, goats were observed in 11 of the 13 SUs that were surveyed (Table 2.4-1), with no observations in SU G1 and G12 (Appendix 3). An example of habitat surveyed is shown in Plate 3.3-1. During the four surveys (winter and summer, 2 surveys per 2006 and 2008), a number of goats were observed (Table 3.3-1). The most goats recorded during any one survey was during the summer 2006 survey, where 132 individuals were observed within 8 SUs. Observations of solitary goats were most common (49% of sightings), while nursery groups accounted for 24% of sightings and non-nursery groups accounted for 27%.

a) Low Elevation Winter Habitat

b) High Elevation Summer Habitat

Plate 3.3-1. Examples of Habitat Surveyed.

Table 3.3-1. Summary of Mountain Goat Population Characteristics, 2006 and 2008

	Winter			Summer		
Year	No. of Goats	Kid-to-Adult Ratio	Density[1] (goat/km²)	No. of Goats	Kid-to-Adult Ratio	Density[1] (goat/km²)
2006	92	0.23	0.18 ± 0.04	132	0.12	0.22 ± 0.05
2008	106	0.23	0.18 ± 0.04	22	0.10	0.08 ± 0.03
All	198	-	0.18 ± 0.03	154	-	0.18 ± 0.04

1 Average density based on capable habitat, calculated from density of goats per SU, excluding SU where no goats were seen (Section 3.3.2.2 and 3.3.2.3).

The density of goats was calculated across three scales: total area, census area, and area of capable habitat (Section 3.2.1.1). However, for this report, density is discussed only for area of capable habitat, since this

provides a better, biologically relevant comparison between SUs. Summer capable habitat density ranged from 0.08 ± 0.03 goat/km^2 (2008) to 0.22 ± 0.05 goat/km^2 (2006). Winter densities were equal in 2006 and 2008, averaging 0.18 ± 0.04 goat/km^2. Overall average densities over both years were very similar between seasons, at 0.18 ± 0.04 goat/km^2 in winter and 0.18 ± 0.03 goat/km^2 in summer (Table 3.3-1).

The ability to detect goats varies between seasons due to coat colour and seasonal habitat preferences, with the sightability of goats being better during the summer than in winter (RIC 1999). Hence, within SUs that were resurveyed between seasons, there was a poor correlation between summer and winter results (R^2 = 0.40) (Table 3.3-1). For this reason, all analyses were conducted separately on summer and winter data. Density estimates were calculated for both summer and winter. However, estimates should be considered with caution, particularly during the winter as sightability of goats is low in forested, low elevation winter habitat.

Two potential mineral licks were indentified in the study area. One was recorded during the winter 2006 survey (see Figure 3.3-1 in Section 3.3.1.2). The other was identified by the terrestrial ecosystem mapping crew in the summer of 2008 (Plate 3.3-2; see Figure 3.3-3 in Section 3.3.1.3).

Plate 3.3-2. Mineral lick documented by the Terrestrial Ecosystem Mapping Crew, July 2008.

3.3.1.2 2006 Surveys

During winter surveys in 2006, 92 goats were observed in 46 groups over eight SUs and 443 km^2 (capable area) (Figure 3.3-1; Tables 3.3-2 and 3.3-3; Appendices 1 and 3). While surveying SU G6a, survey flightlines extended into the adjacent SU (SU G7), where two sightings of goats were recorded. These goats were included in the total for SU G7, although no survey effort was directed in that area in 2006. Goats were not observed in SU G12 during winter surveys. The winter kid-to-adult ratio was 23 kids per 100 adults (Table 3.3-2). One potential mineral lick was identified in SU G6a during the winter survey (Figure 3.3-1).

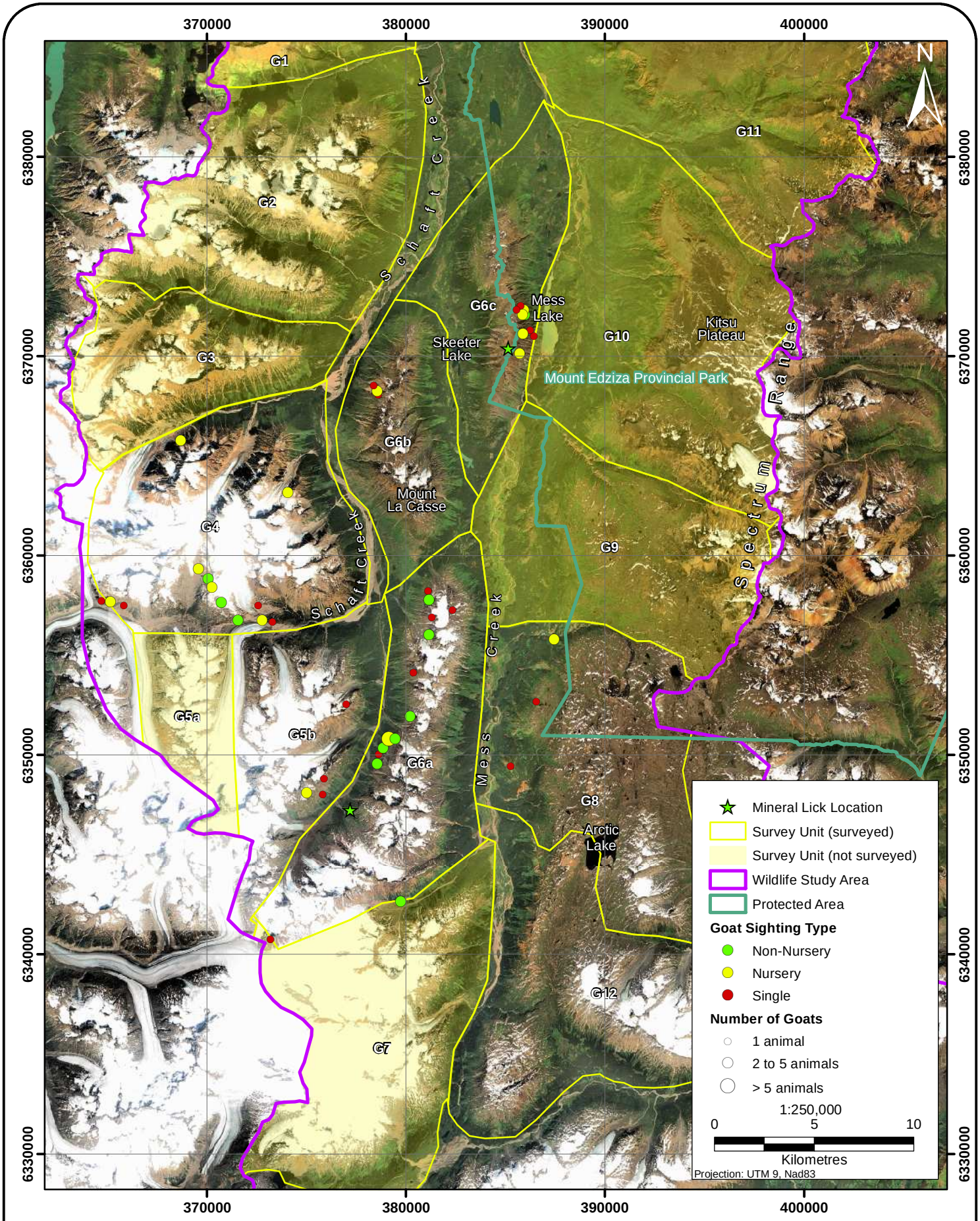


FIGURE 3.3-1

Mountain Goat Winter Sightings, 2006

Table 3.3-2. Mountain Goat Observations and Population Characteristics by Survey Unit, 2006

Survey Unit	No. of Goats			Kid-to-Adult Ratio	Density (goat/km²)		
	Total	Adults	Kids		Total Area	Census Area	Capable Habitat
Winter 2006							
G4	27	20	7	0.35	0.20	0.24	0.23
G5b	7	6	1	0.17	0.09	0.11	0.10
G6a	25	24	1	0.40	0.22	0.27	0.25
G6b	4	3	1	0.33	0.06	0.09	0.08
G6c	17	12	5	0.42	0.22	0.37	0.38
G7	5	5	0	0	0.04	-	0.05
G8	7	6	1	0.17	0.05	0.08	0.15
G12	0	0	0	0	0	0	0
All	**92**	**70**	**16**	**0.23**			
Average					**0.11 ± 0.03**	**0.17 ± 0.05**	**0.15 ± 0.04**
Summer 2006							
G3	0	0	0	0	0	0	0
G4	13	12	1	0.08	0.10	0.12	0.11
G5b	11	10	1	0.10	0.14	0.16	0.16
G6a	48	41	7	0.17	0.42	0.50	0.47
G6b	7	7	0	0	0.11	0.16	0.14
G6c	10	9	1	0.11	0.13	0.27	0.22
G8	2	1	1	1.00	0.02	0.02	0.04
G9	10	10	0	0	0.08	0.12	0.19
G10	31	28	3	0.11	0.18	0.32	0.42
All	**132**	**118**	**14**	**0.12**			
Average					**0.13 ± 0.04**	**0.18 ± 0.05**	**0.19 ± 0.05**

Winter density (based on capable habitat) averaged 0.15 ± 0.04 goats/km² (range: 0 to 0.38) (Table 3.3-2). One SU was devoid of goats (SU G12); the average density of goats increased to 0.18 ± 0.04 goats/km² when this SU was dropped from calculations. The majority of winter observations occurred in SUs G4 (29%), G6a (27%), and G6c (18%). SUs G6a and G6c also supported the highest density of goats (Table 3.3-2).

During summer, 132 goats were observed in 53 groups over nine SUs and 556 km² (capable area) (Figure 3.3-2; Tables 3.3-2 and 3.3-3; Appendices 1 and 3). Goats were not observed in SU G3 during summer surveys. The summer kid-to-adult ratio was 12 kids per 100 adults (Table 3.3-2). As in winter, SUs G6a (36% of total) and SU G4 (10%) contained higher numbers of goats during the summer surveys. Large numbers of goats were also seen in SU G10 (23%), an area not surveyed during the winter.

Summer density across nine SUs was higher than during winter, with an average of 0.19 ± 0.05 goats/km² (range: 0 to 0.47) (Table 3.3-2). When the single SU without goats (SU G3) was removed from calculations, density increased to 0.22 ± 0.04 goats/km². As in the winter, SU G6a had a high density of goats in the summer, as did SU G10 (Table 3.3-2).

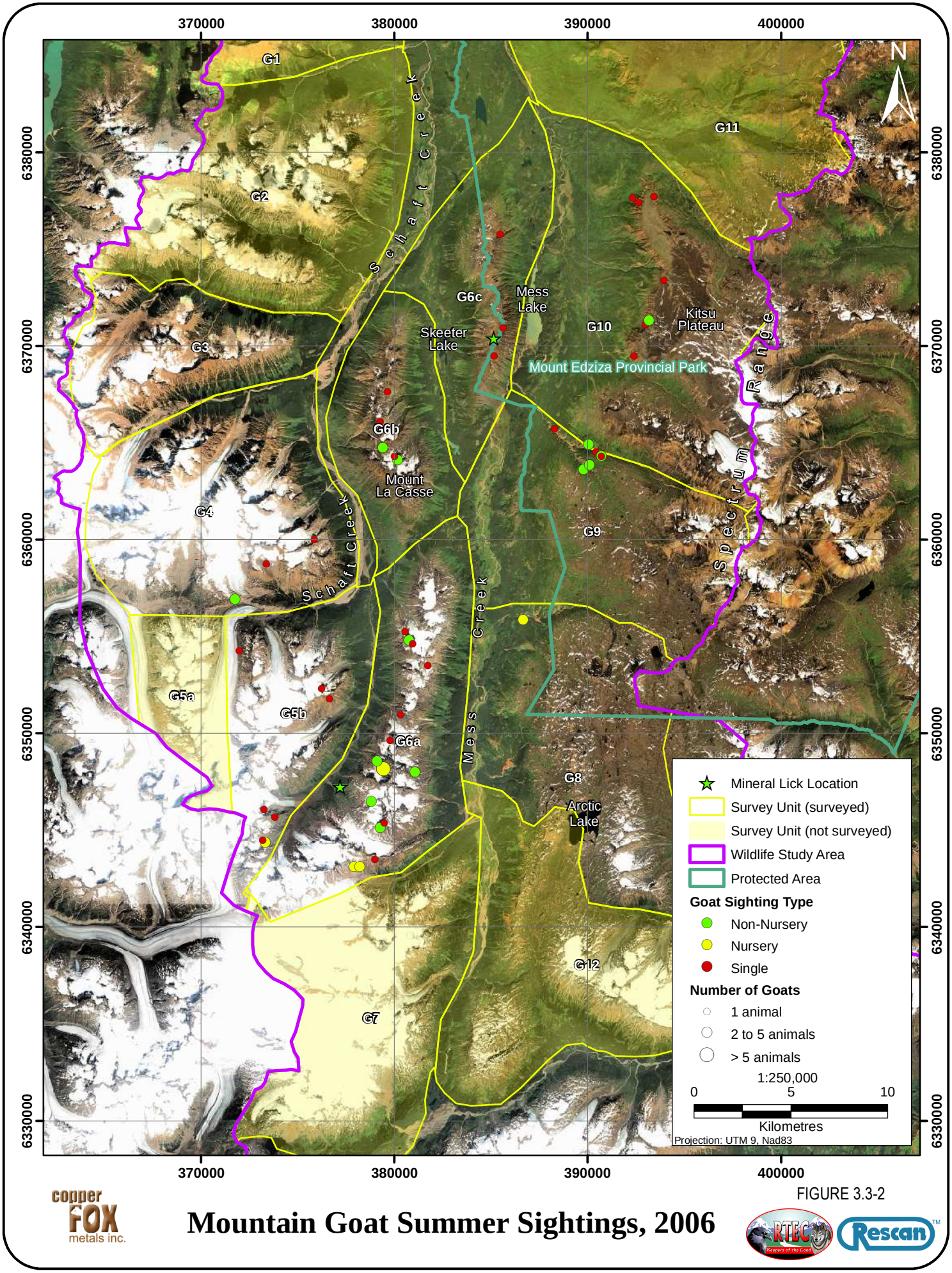


FIGURE 3.3-2

Mountain Goat Summer Sightings, 2006

Observations of single goats were most frequent; 46% and 57% of sightings during the winter and summer, respectively (Table 3.3-3). Observations of groups of goats were almost equally split between nursery and non-nursery groups in both seasons (Table 3.3-3). Group size varied, with nursery groups averaging 5 ± 0.6 individuals and non-nursery groups averaging 3 ± 0.2. Nursery groups most often contained just one kid among adults; however, four kids were observed in one nursery group in SU G6a during summer surveys (Appendix 3).

Table 3.3-3. Summary of Mountain Goat Sightings and Group Composition, 2006

	Winter 2006				Summer 2006			
Survey Unit	**Single**	**Nursery**	**Non-Nursery**	**Total**	**Single**	**Nursery**	**Non-Nursery**	**Total**
G3	-	-	-	**-**	0	0	0	0
G4	4	6	3	**13**	2	1	1	4
G5b	3	1	0	**4**	6	1	0	7
G6a	5	1	6	**12**	7	4	5	16
G6b	1	2	0	**3**	3	0	2	5
G6c	5	3	1	**9**	3	1	0	4
G7	1	0	1	**2**	-	-	-	-
G8	2	1	0	**3**	0	1	0	1
G9	-	-	-	**-**	3	0	3	6
G10	-	-	-	**-**	6	2	2	10
G12	0	0	0	**0**	-	-	-	-
All	**21**	**14**	**11**	**46**	**30**	**10**	**13**	**53**

3.3.1.3 2008 Surveys

During winter surveys in 2008, 106 goats were observed in 46 groups over eight SUs and 565 km^2 (capable area) (Figure 3.3-3; Tables 3.3-4 and 3.3-5; Appendices 1 and 3). While surveying SU G9, survey flightlines extended into the adjacent SU (SU G8), where one sighting of goats was recorded. These goats were included in the total for SU G8, although no survey effort was directed in that area in 2008. The winter kid-to-adult ratio was 23 kids per 100 adults (Table 3.3-4).

Winter density (based on capable habitat) averaged 0.18 ± 0.04 goats/km^2 (range: 0.4 to 0.44) (Table 3.3-4). The majority of winter observations were recorded in SUs G4 (29%) and G6a (21%). These two SUs also supported the highest density of goats (Table 3.3-4).

During summer, 22 goats were observed in 9 groups over four SUs and 352 km^2 (capable area) (Figure 3.3-4; Tables 3.3-4 and 3.3-5; Appendices 1 and 3). Goats were not observed in SU G1 during the summer survey. The summer kid-to-adult ratio was 10 kids per 100 adults (Table 3.3-4). Over half (68%) of the summer observations occurred in SU G2.

Summer density across four SUs was much lower than during winter, with an average of 0.06 ± 0.03 goats/km^2 (range: 0 to 0.10) (Table 3.3-5). When the single SU without goats (SU G1) was removed from calculations, density increased to 0.08 ± 0.04 goats/km^2. As the majority of goats were observed in SU G2, this SU had the highest density (Table 3.3-4).

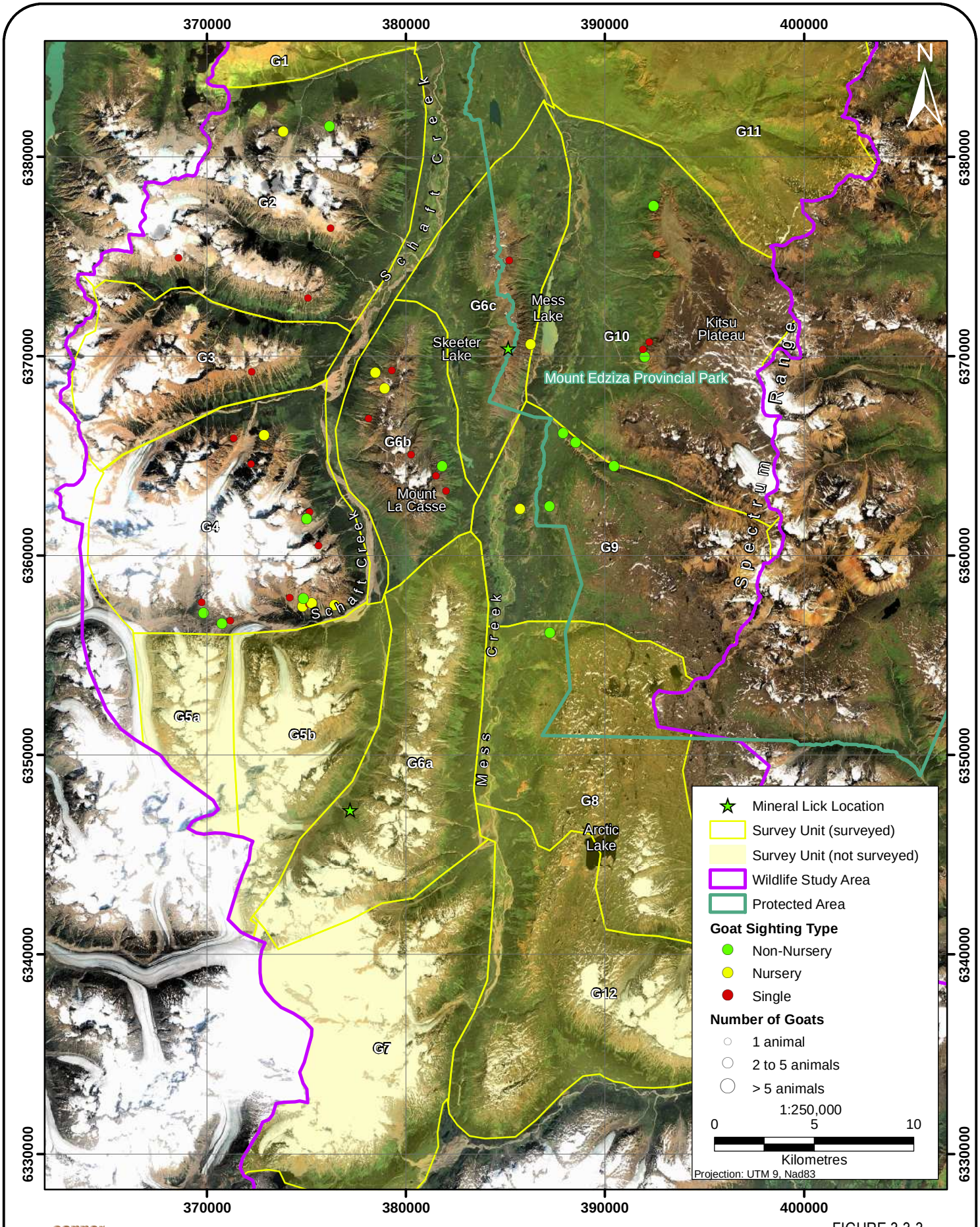


FIGURE 3.3-3

Mountain Goat Winter Sightings, 2008

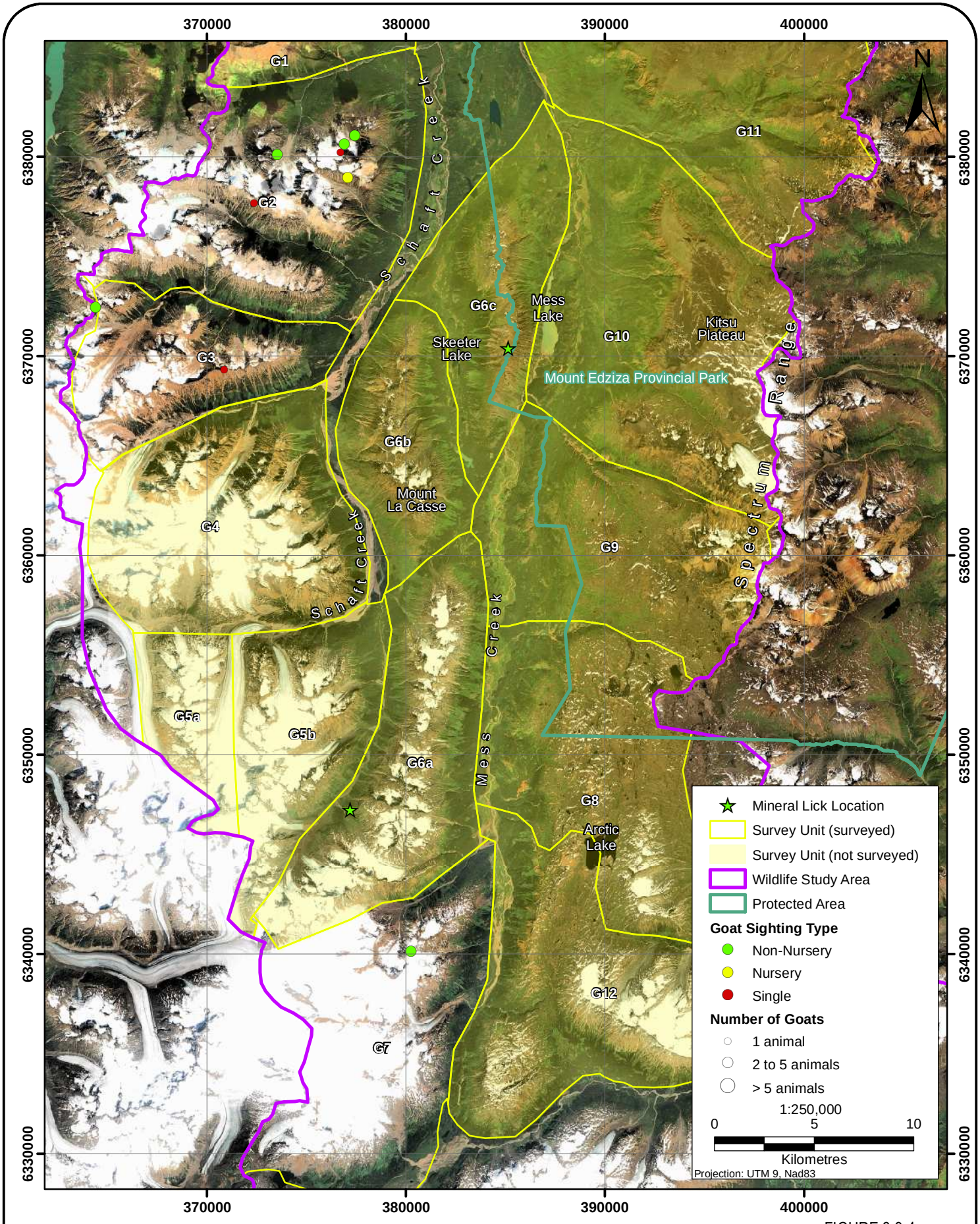


FIGURE 3.3-4

Mountain Goat Summer Sightings, 2008

Table 3.3-4. Mountain Goat Observations and Population Characteristics by Survey Unit, 2008

Survey Unit	No. of Goats			Kid-to-Adult Ratio	Density (goat/km²)		
	Total	Adults	Kids		Total Area	Census Area	Capable Habitat
Winter 2008							
G2	16	11	5	0.45	0.11	0.15	0.15
G3	9	6	3	0.50	0.12	0.15	0.13
G4	31	27	4	0.15	0.23	0.39	0.26
G6b	22	16	6	0.38	0.34	0.53	0.44
G6c	5	4	1	0.25	0.06	0.12	0.11
G8	2	2	0	0	0.02	-	0.04
G9	12	11	1	0.09	0.10	0.33	0.23
G10	9	9	0	0	0.05	0.24	0.12
All	**106**	**86**	**20**	**0.23**			
Average					**0.13 ± 0.04**	**0.27 ± 0.06**	**0.18 ± 0.04**
Summer 2008							
G1	0	0	0	0	0	0	0
G2	15	13	2	0.15	0.10	0.17	0.14
G3	5	5	0	0	0.07	0.09	0.07
G7	2	2	0	0	0.01	0.08	0.02
All	**22**	**20**	**2**	**0.10**			
Average					**0.05 ± 0.02**	**0.08 ± 0.03**	**0.06 ± 0.03**

Table 3.3-5. Summary of Mountain Goat Sightings and Group Composition, 2008

Survey Unit	Winter 2008				Summer 2008			
	Single	Nursery	Non-Nursery	Total	Single	Nursery	Non-Nursery	Total
G1	-	-	-	-	0	0	0	0
G2	3	2	1	6	2	1	3	6
G3	1	1	0	2	1	0	1	2
G4	8	4	4	16	-	-	-	-
G6b	5	3	1	9	-	-	-	-
G6c	1	1	0	2	-	-	-	-
G7	-	-	-	-	0	0	1	1
G8	0	0	1	1	-	-	-	-
G9	0	1	4	5	-	-	-	-
G10	3	0	2	5	-	-	-	-
All	21	12	13	46	3	1	5	9

Similar to 2006, single goats were recorded most frequently on surveys; 46% and 33% of sightings during the winter and summer, respectively (Table 3.3-5). More non-nursery groups were seen in both seasons (Table 3.3-5). Nursery groups tended to be larger than non-nursery groups: 5 ± 0.6 individuals *vs*. 2 ± 0.2 individuals. Over half of the nursery groups contained only one kid (54%); the remaining sightings were equally split between nurseries containing 2 or 3 kids (Plate 3.3-3; Appendix 3).

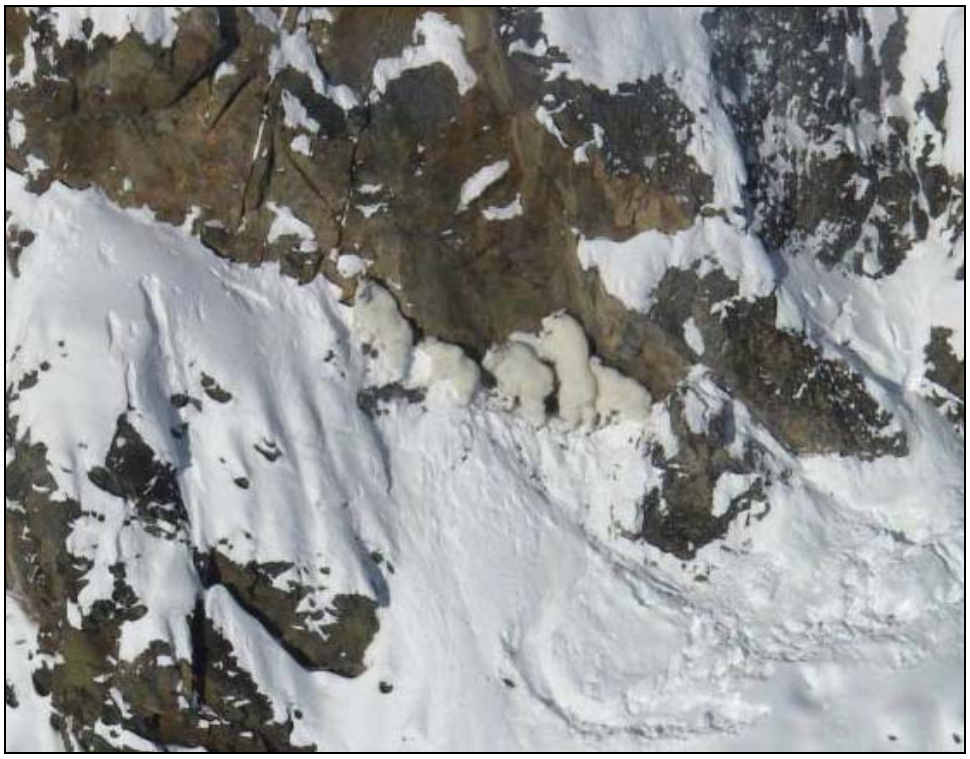


Plate 3.3-3. Mountain Goat Nursery Group (three adults, two kids) seen during the winter 2008 survey.

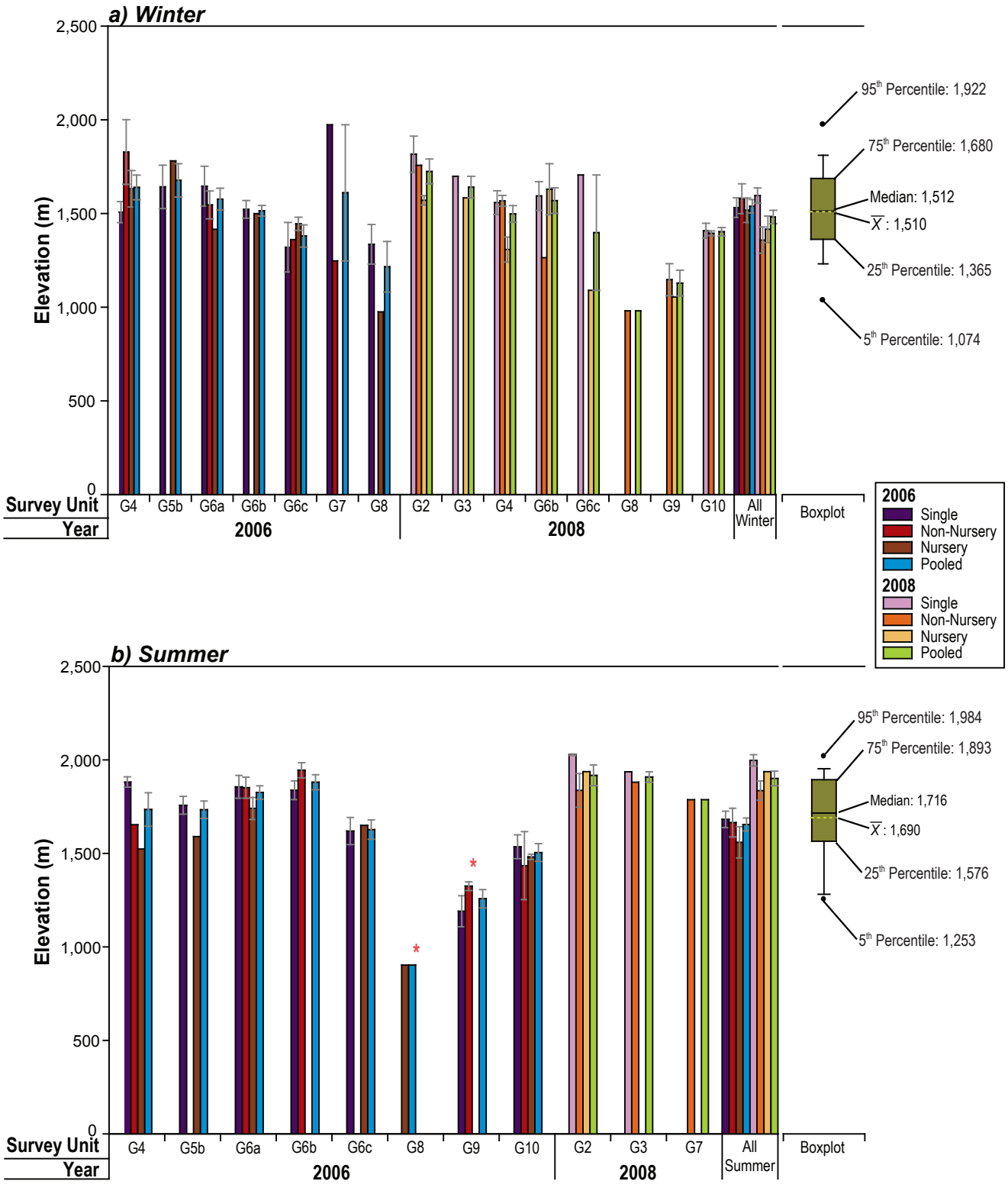
3.3.2 Spatial Distribution

3.3.2.1 Summary

The topographic features associated with all 154 sightings of mountain goats from winter and summer surveys of 2006 and 2008 were analysed using ANOVAs or non-parametric alternatives (Mann-Whitney, Kruskal-Wallace Rank tests). Pooled sighting data suggested that there were differences in some topographic features, in particular elevation, analyzed between seasons (winter and summer) but generally not between SUs or years. There was no difference in habitat occupied between single goats, nursery groups, and non-nursery groups. Multiple comparison procedures were utilized to isolate driving forces for observed differences. Results are presented in the follow sections by topographic feature.

3.3.2.2 Elevation

Mountain goats were observed at lower elevations during the winter and at higher elevations during the summer (ANOVA; $p<0.001$), however there were no differences between 2006 and 2008 (ANOVA; $p=0.062$). During winter, the mean elevation goats sightings was 1,510 ± 25 m and 90% of goat sightings were recorded between 1,074 and 1,922 m (Figure 3.3-5a; Appendix 3). During summer, goats were observed at higher elevations, $\overline{X}$ =1,690 ± 32.3 m, with 90% of sightings between 1,252 and 1,984 m (Figure 3.3-5b; Appendix 3).



*Note: * Statistically Different*

FIGURE 3.3-5

Mean Elevation of Mountain Goat Sightings by Survey Unit, 2006 and 2008

Mountain goats were observed at lower elevations in SUs G8 and G9 in both the winter and summer (ANOVA, Tukey HSD; $p<0.001$) (Figure 3.3-5b). However, sample sizes were very small in these SUs, which means that these statistical differences may not be biologically relevant. Different groups of goats (single goats, non-nursery groups, and nursery groups) were observed at similar elevations (ANOVA; $p=0.127$) (Figures 3.3-5a and 3.3-5b).

3.3.2.3 Aspect

The mean direction of goat sightings was similar between seasons (Watson U^2; $p > 0.1$) and years (Watson U^2; $p > 0.1$). Goats were observed on a wide range of aspects in both seasons. However, goats appeared to more frequently occupy warmer aspects over cooler ones. Of all mountain goat sightings, 90% were between 70 and 312° in winter and (Figure 3.3-6a) and 37° to 297° in summer (Figure 3.3-6b)

3.3.2.4 Slope

Goats were observed on a mean slope of 40 ± 1° in winter, with 90% of sightings on slopes between 21 to 54° (Figure 3.3-7a). Goats were observed on steeper slopes during winter than in summer (Mann-Whitney, $p<0.001$), but there were no differences between 2006 and 2008 ($p=0.546$). The slope of goat sightings in summer was 36 ± 1°, with 90% of all sightings between 20 and 49° (Figure 3.3-7b). Of all sightings, 75% were recorded on slopes steeper than 37° in the winter and steeper than 32° in the summer (Figures 3.3-7a and 3.3-7b).

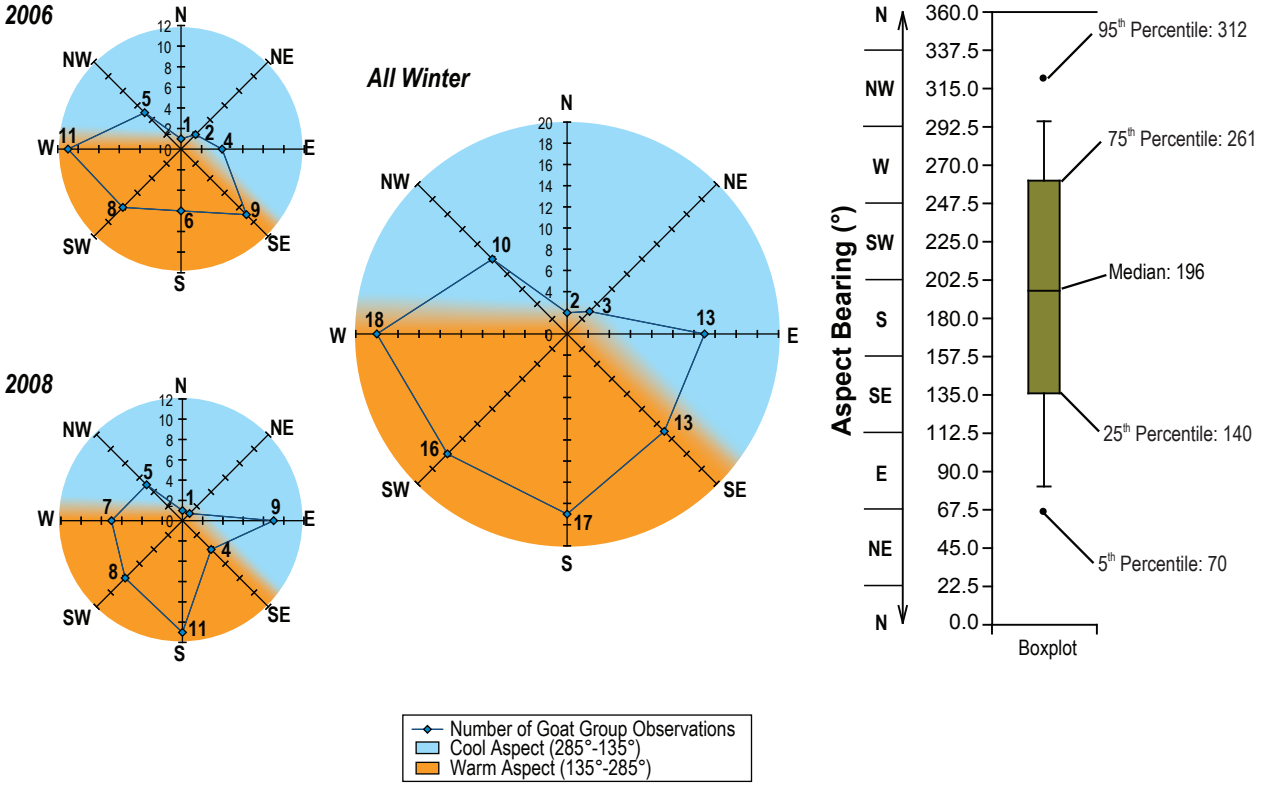
There was no difference in the slope of goat sightings between survey units during winter (Kruskal-Wallace; $p=0.280$) or summer ($p=0.098$). There was also no difference between the slopes occupied by single goats, non-nursery groups, and nursery groups (Kruskal-Wallace; $p=0.851$) (Figures 3.3-7a and 3.3-7b).

3.3.2.5 Distance to Escape Terrain

During winter, the mean observed distance of goats to escape terrain was 99 ± 15 m, with 90% of all sightings recorded were between 0 and 247 m (Figure 3.3-8a). During the summer, goats were closer to escape terrain (Mann-Whitney; $p=0.005$), with a mean of 56 ± 9 m and 90% of all sightings falling between 0 and 204 m (Figure 3.3-8b). There was no difference in distance to escape terrain between 2006 and 2008 (Mann-Whitney; $p=0.315$).

Most goats were observed in class 1 or 2 habitat in the winter (85% of sightings) and in the summer (70%). Class 1 and 2 habitat supports preferred forage species, such as shrub and conifer vegetation, and occurs within 200 m of escape terrain. No biologically relevant trends in the observed distances of goats to escape terrain were observed when analyzed by SU. There was also no difference between how far single goats, non-nursery groups, and nursery groups were from escape terrain (Kruskal Wallace; $p=0.501$) (Figures 3.3-8a and 3.3-8b).

a) Winter



b) Summer

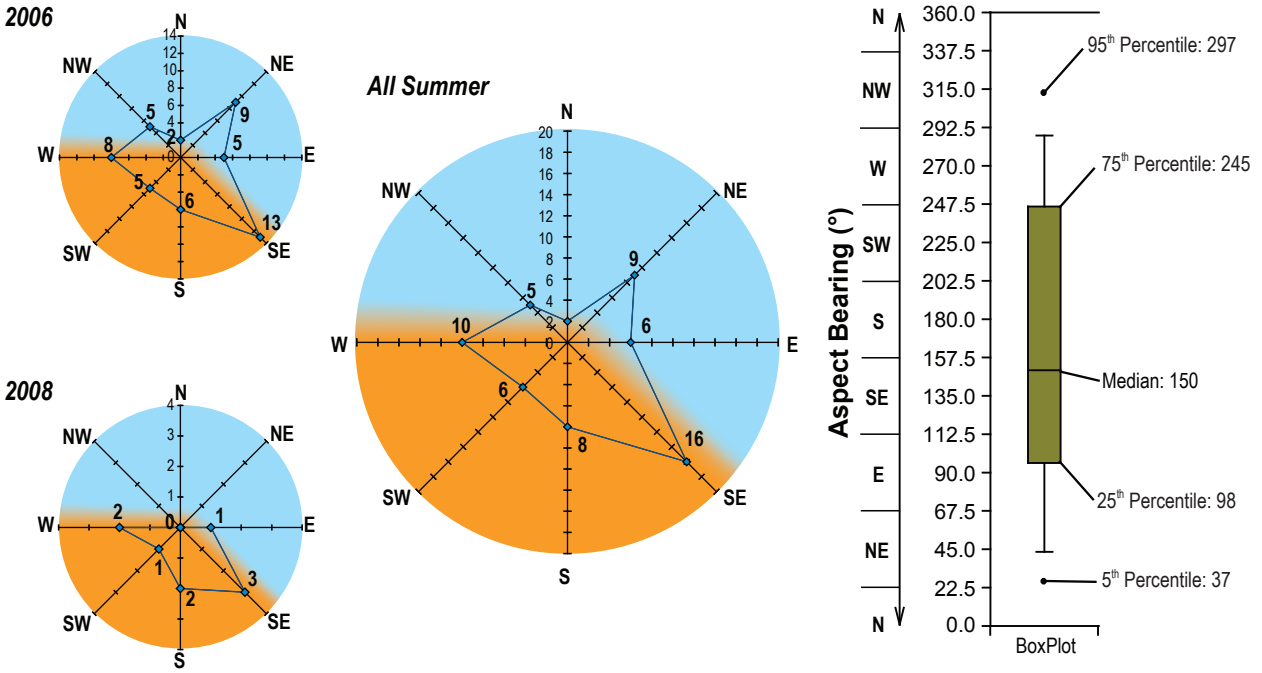


FIGURE 3.3-6

Observed Aspect of Mountain Goat Sightings, 2006 and 2008

copper FOX metals inc.

Rescan™

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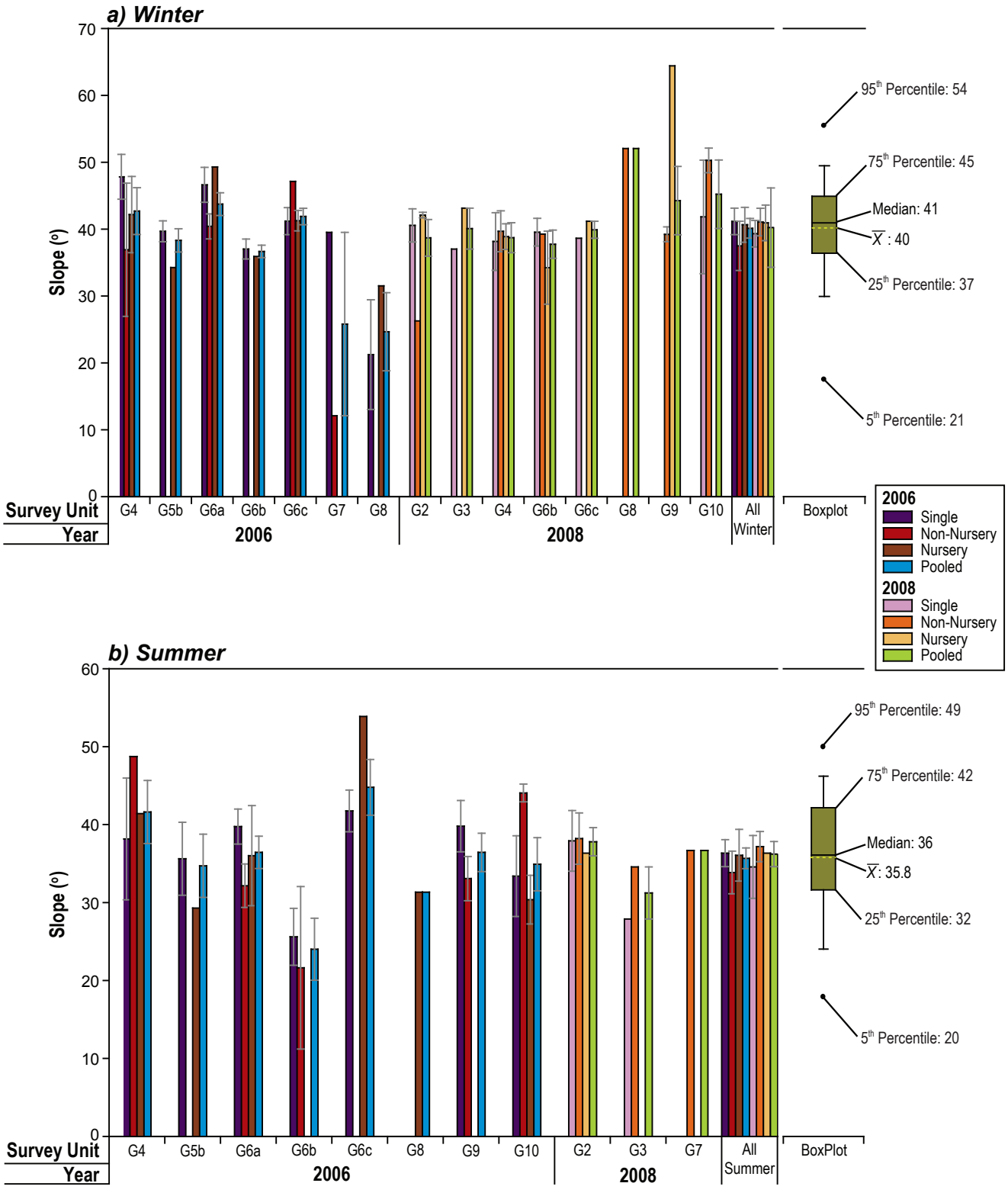

FIGURE 3.3-7

Mean Slope of Mountain Goat Sightings by Survey Unit, 2006 and 2008

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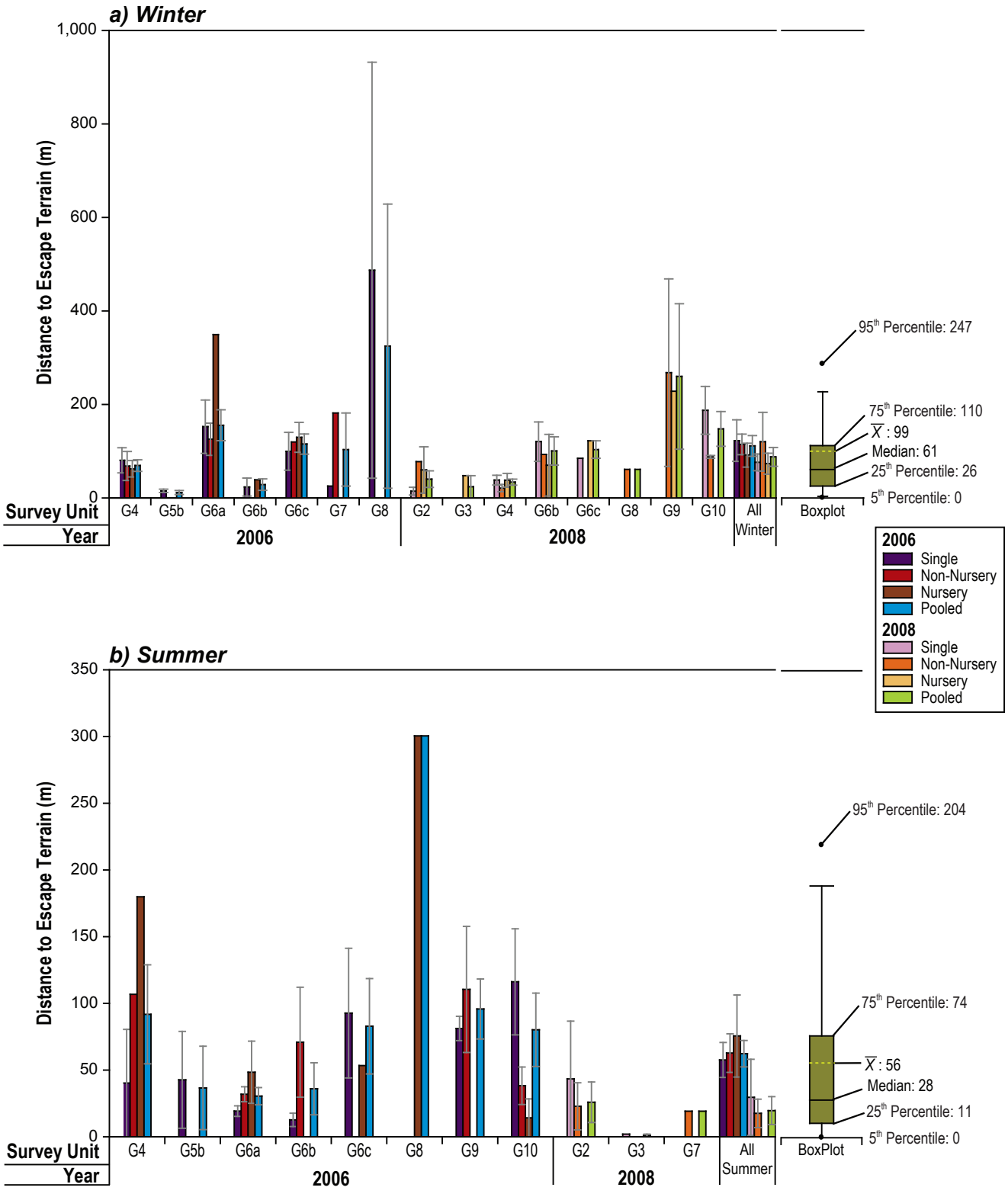

FIGURE 3.3-8

Mean Distance to Escape Terrain of Mountain Goat Sightings by Survey Unit, 2006 and 2008

3.4 DISCUSSION

Over two years of baseline study, 352 goats were observed in 152 groups in 11 SUs within the study area. The density of goats in capable habitat was the same between seasons over both years, 0.18 goats/km^2, when SUs without goats were excluded from calculations. This density is lower than that reported in other studies near the Project. Mountain goats were studied during 2004 and 2005 for the Galore Creek Project to the southwest of the Project (RTEC 2006a). Over a two year study, the average summer density of goats was 0.59 ± 0.15 goats/km^2 in 2004 and 0.29 ± 0.11 goats/km^2 in 2005. These densities are based on census area, which was calculated in a similar fashion to what was done for the present study. Winter average density in 2005 was 0.27 ± 0.05 goats/km^2 (RTEC 2006a). Other studies have recorded even higher densities. Over a two year study (1996 and 1997) of goats in west-central BC just north of Terrace, the mean population density was estimated at 0.7 goats/km^2, based on areas of suitable habitat (Demarchi, Johnson, and Searling 2000). Suitable habitat for this study was generally all habitat above 1,000 m elevation within survey blocks (Demarchi, Johnson, and Searling 2000).

The distribution of mountain goat observations during the 2006 and 2008 surveys is consistent with the expected topographic selection for goats, as discussed below. Goats occupied areas with different elevation, slope and distance to escape terrain in different seasons. Few geographic/spatial trends (i.e., differences between SUs) were observed. No significant trends in habitat occupation by single goats and larger assemblages (nursery and non-nursery groups) were observed.

Goats were observed in habitat above 1,000 m in all seasons; between 1,365 and 1,680 m in winter and 1,576 and 1,893 m in summer. Goats move to lower elevations in winter to avoid higher snowpack (Schoen and Kirchoff 1982; Fox, Smith, and Schoen 1989), and during the growing season, goats move to higher elevations, following the snowmelt and emergence of vegetation. In this study, goats were found at higher elevations in the summer than in the winter ($p<0.001$). Goats in SU G8 and G9 were observed at lower elevations in both winter and summer than goats in other SUs ($p<0.001$). This may be due to habitat distribution, climatic conditions, or a product of small sample size.

It has been well documented that mountain goats are usually found near escape terrain; rocky bluffs and cliffs that provide goats with good visibility and are generally inaccessible to predators (Shackleton 1999). Highly suitable habitat occurs within 200 m of escape terrain (RIC 1999), and goats are seldom found further than 500 m from escape terrain (Fox 1983, Gross et al. 2002; RTEC 2006b). Ninety percent of all goat sightings in 2006 and 2008 were within 250 m of escape terrain during the winter and summer, with goats being closer to escape terrain in the summer than in winter ($p=0.005$). The area within 500 m of escape terrain is also defined as capable habitat for mountain goats (used in density calculations).

As a consequence of habitat preference for suitable escape terrain, goats are rarely found on slopes of less than 25° during the winter and summer seasons in other studies (Fox 1978; Schoen and Kirchoff 1982). During the two year baseline study, the majority (75%) of goat sightings were on slopes steeper than 32° in the summer and 37° in the winter, and 95% of all sightings were above 20° in both seasons. Goats were observed on slightly steeper slopes in winter (40°) than in summer (36°) ($p<0.001$). Goats typically only use lower slope areas to travel to access other preferred habitat, such as other mountains or mineral licks (RTEC 2006b).

Aspect also plays an important role in dictating the habitat use for mountain goats during the winter and less so during the summer. In particular, windswept south-facing slopes are preferred because

snow accumulation is lower and therefore food can be found more readily (Wilson 2005). During the summer, goats may select a wide range of aspects. Snow will melt sooner on warmer southern aspects and vegetation phenology progresses quicker than on northern faces. However, cooler northern faces may provide animals with a refuge from heat and flying insects during summer. This pattern was generally observed during the two year baseline study, with many goats observed on southerly aspects (SE to SW) during the winter and goats occupying a wider range of aspects during the summer. No significant pattern between winter and summer selection for aspect was observed ($p > 0.10$) although goats appeared to be more clustered along warmer slopes in the winter than in the summer.

The British Columbia Ministry of Environment (BC MOE 2006) set guidelines for helicopter use and regional development, suggesting that aerial activity not occur within 1.5 km of goat habitat throughout the year, and larger buffers beyond 1.5 km are recommended during the kidding season (May to July). Several areas of occupied goat habitat occurs in the vicinity of proposed development (SU G4, G5b, G6a, G6b, and G6c), as well as areas identified as interim winter range in the CIS LRMP (BC ILMB 2000). The mineral lick at the top of the mountain bounded by Skeeter and Mess lakes (SU G6c) also appears to be an important habitat feature, as goats were frequently seen near this location in the winter and summer (Figures 3.3-1 to 3.3-3). It is recommended that these areas are considered during construction and operations to limit disturbance to goats within the area.

4. Stone's Sheep

4. Stone's Sheep

4.1 BACKGROUND INFORMATION

The total number of Stone's sheep in BC was estimated at approximately 10,500 individuals in 2003, with 4,750 sheep in the Skeena Region (Demarchi and Hartwig 2004). Stone's sheep is one of the two thinhorn sheep subspecies of BC, the other being Dall's sheep (*O. d. dalli*). Stone's sheep have a broader distribution than Dall's sheep in the province, ranging from Bennett Lake on the British Columbia-Yukon border east along the northern Coast Mountains to the northern end of the Skeena Mountains, through the Cassiar and Omineca Mountains and the northern Rocky Mountains. Dall's sheep only occur in the extreme northwestern corner of the province in the St. Elias Mountains (Shackleton 1999; Demarchi and Hartwig 2004). Population estimates (from 1994) for Wildlife Management Unit (WMU) 6-21, the unit associated with the study area was approximately 300 individuals (Demarchi and Hartwig 2004).

Like mountain goat (Section 3.1), important wintering and lambing areas for Stone's sheep have been identified and mapped in the CIS LRMP (BC ILMB 2000). Habitat selection is similar for Stone's sheep and mountain goat in northern BC, where Stone's sheep are also reliant on the presence of escape terrain for cover and predator avoidance. However, Stone's sheep may also exploit more lower elevation habitats than mountain goat, such as subalpine meadows and the forested areas below them, provided that escape terrain is nearby (Demarchi and Hartwig 2004). Due to the similarity in habitat selection, high value winter habitat (i.e. interim winter range) and lambing areas were identified for Stone's sheep in the Cassiar Iskut-Stikine LRMP that broadly overlap mountain goat high value winter and kidding habitat described in Section 3.1, in addition to a small amount of high value winter habitat for sheep around Arctic Lake (SU G12 and G8).

Studies conducted on the closely related Dall's sheep in Alaska concluded that sheep can be quite sensitive to helicopter disturbance (Frid 2003). It is not known to what degree Stone's sheep are sensitive to disturbance; however, it remains a research priority (Paquet and Demarchi 1999; Demarchi and Hartwig 2004). For this reason, as with mountain goats, the BC MOE (2006) set guidelines of 1.5 km minimum flight distance for avoiding sheep habitats.

4.2 DATA ANALYSIS METHODOLOGY

4.2.1 Population Characteristics

Population characteristics were calculated for Stone's sheep using the same methods as for mountain goat, including: total count, group size and composition (single, nursery, non-nursery), and density. As ewes could be reliably distinguished from rams, the number of lambs per 100 ewes was also calculated. As with goat, survey estimates were not adjusted for sightability.

4.2.2 Spatial Distribution

The topographic features at Stone's sheep sightings were derived and analyzed using the same methods as for mountain goat (Section 3.2.2).

4.3 RESULTS

4.3.1 Population Characteristics

Very few Stone's sheep were observed during surveys, with 35 sheep observed in 12 groups across two of the fifteen SUs (G1 and G10) (Appendix 4). Twenty sheep were observed in SU G10 during the summer of 2006 and 11 were observed in the winter of 2008. Two sheep were observed in SU G1 in the summer of 2008; two sheep were also observed just outside (~500 m) of SU G1 and were included within the total for that SU (Figure 4.3-1; Table 4.3-1).

Ewes accounted for the majority of sheep observed (66%), while lambs accounted for 20% and rams for 14%. Lambs were only observed during the summer; the lamb-to-ewe ratio was 41 lambs per 100 ewes across 2 SUs (Table 4.3-1).

Density of sheep within SU G10 ranged from 0.15 to 0.27 sheep/km^2 in summer 2006 and winter 2008, based on the capable habitat (Table 4.3-1). During the summer of 2008, density of sheep in SU G1 was 0.05 sheep/km^2 based on the capable habitat (Table 4.3-1).

Single sheep, nursery groups, and non-nursery groups were detected with roughly equal frequency (Table 4.3-2). Nursery groups were only observed during the summer and non-nursery groups were only observed in the winter. Overall sex composition within sighting categories varied. Males were often seen alone. Non-nursery groups, averaging 3 ± 0.7 individuals, were often groups of females (67% of non-nursery sightings). Nursery groups were larger in size, averaging 5 ± 1.6 individuals, and never contained a male.

Table 4.3-1. Stone's Sheep Observations and Population Characteristics by Survey Unit, 2006 and 2008

Survey Unit	No. of Sheep				Lamb-to-Ewe Ratio	Density (sheep/km^2)		
	Total	Rams	Ewes	Lambs		Total Area	Census Area	Capable Habitat
G10 (Summer 2006)	20	0	15	5	0.33	0.11	0.20	0.27
G10 (Winter 2008)	11	5	6	0	0	0.06	0.29	0.15
G1 (Summer 2008)	4	0	2	2	1.0	0.03	0.16	0.05
All	**35**	**5**	**23**	**7**	**0.41**[1]			

[1] *Summer lamb-to-ewe ratio (ewes seen during winter 2008 excluded from calculation)*

Table 4.3-2. Summary of Stone's Sheep Sightings and Group Composition, 2006 and 2008

Survey Unit	Single	Nursery	Non-Nursery	Total
G10 (Summer 2006)	1	3	0	4
G10 (Winter 2008)	3	0	3	6
G1 (Summer 2008)	0	2	0	2
All	**4**	**5**	**3**	**12**

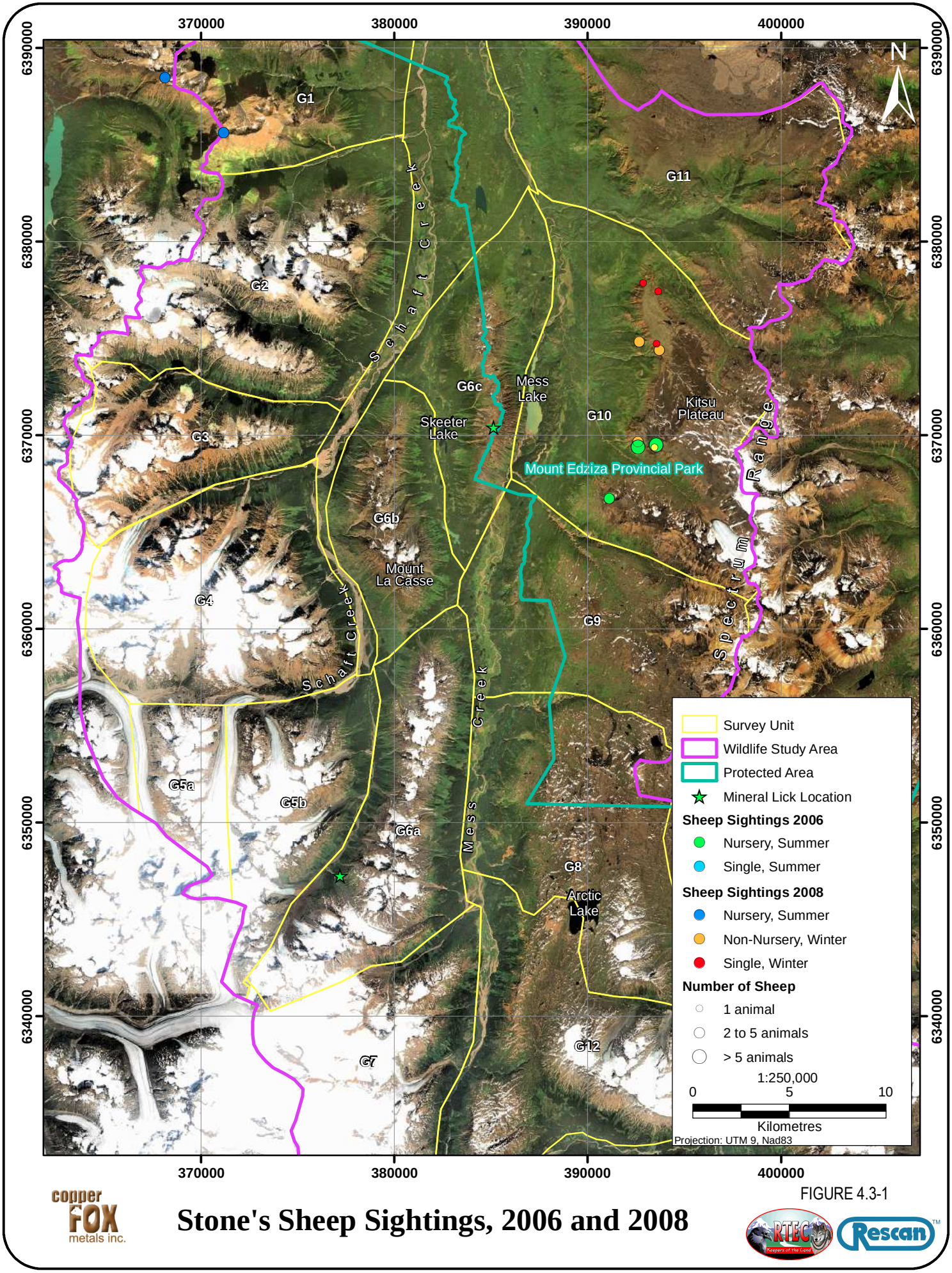

FIGURE 4.3-1

Stone's Sheep Sightings, 2006 and 2008

4.3.2 Spatial Distribution

Stone's sheep observations were made at a mean elevation of 1,563 ± 62 m in the winter (N = 6) and 1,855 ± 92 (N = 5) in the summer (Appendix 4). One sighting of sheep was recorded outside SU G1 where no TRIM and DEM information was available and could not be included in calculations. The lowest elevation recorded was 1,318 m during the winter 2008 survey and the highest was 2,147 m during the summer 2008 survey. Of all sighting, 75% were between 1,426 and 1,683 m in the winter and between 1,702 and 2,026 m in the summer.

Most sheep were observed on southwestern aspects in both the winter and the summer. Of all sheep sightings, only two were recorded on northerly aspects. One sighting was recorded on an aspect of 20° in the winter and one on an aspect of 32° in the summer.

Sheep were observed on similar slopes in winter (41 ± 2°) and summer (35 ± 2°) (Appendix 4). The majority (75%) of sheep sightings occurred on slopes between 38° and 45° in the winter and between 30° and 40° in the summer. The relative spread in the slope data in both the winter and summer suggests a consistent occupation of slopes between 30° and 50° (Appendix 4). Sheep were typically observed within 100 m of escape terrain, 97 ± 58 m in the winter and 32 ± 10 m in the summer.

Data collected during the winter and the summer were analyzed separately. Studies of Stone's sheep in BC have shown that there are some differences in the topographical habitat selection between seasons (Demarchi and Hartwig 2004; Walker, Parker, and Gillingham 2006; Walker et al. 2007).

4.4 DISCUSSION

Stone's sheep are not common in the study area, with few sheep observed during the four survey periods; 12 independent sightings totalling 35 individuals. The population within Wildlife Management Unit (WMU) 6-21, an area of several thousand square kilometres, was approximated at 300 individuals in 1994 (Demarchi and Harwig 2004). Sheep were most abundant in SU G10, where 20 individuals were counted in summer 2006 and 11 were counted in winter 2008.

Some of the area around the Arctic Lake plateau (SU G8 and G12) supports escape terrain that may be used by sheep, but no sheep were observed in these areas. The area around Arctic Lake was identified in the CIS LRMP as interim winter range. However, the vegetation on the plateau itself is very sparse and the topography around Arctic Lake supports great expanses of flat areas with no escape terrain for kilometres, making it less suitable for sheep.

The spatial distribution of Stone's sheep sightings is similar to the expected topographic selection for sheep. Sheep were generally seen above 1,300 m in both winter and summer and tended to be on southwesterly aspects with slopes between 30° and 50°. All sheep were within 500 m of escape terrain (i.e., within capable habitat) with the majority within 100 m in both seasons. These results are consistent with reports of sheep in other area. Studies of sheep in the Besa-Prophet watershed of the Muskwa–Kechika Management Area (northern Rocky Mountains) indicated that sheep often select southern aspects with steep slopes throughout the year, with a less consistent trend in the elevation (Walker et al. 2007).

Like mountain goats, there are minimum recommended distances from occupied sheep habitat (1.5 kilometres) for helicopter activity within BC (BC MOE 2006). No sheep have been observed within the Project footprint areas, but helicopter flyways should be aware of the sheep habitat areas when planning flight paths.

5. Northern Caribou

5. Northern Caribou

5.1 BACKGROUND INFORMATION

In BC, northern caribou are designated as an ecotype[2] of woodland caribou that occur in west-central British Columbia and in northern BC west of and in the Rocky Mountains (Cichowski, Kinley, and Churchill 2004). In 2002, the total population of northern caribou was estimated at 16,235 individuals (Cichowski, Kinley, and Churchill 2004). However, the northern caribou population are spread across the province in several smaller sub-populations. The Mount Edziza sub-population or "herd" of northern caribou is the closest to the Project, inhabiting areas around Mount Edziza and other habitat within and surrounding Mount Edziza Provincial Park. Prior to 2004, this sub-population was small, approximately 100 individuals, and herd was designated as threatened with an unknown population trend (Cichowski, Kinley, and Churchill 2004). However, aerial reconnaissance flights around Mount Edziza to the north of the Project on March 30, 2006, counted approximately 151 caribou (Rick Marshall, BC MOE *unpublished data*). No hunting of Mount Edziza sub-population of caribou is permitted except for First Nations traditional harvest (Cichowski, Kinley, and Churchill 2004).

The Cassiar Iskut-Stikine LRMP has mapped high value habitat (i.e., interim winter range) within the plan area. A small portion of high value habitat overlaps with the study area and is sporadically distributed along mid elevation forested habitats in the eastern study area (SUs G9, G10, and G11) and lower elevation forested habitat in the northern study area on the west side of Schaft Creek just above the Mess Creek confluence (SU G1) (Figure 2.2-2; BC ILMB 2000). These high value habitats are contiguous with much larger and broader areas of high value habitat to the north of the wildlife study area within Mount Edziza Provincial Park (BC ILMB 2000).

There have been relatively few studies investigating the effects of disturbance on northern caribou, and the results of such studies are controversial (Cichowski, Kinley, and Churchill 2004). However, there is evidence to suggest that caribou populations in BC are sensitive to disturbance during the calving and wintering periods (Paquet 2000; COSEWIC 2002b; Cichowski, Kinley, and Churchill 2004). Considering this, the BC MOE (2006) set guidelines of 500 m minimum flight distance for avoiding caribou habitats.

5.2 DATA ANALYSIS METHODOLOGY

5.2.1 Population Characteristics

Population characteristics were calculated for Northern caribou using similar methods as for mountain goat and included: total count, group size, and density. As with goat, survey estimates were not adjusted for sightability.

5.2.2 Spatial Distribution

The topographic features at caribou sightings were derived and analyzed using the same methods as for mountain goat (Section 3.2.1.3).

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[2] The other two ecotypes are boreal caribou, found within the relatively flat boreal forests of northeastern BC, and mountain caribou, which occupy habitat within several mountain ranges in southern BC

5.3 RESULTS

Very few caribou were observed during aerial surveys. On the four surveys that were conducted, caribou were only documented during the summer survey of 2006. One group of three females were observed in SU G10 (Figure 5.3-1). Because of the small sample size, no further analysis of population characteristics or spatial distribution was conducted.

5.4 DISCUSSION

The results of the two year baseline study conclude that caribou are rare within the study area; however, it appears that occasional use of habitat in the eastern portion of the study area can be expected. The results should be interpreted with caution as northern caribou are known to select a variety of habitat types that change seasonally. Northern caribou are characterized by shifts in elevation between and within summer and winter ranges. Low elevation forested habitat and high elevation alpine habitat is used by northern caribou during both winter and summer and specific use of these habitats during the year vary between sub-populations (Cichowski, Kinley, and Churchill 2004). Animals that are using forested habitats are very difficult to observe during aerial surveys unless they are in large groups (RIC 2002).

It was noted during surveys that, across the entire study area, the habitat with the greatest potential to support caribou occurred in the expansive subalpine and alpine plateaus of the northeast (SUs G10 and G11). During the winter, wide open windswept alpine areas provide access to terrestrial lichens and good visibility for detecting predators (Cichowski, Kinley, and Churchill 2004). Similar areas are selected by calving females during the summer, primarily on account of the flat topography that provides a safe, flat area for raising young and good sightlines for detecting predators (Bergerud and Butler 1978; Bergerud, Butler, and Miller 1984; Hatler 1986).

The results of habitat mapping conducted within the Cassiar Iskut-Stikine LRMP area suggest that high value winter habitat (i.e., interim winter range) occur in very small amounts in the northern and eastern portions of the study area (BC ILMB 2000). In comparison, habitats with greater value to caribou, such as large and contiguous patches of older growth pine and spruce forests, are located to the north of the study area (BC ILMB 2000). These forest types are important as they contain a plentiful supply of terrestrial and arboreal lichens that are eaten by caribou throughout the year. Older forests that have less shrubby undergrowth tend to better visibility to detect predators and have a sufficient canopy closure for protection from the snow in the winter (Cichowski, Kinley, and Churchill 2004). Reconnaissance surveys conducted in 2006 also suggest that caribou are more numerous in areas to the north of the study area; 151 caribou were counted in an area approximately 10km to the north of the wildlife study area (Rick Marshall, BC MOE *unpublished data*).

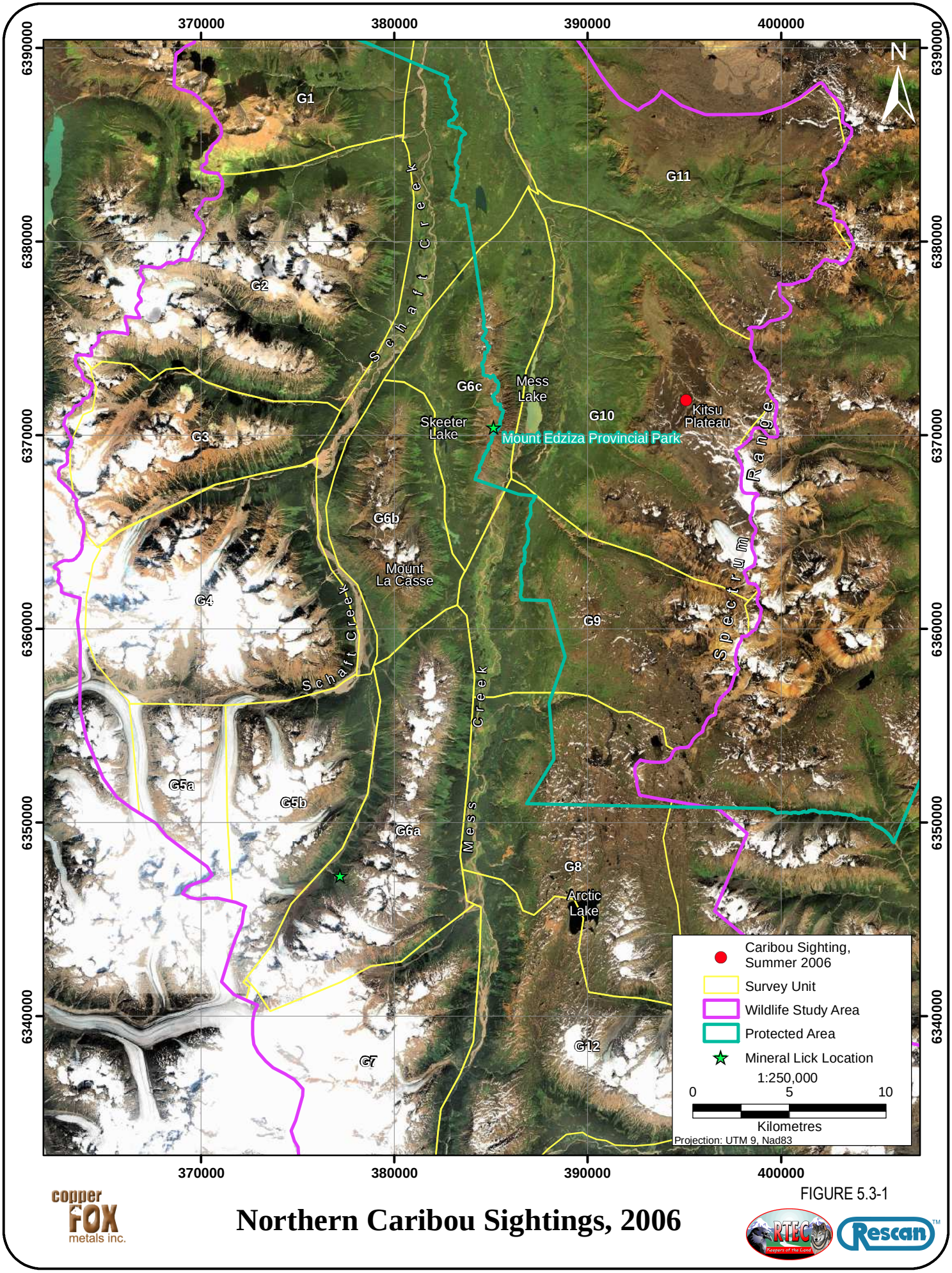


FIGURE 5.3-1

Northern Caribou Sightings, 2006

6. Incidental Wildlife Sightings

6. Incidental Wildlife Sightings

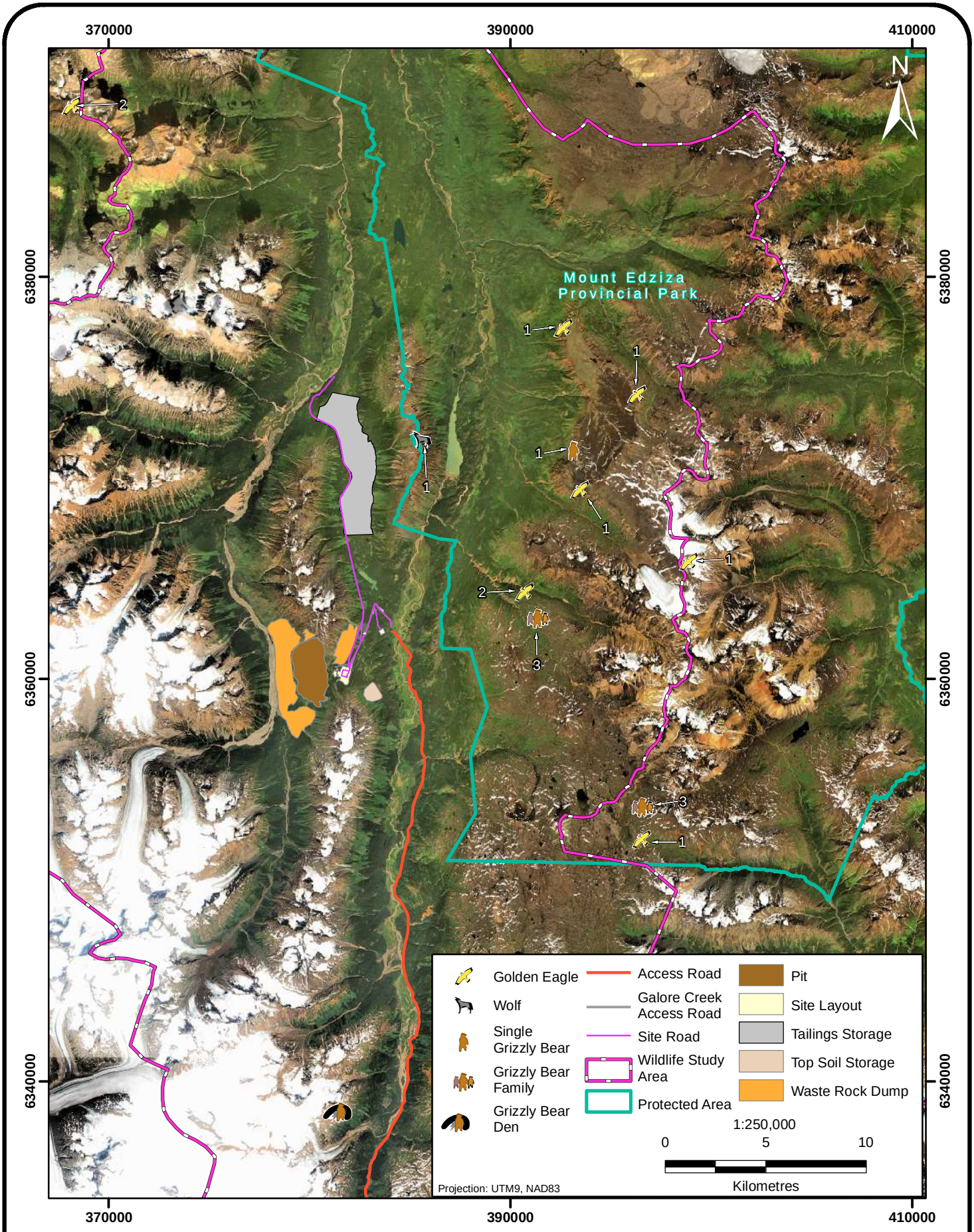
6.1 SPECIES OBSERVED

A number of wildlife species, including three birds and four mammals, were detected incidentally during aerial surveys in 2006 and 2008 (Figure 6.1-1; Table 6.1-1; Appendix 5). Grizzly bears (*Ursus arctos*) and golden eagles (*Aquila chrysaetos*) were the most frequently observed on surveys, with a total of seven and nine individuals recorded, respectively. Two sightings of grizzly bears were of females with offspring (Figure 6.1-1; Table 6.1-1). A probable grizzly den site was also observed during summer 2008 survey. Other species observed included gray wolf (*Canis lupus*), fisher (*Martes pennanti*), red fox (*Vulpes vulpes*), blue grouse (*Dendragapus obscurus*), and a ptarmigan species (likely white-tailed [*Lagopus luecura*] or willow ptarmigan [*L. lagopus*]). Locations were not recorded for the fisher, red fox, blue grouse, and ptarmigan.

Grizzly bear and fisher are blue-listed as species of conservation concern in BC. Grizzly bear are also listed as species of special concern by the COSEWIC (COSEWIC 2002a).

Table 6.1-1. Summary of Incidental Wildlife Sightings, 2006 and 2008

Date	Easting	Northing	Species	No. Observed	Comment
6-Mar-06	385577	6371909	Gray wolf	1	
18-Jul-06	390713	6364329	Golden eagle	2	
18-Jul-06	393470	6369407	Golden eagle	1	
18-Jul-06	392638	6377447	Golden eagle	1	
18-Jul-06	393163	6371337	Grizzly bear	1	
19-Jul-06	396301	6374142	Golden eagle	1	
19-Jul-06	398873	6365828	Golden eagle	1	
19-Jul-06	391395	6362996	Grizzly bear	3	female with cubs
19-Jul-06	396586	6353607	Grizzly bear	3	female with 2-yr olds
19-Jul-06	396523	6352035	Golden eagle	1	
08-Feb-08	-	-	Fisher	0	tracks
08-Feb-08	-	-	Red fox	0	tracks
08-Feb-08	-	-	Blue grouse	1	
08-Feb-08	-	-	Ptarmigan spp.	1	
02-Aug-08	368134	6388511	Golden eagle	2	
03-Aug-08	381563	6338466	Grizzly bear	0	den site



Incidental Wildlife Observations, 2006 and 2008

FIGURE 6.1-1

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Appendix 1

Summary of Mountain Ungulate Aerial Survey Effort, 2006 and 2008

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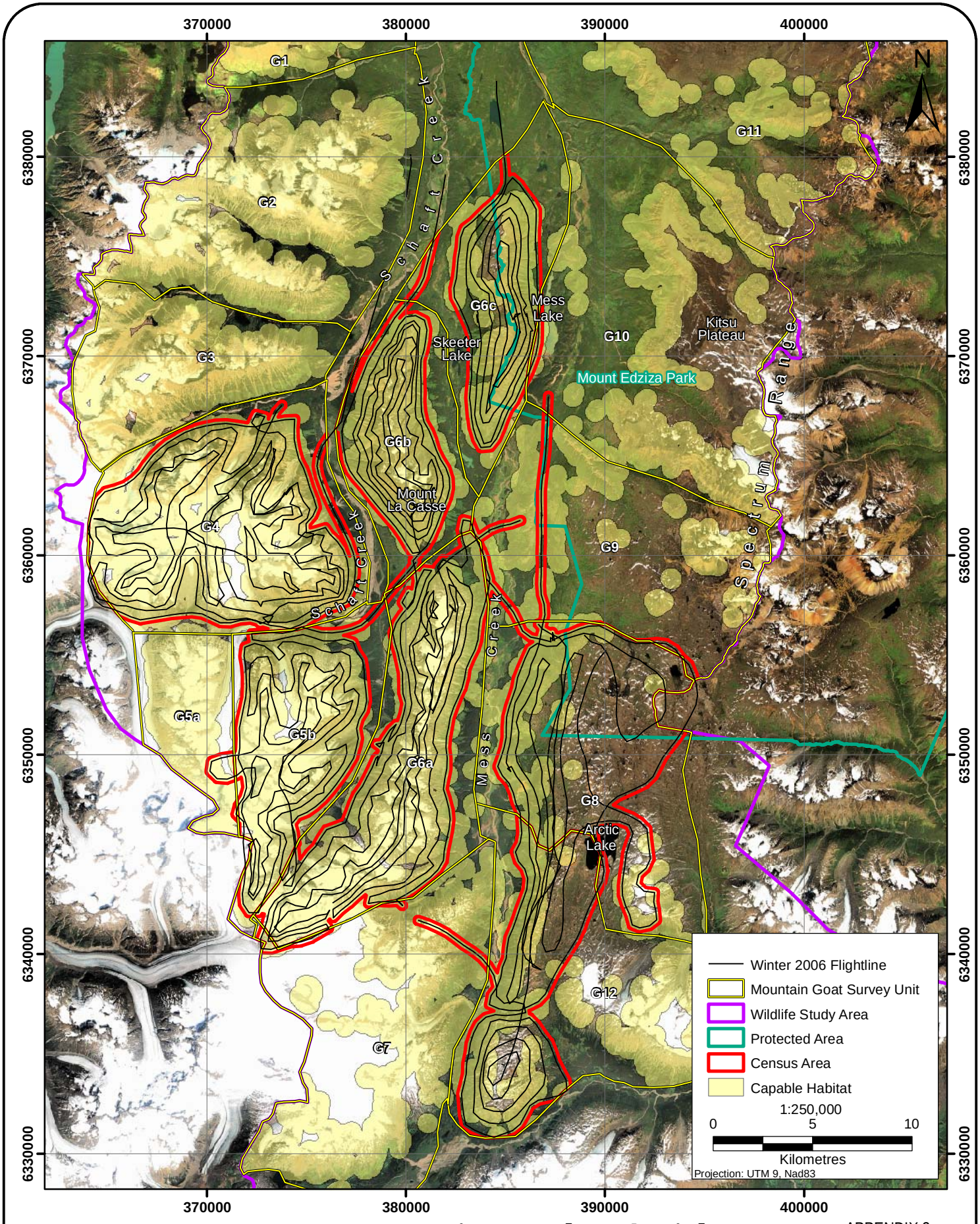
RTEC Keepers of the Land

Appendix 1. Summary of Mountain Ungulate Aerial Survey Effort, 2006 and 2008

Date	Survey Unit (SU)	Total Time (min)	Total Area (km^2)	Total Area Effort (min/km^2)	Census Area (km^2)	Census Area Effort (min/km^2)	Capable Habitat (km^2)	Capable Habitat Effort (min/km^2)
Winter 2006								
6-Mar-06	G4	148	134	1.10	112	1.32	120	1.23
6-Mar-06	G6c	79	79	1.01	45	1.74	45	1.74
13-Mar-06	G6b	74	65	1.15	46	1.61	50	1.47
13-Mar-06 & 31-Mar-06	G8	153	128	1.20	86	1.78	45	3.37
31-Mar-06	G5b	83	79	1.05	66	1.26	68	1.22
31-Mar-06	G6a	127	114	1.11	91	1.39	33	3.88
31-Mar-06	G12	25	134	0.19	58	0.43	81	0.31
All		**689**	**732**		**505**		**443**	
Average				**0.97**		**1.36**		**1.89**
± SE				**0.13**		**0.17**		**0.48**
Summer 2006								
17-Jul-06	G5b	71	79	0.89	69	1.03	68	1.04
17-Jul-06	G6a	115	114	1.01	96	1.20	33	3.52
18-Jul-06	G4	82	134	0.61	105	0.78	120	0.68
18-Jul-06	G6b	49	65	0.76	44	1.11	50	0.97
18-Jul-06	G6c	38	79	0.48	37	1.02	45	0.84
18-Jul-06	G3	44	75	0.59	59	0.75	67	0.65
19-Jul-06	G10	95	177	0.54	98	0.97	74	1.28
19-Jul-06	G9	58	121	0.48	87	0.67	53	1.10
19-Jul-06	G8	51	128	0.40	92	0.56	45	1.12
All		**603**	**971**		**686**		**556**	
Average				**0.55**		**0.84**		**0.95**
± SE				**0.07**		**0.07**		**0.29**
Winter 2008								
8-Feb-08	G3	84	75	1.12	61	1.37	67	1.25
8-Feb-08	G2	145	146	0.99	105	1.38	110	1.32
8-Feb-08 & 20-Mar-08	G4	122	134	0.91	79	1.54	120	1.02
19-Mar-08	G6c	58	79	0.74	40	1.44	45	1.28
20-Mar-08	G6b	61	65	0.94	42	1.46	50	1.21
20-Mar-08	G9	46	121	0.38	37	1.25	53	0.87
20-Mar-08	G10	45	177	0.25	37	1.21	74	0.61
All		**561**	**796**		**402**		**519**	
Average				**0.76**		**1.38**		**1.08**
± SE				**0.12**		**0.04**		**0.10**
Summer 2008								
02-Aug-08	G2	168	146	1.15	89	1.89	110	1.53
02-Aug-08	G1	56	131	0.43	25	2.23	83	0.68
03-Aug-08	G3	73	75	0.98	57	1.28	67	1.08
03-Aug-08	G7	44	136	0.32	25	1.73	92	0.48
All		**341**	**488**		**196**		**352**	
Average				**0.72**		**1.78**		**0.94**
± SE				**0.20**		**0.20**		**0.24**

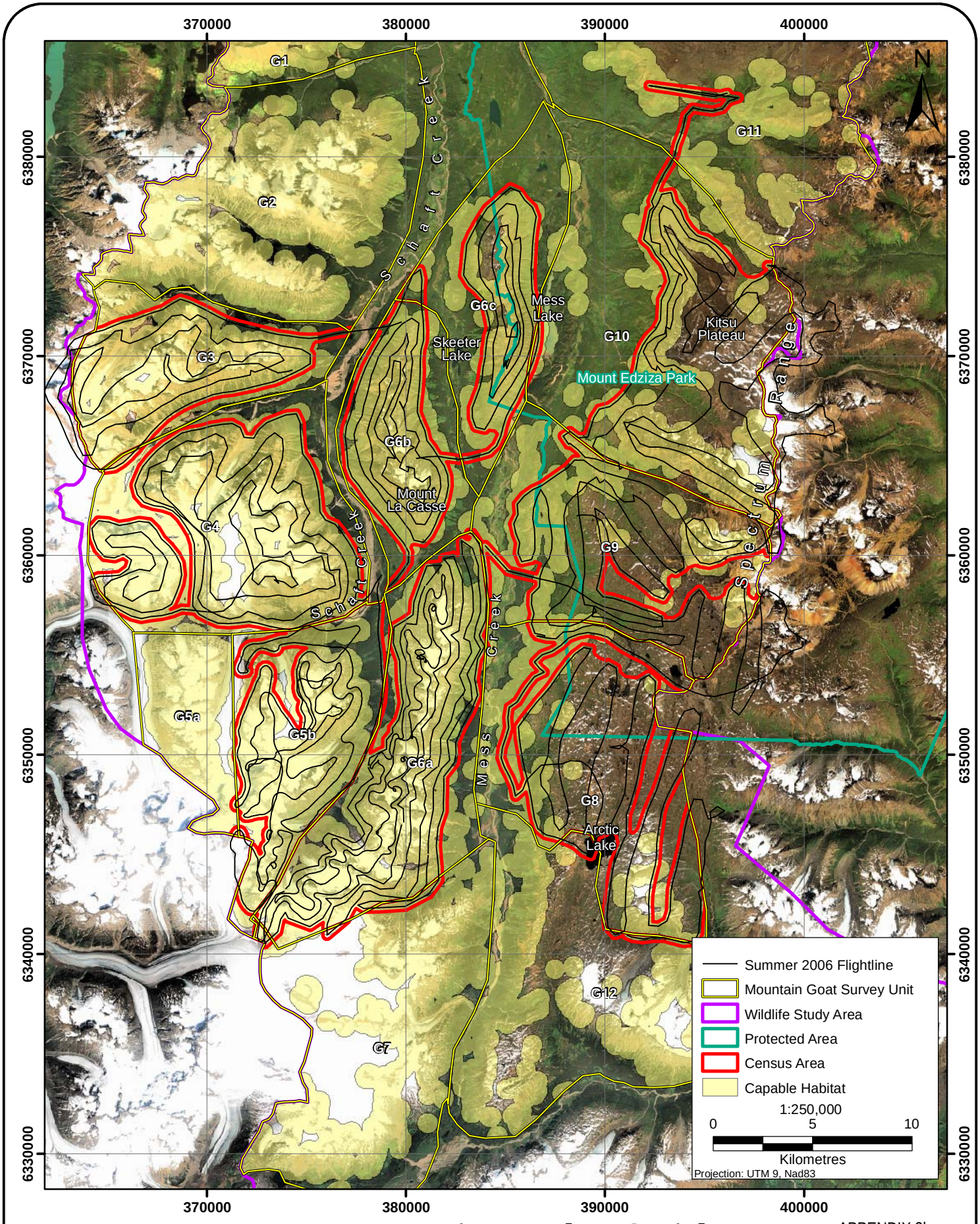
Appendix 2

Maps of Mountain Ungulate Aerial Survey Effort, 2006 and 2008



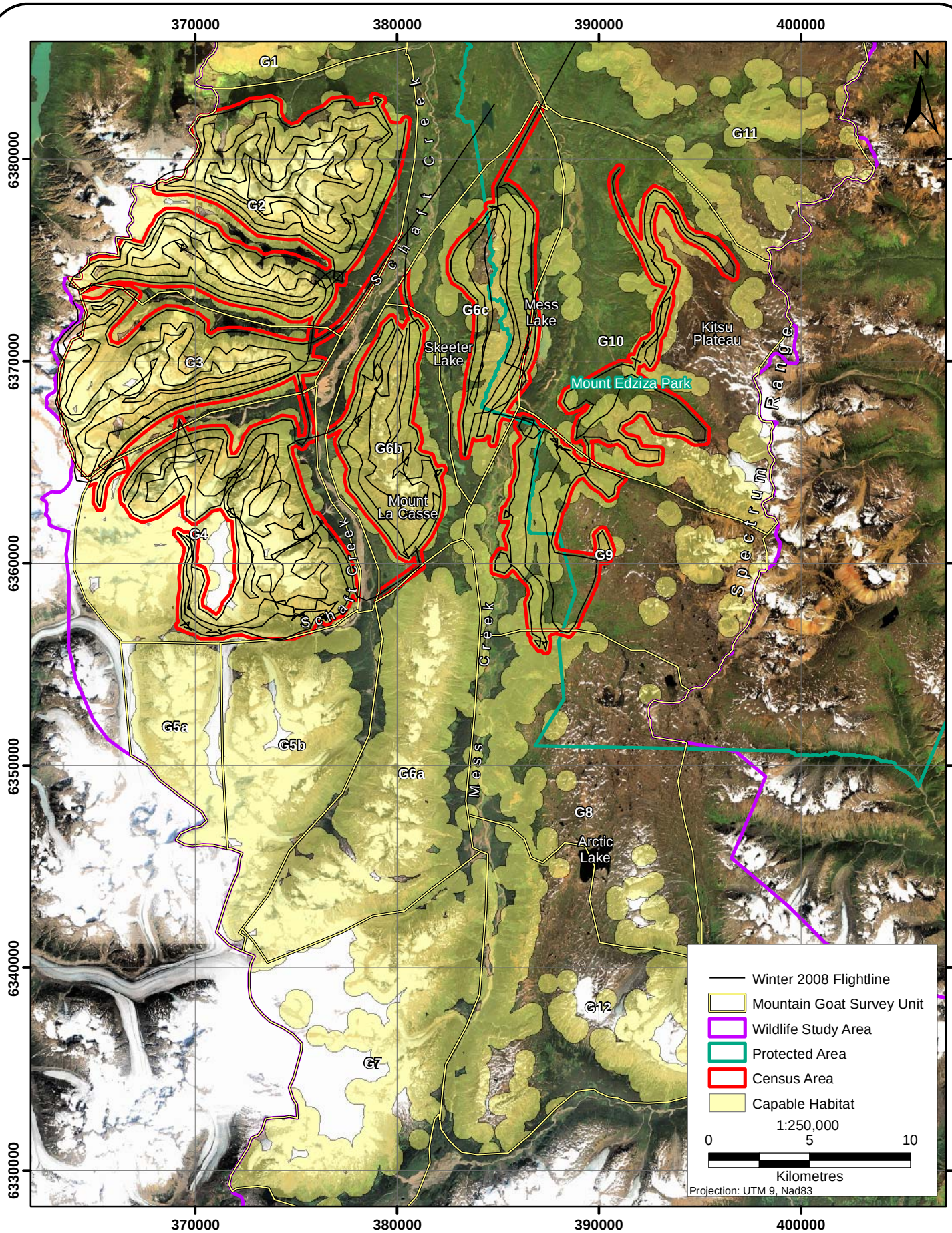
Mountain Ungulate Aerial Survey Effort, Winter 2006

APPENDIX 2a



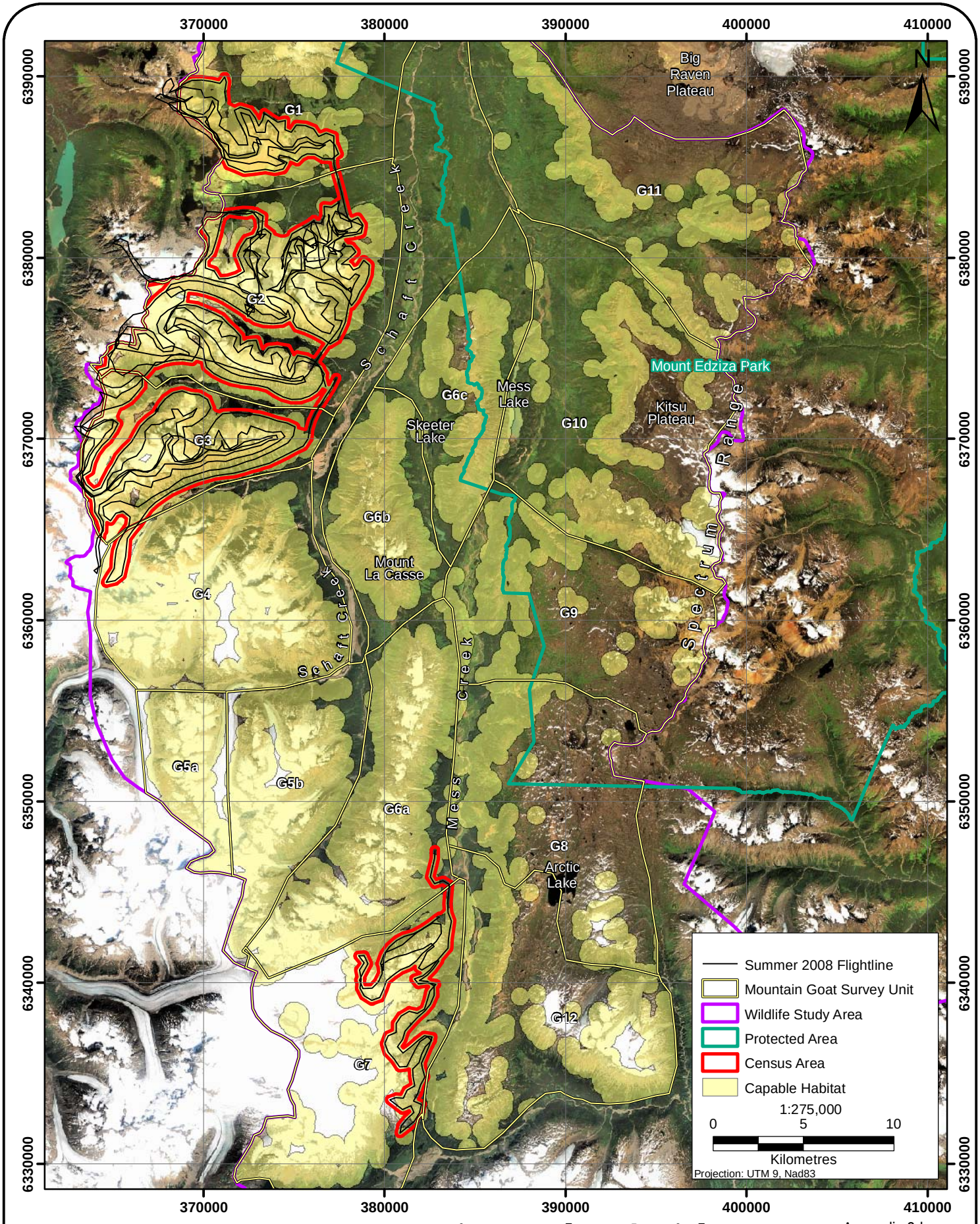
Mountain Ungulate Aerial Survey Effort, Summer 2006

APPENDIX 2b



Mountain Ungulate Aerial Survey Effort, Winter 2008

Appendix 2c



Mountain Ungulate Aerial Survey Effort, Summer 2008

Appendix 2d

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Appendix 3

Mountain Goat Raw Observation Data

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Appendix 3. Mountain Goat Raw Observation Data

							No. Mountain Goats			Topographic Characteristics				
Survey	Date	Time	Survey Unit	Easting	Northing	Sighting No.	Adult	Kid	Total	Elevation (m)	Aspect (o)	Slope (o)	Dist. Escape Terrain (m)	Comment(s)
Winter	6-Mar-06	11:39	G4	371555	6356772	1	2	0	2	1,482.9	159	47	8.5	
Winter	6-Mar-06	12:00	G4	373290	6356662	2	1	0	1	1,388.0	172	47	73.5	
Winter	6-Mar-06	12:00	G4	372747	6356748	3	1	1	2	1,474.3	191	61	91.2	
Winter	6-Mar-06	12:05	G4	369567	6359361	4	1	1	2	1,675.8	245	47	27.2	
Winter	6-Mar-06	12:08	G4	365806	6357507	5	1	0	1	1,575.0	189	40	46.3	
Winter	6-Mar-06	12:08	G4	365123	6357687	6	1	1	2	1,468.8	173	44	54.2	
Winter	6-Mar-06	12:09	G4	364690	6357731	7	1	0	1	1,438.7	216	56	158.2	
Winter	6-Mar-06	12:18	G4	370703	6357657	8	2	0	2	1,988.1	145	17	112.7	
Winter	6-Mar-06	12:39	G4	368664	6365782	9	2	2	4	1,384.0	343	43	121.0	
Winter	6-Mar-06	13:10	G4	370037	6358856	10	2	0	2	2,011.8	268	46	83.2	
Winter	6-Mar-06	13:10	G4	370234	6358412	11	3	1	4	2,016.5	161	18	76.5	
Winter	6-Mar-06	13:15	G4	372558	6357483	12	1	0	1	1,626.9	150	48	43.6	
Winter	6-Mar-06	13:27	G4	374055	6363175	13	2	1	3	1,772.3	307	41	3.2	
Winter	6-Mar-06	15:22	G6c	386408	6371027	14	1	0	1	1,001.4	128	46	109.6	
Winter	6-Mar-06	15:38	G6c	386216	6371317	15	1	0	1	1,233.2	99	36	210.3	
Winter	6-Mar-06	15:40	G6c	385955	6372075	16	2	0	2	1,360.3	96	47	119.6	
Winter	6-Mar-06	15:40	G6c	385897	6372330	17	2	2	4	1,359.8	120	44	91.5	
Winter	6-Mar-06	15:58	G6c	385757	6372519	18	1	0	1	1,425.6	80	42	36.4	
Winter	6-Mar-06	15:58	G6c	385849	6372083	19	1	1	2	1,467.4	60	38	59.0	
Winter	6-Mar-06	16:00	G6c	385698	6370150	20	2	1	3	1,426.2	114	39	183.2	
Winter	6-Mar-06	16:04	G6c	385863	6371130	21	1	1	2	1,525.9	69	44	184.5	
Winter	6-Mar-06	16:05	G6c	385544	6372362	22	1	0	1	1,617.8	117	41	42.4	
Winter	13-Mar-06	12:43	G6b	378600	6368106	23	1	0	1	1,568.9	244	39	42.5	
Winter	13-Mar-06	12:58	G6b	378542	6368275	24	1	1	2	1,498.9	289	36	38.7	
Winter	13-Mar-06	12:59	G6b	378364	6368549	25	1	0	1	1,474.7	241	36	4.0	
Winter	13-Mar-06	13:25	G8	387456	6355841	26	4	1	5	974.9	249	32	0.0	
Winter	13-Mar-06	15:09	G8	385256	6349455	27	1	0	1	1,230.0	261	29	42.1	
Winter	13-Mar-06	15:27	G8	386542	6352681	28	1	0	1	1,441.3	254	13	931.9	
Winter	31-Mar-06	10:57	G5b	375796	6348057	29	1	0	1	1,410.4	142	37	10.6	
Winter	31-Mar-06	11:17	G5b	374991	6348118	30	3	1	4	1,780.2	156	34	1.0	
Winter	31-Mar-06	11:18	G5b	375875	6348815	31	1	0	1	1,755.2	134	41	12.7	
Winter	31-Mar-06	11:22	G5b	376987	6352571	32	1	0	1	1,760.4	327	41	22.1	
Winter	31-Mar-06	12:09	G6a											Mineral lick
Winter	31-Mar-06	12:10	G6a	378615	6350055	33	1	0	1	1,289.8	296	55	343.2	
Winter	31-Mar-06	12:11	G6a	378528	6349573	34	2	0	2	1,345.0	296	43	195.6	
Winter	31-Mar-06	12:12	G6a	378832	6350351	35	2	0	2	1,297.9	256	44	255.3	
Winter	31-Mar-06	12:15	G6a	379136	6350820	36	5	1	6	1,415.2	290	49	349.4	
Winter	31-Mar-06	12:25	G6a	380194	6351973	37	2	0	2	1,629.4	267	37	108.6	
Winter	31-Mar-06	12:26	G6a	379449	6350841	38	4	0	4	1,572.7	294	35	101.6	
Winter	31-Mar-06	12:46	G6a	380354	6354170	39	1	0	1	1,691.4	236	45	79.3	

(continued)

Appendix 3. Mountain Goat Raw Observation Data (continued)

							No. Mountain Goats			Topographic Characteristics				
Survey	Date	Time	Survey Unit	Easting	Northing	Sighting No.	Adult	Kid	Total	Elevation (m)	Aspect (o)	Slope (o)	Dist. Escape Terrain (m)	Comment(s)
Winter	31-Mar-06	14:00	G6a	381102	6358241	40	1	0	1	1,546.1	290	40	224.5	
Winter	31-Mar-06	14:02	G6a	381146	6356057	41	2	0	2	1,689.7	246	46	31.3	
Winter	31-Mar-06	14:05	G6a	381142	6357783	42	2	0	2	1,737.0	269	37	60.6	
Winter	31-Mar-06	14:06	G6a	381285	6356911	43	1	0	1	1,880.2	248	44	59.0	
Winter	31-Mar-06	14:21	G7	373171	6340763	44	1	0	1	1,973.2	221	40	25.2	
Winter	31-Mar-06	14:48	G7	379717	6342676	45	4	0	4	1,247.1	32	12	181.6	
Winter	31-Mar-06	15:06	G6a	382323	6357279	46	1	0	1	1,821.0	207	50	56.1	
Winter	31-Mar-06	15:29	G12											none seen
Winter	31-Mar-06	15:55	G8											none seen
Summer	17-Jul-06	11:35	G5b	371983	6354277	47	1	0	1	1,621.1	274	20	223.2	
Summer	17-Jul-06	11:51	G5b	376632	6351814	48	1	0	1	1,844.3	133	34	0.0	
Summer	17-Jul-06	12:13	G5b	376239	6352330	49	1	0	1	1,943.4	86	54	12.8	
Summer	17-Jul-06	12:20	G5b	373233	6346071	50	1	0	1	1,723.1	58	42	18.8	
Summer	17-Jul-06	12:24	G5b	373301	6344389	51	4	1	5	1,589.9	96	29	0.0	
Summer	17-Jul-06	12:24	G5b	373174	6344498	52	1	0	1	1,703.0	136	30	0.0	
Summer	17-Jul-06	12:26	G5b	373818	6345669	53	1	0	1	1,707.9	124	34	1.0	
Summer	17-Jul-06	12:41	G6a	379250	6345148	54	3	0	3	1,974.3	176	32	26.0	
Summer	17-Jul-06	12:44	G6a	379420	6348179	55	5	1	6	1,889.1	269	17	103.5	
Summer	17-Jul-06	12:44	G6a	379080	6348571	56	3	0	3	1,836.3	244	28	43.4	
Summer	17-Jul-06	12:45	G6a	379770	6349655	57	1	0	1	1,842.7	245	44	28.6	
Summer	17-Jul-06	12:47	G6a	380310	6350982	58	1	0	1	1,769.7	250	35	12.6	
Summer	17-Jul-06	12:50	G6a	380736	6354819	59	4	0	4	1,897.4	295	24	41.1	
Summer	17-Jul-06	12:51	G6a	380552	6355260	60	1	0	1	1,690.2	37	35	21.7	
Summer	17-Jul-06	12:52	G6a	380935	6354664	61	1	0	1	1,895.4	114	50	16.9	
Summer	17-Jul-06	13:09	G6a	378795	6346508	62	5	0	5	1,905.0	315	39	12.8	
Summer	17-Jul-06	14:17	G6a	378982	6343497	63	1	0	1	1,844.8	145	42	28.0	
Summer	17-Jul-06	14:18	G6a	379459	6345404	64	1	0	1	2,187.7	141	35	26.8	
Summer	17-Jul-06	14:24	G6a	381706	6353530	65	1	0	1	1,758.6	130	36	0.0	
Summer	17-Jul-06	14:38	G6a	377897	6343132	66	2	1	3	1,764.6	140	46	70.0	
Summer	17-Jul-06	14:43	G6a	378192	6343109	67	1	1	2	1,609.3	185	38	4.5	
Summer	17-Jul-06	14:47	G6a	381024	6347053	68	8	4	12	1,698.3	152	43	15.4	
Summer	17-Jul-06	14:48	G6a	381055	6348021	69	3	0	3	1,642.2	94	37	35.9	
Summer	18-Jul-06	12:31	G4	371731	6356947	70	2	0	2	1,653.3	178	49	106.8	
Summer	18-Jul-06	12:32	G4	372934	6356809	71	8	1	9	1,523.4	176	41	179.9	
Summer	18-Jul-06	12:52	G4	375850	6360007	72	1	0	1	1,854.0	51	46	80.5	
Summer	18-Jul-06	13:00	G4	373368	6358756	73	1	0	1	1,908.6	152	30	0.0	
Summer	18-Jul-06	14:13	G6b	379628	6367669	74	1	0	1	1,773.7	135	33	5.4	
Summer	18-Jul-06	14:26	G6b	379254	6366116	75	1	0	1	1,935.7	118	24	10.3	
Summer	18-Jul-06	14:29	G6b	380151	6364151	76	2	0	2	1,904.1	288	32	29.7	
Summer	18-Jul-06	14:30	G6b	379999	6364306	77	1	0	1	1,802.7	323	20	22.2	

(continued)

Appendix 3. Mountain Goat Raw Observation Data (continued)

							No. Mountain Goats			Topographic Characteristics				
Survey	Date	Time	Survey Unit	Easting	Northing	Sighting No.	Adult	Kid	Total	Elevation (m)	Aspect (o)	Slope (o)	Dist. Escape Terrain (m)	Comment(s)
Summer	18-Jul-06	14:34	G6b	379393	6364747	78	2	0	2	1,984.6	194	11	112.1	
Summer	18-Jul-06	14:58	G6c	385468	6375781	79	1	0	1	1,525.0	24	39	54.7	
Summer	18-Jul-06	15:13	G6c	385607	6370945	80	1	0	1	1,761.9	126	47	189.1	
Summer	18-Jul-06	15:13	G6c	385655	6371701	81	6	1	7	1,649.7	41	54	53.3	
Summer	18-Jul-06	15:16	G6c	385136	6369519	82	1	0	1	1,570.9	104	39	34.2	
Summer	18-Jul-06	15:24	G3											none seen
Summer	19-Jul-06	11:37	G10	392317	6377667	83	1	0	1	1,252.4	276	34	221.8	
Summer	19-Jul-06	11:45	G9	388297	6365728	84	1	0	1	1,025.7	236	46	80.5	
Summer	19-Jul-06	11:47	G9	390433	6364540	85	1	0	1	1,254.4	49	38	97.2	
Summer	19-Jul-06	11:47	G9	390710	6364346	86	2	0	2	1,277.6	51	28	52.4	
Summer	19-Jul-06	11:48	G9	390713	6364329	87	1	0	1	1,290.2	5	35	65.7	
Summer	19-Jul-06	11:48	G10	390051	6364927	88	4	0	4	1,252.4	170	45	24.2	
Summer	19-Jul-06	11:52	G10	392412	6369527	89	1	0	1	1,607.3	258	36	27.5	
Summer	19-Jul-06	11:53	G10	393008	6371124	90	1	0	1	1,635.9	287	39	202.0	
Summer	19-Jul-06	11:54	G10	393864	6374106	91	8	2	10	1,495.1	265	27	28.3	
Summer	19-Jul-06	11:55	G10	392758	6375639	92	8	1	9	1,466.8	220	33	0.0	
Summer	19-Jul-06	11:57	G10	392638	6377447	93	1	0	1	1,545.4	297	42	11.2	
Summer	19-Jul-06	11:59	G10	393435	6377728	94	1	0	1	1,482.5	42	41	46.7	
Summer	19-Jul-06	12:09	G10	393943	6373400	95	1	0	1	1,687.3	48	8	187.6	
Summer	19-Jul-06	12:10	G10	393163	6371337	96	2	0	2	1,616.0	316	43	52.3	
Summer	19-Jul-06	13:27	G8	386651	6355902	97	1	1	2	902.4	72	31	300.5	
Summer	19-Jul-06	13:38	G9	389773	6363654	98	3	0	3	1,346.5	16	33	204.1	
Summer	19-Jul-06	13:38	G9	390101	6363876	99	2	0	2	1,349.1	213	38	74.8	
Summer	19-Jul-06	14:39	G8											none seen
Winter	08-Feb-08	12:06	G3	372252	6369249	100	1	0	1	1,698.3	182	37	0.0	high pass/small bluff
Winter	08-Feb-08	12:12	G3	367384	6367269	101	5	3	8	1,582.9	168	43	47.6	forage available lower
Winter	08-Feb-08	12:54	G2	375056	6372951	102	1	0	1	1,640.5	213	45	28.9	
Winter	08-Feb-08	14:05	G2	368554	6374959	103	1	0	1	1,973.5	176	36	0.0	on ridgeline
Winter	08-Feb-08	14:47	G2	373824	6381286	104	2	2	4	1,594.3	102	43	109.4	
Winter	08-Feb-08	14:50	G2	376146	6381546	105	2	0	2	1,756.5	261	26	77.6	
Winter	08-Feb-08	14:58	G2	377380	6377283	106	4	3	7	1,545.6	150	42	10.2	
Winter	08-Feb-08	15:21	G2	376212	6376449	107	1	0	1	1,833.5	222	40	14.6	
Winter	08-Feb-08	15:59	G4	371335	6365902	108	1	0	1	1,293.2	111	36	15.1	in cave
Winter	08-Feb-08	16:01	G4	372854	6366036	109	2	1	3	1,389.9	247	43	34.0	
Winter	08-Feb-08	16:07	G4	372195	6364604	110	1	0	1	1,420.2	284	45	78.7	
Winter	19-Mar-08	10:24	G6c	386250	6370607	111	3	1	4	1,089.6	88	41	122.0	
Winter	19-Mar-08	10:37	G6c	385195	6374813	112	1	0	1	1,705.4	50	39	84.7	
Winter	20-Mar-08	10:51	G4	376392	6357512	113	4	1	5	1,110.4	189	36	75.9	
Winter	20-Mar-08	10:58	G4	369809	6357128	114	2	0	2	1,554.8	188	46	40.1	
Winter	20-Mar-08	11:07	G4	370740	6356613	115	3	0	3	1,526.9	182	31	26.0	

(continued)

Appendix 3. Mountain Goat Raw Observation Data (completed)

							No. Mountain Goats			Topographic Characteristics				
Survey	Date	Time	Survey Unit	Easting	Northing	Sighting No.	Adult	Kid	Total	Elevation (m)	Aspect (o)	Slope (o)	Dist. Escape Terrain (m)	Comment(s)
Winter	20-Mar-08	11:08	G4	371168	6356759	116	1	0	1	1,628.1	154	53	56.2	
Winter	20-Mar-08	11:11	G4	374786	6357459	117	3	1	4	1,332.6	171	41	36.5	
Winter	20-Mar-08	11:12	G4	375137	6357579	118	1	0	1	1,371.9	182	29	0.0	
Winter	20-Mar-08	11:13	G4	375249	6357643	119	1	1	2	1,395.7	178	35	4.7	
Winter	20-Mar-08	11:20	G4	374831	6357852	120	2	0	2	1,651.7	162	41	13.4	
Winter	20-Mar-08	11:21	G4	374152	6357894	121	1	0	1	1,643.8	202	39	0.0	
Winter	20-Mar-08	11:25	G4	369726	6357659	122	1	0	1	1,829.0	227	47	61.2	
Winter	20-Mar-08	11:50	G4	375600	6360522	123	1	0	1	1,676.9	84	14	49.2	
Winter	20-Mar-08	12:06	G4	375154	6362189	124	1	0	1	1,595.6	128	42	44.5	
Winter	20-Mar-08	12:07	G4	374999	6361868	125	2	0	2	1,534.6	142	41	4.4	
Winter	20-Mar-08	12:19	G6b	378456	6369200	126	1	1	2	1,358.3	326	40	201.6	
Winter	20-Mar-08	12:32	G6b	378120	6366897	127	1	0	1	1,537.4	261	38	0.0	
Winter	20-Mar-08	12:34	G6b	378915	6368406	128	2	2	4	1,744.4	250	39	7.9	
Winter	20-Mar-08	12:35	G6b	379019	6368465	129	6	3	9	1,784.8	331	23	0.0	
Winter	20-Mar-08	12:40	G6b	379280	6369323	130	1	0	1	1,673.5	269	33	112.6	
Winter	20-Mar-08	12:47	G6b	381500	6364008	131	1	0	1	1,705.3	71	45	183.8	
Winter	20-Mar-08	12:50	G6b	380258	6365099	132	1	0	1	1,731.5	100	39	66.3	
Winter	20-Mar-08	14:15	G6b	381791	6364517	133	2	0	2	1,264.2	78	39	93.0	
Winter	20-Mar-08	14:21	G6b	382011	6363245	134	1	0	1	1,316.8	92	43	238.8	
Winter	20-Mar-08	14:37	G9	385724	6362360	135	3	1	4	1,053.9	263	64	228.2	
Winter	20-Mar-08	14:46	G8	387244	6356153	136	2	0	2	980.2	214	52	60.9	
Winter	20-Mar-08	14:53	G9	387886	6366174	137	2	0	2	909.8	236	42	89.7	
Winter	20-Mar-08	14:56	G9	388535	6365698	138	2	0	2	1,135.9	210	37	8.2	
Winter	20-Mar-08	14:58	G9	390454	6364491	139	2	0	2	1,287.9	79	38	107.2	
Winter	20-Mar-08	15:05	G9	387217	6362496	140	2	0	2	1,252.4	268	40	866.1	
Winter	20-Mar-08	15:39	G10	392012	6369987	141	4	0	4	1,406.6	234	52	84.9	
Winter	20-Mar-08	15:39	G10	391925	6370373	142	1	0	1	1,370.5	295	35	239.7	
Winter	20-Mar-08	15:40	G10	392233	6370709	143	1	0	1	1,486.6	296	59	84.9	
Winter	20-Mar-08	15:58	G10	392449	6377541	144	2	0	2	1,381.4	318	48	90.8	
Winter	20-Mar-08	16:01	G10	392602	6375101	145	1	0	1	1,366.2	21	32	237.1	
Summer	02-Aug-08	11:20	G2	377410	6381081	146	3	0	3	1,893.8	148	42	57.5	
Summer	02-Aug-08	11:27	G2	377064	6378988	147	3	2	5	1,936.6	188	36	0.0	
Summer	02-Aug-08	11:32	G2	376890	6380653	148	2	0	2	1,956.8	134	41	10.9	
Summer	02-Aug-08	12:00	G2	372352	6377695	149	1	0	1	2,023.5	198	34	0.0	Jumbled rock
Summer	02-Aug-08	12:27	G2	373508	6380121	150	3	0	3	1,660.4	91	32	0.0	
Summer	02-Aug-08	13:42	G2	376698	6380223	151	1	0	1	2,031.2	273	42	86.6	
Summer	02-Aug-08	14:05	G1											none seen
Summer	03-Aug-08	11:25	G3	364390	6372466	152	4	0	4	1,880.3	213	35	0.0	
Summer	03-Aug-08	11:38	G3	370844	6369341	153	1	0	1	1,936.4	280	28	1.9	
Summer	03-Aug-08	13:21	G7	380224	6340148	154	2	0	2	1,786.8	143	37	19.1	

Appendix 4

Stone's Sheep Raw Observation Data

Appendix 4. Stone's Sheep Raw Observation Data

							No. Stone's Sheep				Topographic Characteristics				
Survey	Date	Time	Survey Unit	Easting	Northing	Sighting No.	Ram	Ewe	Lamb	Total	Elevation (m)	Aspect (o)	Slope (o)	Dist. Escape	Comment(s)
Summer	19-Jul-06	11:52	G10	393470	6369407	1	0	1	0	1	1,715	206	34	46	
Summer	19-Jul-06	11:53	G10	392626	6369400	2	0	6	2	8	1,690	219	37	1	4 yearlings, 2 lambs
Summer	19-Jul-06	12:12	G10	393557	6369531	3	0	7	2	9	1,819	202	31	57	
Summer	19-Jul-06	12:16	G10	391125	6366747	4	0	1	1	2	1,904	20	43	24	2 yearlings
Winter	20-Mar-08	15:45	G10	392607	6369706	5	0	4	0	4	1,767	250	42	17	
Winter	20-Mar-08	15:47	G10	393721	6374435	6	1	1	0	2	1,632	206	41	31	
Winter	20-Mar-08	15:48	G10	393579	6374754	7	1	0	0	1	1,619	234	42	40	
Winter	20-Mar-08	15:50	G10	392865	6377880	8	0	1	0	1	1,550	287	49	42	
Winter	20-Mar-08	15:51	G10	393648	6377422	9	1	0	0	1	1,490	32	40	70	
Winter	20-Mar-08	16:02	G10	392680	6374855	10	2	0	0	2	1,318	233	34	384	
Summer	02-Aug-08	14:16	G1	368134	6388511	11	0	1	1	2	n/a - seen outside of survey area				more sheep habitat to the west of block
Summer	02-Aug-08	14:19	G1	371175	6385638	12	0	1	1	2	2,147	257	30	31	

Appendix 5

Incidental Wildlife Raw Observation Data

copper FOX metals inc.

RTEC Keepers of the Land

Appendix 5. Incidental Wildlife Raw Observation Data

Survey	Date	Time	Easting	Northing	Species	Scientific Name	No. Observed	Comment(s)
Winter	6-Mar-06	16:10	385577	6371909	Gray wolf	*Canis lupus*	1	
Summer	18-Jul-06	11:48	390713	6364329	Golden Eagle	*Aquila chrysaetos*	2	
Summer	18-Jul-06	11:52	393470	6369407	Golden Eagle	*Aquila chrysaetos*	1	
Summer	18-Jul-06	12:00	392638	6377447	Golden Eagle	*Aquila chrysaetos*	1	
Summer	18-Jul-06	12:10	393163	6371337	Grizzly Bear	*Ursus arctos*	1	
Summer	19-Jul-06	12:39	395095	6371845	Caribou	*Rangifer tarandus*	3	3 females
Summer	19-Jul-06	12:04	396301	6374142	Golden Eagle	*Aquila chrysaetos*	1	
Summer	19-Jul-06	13:09	398873	6365828	Golden Eagle	*Aquila chrysaetos*	1	
Summer	19-Jul-06	13:40	391395	6362996	Grizzly Bear	*Ursus arctos*	3	mom with 2 cubs
Summer	19-Jul-06	14:34	396586	6353607	Grizzly Bear	*Ursus arctos*	3	mom with 2 2-yr olds
Summer	19-Jul-06	14:35	396523	6352035	Golden Eagle	*Aquila chrysaetos*	1	
Winter	08-Feb-08	n/a	n/a	n/a	Fisher	*Martes pennati*	0	tracks
Winter	08-Feb-08	n/a	n/a	n/a	Red fox	*Vulpes vulpes*	0	tracks
Winter	08-Feb-08	n/a	n/a	n/a	Blue grouse	*Dendragapus obscurus*	1	
Winter	08-Feb-08	n/a	n/a	n/a	Ptarmigan spp.	*Lagopus* spp.	1	
Summer	02-Aug-08	14:16	368134	6388511	Golden Eagle	*Aquila chrysaetos*	2	
Summer	03-Aug-08	12:51	381563	6338466	Grizzly Bear	*Ursus arctos*	0	den site