Appendix 15-B

Baseline Survey Report: Mammals

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Crown Mountain Coking Coal Project

NWP Coal Canada Ltd

November 27, 2020

Keefer Ecological Services Ltd

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Mammal Baseline Report

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1. Introduction

1.1. Project Overview and Study Area

The Crown Mountain Coking Coal Project (the Project) is a proposed new open pit metallurgical coal mine in the Elk Valley coal field in the East Kootenay region of southeastern British Columbia. Under the *Canadian Environmental Assessment Act* and the *BC Environmental Act*, the Project is subject to the formal and legislated Environmental Assessment (EA) process. It is anticipated that the Project will have a production capacity of up to 4.0 million run-of-mine tonnes per annum for a production duration of approximately 15 years. Several existing metallurgical coals are located close to the Project in the Elk Valley and Crowsnest coal fields, including Teck Coal Limited's Elkview mine and Line Creek mine that are both less than 12 kilometers (km) from the Project area. The proposed Project footprint is approximately 1300 ha.

The Local Study Area (LSA) encompasses the Project Footprint and surrounding area where all or most of the Project effects are anticipated to occur. The terrestrial LSA is approximately 242 km^2 and was selected to encompass the landscapes, ecosystems and habitats that may experience changes from the Project resulting in direct and/or indirect effects including; the Elk River, Alexander, Michel and Grave Creek drainages, Grave Prairie, Erickson Ridge and Sheep Mountain (**Figure 1.1-1**). The LSA was selected to include the existing diversity of wildlife species habitats (e.g., riparian, forest, grassland, wetland and alpine ecosystems) in addition to known and anticipated wildlife movement corridors.

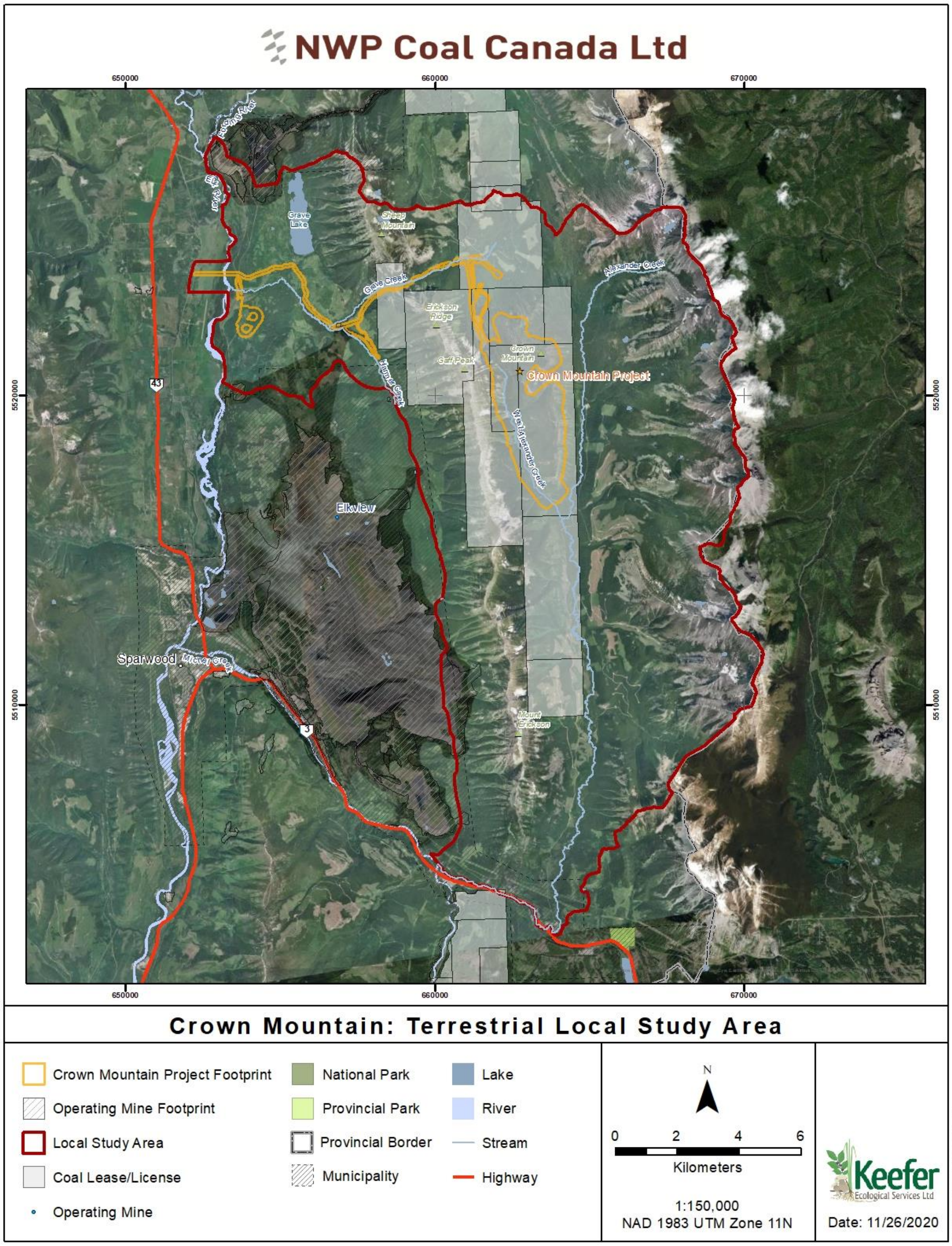

Figure 1.1-1 Overview of the (242 km²) Crown Mountain Coking Coal Project LSA in the Elk Valley of South-Eastern British Columbia

2. Purpose and Objectives of Baseline Study

The project-specific provincial Application Information Requirements (AIR; BC EAO, 2018) and federal Environmental Impact Statement (EIS) Guidelines (CEAA, 2015) for the Project's EA identify several mammal species as Valued Components (VCs). Understanding existing mammal communities and their associated habitats in the Project's LSA and RSA is necessary in order to assess potential effects of Project activities on this wildlife group. The primary objective of this baseline program was to determine the occurrence of mammal species and their associated habitat availability and distribution within a local and regional context. To achieve this objective, comprehensive baseline surveys were conducted to document mammal species occurrence (detected/not-detected), distribution, and demographics within the LSA.

There are four ungulate species identified as VCs for the Project, including elk (*Cervus elaphus*), moose (*Alces alces*), bighorn sheep (*Ovis canadensis*), and mountain goat (*Oreamnos americanus*). Other ungulates species present in the region include white-tailed deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*). Of these species in the region, bighorn sheep and mountain goats are listed provincially as species of concern (i.e., Blue-listed; BC Conservation Data Centre (CDC), 2011). Plains bison (*Bos bison bison*) were historically present in the Elk Valley, although occurrences were likely rare as British Columbia was the furthest west extent of their range in Canada (COSEWIC 2004; COSEWIC, 2013). There are currently only five subpopulations of plain bison considered "wild by nature" present in Canada, only 1 of which is located in British Columbia (Pink Mountain; COSEWIC, 2013). For a species to be considered "wild by nature" by SARA and COSEWIC, the population must function long term in an ecological and evolutionary manner the maintains the wild nature of the species, and are distinct (genetically or geographically) from populations managed for purposes other than conservation (COSEWIC, 2013). The historical range of mountain caribou (*Rangifer tarandus*) also extended through the Elk Valley region, however there are currently no caribou populations in the region (MRLNRORD, 2018).

Carnivore species identified as VCs for the Project include grizzly bear (*Ursus arctos)*, wolverine (*Gulo gulo*), American badger (*Taxidea taxus*), American marten (*Martes americana*) and Canada lynx (*Lynx canadensis*). Three of these species are of conservation concern in British Columbia, including American badgers which are federally endangered under the *Species at Risk Act* (SARA, 2002; COSEWIC, 2012b) and at risk of extinction in BC (i.e., Red-Listed; Provincial Conservation Status: S1; BC Conservation Data Centre, 2018). Both grizzly bears and wolverines which are listed as species of Special Concern under the *Species at Risk Act* (COSEWIC, 2012a; COSEWIC, 2014) and grizzly bears are considered vulnerable to extirpation or extinction in BC (i.e., Blue-listed, BC Conservation Data Centre, 2019). Additional carnivores within the region include bobcat (*Lynx rufus*), cougar (*Puma concolor*), fisher (*Martes* pennanti) and grey wolf (*Canis lupus*; Apps et al., 2007; Apps et al., 2010; Mowat 2007). Fishers exist in low populations throughout BC, however, are suggested to be extirpated from the Rocky Mountain ranges south of Kinbasket Resevoir (Weir, 2003). The East Kootenay Fisher Reintroduction Program was initiated in 1994 to re-establish fisher populations in southeastern BC west of Cranbrook (Fontana, Teske, Pritchard & Evans, 1999). This program may have restored a small population of fishers in this region, although monitoring has been limited (Fontana et al., 1999; Weir, 2003).

Of the sixteen bat species present in British Columbia, eleven of them can be found in the Kootenay region (Craig et al., 2014). This includes little brown myotis (*Myotis lucifugus*), Yuma myotis (*Myotis yumanensis*), long-legged myotis (*Myotis volans*), Californian myotis (Myotis californicus), fringed myotis

(*Myotis thysanodes*), long-eared myotis (*Myotis evotis*), northern Myotis (*Myotis septentrionalis*), Townsend's big-eared bat (*Corynorhinus townsendii*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*; Craig et al., 2014). Within the Project LSA, the little brown myotis, northern myotis, and Eastern red bat all have the potential to occur. The northern myotis and the little brown myotis were both federally listed on Schedule 1 of the *Species At Risk Act* as Endangered as their survival is imminently threatened by WNS (Environment Canada, 2014). The northern myotis, fringed myotis and Townsend's big-eared bat are listed provincially as a species of special concern (i.e., Blue-listed; BC Conservation Data Centre (CDC), 2013; 2014; 2015).

3. Methods

3.1. Overview

Comprehensive baseline surveys were conducted to collect data and information on carnivores, ungulates and bats during 2014-2020 within the LSA (**Table 3.1-1**). There were eight baseline field surveys conducted (**Table 3.1-1**). Survey methods included remote cameras, ground and aerial transects, burrow surveys, hair-snagging surveys, GPS collaring of grizzly bear and acoustic monitoring and live capture of bats. Baseline surveys were conducted by multiple contractors and targeted a wide range of habitat types (e.g., land cover, elevations, slopes) across the LSA and RSA.

Table 3.1-1 Baseline Field Surveys Conducted to Estimate the Occurrence, Distribution and Relative abundance of mammals in the Crown Mountain Project LSA

Survey Type	Survey Date(s)	Valued Components	Standards/ Protocols	Surveyors
Remote Camera Surveys (KES)	• February 1 to May 19, 2014 (Quinn & Klafki, 2015) • January 31 to May 2, 2015 (Quinn & Klafki, 2015) • January 1, 2017 to September 13, 2019 (KES) • June 9, 2016 to December 19, 2018	• Moose • Elk • Bighorn sheep/ Mountain goat • Canada lynx • American marten • Wolverine • Grizzly bear	• Inventory Methods of Medium-Sized Terrestrial Carnivores: coyote, red fox, lynx, bobcat, wolverine, fisher & badger (RISC, 1999a) • Wildlife Camera Metadata Protocol (RISC, 2019)	Quinn & Klafki, 2015 Des Rosiers-Ste. Marie, 2019 (KES) Chow, 2019 (FLNRO)
Aerial Transects	• October 17, 2014 • March 11, 2014 • June 17, 2015	• Moose • Elk • Bighorn sheep • Mountain goat • Grizzly bear	• Aerial–based Inventory Methods for Selected Ungulates: bison, mountain goat, mountain sheep, moose, elk, deer and caribou (RISC, 2002) • Inventory Methods for Medium-Sized Territorial Carnivores – coyote, red fox, lynx, bobcat, fisher, & badger (RISC, 1999a)	DeMars & Tipper, 2014 DeMars, 2014 DeMars, 2015

Survey Type	Survey Date(s)	Valued Components	Standards/ Protocols	Surveyors
Ground Transects	• February 6 to 10, 24 to 28, 2014 (Quinn & Klafki, 2015) • March 27 to 28, 2014 (Quinn & Klafki, 2015) • February 13 to 16, 23 to 25, 2015 (Quinn & Klafki, 2015) • March 7 to 9, 17, 30 to 31, 2015 (Quinn & Klafki, 2015) • July 9 to 10 and 15 to 19, 2019 (KES)	• Moose • Elk • Bighorn sheep • Canada lynx • American marten • Wolverine	• Inventory Methods for Medium-Sized Territorial Carnivores – coyote, red fox, lynx, bobcat, fisher, & badger (RISC, 1999a) • Ground-based Inventory Methods for Selected Ungulates: moose, elk and deer. (RISC, 1998a)	Quinn & Klafki, 2015 KES, 2019 (this report)
Burrow Surveys	• July 28 and August 1, 2014 (Klafki, 2014) • July 3 to 4, 2018 (Hausleitner & Lowey, 2018) • July 9 to 10, and 15 to 19, 2019 (KES, 2019)	• American badger	• Inventory Methods of Medium-Sized Terrestrial Carnivores: coyote, red fox, lynx, bobcat, wolverine, fisher & badger (RISC, 1999a)	Klafki, 2014 Hausleitner & Lowey, 2018 KES, 2019 (this report)
Hair-Snagging Surveys	• February 1 to May 19, 2014 • January 31 to May 2, 2015	• Canada lynx • American marten • Wolverine	• Inventory Methods of Medium-Sized Terrestrial Carnivores: coyote, red fox, lynx, bobcat, wolverine, fisher & badger (RISC, 1999)	Quinn & Klafki, 2015
GPS Collar Surveys	• 2003 to 2018	• Grizzly bear	• Inventory Methods for bears (RISC, 1998b)	Apps & Lamb, 2019
Acoustic Bat Surveys	• June 15 to August 4, 2017	• Bats	• Acoustic detection surveys following *Inventory Methods for Bats* (RISC 1999b)	Isaac, 2018 KES, 2019 (this report)
Live-Capture Bat Surveys	• August 8 to 10, 2017 • August 14, 2017	• Bats	• Live-capture mist net surveys following *Inventory Methods for Bats* (RISC 1999b)	Isaac, 2018

3.2. Baseline Field Surveys

3.2.1. Remote Cameras

Carnivores are notoriously difficult to census due to their often nocturnal, elusive natures and low population densities (Long, Mackay, Zielinkski & Ray, 2008). Remote camera surveys are a widely used, non-invasive sampling approach that is particularly useful for collecting abundant data on carnivores and ungulates, which are often more difficult to observe directly (Kelly, Betsch, Wultsch, Mesa & Mills, 2012; RISC, 1999a; RISC, 2019). Information collected can be used to quantify species occurrence, distribution, demographics and relative abundance (Brennan, Tri & Marcot, 2019; Long et al., 2008).

Forty camera stations (Browning Trail Cameras) were established in the LSA from February 1 to May 19, 2014 (Reconyx Trail Cameras); January 31 to May 2, 2015 (Quinn & Klafki, 2015; Reconyx Trail Cameras); and January 1, 2017 to September 13, 2019 (this report). In addition, the baseline assessment included data obtained from 80 camera stations (Reconyx Trail Cameras) established by FLRNO staff as part of a five-year monitoring project (Chow, 2019; **Figure 3.2-1**). The data included was collected from June 9, 2016 to December 19, 2018 (Chow, 2019).

Remote cameras were established to include representative habitat types, while focusing effort on areas where ungulates and their predators would be expected to be found if present, including trails, roads and other linear landscape features that facilitate animal movements (Kelly et al., 2012; Mackenzie et al., 2002; RISC, 1999a; RISC, 2019; Quinn & Klafki, 2015; Chow, 2019). Surveys were conducted during winter and summer in order to capture seasonal variability in habitat selection and distribution (RISC, 1999a; Tri, 2019). To increase the probability of detecting carnivores and ungulates, the selection of locations included local hunters' input addition to the KES team's knowledge of wildlife use of the LSA (Marcot, 2019). As a result, locations included areas of important ungulate winter range and wetlands in the lower western elevations adjacent to the Elk River; at known mountain goat and sheep movement corridors throughout the Grave Creek canyon; at suspected movement corridors adjacent to creeks on the east side of the canyon.

[Photo: Keefer Ecological Services]

Cameras were installed on trees using a strap and a lock, at an approximate height of 1.0 – 2.5 m high and 2.0-5.0 m from a trail, angled slightly downward to capture images of smaller animals (Kelly et al., 2012). Camera stations were non-baited, and physical and scent disturbances were minimized in the area of the camera during deployment (RISC, 1999a; Quinn & Klafki, 2015; Chow, 2019). For the larger RSA study, motion-triggered cameras were placed at a density of 1 per 100 km^2 to allow for even and complete coverage across the study area, while balancing cost and field logistics (Chow, 2019; Steenweg et al., 2015).

Baited Stations

During the 2014/2015 surveys, seven remote camera stations (n=7) were coupled with bait/scent hair-snags to increase the probability of detecting rare and wide-ranging carnivores and to collect genetic (hair) samples that can be used to identify individuals (Kelly et al., 2012; Quinn & Klafki, 2015). Remote cameras were attached to a tree 1.5 m in height and approximately 12-15 m away from the sample tree. The baited sites were positioned in high quality habitats (e.g., away from human activity, mature forest with open understory) and aimed at the base of the sample tree and checked and maintained every three to four weeks from January to early-April (before suspected bear emergence). Photos were also used to identify individual wolverine based on their unique pelage patterns (Quinn & Klafki, 2015).

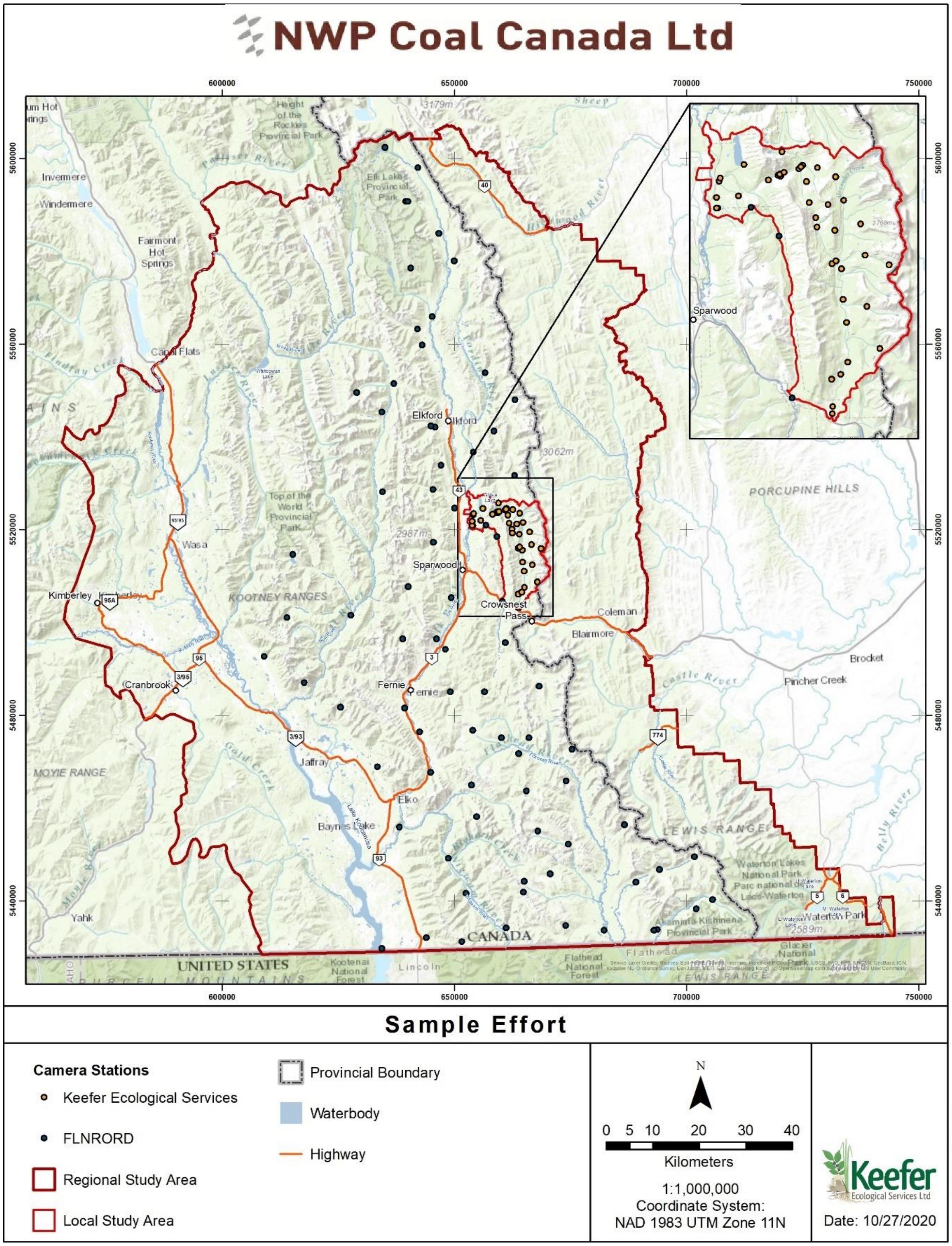

Figure 3.2-1 Remote Camera Stations Established in the LSA (KES, n=40) and Surrounding RSA (FLNRORD, n=80) to Collect Data on Ungulates and Carnivores

3.2.2. Aerial Transects

To provide information on the occurrence, distribution, relative abundance, and demographics of ungulates within the LSA, aerial surveys were conducted following an encounter transect approach (DeMars, 2014; DeMars & Tipper, 2014; DeMars, 2015; RISC, 2002). Aerial surveys were conducted in the fall (October 17, 2014; DeMars & Tipper, 2014), winter (March 11, 2014; DeMars, 2014) and spring (June 17, 2015; DeMars, 2015) to capture seasonal variability in habitat selection and distribution (Figure 3.2-2; RISC, 1998a; RISC, 2002). Surveys were conducted using a Bell 206 Jet Ranger equipped with rear bubble windows (maintaining an average speed of 75 - 100 km/hr approximately 100-200 m above ground level). In addition to the pilot, personnel included two observers in the rear seats and one observer/navigator in the front left seat. Aerial transects were spaced approximately 500 m apart following contours parallel to valley drainages in the LSA. Winter surveys were primarily flown over known ungulate winter ranges, whereas fall and spring surveys were expanded to include the entire LSA.

For each ungulate group encountered, the following information was recorded: species, the Broad Ecosystem Unit of the location (RISC, 1998c), group size, composition (females, males, and juveniles), topographic position (UTMs, elevation), behaviour (e.g. standing, lying, walking, running) and oblique vegetation cover (DeMars & Tipper, 2014; RISC 2002; Unsworth et al., 1998). The composition (sex and age class) of each individual in a group was determined based on body size, presence/absence of antlers (elk, moose, deer species; season dependent), horn structure (bighorn sheep, mountain goat), and/or presence of a vulva patch (moose; DeMars & Tipper, 2014). If possible, bighorn sheep males were further classified into Class I-IV rams based on the relative curl of the horn (Class I < ½ curl, Class II > ½ but < ¾ curl. Class III > ¾ curl but < full curl, Class IV full curl). The amount of time spent determining group composition was limited in the fall and spring surveys to reduce added stress to individuals during the hunting and birthing seasons (DeMars & Tipper, 2014; DeMars, 2015). Observers frequently communicated with each other to ensure that large groups of animals were correctly counted and classified. The percent oblique vegetation cover was estimated (to the nearest 5%) in 10-m radius surrounding each ungulate group. Incidental observations of large carnivores were also recorded.

[Photo: Keefer Ecological Services]

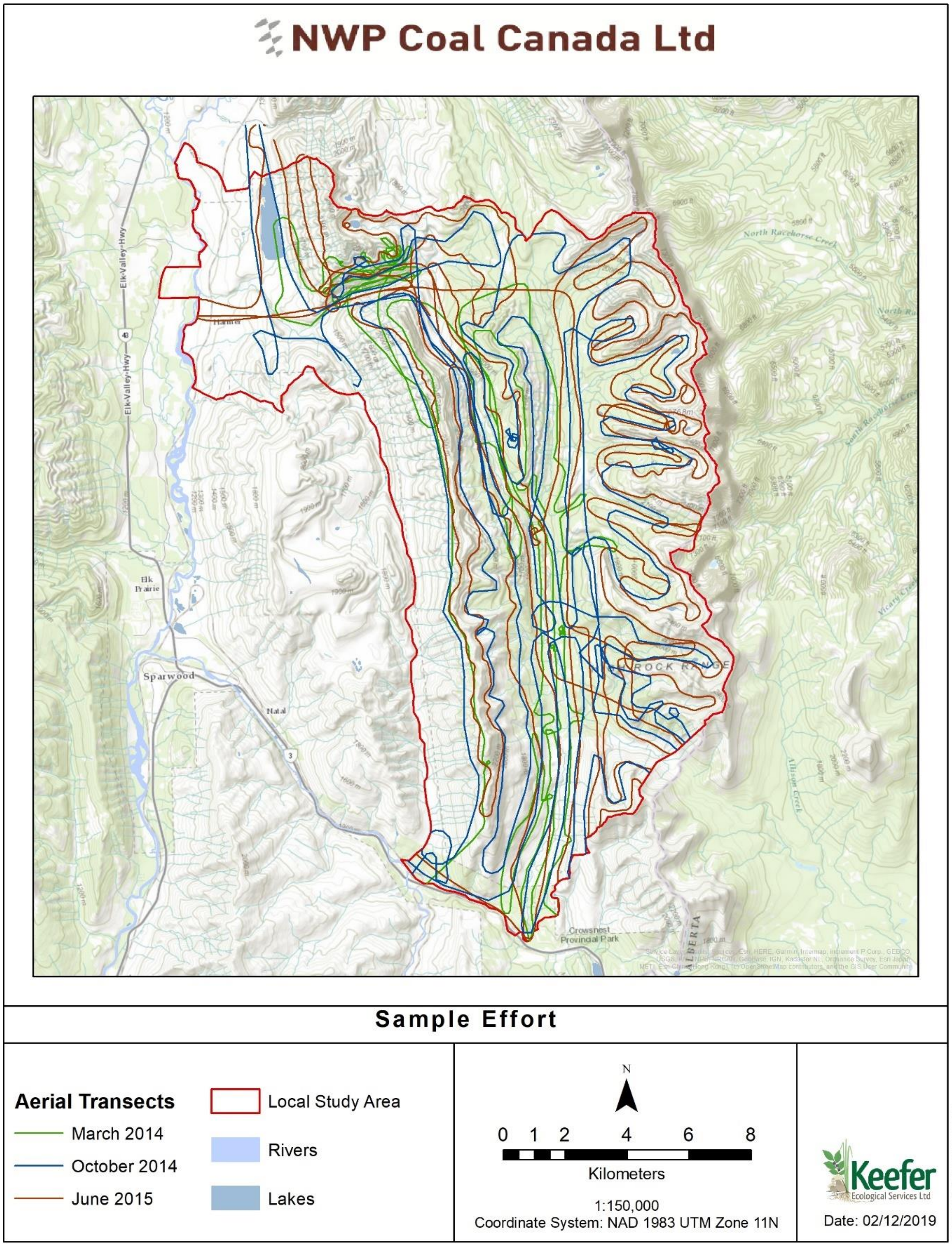

Figure 3.2-2 Aerial Surveys (n= 874.08 km) Conducted in the LSA in 2014 (March n= 183.59 km; October n= 262.98 km) and 2015 (June n= 366.86 km)

3.2.3. Ground Transects

Detection/non-detection sign (i.e., track, scat etc.) surveys are a widely used and useful means of obtaining sufficient data on carnivores that are otherwise difficult to observe and count directly (Kelly et al., 2012; Long et al., 2008; RISC, 1999a). Track and sign surveys were conducted systematically along transects within the LSA to provide information on species occurrence, distribution and relative abundance (RISC, 1999a). To ensure that sampling included representative wildlife species habitats, the LSA was first stratified by BEC subzones. Transects were established in habitats in proportion to their occurrence, while focusing effort on areas where ungulates and their predators would be expected to be found if present, including old regenerating exploratory road cuts (with narrow openings), trails, riparian corridors, saddles, ridges and roads (Kelly et al., 2012; Mackenzie et al., 2002).

The primary objective of the ground transects were to collect detection/non-detection data of meso-carnivores (American marten, wolverine, and Canada lynx) and their prey (snowshoe hare, grouse species and red tree squirrel). Tracks and signs of other carnivores (e.g., wolf, grizzly bear, cougar) and ungulates were also recorded. Ground surveys for American badger were conducted separately during snow-free periods (see **Section 4.2.1**).

Surveys were conducted along transects during winter months of 2014 (February 6 to 10, 24 to 28, and March 27 to 28) and 2015 (February 13 to 16, 23 to 25) (**Figure 3.2-3**; Quinn and Klafki, 2015). Transects were sampled for two consecutive winters (2014/2015) to address annual variations in species distribution and relative abundance. Winter surveys were conducted on foot, snowshoes, or skis to permit accurate identification and recording of tracks and signs of wildlife species. To account for seasonal variation, each transect was replicated once per month (January – March). During winter, approximately five days/session of effort were attributed to snow-tracking. Environmental attributes recorded included elevation, snow depth, snow cover, snow conditions, wind, precipitation, temperature, cloud cover, days since 5 cm snowfall, and BEC subzone. Additional transects were conducted during summer to capture seasonal variability in habitat selection and distribution.

Winter transect data was used to provide estimates of relative abundance. Track observations were converted to frequency of tracks/km- day to rank habitat use (Quinn and Klafki, 2015). This was derived by dividing the number of tracks observed by the distance surveyed (km) and by the number of days since last snowfall for each respective BEC subzone.

[Photos: Keefer Ecological Services]

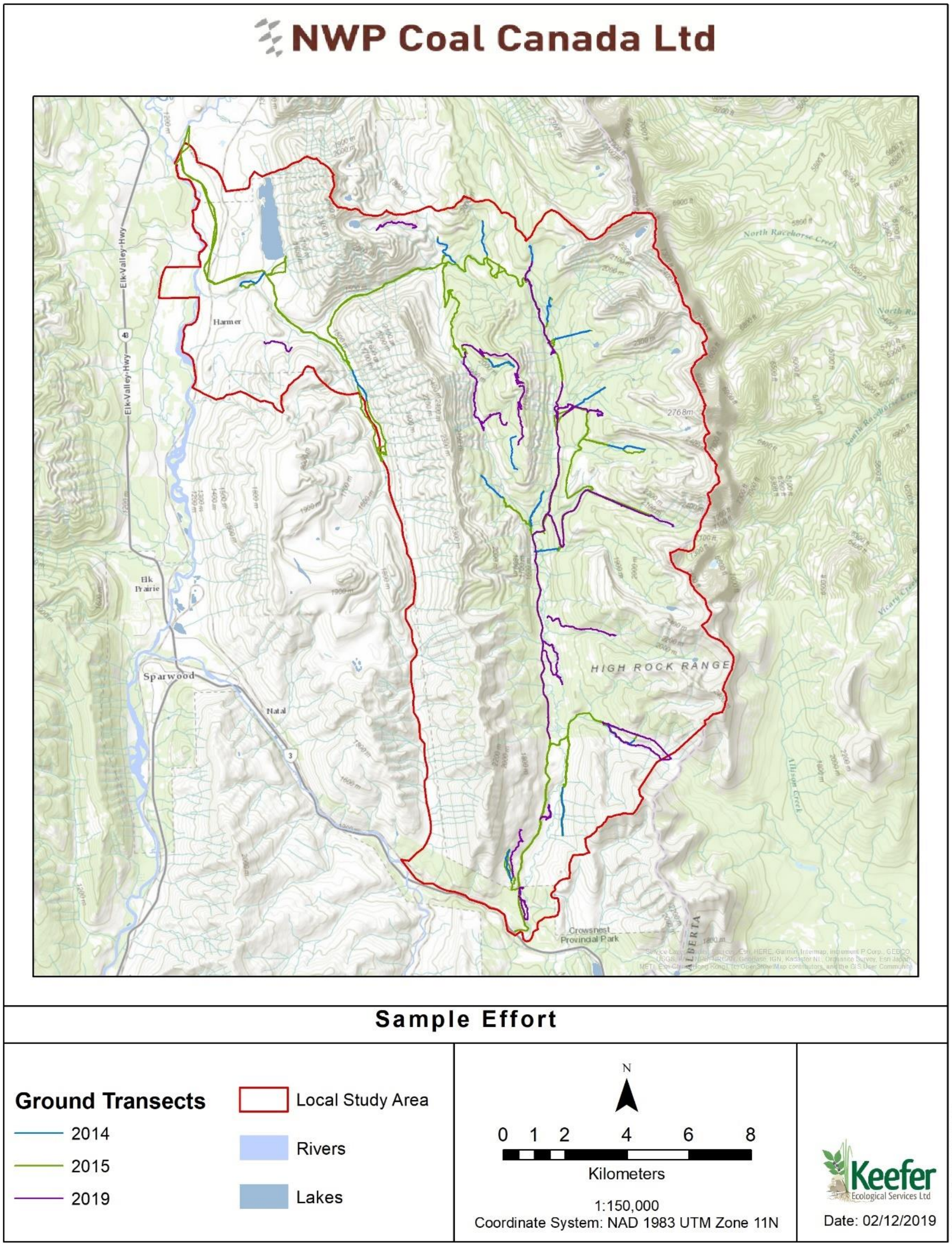

Figure 3.2-3 Ground Transects (n = 557.2 km) Conducted in Search of Evidence of Ungulates and Carnivores in the LSA in 2014 (n = 220.2 km), 2015 (n = 262.9 km) and 2019 (74.0 km)

3.2.4. American Badger Burrow Surveys

Systematic detection/non-detection surveys for American badger burrows are a useful approach for acquiring sufficient data and information to determine species occurrence, distribution, and resource selection (Kelly et al., 2012; RISC, 2007). Surveys were conducted along transects within the LSA during snow-free periods when American badgers are most active, and before mid-August when their primary prey, Columbian ground squirrels, are still active (RISC, 2007). Surveys were conducted during 28 July and 01 August 2014 (Klafki, 2015), 03 to 04 July 2018 (Hausleitner & Lowey, 2018) and 9 to 10 and 15 to 19 July 2019 (KES, 2019). Transects were established within the LSA to include representative ecosystems, while focusing effort on areas where American badgers would be expected to be found if present (Long et al., 2008; RISC, 2007). The Project area was stratified for American badger using criteria identified through previous analysis of important factors influencing site selection (Klafki, 2015). Badger habitat was stratified using existing digital data sources (forest inventory data, biogeoclimatic ecosystem data and surficial geology data), and into either favourable or non-favourable categories based on parent material, tree cover and biogeoclimatic units. Sampling involved conducting surveys for signs of American badgers (i.e., burrows) and their prey (i.e., sight or sound detections of Columbian ground squirrels or their colonies) along transects in potentially suitable habitat for American badgers (RISC, 2007). Surveys along transects were conducted using 4-wheel drive vehicles on open logging/mining roads, all-terrain vehicles (ATVs) on deactivated roads, and by foot into remote areas. Each American badger burrow encountered was documented by recording the location and a freshness of use assessment (i.e., currently used, used within weeks or months, used within a year). The locations of Columbian ground squirrel and northern pocket gopher (detected by sight, sound and/or the presence of colonies or diggings) encountered along survey routes (separated by 20 m or more) were also recorded. Other incidental wildlife observations were recorded when encountered.

[Photo: Keefer Ecological Services]

3.2.5. Hair-Snagging of Carnivores

Non-invasive sampling sites for selected furbearers were deployed in two consecutive winters in the LSA (2013/14 and 2014/15) to address annual variation in species distribution (Quinn and Klafki, 2015). Bait/scent hair-snag stations were coupled with remote cameras to increase the probability of detecting of rare and wide-ranging carnivores (see **section 4.2.1**; Quinn and Klafki, 2015). Hair samples can provide unique genetic identifications of individuals, including gender (RISC, 1999a). Baited and scented sampling stations equipped with hair-snagging devices (i.e., barbed wire) and remote cameras were deployed in five 100 km^2 grid cells overlaying the LSA (see **section 4.2.1**; **Figure 3.2-4**; RISC, 1999a). These sampling stations were baited with road-killed ungulates and/or trapper-killed beaver carcasses (skinned) and attraction scents (combinations of beaver castor, skunk essence, and weasel musk). The bait was attached approximately 2-3 m in height with barbed wire wrapped around the tree to snag hair from carnivores climbing up to the bait. Bait/scent was replaced or refreshed with every site visit, and human scent was limited as much as possible. Hair samples (n=65) were carefully extracted from the barbed wire sample trees as well as from natural rub trees/beds. Samples were sent to a genetic lab for DNA analysis (species identification) as coordinated by BC Ministry of Forests and Natural Resource Operations staff.

[Photo: Keefer Ecological Services]

[Photo: Keefer Ecological Services]

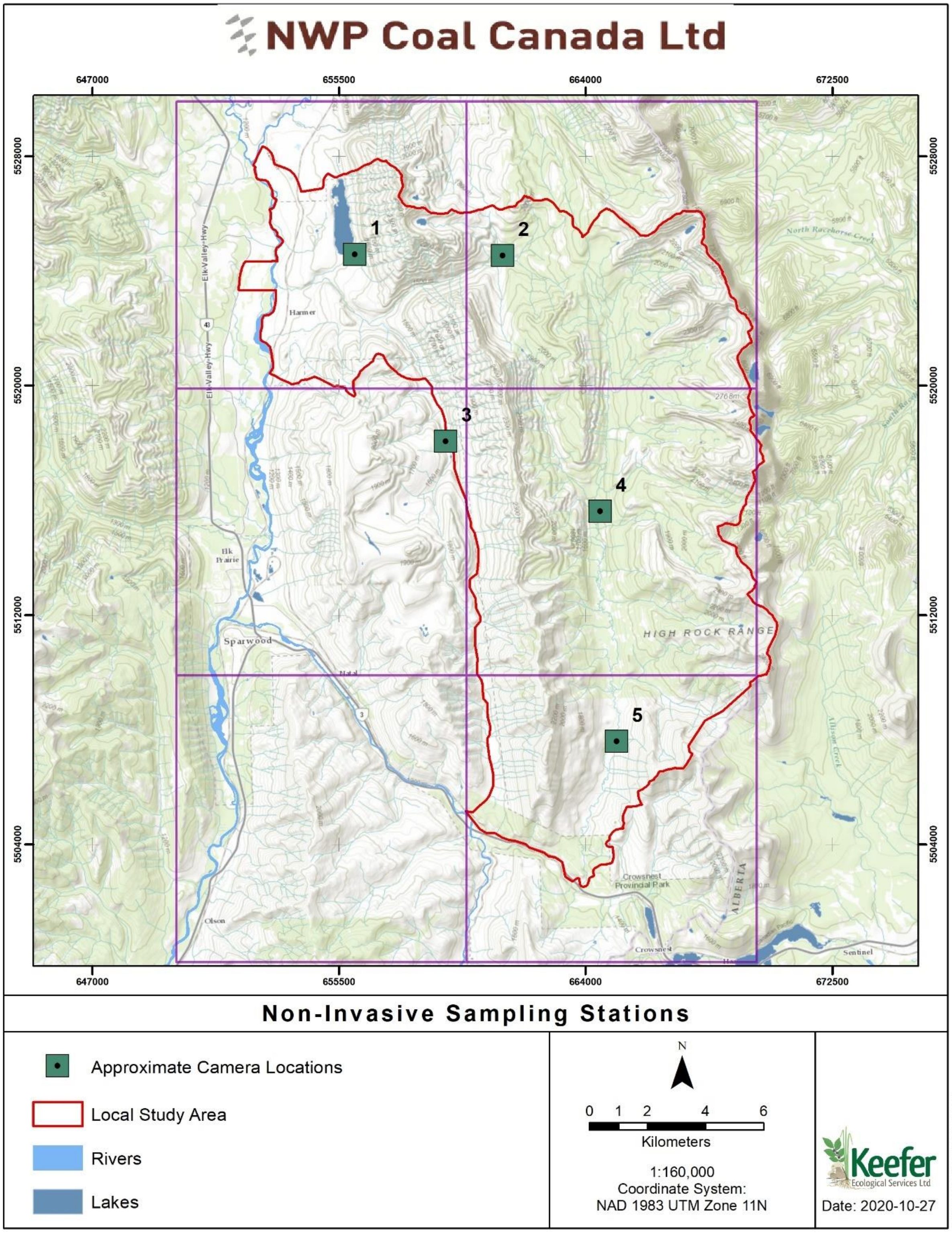

Figure 3.2-4 Locations of Non-Invasive Sampling Stations within 100 km² Sample Units in the LSA

3.2.6. GPS Collaring of Grizzly Bear

The assessment of grizzly bear included data obtained from a collaborative research program that seeks to understand behavioural responses by grizzly bears against a suite of factors pertaining to habitat and human influence (Apps & Lamb, 2019). Grizzly bears were captured through localized ground trapping using cable-snares, culvert traps, free-range darting, as well as through helicopter searching and aerial darting (Apps & Lamb, 2019). The majority of location fixes occurred every 6 hours, with some occurring at 2, 4, 13 hour or daily intervals. Winter den sites for grizzly bears were also determined from GPS location data during November to April. Den site locations were inferred based on clustering of GPS location data during the expected denning period (Apps & Lamb, 2019).

3.2.7. Acoustic Monitoring of Bats

Twelve acoustic detectors (Anabat SD2 [Titley Electronics Ltd.] and SM2 BAT [Wildlife Acoustics Inc.]) were deployed in representative habitat types throughout the Grave Creek and Alexander Creek drainages to identify the bat species presence and use during summer (**Figure 3.2-5**; Isaac, 2018; RISC, 1999b). Seven of the eleven detectors were located within the operating mine footprint because of increased disturbance expected in this region due to Project activities. Sampling effort at each site varied from one to sixteen nights. Additional detectors (n=3) were later deployed during fall 2019 - winter 2020. The site names and respective habitat types and sampling dates are shown in **Table 3.2-1**.

[Photo: Isaac, 2018)

Acoustic data were filtered to remove any files with high ambient noise, and the remaining files were subjected to two rounds of automatic bat identification. The first round used Kaleidoscope Pro and the second round used the SCAN option in AnalookW, using strict diagnostic filters built for the North American Bat Monitoring Network. Subsequent to automatic identification, all acoustic files were manually vetted by a trained biologist to confirm species identification (Isaac, 2018).

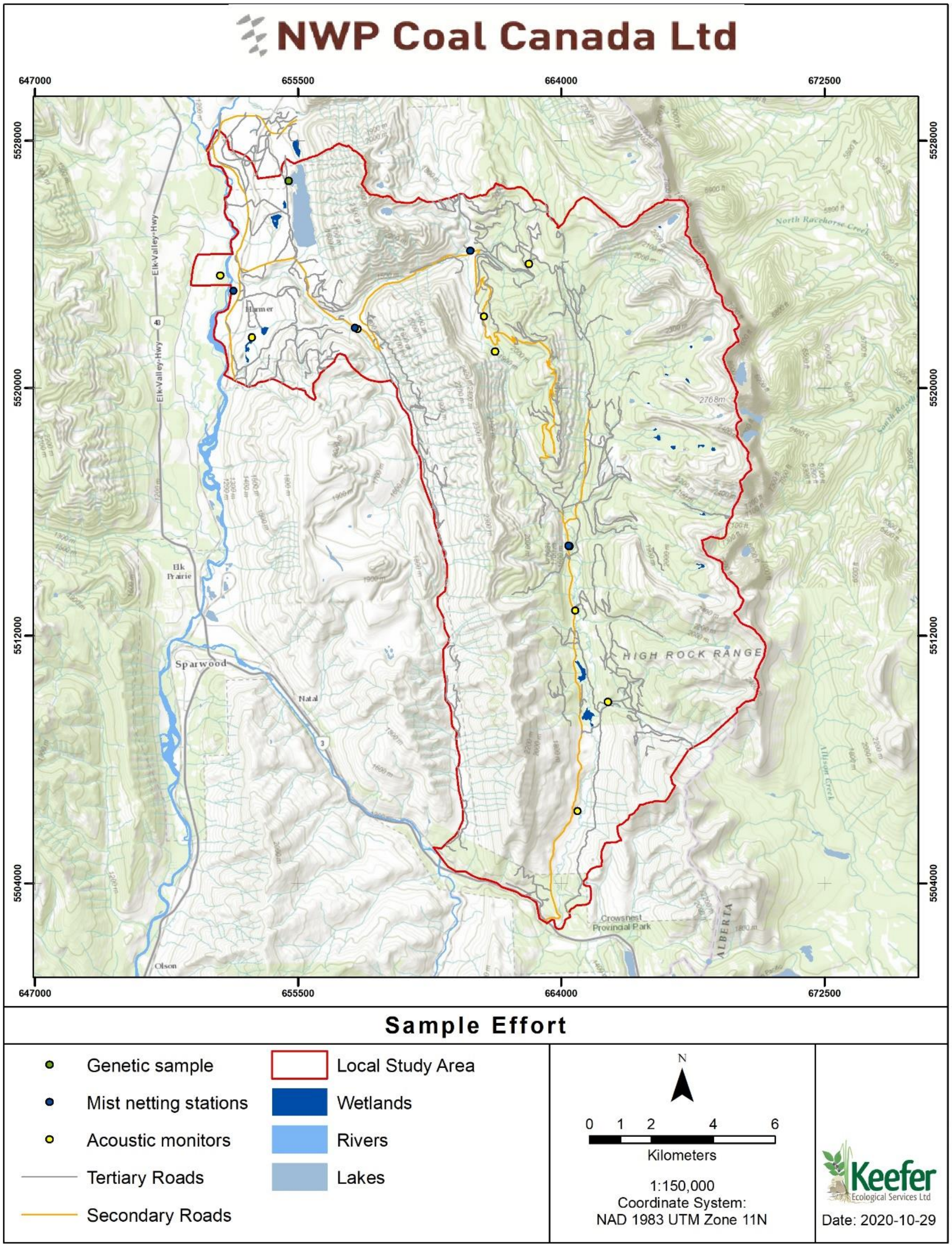

Figure 3.2-5 Location of Acoustic Detectors Deployed within the Project LSA

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Table 3.2-1 Summary of Locations and Habitat Types where Acoustic Detectors were Deployed in 2017 to Characterize Bat Species Occurrence in the Project LSA

Site Name	Habitat Types	Sampling Dates	UTM x	UTM y
Grave Prairie	Open grassland prairie	June 16-June 26, 2017 (11 nights)	653419	5523140
Grave Prairie forest	Mixed forest adjacent to grassland prairie	June 28-July 12, 2017 (15 nights)	654009	5521642
Harmer Lake	Riparian shrubs leading into lake	June 15-June 18, 2017 (4 nights)	657336	5521949
Grave Canyon	Rock face with talus slope	June 15-June 18, 2017 (4 nights)	652986	5523632
Grave Creek Branch C landing	Forest clearing adjacent to forest service road	July 18-Aug 4, 2017 (18 nights)	661065	5524431
Grave Creek avalanche bowl	High elevation site overlooking avalanche chutes	July 18-Aug 4, 2017 (18 nights)	661505	5522316
Grave Creek Forest Service Road	Coniferous forest on edge of unused forest service road	July 18-Aug 3, 2017 (17 nights)	662950	5524011
Grave Creek at Teck reservoir	Adjacent to reservoir	Oct 22-Oct 25, 2019 (4 nights); January 30-February 3, 2020 (5 nights)	657420	5521903
Alexander Creek talus	Talus slope	June 16-June 26, 2017 (11 nights)	665502	5509869
Alexander Creek wetland	Wetland	June 16-June 25, 2017 (10 nights); October 21-Nov 11, 2019 (22 nights); January 30-31, 2020 (2 nights); April 10-11 (2 nights)	664241	5514917
Headwaters of West Alexander Creek	Wetland	October 22-29, 2019 (8 nights); January 1-January 8, 2020 (8 nights); January 30-February 3, 2020 (5 nights)	661866	5521191

Alexander Creek open field	Open meadow adjacent to Alexander Creek	June 22-June 26, 2017 (5 nights)	664458	5512813
Alexander Creek aspen grove	Edge of grove of aspen trees in field near Alexander Creek	July 27, 2017 (1 night)	664533	5506341

3.2.8. Live-Capture of Bats

To confirm identification of bat species from the acoustic files, live capture and subsequent genetic testing of bats was conducted (Isaac, 2018; RISC 1999b). The little brown myotis was the focal species because its identification cannot be confirmed by acoustics alone, as well as its conservation status and likelihood to exist in the LSA. Mist nets were erected between August 8 – 10, and August 14, 2017 in foraging habitats for the little brown myotis (fly-ways leading to water bodies, edge of water bodies) at the Alexander Creek wetland site, the Harmer Lake site, and near the Grave Prairie site and the Grave Creek Branch C landing site (**Figure 3.2-5**). Captured bats were morphologically identified, weighed, sexed, and their reproductive status was determined. Wing tissue samples from bats morphologically identified as little brown myotis were taken and submitted to Wildlife Genetics International (WGI) for DNA sequencing for positive identification. Additionally, one guano sample from a suspected little brown myotis colony in a bat house installed on a cabin at Grave Lake was submitted to WGI for DNA sequencing (Isaac, 2018).

[Photo: Isaac, 2018)

4. Results

4.1. Mammal Summary

Mammal species detected in project LSA through baited and non-baited remote camera surveys and ground transect surveys during 2014-2019 are summarized in **Table 4.1-1** (Quinn & Klafki, 2015; Des Rosiers-Ste. Marie, 2019).

Table 4.1-1 Mammal Species Detected in the Remote Camera Surveys (Baited and Non-Baited) and Ground Transects (Winter and Summer) in the Project LSA

Species	Baited Cameras	Non-Baited Cameras	Winter Ground Transects	Summer Ground Transect	Hair Snag
American Marten	30	16	133	-	-
Beaver	-	-	-	6	-
Bighorn Sheep	-	82	1	12	-
Black Bear	1	56	-	5	-
Bobcat	-	1	-	-	-
Canada Lynx	18	28	156	5	-
Columbian Ground Squirrel	-	-	-	-	-
Cougar	18	7	3	3	-
Coyote	18	55	86	3	2
Elk	14	277	13	15	-
Ermine	1	-	-	-	-
Flying Squirrel	2	1	-	-	-
Fox	30	82	-	2	-
Grizzly Bear	13	43	1	6	4
Least Weasel	-	-	3	-	-
Long-Tailed Weasel	-	3	-	-	-
Moose	5	72	39	57	-
Mountain Goat	-	14	-	-	-
Mule Deer	-	96	-	-	-
Pika	-	2	-	1	-
Porcupine	-	1	-	-	-
Red Back Vole	-	-	-	1	-
Red Tree Squirrel	-	-	-	1	-
River Otter	-	-	3	-	-
Skunk	6	-	-	-	-
Snowshoe Hare	53	137	1610	2	-
White-Tailed Deer	26	189	3	1	-

Species	Baited Cameras	Non-Baited Cameras	Winter Ground Transects	Summer Ground Transect	Hair Snag
Wolf	9	52	41	30	-
Wolverine	36	1	29	0	2

4.2. Ungulates

Remote camera surveys:

Remote camera surveys showed considerable seasonal variation in the occurrences of most ungulates, with a greater number of detections in spring/summer (March 23- September 22) than in fall/winter (September 23- March 22; **Table 4.2-1**; Quinn & Klafki, 2015; Des Rosiers-Ste. Marie, 2019; Chow, 2019).

Table 4.2-1 Summary Table of Ungulate Detections (Bighorn Sheep, Elk, Moose, Mountain Goat, Mule Deer and White-Tailed Deer) from Remote Camera Surveys in the LSA

Survey period	Bighorn Sheep	Mountain Goat	Elk	Moose	Mule Deer	White-tailed Deer	Unclassified Deer
Spring/Summer	55	11	159	100	84	139	10
Fall/Winter	22	3	156	19	10	74	-
Total	**77**	**14**	**315**	**119**	**94**	**213**	**10**

Aerial transects:

Aerial transects showed that ungulate use appeared to be highest during the early spring and summer (**Table 4.2-2**; DeMars & Tipper, 2014; DeMars, 2014; DeMars, 2015). Aerial spring surveys found twice the number of ungulates observed during the fall survey and five times more than the winter survey (DeMars, 2015).

Table 4.2-2 Summary Table of Individual Ungulates (Bighorn Sheep, Elk, Moose, Mountain Goat, Mule Deer and White-Tailed Deer) Detected in Aerial Transects in the Crown Mountain Project LSA

Survey period	Bighorn Sheep	Elk	Moose	Mountain Goat	Mule Deer	White-tailed Deer
Fall (October, 2014)	36	1	4	39	0	0
Winter (March, 2014)	23	0	1	2	0	0
Spring (June, 2015)	33	27	1	4	17	3
Total	**92**	**28**	**6**	**45**	**17**	**3**

Ground Transects:

The overall mean track density for all ungulate tracks detected in 2014 was 0.20 tracks/km-day (**Table 4.2-3**). This density rose to 0.30 tracks/km-day in 2015, likely due to lower snowpack levels in the winter of 2015 allowing easier access into habitats normally covered by a deeper snowpack (Quinn & Klafki, 2015).

Table 4.2-3 Summary Table of Ungulates (Bighorn Sheep, Elk, Moose, Deer Species) Detected in Ground Transects in the LSA

Survey period	Bighorn Sheep	Elk	Moose	Deer Species
2014	-	3	28	-
2015	1	10	11	3
2019	12	15	57	14
Total	**13**	**28**	**98**	**17**

4.2.1. Bighorn Sheep and Mountain Goat

<u>Remote Cameras:</u>

Remote camera surveys resulted in a total of 77 detections of bighorn sheep and 14 detections of mountain goat in the LSA (**Table 4.2-4**). Results showed seasonal variation in bighorn sheep sex ratios and lamb to ewe ratios (**Table 4.2-4**). In the LSA, the spring/summer surveys showed a 90 ram to 100 ewe ratio, and 14 lambs to 100 ewes. Fall/winter showed a ratio of 167 rams to 100 ewes and 50 lambs to 100 ewes.

Table 4.2-4 Seasonal Variation in Bighorn Sheep Detections using Remote Cameras in the Crown Mountain LSA

Survey Period	BHS Groups	BHS Individuals	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Spring/Summer	55	72	1.31	1-5	21	19	29	3
Fall/Winter	22	33	1.50	1-6	6	10	14	3

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Table 4.2-5 Seasonal Variation in Mountain Goat Detections using Remote Cameras in the Crown Mountain LSA

Survey Period	Mtn Goat Groups	Mtn Goat Individuals	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Spring/Summer	11	26	1.44	1-3	3	2	19	2
Fall/Winter	3	3	1	1-1	0	0	3	0

Aerial Transects:

Aerial transects resulted in a total of 92 individual bighorn sheep and 45 mountain goat detections in the LSA (**Table 4.2-6; Table 4.2-7**). Surveys found 5 groups of bighorn sheep and 7 groups of mountain goats in fall surveys (DeMars & Tipper, 2014). Four groups of bighorn sheep and two groups of mountain goats were encountered during the winter survey (DeMars, 2014) and five groups of bighorn sheep and four solitary mountain goats were encountered during spring (DeMars, 2015).

Table 4.2-6 Bighorn Sheep Detections During Fall, Winter and Spring Aerial Transects in the LSA in 2014/2015

Survey Period	Bighorn Sheep Group Size	Bighorn Sheep Individuals	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	5	36	4	25	0	7
Winter (March, 2014)	4	23	4	15	2	2
Spring (June, 2015)	5	33	10	18	-	5
Total	**14**	**92**	**18**	**58**	**0**	**12**

Table 4.2-7 Mountain Goat Detections During Fall, Winter and Spring Aerial Transects in the LSA in 2014/2015

Survey Timing	Mountain Goat Group Size	Mountain Goat Individuals	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	7	39	5	4	22	8
Winter (March, 2014)	2	2	-	-	2	-
Spring (June, 2015)	4	4	-	-	4	-
Total	**13**	**45**	**5**	**4**	**28**	**8**

Ground Transects:

Ground transects resulted in a total of 13 bighorn sheep detections in the LSA. There were no detections of mountain goat during all ground transects. There was only 1 group of bighorn sheep found in winter surveys, the remaining groups were detected in summer (July, 2019) surveys (**Table 4.2-8**). There was an average group size of 1 bighorn sheep in the winter (February and March), and 2 bighorn sheep in the summer (July). There were no lambs detected in ground transects. There were no relative abundances estimates calculated for bighorn sheep or mountain goat for the 2014/15 ground transect surveys.

Table 4.2-8 Average Bighorn Sheep Group Size and Number of Lambs Detected in Winter and Summer Ground Transects

Survey Timing	Bighorn Sheep Group Size	Lambs Detected
Winter (February, March)	1	0
Summer (July)	2	0

Bighorn Sheep/ Mountain Goat Summary:

Survey efforts resulted in a total of 218 unique detections of bighorn sheep across the LSA (**Figure 4.2-1; Table 4.2-9**). Bighorn sheep were broadly distributed in high elevation areas along Erickson Ridge and on Sheep Mountain. Efforts also documented bighorn sheep in proximity to steep high elevation features along the continental divide (**Figure 4.2-1**).

Survey efforts resulted in a total of 20 unique detections of mountain goat across the LSA (**Figure 4.2-2**; **Table 4.2-10**). Mountain goat sighting were distributed similarly to those of bighorn sheep; in the high elevation areas of the LSA (i.e., Sheep Mountain, Erickson Ridge and the continental divide; **Figure 4.2-2**).

Table 4.2-9 Relative Abundance Estimate of Bighorn Sheep from Various Survey Methods (Cameras, Aerial, and Ground Transects) in the Crown Mountain LSA and RSA

Survey Method	Total Bighorn Sheep Detections	Sample Effort	Total Relative Abundance	Winter Relative Abundance	Summer Relative Abundance
LSA Remote Cameras	77	8,198 sampling nights	0.01 detections/ sampling night	0.003 detections/sampling night	0.009 detections/sampling night

Table 4.2-10 Relative Abundance Estimate of Mountain Goat in the Crown Mountain LSA

Survey Method	Total Mountain Goat Detections	Sample Effort	Total Relative Abundance
LSA Remote Cameras	7	8,198 sampling nights	0.001 detections/sampling night

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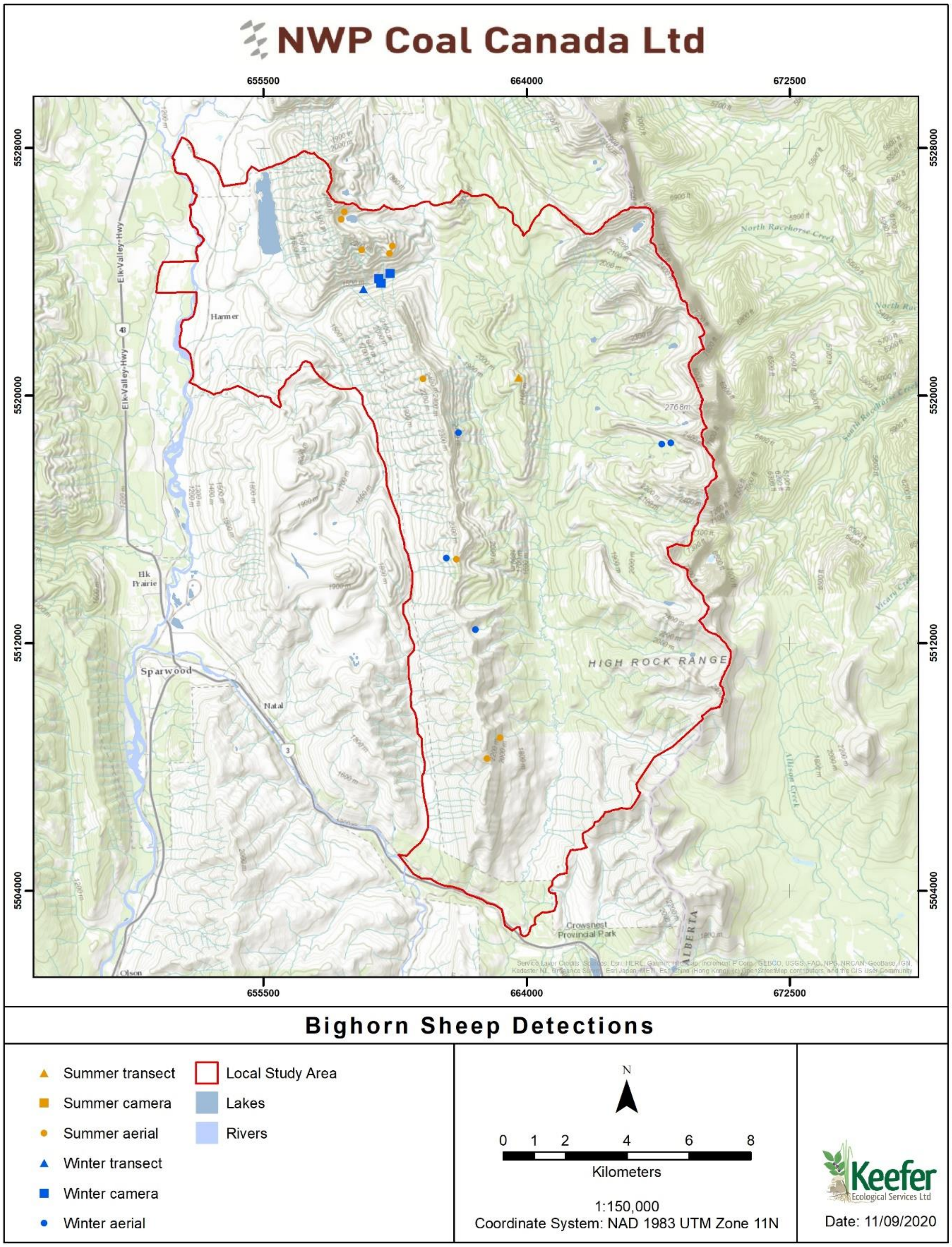

Figure 4.2-1 Detections (n = 218) of Bighorn Sheep Detections Recorded in the Crown Mountain LSA

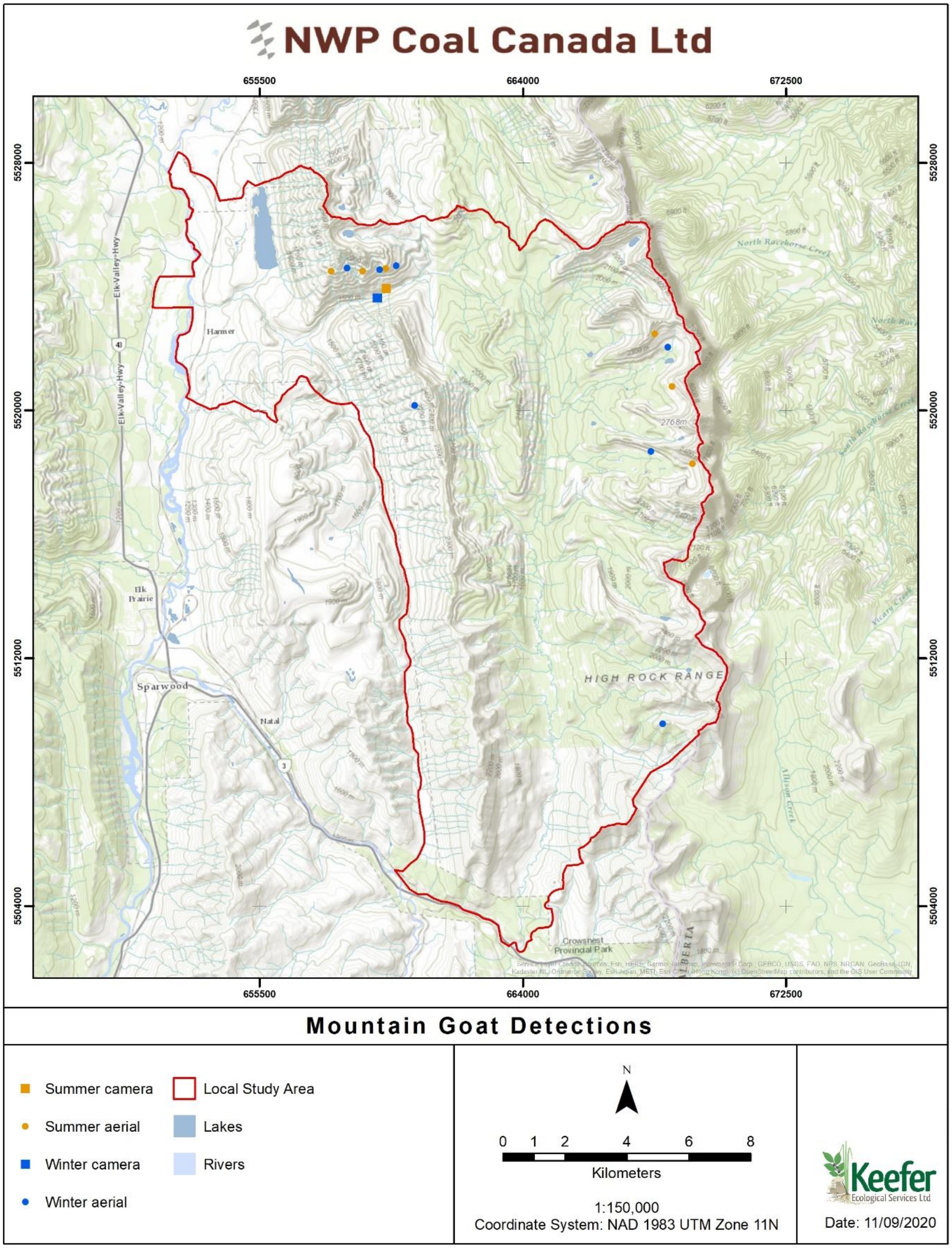

Figure 4.2-2 Detections (n = 20) of Mountain Goat Detections Recorded in the Crown Mountain LSA

4.2.2. Elk

Remote Cameras:

Remote camera surveys resulted in a total of 315 detections of elk in the LSA. Results showed seasonal variation in elk sex ratios and calf to cow ratios (**Table 4.2-11**). In the LSA, the spring/summer showed a ratio of 71 bulls to 100 cows, and 22 calves to 100 cows. Fall/winter in the LSA showed 51 bulls to 100 cows and 20 calves to 100 cows. The RSA has a spring/summer ratio of 53 bulls to 100 cows, and 19 calves to 100 cows. The fall/winter ratio was 42 bulls to 100 cows, and 21 calves to 100 cows.

Table 4.2-11 Seasonal Variation in Elk Detections using Remote Cameras in the Crown Mountain LSA

Survey Period	Elk Groups	Elk Individuals	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Spring/Summer	159	749	1.45	1-8	303	216	164	66
Fall/Winter	156	287	1.38	1-15	107	55	104	21

Aerial Transects:

Aerial transect surveys resulted in 28 elk detections in the LSA. In fall, a lone male elk observation was observed in an alpine basin just above tree line on the eastern aspect of Erickson Ridge (DeMars & Tipper, 2014). There was a lack of elk observations in winter (**Table 4.2-12**). Elk use appeared to be highest during the early spring and summer aerial transects (DeMars, 2015). The number of elk recorded in particular was considerably higher in the spring (*n* = 27; fall: *n* =1; winter: *n* = 0) with the majority of elk groups observed within subalpine meadows and open avalanche chutes. Increased use by elk in the spring is consistent with the migratory behaviour of the species (Boyce, 1991).

Table 4.2-12 Elk Detections During Fall, Winter and Spring Aerial Transects in the LSA in 2014/2015

Survey Period	Elk Groups Detected	Elk Individuals Detected	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	1	1	1	-	-	-
Winter (March, 2014)	0	-	-	-	-	-
Spring (June, 2015)	11	27	2	15	6	4
Total	12	28	**3**	**15**	**6**	**4**

Ground Transects:

Ground transects resulted in 28 elk detections in the LSA. Elk were commonly encountered in the LSA during winter 2015 and limited to lower elevations in the MSdk1 (Quinn & Klafki, 2015; **Table 4.2-13**). There was an average group size of 1.77 elk in the winter (February and March), and 1 elk in the summer

(July). No elk calves were detected in the ground transects. There were no relative abundances estimates calculated for elk during the 2014/15 ground transect surveys.

Table 4.2-13 Average Elk Group Size and Number of Calves Detected in Winter and Summer Ground Transects

Survey Timing	Elk Group	Calves Detected
Winter (February, March)	1.77	0
Summer (July)	1.0	0

<u>Elk Summary</u>

Survey efforts resulted in a total of 315 unique detections/locations of elk in the LSA (**Table 4.2-14**; **Figure 4.2-3**). Elk were broadly distributed, occurring at various elevations including along the northwest edge of Erickson Ridge, Sheep Mountain, throughout valley bottoms within the Alexander and Grave Creek drainages, and (transboundary) mountain passes (i.e., Deadman and Racehorse). Elk detections occurred most frequently within Grave prairie, Grave Creek (between Sheep Mountain and Erickson Ridge), and in the portion of the Alexander Creek drainage near the Crowsnest highway.

Table 4.2-14 Relative Abundance Estimate of Elk from Various Survey Methods (Camera, Aerial and Ground Transects) in the Crown Mountain LSA

Survey Method	Total Elk Detections	Sample Effort	Total Relative Abundance	Winter Relative Abundance	Summer Relative Abundance
LSA Remote Cameras	315	8,198 sampling nights	0.038 detections/ sampling nights	0.019 detections/ sampling nights	0.019 detections/ sampling nights

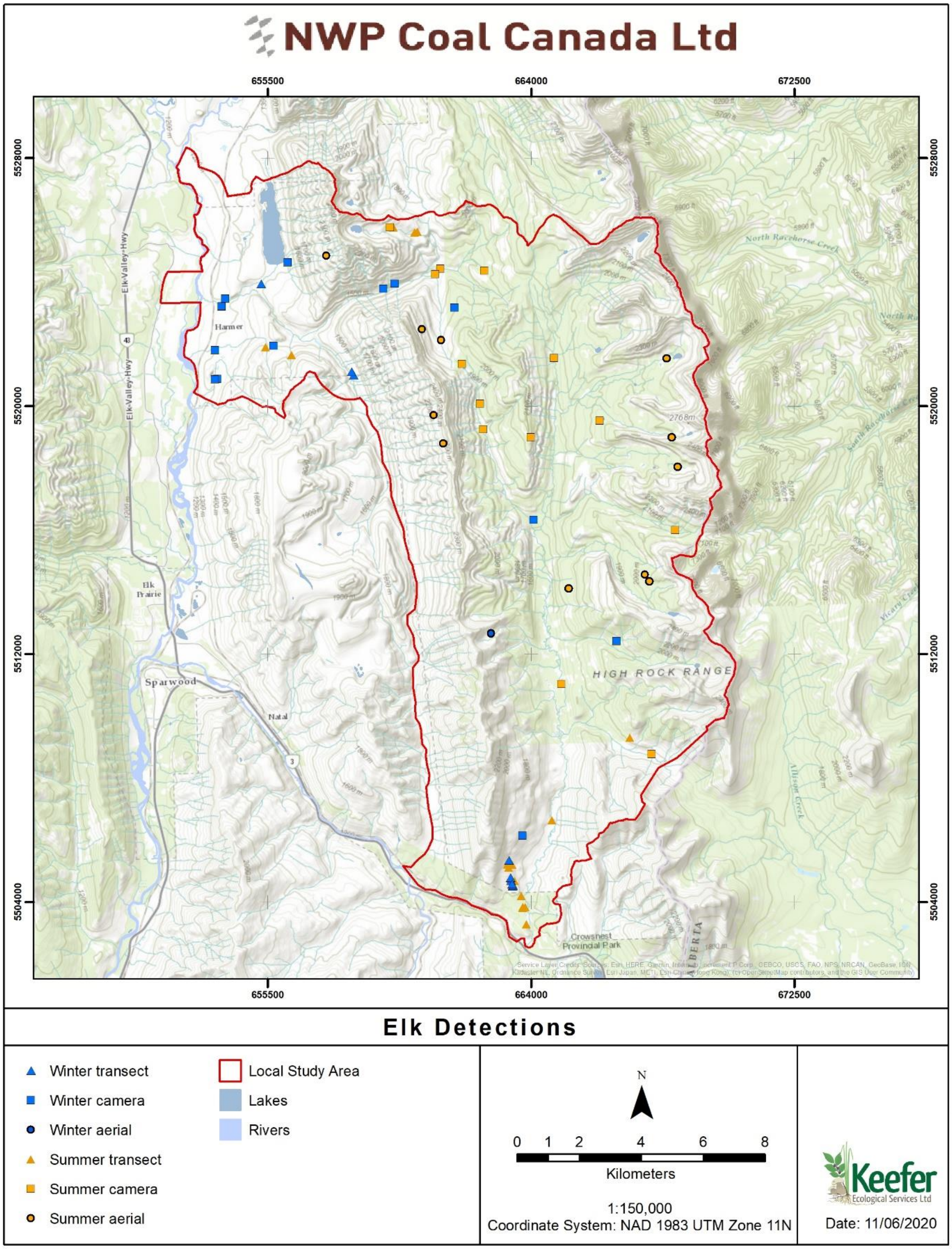

Figure 4.2-3 Detections (n = 355) of Elk Recorded in the Crown Mountain LSA (2014-2019)

4.2.3. Moose

Remote Cameras:

Remote camera surveys resulted in a total of 119 detections of moose in the LSA and 1256 detections in the RSA. There was seasonal variation in moose sex ratios and calf to cow ratios in the Crown Mountain LSA and RSA (**Table 4.2-15**). There was a considerably greater number of detections of cow moose during summer than in winter, indicating increased animal movement and the value of the LSA during the calving season. Bull to cow ratios in the LSA during spring/summer were 67 bulls to 100 cows, and 29 calves to 100 cows. The LSA fall/ winter ratios were 71 bulls to 100 cows and 7 calves to 100 cows. The RSA during spring/summer showed a ratio of were 64 bulls to 100 cows, and 34 calves to 100 cows. The RSA fall/ winter ratios were 187 bulls to 100 cows and 40 calves to 100 cows.

Table 4.2-15 Seasonal Variation in Moose Detections using Remote Cameras in the Crown Mountain LSA

Survey Timing	Moose Groups	Moose Individuals	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Spring/Summer	100	461	1.22	1-6	189	126	92	54
Fall/Winter	19	39	1.18	1-2	14	10	14	1

Aerial transects:

Aerial transects resulted in a total of six individual moose detections in the LSA (**Table 4.2-16**). One of the moose groups was located within the boundary of the proposed mine footprint while the other group was located on the edge of a regenerating cut block. A single moose was detected in the winter surveys in the middle third of the Alexander Creek drainage (DeMars, 2014). Moose may be limited by snow depth (as indexed by elevation) and snowmobile activity in the Alexander Creek drainage, resulting in late winter abundance and distribution of moose in the LSA (DeMars & Tipper, 2014). Only a single moose was seen in spring 2015 surveys.

Table 4.2-16 Moose Detections During Fall, Winter and Spring Aerial Transects in the Crown Mountain Project LSA in 2014/2015

Survey Timing	Moose Group Sized	Moose Individuals	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	2	4	-	1	2	1
Winter (March, 2014)	1	1	-	-	1	-
Spring (June, 2015)	1	1	1	-	-	-
Total	**4**	**6**	**1**	**1**	**3**	**1**

Ground Transects:

Ground transects resulted in a total of 96 moose detections in the LSA (**Table 4.2-17**). Moose were encountered on transects up to mid-elevations in Alexander and Harmer Creeks (Quinn & Klafki, 2015). Moose were more commonly encountered in the mid elevation ESSKdk1 (Quinn & Klafki, 2015). The mean track density of moose in 2015 was 0.14 tracks/km-day, compared to a similar 0.12 tracks/km-day in 2014 (Quinn & Klafki, 2015). There was an average group size of 1.54 moose in the winter (February and March), and one moose in the summer (July; **Table 4.2-17**). There were four moose calves detected in the winter and none in the summer. The relative abundance estimate of moose in the 2014 surveys was 0.116 tracks/km-day, and 0.139 tracks/km-day in the 2015 surveys (Quinn & Klafki, 2015).

Table 4.2-17 Average Moose Group Size and Number of Calves Detected in Winter and Summer Ground Transects

Survey Timing	Moose Group Size	Calves Detected
Winter (February, March)	1.54	4
Summer (July)	1.54	4

Moose Summary

Survey efforts resulted in a total of 219 unique observations of moose across the Project LSA. Moose were broadly distributed, occurring at various elevations within the Alexander, Grave, and Harmer Creek drainages and transboundary mountain passes (e.g., Deadman Pass; **Table 4.2-18; Figure 4.2-4**).

Table 4.2-18 Relative Abundance Estimate of Moose from Various Survey Methods (Camera, Aerial, and Ground Transects) in the Crown Mountain LSA and RSA

Survey Method	Total Moose Detections	Sample Effort	Total Relative Abundance	Winter Relative Abundance	Summer Relative Abundance
LSA Remote Cameras	119	8,198 sampling nights	0.015 detections/sampling night	0.002 detections/sampling night	0.012 detections/sampling night

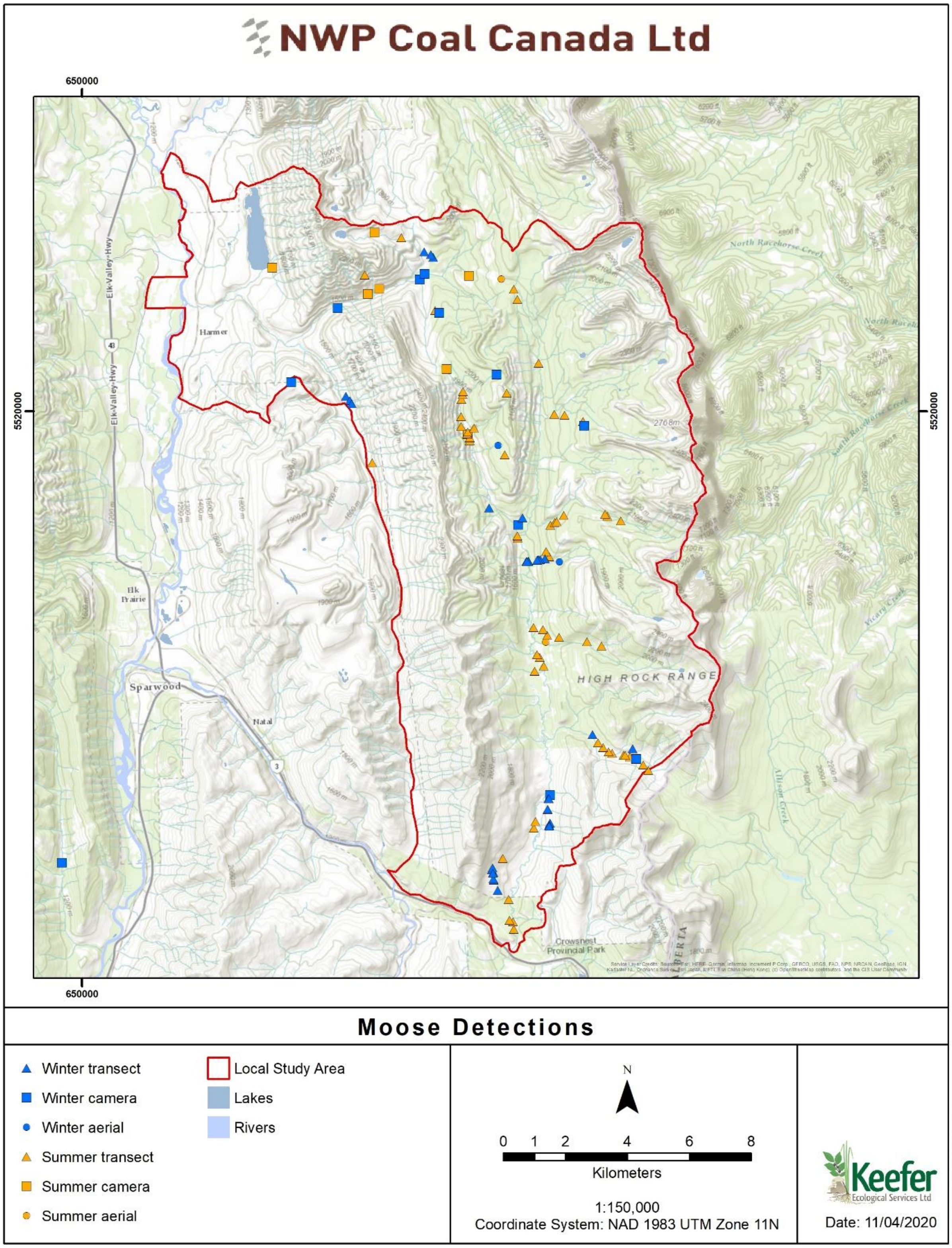

Figure 4.2-4 Detections (n=219) of Moose (Detection and Sign) Recorded in the LSA (2014-2019)

4.3. Carnivores

4.3.1. Grizzly Bear

GPS location Data:

GPS collars were deployed on a total of 75 grizzly bears (99 times) between 2003 and 2019, with a variable interval of location fixes (Apps & Lamb, 2019). In the Crowsnest Highway (including lower Elk Valley and Crowsnest Pass), 32 GPS radio collars (Lotek 4000/4400M) were placed on adult grizzlies (15M, 17F) 37 times between 2003 and 2010 at location fixes occurring every 1 or 2 hours. Between 2015 and 2018, GPS radio collars (Followit or Vectronic) were deployed on 43 grizzlies (22M, 21F) 62 times within the Elk Valley.

Remote Cameras and Ground Transects:

Remote camera surveys resulted in a total of 55 detections of grizzly bear in the LSA (**Table 4.3-1**). Remote camera detections in the LSA found a total grizzly bear relative abundance estimate of 0.007 detections per sampling night. Remote camera detections in the RSA found a total grizzly bear relative abundance estimate of 0.001 detections per sampling night. Grizzly bear were detected on 7 occassions during ground transects in the LSA (**Table 4.3-1**). Three grizzly bear individuals (2F, 1M) were detected from a total of 21 hair snag samples during 2015 surveys, and 1 male individual was detected at Leach Creek Station from 2016 CanAus sampling.

Table 4.3-1 Detections and Relative Abundance Estimate of Grizzly Bear from Various Survey Methods (Camera and Ground Camera Transects) in the Crown Mountain LSA

Survey Method	# Grizzly Bear Detections	Sample Effort	Relative Abundance
LSA Remote Cameras	55	8,198 sampling nights	0.007 detections/sampling night
Ground Transects	7	557.21 km	-

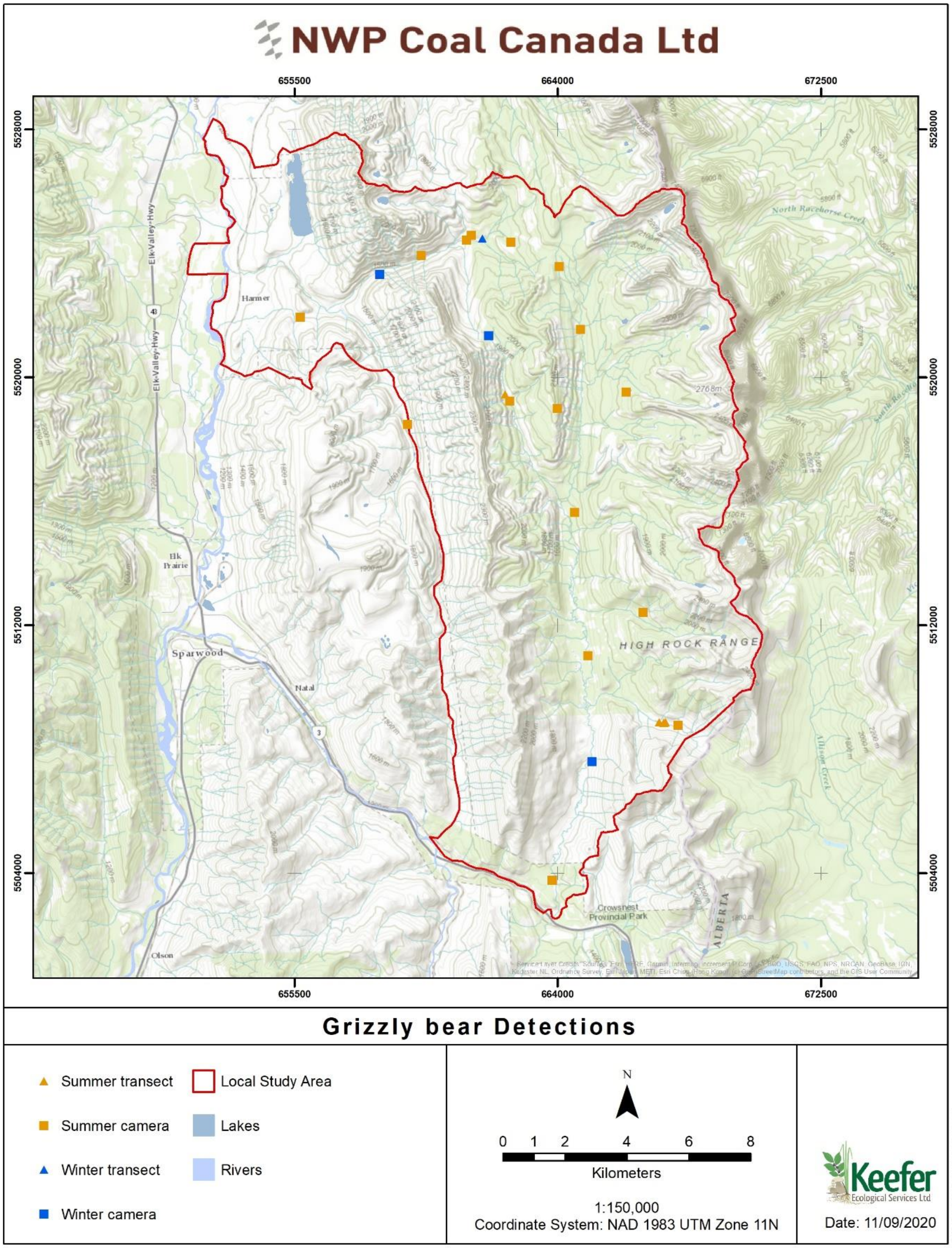

Figure 4.3-1 Detections (n=62) of Grizzly Bears Recorded in the Crown Mountain LSA

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4.3.2. American Badger

A total of 250.46 km of transects for definitive evidence of American badger burrows and their prey during July 28 and August 1, 2014 (n = 135.07 km; Klafki, 2015), July 3 to 4, 2018 (n = 41.38 km; Hausleitner & Lowey, 2018), and July 9 to 10, 15 to 19, 2019 (n = 74.01).

Survey efforts resulted in a total of 73 unique detections/locations of American badger burrows across the study area, including 6 active or recently-used burrows in 2014 and 2 active or recently-used burrows in 2018 (Klafki, 2014; see **Table 4.3-2; Figure 4.3-2; Figure 4.3-4**). In addition, survey efforts resulted in a total of 469 unique detections (i.e., a minimum of 20 metres apart) of Columbian ground squirrel and northern pocket gopher see **Table 4.3-2; Figure 4.3-3**). American badgers were broadly distributed throughout the LSA, although active or recently-used burrows were only documented in the northwest portion of the LSA, to the south and south-east of Grave Lake (**Figure 4.3-2**). The area south of Grave Lake corresponds to the area with the highest concentration of Columbian ground squirrel detections/colonies (see **Figure 4.3-3**). Several American badger burrows in the Grave Lake area were characterized as potential maternity dens, with multiple chambers and entrances and a large soil berm (Klafki, 2014; Lindzey, 1976). An American badger was observed entering a den in the Grave Lake area during both 2014 (Klafki, 2015) and 2018 (Hausleitner & Lowey, 2018). Of note, an American badger was reported struck and injured by a vehicle along Valley Service Road in the northernmost portion of the LSA in 2018.

Survey efforts in 2014 documented 57 spatially unique locations containing a total of 79 separate American badger burrows (Klafki, 2014). The highest concentration of active burrows was south of Grave Lake, showing fresh active burrows and potential natal/maternal denning areas. Columbia ground squirrel activity was associated with all detected American badger burrows (<100m apart). The average elevation of badger burrows was 1376 m ASL, coinciding with low elevation valley benches. Only 17% (n=10) of American badger burrow locations were above 1400 meters and these were located along the access road over Crown Mountain. While Columbia ground squirrels were spread throughout the LSA, the majority of Northern pocket gopher activity was in the southern extent of the LSA (north of Highway 3).

Table 4.3-2 Results of Systematic Detection/Non-Detection Sign Surveys Conducted per Year along Transects in Search of Evidence of American Badger (Burrows) and their Primary (Columbian Ground Squirrel) and Secondary (Northern Pocket Gopher) Prey in the LSA

Survey Year	Distance Surveyed (km)	# American Badger Burrows Detected (Recent: Old)	# Columbian Ground Squirrel Detections	# Northern Pocket Gopher Detections
2014	135.1	57 (6: 51)	274	28
2018	41.4	16 (2:13)	152	2
2019	74.0	0	13	0
Total	**250.5**	**73**	**439**	**30**

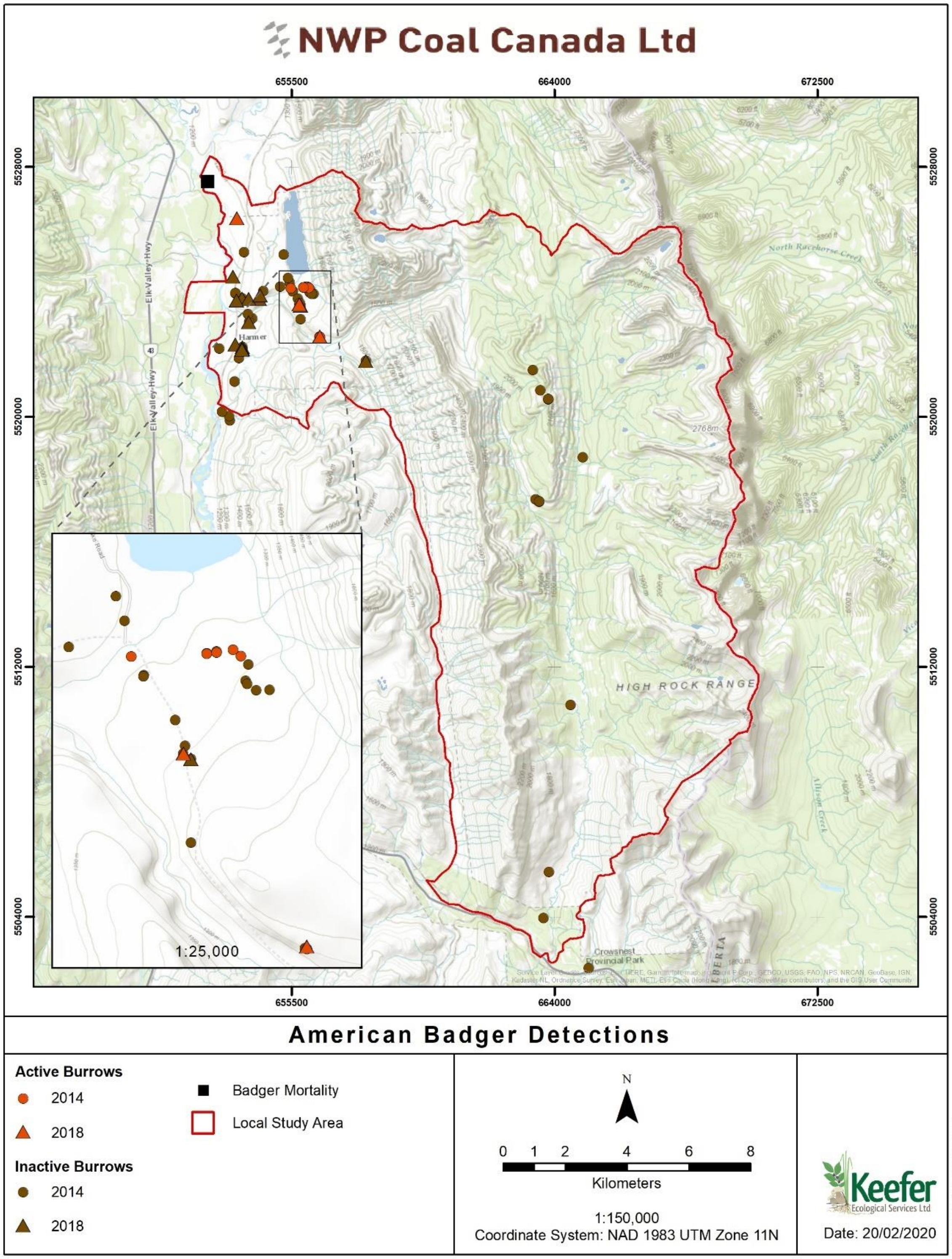

Figure 4.3-2 Detections (n=73) of American badger (detection and sign) recorded in the LSA (2014-2019)

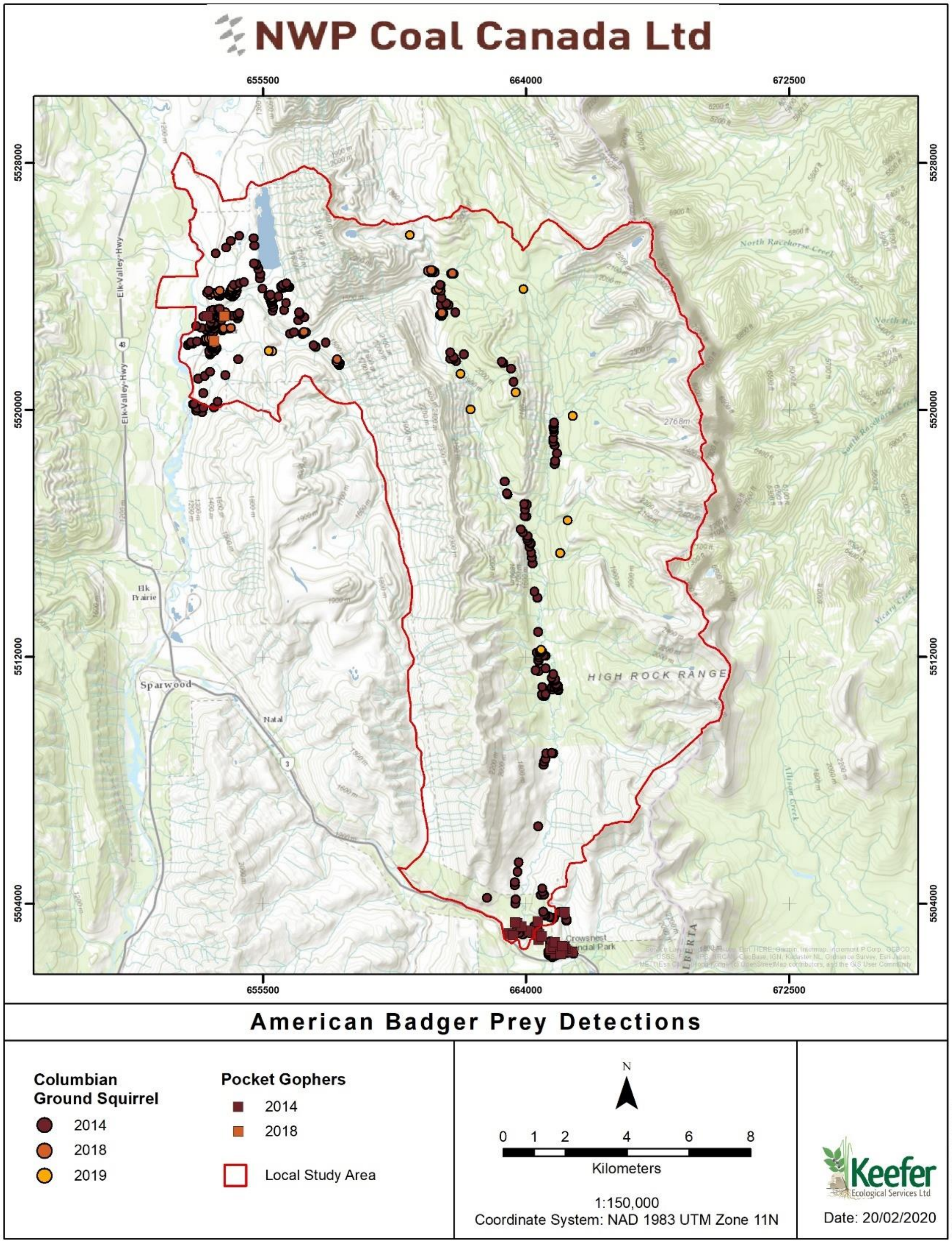

Figure 4.3-3 Detections of Columbia Ground Squirrels (n=439) and Northern Pocket Gophers (n=30) Recorded in the LSA (2014-2019)

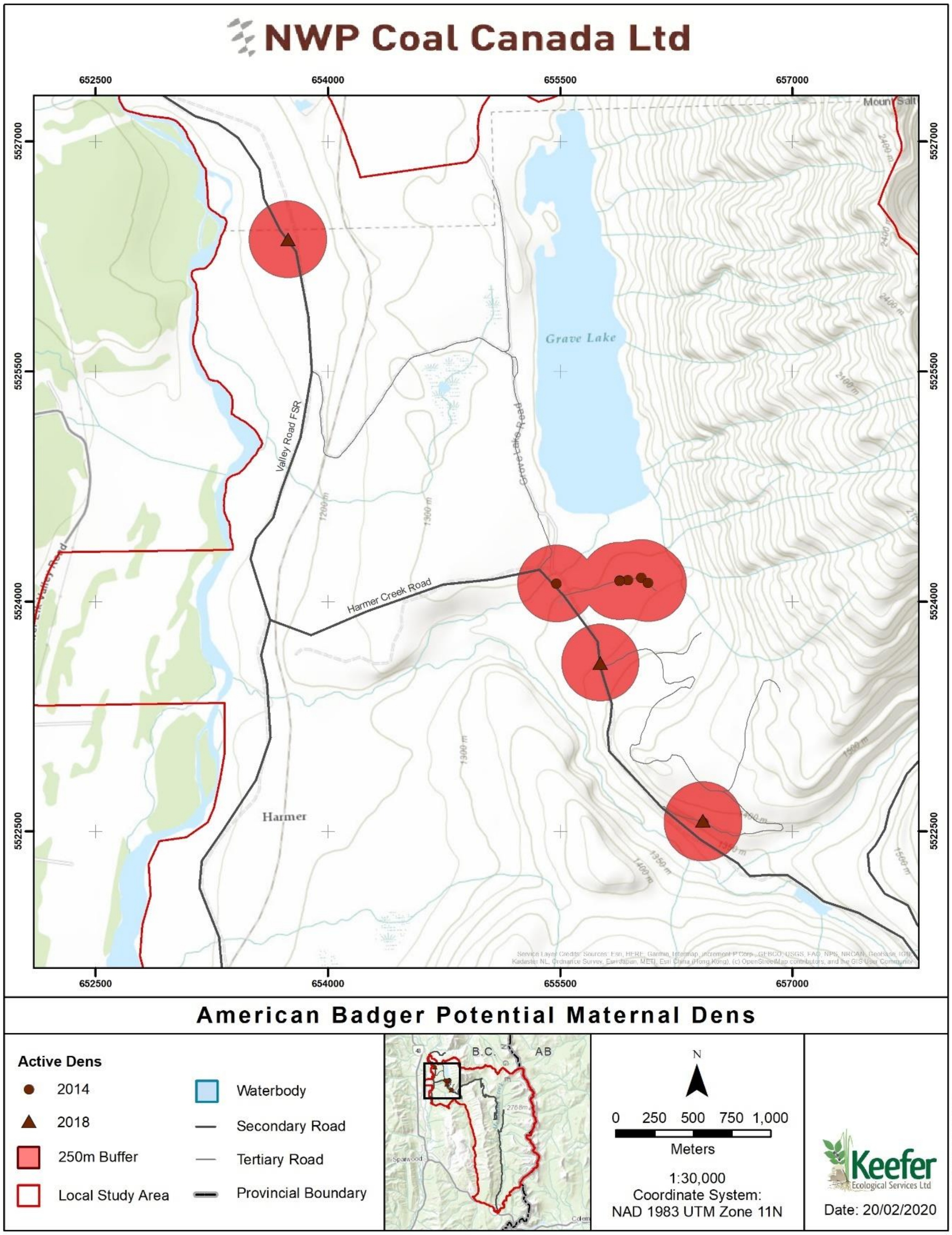

Figure 4.3-4 Locations of American Badger Burrows (n = 8) that were Actively or Recently Used (i.e., Within Weeks or Months) in the LSA

4.3.3. Wolverine

Remote Cameras:

Remote camera surveys resulted in a total of 37 detections of wolverine in the LSA (**Table 4.3-3**). Remote camera detections in the LSA found a total wolverine relative abundance estimate of 0.005 detections per sampling night. Remote camera detections in the RSA found a total wolverine relative abundance estimate of 0.001 detections per sampling night.

Ground Transect/ Hair-Snagging Surveys:

Ground transects resulted in 28 wolverine detections in the LSA (**Table 4.3-3**). Wolverine tracks were detected in all three BEC zones, with no significant difference between detection in different zones. No wolverine tracks were detected west of Erickson ridge or lower Grave Lake area but were detected on transects (and incidentally observed) across the eastern portion of the LSA including upper Grave Creek, Crown Mountain, Alexander Creek, Racehorse Pass, and Deadman Pass areas. The relative abundance estimates of wolverine during 2014 transect surveys was 0.044 tracks/km-day and 0.059 tracks/km-day in 2015 (Quinn & Klafki, 2015).

One wolverine bed was encountered, from which a scat sample was collected for DNA analysis (See **Appendix I**). Wolverine hair was collected from both a natural rub tree as well as from one of the non-invasive sampling sites. One wolverine individual was detected from 11 hair snag samples during 2015 surveys, and 1 additional individual was detected at Flathead Pass Station during 2016 CanAus surveys.

Table 4.3-3 Detections and Relative Abundance Estimate of Wolverines from Various Survey Methods (Camera and Ground Camera Transects) in the Crown Mountain LSA and RSA

Survey Method	# Wolverine Detections	Sample Effort	Total Relative Abundance
LSA Remote Cameras	37	8,198 sampling nights	0.005 detections/ sampling night
Ground Transects	28	557.21 km	-

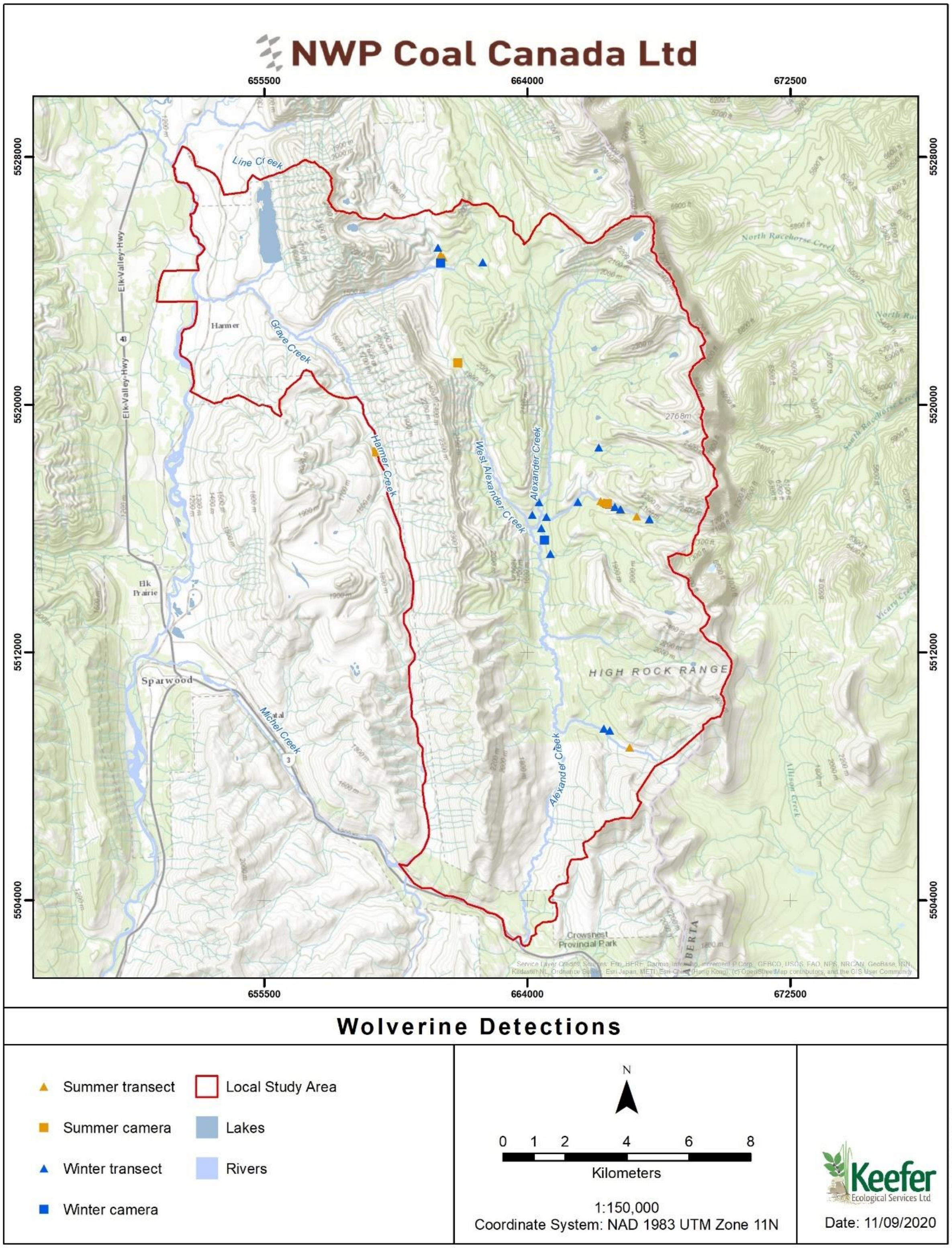

Figure 4.3-5 Detections (n=65) of Wolverine (Detection and Sign) Recorded in the Crown Mountain LSA (2014-2019)

4.3.4. Canada Lynx

Remote Cameras:

Remote camera surveys resulted in a total of 55 detections of Canada lynx in the LSA (**Table 4.3-4; Table 4.3-5**

Table 4.3-5). Remote camera detections in the LSA found a total Canada lynx relative abundance estimate of 0.007 detections per sampling night and 0.024 snowshoe hare detections per sampling night. Remote camera detections in the RSA found a total Canada lynx relative abundance estimate of 0.008 detections per sampling night and 0.034 snowshoe hare detections per sampling night.

Ground Transects:

Ground transects resulted in 161 Canada lynx detections and 1612 snowshoe hare detections in the LSA (**Table 4.3-4;**

Table 4.3-5; **Figure 4.3-6**; **Figure 4.3-7**). Ground surveys in 2015 found Canada lynx tracks were detected a total of 48 times across the study area for an overall relative abundance estimate of 0.251 tracks/km-day in 2014 and of 0.276 tracks/km-day in 2015 (Quinn & Klafki, 2015). The highest density of tracks was in the ESSFdk1 (0.16 tracks/kmday) followed by and while considerably lower in the MSdk1 (0.056 tracks/km-day), in the ESSFdkw (0.057 tracks/km-day) there were no significant differences in track densities between subzones. Canada lynx tracks were also frequently encountered while traversing the study area on snowmobile. Ground surveys found an overall relative abundance estimate of 0.251 tracks/km-day (Quinn & Klafki, 2015).

Snowshoe hare were again the most common of the three prey species recorded with an overall relative abundance estimates of 8.877 tracks/km-day in the LSA in 2015 (compared to a similar density of 7.86 tracks/km-day in the LSA in the 2014 season). Relative abundance estimates were highest in the ESSFdk1, with 4.96 tracks/km-day, which was more than double the track densities in both the ESSFdkw (with 1.79 tracks/km-day) and MSdk1 (with 2.12 tracks/km-day). The relative abundance estimates should be considered minimum estimates as many runways may have had more than 5 tracks associated with them but were given a 5 count to maintain consistency during snow-tracking transects.

Table 4.3-4 Detections and Relative Abundance Estimate of Canada Lynx from Various Survey Methods (Remote Camera and Ground Transects) in the Crown Mountain LSA

Survey Method	# Canada Lynx Detections	Sample Effort	Total Relative Abundance
LSA Remote Cameras	55	8,198 sampling nights	0.007 detections/ sampling night
RSA Remote Cameras	345	43,268 sampling nights	-
Ground Transects	161	557.21 km	-

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Table 4.3-5 Detections and Relative Abundance Estimate of Snowshoe Hare from Various Survey Methods (Remote Camera and Ground Transects) in the Crown Mountain LSA

Survey Method	# Snowshoe Hare Detections	Sample Effort	Total Relative Abundance
LSA Remote Cameras	198	8,198 sampling nights	0.024 detections/ sampling night
RSA Remote Cameras	1472	43,268 sampling nights	-
Ground Transects	1612	557.21 km	-

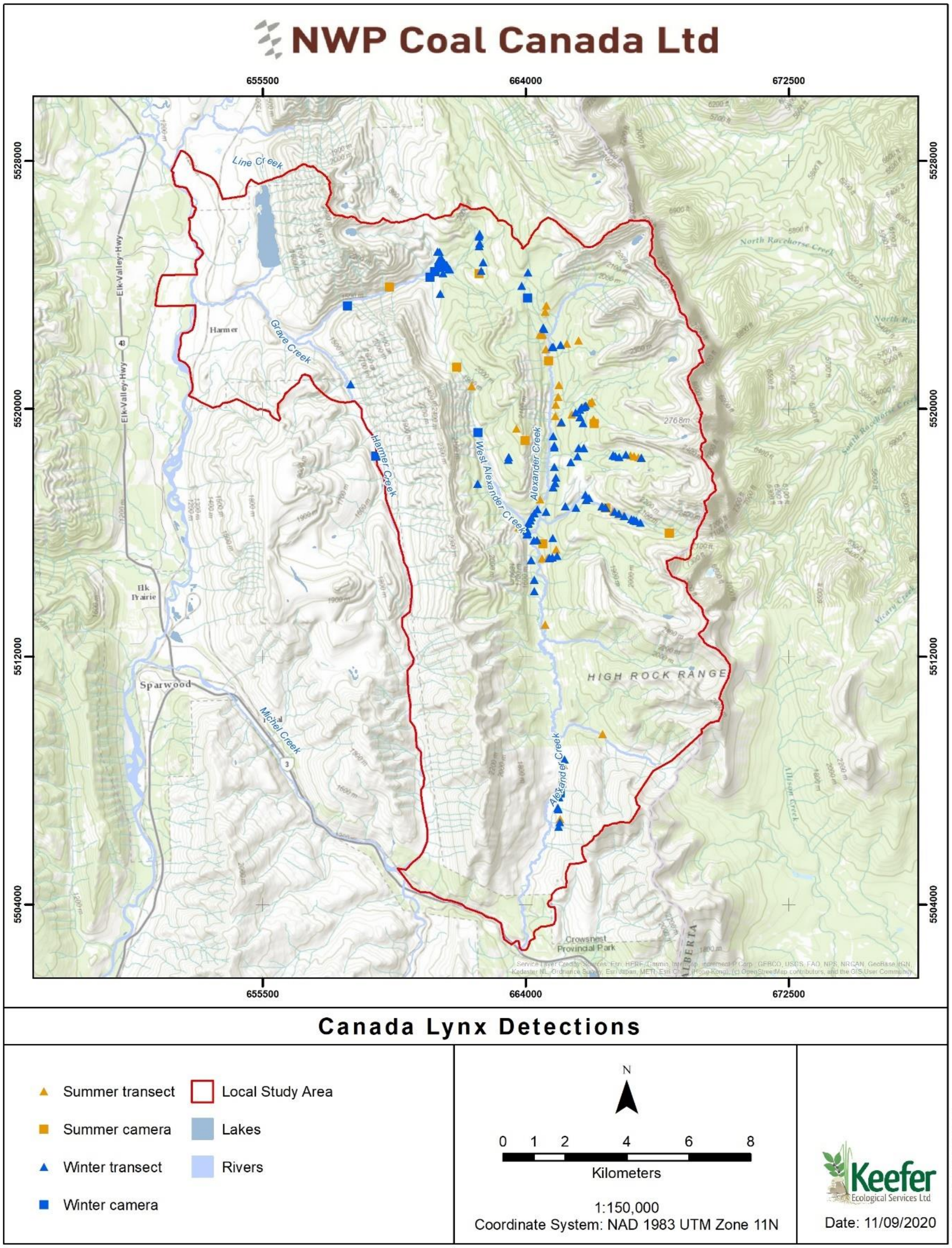

Figure 4.3-6 Detections (n=216) of Canada Lynx (Detection and Sign) Recorded in the Crown Mountain LSA (2014-2019)

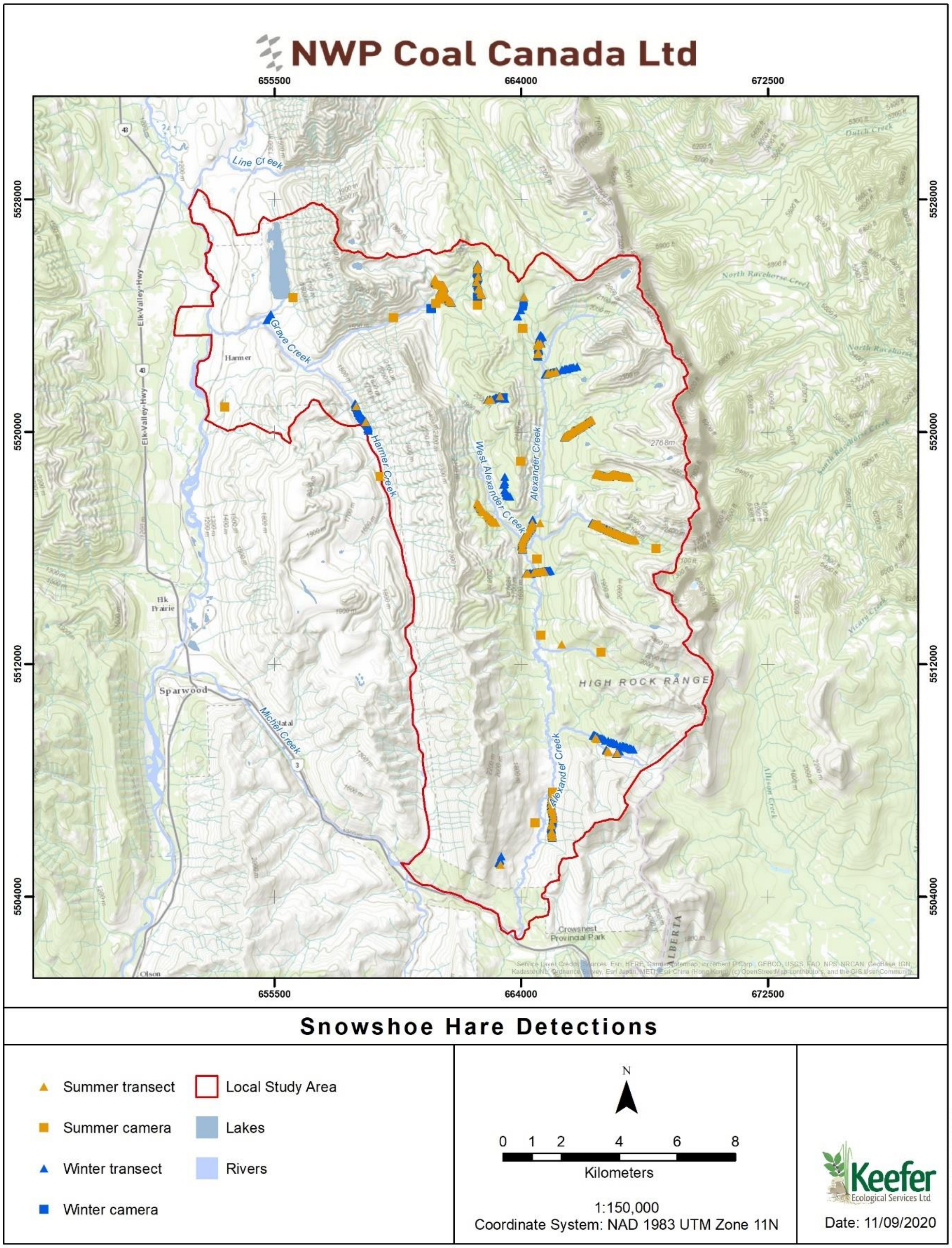

Figure 4.3-7 Detections (n=1810) of Canada lynx Prey (Snowshoe Hare) Recorded in the Crown Mountain LSA (2014-2019)

4.3.5. American Marten

Remote Cameras:

Remote camera surveys resulted in a total of 45 detections of American marten in the LSA (**Figure 4.3-8; Table 4.3-6**). Remote camera detections in the LSA found a total American marten relative abundance estimate of 0.006 detections per sampling night.

Ground Transects:

Ground transects resulted in a total of 133 American marten detections in the LSA (**Figure 4.3-8; Table 4.3-6**). Ground transects found a total American marten relative abundance estimate of 0.239 tracks/ km. The relative abundance estimates for American marten during 2014 ground transect surveys is 0.236 tracks/km-day and 0.453 tracks/km-day in 2015 surveys.

Table 4.3-6 Detections and Relative Abundance Estimate of American Marten from Various Survey Methods (Remote Camera and Ground Transects) in the Crown Mountain LSA and RSA

Survey Method	# American Marten Detections	Sample Effort	Total Relative Abundance
LSA Remote Cameras	45	8,198 sampling nights	0.006 detections/ sampling night
Ground Transects	133	557.21 km	-

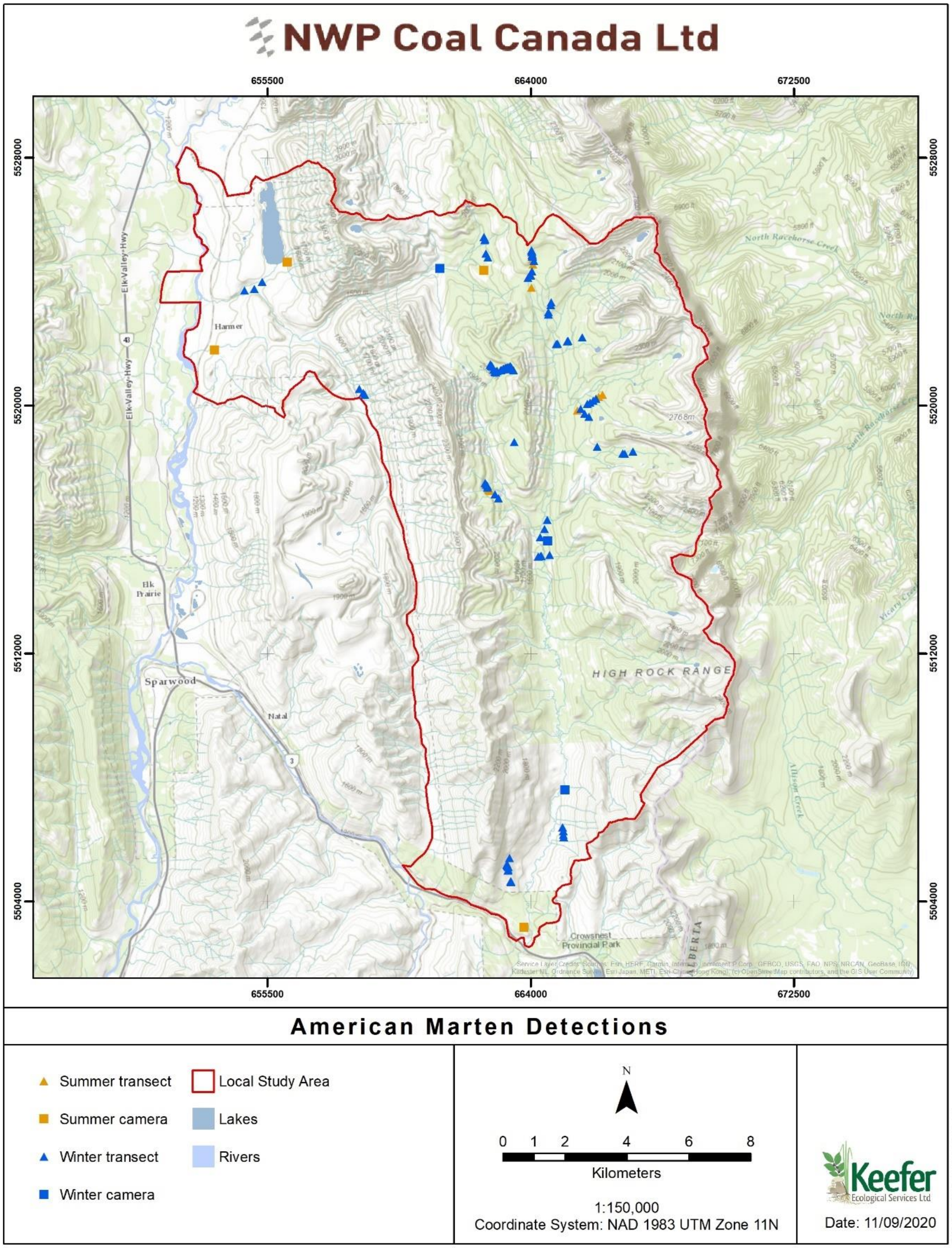

Figure 4.3-8 Detections (n=178) of American Marten (Detection and Sign) Recorded in the LSA (2014-2019)

4.4. Bats

Acoustic Surveys:

After the removal of high ambient noise files, a total of 9289 acoustic files detecting bats were recorded. When accounting for survey effort, the highest relative number of acoustic files were recorded at the Grave Creek Branch C landing site (n=268.8 files/survey night), followed by the Grave Prairie forest site (n=134.7 files/survey night) and the Alexander Creek wetland site (n=111.7 files/survey night).

The highest species diversities were recorded at the Grave Prairie forest site (n = 17 species and/or species grouping) followed by the Alexander Creek wetland site (n = 15 species and/or species grouping), the Grave Creek Branch C landing site (n = 14 species and/or species grouping) and the Grave Creek Forest Service Road site (n = 14 species and/or species grouping).

All three of the at-risk bat species selected as VCs were acoustically identified in the Project LSA. Overall, the most abundant bat species identified was the silver-haired bat, followed by the big brown bat, the hoary bat, and the little brown myotis. Other bat species identified in lower abundances included the long-eared myotis, Townsend's long-eared bat, the eastern red bat, the long-legged myotis, the northern myotis, and the California myotis.

The bat species detected during winter months (November-February) were silver haired bat, big brown bat and little brown myotis (in order of relative abundance). Acoustic detectors recorded a total of 37 unique bat passes. While accounting for survey effort, the highest relative number of acoustic files recorded during winter was at the West Alexander headwaters followed by the Alexander wetland, with only one recording of a silver haired bat at the Grave Creek reservoir.

The little brown myotis was acoustically identified at 9 of the sites suggesting this species occurs throughout the LSA. Further, little brown myotis were documented within the Project footprint at the West Alexander headwaters wetland on January 3, 2000. These results indicate nearby (within 2 km) hibernacula (Holroyd, Craig & Govindarajulu, 2016).

The northern myotis was acoustically identified at 8 of the sites suggesting this species also occurs throughout the LSA, although in relatively lower abundance. The eastern red bat was acoustically detected at 4 of the sites in low abundance, suggesting it only occurs in select portions of the LSA (**Figure 3.2-5**). Based on the species diversity and relative abundances from the acoustic data, the Grave Creek Branch C landing site, the Grave Prairie forest site, and the Alexander Creek wetland site were identified as hot spots for bats. All three of the at-risk bat species were acoustically identified in these hot spot sites.

Live-capture surveys:

A total of 44 bats of six bat species were live captured, with the little brown myotis being captured and genetically confirmed at the Alexander Creek wetland site and the Harmer Lake site. At the Alexander Creek wetland site, 14 adult and one volant juvenile little brown myotis were captured, with an even mix of males and females. Of the females captured, one was post-lactating, and the rest had reproduced in the past (parous). At the Harmer Lake site, two adult female little brown myotis were captured, one of which was post-lactating, and the other was parous. A little brown myotis colony was also genetically confirmed at a cabin on the northwest side of Grave Lake (**Figure 3.2-4; Figure 4.4-1**). The presence of post-lactating females at both sites suggest that a maternity roost is nearby, and the presence of a volant juvenile at the Alexander Creek wetland site suggests that successful reproduction occurred at the maternity roost.

a)

b)

c)

Figure 4.4-1 A Selection of Bats Captured During the Four Nights of Mist Netting. A) Myotis species, b) Silver-Haired Bat (*Lasionycteris noctivagans*), and c) Hoary Bat (*Lasiurus cinereus*; Isaac, 2018)

Although the acoustic evidence suggested that the little brown myotis was abundant at the Grave Creek Branch C landing site, no bats of this species were live-captured there, likely due to poor weather conditions. The habitat in this area is not suitable foraging habitat for the little brown myotis, but rather has a moving body of water (Grave Creek) that gives off ultrasonic noise allowing bats in the area to use it for navigation. Therefore, this area was identified as an important travel corridor for the little brown myotis.

While the acoustic data suggests that the northern myotis and the eastern red bat were present in relatively low abundances, neither of these species were live-captured to confirm their presence. To support the acoustic presence data, there is evidence of nearby populations which increase the likelihood that these two at-risk bat species were in fact detected in the LSA. Waterton Lakes National

Park, about 100 km southeast of Crown Mountain, has been identified as a significant migration route for tree roosting bat species, including the eastern red bat (Parks Canada, 2017). The closest detection of the northern myotis to the Project LSA is near Trout Lake, a straight-line distance of approximately 220 km (Lausen and Hill, 2010). Although it was previously thought that old growth/mature forests were a strict habitat requirement of the northern myotis, recent studies from other parts of its range have shown that this species uses a variety of tree heights and ages as roosting habitat, suggesting this species may be adaptable to different habitats, or that there is a high degree of local variation in this species ecology and behaviour (Alberta Sustainable Resource Development and Alberta Conservation Association, 2009).

Targeting the little brown myotis for species confirmation via live-capturing and genetic testing resulted in a data gap for species confirmation of the northern myotis and eastern red bat in the LSA. Given that the acoustic evidence suggests that the northern myotis and eastern red bat could be present in the LSA, it was assumed that these two bat species are present in the LSA as a conservative approach for the potential effect's assessment.

5. References

Alberta Sustainable Resource Development and Alberta Conservation Association. (2009). *Status of the Northern Myotis (Myotis septentrionalis) in Alberta*. Wildlife Status Report No. 3. Edmonton, AB. https://www.ab-conservation.com/downloads/AWSR/Mammal%20Reports/Status%20of%20Northern%20Myotis%20in%20Alberta_udpate%202009.pdf

App, C. & Lamb, C. (2019). *Scale-integrated Grizzly Bear habitat modeling to inform environmental assessment for NWP Coal's Crown Mountain project*. Prepared for NWP Coal Canada Ltd. and Keefer Ecological Services Ltd. Cranbrook, BC.

Apps, C., Weaver, J. L., Paquet, P. C., Bateman, B., & McLellan, B. N. (2007). Carnivores in the southern Canadian Rockies: core areas and connectivity across the Crowsnest highway. Wildlife Conservation Society Canada Report No.3

Apps, C. D., Weaver, J. L., Paquet, P. C., Bateman, B., & McLellan, B. N. (2010). Carnivores in the Southern Canadian Rockies-Core Areas and Connectivity Across the Crowsnest Highway.

B.C. Conservation Data Centre. (2013). Conservation Status Report: *Myotis thysanodes*. BC Ministry of Environment. Retrieved from https://a100.gov.bc.ca/pub/eswp/esr.do?id=14326

BC Conservation Data Centre. (2014). *Species Summary: Myotis septentrionalis*. BC Ministry of Environment. Retrieved from http://a100.gov.bc.ca/pub/eswp/speciesSummary.do?id=16442

B.C. Conservation Data Centre. (2015). Conservation Status Report: *Corynorhinus townsendii*. BC Ministry of Environment. Retrieved from https://a100.gov.bc.ca/pub/eswp/esr.do?id=17017

British Columbia Environmental Assessment Office [BC EAO]. (2018). *Application Information Requirement s- Crown Mountain Coking Coal Project*.

Boyce, M. S. (1991). Migratory behaviour and management of elk (*Cervus elaphus*). *Applied Animal Behaviour Science, 29*(14), 239-250.

Canadian Environmental Assessment Agency [CEAA]. (2015). *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012, Crown Mountain Coking Coal Project, NWP Coal Canada Ltd*.

Chow, E. (2019). *Kootenay Remote Camera Wildlife Monitoring Project.* Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

COSEWIC (2004). COSEWIC assessment and status report on the plains bison *Bison bison bison* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 71 pp.

COSEWIC (2010). Instructions for the Preparation of COSEWIC Status Reports. Approved by COSEWIC in April 2010, updated July 2010.

COSEWIC (2012a). COSEWIC assessment and status report on the Grizzly Bear Ursus arctos in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr_ours_grizz_bear_1012_e.pdf

COSEWIC (2012b). *COSEWIC assessment and status report on the American Badger Taxidea taxus in Canada.* Committee on the Status of Endangered Wildlife in Canada. Ottawa. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/american-badger-2012.html

COSEWIC (2013). Plains bison and wood bison: COSEWIC assessment and status report 2013. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/plains-bison-wood-bison-2013.html#_02_3

COSEWIC (2014). COSEWIC assessment and status report on the Wolverine Gulo gulo in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. https://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Wolverine_2014_e.pdf

Craig, J., M. Sarell and S. Holroyd. (2014). Kootenay Community Bat Project. Frequently Asked Questions. https://www2.gov.bc.ca/assets/gov/environment/pesticides-and-pest-management/managing-pests/bats/kcbp_bats.pdf

DeMars, C. (2014). *Fall Ungulate Distribution within the Crown Mountain Project Area, East Kootenay Region, BC*. Prepared for Keefer Ecological Services Ltd. Cranbrook, BC.

DeMars, C. & Tipper, G. (2015). *Spring ungulate distribution within the Crown Mountain Project Area, East Kootenay Region, BC*. Prepared for Keefer Ecological Services Ltd. Cranbrook, BC.

DeMars, C., & Tipper, G. (2014). *Winter ungulate distribution within the Crown Mountain Project Area, East Kootenay Region, BC*. Keefer Ecological Services Ltd. Cranbrook, BC.

Des Rosiers-Ste.Marie, C. (2019). *Remote Camera Study, 7*(250), 1–31.

Des Rosiers-Ste.Marie, C. (2019). *Remote Camera Study: Crown Mountain Coking Coal Project*. Prepared for Keefer Ecological Services Ltd. Cranbrook, BC.

Environment Canada. (2014*). Little Brown Myotis, Northern Myotis and Tri-colored Myotis.* Retrieved from https://www.canada.ca/content/dam/eccc/migration/sara/42e533d4-dcc7-4172-906a-023e02c10b42/fs_chauvesouris_bats_gen-v03_0215_e.pdf

Holroyd, S.L., V.J. Craig, and P. Govindarajulu. 2016. Best Management Practices for Bats in British Columbia. B.C. Ministry of Environment, Victoria, BC. 108 pp.

Kelly, M. J., Betsch, J., Wultsch, C., Mesa, B., & Mills, L. S. (2012). Noninvasive sampling for carnivores. *Carnivore ecology and conservation: a handbook of techniques*, 47-69.

Klafki, R. (2014). *Crown Mountain Furbearer Survey.* Prepared for Keefer Ecological Services.

Klafki, R. W. (2014). *Road ecology of a northern population of badgers (Taxidea taxus) in British Columbia, Canada* (Unpublished master's thesis). Thompson Rivers University, Kamloops, Canada.

Klafki, R. (2015). *Badger burrow and prey surveys in the Crown Mountain LSA in southeastern British Columbia July 28-31, 2014.* Cranbrook, B.C: Keefer Ecological Services Ltd.

Kelly, M. J., Betsch J., Wultsch, C., Mesa, B., and Mills, S. (2012). Noninvasive Sampling for Carnivores. In L. Boitani, & R.A., Powell (Eds.), *Carnivore Ecology and Conservation: A Handbook of Techniques* (pp. 47-69), New York, Oxford University Press.

Hausleitner, D., & Lowey, J. (2018). *Badger burrow surveys in the Crown Mountain area of southeastern British Columbia July 3-4, 2018*. Cranbrook, B.C: Keefer Ecological Services Ltd.

Isaac, L. (2018). *Baseline Report: Acoustic and live capture inventory of bats for the Crown Mountain Project*. VAST Resource Solutions Inc.

Lausen, C., & Hill, T. (2010). *A summary of bat work in 2009 in the Columbia Basin as part of the Provincial taxonomic study of Long-eared Bats in BC.* Selkirk Geospatial Research Centre. http://www.sgrc.selkirk.ca/bioatlas/pdf/Summary_of_Bat_Work_in_2009_Columbia_Basin.pdf

Lindzey, F. G. (1976). Characteristics of the natal den of the badger. *Northwest Science, 50*, 178–180.

Long, R. A., MacKay, P., Zielinski, W. J., & Ray, J. C. (2008). *Noninvasive Survey Methods for Carnivores*. Washington, DC, US: Island Press.

Mackenzie, D. L., Nichols, J. D., Lachman, G. B., Droege, S., Royle, A., & Langtimm, C. A. (2002) Estimating site occupancy rates when detection probabilities are less than one. *Ecology, 83*(8), 2248-2255.

Mowat, G. (2007). Large carnivore population review for the Kootenay Region. *Unpublished report, Ministry of Environment, Nelson, BC, Canada*.

Parks Canada. (2017). *Bats in the mountain national parks*. Retrived from https://www.pc.gc.ca/en/pn-np/mtn/chauvessouris-bat

Quinn, D., & Klafki, R. (2015). *Crown Mountain Furbearer Surveys.* Prepared for Keefer Ecological Services, Cranbrook, BC.

Resources Information Standards Committee (RISC). (1998a). *Ground-based Inventory Methods for Selected Ungulates: Moose, Elk and Deer.* Standards for components of British Columbia's biodiversity number 32. Victoria, British Columbia, Canada: Resources Inventory Standards Committee, Province of British Columbia.

Resources Information Standards Committee (RISC). (1998b). *Inventory Methods of Bear.* Standards for components of British Columbia's biodiversity No. 21, Version 2.0. Victoria, British Columbia, Canada: Resources Inventory Standards Committee, Province of British Columbia.

Resource Information Standards Committee (RISC). (1998c). *Standards for broad terrestrial ecosystem classification and mapping for British Columbia: classification and correlation of the broad habitat classes used in 1:250,000 ecological mapping.* Ecosystems Working Group Version 2.0. Victoria, British Columbia, Canada: Resources Inventory Standards Committee, Province of British Columbia.

Resources Information Standards Committee (RISC). (1999a). *Inventory Methods for Medium-Sized Territorial Carnivores: Coyote, Red Fox, Lynx, Bobcat, Wolverine, Fisher & Badger.* Standards for Components of British Columbia's biodiversity number 25, Version 2.0. Victoria, British Columbia, Canada: Resources Inventory Standards Committee, Province of British Columbia.

Resources Information Standards Committee (RISC). (1999b). *Inventory Methods for Bats*. Standards for Components of British Columbia's biodiversity No. 20, Version 2.0. Victoria, British Columbia, Canada: Resources Inventory Standards Committee, Province of British Columbia.

Resources Information Standards Committee (RISC). (2002). *Aerial-based inventory methods for selected ungulates: bison, mountain goat, mountain sheep, moose, elk, deer and caribou*. Standards for components of British Columbia's biodiversity No. 32. Version 2.0. Resources Inventory Committee, BC Ministry of Sustainable Resource Management, Victoria, British Columbia.

Resources Information Standards Committee (RISC). (2007). *Inventory methods for medium-sized territorial carnivores: badger.* Standards for components of British Columbia's biodiversity No. 25a, Version 1.0. Victoria, British Columbia, Canada: Resources Inventory Standards Committee, Province of British Columbia.

Resources Information Standards Committee (RISC). (2019). *Wildlife Camera Metadata Protocol*. Standards for components of British Columbia's biodiversity No. 44. Version 1.0. Resources Inventory Committee, BC Ministry of Sustainable Resource Management, Victoria, British Columbia.

Steenweg, R., Whittington, J., & Hebblewhite, M. (2015). Canadian Rockies remote camera multi-species occupancy project: examining trends in carnivore populations and their prey using remote cameras in Banff, Jasper, Kootenay, Yoho and Waterton Lakes National Parks. Jasper, Kootenay, Yoho and Waterton Lakes National Parks. Parks Canada, 94pp.

Tri, A. N. (2019). Spatial Statistics in Wildlife Research. In L.A. Brennan, A.N. Tri & B.G Mowat (Eds.), *Quantitative Analysis in Wildlife Science* (pp. 216-231). John Hopkins University Press. Baltimore, Maryland.

Unsworth, J. W., Leboan, F. A, Garton, E. O., Leptich, D. J., & Zager, P. (1998). Aerial survey: user's manual. Electronic edition. Idaho Department of Fish and Game, Boise, Idaho.

Weir, R. D. (2003). Status of the fisher in British Columbia. *BC Ministry of Sustainable Resource Management, Conservation Data Centre, and BC Ministry of Water, Land and Air Protection, Biodiversity Branch, Victoria, BC. Wildlife Bulletin No. B-105. 38pp*, 3.Wilson, D. E., & Ruff, S. (Eds). (1999). *The Smithsonian Book of North American Mammals*. Washington, DC: Smithsonian Institution Press.