Eagle Gold Project: 2019 Late-Winter Moose Distribution Survey

Prepared For
Victoria Gold Corp.
1050 West Pender Street, Suite 1000
Vancouver, BC, V6E 3S7

Prepared By
EDI Environmental Dynamics Inc.
2195 – 2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Alain Fontaine, M.Sc.
Wildlife Biologist and Project Manager

EDI Project
19Y0010
July 2019

ENVIRONMENTAL DYNAMICS INC.
Down to Earth Biology

This page is intentionally blank.

EXECUTIVE SUMMARY

Following advanced exploration activities and obtention of regulatory approvals, Victoria Gold Corp.'s Eagle Gold Mine (the Project) is currently in the construction stage of mine development. As part of their operating licence terms and conditions, Victoria Gold is required to conduct annual winter moose surveys within 10 km of the Project footprint.

The primary objective of this study was to document the distribution and abundance of moose during the late-winter season to inform adaptive management strategies for mitigating Project effects on moose. The 2019 survey is the second construction phase survey completed at the Eagle Gold Mine following the 2018 survey and builds on the baseline/pre-construction studies conducted from 2011 to 2013.

The 2019 aerial survey was conducted in late winter from 5 to 7 March 2019. A total of 11.6 hours of flight time was required to complete the moose survey resulting in a survey intensity of 0.52 min/km² which is consistent with standard intensive stratification survey protocols required for adequate coverage. A total of 100 moose were observed during the survey of which 82 were observed within the study area boundary. Most moose were observed as individuals or pairs.

The number of moose observed within the survey area in 2019 was similar to 2018; however, the number of moose observed in 2018 and 2019 was considerably higher than in previous surveys. Potential factors for the variation in moose numbers typically include observer bias and seasonal variability in the regional distribution of moose. The latter can be influenced by annual and regional variations in snow characteristics such as depth and hardness Variability could also be the result of high wolf activity preceding surveys within or near habitats seasonally important to moose.

Moose distribution varied in each year of the study. In 2018 and 2019, moose were predominantly observed in moderate elevation burns, mid-slope mixed shrub and spruce, and subalpine mixed shrub and subalpine fir. Higher densities of moose were observed in low elevation valleys in 2012 and 2013 than in 2018 and 2019. These patterns may be attributed to annual snow loads, with moose using the mid and high elevation areas more in years with lower snow loads (i.e., 2018 and 2019) and using the valleys more in deeper snow years (i.e., 2012 and 2013).

ACKNOWLEDGEMENTS

The 2019 Eagle Gold Project moose survey was completed with the assistance from Katie Babin, Phil Emerson, and Helaina Moses (Victoria Gold Corp.), Brian Moses (First Nation of Na-Cho Nyäk Dun), and Andrew Swenson (Alpine Aviation). Their professionalism, vigilance, and companionship during the survey were greatly appreciated. We thank Stephen Wilbur, Katie Babin, and Phil Emerson (Victoria Gold Corp.) for their review of the first draft of this report.

AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. Staff who contributed to this project include:

Alain Fontaine, M.Sc. .... Author and Project Manager

Hannah Gray, B.Sc. .... GIS and data analysis

Todd Mahon, M.Sc., R.P.Bio. .... Senior Review

Mike Setterington, M.Sc., R.P.Bio. .... Senior Review

Suggested Citation:

EDI Environmental Dynamics Inc. 2019. Eagle Gold Project: 2019 Late-Winter Moose Distribution Survey. Prepared for Victoria Gold Corp. 16 pp.

ACRONYMS AND ABBREVIATIONS

EDI .... EDI Environmental Dynamics Inc.

FNNND .... First Nation of Na-Cho Nyäk Dun

the Project .... the Eagle Gold Project

VIT .... Victoria Gold Corporation

YESAA .... Yukon Environmental and Socio-economic Assessment Act

YG .... Yukon Government

ZOI .... Zone of Influence

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

This page is intentionally blank.

1 BACKGROUND

Following advanced exploration activities and obtention of regulatory approvals, Victoria Gold Corp.'s (VIT) Eagle Gold Mine (the Project) is currently in the construction stage of mine development. As part of their operating licence terms and conditions, Victoria Gold is required to conduct annual winter moose surveys within 10 km of the Project footprint. The Eagle Gold Mine will produce ore from a conventional open pit operation and gold recovery plant. The Project is located approximately 85 km by road from the village of Mayo and VIT has year-round road access to the site. The Eagle Gold Project has received all major permits required for construction and operations following the Environmental Assessment process.

As part of the environmental assessment completed under *YESAA*, VIT committed to conducting annual winter moose distribution surveys. Commitment #35 from Appendix A of the YESAB Screening Report and Recommendation (YOR 2010-0267-358-2) states:

> *VIT will implement annual aerial mapping of winter moose distribution within 5 km of the access road and mine site and in adjacent control areas. This will be conducted before construction (in 2011 and 2012), during construction, and during mine operations, to allow assessment of displacement and population reduction resulting from mine activities, and adaptive management measures if negative effects occur.*

Commitment #35 is re-iterated in the Final Screening Report and Recommendation issued by YESAB February 13, 2013. However, the YESAB recommendation specifies that the survey area be extended to 10 km from Project infrastructure. This recommendation was initially proposed on August 24, 2011, by Environment Yukon's Environmental Programs Branch (YOR 2010-0267-197-1). It was recommended that the study design change to delineate a zone of influence (ZOI) extending 5 km from the Project area and access road and that a survey area extending from 5 km to 10 km beyond the ZOI be treated as the "control" area. This study design, referred to as before-after control-impact (BACI), is intended to detect changes in moose distribution near Project infrastructure due to unanticipated Project effects. It should be noted here that moose winter habitat distribution is not homogenous across the study area.

In their Screening Report and Recommendation issued on February 19, 2013, YESAB recommended to the Yukon Government that this commitment become a Term and Condition which was supported by the Yukon Government in their Decision Document (YOR 2010-0267-361-1). Term and Condition #99 states:

> *The Proponent shall, in cooperation with Government of Yukon, Department of Environment, design and conduct annual winter moose surveys consistent with methodology and study area (ten kilometres from infrastructure) used in 2011.*

Moose are the most common ungulate species in the region and occur in the Project area during all seasons. The most critical season for moose is late-winter (January–April) when availability and access to food is most limited. The Project area was identified as important moose habitat by local residents and contains some high quality early successional and lower elevation winter habitat. According to the Terrestrial Wildlife Environmental Baseline Report (Stantec Consulting Ltd. 2011a) and the Yukon Government regional biologist (personal communication with M. O'Donoghue), the South McQuesten River and Haggart Creek valleys contain winter habitats of particular importance to the local moose population.

Studies examining the effects of disturbance on the distribution and behaviour of moose along access corridors found that these effects were limited to within 1000 m of the corridors (Colescott and Gillingham 1998, Yost and Wright 2001, Laurian et al. 2008, 2012, Shanley and Pyare 2011). If avoidance of habitat due to mining-related activities was observed, this data would be useful in understanding moose distribution near the access road in order to implement additional mitigation measures to reduce traffic/moose interactions and potential of vehicle collisions.

In consultation with Environment Yukon, VIT agreed to conduct late-winter moose distribution monitoring relative to the Project infrastructure for a total of five years including 2 years pre-construction, 2 years of the construction phase, and the first year of operations (email communication with Mark O'Donoghue, Northern Tutchone Regional Biologist, on 5 August 2010). The study was designed with input from Environment Yukon to monitor moose distribution within the ZOI of the proposed mine site (0 to 1 km), and to include a control area well outside of the ZOI (5 to 10 km). If no effects were observed after five years of monitoring, the parties agreed that the frequency of this monitoring could be reduced during subsequent years of the operations phase (email communication with Mark O'Donoghue, Northern Tutchone Regional Biologist, on 5 August 2010).

To date, moose surveys were conducted in early-March of 2011, 2012, 2013, and 2018. The 2011 baseline moose distribution survey was conducted in March 2011 by Stantec (Stantec Consulting Ltd. 2011b) using a 10 km buffer from the Project and access road footprints. The 2012, 2013, and 2018 surveys were conducted by EDI Environmental Dynamics Inc. (EDI) using the 2011 survey methodology and study area as per Term and Condition #99 (EDI Environmental Dynamics Inc. 2012, 2013, 2018). However, in consultation with the Environment Yukon Regional Biologist for the Northern Tutchone Region, EDI made some slight modifications to the survey methodology to improve efficiency, moose detection rates, and crew safety while maintaining the same survey intensity.

This report presents and compares the results of the 2019 late-winter moose distribution survey with those of previous surveys. The 2019 survey follows the three baseline/pre-construction surveys and represents the second construction phase survey following the 2018 survey upon which subsequent surveys will be compared to evaluate potential changes in moose distribution and abundance in the survey area.

2 METHODS

2.1 SURVEY AREA

The Project is located approximately 45 km north of Mayo. In 2011, a 1,130 km² survey area was generated by applying a 10 km buffer to the proposed mine site and the access road footprints. In 2012, the size of the survey area was increased by 10 km² to accommodate a modified Project footprint. In 2013, a survey grid comprised of 5 minutes longitude by 2 minutes latitude blocks (approximately 4 x 4 km at this latitude) was developed to guide survey intensity. This method also aligns with the methods used by the Yukon Government for moose stratification (distribution) surveys (Environment Yukon 2010, O'Donoghue et al. 2014). The addition of blocks at the edge of the survey area increased the size of the survey area from 1,140 km² to 1,320 km². The 2018 and 2019 surveys followed the same survey design as the 2013 survey (Map 1).

Most of the survey area is suitable moose winter habitat except for small portions of rock cliffs and scree on Mount Haldane and other hilltops as well as a few small lakes. The Silver Trail Highway, which extends from Mayo to Keno City, cuts across the southeast corner of the study area. Major geographic features of the area include the valley and riparian flats of the South McQuesten River as well as Mount Haldane, a prominent mountain in the region.

The survey area lies entirely within the Yukon Plateau North ecoregion (Smith et al. 2004). The survey area consists of rolling highlands with a generally northeast-southwest orientation dissected by numerous small creeks. Vegetation cover is predominantly boreal but ranges from boreal to alpine. Alpine environments are characterized by low ericaceous shrubs, small willows (*Salix sp.*), and lichens. Subalpine environments are typically vegetated with willow and shrub birch (*Betula glandulosa*) with scattered white spruce (*Picea glauca*) and subalpine fir (*Abies lasiocarpa*). At lower elevations, black spruce (*P. mariana*) and white spruce forests grow over moist sites. Trembling aspen (*Populus tremuloides*), lodgepole pine (*Pinus contorta*), and white spruce stands grow in warmer and better-drained sites. Some nearly pure deciduous stands comprised primarily of birch and aspen can be found on south aspect slopes in southeastern portions of the study area. A riparian flat approximately 3 km wide dominated by a mix of shrub lands, grasslands, and black spruce can be found along the South McQuesten River.

The survey area is located near the Tintina Trench, which has a high incidence of thunderstorms. Consequently, the study area has a complex and diverse forest fire history contributing to the high diversity of forest covers. These burned areas have variable habitat suitability for moose depending on their age, elevation, and intensity of the burn. Two large fires have occurred recently in the study area. The most recent is a 2005 fire that burned 55 km² of forest in the headwaters of Shanghai Creek north of the South McQuesten River and that extended west to the Project area. A 1998 fire that burned 71 km² of forest from Hanson Lake to Skate Creek only partially overlaps with the study area. Other smaller fires, mainly from the mid-1990s, are scattered throughout the area.

Air temperatures at the Project site are consistent with those throughout the Yukon interior. Mean annual air temperature is -3.2°C at the Camp (782 m) weather station and -3.8°C at the Potato Hills (1420 m) weather station (Lorax Environmental Services Ltd. 2019). The temperature gradient usually shifts at low elevation and high elevation between winter and summer (i.e., temperature inversion). In December, monthly average temperature is -19.9°C at the Camp station and -15.2°C at the Potato Hill station (i.e., warmer at higher elevation). In July, monthly average temperature is 13.2°C at the Camp station and 10.8°C at the Potato Hill station (i.e., warmer at lower elevation) (Lorax Environmental Services Ltd. 2019). Rain and snowfall is moderate in the region and annual precipitation amounts range from 93 to 161 mm at the Camp station and 190 to 410 mm a the Potato Hills station (snow water equivalent) (Lorax Environmental Services Ltd. 2019). Mean monthly wind speeds are higher in spring, summer, and fall months and lower in the winter with annual minimums occurring in December and maximums occurring in April and May (Lorax Environmental Services Ltd. 2019).

2.2 SURVEY DETAILS

The survey took place 5 to 7 March 2019. Survey crews included Andrew Swenson (pilot, Alpine Aviation), Alain Fontaine (navigator, EDI), and Helaina Moses (observer, Victoria Gold Corp.) on all days in addition to Phil Emerson (observer, Victoria Gold Corp.), Brian Moses (observer, FNNND), and Katie Babin (observer, Victoria Gold Corp) for a day each from 5 to 7 March, respectively. The survey was completed with a Cessna 206 (C-FBVA) flown at 120–150 km/hr and an elevation of 100–200 m above ground level.

The design of the 2011 moose survey included forty east-west transects spaced at 1 km intervals (Stantec Consulting Ltd. 2011b). Flight lines followed the planned transects to the extent possible based on flight and terrain conditions. In 2012, EDI adjusted the survey methods used in the 2011 survey to increase their efficiency, moose sightability, and safety in mountainous terrain while maintaining the same survey intensity. The method used the same transect spacing (1 km) but did not restrict the survey crew to predetermined east-west transect lines. Instead, the survey crew flew linear transects (generally east-west) when flying over terrain with moderate topography but adjusted transects to follow contour lines over terrain with more relief and topography. This allowed the aircraft to fly at a more consistent height and speed and minimized crew discomfort which generally improves ungulate detection rates.

In 2013, 2018, and 2019 survey blocks were used to guide survey intensity while providing flexibility to fly according to the terrain. This alteration in methodology improves comparability among years and with other moose surveys conducted by Environment Yukon (Environment Yukon 2010). Blocks were used to confirm that a minimum of four passes were flown through each block, which is equivalent to 1 km transect spacing and similar to previous surveys. As per the 2012 survey, linear north-south and east-west transects were flown over terrain with moderate topography while terrain guided transects in areas with more relief. A limitation of moose distribution surveys conducted following intensive stratifications methods using fixed-wing aircraft is a sightability bias towards open habitats. Moose are more easily observed in open habitats compared to dense cover and open habitats are often composed of early seral stage vegetation (i.e., burns) that contain higher browse quality (i.e., shrubs). Furthermore, monitoring of moose distribution via annual aerial surveys provides a snapshot in time of moose abundance and distribution that can be influenced by weather, snow conditions, and predation risk.

During the survey, observers recorded all moose observations as well as any incidental wildlife sightings. All moose and wildlife observations were recorded as waypoints using a handheld GPS (Garmin GPSMAP 64). Wildlife observations documented the species and number of animals in the group and, when possible, the age class (adult/calf) and sex of the animals. However, it is generally difficult to classify animals by age and sex during moose distribution surveys given the speed and elevation of fixed-wing aircraft flights. Therefore, most moose were unclassified. We estimated the distance and direction of animals relative to the position of the plane when the waypoint was recorded to correct the spatial location.

Previous surveys also recorded fresh moose tracks crossing directly beneath the aircraft flight path using methods consistent with the intensive stratification survey track recording protocol developed by Environment Yukon (Environment Yukon 2011, EDI Environmental Dynamics Inc. 2018). This was unfeasible in 2019 due to snow age (> 3 weeks old) and associated difficulty identifying fresh tracks under these conditions. Recording fresh tracks is meant to supplement moose observations to better delineate moose distribution at the time of the survey. In 2019, moose tracks were ubiquitous across the landscape; however, the survey crew was unable to ascertain their relative age due to the length of time elapsed since the last snow event.

2.3 SURVEY CONDITIONS

Weather conditions in 2019 were ideal for aerial wildlife surveys (Table 1); however, old snow reduced the ability to use tracks to help locate moose. Fresh snow would have improved the detection of moose. Weather conditions were consistent throughout the survey; winds were calm to light, skies were clear, light conditions were bright, and temperatures ranged from -31°C to -25°C. The survey crew could not survey after the mid-day refuel on 6 March as a result of observer fatigue. Survey conditions were ideal for aerial wildlife surveys in 2012, 2013, and 2018 but old snow and flat light during afternoons in 2011 made it more difficult to sight moose (Table 1).

Table 1. Survey conditions during 2011, 2012, 2013, 2018 and 2019 late-winter moose distribution surveys at the Eagle Gold Project.

Survey Conditions	2011	2012	2013	2018	2019
Date	7-9 March	7-8 March	4-6 March	5-6 March	5-7 March
Snow Condition	Old (> 2 weeks)	Lots of fresh snow prior to the survey	~10 days old	Some fresh snow prior to the survey and on the morning of 6 March	Old (> 3 weeks)
Cloud Cover	Clear in the morning changing to overcast by late afternoon on all days	Clear to slightly overcast on 8 March	Clear	Clear on 5 March; clear in the morning changing to slightly overcast by mid-afternoon on 6 March	Clear; light high-altitude haze on 7 March
Light	Bright in the morning to flat by late afternoon	Bright	Bright	Bright	Bright
Wind	Light to moderate	Calm	Calm	Calm	Calm to light
Temperature	-35°C to -17°C	-30°C to -10°C	-27°C to -10°C	-20°C to -10°C	-31°C to -25°C
Comment	Old snow and flat afternoon light made it difficult to sight moose	Considerable snow fall in days prior to the survey	Delayed both mornings due to low fog	Light snow and low ceiling delayed the start of the survey on the second day	Very old snow made recording fresh tracks unfeasible Could not survey the afternoon of 6 March due to observer fatigue

3 RESULTS AND DISCUSSION

A total of 12.9 hours of flight time was required to complete the survey of which 11.6 hours were spent surveying moose and 1.3 hours were needed to ferry between the survey area and Mayo. In addition, 2.7 hours of ferry time was required to mobilize and demobilize the aircraft between Whitehorse and Mayo.

Survey intensity was 0.52 min/km² and consistent with the survey intensity of previous years which ranged from 0.49 min/km² in 2018 to 0.53 min/km² in 2011 (Table 2). A survey intensity of 0.4 to 0.5 min/km² is required for adequate coverage of the study area and for consistency in comparing survey results between years and with other surveys across Yukon (Environment Yukon 2010). In total, 100 moose were observed during the survey of which 82 were observed within the study area boundary (Table 2). Most moose were observed as individuals or pairs with few observations of groups of three or four moose.

The number of moose observed within the survey area in 2018 and 2019 was much larger than in previous surveys (Table 2). It should be noted here that in 2013, many moose (28 moose) were observed just outside the study area boundary in the 1998 Hanson Lake burn. Potential factors for the variation in annual moose numbers include a methodology change in 2012 that increased detection rates (however, methods were consistent from 2012 forward), observer bias (i.e., observer experience and variability in survey crews), and changes in the regional distribution of moose. The latter can be influenced by annual and regional variations in snow characteristics such as depth and hardness as well as high wolf activity preceding the survey within or near habitats seasonally important to moose (wolves are the only predator of moose in Yukon over the winter). Survey results from 2011 are not covered in detail in the following discussion due to the low sample size and the change in survey method starting in 2012 making direct comparisons to other survey years inadequate.

Table 2. Survey intensity and moose observations within the survey area for 2011, 2012, 2013, 2018, and 2019 late-winter moose distribution surveys at the Eagle Gold Project.

Year	Survey Intensity (min/km²)	Total Moose in Study Area (10 km buffer)	Total Moose Observed[1]
2011	0.53	26	31
2012	0.52	48	61
2013	0.50	39	74
2018	0.49	75	100
2019	0.52	82	100

[1]Inlcudes moose observed just outside the study area, within the survey grid (2013, 2018, and 2019), and incidental moose observations in transit to and from Mayo.

Although moose are well adapted to snow environments, characteristics of snow such as temperature, density, hardness, and depth, influence moose movement, distribution, and habitat use (Peek 2007). Snow depth is the most frequently studied variable and depths of 70 to 99 cm have been shown to restrict moose movement (Kelsall 1969, Telfer 1970, Peek 2007). In mountainous terrain, some moose populations make an altitudinal migration within their winter range in response to increasing snow depth (O'Donoghue 2005, Gillingham and Parker 2008, O'Donoghue et al. 2014, McCulley et al. 2017). During early winter, moose are generally found at higher elevations in open habitats with extensive deciduous shrub communities cover, such as subalpine shrublands and mid-elevation early-succession forests following wildfires. As winter progresses, increasing snow depth and hardness at higher elevation habitats cause a seasonal movement to lower elevation habitats where snow conditions are shallower and softer through late-winter. When snow loads are low, some moose may remain in higher elevation habitats through the winter. Thus, late winter habitats may not be used to the same degree or by as many moose every year, but in deep snow years, these areas are critical to moose over-winter survival. Local knowledge and results from Environment Yukon surveys confirm that moose in the Project region exhibit this typical seasonal movement from higher to lower elevation as winter advances (Stantec Consulting Ltd. 2011a, O'Donoghue et al. 2014).

We obtained snow depth data from the Water Resources Branch, Environment Yukon, for the snow course survey stations nearest to the Project (Mayo A, Mayo B, and Calumet). The Calumet snow station (1310 m) is generally more representative of snow conditions in the Project area than the Mayo A and B snow stations. The latter are located near the Mayo airport at lower elevations and are subject to wind scour and human disturbance related to airport activities (Email communication on 27 April 2018 with Steve Therriault, Energy, Mines and Resources, and Jonathan Kollot, Environment Yukon). Snow depth was also measured at two climate stations within the Project area: Potato Hills (alpine, 1420 m) and Camp (valley bottom, 782 m) (Lorax Environmental Services Ltd. 2019).

Table 3. Snow depth for 2011 to 2013 and 2018 to 2019 at weather stations within or near the Eagle Gold Project during the sampling event closest to survey dates.

Year	VIT Camp (cm)[1]	VIT Potato Hills (cm)[1]	YG Mayo Airport A (cm)[2]	YG Mayo Airport B (cm)[2]	YG Calumet (cm)[2]
2011	55	105	55	55	88
2012	78	99	51	64	94
2013	61	96	62	60	87
2018	53	85	40	46	83
2019	48	79	41	36	63
2010-2019 Average	56.2	93.7	49.2	50.4	80.4
1987-2019 Average	n/a	n/a	50.4	51.5	84.8

[1](Lorax Environmental Services Ltd. 2019)
[2]Snow depth data for the Mayo A, Mayo B, and Calumet snow course stations were obtained from the Water Resources Branch, Environment Yukon.

Regionally, snow depth in 2012 and 2013 was above average while 2018 and 2019 were below average (Table 3). Snow depth at stations located at higher elevations (Potato Hill, Calumet) was much deeper and denser than those recorded at stations located at lower elevations (Camp, Mayo A and B; Table 3) (Lorax Environmental Services Ltd. 2019). This higher than average snow depth from 2012 to 2013, especially at higher elevations, might explain the greater use of moderate to low elevation habitats by moose during those surveys relative to 2018 and 2019. However, the snow depth at high elevation within the study area was deeper than those reported to affect moose distribution in all years (Kelsall 1969, Telfer 1970, Peek 2007).

To examine the potential effects of Project disturbance on moose distribution, moose abundance was stratified in 1 km buffer increments from the Project footprint (Figure 1). Moose densities are presented rather than the total number of moose observed within each distance buffer (Figure 1). This provides a better relative basis for comparison because the area of each buffer increases in size as the distance from the Project footprint increases. Moose densities of 5.2 moose per 100 km² were observed within 1 km of the proposed Project footprint along the Haggart Creek Access Road and infrastructure in 2019, compared to 11.2 moose per 100 km² in both 2012 and 2013, and 0 moose per 100 km² in 2018 (Figure 1). The Haggart Creek valley contains abundant browse and cover that moose select for winter habitat in some deep snow years. Land clearing associated with the road right of way and historic placer mining operations adjacent to the Haggart Creek Access Road has created early-successional habitats favoured by moose. Moose are likely to continue to use these areas as late-winter habitat; however, the intensity of use appears to be highly variable between years and, to date, unrelated to anthropogenic disturbance effects. Human activity along the access road and at the Project site during the winter 2018 survey was similar to that of previous surveys; construction activities occurred from August to October 2017 and were started again in April 2018 and the road was not accessible other than by snowmobile over the winter between those periods. Therefore, construction activities did not influence moose distribution in early-March 2018. Although snow depth at higher elevations at the time of the 2018 survey (Table 3) fell within the range typical of those restricting moose movement (Kelsall 1969, Telfer 1970, Peek 2007), moose did not appear to follow the pattern of altitudinal migration as no moose were observed in valley bottoms in 2018 (Figure 1). More moose were observed close to project infrastructure in 2019, during construction activities, than in 2018 when no construction was occurring (Figure 1).

In 2019, most moose were distributed in high-density clusters within moderate and higher elevation burned plateaus on the eastern side of the survey area, namely within the 2005 burn of the Shanghai Creek and Lynx Creek drainages (blocks 24, 25, 34, 35, 43, and 44; Map 1). Moose tracks of mixed ages were abundant throughout the burn indicating the long-term occupation of the area over the winter. Elsewhere, moose were observed in small clusters in small mid-1990's burns at mid-elevation and mid-slope in mixed shrub and spruce habitats. Two moose were observed in the South McQuesten River valley and six moose were observed in the Haggart Creek valley; both valleys were reported to be important for moose in late-winter (Stantec Consulting Ltd. 2011a) and are overlapped in part by a moose late-winter key area (Map 1).

The distribution of moose observed within the survey area varied throughout all survey years (Map 2). However, some areas receive consistent use across survey years such as the 2005 Shanghai Creek and Lynx Creek burn, the 1998 Hanson Lake burn, the high elevation ridges between Red Mountain and Haggart Creek, and small burns along the southern edge of the study area. Moose made greater use of low elevation habitats during the 2012 and 2013 surveys; fewer moose were observed at low elevation during the 2018 and 2019 surveys. During the 2011 survey, moose were observed scattered throughout the survey area with most moose occurring at mid to lower elevations east and south-east of the mine site between Lynx Creek and the South McQuesten River. During the 2012 survey, moose continued to be observed using mid to low elevations, but were primarily observed in old burns, and west of the Haggart Creek Access Road and the existing advanced exploration camp operated by VIT. In 2013, moose were again observed in mid to low elevation areas; however, most observations were east of the Haggart Creek Access Road and the mine site in the moderate elevation burns (Map 2). In 2018 and 2019, moose were predominantly observed in moderate elevation burns. High densities of moose were also observed in subalpine mixed shrub and subalpine fir habitats in 2018 whereas in 2019 they appeared to occupy mid-slope mixed shrub and spruce habitats. Fewer moose were observed in the high elevation ridges between Red Mountain and Haggart Creek in 2019 than in 2018. This may be a result of the age of the snow and inability of observers to detect fresh tracks that would have otherwise alerted observers to the presence of moose and increased detection rates as well as lower sightability of moose in more heavily vegetated habitats mid-slope.

Yearly variation in the distribution of large ungulates is common. Food availability, snow depth, and risk of predation affect late-winter moose distribution (Dussault et al. 2005). Food availability is assumed to be constant year over year because there have not been major changes to moose habitat in the survey area during the survey years. However, the Shanghai Creek burn may be entering a successional stage of high-quality moose winter habitat (i.e., a greater abundance of winter browse) where the local moose population is becoming increasingly concentrated over the winter months.

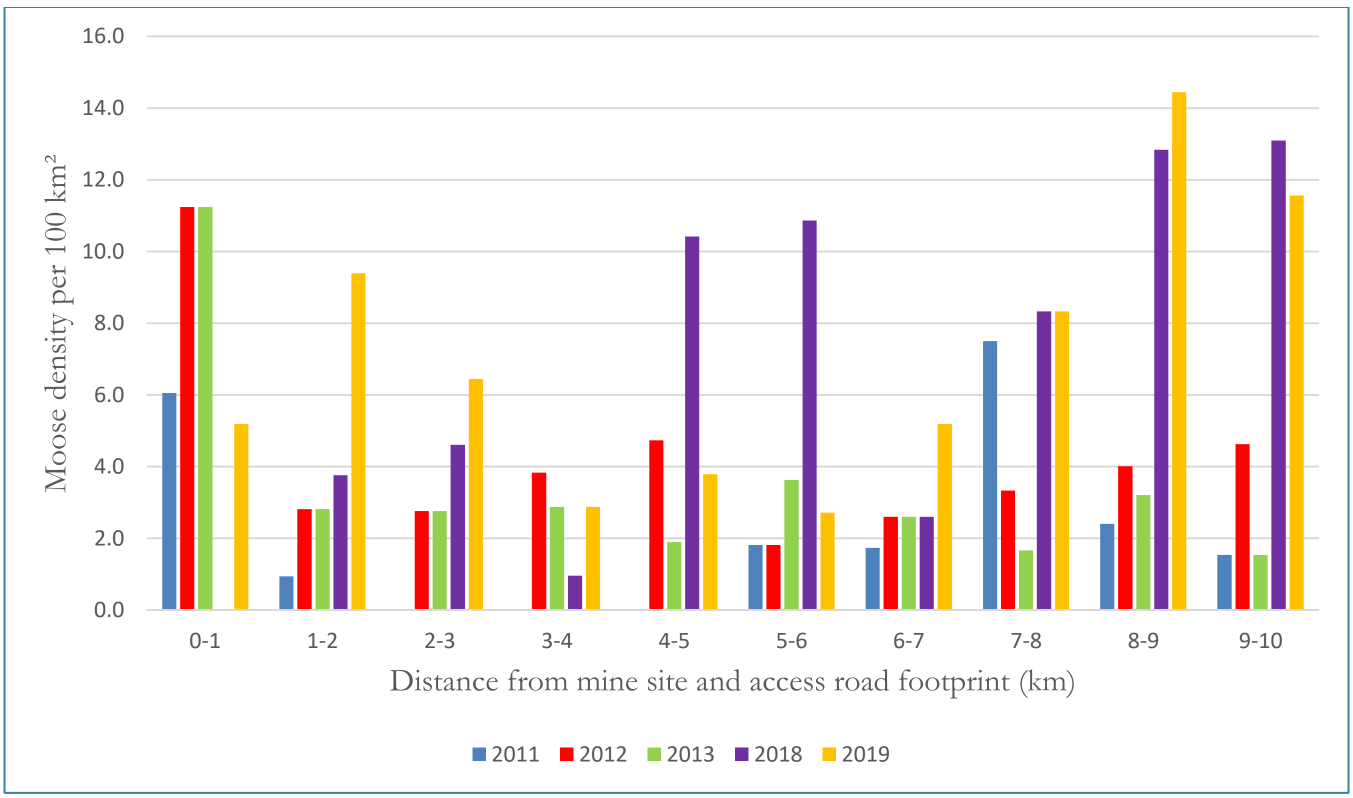


Figure 1. Moose density per 100 km² at 1 km intervals within 10 km of the Eagle Gold Project infrastructure during late-winter 2011, 2012, 2013, 2018, and 2019 moose surveys.

3.1 INCIDENTAL OBSERVATIONS

Caribou or caribou tracks were not observed during the 2011, 2012, and 2019 late-winter surveys. However, a group of five woodland caribou was observed in 2013 in an alpine area on Red Mountain, which is located on the western edge of the survey area approximately 10 km from the Haggart Creek Access Road. In 2018, caribou cratering (i.e., digging in snow for forage and mineral-rich water) was observed in a wetland complex along the South McQuesten River approximately 14 km southeast of the Project, and an east-west oriented trail from around the same time period and thought to be from a group of caribou was observed on the ridgeline between the South McQuesten River and the Project.

In the Terrestrial Wildlife Environmental Baseline Report, local knowledge indicated that caribou were known to occur in the Red Mountain area (Stantec Consulting Ltd. 2011a). However, based on the distribution of herd ranges in the region, caribou are expected to be an uncommon occurrence in the study area. The closest woodland caribou herd to the survey area is the Clear Creek caribou herd located approximately 8.5 km to the west of the study area boundary. A 2001 survey estimated the herd to be composed of 900 caribou (Environment Canada 2012).

One wolf was observed between the eastern foothills of Mount Haldane and Haldane Creek during the 2019 survey. Detecting wolf tracks in 2019 was difficult given snow age and the abundance of moose tracks throughout the study area. However, wolf tracks were detected at a few locations on the South McQuesten River west of the road crossing. No wolves were observed during the 2018 survey but wolf tracks, fresh and old, were common throughout the lower elevation creek and river valleys. The flats along the South McQuesten River had high densities of wolf tracks especially in the blocks west of the access road. This area also had high densities of old moose tracks but few fresh tracks were observed. No wolves were observed in 2011 and 2012; however, three packs were observed in 2013 (EDI Environmental Dynamics Inc. 2013). Two of the packs observed in 2013 were in the vicinity of the South McQuesten River area where we observed high densities of wolf tracks in 2018. Survey notes from 2013 also indicate that the survey crew observed high densities of wolf tracks in the South McQuesten River and Haggart Creek valleys.

4 CONCLUSIONS

The data collected as part of the 2011–2013 moose surveys were intended to reflect the baseline pre-construction distribution of moose in the study area, while those of the 2018 survey were collected near the end of a 5-month halt during the construction phase and those of the 2019 survey were collected during construction activities. The survey schedule was designed to detect the potential effects of mine construction and operation activities on moose sensory disturbance and subsequent avoidance of habitat within a zone of influence (ZOI) around the mine site and access road.

Changes in distribution and density of moose were expected among years as a result of annual snow loads, dynamic habitat variables and predation risk. However, although some areas appear to hold higher moose densities, overall moose distribution to date has been variable between years but predominantly associated with moderate elevation burns. No moose were observed within 1 km of the Project footprint in 2018 during a 5-month halt in construction activities and unmaintained road access conditions, but this is attributed to natural variability. Moose densities were moderate within 1 km of the Project footprint in 2019 when construction was in earnest. No evidence of moose harvest was documented along the access road in 2019 or previous surveys (as in all survey years, a transect was run along each side of the access road). This evidence suggests that variation in the distribution of moose likely has more to do with annual snow depths and winter habitat distribution than project activities at the mine and along the road. Furthermore, survey results also reflect the variance expected given the survey methods (i.e., fixed-wing aircraft at high elevation and speed) and intensity (i.e., wide transect spacing).

5 REFERENCES

Colescott, J.H. and Gillingham, M.P. 1998. Reaction of moose (*Alces alces*) to snowmobile traffic in the Greys River Valley, Wyoming. Alces 34:329–338.

Dussault, C., Ouellet, J.-P., Courtois, R., Huot, J., Breton, L., and Jolicoeur, H. 2005. Linking moose habitat selection to limiting factors. Ecography 28(5):619–628.

EDI Environmental Dynamics Inc. 2012. Eagle Gold late winter moose survey — 2012. Prepared by EDI Environmental Dynamics Inc., Whitehorse, Yukon, for Victoria Gold Corp., Whitehorse, Yukon, Whitehorse, Yukon. 11 pp.

EDI Environmental Dynamics Inc. 2013. Eagle Gold Project: late winter moose distribution survey — 2013. Prepared by EDI Environmental Dynamics Inc., Whitehorse, Yukon, for Victoria Gold Corp., Whitehorse, Yukon, Whitehorse, Yukon. 13 pp.

EDI Environmental Dynamics Inc. 2018. Eagle Gold Project: 2018 late-winter moose distribution survey. Prepared by EDI Environmental Dynamics Inc., Whitehorse, Yukon, for Victoria Gold Corp., Whitehorse, Yukon, Whitehorse, Yukon. 15 pp.

Environment Canada. 2012. Management plan for the northern mountain population of woodland caribou (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa, Ontario. 79 pp.

Environment Yukon. 2010. Moose intensive stratification survey technique - briefing notes. File Report. Environment Yukon, Fish and Wildlife Branch, Whitehorse, Yukon. 3 pp.

Environment Yukon. 2011. Collecting track data during early and late winter moose surveys. File Report. Environment Yukon, Fish and Wildlife Branch, Whitehorse, Yukon. 2 pp.

Gillingham, M.P. and Parker, K.L. 2008. Differential habitat selection by moose and elk in the Besa-Prophet area of northern British Columbia. Alces 44:41–63.

Kelsall, J.P. 1969. Structural adaptations of moose and deer for snow. Journal of Mammalogy 50(2):302–310.

Laurian, C., Dussault, C., Ouellet, J.-P., Courtois, R., and Poulin, M. 2012. Interactions between a large herbivore and a road network. Ecoscience 19(1):69–79.

Laurian, C., Dussault, C., Ouellet, J.-P., Courtois, R., Poulin, M., and Breton, L. 2008. Behavior of moose relative to a road network. Journal of Wildlife Management 72:1550.

Lorax Environmental Services Ltd. 2019. Eagle Gold Climate Data Report. Prepared by Lorax Environmental Services Ltd., Vancouver, BC, for Victoria Gold Corp., Vancouver, BC, Vancouver, BC. 34 pp.

McCulley, A.M., Parker, K.L., and Gillingham, M.P. 2017. Yukon moose: II. Range sizes, movement rates, and use of elevation and land cover by males and females. Alces 53:137–157.

O'Donoghue, M. 2005. Late winter habitat use by moose: survey of the Pelly and MacMillan river areas, March 2001. Fish and Wildlife Branch Report. SR-05-01. Department of Environment, Fish and Wildlife Branch, Whitehorse, Yukon. 8 pp.

O'Donoghue, M., Bellmore, J., Czetwertynski, S., and Westover, S. 2014. Moose survey: Mayo Moose Management Unit, late-winter 2014. Fish and Wildlife Branch Report. SR-16-05. Environment Yukon, Fish and Wildlife Branch, Whitehorse, Yukon. 12 pp.

Peek, J.M. 2007. Habitat relationships. pp. 351–376. Ecology and management of the North American moose, Second Edition. Smithsonian Institution Press, Washington, D.C.

Shanley, C.S. and Pyare, S. 2011. Evaluating the road-effect zone on wildlife distribution in a rural landscape. Ecosphere 2(2):1–16.

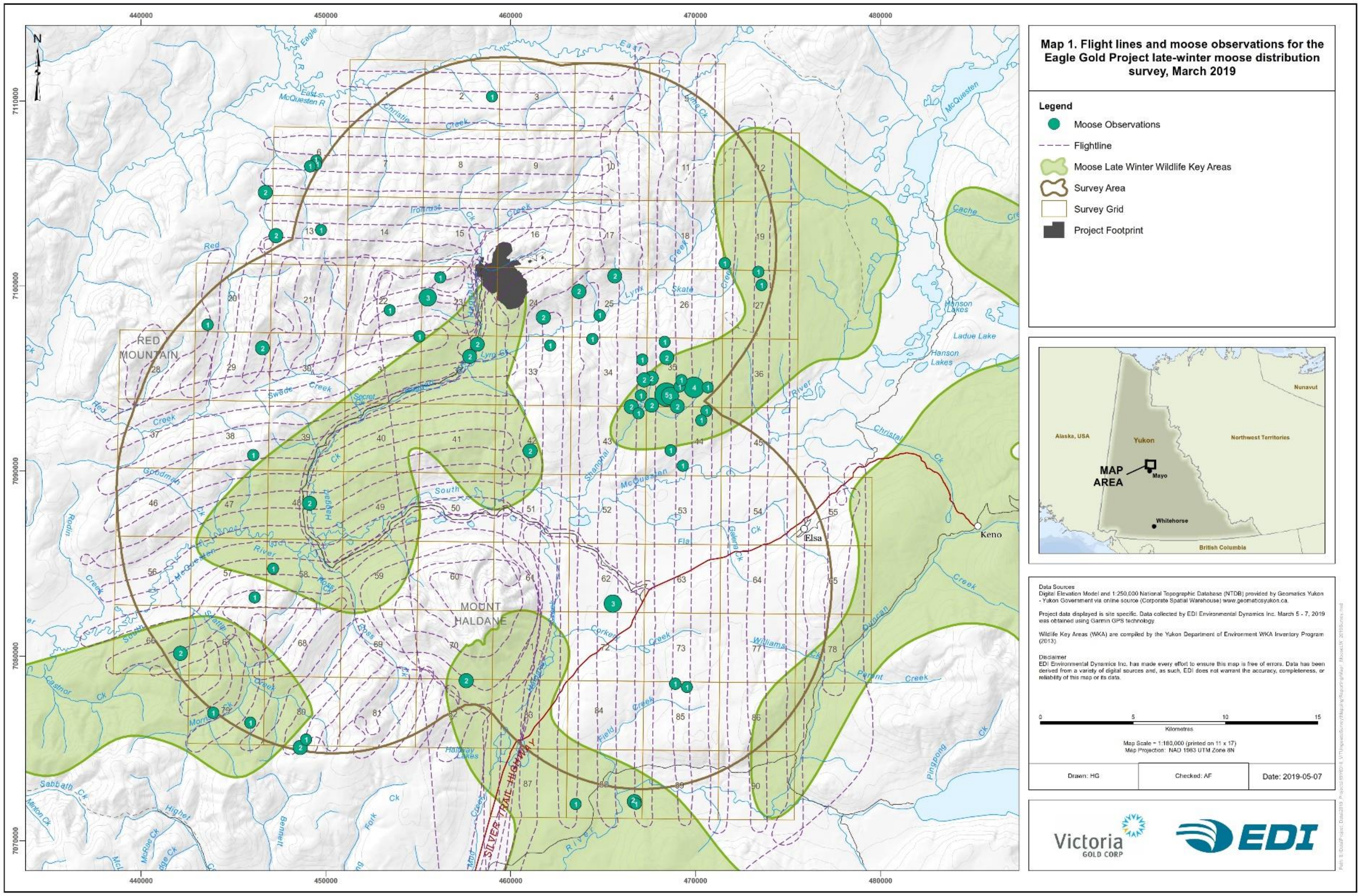
Smith, C.A.S., Meikle, J.C., and Roots, C.F. 2004. Ecoregions of the Yukon Territory: biophysical properties of Yukon landscapes. Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia. 313 pp.

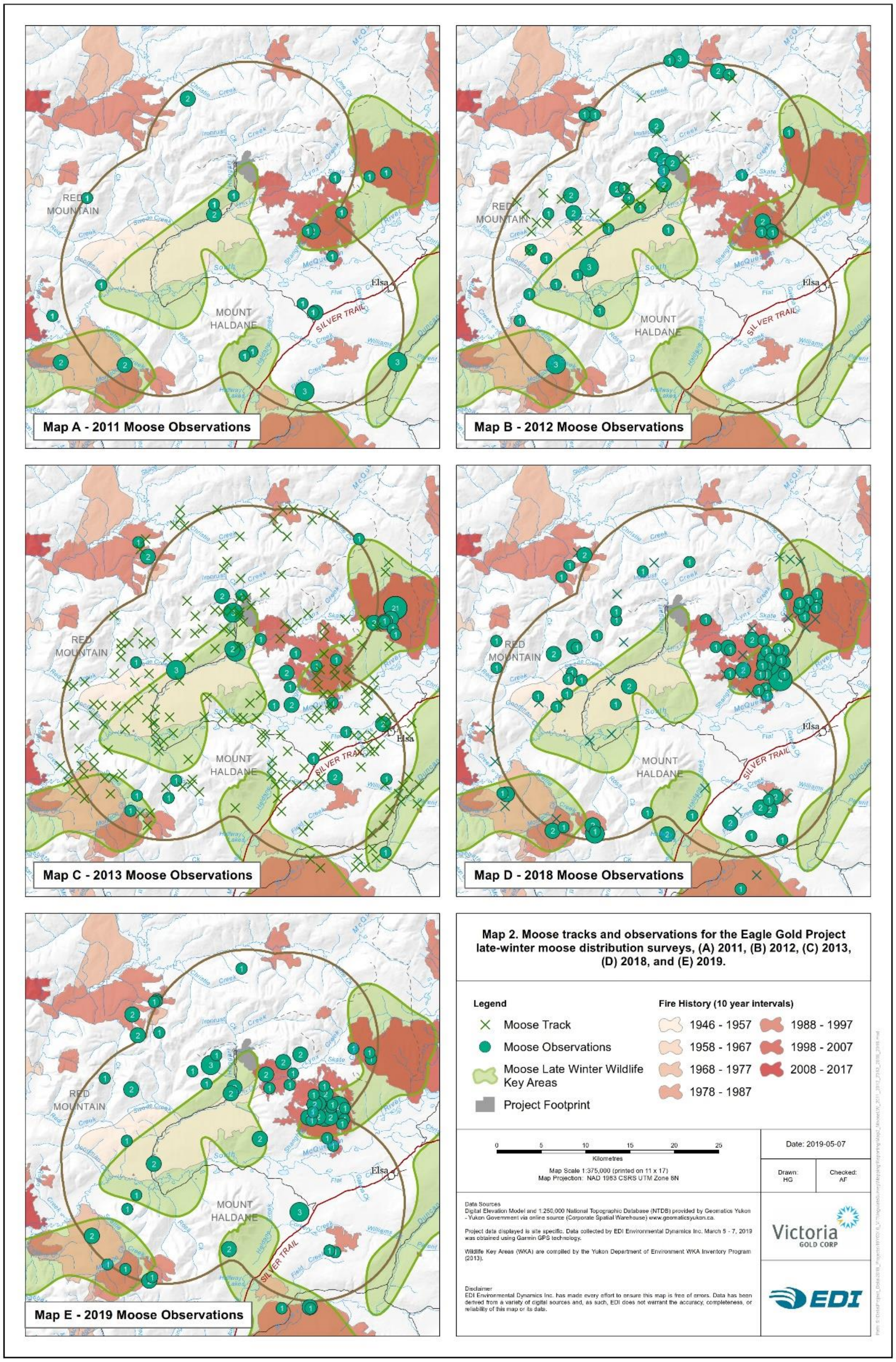
Stantec Consulting Ltd. 2011a. Eagle Gold Project. Environmental baseline report: terrestrial wildlife. Prepared by Stantec Consulting Ltd., Burnaby, BC, for Victoria Gold Corp., Vancouver, BC, Burnaby, British Columbia. 21 pp.

Stantec Consulting Ltd. 2011b. Eagle Gold Project. Technical data report: 2011 aerial survey of moose distribution. Prepared by Stantec Consulting Ltd., Burnaby, BC, for Victoria Gold Corp., Vancouver, BC, Burnaby, British Columbia. 7 pp.

Telfer, E.S. 1970. Winter habitat selection by moose and white-tailed deer. The Journal of Wildlife Management 34(3):553–559.

Yost, A.C. and Wright, R.G. 2001. Moose, caribou, and grizzly bear distribution in relation to road traffic in Denali National Park, Alaska. Arctic 54(1):41–48.


Map 1. Flight lines and moose observations for the Eagle Gold Project late-winter moose distribution survey, March 2019
Legend
Moose Observations
Flightline
Moose Late Winter Wildlife Key Areas
Survey Area
Survey Grid
Project Footprint
Alaska, USA
Yukon
Northwest Territories
Nunavut
MAP AREA
Mayo
Whitehorse
British Columbia
Data Sources
Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. March 5 - 7, 2019 was obtained using Garmin GPS technology.
Wildlife Key Areas (WKA) are compiled by the Yukon Department of Environment WKA Inventory Program (2013).
Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.
0 5 10 15
Kilometres
Map Scale = 1:180,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 8N
Drawn: HG
Checked: AF
Date: 2019-05-07
RED MOUNTAIN
MOUNT HALDANE
Elsa
Keno
SILVER TRAIL HIGHWAY
Ladue Lake
Hanson Lakes
440000
450000
460000
470000
480000
7110000
7100000
7090000
7080000
7070000



Map 2. Moose tracks and observations for the Eagle Gold Project late-winter moose distribution surveys, (A) 2011, (B) 2012, (C) 2013, (D) 2018, and (E) 2019.