Valentine Gold Project: 2021 Aerial Survey of Caribou Calving Grounds

Final Report

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Executive Summary

Marathon Gold Corporation (Marathon) is planning to develop the Valentine Gold Project (the Project), located in the Central Region of the Island of Newfoundland. The Project overlaps with woodland caribou (*Rangifer tarandus*) range in central Newfoundland. The Wildlife Division of the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture identified the need to gather information about the Buchans Herd and resident caribou that calve in the Project's zone of influence (ZOI).

Stantec Consulting Ltd. (Stantec) undertook an aerial post-calving survey to obtain herd composition information about the Buchans herd and resident caribou that calve in the ZOI, and to complete a population estimate on the Buchans herd calving ground. The survey was completed from July 7-11, 2021.

The overall survey area was divided into two smaller survey areas: 1) Buchans herd post-calving survey area, and 2) resident caribou post-calving survey area. Collectively, more than 1,900 caribou were detected during the survey. Within the resident caribou post-calving survey area there were 14% calves and 35% males, and within the Buchans herd post-calving survey area there were 24% calves and 20% males. The classification metrics are not intended for population census purposes, though may provide future insight on avoidance behaviours between sexes or age classes if such effects are evident. Additionally, the population in the Buchans herd post-calving survey area was estimated at 2,500 individuals.

This report provides a description of methods and results from the 2021 Aerial Survey of Caribou Calving Grounds. This information, including the analysis of telemetry data, will augment the baseline caribou data for the Project and may be included in future discussions about caribou group composition and distribution on the calving grounds if change occurs over time.

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Abbreviations

agl	Above Ground Level
AIC	Akaike's Information Criterion
CI	Confidence Interval
EIS	Environmental Impact Statement
GIS	Geographic Information System
GPS	Geographic Positioning System
km	Kilometre
km^2	Square kilometre
m	Metre
n	Number
NLDFFA-WD	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Wildlife Division
NL	Newfoundland and Labrador
SE	Standard Error
ZOI	Zone of Influence

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Marathon Gold Corporation (Marathon) to undertake several baseline environmental studies for the Valentine Gold Project (the Project), including analysis of woodland caribou (*Rangifer tarandus*) migration, distribution, and use of the Project Area (Figure 1-1). Woodland caribou were identified as a valued component in the Environmental Impact Statement (EIS) Guidelines for the Project issued by both the federal and provincial governments (Impact Assessment Agency of Canada 2019; Government of Newfoundland and Labrador [NL] 2020a). Although the Newfoundland Population of woodland caribou is not listed under the provincial *Endangered Species Act*, the federal *Species at Risk Act* was recently amended to include the Newfoundland population of caribou on Schedule 1 as Special Concern (Government of Canada 2021). The results of these ongoing baseline studies during Project development may be used to document potential change in caribou distribution and use of the Project area.

The Project is in central Newfoundland, approximately 57 km south of Buchans, and will be comprised of two open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities, a tailings management facility, personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities. The mine site is accessed by an existing gravel road, approximately 84 km in length, which extends to the Project area south from Millertown. Approximately 76 km of this existing access road will be upgraded and maintained by Marathon as part of the Project.

Stantec, on behalf of Marathon, undertook an aerial survey in 2021 to classify and determine the number of calf:female pairs on the calving grounds for both the Buchans herd and for resident caribou that calve within the Project's zone of influence (ZOI). The ZOI was determined for the 2020 survey (BSA.2, Appendix 2-C) and included a 17-km buffer around the mine site and a 4-km buffer along the south side of the access road. The 17-km buffer was selected based on results from noise modelling completed for the Project which predicted a return to baseline sound pressure levels at 5 km from the mine site (EIS, Chapter 5), and from published information on caribou ZOIs around mines ranging from 2 km to 14 km (Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012; LeBlond et al. 2014; Johnson et al. 2015; Eftestøl et al. 2019). This report presents the results of the 2021 survey and includes a population estimate for the Buchans herd post-calving survey area, and distribution and demographic information for both the Buchans herd post-calving survey area and resident caribou post-calving survey area.

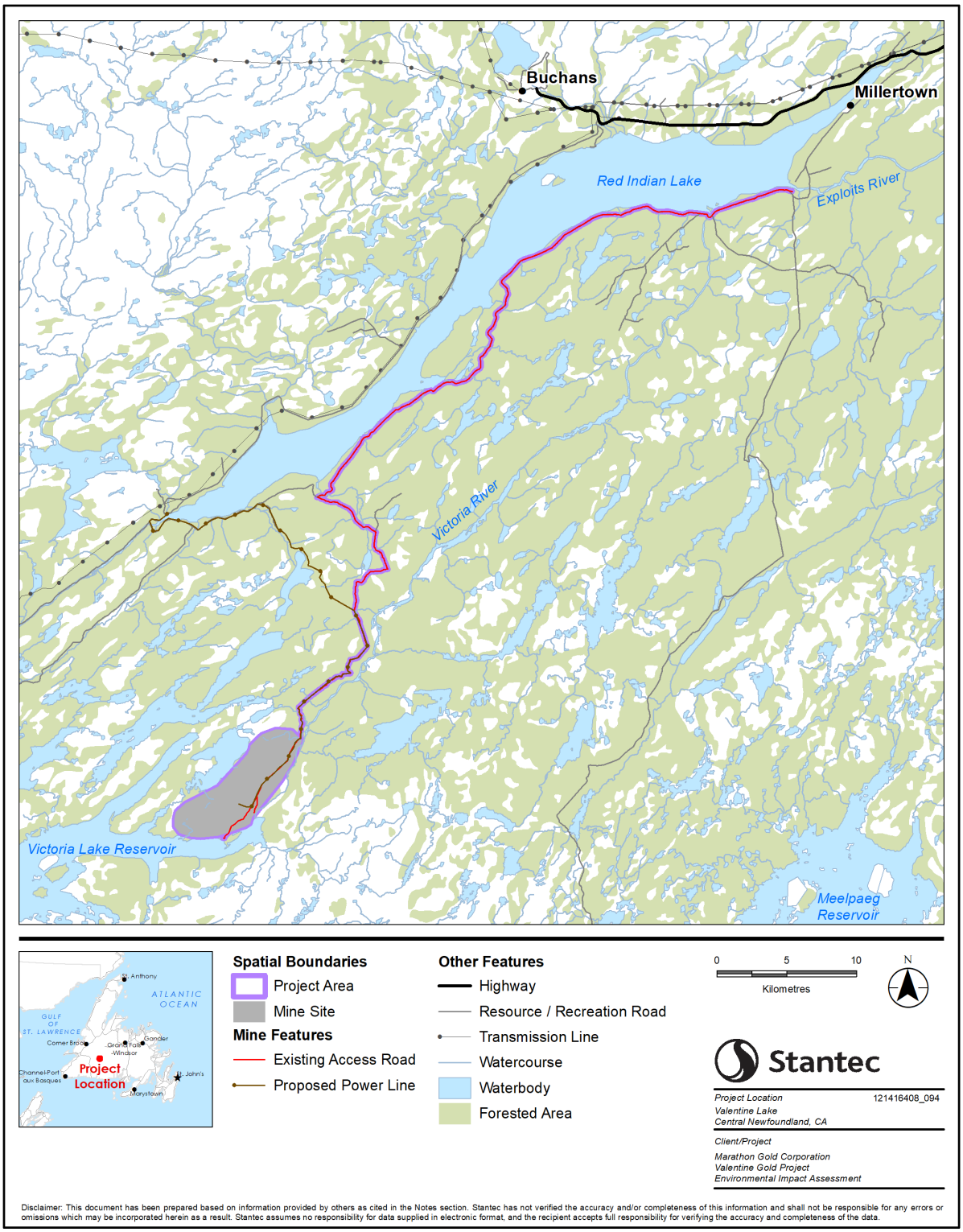

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Figure 1-1 Project Area

2.0 BACKGROUND AND CONTEXT

2.1 PROJECT OBJECTIVES

The objectives of the 2021 aerial survey were to:

- Determine a caribou population estimate for the Buchans herd post-calving survey area
- Determine caribou group size and composition, including the number of cow:female pairs (i.e., classification), for the:
  - Buchans herd post-calving survey area
  - resident caribou post-calving survey area

2.2 CONTEXT

The caribou population on the Island of Newfoundland is comprised of several sub-populations differentiated by annual movement patterns, spatial affiliations, and genetic structure (Wilkerson 2010; Government of NL 2015). The caribou population on the Island of Newfoundland has decreased by approximately 60% since the late 1990s (Soulliere et al. 2010; COSEWIC 2014; Government of NL 2015).

The EIS assessed the effects on four caribou herds (EIS Chapter 11) that potentially interact with the Project: Buchans, Gaff Topsails, Grey River and La Poile. These herds are part of the South Coast sub-population (Wilkerson 2010; Schaefer and Mahoney 2013; Government of NL 2019). The South Coast caribou herds share winter range near the southern shore between Burgeo and the Connaigre Peninsula (Weir et al. 2014), however have separate calving areas and summer ranges. Recent surveys (i.e., 2019) of some herds in this area (i.e., Buchans, Grey River, Gaff Topsails, La Poile) suggest that population trends (i.e., population size, % calves) may be stabilizing (Government of NL 2019). The 2021 post-calving survey was undertaken to complete classification of both the Buchans herd and resident caribou post-calving survey areas and to develop a post-calving population estimate for the Buchans herd post-calving survey area. While the herd affiliation for caribou that calve within the ZOI is uncertain, their distribution overlaps with the calving range of the Grey River herd. It is assumed therefore that most caribou in the resident caribou post-calving survey area are Grey River caribou. The survey dates were based on the generalized dates for caribou seasons on the Island of Newfoundland (Table 2.1).

Table 2.1 General Seasons for Island Caribou in Newfoundland

Season	Seasonal Dates
Winter	December 16 – March 31
Spring Migration/Pre-calving	April 1 – May 19
Calving	May 20 – June 10
Post-calving Migration/Dispersal	June 11 – June 30
Post-calving Rearing	July 1 – August 31
Fall Rut	September 1 – October 31
Fall Migration/Dispersal	November 1 – December 15
Source: Emera (2013)	

3.0 SURVEY AREA AND METHODS

3.1 SURVEY AREA

The overall survey area (6,101 km^2) includes two smaller survey areas: 1) the Buchans herd post-calving survey area; and 2) the resident caribou post-calving survey area (Figure 3-1). Surveys in the post-calving survey areas were completed along parallel transects that were spaced 2.5 km apart and oriented east-west, and surveys for the road were completed along meandering transects that were 1 km and 4 km from the road. The 2021 survey area is the same as that used in the 2020 survey; information on the delineation of the survey area is available in BSA.2 (Attachment 2-C), which was appended to the EIS. However, the methods for determining herd affiliation differed from that used in the 2020 survey (see Section 3.3.1).

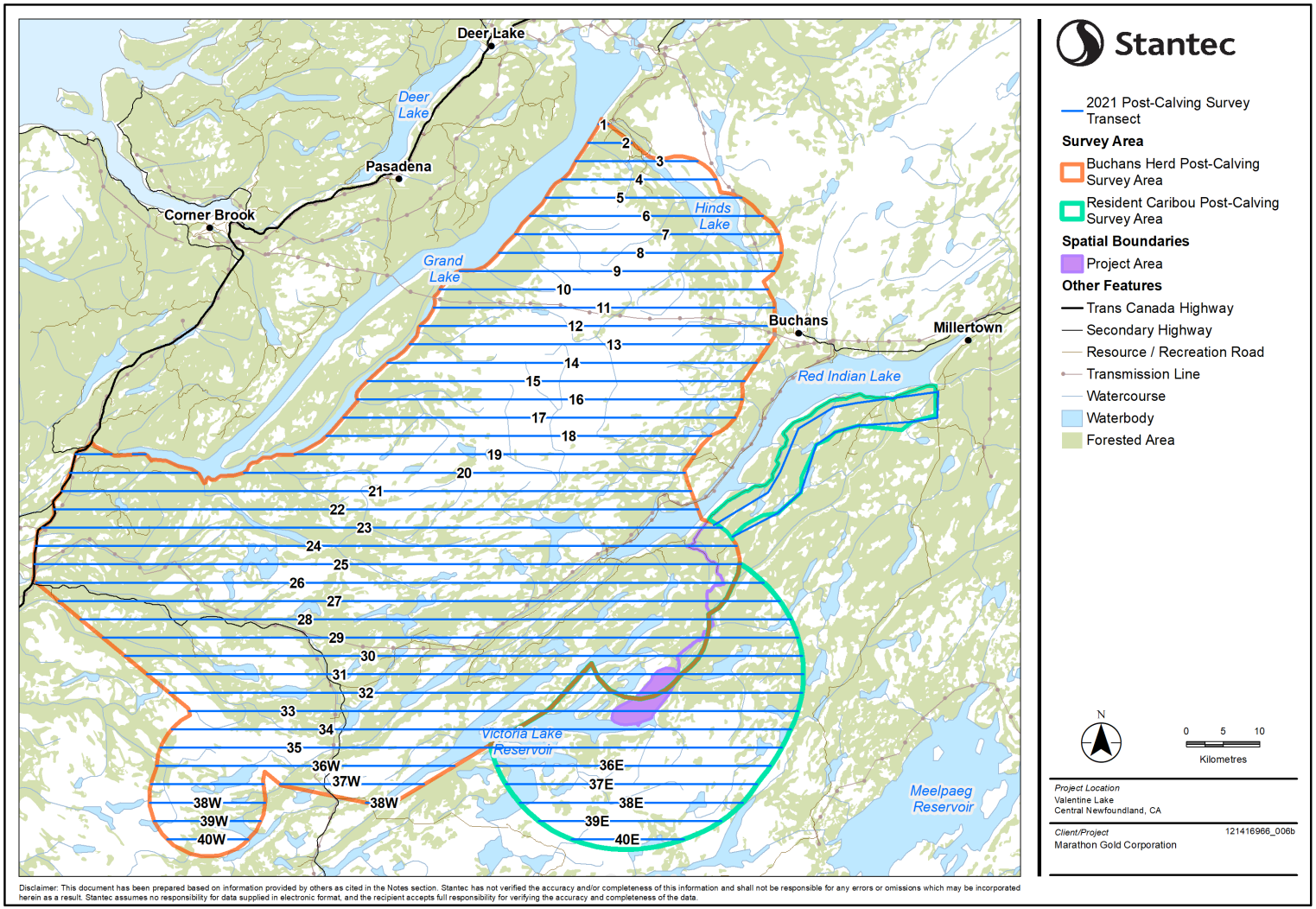

Figure 3-1 Survey Area for 2021 Aerial Survey of Caribou Calving Grounds

3.2 SURVEY METHODS

A Bell 206L Long Ranger helicopter (with 'bubble' rear windows to enhance observer visibility) was used for the survey. The survey team consisted of a navigator/recorder in the front seat, and two rear seat observers (Table 3.1). Per the conditions of a survey permit (Appendix B) the rear seat observers switched viewing positions approximately halfway through each survey day. The helicopter was flown at 100-120 km/hour at approximately 100 m above ground level (agl). Prior to the survey the survey team calibrated their windows at 100 m agl to delineate six distance classes for the purpose of estimating the horizontal distance to caribou from the transect line. Horizontal lines were marked on the helicopter window as follows: 1 = 0-100 m; 2 = 100-200 m; 3 = 200-300 m; 4 = 300-400 m; 5 = 400-500 m; and 6 > 500 m. The window-based distance classes were used only in instances where a rangefinder could not be used to determine horizontal distance or when there was concern about obtaining an accurate distance measurement before the caribou moved in response to the helicopter. Window markings were recalibrated when rear seat observers switched viewing positions such that the calibrations matched their height and sitting position.

Table 3.1 Survey Team for 2021 Aerial Survey of Caribou Calving Grounds

Team Member	Role (Position in Helicopter)
Dave Bursey	Pilot, Newfoundland Helicopters
Tony Parr	Stantec - Field Team Lead, Biologist (Navigator, Front Left)
Catie Young	Stantec – Biologist (Observer, Rear Seat)
Aaron Coward	NLDFFA-WD – Ecologist (Observer, Rear Seat)

Transect lines were uploaded into a Geographic Positioning System (GPS) for pilot navigation and for observer reference. Transect names and lengths are provided in Appendix C. At the start of each transect the habitat type, weather conditions, and visibility were documented (Appendix E).

Caribou detections from the transect line were geo-referenced using a GPS (Appendix D). Estimates of population size based on distance sampling methods requires that the perpendicular horizontal distance between each caribou detection and the transect line be obtained (Figure 3-2). For this survey, all horizontal distances were measured perpendicularly with respect to the transect. Caribou were detected from helicopter (i.e., observers were 100 m agl) and the horizontal distance between detected caribou and the transect line was determined using one of three approaches: 1) measured in the field using the rangefinders; 2) calculated after the survey from the location of the detected caribou; or 3) measured using the distance bin calibrations on the helicopter window. The preferred method was to measure the horizontal distance in the field using TruPulse 200L rangefinders. The 'Horizontal Distance Measurement Mode' was used to calculate level distance between the rangefinder and the plane of the target (in this case, caribou) (Laser Technology, Inc 2013), which calculated the measure of horizontal distance that accounted for the height of land where the caribou was located. It is assumed that the helicopter was on a level plane (i.e., angle of pitch was 0°) when the rangefinder was used. Following the measurement of horizontal distance, the number of caribou initially detected from the transect line was also recorded.

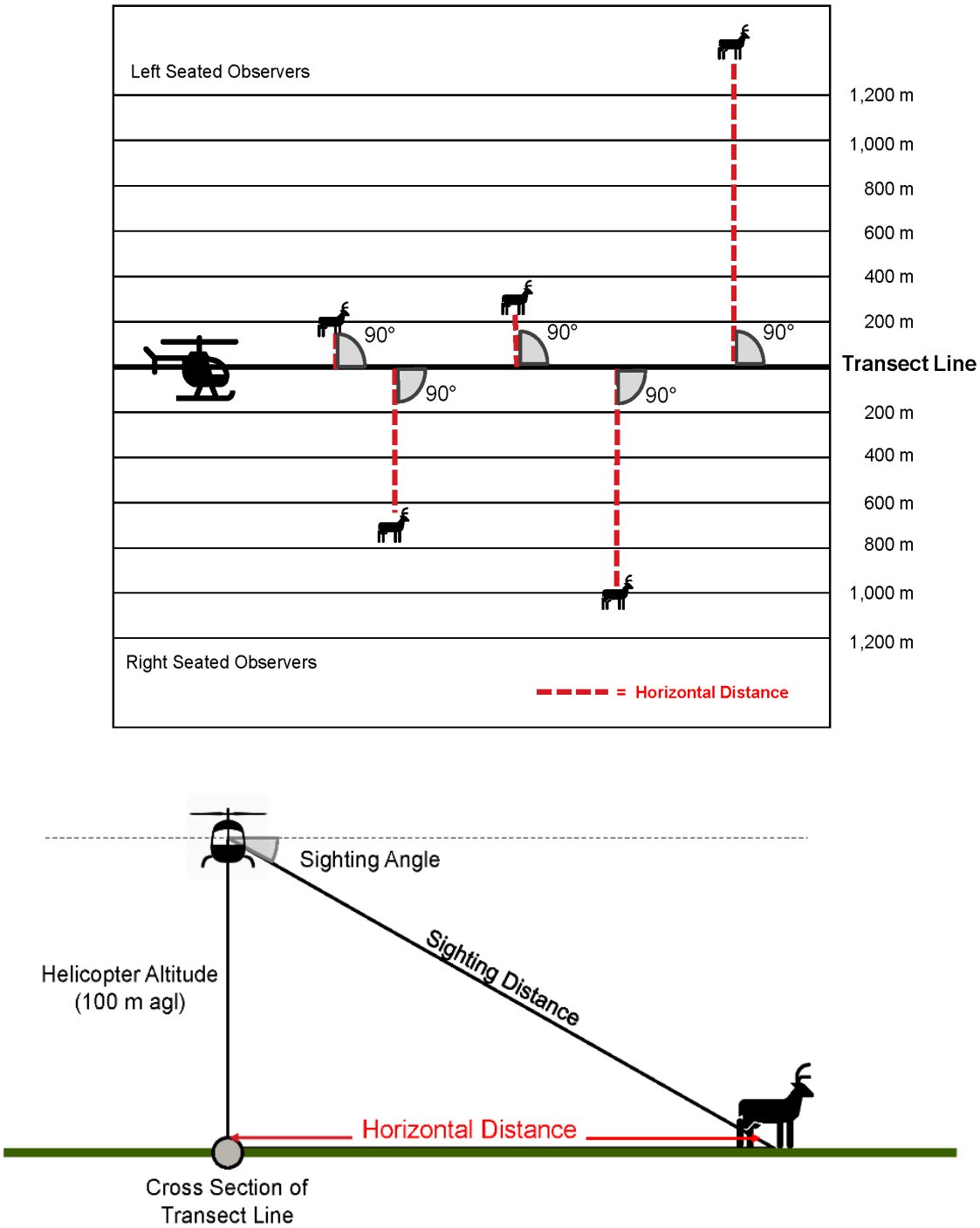

Figure 3-2 Measurement of Perpendicular Horizontal Distance between Caribou and Transect Line

In some instances, the horizontal distance could not be determined with the rangefinder (e.g., rangefinder could not focus on caribou due to movement of helicopter, distortion through helicopter window). In these situations, the horizontal distance from the transect line was determined by making note of a landmark near the detected caribou (e.g., distinctive rock or tree, barren patch). When the helicopter departed the transect line to classify detected caribou, the location of the noted landmark was geo-referenced using the GPS (Figure 3-3). For these detections, the horizontal distance between the location of detected caribou and the transect were later calculated during analysis.

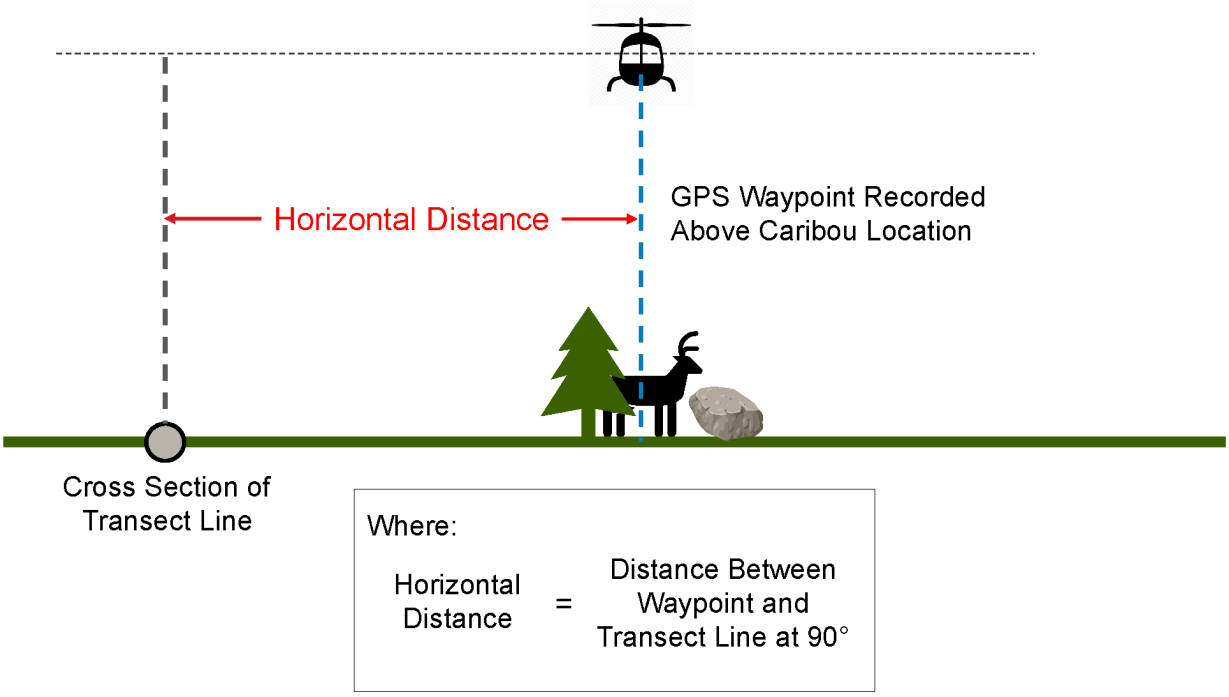

Figure 3-3 Determination of Horizontal Distance between Caribou and Transect Line using Waypoint of Caribou Location

In some instances (e.g., concern regarding obtaining a distance measurement before the caribou moved away from their initial location), the horizontal distance was determined by using the distance bins calibrated on the aircraft windows. However, obtaining distance by this method was considered a last resort and was only used when the distance could not be determined through either the rangefinder, or by use of a geo-referenced landmark.

Once the horizontal distance was determined and the initial number of caribou detected from the transect line were recorded, the helicopter departed the transect line to obtain a precise count of the number of caribou in the group and to classify them by age (i.e., calves = neonates; yearlings = 1 to 2 years; adults > 2 years) and by sex (i.e., based on presence of vulvae or penis, head and body size, and antler characteristics) if possible. Caribou classified as 'Adult Unknown' include adult caribou whose sex could not be determined, and the category of 'Total Caribou' includes adults, yearlings, calves, and unknown

adults. If detected caribou could not be classified from the transect line, the helicopter approached the caribou and classified from a nearer location.

Other information recorded for each detection included observer name and their seat position in the helicopter, terrain (whether habitat was open or closed), and relative slope. Classes for describing relative slope were: 1 = flat; 2 = sloped or rolling; and 3 = steep. In instances where several groups of caribou were detected simultaneously (e.g., on different sides of the helicopter; at different distances from transect line), obtaining accurate distance measurements and counting the number of caribou was prioritized over the collection of supplementary information (e.g., terrain, relative slope, or observer). Therefore, supplementary information was not recorded for some detections. The datasheet used to record survey information is provided in Appendix D.

Incidental sightings of other wildlife (e.g., moose [*Alces alces*], black bear [*Ursus americanus*]) detected while on transects and while ferrying were recorded as incidental observations.

Conditions of the permit from NLDFFA-WD (Appendix B) were followed including: limiting both the positioning of caribou (e.g., maneuvering caribou onto more suitable terrain for classification) and the following of caribou with the helicopter for classification; avoiding hovering and circling around caribou; reducing the amount of time maneuvering over one animal; and recording the number of helicopter passes required to classify caribou.

The aerial survey included the preparation and review of Stantec safety measures, including COVID-19 related protocols, by all members of the survey team prior to the start of the survey.

3.3 ANALYTICAL METHODS

3.3.1 Determination of Herd Affiliation

While the overall 2021 survey area is the same as that used in the 2020 survey, the boundaries of the Buchans herd and resident caribou post-calving survey areas differ (BSA.2, Attachment 2-C). Criteria used to delineate the 2020 Buchans herd post-calving survey area are described in BSA.2, Attachment 2-C. The boundary for the 2020 Buchans herd post-calving survey was based on the calving range (estimated from telemetry data) plus a 5-km buffer, and boundaries as suggested by NLDFFA-WD. This area was considered the 2021 Buchans herd post-calving survey area and caribou detected in this area were considered Buchans caribou. For this survey, the remaining portion of the overall survey area was considered the resident caribou post-calving survey area and caribou detected in this portion were considered resident caribou. While the herd affiliation of caribou in the resident caribou post-calving survey area is uncertain, their distribution does overlap with the calving range of the Grey River herd. It is assumed therefore that most caribou in the post-calving survey area for resident caribou are Grey River caribou.

3.3.2 Classification and Composition

Group composition (i.e., group size, sex ratios and age classes) metrics include the following: male:100 adult ratio, female:100 adult ratio, calf:100 females ratio, percent females (females/total caribou x 100), percent males (males/total caribou x 100), percent yearlings (yearlings/total caribou x 100) and percent calves (calves/total caribou x 100). Calculations only included caribou detected from the transects. These metrics are not intended for population census purposes, though may provide future insight on avoidance behaviours between sexes or age classes if such effects are evident.

3.3.3 Population Estimate

A population estimate was calculated for the Buchans herd post-calving survey area using distance sampling methods and caribou detections only from that area.

There are several key assumptions in distance sampling (Buckland et al. 2001), which were satisfied through survey design and field methods:

1. Transects lines are placed randomly within the survey area with respect to caribou distribution.
    a. The transect lines were delineated using a geographic information system (GIS) such that the transects were 2.5 km apart from each other and the maximum number of transects were fit into the study area. There was no prior knowledge of transect placement other than the survey boundaries within which they were located (Figure 3-1).
2. Caribou on the transect line (i.e., at 0 m) are detected with certainty.
    a. The helicopter was fitted with rear ‘bubble’ windows to increase visibility. There were two observers on each side of the helicopter (i.e., the pilot also observed for wildlife). The helicopter flew at an altitude and speed (i.e., 100 m agl and 100-120 km/hr), selected to increase detection of wildlife along the transect. In addition, the terrain was mostly open in the survey area. As such, caribou on the transect line were detected with a high degree of certainty.
3. Caribou are detected at their initial location and do not move in response to the observers.
    a. The survey team measured the distance between the caribou and the transect quickly after detection, and prior to approaching with the helicopter or classifying the caribou. Caribou generally did not react to the helicopter (e.g., move away, stand up from a laying position) on the first pass, allowing the distance to be measured accurately. Where there was a concern that the caribou may move in response to the helicopter hovering while the distance was measured with the rangefinder, a prominent landmark near the caribou was noted and that location was recorded with the GPS from directly above the landmark, or distance bins were used to obtain a distance class.
4. Measurements are exact.
    a. Rangefinders were used by the observers to measure the distance between caribou and the transect line wherever possible. The professional rangefinders (i.e., TruPulse 200L) that were used have an accuracy rating ± 1 m. Distance bins or landmarks were used to determine the distance when the rangefinder could not be used.

Caribou detections were analyzed using R 3.5.3 (R Core Team 2019) and R Distance package (Miller et al. 2019). Initially, only caribou detections with horizontal distances from the rangefinder or calculated from caribou waypoints was explored (i.e., detections from bins were omitted). This frequency distribution had fewer detections from 0 to 200 m than from 200 to 225 m and lacked a 'shoulder' near the transect line (Buckland et al. 2001), thus causing the shape criterion of the detection function to be violated (Buckland et al. 2001). To further explore fit, detections from the bins were added to the frequency distribution and distances from the rangefinder and waypoint sources were grouped into 100 m distance classes for consistency with the bin classes. The resulting distribution created a suitably shaped detection function that did not violate the shape criterion for the models (Buckland et al. 2001).

Different detection function models with adjustment terms (uniform, hazard rate, and half normal), were explored for the Buchans herd post-calving survey area and were assessed for fit using Chi-square and AIC. It was determined that group size bias was present in the detections (i.e., small groups were not detected at farther distances). Subsequently, group size was included as a covariate; the R Distance package uses a Horvitz-Thomson-like estimator to account for potential effects of group size on detectability (Miller et al. 2019). With the inclusion of group size as a covariate, adjustment terms could no longer be used. The number of caribou observed during the classification (i.e., after helicopter had left transect line to approach caribou) was used as group size when available, as this was assumed to be more accurate as the number of caribou was determined at short range. If not available, the number of caribou observed during initial detection from the transect line was substituted. During the survey, other potential covariate data (e.g., terrain, slope, observer and seat position) were not collected for all sightings (8 of 267[1]); these detections were excluded from the model estimators. The data were right-truncated to 1,100 m (Figure 3-4) to better fit the detection function (Buckland et al. 2001).

[1] Although the total number of groups detected in the Buchans herd post-calving survey area was 282 (Table 4-1 and Table 4-2), a number of detections were omitted from the model as the data was right truncated to 1,100 m, leaving 267 detections.

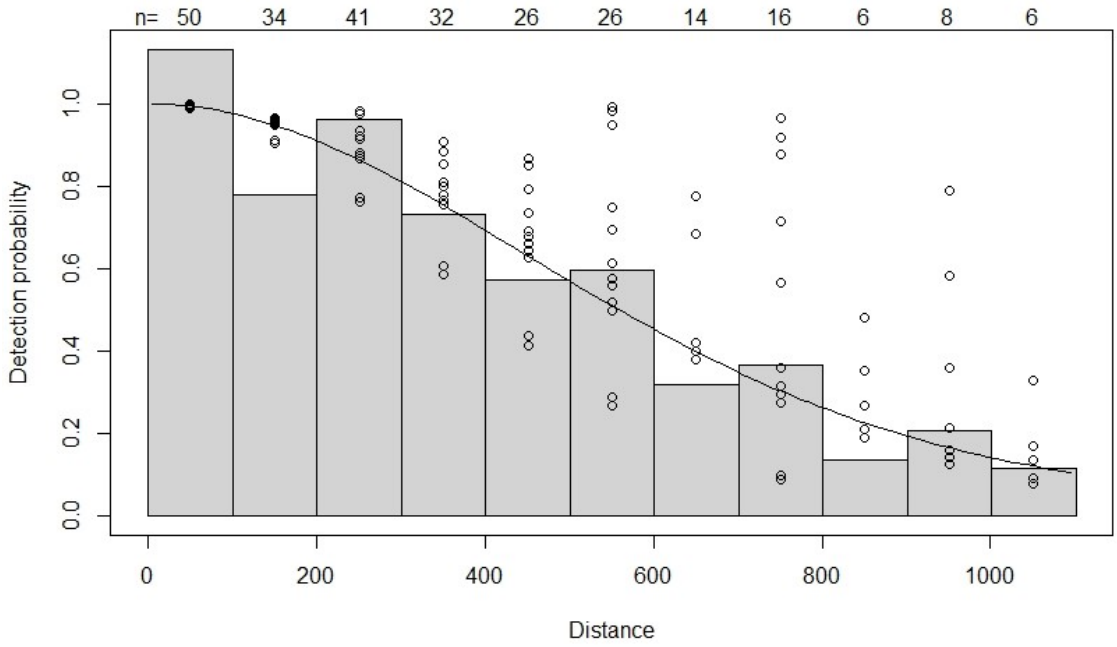

Figure 3-4 Detection Probability Function for Caribou Detections during 2021 Aerial Survey of Buchans Herd Post-calving Survey Area

The best model was selected based on Akaike's Information Criterion (AIC) (Buckland et al. 2001) and goodness of fit (chi-square p-value). The AIC is a method of comparing several models to determine their relative quality based on how well each which model fits the data and on the number of variables in the model. The model with the lowest AIC value is best able to explain the data with the fewest variables. Based on lowest AIC and goodness of fit, the half-normal model with group size and habitat as covariates was selected (Table 3.2).

Table 3.2 Detection Function Model Results for Models Including Group Size, Slope, and Habitat as Covariates

Key Function	Formula	ΔAIC	Chi-square p-value	$\hat{P}_a$[1]	SE ($\hat{P}_a$)[2]
Hazard rate	group size + factor(slope)	0	0.215	0.570	0.036
Half normal	*group size + factor(habitat)*	*1.09*	*0.523*	*0.541*	*0.027*
Half normal	group size + factor(slope)	1.407	0.411	0.570	0.026
Half normal	group size	2.814	0.623	0.538	0.027
Hazard rate	group size + factor(habitat)	3.129	0.296	0.576	0.037
Hazard rate	group size	4.4	0.383	0.575	0.038

Notes:
Selected model is in italics.
[1] $\hat{P}_a$ = probability of detection
[2] SE = standard error

4.0 RESULTS

The aerial survey was flown from June 7-12, 2021. Forty-two transects were flown during which conditions were considered optimal (Appendix E).

4.1 BUCHANS HERD

Within the Buchans herd post-calving survey area, 282 groups of caribou were detected (Table 4.1and Table 4.2). Total number of caribou detected was 1,837 including twenty caribou with collars (Table 4.2). Mean group size was seven (range: 1-259). The greatest concentration of caribou was detected north-west of the Project Area (Figure 4-1). Most of the detected groups in the Buchans herd post-calving survey area consisted of single caribou (38%) and pairs (26%) (Table 4.1, Figure G-1). Single caribou were predominantly male (56%) (Figure G-2). Of the pairs, 49% were calf:female pairs and 36% of pairs had at least one male (Figure G-2).

Table 4.1 Frequency of Caribou Group Sizes from 2020 and 2021 Aerial Surveys of Caribou Calving Grounds: Buchans Herd Post-Calving Survey Area[1]

	Frequency (Percent of Total Groups Detected)[2]	
Group Size	**2020**	**2021**
1	77 (25%)	107 (38%)
2	98 (32%)	73 (26%)
3-4	57 (19%)	36 (13%)
5-10	35 (12%)	28 (10%)
11-20	16 (5%)	19 (7%)
21+	20 (7%)	19 (7%)
Total Number of Groups	303	282
Largest Group	108	259

Notes:
1 Includes all caribou detected in Buchans herd post-calving survey area. Boundary of Buchans herd post-calving survey area differed between 2020 and 2021 survey.
2 Percentages may not add up to 100% due to rounding.

More female than male caribou were detected in the Buchans herd post-calving survey area, with ratios of 30 males:100 adults (15% males) and 68 females:100 adults (33% females) (Table 4.1). The detected caribou included 422 calf:female pairs and a calf:100 female ratio of 49. Calves comprised 23% of caribou detected in the Buchans herd post-calving survey area. The greatest concentration of caribou was detected on the Buchans Plateau between Hinds Lake and Lloyd's Lake (Figure 4-1). There was a smaller cluster at the margin of the Buchans herd post-calving survey area, approximately 2.5 km northwest of the Project Area. The greatest concentration of single females and calf:female pairs was on the Buchans Plateau, however they were also dispersed south-west of the Buchans Plateau. Yearlings were primarily distributed on the Buchans Plateau as well, however with fewer detections in the south-

western portion of the survey area (Figure 4-2). Males were detected throughout much of the survey area (although not detected south of Grand Lake) and were concentrated on the Buchans Plateau.

Most groups of caribou were classified with a single pass of the helicopter; however, five groups needed a second pass, two groups need a third pass, and a single group need a fourth pass. Incidental observations of species other than caribou (e.g., moose and black bear) are included in Figure 4-3.

Table 4.2 Group Demographics from 2020 and 2021 Aerial Surveys of Caribou Calving Grounds: Buchans Herd Post-Calving Survey Area[1]

Classification	2020[2]	2021[2]	Mean (SE)[3]
Total Number of Groups	307	282	295 (12.5)
Mean Group Size (Range in Brackets)	6 (1-108)	7 (1-259)	6 (0.5)
Total Caribou Detected from Classification	1,700	1,837	1,769 (68.5)
Total Adults[4]	1,075	1,268	1,172 (96.5)
Adult Females	798	862	830 (32.0)
Adult Males	171	382	277 (105.5)
Unknown Adults	106	24	65 (41.0)
Yearlings	109	145	127 (18.0)
Calves	516	424	470 (46.0)
Calf:Female Pairs	516	422	469 (47.0)
Female:100 Adults	74	68	71 (3.1)
Male:100 Adults	16	30	23 (7.1)
Calf:100 Females	65	49	57 (7.7)
Percent Females (%)	47	20	33 (13.5)
Percent Males (%)	10	21	15 (5.4)
Percent Calves (%)	30	23	27 (3.6)
Percent Yearlings (%)	6	8	7 (0.7)
Number of Collars Observed	4	20	n/a
Transect Distance (km)	1,765	2,093	n/a
Survey Area (km^2)	4,840	5,230	n/a

Notes:
n/a = not applicable
1 Includes all caribou detected in Buchans herd post-calving survey area. Boundary of Buchans herd post-calving survey area differed between 2020 and 2021 survey.
2 Values rounded to the nearest whole integer
3 Means calculated from raw data and rounded to nearest integer; SE = standard error, rounded to one decimal place[4] Total adults = adult females + adult males + unknown adults

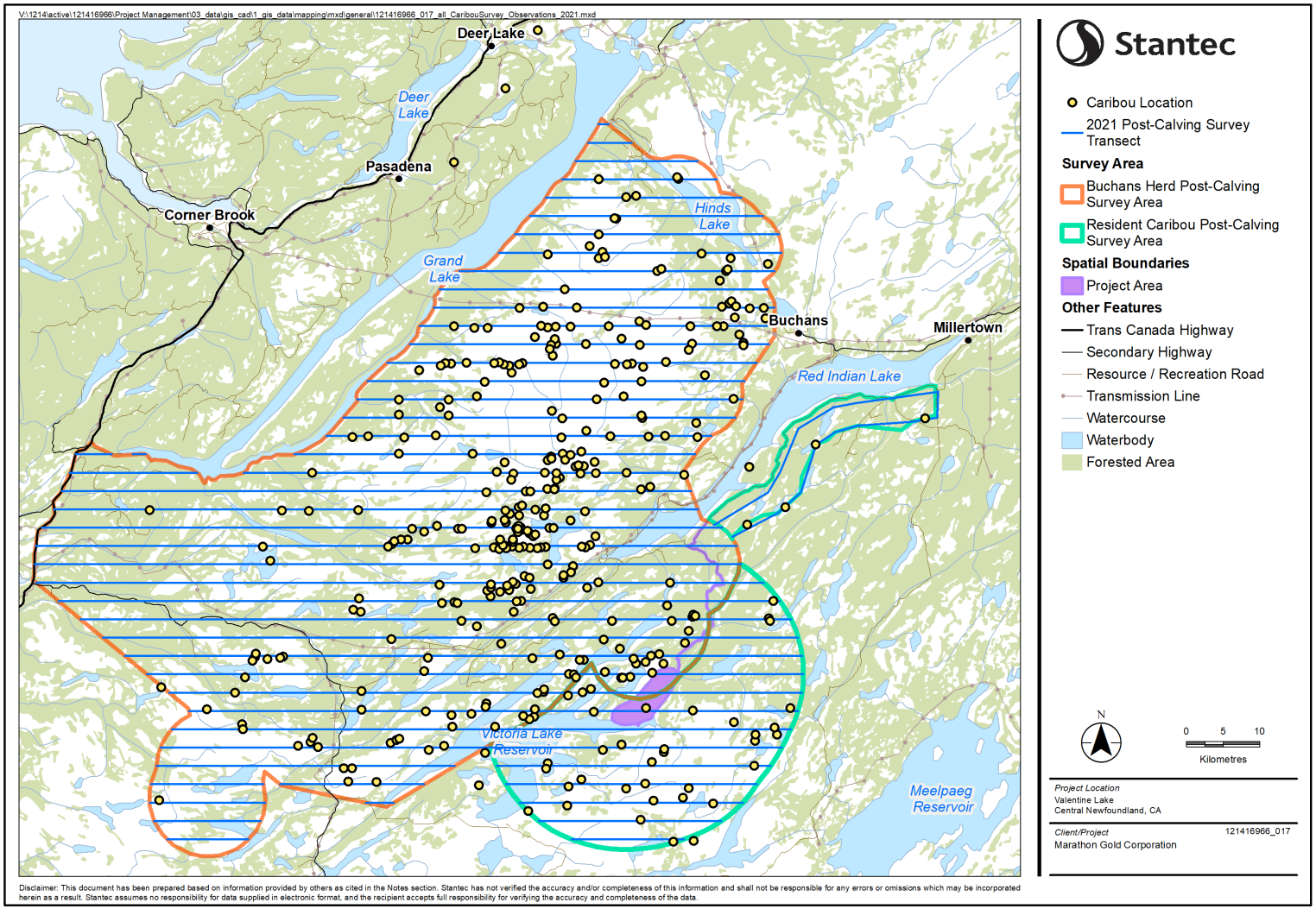

Figure 4-1 Distribution of Detected Caribou from 2021 Aerial Survey of Caribou Calving Grounds

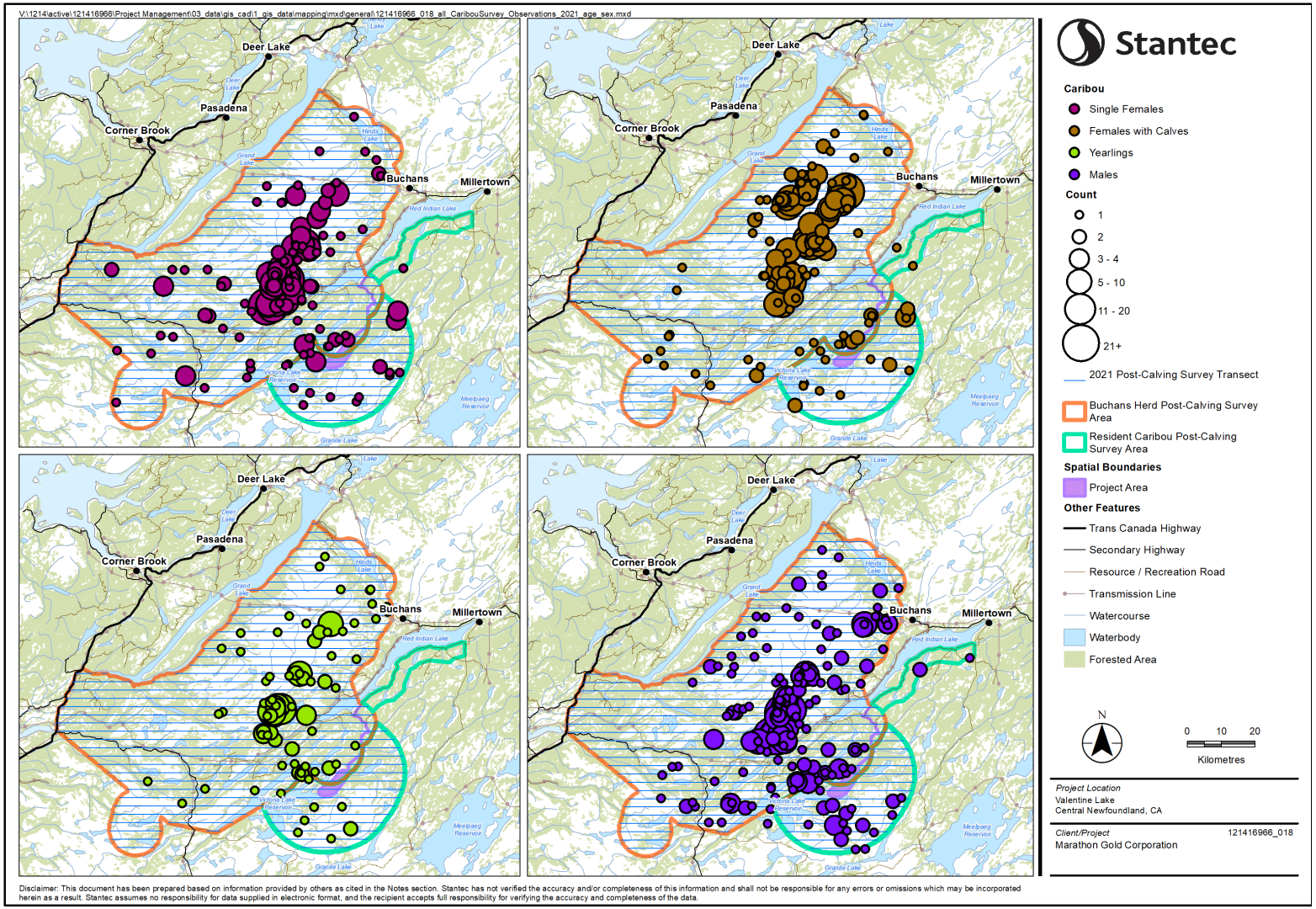

Figure 4-2 Distribution of Caribou Age and Sex Classes from 2021 Aerial Survey of Caribou Calving Grounds

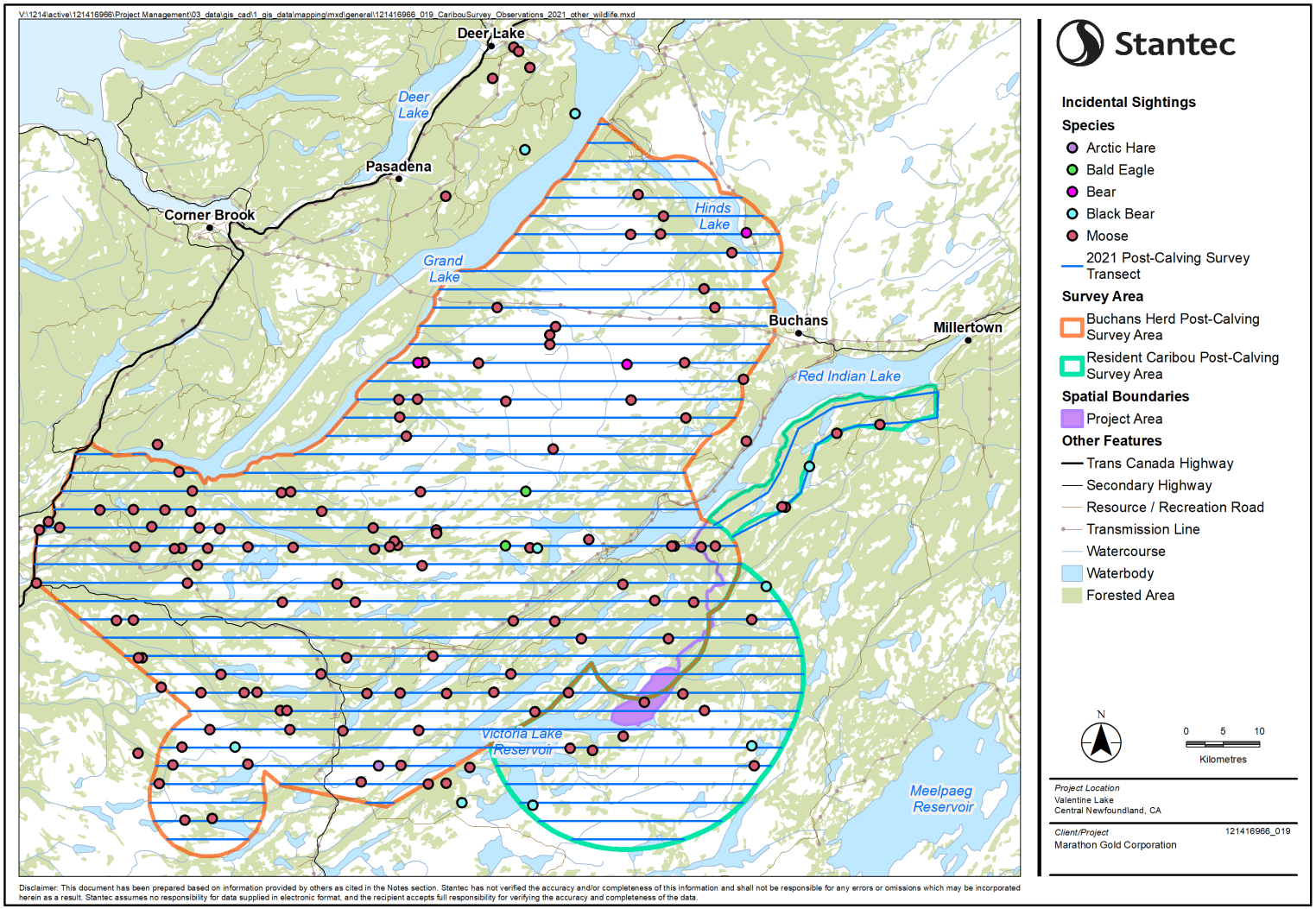

Figure 4-3 Other Wildlife Detections from 2021 Aerial Survey of Caribou Calving Grounds

The 2021 population estimate for the Buchans herd post-calving survey area is 2,459 caribou (1,585-3816 based on 95% confidence interval) (Table 4.3). The model estimated a mean group size of approximately five caribou (Table 4.3). This differs from the mean group size calculated from the classification data as the model only included detections with a distance measurement and habitat information (i.e., the model used a subset of the data that was used for the classification).

Table 4.3 Population Estimate for the 2021 Aerial Survey of the Buchans Herd Post-calving Survey Area

Number of Detections	$\hat{N}$[1]	SE ($\hat{N}$)[2]	CI[3]	Mean Group Size	SE Group Size[2]
259	2,459	542.14	1,585 – 3,816	4.68	0.89

Notes:
Decimal numbers rounded to two decimal places
1 $\hat{N}$ = population estimate
2 SE = standard error, rounded to two decimal places
3 CI = 95% confidence interval

4.2 RESIDENT CARIBOU THAT CALVE WITHIN THE ZONE OF INFLUENCE

In the 2021 survey, 36 groups of caribou, with a mean group size of three (range: 1 to 14), were detected within the resident caribou post-calving survey area (Table 4-4 and Table 4-5). Detections of caribou groups were distributed throughout the survey area, although most detections of yearlings were in the western part of the survey area (Table 4.2). Within the resident caribou post-calving survey area, the most dense distribution of caribou was detected west of the Project Area, near the boundary of the resident caribou post-calving survey area. Several mid-sized groups, single females, and calf:female pairs were also detected northeast of the Project near the boundary of the survey area, and small groups were dispersed within the survey area south of the Project. Yearlings were detected primarily in the western part of the resident caribou post-calving survey area (Table 4.2). Males were detected northwest of the Project with the single females, calf:female pairs, and yearlings. However, males were also detected south of the Project in several groups. A single caribou was detected in the Project area and two groups (n = 5 and n = 7) were detected within the Project's Local Assessment Area. Two single caribou, and a group of two and a group of three, were detected on the southern transect along the access road.

Within the resident caribou post-calving survey area, most of the detected groups consisted of single caribou (31%), pairs (19%), and groups of three (36%) (Table 4.4, Figure G-3). Single caribou were predominantly male (82%) (Figure G-4). Of the pairs, 29% were calf:female pairs and 58% had at least one male (Figure G-4).

Similar proportions of male and female caribou were detected in the resident caribou post-calving survey area. Males constituted 32% of detected caribou with a ratio of 42 males:100 adults, and the percent females was 42% with a ratio of 55 females:100 adults (Table 4.5). The percent of calves was 31% of total caribou detected, and 30 calf:female pairs were detected. Within the resident caribou post-calving survey area, the greatest concentration of caribou was detected west of the Project near Victoria Lake.

In most instances, a single helicopter pass was needed to classify caribou, although two groups required a second pass. Detections of species other than caribou in the resident caribou post-calving survey area (e.g., moose and black bear) are included in Figure 4-3.

Table 4.4 Frequency of Caribou Group Sizes from 2020 and 2021 Aerial Surveys of Caribou Calving Grounds: Resident Caribou Post-Calving Survey Area[1]

	Frequency (Percent of Total Groups Detected)[2]	
Group Size	**2020**	**2021**
1	35 (43%)	11 (31%)
2	19 (23%)	7 (19%)
3-4	16 (20%)	13 (36%)
5-6	8 (10%)	3 (8%)
7-8	1 (1%)	2 (6%)
9-10	1 (1%)	n/a
11-12	1 (1%)	n/a
13-14	n/a	n/a
15	1 (1%)	n/a
Total Number of Groups	82	36
Largest Group	15	7

Notes:
n/a = not applicable
[1] Includes all caribou detected in resident caribou post-calving survey area. Boundary of resident caribou post-calving survey area differed between 2020 and 2021 survey.
[2] Percentages may not add up to 100% due to rounding.

Table 4.5 Group Demographics from 2020 and 2021 Aerial Surveys of Caribou Calving Grounds: Resident Caribou Post-Calving Survey Area[1]

Classification	2020[2]	2021[2]	Mean (SE)[3]
Total Number of Groups	82	36	59 (23)
Mean Group Size (Range in Brackets)	3 (1–15)	3 (1-7)	3 (0.1)
Total Caribou	212	98	155 (5.7)
Total Adults[4]	154	74	114 (40.0)
Adult Females	77	41	59 (18.0)
Adult Males	67	31	49 (18.0)
Unknown Adults	10	2	6 (4.0)
Yearlings	34	8	21 (13.0)
Calves	24	30	27 (3.0)
Calf:Female Pairs	24	30	27 (3.0)
Female:100 Adults	50	55	52 (2.7)
Male:100 Adults	44	42	43 (0.8)

Table 4.5 Group Demographics from 2020 and 2021 Aerial Surveys of Caribou Calving Grounds: Resident Caribou Post-Calving Survey Area[1]

Classification	2020[2]	2021[2]	Mean (SE)[3]
Calf:100 Females	31	73	52 (21)
Percent Females (%)	36	42	39 (2.8)
Percent Males (%)	32	32	32 (0.0)
Percent Calves (%)	11	31	21 (9.6)
Percent Yearlings (%)	16	8	12 (3.9)
Number of Collars Observed	1	0	n/a
Transect Distance (km)	575	423	n/a
Survey Area (km^2)	1,262	871	n/a

Notes:
n/a = not applicable
1 Includes all caribou detected in resident caribou post-calving survey area. Boundary of resident caribou post-calving survey area differed between 2020 and 2021 survey.
2 Values rounded to the nearest whole integer
3 Means calculated from raw data and rounded to nearest integer; SE = standard error, rounded to one decimal place
4 Total adults = adult females + adult males + unknown adults

5.0 DISCUSSION

The overall distribution of caribou within the survey area in 2021 was similar to the 2020 survey. In the Buchan herd post-calving survey area, detected caribou were primarily aggregated on the Buchans plateau in both years (Figure 4-2 and Figure H-1). While the distribution of yearlings was similar in 2020 and 2021, the distribution of single females, calf:female pairs, and males in 2020 was more widespread and detections were more densely clustered than in 2021 (Figure 4-2 and Figure H-1). In the resident caribou post-calving survey area, the greatest concentrations of caribou in 2020 and 2021 were west of the Project near Victoria Lake (Figure 4-2 and Figure H-1). The distribution of single females and calf:female pairs was similar in 2020 and 2021 (Figure 4-2and Figure H-1), although in 2021 the distribution of males and yearlings was more concentrated than in 2020 (Figure 4-2 and Figure H-1). In this survey, one caribou was detected in the Project Area, and two groups were detected in the LAA. In 2020, no caribou were detected in the Project Area and three groups were detected in the LAA (BSA.2 Attachment 2-C). While no caribou were detected along the access road transects in 2020 (BSA.2 Attachment 2-C), four groups were detected in 2021.

In the Buchans herd post-calving survey area, more caribou were detected in the 2021 survey (n = 1,837) than in 2020 (n = 1,700), however in fewer groups (2020: n = 307; 2021: n = 282). Although mean group size in 2021 was seven caribou (based on the classification data), most detections were of single caribou (38%). This differs from the 2020 survey where groups of two were the most frequently detected group size (32%). Mean group size for 2020 and 2021 was six caribou (SE = 0.5). In the resident caribou post-calving survey area, fewer caribou were detected in 2021 (n = 98) than in 2021 (n = 212). Fewer groups were also detected in 2021 (2020: n = 82; 2021: n = 36), although mean group size was the same in both years (three caribou).

Within the Buchans herd post-calving survey area, more females were detected than males. However, within the resident caribou post-calving survey area, the proportion of male and females was similar. The caribou sex ratio on the Island of Newfoundland is generally more females to males, with a decreasing trend in males detected since the 1980s (Weir et al. 2014). The decline in sex ratio since the 1980s may have slowed as a greater percentage of males has been detected since 2006 (Weir et al. 2014). The fall sex ratio had increased to approximately 23 males:100 adult caribou between 2000 and 2012 (Weir et al. 2014). This survey detected 30 males:100 females and 21% males in the Buchans herd post-calving survey area, considerably more than the previous 2020 survey, which had 10% males (BSA.2 Appendix 2-C). The percent males detected in 2021 is more similar to that detected during winter surveys in 2016, 2018 and 2019 (ranged from approximately 22-28% males) (Government of NL 2020b,c). Caribou distribution can be segregated by sex at certain times of year (Jakimchuk et al. 1987) including calving (Lent 1966; Cameron and Whitten 1979), which could explain the low proportion of males detected in 2020. Within the resident caribou post-calving survey area, the proportion of males in 2021 was 42 males:100 adults, which is comparable to that detected in 2020 (44 males:100 adults). Additionally, the percent males detected for the resident caribou post-calving survey area (32%) was the same as that detected in 2021 (32%) and to the proportion detected in previous fall and winter surveys of the Grey River herd (approximately 37% in 2019) (Government of NL 2019).

On the Island of Newfoundland, caribou populations are limited by poor calf survival (Government of NL 2015). Calf survival has decreased since the mid-1990s due to an increase in predation rate (Government of NL 2015), which has led to poor recruitment rates. Black bear and coyote are the primary predators of caribou calves on the Island of Newfoundland (Mumma et al. 2016, 2019; Bastille-Rousseau et al. 2016). However, calves are also preyed upon by other predators such as bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*) and Canada lynx (*Lynx canadensis)* (Lewis et al. 2017). In this study, a bald eagle was observed feeding on a calf carcass, although it may not have killed it. During the Island-wide population increase between 1979 and 1997, the predation rate on calves was approximately 60%, which increased to 83% between 2003 and 2007 (Mahoney and Weir 2009). Between 2003 and 2012, approximately 90% of collared calf deaths were attributed to predation (Lewis and Mahoney 2014).

The proportion of calves detected in this survey in the Buchans herd post-calving survey area was 23%, which is similar to that detected in 2020 (30%). Within the resident caribou post-calving survey area, 31% calves were detected, which is considerably higher than the percentage observed in 2020 (11%). On the Island of Newfoundland, the calf survival rate (i.e., proportion of calves surviving to six months) was approximately 66% between 1979 and 1997 (during period of population increase to peak population size), however this decreased to less than 8% in 2003 (during period of population decline) (Mahoney et al. 2015). The calf survival rate may be increasing (Government of NL 2015) to more sustainable levels, having reached nearly 50% in 2012 (Mahoney et al. 2015). Fall and winter surveys completed in 2007, 2011, 2016, and 2019 found between 8-16% calves in the Buchans herd, and 6-15% calves in the Grey River herd (Government of NL 2020b). The 2020 and 2021 surveys of the calving grounds detected a higher proportion of calves for the Buchans herd post-calving survey area than the earlier fall and winter surveys, which is expected from a survey immediately following calving. However, a similar proportion of calves was detected for resident caribou post-calving survey area in the 2020 and 2021 surveys as in the earlier fall and winter surveys, even though the survey occurred shortly after calving. The resident caribou post-calving survey area had a higher mean proportion of males (mean: 32%) than the Buchans herd

post-calving survey area (mean: 15% males), whereas the proportion of females was similar (mean: resident – 39%; Buchans – 33%). The mean proportion of calves was similar between the Buchans herd post-calving survey area (mean: 27%) and the resident caribou post-calving survey area (mean: 21%).

The 2021 population estimate for the Buchans herd post-calving survey area is 2,459 caribou (95% CI: 1,585–3,816). The Buchans herd was previously estimated at 4,112 caribou in 2019 based on a winter mark-resight survey (Government of NL 2019, 2020b). Differences in seasonal distribution and group size composition may have contributed to the population difference between the post-calving and winter estimates. A lower proportion of male caribou was detected in the post-calving surveys (2020 and 2021) compared to the earlier fall and winter surveys, suggesting a portion of the males was not within the survey area at the time of the survey. In Alaska, male and calving females occupy distinct areas during post-calving (Jakimchuk et al. 1987), and caribou in British Columbia show segregation following calving, with females selecting habitats with lower predation risk, possibly at the expense of forage availability (Bergerud et al. 1984). Sexual segregation on the calving grounds has also been observed in the George River herd in Labrador (Couturier et al. 1996) and in the Bluenose-East Herd in the Northwest Territories (Adamczewski et al. 2010). The 2020 and 2021 post-calving surveys indicate that while females with calves were primarily aggregated in one portion of the Buchans herd post-calving survey area, males were more widely dispersed. The difference between this estimate from the Buchans herd post-calving survey area (2021: 2,459 caribou) and the winter estimate (2019: 4,112 caribou) is similar to reported estimates from the Middle Ridge, where the estimate from a survey in early June 2012 (2,905 caribou; 95% CI 1,893–4,459) (Fifield et al. 2012) was markedly lower than two winter surveys in 2006 and 2010 when more than 8,800 caribou were estimated (Dyke 2010 in Fifield et al. 2012).

Another factor that could have contributed to the difference between the post-calving and winter estimates is that South Coast herds share winter range (Weir et al. 2014). The previous winter survey may have included caribou from other herds, as the Buchans herd intermixes with others on the winter range.

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APPENDIX A

Scientific Research Permit Application

APPLICATION TO CONDUCT WILDLIFE RESEARCH IN NEWFOUNDLAND AND LABRADOR

April 29, 2021

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TITLE OF INVESTIGATION: *Aerial Survey of Caribou Calving Grounds for the Valentine Gold Project 2021*

Stantec Consulting Ltd. (Stantec) is undertaking an aerial survey as part of monitoring activities associated with the Valentine Gold Project (the Project) on behalf of Marathon Gold Corporation (Marathon). Marathon is seeking a permit for the aerial survey as this activity has the potential to disturb wildlife. As there were errors in the survey design for the population estimate for the calving grounds of the Buchans herd, a reliable population estimate is not available. This survey will use the 2020 survey area, however, the transect lines in the Buchans herd survey area will be modified to improve the distance sampling survey design.

The objectives of the 2021 aerial survey are:

- Complete a population estimate of the entire calving grounds for the Buchans herd
- Determine caribou group size and composition including the number of cow-calf pairs (i.e., classification) on:
  - the Buchans herd calving grounds; and
  - the calving grounds within the zone of influence

SURVEY AREA

The 2021 survey will use the boundaries of the 2020 survey area (Figure 1). There are 42 transects in the overall survey area, with a total distance of 2,518 km.

Buchans Herd

The Buchans herd survey area was delineated based on telemetry data transferred from the Wildlife Division (Argos and GPS collar data from 2007-2012 and 2016-2017) as well as discussion with the Wildlife Division. Kernels were developed (95% kernels) for the calving season (May 20 – June 10). Individuals with fewer than 50 locations in the season of interest were not included in the calculation of calving range because of their potential to bias home population-level range

estimates. Seaman et al. (1999) found that the bias and variance of kernel home range estimates approached an asymptote at about 50 locations per home range. The threshold of at least 50 locations per individual is a commonly used parameter for kernel estimation for caribou (e.g., caribou: Donovan et al. 2017) and other ungulates (e.g., Rosatte 2016; Vander Wal and Rodgers 2012; Schrautemeier 2017), as well as other wildlife species (e.g., Nicholson et al. 2014; Barg et al. 2005; Tri et al. 2014). A kernel was generated for each collared caribou and included all years for which there was sufficient data. Individual kernels were then pooled to create the range estimate for the herd. The calving range estimate included collared caribou with 50 or more locations in the calving season. A 5-km buffer was added to the calving range kernel. This was overlaid with information from the Wildlife Division that suggested survey boundaries. The final survey area was determined by merging the entirety of the area suggested by the Wildlife Division with the area of the 95% kernel with 5-km buffer (Figure 1).

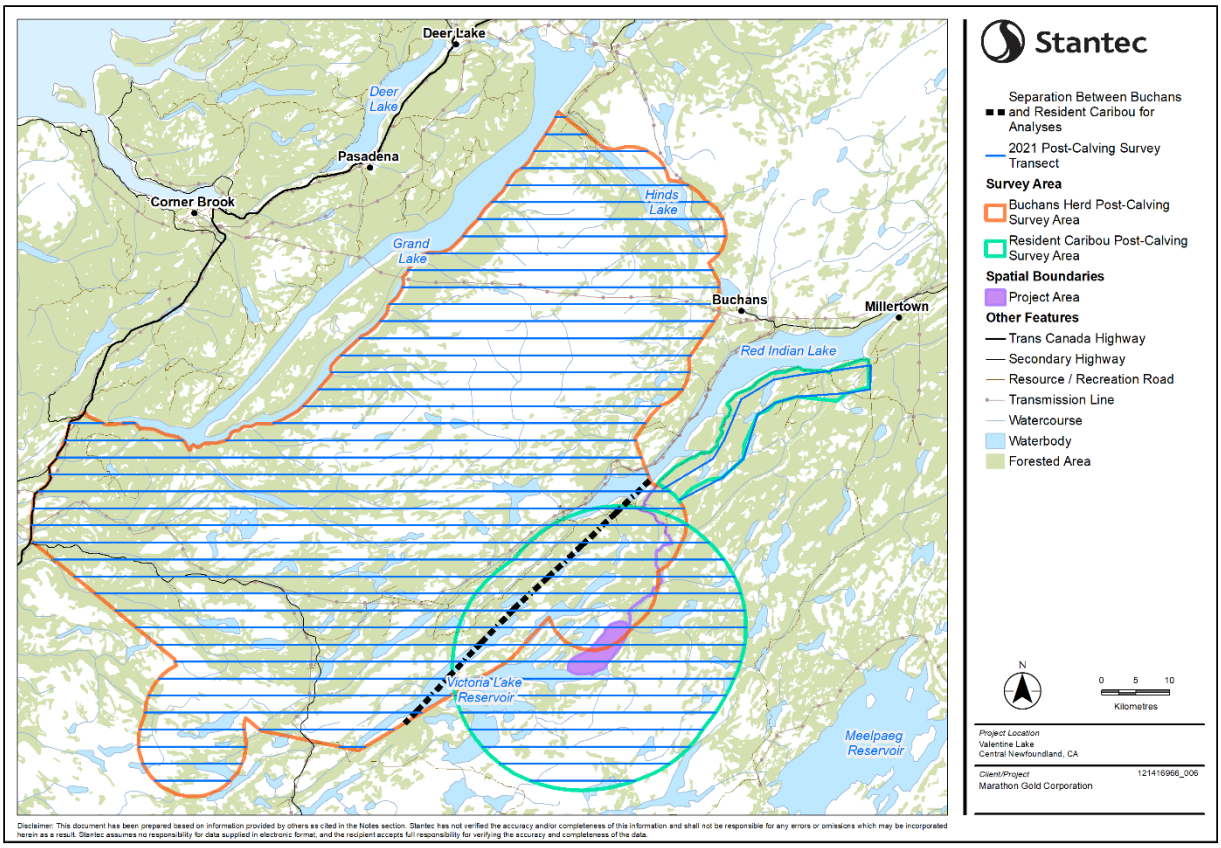

Figure 1 Survey Area and Transects for the 2021 Aerial Survey of Caribou Calving Grounds

Buckland et al. (2001) suggest that to adequately estimate sampling variances the target sample size should be 60-80 detections. Fifield et al. (2012) suggest a target sample size of 70-100 detections with 30-40 transects. However, it has also been suggested that a sample size of 60-80 is insufficient to precisely estimate abundance (Glass et al. 2015). In the 2020 survey, approximately 2,400 km of transects were overflown and 389 groups of caribou were detected. Given the importance of obtaining a reliable population estimate for the entire calving grounds of the Buchans herd to establish baseline conditions prior to construction, the transect lines in the Buchans herd survey area will be spaced at 2.5-km intervals for the 2021 survey. Given the number of detections obtained in the 2020 survey, the transect length proposed for the 2021 survey is expected to yield sufficient detections to adequately estimate sampling variance. Increasing the total transect length compared to the 2020 survey will increase the detection rate, which is expected to increase the reliability of the population estimate.

Resident Caribou who Calve within the Zone of Influence

The survey area for resident caribou includes a 17-km buffer around the mine site in addition to a 4-km buffer along the south side of the access road (Figure 1). The 17-km buffer was selected based on results from noise modelling conducted for the Project, which predicted a return to baseline sound pressure levels 5 km from the mine site; and ZOIs presented in the literature that show caribou avoidance of mines between 2 and 11 km (Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012; LeBlond et al. 2014; Johnson et al. 2015; Pigeon et al. 2016; Eftestøl et al. 2019). Transects were established within the survey area at 2.5-km intervals. Additionally, a 4-km survey area was added around the access road. Caribou exhibit avoidance of roads up to 4 km (Dyer et al. 2001; Vistnes and Nellemann 2001; Nellemann et al. 2003; Polfus et al. 2011). Within the survey area of the access road, the transects from the 2020 survey will be reused. The two transects will be at a 3-km interval (i.e., transects will be positioned 1 and 4 km from the road) (Figure 1).

Note: the area of overlap between the Buchans Herd and resident caribou survey areas (Figure 1) will only be surveyed once.

2021 AERIAL SURVEY OF CARIBOU CALVING GROUNDS

The aerial survey is scheduled to occur in early June and will involve the following:

- Preparation and review of safety and survey protocols with all members of the Survey Team prior to the start of the field program, including COVID-19 protocols
- Close collaboration with the NLDFFA-Wildlife Division in survey design and completion.

Methods

A Bell 206L Long Ranger helicopter (with 'bubble' rear windows to enhance observer visibility) will fly along the transect lines at approximately 100-120 km/hr and an altitude of approximately 100 m above ground level. The Survey Team will include a navigator (positioned in the left front seat of the helicopter), and an observer (seated in the right rear seat) (Table 1).

Table 1 Aerial Survey Team

Team Member	Role	Position in Helicopter
Pilot	Pilot	Right Front
Tony Parr, Stantec	Navigator/Recorder	Left Front
Field Technician*, Stantec	Observer	Right Rear
NOTE: * Field Technician will be either Karen Rashleigh, Doug Rimmer or Catie Young depending on availability		

Distance sampling will be used to estimate the population of the caribou on the Buchans herd calving ground. The population of resident caribou that calve within the zone of influence will not be estimated. At the start of each transect, the Survey Team will record temperature, wind direction and speed, cloud cover and precipitation, and estimate visibility and percent snow cover on field data sheets. Caribou will not be handled during the survey. Observations of caribou individuals and tracks will be recorded as geo-referenced waypoints using a handheld GPS unit.

Distance sampling methods require that the perpendicular distance between detected animals and the transect line is determined. When a group of caribou is observed, the Survey Team will record the location of the helicopter on the GPS unit (which will also record altitude). A laser rangefinder will be used to measure the distance to the detected caribou. Should the rangefinder not be able to adequately 'target' the detected caribou such that a distance can be measured, the sighting angle between the helicopter and the caribou will be measured. During analysis, this information will be used to calculate the perpendicular distance between the caribou and the transect line. In addition to measuring the distance to the caribou (or sighting angle), the Survey Team will estimate the perpendicular distance of the caribou from the transect line using calibrations on the helicopter windows. Prior to the survey, the Survey Team will calibrate the windows at 100 m above ground level by marking horizontal lines on the helicopter window that correspond to distance classes (e.g., 1 = 0-200 m; 2 = 200-400 m; 3 = 400-600m; 4 = 600-800 m; 5 = 800-1,000 m; 6 = 1,000-1,200m; and 7 > 1,200 m). The 2020 survey only estimated perpendicular distance (using calibrations on helicopter window) up to 500 m from the transect line. In 2020, caribou detected at distances greater than 500 m were recorded, but the perpendicular distance was not estimated, and hence those detections could not be included in the detection function. For this survey, the perpendicular distance will be calculated during analysis for all detected caribou using trigonometry. Other information related to the detection (e.g., whether the habitat is open or closed, visibility) will also be recorded on field data sheets.

The number of observed caribou and group composition (e.g., numbers of males, females, calves, yearlings) will be recorded on field data sheets. Locations of other wildlife species or tracks observed on transects will be recorded on the GPS unit and on the data sheets as incidental. Wildlife that are observed while ferrying between transects (e.g., tracks or sightings of caribou or other wildlife species) will be recorded on the GPS unit. Professional judgment/discretion of experience field staff will be applied in the field to determine if transects need to be modified to accommodate presence/absence of caribou observed in the field.

Perpendicular distance will be calculated for detected caribou in both the Buchans and resident caribou survey areas. The distance between the helicopter and the detected caribou (or the sighting angle) will be measured in the field with a rangefinder, and the altitude above ground will be calculated (altitude above ground = helicopter altitude − land elevation). Using this information, the perpendicular distance between the detected caribou and the transect line will be calculated using trigonometry. The data set will be explored prior to analysis. If required, the detection distances may be right-truncated (e.g., exclude the furthest 5% of detections; truncate detections at the distance where detection probability is < 0.15) to reduce the effect of outliers on the population estimate (Buckland et al. 2001: 103-104). While caribou detections in both portions of the survey area will be used to model detection function (i.e., Buchans herd and resident caribou survey areas), the population will only be estimated for the Buchans herd survey area.

The survey is scheduled to occur in early June and is anticipated to take approximately six days.

MITIGATION

The Study Team will implement measures to avoid or reduce disturbance associated with helicopter use. These include:

- Maintaining a minimum flight altitude of 100 m above ground along transects.
- Increasing altitude and distance if animals show signs of stress from the helicopter
- Avoiding hovering and circling where possible
- Maintaining a minimum flight altitude of 200 m above ground outside of transects
- Limiting helicopter activity to that necessary to locate, count, and classify caribou
- Limiting herding caribou for the purpose of repositioning to facilitate classification to five minutes

REPORTING

Stantec will prepare a report to summarize the findings of the 2021 survey, and will submit the report to Marathon for approval and further release to the Wildlife Division.

SUBMISSION

Blair Adams
Director – Fisheries, Forestry and Agriculture
Email: BlairAdams@gov.nl.ca
Phone: (709) 256-1450

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APPENDIX B

Scientific Research Permit

Government of Newfoundland and Labrador
Department of Fisheries, Forestry & Agriculture
Forestry and Wildlife Branch

Scientific Research Permit

(as under section 86 of the Wildlife Regulations, Consolidated Newfoundland and Labrador Regulation 1156/96)

Permit request #: WLR2021-26

Issued to: James Powell, Vice-President Regulatory and Government Affairs
Marathon Gold Corporation
P.O. Box 4006, Pearlgate PO
Mt. Pearl, NL A1N 0A1

Tel: (709) 730-5046
jpowell@marathon-gold.com

Study Title: Aerial Survey of Caribou Calving Grounds for the Valentine Gold Project 2021

Purpose: Conduct an aerial survey (using distance sampling) of caribou calving grounds of the Buchans herd and the caribou present within the zone of influence of the proposed mine, to determine caribou group size and composition (i.e. classification of animals present) and to complete a population estimate of the entire calving grounds for the Buchans herd.

This work is being completed in relation to the Valentine Gold Project in west-central Newfoundland, as per requirements of the Environmental Impact Statement (EIS) Guidelines.

Location: The aerial survey of the calving grounds will occur in the area between Grand Lake and Victoria Lake as shown in Figure 1 (See schedule 1).

Conditions:

1) This permit authorizes Stantec Consulting to conduct activities on behalf of Marathon Gold Corporation. The permit holder is responsible for ensuring all conditions of the permit are met.

2) Stantec Consulting nominees under this permit include: Tony Parr, Karen Rashleigh , Doug Rimmer, and Catie Young.

3) Any herding of caribou at higher flying elevation for the purpose of positioning animals onto more optimal terrain prior to low-level approach for conducting classifications shall not exceed five minutes.

4) The methods described in the attached permit application shall be followed as closely as possible. Any changes to the survey design, methodology or crew outlined in the permit application will require prior approval.

5) Further to the methods described in the attached permit application, the Wildlife Division requires the following additional protocols to be followed during surveys:

   i) there must be two (2) (rear seat) observers in addition to the navigator/recorder;

   ii) observers must switch viewing positions halfway through each survey day;

   iii) each recorded observation must include the observer who made it, distance/angle, and group size and as well as other information the detection function;

   iv) air craft heading should be recorded for each transect.

6) The permit holder shall advise all nominees that their information will be provided to the Forestry and Wildlife Branch. Names and contact information for any additional individuals/nominees participating in the survey shall be provided to the following Forestry and Wildlife Branch staff prior to commencement of field activities:

   Shelley Moores, Senior Manager of Wildlife Research (shelleymoores@gov.nl.ca);
   Jessica Humber, Ecosystem Management Ecologist (jessicahumber@gov.nl.ca).

7) All raw data collected under the authority of this permit (NL provincial lands) shall be provided in digital format to the Forestry and Wildlife Branch (Shelley Moores, Jessica Humber, and Blair Adams) by **August 1, 2021**. Data shall include, but not be limited to flight tracts, number of caribou observed per transect, number of low-level passes per group of classified caribou, georeferenced caribou locations and an accompanying map, raw caribou classification results (percent calves, percent cows, percent males, calves/100F), and caribou group size data as well as the total caribou observed on transect and in total. Ancillary observations of Black bears and coyotes should also be reported.

8) A final report including a detection function and population estimate and summaries of classification data should be provided within 3 months (September 1 2021)

9) Should any wildlife be injured, harmed or display any signs of adverse reactions to the project activities, these observations must be immediately reported to the Wildlife Division (Shelley Moores).

10) A copy of this permit shall be retained in the field at all times by at least one person on

the permit personnel list and is to be provided to a Newfoundland and Labrador Resource Enforcement Officer or other person of delegated authority upon request.

11) This permit does not absolve or relieve the permit holder from any other laws, permits, regulations or orders, not otherwise specified herein.

12) This permit does not relieve the permit holder from the requirement to acquire permission to access private property.

13) Future requests for scientific research permits will be re-assessed based on the outcome of the current undertaking and the submission of findings and data to the Wildlife Division.

14) The Senior Manager of Wildlife Research reserves the right to revise or revoke this permit at any time.

Date of Commencement: May 18, 2021 **Date of Expiration: June 15, 2021**

<original signed by>

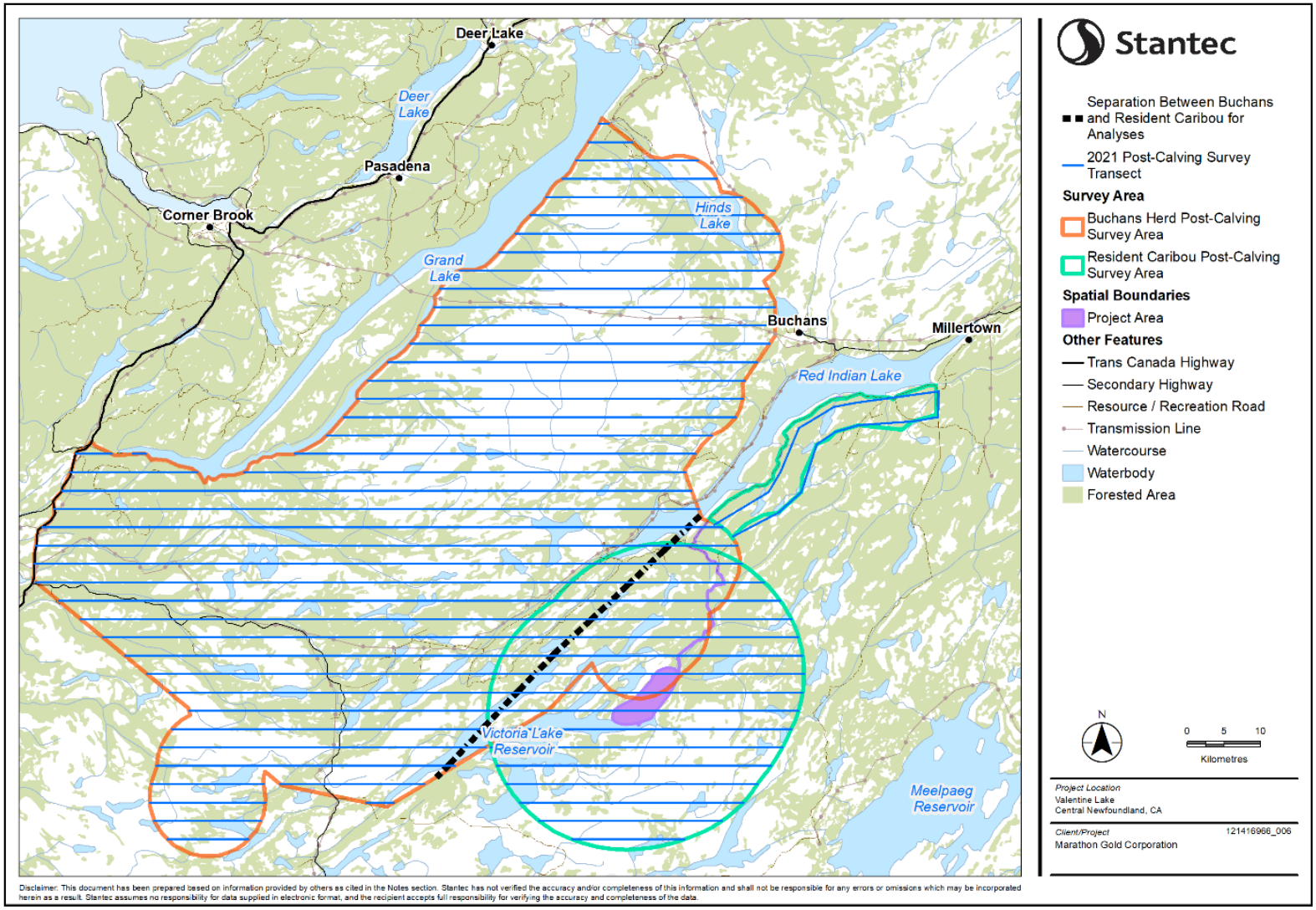
May 19, 2021

Date **Director of Wildlife**

Attachment: Schedule 1 – Survey Area and transects for the 2021 Aerial Survey of Caribou Calving Grounds for the Buchans Herd

cc:
Shelley Moores, Senior Manager of Wildlife Research
Wildlife Division
shelleymoores@gov.nl.ca

Schedule 1



Survey Area and transects for the 2021 Aerial Survey of Caribou Calving Grounds for the Buchans Herd

APPENDIX C

Transect Lengths

Table C.1 Transect Lengths in the Survey Area

Transect Number	Transect Length in Buchans Herd Post-Calving Survey Area (km)[A]	Transect Length in Resident Caribou Post-Calving Survey Area (km)[A]	Total Length (km)[A]
1	1.4		1.4
2	5.9		5.9
3	16.7		16.7
4	21.0		21.0
5	26.7		26.7
6	31.7		31.7
7	36.0		36.0
8	38.6		38.6
9	43.0		43.0
10	44.8		44.8
11	46.5		46.5
12	48.4		48.4
13	49.0		49.0
14	50.4		50.4
15	51.4		51.4
16	52.6		52.6
17	53.5		53.5
18	52.5		52.5
19	61.3		61.3
20	77.6		77.6
21	85.9		85.9
22	87.9		87.9
23-B and 23-R	92.8		92.8
24-B and 24-R	95.7		95.7
25-B and 25-R	96.5		96.5
26-B and 26-R	95.1	4.2	99.3
27-B and 27-R	90.8	7.7	98.5
28-B and 28-R	85.8	11.2	97.0
29-B and 29-R	82.5	12.5	94.9
30-B and 30-R	78.5	14	92.5
31-B and 31-R	70.7	18.9	89.6
32-B and 32-R	60.2	26.1	86.4
33-B and 33-R	49	34.1	83.1
34-B and 34-R	46.8	37.7	84.5

Table C.1 Transect Lengths in the Survey Area

Transect Number	Transect Length in Buchans Herd Post-Calving Survey Area (km)[A]	Transect Length in Resident Caribou Post-Calving Survey Area (km)[A]	Total Length (km)[A]
35-B and 35-R	44.8	39.9	84.8
36-B and 36-R	40.7	37.4	78.1
37-B and 37-R	35.0	34.3	69.3
38-B and 38-R	19.6	30.5	50.0
39-B and 39-R	14.5	25.0	39.5
40-B and 40-R	11.1	15.3	26.4
Access Road-N		38.3	38.3
Access Road-S		35.4	35.4
Total Transect Length (km)[A]	2,092.3	422.5	2,515.4
Total Survey Area (km^2)[A]	5,229.6	871.4	6,101.0

Notes:
B = Buchans herd post-calving survey area; R = resident caribou post-calving survey area
[A] Numbers are rounded to one decimal place. Transects may not add up to total amounts due to rounding.

APPENDIX D

Data Sheet for Aerial Survey

121416966 – Marathon Caribou Post-Calving Aerial Survey Data

Page ____ of _____ for transect_____ Data Recorder/Navigator (Front Left): _____

Date:_____ Pilot (Company): _____ Helicopter:_____ Rear Left:_____

Rear Right: _____

Habitat, Effort, and Survey Conditions

Habitat Description (% open/% closed on transect)	Time		Helicopter Heading	Temperature	Wind Speed/ Direction	Cloud Cover	Visibility	Precipitation	Snow Cover	Date of Last Snow Fall
	Start	End								

Observations

Waypoint	Species		Observer (Initials)	RANGE FINDER S (Sighting Dist) or H (Horiz. Dist) or I (Inclination)	Bin (Perp. Distance)	Open (O) / Closed (C) Habitat	Slope (1 = flat, 2 = sloped or rolling, 3 = steep)	NO CALF		Cow:Calf Pairs	Calf - Single	Male (Bald)	Male (Antlered)	Adult – Unknown Sex	Yearling	Collars Observed	Number of Passes	Comments / Photos
	Caribou	Other						Female (Bald)	Female (Antlered)									

APPENDIX E

Aerial Survey Effort and Weather Conditions

Table E.1 Aerial Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time / End Time	Helicopter Heading	Habitat Description (% open / % closed)	Temperature (°C)	Wind Speed (Direction / km/hr)	% Cloud Cover	Visibility (km)	Precipitation
		Right Front Seat	Left Front Seat	Right Rear Seat	Left Rear Seat								
1	June 12, 2021	DB	TP	CY	AC	15:15 / 15:15	110	0 / 100	13	WSW 10 km/hr	90	Unlimited	0
2	June 12, 2021	DB	TP	CY	AC	15:11 / 15:14	290	20 / 80	13	WSW 10 km/hr	95	Unlimited	0
3	June 12, 2021	DB	TP	CY	AC	15:10 / 15:07	110	40 / 60	13	WSW 10 km/hr	90	Unlimited	Scattered Shower
4	June 12, 2021	DB	TP	CY	AC	14:48 / 14:59	290	40 / 60	12	WSW 10 km/hr	95	Unlimited	0
5	June 12, 2021	DB	TP	CY	AC	14:32 / 14:45	110	60 / 40	12	WSW 10 km/hr	95	Unlimited	0
6	June 12, 2021	DB	TP	CY	AC	14:16 / 14:31	290	70 / 30	10	WSW 10 km/hr	95	Unlimited	0
7	June 12, 2021	DB	TP	CY	AC	13:59 / 14:14	110	70 / 30	12	WSW 5-10 km/hr	95	Unlimited	0
8	June 12, 2021	DB	TP	CY	AC	12:28 / 12:40	290	80 / 20	11	W 10 km/hr	90-95	Unlimited	0
				AC	CY	13:43 / 13:59				WSW 5-10 km/hr			
9	June 12, 2021	DB	TP	AC	CY	12:07 / 12:27	110	70 / 30	11	WSW 10 km/hr	80	Unlimited	0
10	June 12, 2021	DB	TP	AC	CY	11:45 / 12:05	290	80 / 20	10	SW 10 km/hr	70	Unlimited	0
11	June 12, 2021	DB	TP	AC	CY	11:15 / 11:44	110	80 / 20	12	W 10 km/hr	40	Unlimited	0
12	June 12, 2021	DB	TP	AC	CY	10:16 / 11:13	290	95 / 5	10	W 5-10 km/hr	5	Unlimited	0

Table E.1 Aerial Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time / End Time	Helicopter Heading	Habitat Description (% open / % closed)	Temperature (°C)	Wind Speed (Direction / km/hr)	% Cloud Cover	Visibility (km)	Precipitation
		Right Front Seat	Left Front Seat	Right Rear Seat	Left Rear Seat								
13	June 12, 2021	DB	TP	AC	CY	9:36 / 10:15	110	95 / 5	9	W 5 km/hr	5	Unlimited	0
14	June 11, 2021	DB	TP	AC	CY	16:18 / 17:03	295	90 / 10	7	NW 15 km/hr	100	Unlimited	0
15	June 11, 2021	DB	TP	AC	CY	15:32 / 16:17	110	90 / 10	5	WNW 5 km/hr	100	Unlimited	0
16	June 11, 2021	DB	TP	AC	CY	14:54 / 15:30	290	90 / 10	7	W 15 km/hr	100	Unlimited	0
17	June 11, 2021	DB	TP	AC	CY	14:23 / 14:53	110	80 / 20	5	NW 15 km/hr	100	Unlimited	0
18	June 11, 2021	DB	TP	CY	AC	12:21 / 12:34	290	85 / 15	6	NW 10 km/hr	100	Unlimited	0
				AC	CY	14:01 / 14:22							
19	June 11, 2021	DB	TP	CY	AC	11:02 / 11:07	110	80 / 20	7	n/a	95		
						11:33 / 12:19							
20	June 11, 2021	DB	TP	CY	AC	10:05 / 11:01	290	70 / 30	7	WS 10 km/hr	75	Unlimited	0
21	June 11, 2021	DB	TP	AC	CY	16:17 / 17:18	105		7	NE 10 km/hr	100	Unlimited	0
				CY	AC	9:49 / 10:04				W 5 km/hr	50		
22	June 10, 2021	DB	TP	AC	CY	14:12 / 15:03	285	60 / 40	5	NE 20-30 km/hr	100		occasional shower

Table E.1 Aerial Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time / End Time	Helicopter Heading	Habitat Description (% open / % closed)	Temperature (°C)	Wind Speed (Direction / km/hr)	% Cloud Cover	Visibility (km)	Precipitation
		Right Front Seat	Left Front Seat	Right Rear Seat	Left Rear Seat								
23	June 10, 2021	DB	TP	CY	AC	10:27 / 10:55	110	n/a	4	ESE 10-15 km/hr	100	Unlimited	0
						15:09 / 15:39			7	NE 5-10 km/hr			
24	June 10, 2021	DB	TP	CY	AC	9:51 / 10:25	289	30 / 70	4	ESE 10-15 km/hr	100	Unlimited	0
						15:41 / 16:13			5				
25	June 9, 2021	DB	TP	CY	AC	15:16 / 16:06	110	40 / 60	15	N 5-10 km/hr	50	Unlimited	0
26	June 9, 2021	DB	TP	CY	AC	13:43 / 14:00	280	30 / 70	15	NW 5-10 km/hr	0	Unlimited	0
27	June 9, 2021	DB	TP	CY	AC	14:28 / 15:16	280	30 / 70	15	NW 5-10 km/hr	0	Unlimited	0
						12:28 / 13:41	105	40 / 60					
28	June 9, 2021	DB	TP	AC	CY	10:18 / 11:22	290	20 / 80	12	NW 5-10 km/hr	10	Unlimited	0
29	June 8, 2021	DB	TP	CY	AC	16:12 / 16:37	110	30 / 70	18	W 10-20 km/hr	0	Unlimited	0
	June 9, 2021	DB	TP	AC	CY	10:01 / 10:17	110	30 / 70	12	NW 5-10 km/hr	10	Unlimited	0
30	June 8, 2021	DB	TP	CY	AC	14:40 / 15:30	295	60 / 40	22	W 20-40 km/hr	1	Unlimited	0
31	June 8, 2021	DB	TP	CY	AC	13:48 / 14:39	110	50 / 50	15	WNW 10 km/hr	75	some haze, visibility 10-15 km	0

Table E.1 Aerial Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time / End Time	Helicopter Heading	Habitat Description (% open / % closed)	Temperature (°C)	Wind Speed (Direction / km/hr)	% Cloud Cover	Visibility (km)	Precipitation
		Right Front Seat	Left Front Seat	Right Rear Seat	Left Rear Seat								
32	June 8, 2021	DB	TP	AC	CY	11:50 / 12:04	285	40 / 60	22	W 10-15 km/hr	50	Unlimited	0
				CY	AC	13:02 / 13:45							
33	June 8, 2021	DB	TP	AC	CY	11:01 / 11:49	100	40 / 60	18	W 10-15 km/hr	80	Unlimited	0
34	June 8, 2021	DB	TP	AC	CY	10:01 / 10:59	210	60 / 40	18-20	WSW 20-40 km/hr (changed to WNW during transect)	5	Unlimited	5
35	June 7, 2021	DB	TP	CY	AC	16:16 / 17:06	110	60 / 40	13	n/a	50	Unlimited	0
36-B	June 7, 2021	DB	TP	CY	AC	15:51 / 16:15	280	50 / 50	13	WSW	50	Unlimited	0
36-R						15:29 / 15:46							
37-B	June 7, 2021	DB	TP	CY	AC	14:39 / 14:57	110	60 / 40	14	SW 10-15 km/hr	85	Unlimited	0
37-R						15:07 / 15:29							
38-B	June 7, 2021	DB	TP	AC	CY	12:46 / 12:57	290	50 / 50	10	SW 10-15 km/hr	50	Unlimited	0
38-R						12:09 / 12:42							
39-B	June 7, 2021	DB	TP	AC	CY	12:57 / 13:02	110	80 / 20	8	SW 10-15 km/hr	50	Unlimited	0
39-R						11:55 / 12:08							

Table E.1 Aerial Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time / End Time	Helicopter Heading	Habitat Description (% open / % closed)	Temperature (°C)	Wind Speed (Direction / km/hr)	% Cloud Cover	Visibility (km)	Precipitation
		Right Front Seat	Left Front Seat	Right Rear Seat	Left Rear Seat								
40-B	June 7, 2021	DB	TP	AC	CY	13:04 / 13:09	290	80 / 20	8	SW 10-15 km/hr	50	Great	0
40-R						11:49 / 11:52							
Access Road-N and -S	June 11, 2021	DB	TP	CY	AC	12:20 / 13:00	n/a	20 / 80	6	NE 1-15 km/hr	100	Unlimited	0

Notes:
B = Buchans herd post-calving survey area; R = resident caribou post-calving survey area
n/a = not applicable

APPENDIX F

Incidental Detections

Table F.1 Incidental Detections from Aerial Survey

Transect	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
5	June 12, 2021	656	Moose	48.99401	-57.1518	2	female and calf
6	June 12, 2021	651	Moose	48.96775	-57.1045	1	unknown
7	June 12, 2021	647	Moose	48.94535	-57.166	2	female and calf
7	June 12, 2021	648	Moose	48.94581	-57.1101	1	unknown
7	June 12, 2021	649	Black Bear	48.94728	-56.9498	1	unknown
8	June 12, 2021	635	Moose	48.92317	-56.9775	1	unknown
10	June 12, 2021	626	Moose	48.8788	-57.0289	1	unknown
11	June 12, 2021	613	Moose	48.85534	-57.4143	2	unknown
11	June 12, 2021	618	Moose	48.85604	-57.0089	1	unknown
12	June 12, 2021	606	Moose	48.8322	-57.3047	1	unknown
13	June 12, 2021	583	Moose	48.80997	-57.3156	2	female and yearling
14	June 11, 2021	558	Moose	48.78815	-57.0649	1	unknown
14	June 11, 2021	561	Black Bear	48.78574	-57.1726	1	unknown
14	June 11, 2021	570	Moose	48.78694	-57.4479	3	unknown
14	June 11, 2021	576	Moose	48.78725	-57.5485	1	unknown
14	June 11, 2021	577	Black Bear	48.78688	-57.5609	1	unknown
15	June 11, 2021	557	Moose	48.7677	-56.9553	1	unknown
16	June 11, 2021	542	Moose	48.74225	-57.1646	2	unknown
16	June 11, 2021	544	Moose	48.74015	-57.3972	2	female and calf
16	June 11, 2021	550	Moose	48.74203	-57.5606	1	unknown
16	June 11, 2021	551	Moose	48.74113	-57.5959	1	unknown
17	June 11, 2021	531	Moose	48.71983	-57.5941	1	unknown
17	June 11, 2021	538	Moose	48.72028	-57.0631	1	unknown
18	June 11, 2021	525	Moose	48.69644	-57.581	1	unknown
19	June 11, 2021	501	Moose	48.68331	-58.0427	1	unknown
20	June 11, 2021	500	Moose	48.64999	-58.0015	1	unknown
21	June 11, 2021	467	Moose	48.62641	-57.9769	1	unknown
21	June 11, 2021	468	Moose	48.62606	-57.8115	4	unknown
21	June 11, 2021	469	Moose	48.62706	-57.7948	1	unknown
21	June 11, 2021	470	Moose	48.62865	-57.5541	1	unknown
21	June 11, 2021	472	Bald Eagle	48.62985	-57.3588	1	unknown
22	June 10, 2021	430	Moose	48.60324	-57.7365	2	unknown
22	June 10, 2021	433	Moose	48.60146	-57.979	2	unknown
22	June 10, 2021	434	Moose	48.60279	-58.0271	2	unknown

Table F.1 Incidental Detections from Aerial Survey

Transect	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
22	June 10, 2021	436	Moose	48.60282	-58.0852	1	unknown
22	June 10, 2021	437	Moose	48.60141	-58.1472	2	unknown
23	June 10, 2021	369	Moose	48.58184	-57.5247	1	unknown
23	June 10, 2021	439	Moose	48.57624	-58.2589	1	unknown
23	June 10, 2021	440	Moose	48.57971	-58.2213	1	unknown
23	June 10, 2021	441	Moose	48.58224	-58.051	1	unknown
23	June 10, 2021	442	Moose	48.5813	-57.9625	1	unknown
23	June 10, 2021	443	Moose	48.58058	-57.9251	1	unknown
23	June 10, 2021	444	Moose	48.58371	-57.6414	1	unknown
23	June 10, 2021	449	Moose	48.57772	-57.5236	1	unknown
24	June 10, 2021	348	Moose	48.56291	-57.0081	2	unknown
24	June 10, 2021	349	Moose	48.56218	-57.0343	2	unknown
24	June 10, 2021	350	Moose	48.56284	-57.084	2	unknown
24	June 10, 2021	357	Black Bear	48.55977	-57.3368	1	unknown
24	June 10, 2021	358	Moose	48.56056	-57.3513	1	unknown
24	June 10, 2021	362	Bald Eagle	48.56264	-57.3965	1	unknown
24	June 10, 2021	452	Moose	48.56245	-57.5955	1	unknown
24	June 10, 2021	456	Moose	48.56759	-57.6019	1	unknown
24	June 10, 2021	457	Moose	48.56092	-57.6099	1	unknown
24	June 10, 2021	459	Moose	48.55776	-57.6385	2	unknown
24	June 10, 2021	460	Moose	48.55861	-57.789	1	unknown
24	June 10, 2021	462	Moose	48.5585	-57.8728	2	unknown
24	June 10, 2021	463	Moose	48.55665	-57.9472	1	unknown
24	June 10, 2021	464	Moose	48.55622	-57.9957	1	unknown
24	June 10, 2021	465	Moose	48.55552	-58.008	1	unknown
24	June 10, 2021	466	Moose	48.55717	-58.081	1	unknown
25	June 9, 2021	335	Moose	48.53571	-57.9658	1	unknown
25	June 9, 2021	337	Moose	48.53778	-57.5502	1	unknown
26	June 9, 2021	314	Moose	48.51604	-57.179	1	unknown
26	June 9, 2021	332	Moose	48.51463	-57.7072	1	unknown
26	June 9, 2021	333	Moose	48.51336	-57.9841	1	unknown
26	June 9, 2021	334	Moose	48.51093	-58.263	2	female and calf
27	June 9, 2021	292	Moose	48.4912	-57.8076	2	female, and female and calf
27	June 9, 2021	293	Moose	48.49211	-57.6734	1	unknown

Table F.1 Incidental Detections from Aerial Survey

Transect	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
27	June 9, 2021	310	Moose	48.49604	-57.12	1	unknown
27	June 9, 2021	311	Moose	48.49432	-57.0476	1	unknown
28	June 9, 2021	276	Moose	48.47294	-56.941	1	unknown
28	June 9, 2021	282	Moose	48.47051	-57.3047	1	unknown
28	June 9, 2021	283	Moose	48.47062	-57.3812	1	unknown
28	June 9, 2021	290	Moose	48.46733	-58.0821	1	unknown
28	June 9, 2021	291	Moose	48.46626	-58.1137	2	unknown
29	June 9, 2021	270	Moose	48.4492	-57.2552	1	unknown
29	June 9, 2021	273	Moose	48.44955	-57.0942	1	unknown
30	June 8, 2021	247	Moose	48.427	-57.5293	2	female and calf
30	June 8, 2021	249	Moose	48.42421	-57.6882	1	unknown
30	June 8, 2021	258	Moose	48.42135	-58.0653	1	unknown
30	June 8, 2021	259	Moose	48.42096	-58.0719	1	unknown
31	June 8, 2021	213	Moose	48.40199	-57.9199	2	unknown
31	June 8, 2021	216	Moose	48.40362	-57.7356	1	unknown
31	June 8, 2021	219	Moose	48.4055	-57.3854	1	unknown
32	June 8, 2021	192	Moose	48.3817	-57.0673	1	unknown
32	June 8, 2021	197	Moose	48.38268	-57.2785	2	unknown
32	June 8, 2021	202	Moose	48.3832	-57.4162	2	males
32	June 8, 2021	203	Moose	48.38107	-57.5031	1	male
32	June 8, 2021	204	Moose	48.3813	-57.5891	2	female and calf
32	June 8, 2021	205	Moose	48.38055	-57.6504	2	unknown
32	June 8, 2021	208	Moose	48.38063	-57.853	1	unknown
32	June 8, 2021	209	Moose	48.37998	-57.8768	1	unknown
32	June 8, 2021	211	Moose	48.37919	-57.9562	2	female and calf
33	June 8, 2021	172	Moose	48.3583	-57.8092	2	female and calf
33	June 8, 2021	173	Moose	48.35842	-57.7973	1	male
33	June 8, 2021	183	Moose	48.35956	-57.3401	1	unknown
33	June 8, 2021	191	Moose	48.36128	-57.0279	1	unknown
34	June 8, 2021	157	Moose	48.32954	-57.1776	1	unknown
34	June 8, 2021	163	Moose	48.33569	-57.554	2	cow and calf
34	June 8, 2021	166	Moose	48.33443	-57.6939	1	unknown
34	June 8, 2021	167	Moose	48.33519	-57.792	1	unknown
34	June 8, 2021	170	Moose	48.33433	-57.9394	1	unknown
35	June 7, 2021	121	Moose	48.31214	-57.9901	1	unknown

Table F.1 Incidental Detections from Aerial Survey

Transect	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
35	June 7, 2021	122	Black Bear	48.31299	-57.8922	1	unknown
35	June 7, 2021	136	Moose	48.31495	-57.2754	1	male
35	June 7, 2021	137	Moose	48.31235	-57.2339	2	unknown
35	June 7, 2021	143	Black Bear	48.31826	-56.941	1	unknown
36	June 7, 2021	109	Moose	48.29371	-56.9361	1	unknown
36	June 7, 2021	114	Moose	48.2909	-57.4601	2	female and calf
36	June 7, 2021	115	Moose	48.29288	-57.5862	1	unknown
36	June 7, 2021	116	Arctic Hare	48.29201	-57.6279	1	unknown
36	June 7, 2021	119	Moose	48.29218	-57.8682	1	unknown
36	June 7, 2021	120	Moose	48.29023	-58.0063	2	unknown
37	June 7, 2021	88	Moose	48.26687	-58.0306	2	unknown
37	June 7, 2021	91	Moose	48.27176	-57.6598	2	female and calf
37	June 7, 2021	94	Moose	48.26977	-57.536	1	unknown
37	June 7, 2021	95	Moose	48.27139	-57.5032	1	unknown
38	June 7, 2021	78	Black Bear	48.24481	-57.3437	4	unknown adult and 3 calves
38	June 7, 2021	81	Black Bear	48.24712	-57.4739	1	unknown
39	June 7, 2021	84	Moose	48.22263	-57.9827	1	unknown
39	June 7, 2021	85	Moose	48.22519	-57.9321	1	unknown
Access Road	June 10, 2021	401	Moose	48.71168	-56.7024	1	male
Access Road	June 10, 2021	402	Moose	48.70154	-56.7829	1	male
Access Road	June 10, 2021	405	Black Bear	48.66056	-56.8335	1	unknown
Access Road	June 10, 2021	406	Moose	48.61079	-56.8786	1	unknown
Access Road	June 10, 2021	407	Moose	48.61122	-56.8848	1	unknown
off transect	June 7, 2021	59	Moose	48.57103	-57.2422	1	unknown
off transect	June 7, 2021	63	Moose	48.37169	-57.1386	1	unknown
off transect	June 7, 2021	86	Moose	48.30406	-58.0702	1	unknown
off transect	June 7, 2021	212	Moose	48.38535	-58.0298	1	unknown
off transect	June 10, 2021	313	Black Bear	48.51371	-56.9135	1	unknown

Table F.1 Incidental Detections from Aerial Survey

Transect	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
off transect	June 10, 2021	340	Moose	48.68165	-57.3091	2	female and calf
off transect	June 10, 2021	345	Moose	48.69208	-56.95	1	unknown
off transect	June 10, 2021	413	Moose	48.56305	-57.0888	2	unknown
off transect	June 11, 2021	438	Moose	48.5862	-58.2422	1	unknown
off transect	June 11, 2021	477	Moose	49.17465	-57.3852	1	unknown
off transect	June 11, 2021	478	Moose	49.16929	-57.3758	1	unknown
off transect	June 11, 2021	479	Black Bear	49.09315	-57.2705	2	unknown
off transect	June 11, 2021	519	Black Bear	49.04867	-57.3637	4	unknown
off transect	June 11, 2021	520	Moose	48.82165	-57.316	1	unknown
off transect	June 12, 2021	579	Moose	49.13632	-57.4245	1	unknown
off transect	June 12, 2021	582	Moose	48.99109	-57.5109	1	unknown
off transect	June 12, 2021	638	Moose	49.14936	-57.3553	1	unknown

APPENDIX G

Comparison of 2020 and 2021 Post-Calving Caribou Survey Classification Results

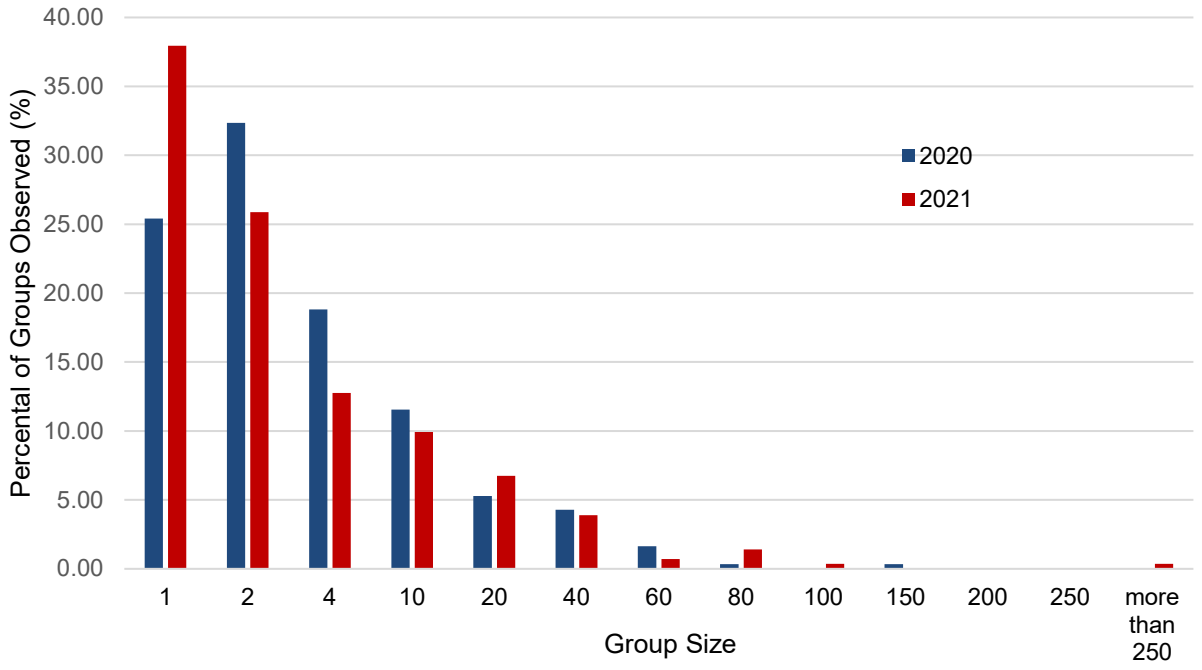


Figure G-1 Frequency of Group Size Detected in 2020 and 2021 Surveys in Buchans Herd Post-Calving Survey Area

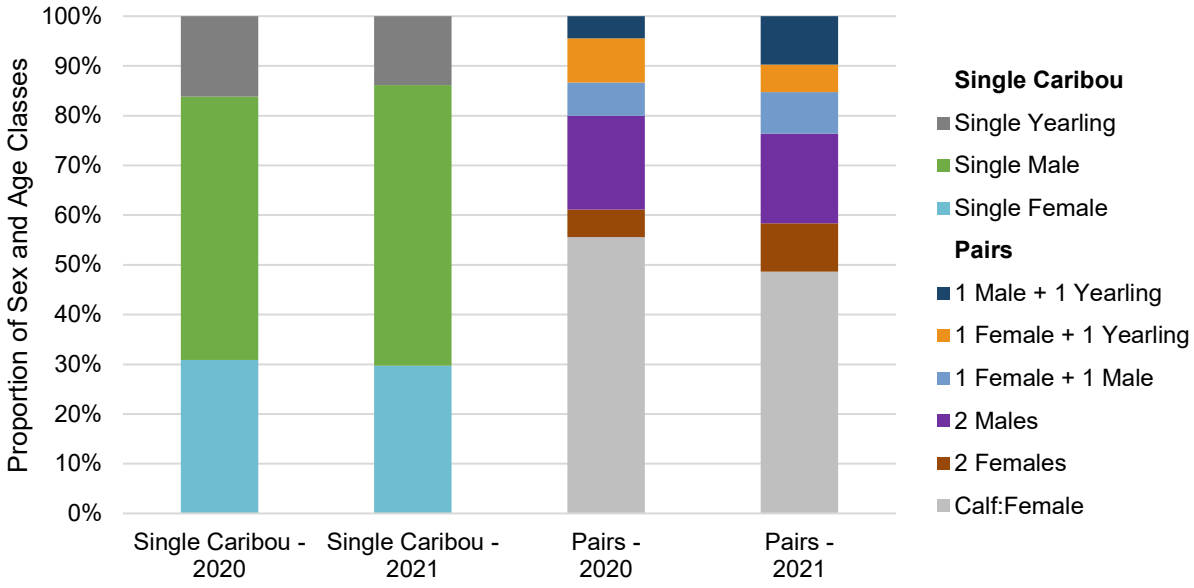


Figure G-2 Proportion of Age and Sex Classes in Single Caribou and Pairs Detected in 2020 and 2021 Post-Calving Surveys in Buchans Herd Post-Calving Survey Area

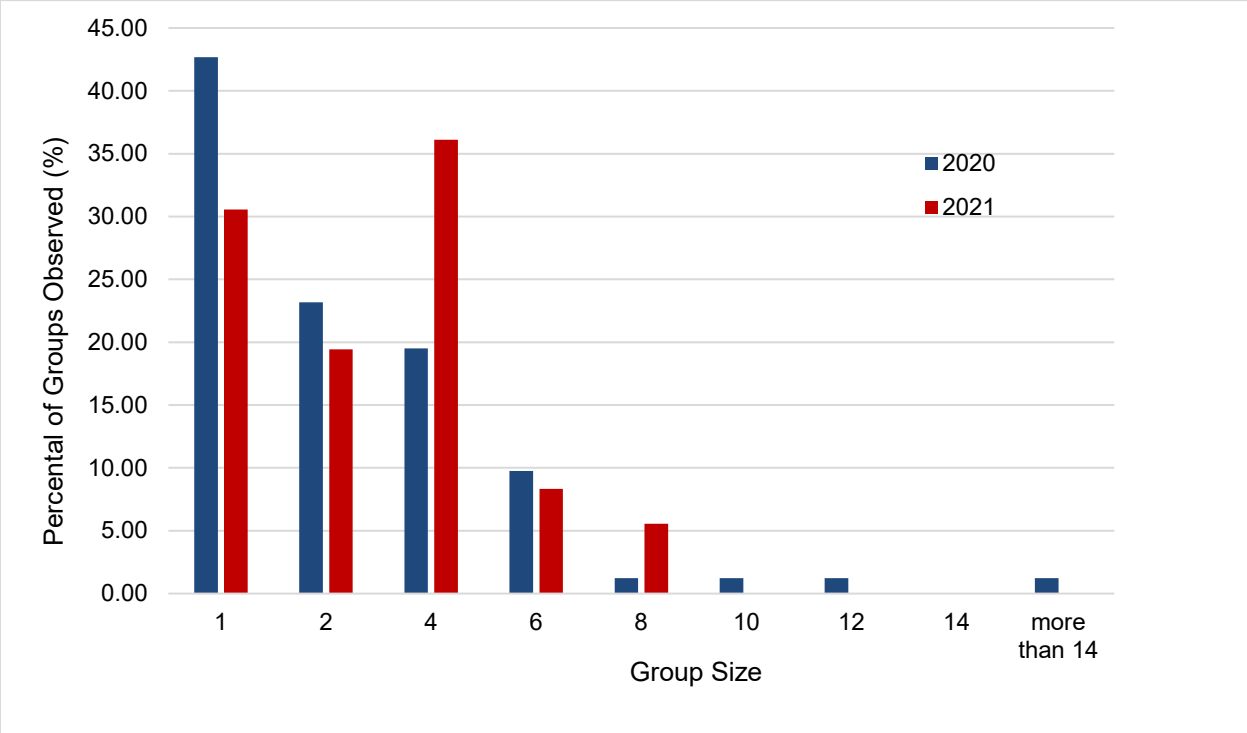


Figure G-3 **Frequency of Group Size Detected in 2020 and 2021 Post-Calving Surveys in Resident Caribou Post-Calving Survey Area**

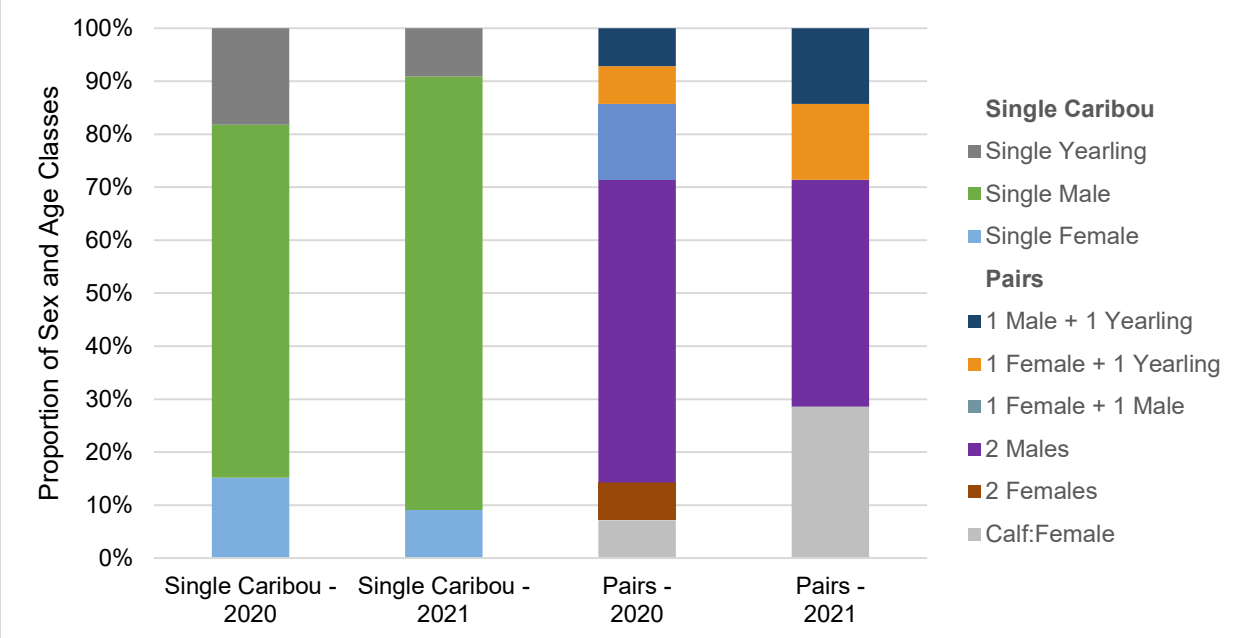
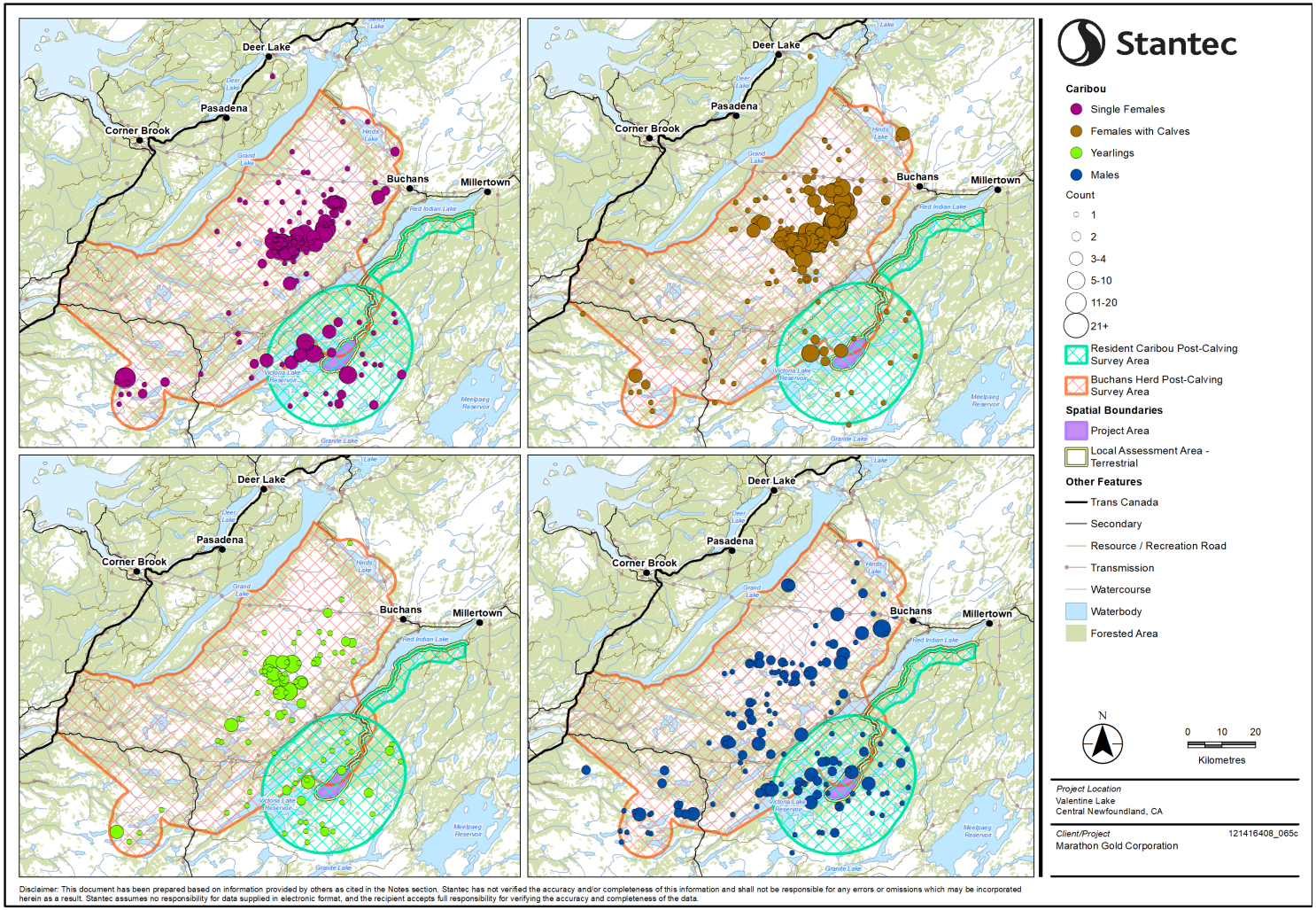


Figure G-4 **Proportion of Age and Sex Classes in Single Caribou and Pairs Detected in 2020 and 2021 Post-Calving Surveys in Resident Caribou Post-Calving Survey Area**

APPENDIX H

Distribution of Caribou from 2020 Post-Calving Caribou Survey



(Source: BSA.2 Appendix 2)

Figure H-1 Distribution of Caribou Age and Sex Classes from 2020 Post-Calving Caribou Survey

Valentine Gold Project: 2022 Aerial Survey of Caribou Calving Grounds

Final Report

September 26, 2022

Prepared for:

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Executive Summary

Marathon Gold Corporation (Marathon) is planning to develop the Valentine Gold Project (the Project), located in the Central Region of the Island of Newfoundland. The Project overlaps with woodland caribou (*Rangifer tarandus*) range in central Newfoundland. The Wildlife Division of the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture identified the need to gather information about the Buchans herd and resident caribou that calve in the Project's zone of influence.

Stantec Consulting Ltd. (Stantec) undertook aerial surveys to complete a population estimate on the Buchans herd calving ground, and to obtain herd composition information about the Buchans herd and resident caribou that calve in the zone of influence. The survey area is approximately 6,101 km^2 and is comprised of: 1) the Buchans herd calving grounds; and 2) resident caribou calving grounds within a 17 km buffer around the mine site and 4-km buffer along the south side of the Project access road (the zone of influence). The survey was completed from June 6 to 12, 2022; June 6, 7 and 8 surveys were dedicated to the census of the Buchans herd, and June 9 and 12 surveys were dedicated to caribou group classification.

Collectively, 320 groups of caribou totaling 1,163 individuals were detected during the census survey. The caribou group classification surveys included information on 1,570 caribou from 186 caribou groups.

Within the resident caribou calving grounds in the zone of influence, classified caribou were 17% calves, 8% yearlings, 44% females, and 29% males, and within the Buchans herd calving grounds there were 29% calves, 7% yearlings, 54% females, and 7% males. The population in the Buchans herd calving grounds was estimated at 1,724 individuals (95% confidence interval: 1,090-2,726).

This report provides a description of methods and results from the 2022 Aerial Survey of Caribou Calving Grounds. The results of these and other ongoing baseline studies, including the analysis of telemetry data, will augment baseline caribou data for the Project and is a component of Marathon's Caribou Protection and Environmental Effects Monitoring Plan.

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Abbreviations

agl	Above Ground Level
AIC	Akaike's Information Criterion
EIS	Environmental Impact Statement
GPS	Geographic Positioning System
km	Kilometre
km^2	Square kilometre
m	Metre
n	Number
NLDFFA-WD	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Wildlife Division
NL	Newfoundland and Labrador
SE	Standard Error
ZOI	Zone of Influence

1.0 INTRODUCTION

Woodland caribou (*Rangifer tarandus*) was identified as a valued component in the Environmental Impact Statement (EIS) Guidelines for the Valentine Gold Project (the Project) issued by the federal and provincial governments (Impact Assessment Agency of Canada 2019; Government of Newfoundland and Labrador [NL] 2020a). The Newfoundland Population of woodland caribou is not listed under the provincial *Endangered Species Act*; however, it was added to Schedule 1 of the federal *Species at Risk Act* as a species of Special Concern in August 2021 (Government of Canada 2021).

Marathon Gold Corporation (Marathon) retained Stantec Consulting Ltd. (Stantec) to undertake baseline monitoring activities associated with the Project, including analysis of woodland caribou migration, distribution, habitat use, population size, and group composition. This report presents the results of the 2022 survey, which represents the third in a series of annual aerial surveys beginning in 2020. The results of these and other ongoing baseline studies, including the analysis of telemetry data, will augment baseline caribou data for the Project and is a component of Marathon's Caribou Protection and Environmental Effects Monitoring Plan.

1.1 PROJECT OVERVIEW

The Project (Figure 1-1) is in central Newfoundland, approximately 57 km south of Buchans, and is comprised of two open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities, a tailings management facility, personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities. The mine site is accessed by an existing gravel road, approximately 82 km in length, which extends south from Millertown to the Project. Approximately 73 km of this existing access road will be upgraded and maintained by Marathon as part of the Project.

The spatial boundaries for the assessment of potential Project effects on caribou include the Project Area (Figure 1-1), defined as the mine site and access road (plus a 20 m buffer on either side of the road), and the Local Assessment Area (LAA), which includes a 1 km buffer surrounding the mine site and a 500 m buffer surrounding the access road (Figure 1-1). The LAA encompasses the area in which Project-related environmental effects (direct or indirect) can be predicted or measured. The EIS also defined a Regional Assessment Area, to inform the assessment of cumulative effects, which includes the combined population ranges of the Buchans, Gaff Topsails, Grey River and La Poile caribou herds as determined by caribou telemetry data obtained from the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Wildlife Division (NLDFFA-WD).

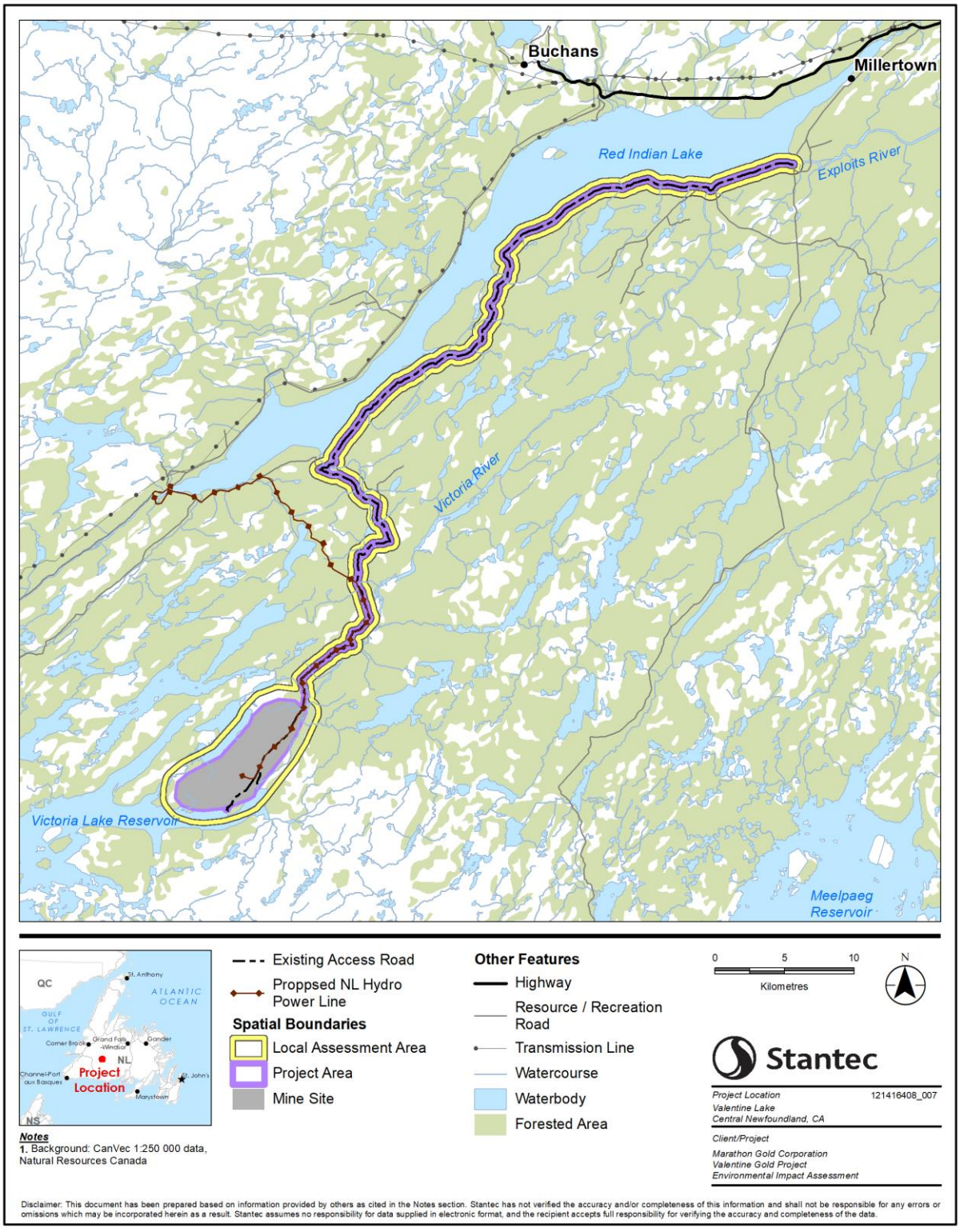

Figure 1-1 Project Location and Spatial Boundaries

1.2 DELINEATION OF CALVING GROUNDS AND HERD AFFILIATION

The caribou population on the Island of Newfoundland is comprised of several sub-populations that are differentiated by annual movement patterns, spatial affiliations, and genetic structure (Wilkerson 2010; Government of NL 2015). The EIS assessed the effects on four caribou herds (EIS Chapter 11) that potentially interact with the Valentine Gold Project: Buchans, Gaff Topsails, Grey River, and La Poile. These herds are part of the South Coast sub-population (Wilkerson 2010; Schaefer and Mahoney 2013; Government of NL 2019) and share winter ranges near the southern shore between Burgeo and the Connaigre Peninsula (Weir et al. 2014), however have separate calving areas and summer ranges. This study focuses on caribou on the Buchans herd calving grounds and resident caribou on calving grounds within a 17-km buffer around the mine site plus 4-km buffer along the south side of the Project access road (the Zone of Influence [ZOI] associated with the Project). While the herd affiliation for caribou that calve within the ZOI is uncertain, the ZOI does overlap with the calving range of the Grey River herd. It is therefore assumed that most caribou in the calving grounds within the ZOI are resident Grey River caribou. Caribou from both the Buchans and Grey River herds have the potential to occur in the Project Area and LAA.

The spatial range for the Buchans herd calving grounds was estimated from telemetry data from 2007-2012 and 2016-2017, plus a 5-km buffer, and boundaries suggested by the NLDFFA-WD (Figure 1-2). Criteria used to delineate the Buchans herd calving grounds are described in detail in BSA.2, Attachment 2-C of the EIS.

The ZOI was defined as a 17-km buffer around the mine site and a 4-km buffer along the south side of the access road (Figure 1-2). The 17-km buffer was selected as a conservative buffer based on results from noise modelling completed for the Project, which predicted a return to baseline sound pressure levels 5 km from the mine site (EIS, Chapter 5) and ZOIs presented in the literature indicating caribou avoidance of mines ranging from 2 km to 18.7 km (Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012 and 2021; LeBlond et al. 2014; Johnson et al. 2015; Eftestøl et al. 2019). The 4-km buffer along the road was similarly selected based on ZOIs in the literature which show caribou avoidance of roads up to 4-km (Dyer et al. 2001; Vistnes sand Nellemann 2001; Nellemann et al. 2003; Polfus et al. 2011).

While the delineation of the Buchans herd calving grounds has remained unchanged throughout the annual surveys from 2020 to 2022, the boundary separating the calving grounds within the ZOI from the Buchans herd has changed, per direction from NLDFFA-WD. Initially in 2020, there was an area of overlap between the Buchans and resident caribou survey areas that was subdivided to complete separate analyses for the two herds. Beginning in 2021, the boundary for the resident caribou survey area was modified to be mutually exclusive from the Buchans herd survey area (i.e., only the portion of the ZOI that is outside the Buchans herd calving grounds was considered the resident caribou survey area). Refer to Section 2.1 for additional details.

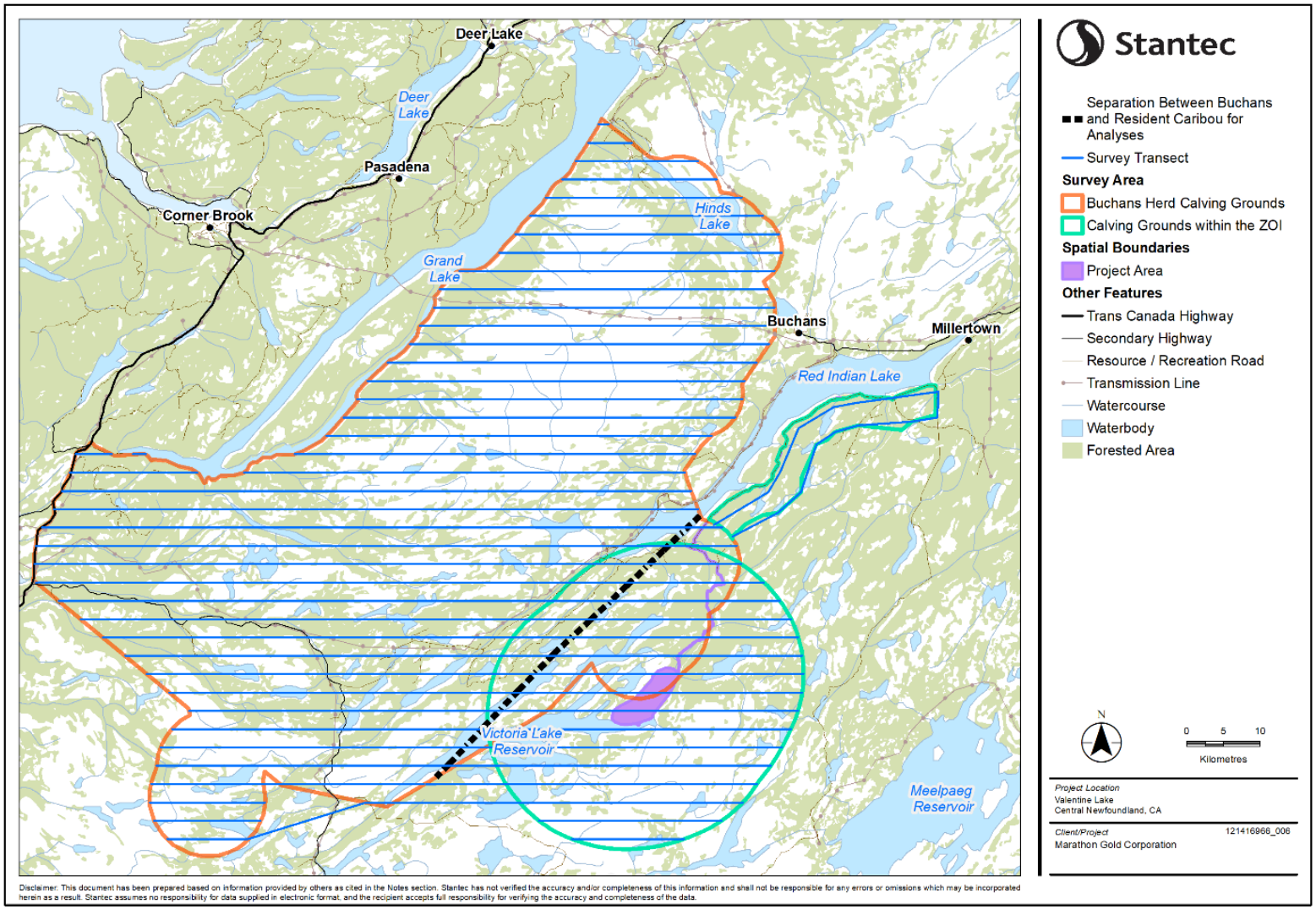

Figure 1-2 2020 Survey Area and Subdivision of Herds

1.3 SURVEY OBJECTIVES

The objectives of the 2022 aerial survey were to:

- Complete a caribou population estimate for the Buchans herd calving ground survey area
- Sample caribou group size and composition, including the number of calf:female pairs (i.e., classification survey), for caribou in the Buchans herd calving grounds survey area and on calving grounds within the Project's ZOI

Aerial surveys were undertaken in accordance with methods and conditions outlined in Scientific Research Permit WLR2022-51 (Appendix A) issued by NLDFFA-WD. A copy of the permit application is provided in Appendix B.

2.0 SURVEY AREA AND METHODS

2.1 SURVEY AREA

The survey area for population and group composition surveys, the focus of this report, is approximately 6,101 km^2 and is comprised of two mutually exclusive sub-areas based on herd affiliation (Figure 2-1):

1. Buchans herd calving grounds survey area (5,229.6 km^2). The boundary of this survey area is indicated in red on Figure 2-1.
2. Resident caribou calving grounds survey area within the ZOI (871.4 km^2), defined as a 17-km buffer around the mine site and 4-km buffer along the south side of the Project access road. The boundary of this survey area is indicated in green on Figure 2-1.

Surveys were completed along 40 parallel transects within the calving grounds (labelled 1 through 42 in the 2022 survey) and two transects (labelled 43 and 44) south of the access road (Figure 2-1). The combined total transect distance is 2,515 km, with approximately 2,093 km and 422 km associated with the Buchans herd and resident caribou, respectively (Appendix C). Transects within the calving grounds were spaced 2.5 km apart and oriented east-west, and surveys for the road were completed along transects that were 1 km and 4 km south of the road.

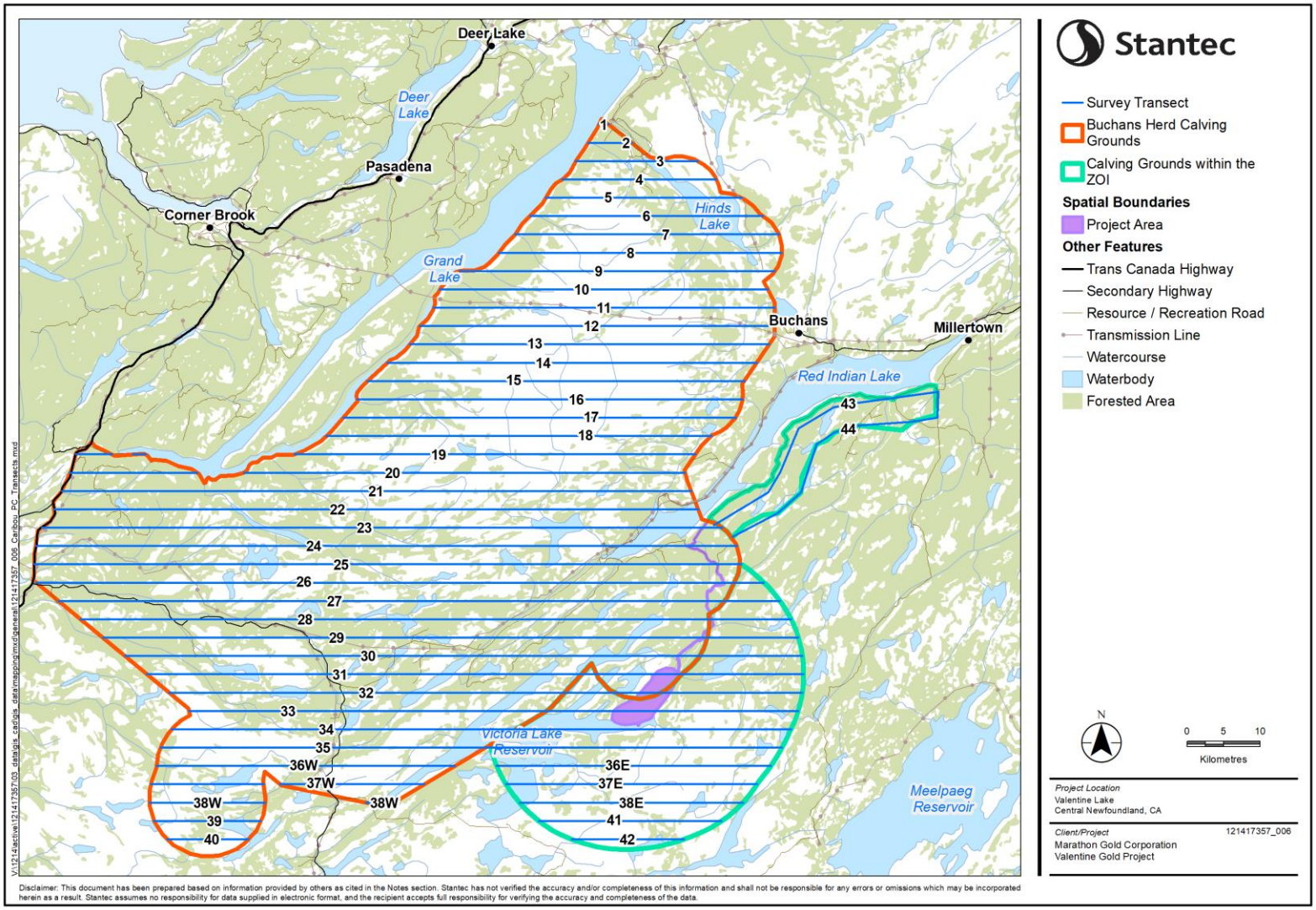

Figure 2-1 2022 Survey Transects in the Caribou Calving Grounds Survey Areas

2.2 AERIAL SURVEY AND TIMING

Per direction from NLDFFA-WD, the 2022 survey was divided into two survey periods to align with the survey objectives:

1. Census Survey: three-day census (June 6-8, 2022) to complete a caribou population estimate for the Buchans herd calving ground survey area (red boundary on Figure 2-1). Resident caribou on calving grounds within the ZOI (green boundary on Figure 2-1) were also counted but not used to generate a population estimate, as most caribou in this area are assumed to be resident Grey River caribou (see Section 1.2).
2. Classification Survey: two-day classification (June 9 and 12, 2022) of caribou on the Buchans herd calving grounds and resident caribou on calving grounds within the ZOI.

Note that this differs from previous surveys (i.e., 2021 and 2020) when the census and classification surveys were completed concurrently.

The temporal ranges for the annual aerial surveys are based on the generalized dates for caribou seasons on the Island of Newfoundland (Table 2.1) and target the late calving period (i.e., after calves are born).

Table G 1 General Seasons for Island Caribou in Newfoundland

Season	Seasonal Dates
Winter	December 16 – March 31
Spring Migration/Pre-calving	April 1 – May 19
Calving	May 20 – June 10
Post-calving Migration/Dispersal	June 11 – June 30
Post-calving Rearing	July 1 – August 31
Fall Rut	September 1 – October 31
Fall Migration/Dispersal	November 1 – December 15
Source: Emera (2013)	

For each survey, a Bell 206L Long Ranger helicopter (with ‘bubble’ rear windows to enhance observer visibility) was used. Transect lines (Appendix C) were uploaded into a Geographic Positioning System (GPS) for pilot navigation and for observer reference. Per the conditions of the survey permit (Appendix A), the survey team consisted of a navigator/recorder in the front seat, and two rear seat observers (Table 2.2) who switched viewing positions approximately halfway through each survey day.

Table G 2 Survey Team for 2022 Aerial Survey of Caribou Calving Grounds

Team Member	Role and Position in Helicopter
Less Phillips	Pilot, Newfoundland Helicopters
Truman Porter	Contract – Lead, Biologist (Navigator, Front Left)
Doug Rimmer	Stantec – Field Lead, Biologist (Observer, Rear Seat)
Aaron Coward	NLDFFA-WD – Ecologist (Observer, Rear Seat)

The helicopter was flown at 100-120 km/hour, approximately 100 m above ground level (agl). Conditions of the permit from NLDFFA-WD (Appendix A) were followed including limiting the positioning or following of caribou with the helicopter, avoiding hovering and circling around caribou, reducing the amount of time maneuvering over one animal, and recording the number of helicopter passes required to classify caribou.

Incidental sightings of other mammal species (e.g., moose [*Alces alces*] and black bear [*Ursus americanus*]) detected while on transects and while ferrying were also recorded.

2.2.1 Census Survey – Buchans Herd Calving Ground Population Estimate

Transects were flown over three consecutive days from June 6-8, 2022. At the start of each transect the habitat type, weather conditions, and visibility were documented (Appendix D). Information recorded for each caribou detection along the transect included the observer's name and their seat position in the helicopter, terrain (whether habitat was open or closed), and relative slope (1 = flat; 2 = sloped or rolling; 3 = steep). In instances where several groups of caribou were detected simultaneously (e.g., on different sides of the helicopter; at different distances from transect line), obtaining accurate distance measurements and counting the number of caribou was prioritized over the collection of supplementary information (e.g., terrain, relative slope, or observer). Therefore, supplementary information was not recorded for some detections. The datasheet used to record survey information is provided in Appendix E.

Prior to the survey the survey team calibrated their windows at 100 m agl to delineate six distance classes for the purpose of estimating the horizontal distance to caribou from the transect line. Horizontal lines were marked on the helicopter window as follows: 1 = 0-100 m; 2 = 100-200 m; 3 = 200-300 m; 4 = 300-400 m; 5 = 400-500 m; and 6 > 500 m. The window-based distance classes were used only in instances where a rangefinder could not be used to determine horizontal distance or when there was concern about obtaining an accurate distance measurement before the caribou moved in response to the helicopter. Window markings were recalibrated when rear seat observers switched viewing positions such that the calibrations matched their height and sitting position.

Caribou detections from the transect line were geo-referenced using a GPS. An estimate of population size from distance-based sampling methods requires that the perpendicular horizontal distance between each caribou detection and the transect line be obtained (Figure 2-2). For this survey, horizontal distances were measured perpendicularly with respect to the transect. Caribou were detected from helicopter (i.e., observers were 100 m agl) and the horizontal distance between detected caribou and the transect line was determined using one of three approaches: 1) measured in the field using the

rangefinders; 2) calculated after the survey from the location of the detected caribou; or 3) measured using the distance bin calibrations on the helicopter window. The preferred method was to measure the horizontal distance in the field using TruPulse 200L rangefinders. The ‘Horizontal Distance Measurement Mode’ was used to calculate level distance between the rangefinder and the plane of the target (in this case, caribou) (Laser Technology Inc. 2013), which calculated the measure of horizontal distance that accounted for the height of land where the caribou was located. It is assumed that the helicopter was on a level plane (i.e., angle of pitch was 0°) when the rangefinder was used. Following the measurement of horizontal distance, the number of caribou initially detected from the transect line was also recorded.

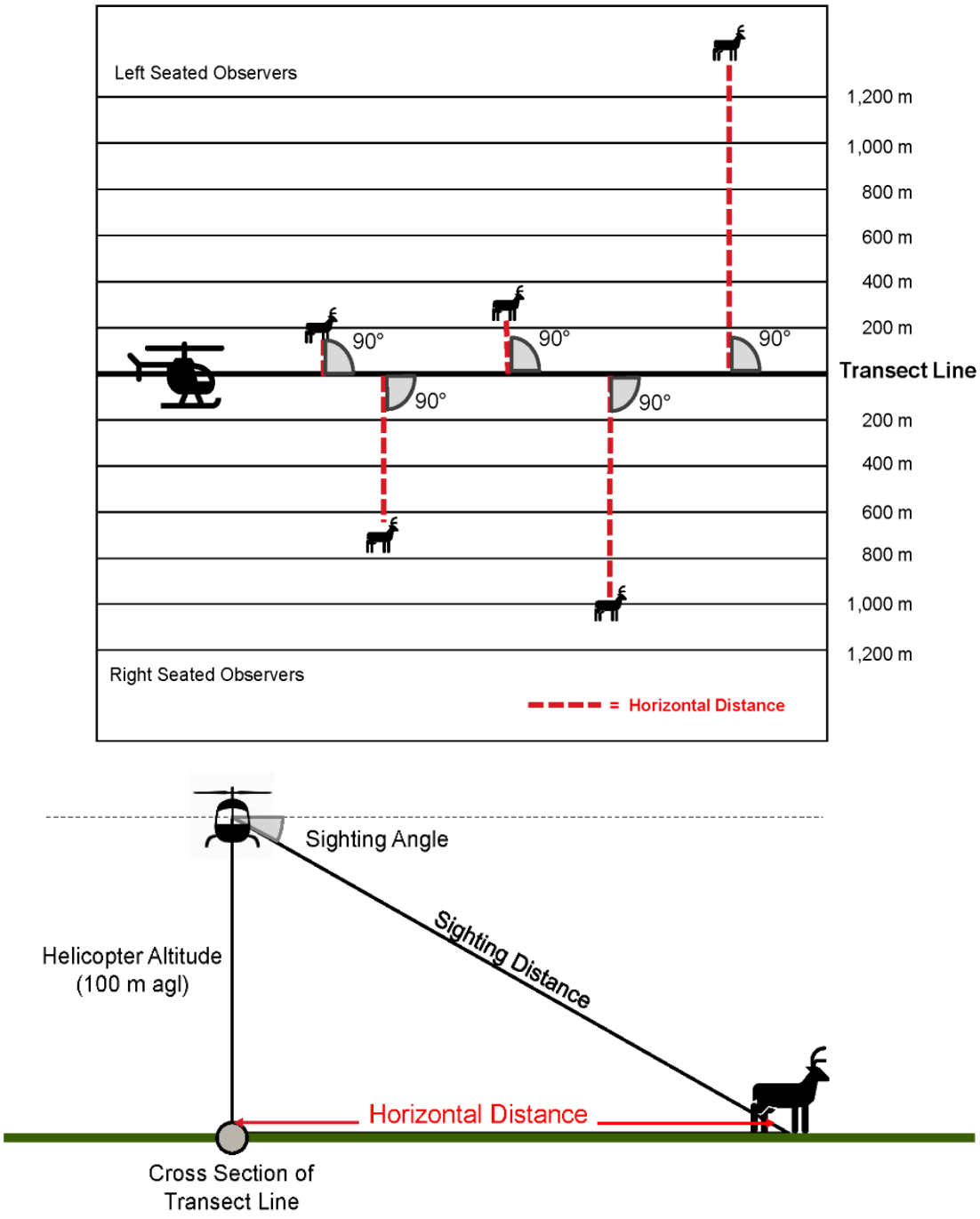

Figure 2-2 Measurement of Perpendicular Horizontal Distance between Caribou and Transect Line

In some instances, the horizontal distance could not be determined with the rangefinder (e.g., rangefinder could not focus on caribou due to movement of helicopter, distortion through helicopter window). In these situations, the horizontal distance from the transect line was determined by making note of a landmark near the detected caribou (e.g., distinctive rock or tree, barren patch). When the helicopter departed the transect line to classify detected caribou, the location of the noted landmark was geo-referenced using the GPS (Figure 2-3). For these detections, the horizontal distance between the location of detected caribou and the transect were later calculated during analysis.

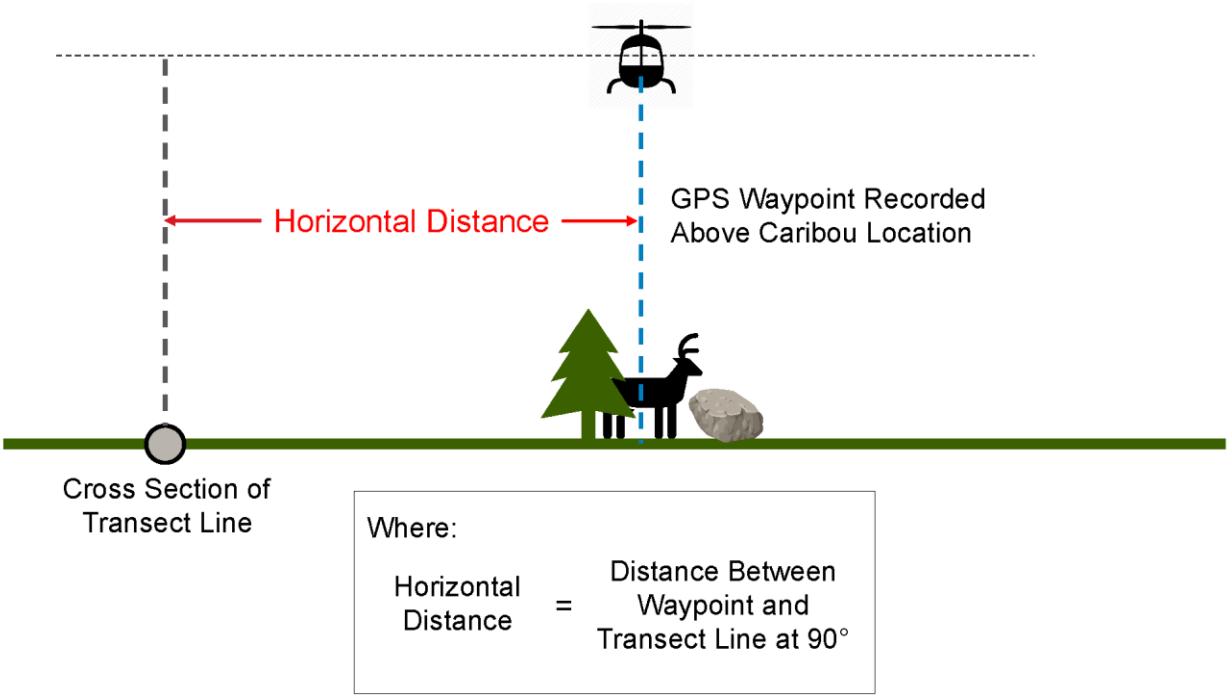

Figure 2-3 Determination of Horizontal Distance between Caribou and Transect Line using Waypoint of Caribou Location

If there was concern about obtaining a distance measurement before the caribou moved away from their initial location, the horizontal distance was determined by using the distance bins calibrated on the aircraft windows. However, obtaining distance by this method was considered a last resort and was only used when the distance could not be determined through either the rangefinder, or by use of a geo-referenced landmark.

2.2.2 Classification of Caribou on Buchans Herd Calving Grounds and Resident Caribou on Calving Grounds within the ZOI

Following completion of the census survey, the survey area was revisited on June 9 and June 12, 2022, to classify a sample of caribou groups using locations where caribou were previously identified as a general reference. When a caribou group was located, the helicopter approached the group to obtain a precise count of the number of caribou in the group and to classify them by age (i.e., calves = neonates; yearlings = 1 to 2 years; adults > 2 years) and by sex (i.e., based on presence of vulva or penis, head and body size, and antler characteristics), if possible. Adult caribou whose sex could not be determined were classified as 'Adult Unknown'. When summarizing the data, the category of 'Total Caribou' included adults, yearlings, calves, and unknown adults.

2.3 ANALYTICAL METHODS

The survey areas defined in Section 2.1 were used as boundaries to calculate the population estimate and describe group composition.

2.3.1 Classification and Composition

Group composition (i.e., group size, sex ratios and age classes) metrics include the following: male:100 adult ratio, female:100 adult ratio, calf:100 females ratio, percent females (females/total caribou x 100), percent males (males/total caribou x 100), percent yearlings (yearlings/total caribou x 100), and percent calves (calves/total caribou x 100). Calculations only included caribou located within the survey area (i.e., incidental observations from outside the survey area were omitted). These metrics are not intended for population census purposes, though they may provide future insight on potential differences in project effects on sexes or age classes if such effects occur.

2.3.2 Population Estimate

A population estimate was calculated for the Buchans herd calving grounds survey area using distance sampling methods (census data) and caribou detections. There are several key assumptions in distance sampling (Buckland et al. 2001), which were satisfied through survey design and field methods:

1. Transects lines are placed randomly within the survey area with respect to caribou distribution.
    a. The transect lines were delineated using a geographic information system such that the transects were 2.5 km apart from each other and the maximum number of transects was fit into the study area. There was no prior determination of transect placement other than the survey boundaries within which they were located (Figure 3-1).
2. Caribou on the transect line (i.e., at 0 m) are detected with certainty.
    a. The helicopter was fitted with rear ‘bubble’ windows to increase visibility. There were two observers on both sides of the helicopter (i.e., the pilot also observed for wildlife). The helicopter flew at an altitude (100 m agl) and speed (100-120 km/hr) to increase the detection probability of caribou along the transect. In addition, the terrain was mostly open and caribou on the transect line were detected with a high degree of certainty.

3. Caribou are detected at their initial location and do not move in response to the observers.
    a. The survey team measured the distance between caribou detections and the transect quickly, and prior to approaching with the helicopter. Caribou generally did not react to the helicopter (e.g., move away, stand up from a laying position) on the first pass, allowing the distance to be measured accurately from the perpendicular position. Where there was a concern that the caribou would move in response to the helicopter, either a prominent landmark near the caribou was used to record the location, or distance bins were used to obtain a distance class.
4. Measurements are exact.
    a. Rangefinders were used by the observers to measure the distance between caribou and the transect line wherever possible. The TruPulse 200L professional rangefinders that were used have an accuracy rating ± 1 m. Distance bins or landmarks were used to determine the distance when the rangefinder could not be used, and the distance bins were calibrated and adjusted for each observer, including for when they switched seats.

Caribou detections were analyzed using R 3.5.3 (R Core Team 2019) and R Distance package (Miller et al. 2019). Caribou detections with horizontal distances from the rangefinder were explored (i.e., detections based on distance bin calibrations on the helicopter window were omitted), and detections were added to a frequency distribution with distances grouped into 100 m distance classes. The resulting distribution created a suitably-shaped detection function that did not violate the shape criterion for the models (Buckland et al. 2001).

Different detection function models with adjustment terms (uniform, hazard rate, and half normal) were explored for the Buchans herd calving grounds survey area and were assessed for fit using Chi-square and Akaike's Information Criterion (AIC). It was determined that group size bias was present in the detections (i.e., small groups were not detected at farther distances). Subsequently, group size was included as a covariate; the R Distance package uses a Horvitz-Thomson-like estimator to account for potential effects of group size on detectability (Miller et al. 2019). With the inclusion of group size as a covariate, adjustment terms could no longer be used.

Detections where potential covariate data (e.g., terrain, slope, observer, and seat position) or distance information were not collected (7 of 320) were excluded from the model estimators. The data were right-truncated to 1,100 m (Figure 2-4) to better fit the detection function[1] (Buckland et al. 2001).

[1] This resulted in the omission of one data point (seven caribou)

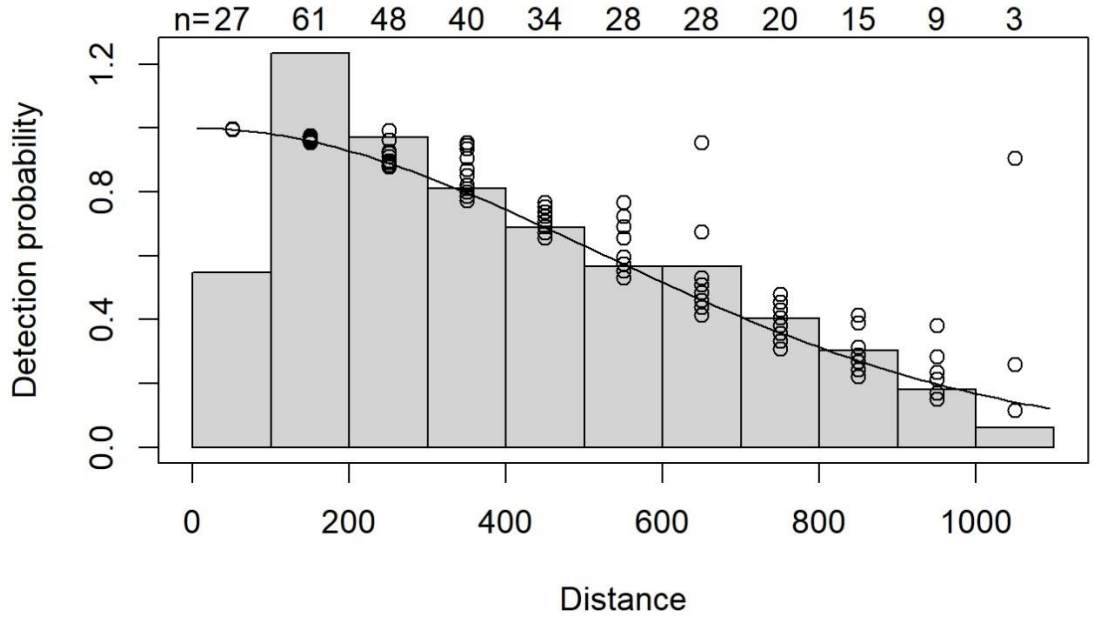

Figure 2-4 Detection Probability Function for Caribou Detections during 2022 Aerial Survey of Buchans Herd Post-calving Survey Area

The best model was selected based on AIC (Buckland et al. 2001) and goodness of fit (chi-square p-value). The AIC is a method of comparing several models to determine their relative quality based on how well each which model fits the data and on the number of variables in the model. Based on a combination of low AIC and goodness of fit, the half-normal model with group size and habitat as covariates was selected (Table G 3). This is the same model that was selected in 2021.

Table G 3 Detection Function Model Results for Models Including Group Size, Slope, and Habitat as Covariates

Key Function	Formula	ΔAIC	Chi-square p-value	$\hat{P}_a$	SE ($\hat{P}_a$)
Half Normal	group size + factor(slope)	0	0.005	0.576	0.030
Half Normal	*group size + factor(habitat)*	*0.341*	*0.019*	*0.576*	*0.030*
Half Normal	group size + factor(slope) + factor(habitat)	2.606	< 0.001	0.575	0.030
Hazard Rate	group size + factor(slope)	2.975	0.001	0.676	0.030
Hazard Rate	group size + factor(habitat)	3.195	0.006	0.678	0.030
Half Normal	group size	26.244	0.036	0.581	0.030
Hazard Rate	group size	29.044	0.014	0.668	0.032

Notes:
1. The 'best fit' model is displayed in italics
2. $\hat{P}_a$ = probability of detection; SE = standard error

3.0 RESULTS

3.1 BUCHANS HERD

3.1.1 Classification of Caribou on the Buchans Herd Calving Grounds Survey Area

Within the Buchans herd calving grounds survey area, 162 groups of caribou were classified (Table G 4 and Table G 5). There were 1,504 caribou detected, including 21 caribou with collars (Table G 5). Mean group size was 9 (range: 1-103). Most groups were comprised of single caribou (27%) and pairs (20%) (Table G 4). Single caribou of known sex were predominantly female (50%) (Figure G-2 in Appendix G), with males and yearlings accounting for 43% and 7%, respectively. Of the 32 pairs where sex and age were determined, 38% were calf:female pairs and 34% of pairs had at least one male (Figure G-2 in Appendix G).

Table G 4 Frequency of Buchans Herd Caribou Group Sizes, 2020 – 2022

Group Size	Frequency (Percent of Total Groups Detected)[1]
1	44 (27%)
2	33 (20%)
3-4	19 (12%)
5-10	26 (16%)
11-20	20 (12%)
21+	20 (12%)
Total Groups	162
Largest Group	103

[1] Percentages may not add up to 100% due to rounding.

More female than male caribou were detected, with ratios of 11 males:100 adults (7% males) and 85 females:100 adults (55% females) (Table 3.2) There were 436 calf:female pairs and a calf:100 female ratio of 54. Calves comprised 29% of caribou detected.

Table G 5 Group Demographics of Buchans Herd Caribou

Classification	Total[1]
Total Number of Groups	162
Mean Group Size (Range)	9 (1-103)
Total Caribou Detected from Classification	1,504
Total Adults	964
Adult Females	820
Adult Males	103

Table G 5 Group Demographics of Buchans Herd Caribou

Classification	Total[1]
Unknown Adults	41
Yearlings	100
Calves	440
Calf:Female Pairs	436
Female:100 Adults	85
Male:100 Adults	11
Calf:100 Females	54
Percent Females (%)	55
Percent Males (%)	7
Percent Calves (%)	29
Percent Yearlings (%)	7
Number of Collars Observed	21
Transect Distance (km)	2,093
Survey Area (km^2)	5,230

[1]All values are rounded to the nearest whole integer.

The greatest concentration of caribou was detected on the Buchans Plateau, between transect lines 12 and 22 (Figure 3-1). This is also where the greatest concentration of single females, calf:female pairs, and yearlings were found (Figure 3-2). A smaller concentration of caribou was detected at the margin of the survey area, approximately 2.5 km northwest of the Project Area between transect lines 30 and 32 (Figure 3-1), comprised of a mix of single females, calf:female pairs, yearlings, and males (Figure 3-2). Males were detected throughout much of the survey area, with concentrations on the Buchans Plateau and the area between the plateau and the Project Area (Figure 3-2).

Incidental observations (e.g., moose, black bear) are included in Figure 3-3. Caribou observed while in transit (e.g., during refueling) or outside the survey area boundaries were also considered incidental. A summary of the results from previous surveys (i.e., 2020 and 2021) is provided in Appendix G.

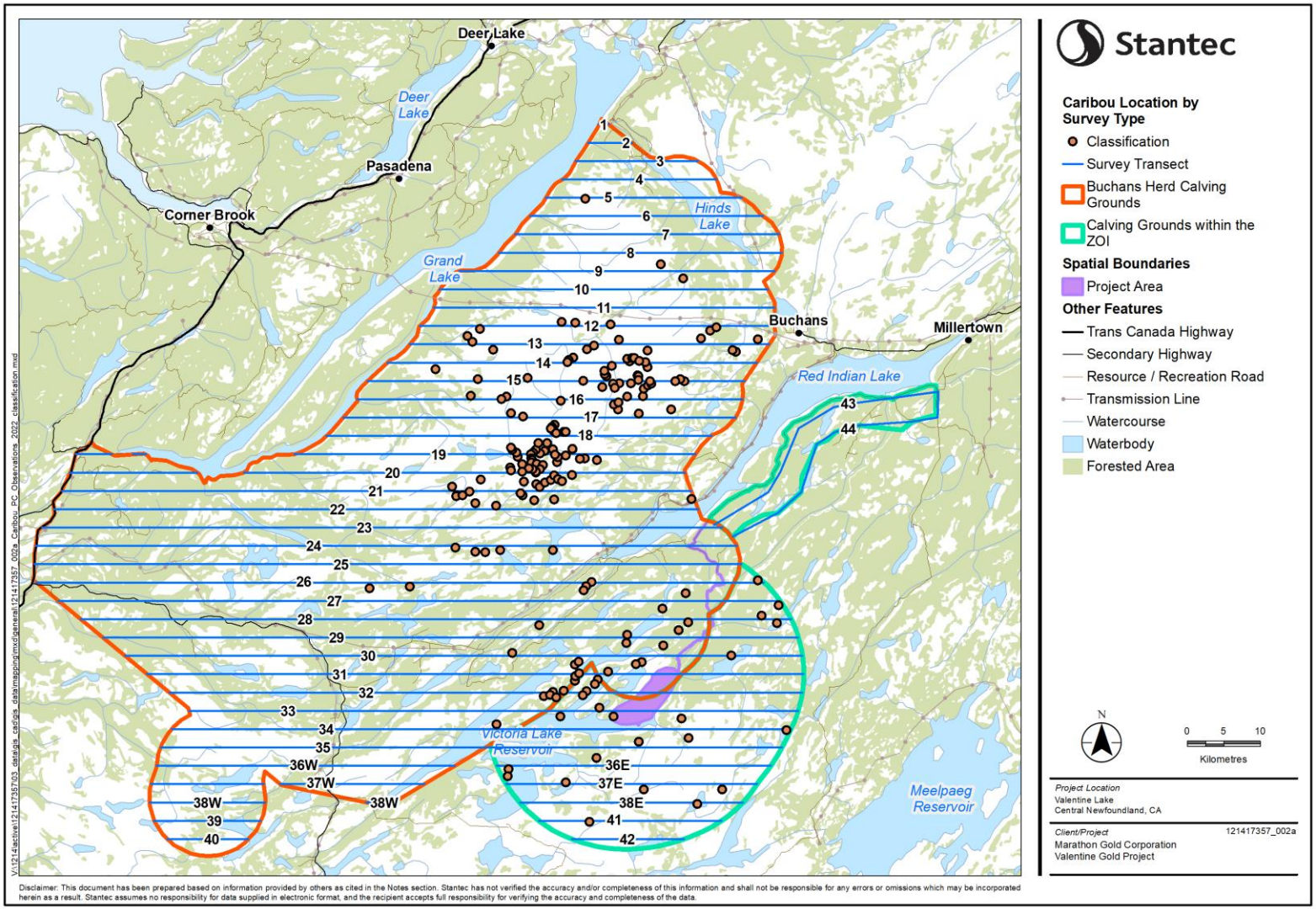

Figure 3-1 Distribution of Caribou Detected during the Classification Survey

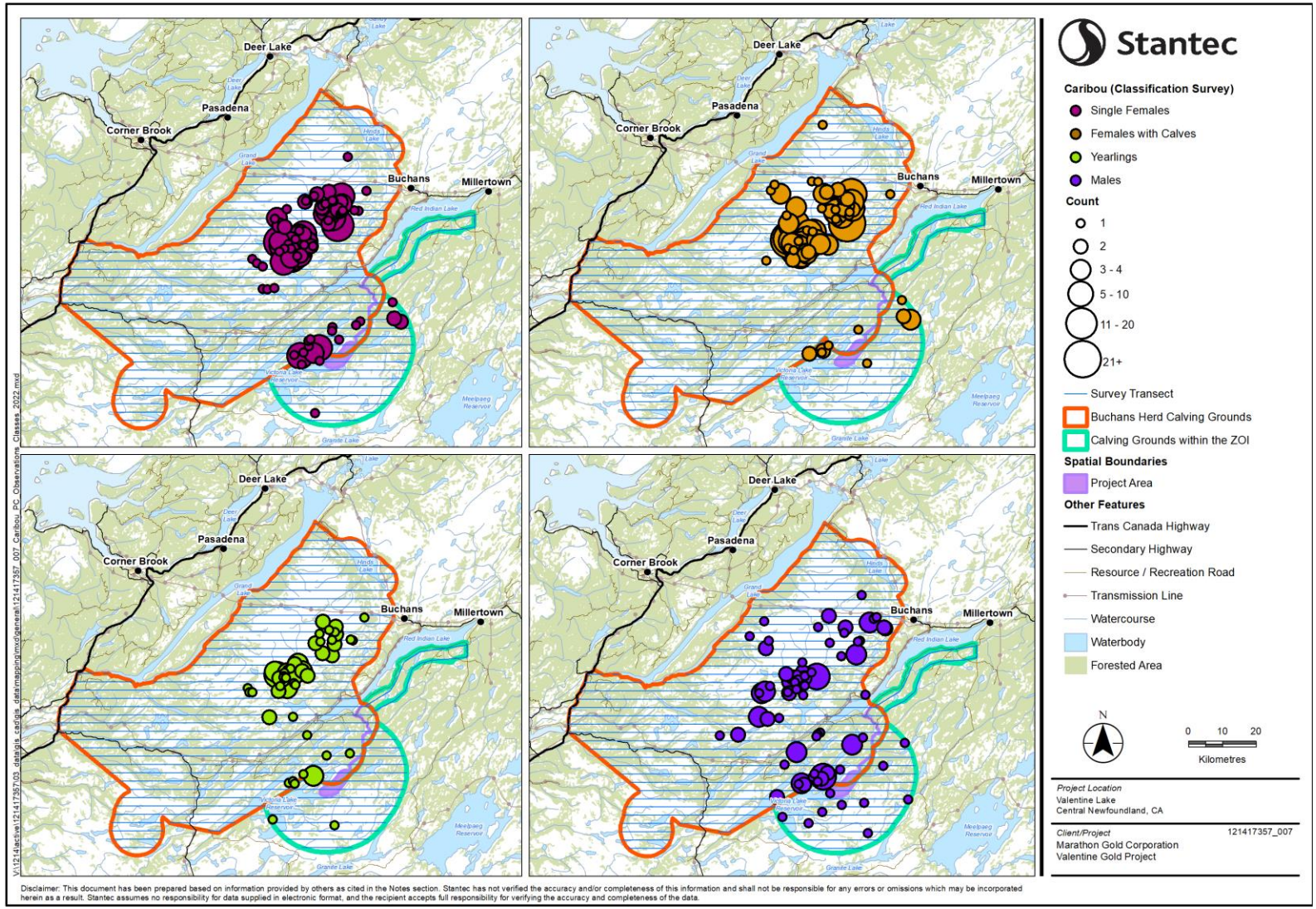

Figure 3-2 Distribution of Caribou Age and Sex Classes Identified during the Classification Survey

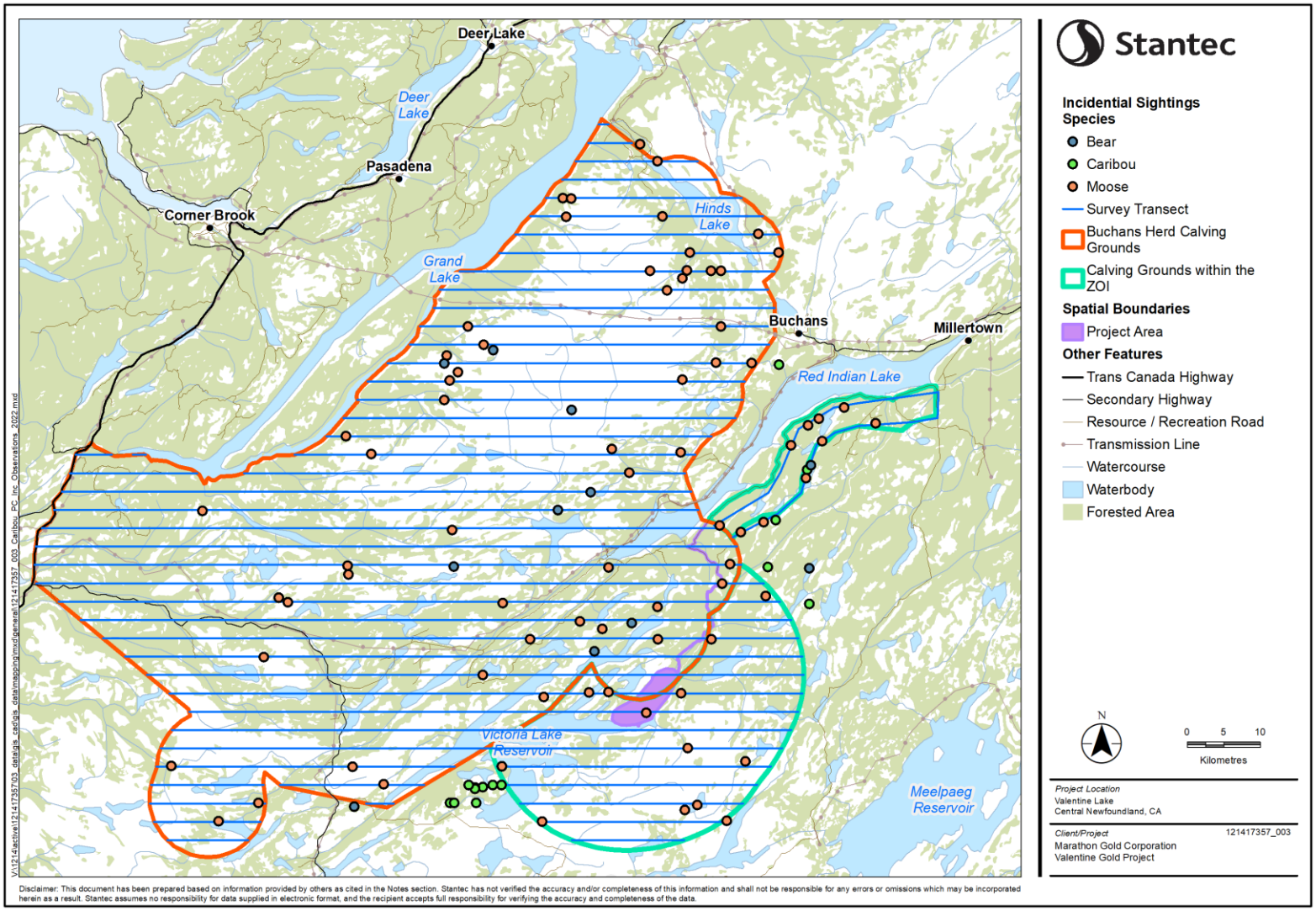

Figure 3-3 Incidental Detections during the 2022 Aerial Surveys

3.1.2 Population Estimate for Buchans Herd Caribou

Within the Buchans herd calving grounds survey area, 320 groups of caribou totaling 1,163 individuals were detected during the census survey.

The 2022 population estimate for the Buchans herd is 1,724 caribou (1,090 to 2,726 based on 95% confidence interval) (Table 3.3). The model estimated a mean group size of approximately 3.65 caribou (Table 3.3).

Table G 6 Population Estimate from the 2022 Aerial Survey of the Buchans Herd Calving Grounds Survey Area

Year	Number of Detections	$\hat{N}$	SE	CI	Mean Group Size	SE Group Size
2022	313	1,724	396.09	1,090 – 2,726	3.65	0.31

Notes:

1. $\hat{N}$ = population estimate, SE = standard error, CI = 95% confidence interval
2. Model is based on census only data and not the classification data as these two datasets are separated temporally.
3. Only caribou detections with distance and habitat information were included. This resulted in the omission of seven caribou groups (15 caribou).

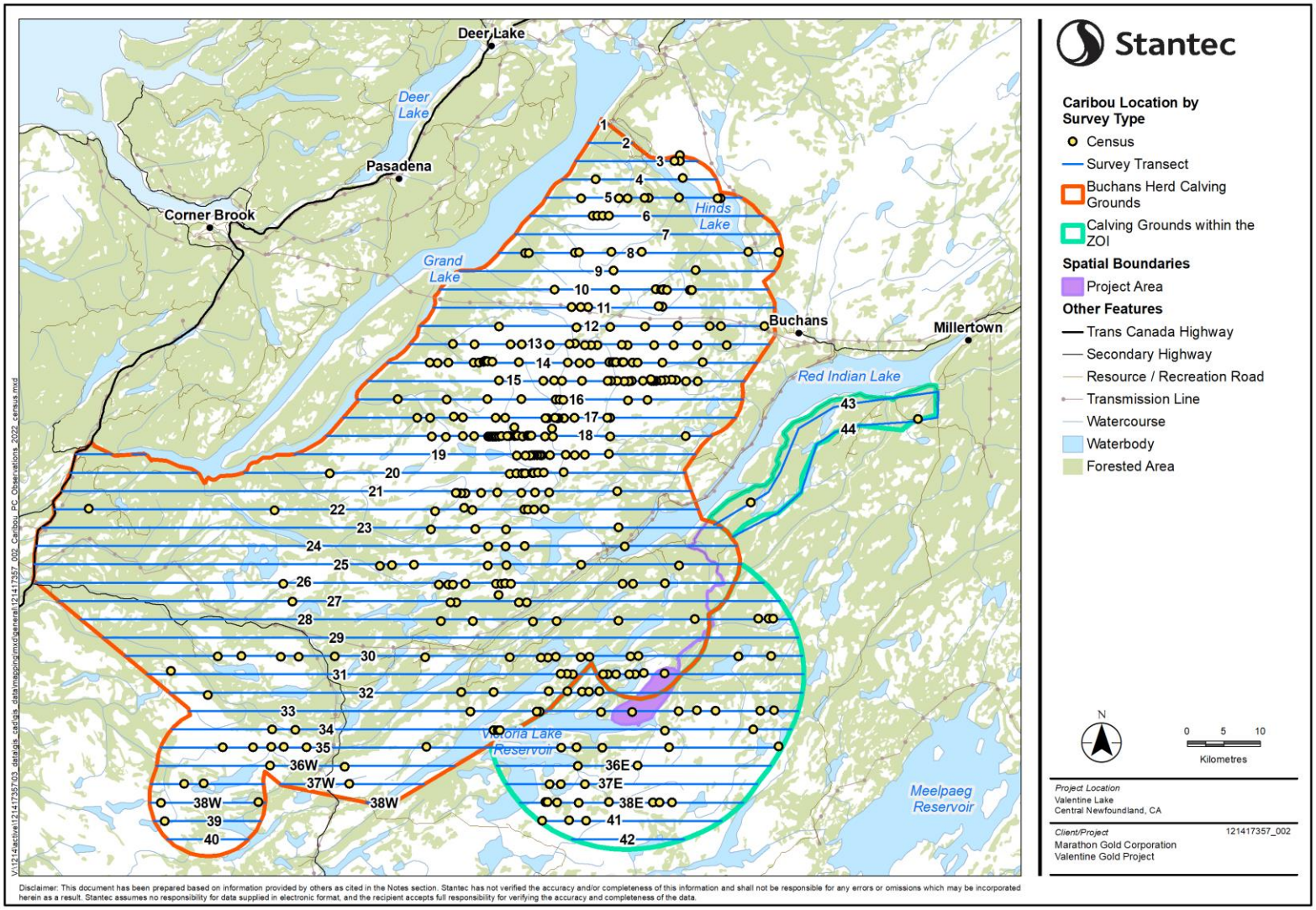

Figure 3-4 Distribution of Caribou Detected during the Census Survey

3.2 RESIDENT CARIBOU

3.2.1 Classification of Caribou on Calving Grounds within the ZOI

There were 24 groups of caribou classified within the resident caribou calving grounds survey area (Table 3.4 and Table 3.5). The number of caribou detected was 66, with a mean group size of three (range: 1 to 17) (Table 3.4). None of the caribou was collared. Most detections consisted of single caribou (63%) (Table G 7 Figure G-3 in Appendix G) that were predominantly male (64% of caribou of known sex) (Figure G-4). Sex and age were confirmed for three of the four pairs detected: two were calf:female pairs (67%) and the individuals in the third pair were both male (33%) (Figure G-4 in Appendix G).

Table G 7 Frequency of Resident Caribou Group Sizes 2022

Group Size	Frequency (Percent of Total Groups Detected)[1]
1	15 (63%)
2	4 (17%)
3-4	1 (4%)
5-6	1 (4%)
7-8	1 (4%)
9-10	1 (4%)
11-12	n/a
13-14	n/a
15+	1 (4%)
Total Groups	24
Largest Group	17

[1] Percentages may not add up to 100% due to rounding.

Males comprised 29% of caribou with a ratio of 38 males:100 adults, females comprised 44% with a ratio of 58 females:100 adults, and calves comprised 17% with a calf:100 female ratio of 38 (Table 3.5). In total, 11 calf:female pairs were detected on calving grounds in the ZOI (Table 3.5).

Table G 8 Group Demographics of Resident Caribou 2022

Classification	Total[1]
Total Number of Groups	24
Mean Group Size (Range)	3 (1-17)
Total Caribou	66
Total Adults	50
Adult Females	29
Adult Males	19
Unknown Adults	2
Yearlings	5

Table G 8 Group Demographics of Resident Caribou 2022

Classification	Total[1]
Calves	11
Calf:Female Pairs	11
Female:100 Adults	58
Male:100 Adults	38
Calf:100 Females	38
Percent Females (%)	44
Percent Males (%)	29
Percent Calves (%)	17
Percent Yearlings (%)	8
Number of Collars Observed	0
Transect Distance (km)	423
Survey Area (km^2)	871
[1]All values are rounded to the nearest whole integer.	

Caribou groups were detected throughout the survey area, although observations of single females, calf:female pairs, and yearlings occurred over a smaller area compared to males (Figure 3-2). Single females and calf:female pairs were primarily found in two locations: northeast of the Project Area near the boundary of the survey area, and west of the Project Area near the boundary of the resident caribou calving survey area (Figure 3-2). The largest group of yearlings (n=3) and males (n=6) was also detected west of the Project Area near the boundary of the resident caribou calving survey grounds (Table G 5). Elsewhere, males were mostly single individuals scattered throughout the survey area.

Incidental observations are included above in Figure 3-3. Caribou observed while in transit (e.g., during refueling) or outside the survey area boundaries were also considered incidental. A summary of the results from previous surveys (i.e., 2020 and 2021) is provided in Appendix G.

3.3 DETECTIONS IN THE PROJECT AREA AND LAA

Five caribou were detected in the Project Area, comprised of a single observation and one group of three during the census survey, and a single male during the classification survey. There were also two groups of two caribou detected along the road transects during the census survey. There were no caribou detected in portion of the LAA outside of the Project Area.

4.0 SUMMARY AND DISCUSSION

4.1 BUCHANS HERD CALVING GROUNDS SURVEY AREA

Caribou detected on the Buchans herd calving grounds were primarily aggregated on the Buchans plateau, as observed in previous survey years (Figure 3-2 and Appendix H). In total, 1,163 caribou were detected during the census and 1,504 during the classification survey. The number of groups classified in 2022 was 162, which is lower than in previous years (Appendix G) however is likely reflective of the survey methods used in 2022 (i.e., only a subset of the survey area was surveyed versus all caribou groups detected during the census). Although the mean group size in 2022 was nine (based on the classification data), most groups were of single caribou (27%), and half of these were female. The largest group was 103 animals.

Overall, more females (n=820) than males were observed (n=103). Caribou detections were comprised of 54% females, 7% males, 29% calves, and 7% yearlings. The proportion of females was 85:100 adults and of males was 11:100 adults.

The 2022 population estimate for the Buchans Herd calving grounds survey area was 1,724 caribou (95% CI: 1,585–3,816).

4.2 RESIDENT CARIBOU ON CALVING GROUNDS WITHIN THE ZOI

In the resident caribou calving grounds survey area, the greatest concentration of caribou in 2022 was west of the Project Area near Victoria Lake, same as the 2021 and 2020 survey results (Figure 3-2 and Appendix H). In total, 78 caribou were detected during the census and 66 during the classification survey. The total number of groups classified was 24 and the mean group size was 3 (although 63% of caribou detections were of single animals). The largest group was 17.

Overall, more females (n=29) were detected than males (n=19). Classified caribou were 44% females, 29% males, 17% calves, and 8% yearlings. The proportion of females was 58 females:100 adults and of males was 38 males:100 adults.

4.3 CARIBOU DETECTIONS IN THE PROJECT AREA AND LAA

In 2022, there were nine caribou detected in the Project Area, including four along the access road transects, and none in the larger LAA (i.e., outside of the Project Area). For comparison, in 2021 there was one caribou detected in the Project Area, two groups detected in the LAA, and four groups detected along the access road transects. In 2020 there were three groups detected in the LAA, however these were outside of the Project Area.

4.4 DISCUSSION

On the Island of Newfoundland, caribou populations are limited by poor calf survival and, since the mid-1990s, calf survival has decreased due to an increase in the predation rate (Government of NL 2015). Black bear and coyote are the primary predators of caribou calves on the Island of Newfoundland (Mumma et al. 2016, 2019; Bastille-Rousseau et al. 2016), although calves are also preyed upon by other predators such as bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), and Canada lynx (*Lynx canadensis)* (Lewis et al. 2017).

During the Island-wide caribou population increase between 1979 and 1997, the predation rate on caribou calves was approximately 60% and the calf survival rate (i.e., proportion of calves surviving to six months) was approximately 66%. Calf survival dropped to less than 8% in 2003 (Mahoney et al. 2015), as predation rates continued to increase (reaching 83% between 2003 and 2007) (Mahoney and Weir 2009). During the period from 2003 to 2012, approximately 90% of collared calf deaths were attributed to predation (Lewis and Mahoney 2014). Recent studies suggest that the calf survival rate may be increasing to more sustainable levels, with reports of a nearly 50% survival rate in 2012 (Mahoney et al. 2015).

In the 2022 survey, 29% and 17% of caribou on the Buchans herd calving grounds and resident caribou calving grounds in the ZOI, respectively, were calves. The percentage of calves on the Buchans herd calving grounds in 2022 was similar across survey years (23% in 2021 and 30% in 2020), while that on the resident calving grounds is more variable (11% in 2020 and 31% in 2021). Previous surveys completed during the fall and winter of 2007, 2011, 2016 and 2019 found between 8-16% calves in the Buchans herd and 6-15% calves in the Grey River herd (Government of NL 2020b). A higher proportion of calves would be expected in the current surveys compared to fall or winter, as they occur immediately following calving. However, for resident caribou a similar proportion of calves was detected in the 2022 and 2020 surveys compared to the earlier fall and winter surveys, even though the surveys occurred shortly after calving. The resident caribou calving grounds survey area also had a higher proportion of males (29%) than the Buchans herd calving grounds survey area (7%), whereas the proportion of females was similar (resident – 44%; Buchans – 55%).

The caribou sex ratio on the Island of Newfoundland is generally more females to males, with a decreasing trend in males detected since the 1980s (Weir et al. 2014). The decline appears to have slowed since 2006, and the fall sex ratio increased between 2000 and 2012 to approximately 23 males:100 adult caribou (Weir et al. 2014). As indicated, more females were detected than males in each survey area, however the difference was most pronounced for caribou on the Buchans herd calving grounds (7% males). Caribou distribution can be segregated by sex at certain times of year (Jakimchuk et al. 1987) including during calving (Lent 1966; Cameron and Whitten 1979), which could explain the low proportion of males detected on the calving grounds. In Alaska, male and calving females occupy distinct areas following calving (Jakimchuk et al. 1987), and caribou in British Columbia show segregation following calving, with females selecting habitats with lower predation risk, possibly at the expense of forage availability (Bergerud et al. 1984). Sexual segregation on calving grounds has also been observed in the George River herd in Labrador (Couturier et al. 1996), and in the Bluenose-East Herd in the Northwest Territories (Adamczewski et al. 2014). Indeed, caribou detections in the current and previous surveys indicate that while females and females with calves are primarily aggregated in one portion of the Buchans herd calving grounds survey area, males are generally more widely dispersed.

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APPENDIX A

Scientific Research Permit

Government of Newfoundland and Labrador
Department of Fisheries, Forestry & Agriculture
Wildlife Division

Scientific Research Permit

(as under section 86 of the Wildlife Regulations, Consolidated Newfoundland and Labrador Regulation 1156/96)

Permit request #: WLR2022-51

Issued to: James Powell, Vice-President Regulatory and Government Affairs
Marathon Gold Corporation
P.O. Box 4006, Pearlgate PO
Mt. Pearl, NL A1N 0A1

Tel: (709) 730-5046
jpowell@marathon-gold.com

Study Title: Aerial Survey of Caribou Calving Grounds for the Valentine Gold Project 2022

Purpose: 1. Conduct an aerial survey (using distance sampling) of caribou calving grounds of the Buchans herd and the caribou present within the zone of influence of the proposed mine and to complete a population estimate of the entire calving grounds for the Buchans herd. 2. Conduct a classification survey (to determine caribou group size and composition) .

This work is being completed in relation to the Valentine Gold Project in west-central Newfoundland, as per requirements of the Environmental Impact Statement (EIS) Guidelines.

Location: The aerial survey of the calving grounds will occur in the area between Grand Lake and Victoria Lake as shown in Figure 1 (See schedule 1).

Conditions:

1) This permit authorizes Stantec Consulting to conduct activities on behalf of Marathon Gold Corporation. The permit holder is responsible for ensuring all conditions of the permit are met.

2) Stantec Consulting nominees under this permit include: Truman Porter (Navigator/Recorder), Karen Rashleigh, Doug Rimmer, Robyn Knight and Wayne Tucker.

3) Any herding of caribou at higher flying elevation for the purpose of positioning animals onto more optimal terrain prior to low-level approach for conducting classifications shall not exceed five minutes.

4) The methods described in the attached permit application shall be followed as closely as possible. Any changes to the survey design, methodology or crew outlined in the permit application will require prior approval.

5) Further to the methods described in the attached permit application, the Wildlife Division requires the following additional protocols to be followed during surveys:

   i) there must be two (2) (rear seat) observers in addition to the navigator/recorder;

   ii) observers must switch viewing positions halfway through each survey day;

   iii) each recorded observation must include the observer who made it, distance/angle, and group size and as well as other information the detection function;

   iv) air craft heading should be recorded for each transect.

6) The permit holder shall advise all nominees that their information will be provided to the Forestry and Wildlife Branch. Names and contact information for any additional individuals/nominees participating in the survey shall be provided to the following Forestry and Wildlife Branch staff prior to commencement of field activities:

   Shelley Moores, Senior Manager of Wildlife Research (shelleymoores@gov.nl.ca);
   Jessica Humber, Ecosystem Management Ecologist (jessicahumber@gov.nl.ca).

7) All raw data collected under the authority of this permit (NL provincial lands) shall be provided in digital format to the Forestry and Wildlife Branch (Shelley Moores, Jessica Humber, and Blair Adams) by **August 1, 2022**. Data shall include, but not be limited to flight tracts, number of caribou observed per transect, number of low-level passes per group of classified caribou, georeferenced caribou locations and an accompanying map, raw caribou classification results (percent calves, percent cows, percent males, calves/100F), and caribou group size data as well as the total caribou observed on transect and in total. Ancillary observations of Black bears and coyotes should also be reported.

8) A final report including a detection function and population estimate and summaries of classification data should be provided within 3 months (September 1, 2022)

9) Should any wildlife be injured, harmed or display any signs of adverse reactions to the project activities, these observations must be immediately reported to the Wildlife Division (Shelley Moores).

10) A copy of this permit shall be retained in the field at all times by at least one person on

the permit personnel list and is to be provided to a Newfoundland and Labrador Resource Enforcement Officer or other person of delegated authority upon request.

11) This permit does not absolve or relieve the permit holder from any other laws, permits, regulations or orders, not otherwise specified herein.

12) This permit does not relieve the permit holder from the requirement to acquire permission to access private property.

13) Future requests for scientific research permits will be re-assessed based on the outcome of the current undertaking and the submission of findings and data to the Wildlife Division.

14) The Senior Manager of Wildlife Research reserves the right to revise or revoke this permit at any time.

Date of Commencement: June 5, 2022 **Date of Expiration: June 15, 2022**

<original signed by>

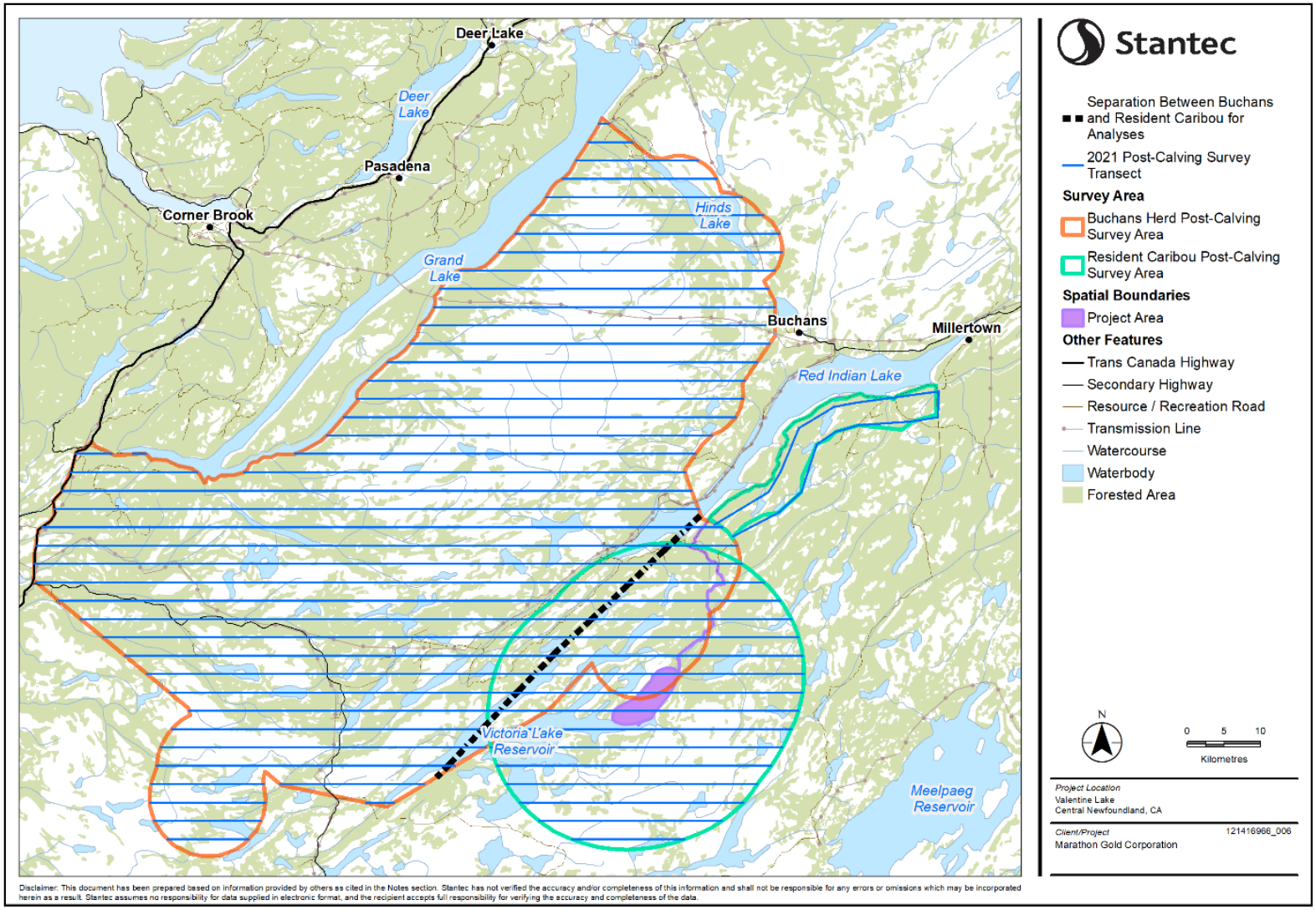
June 5, 2022

Date **Director of Wildlife**

Attachment: Schedule 1 – Survey Area and transects for the 2021 Aerial Survey of Caribou Calving Grounds for the Buchans Herd (being repeated in 2022)

cc:
Shelley Moores, Senior Manager of Wildlife Research
Wildlife Division
shelleymoores@gov.nl.ca

Schedule 1



Survey Area and transects for the 2021 Aerial Survey of Caribou Calving Grounds for the Buchans Herd

APPENDIX B

Scientific Research Permit Application

APPLICATION TO CONDUCT WILDLIFE RESEARCH IN NEWFOUNDLAND AND LABRADOR

June 1, 2022

APPLICANT: **James Powell,** Vice-President Regulatory and Government Affairs
Marathon Gold Corporation
P.O. Box 4006, Pearlgate PO,
Mt. Pearl, NL, A1N 0A1
Phone: +1 (709) 730-5046
jpowell@marathon-gold.com

TITLE OF INVESTIGATION: *Aerial Survey of Caribou Calving Grounds for the Valentine Gold Project 2022*

Stantec Consulting Ltd. (Stantec) is undertaking an aerial survey as part of monitoring activities associated with the Valentine Gold Project (the Project) on behalf of Marathon Gold Corporation (Marathon). Marathon is seeking a permit for the aerial survey as this activity has the potential to disturb wildlife. The approach has been modified from that applied during the 2021 survey, permit # WLR2021-26 to reflect the discussion with NLDFAA-Wildlife Division on May 31, 2022.

The objectives of the 2022 aerial survey are:

- Complete a population estimate, including group size estimates, of the entire calving grounds for the Buchans herd
- Sample caribou composition including the number of cow-calf pairs (i.e., classification) on:
  - the Buchans herd calving grounds; and
  - the calving grounds within the zone of influence (we have assumed the same area as surveyed in 2021 and has been confirmed by NLDFFA-Wildlife Division)

SURVEY AREA

The 2022 survey will use the boundaries of the 2021 survey area (Figure 1). There are 42 transects in the overall survey area, with a total distance of 2,518 km.

Buchans Herd

The Buchans herd survey area was delineated based on telemetry data transferred from the Wildlife Division (Argos and GPS collar data from 2007-2012 and 2016-2017) as well as discussion with the Wildlife Division. Kernels were developed (95% kernels) for the calving season (May 20 – June 10). Individuals with fewer than 50 locations in the season of interest were not included in the calculation of calving range because of their potential to bias home population-level range

estimates. Seaman et al. (1999) found that the bias and variance of kernel home range estimates approached an asymptote at about 50 locations per home range. The threshold of at least 50 locations per individual is a commonly used parameter for kernel estimation for caribou (e.g., caribou: Donovan et al. 2017) and other ungulates (e.g., Rosatte 2016; Vander Wal and Rodgers 2012; Schrautemeier 2017), as well as other wildlife species (e.g., Nicholson et al. 2014; Barg et al. 2005; Tri et al. 2014). A kernel was generated for each collared caribou and included all years for which there was sufficient data. Individual kernels were then pooled to create the range estimate for the herd. The calving range estimate included collared caribou with 50 or more locations in the calving season. A 5-km buffer was added to the calving range kernel. This was overlaid with information from the Wildlife Division that suggested survey boundaries. The final survey area was determined by merging the entirety of the area suggested by the Wildlife Division with the area of the 95% kernel with 5-km buffer (Figure 1).

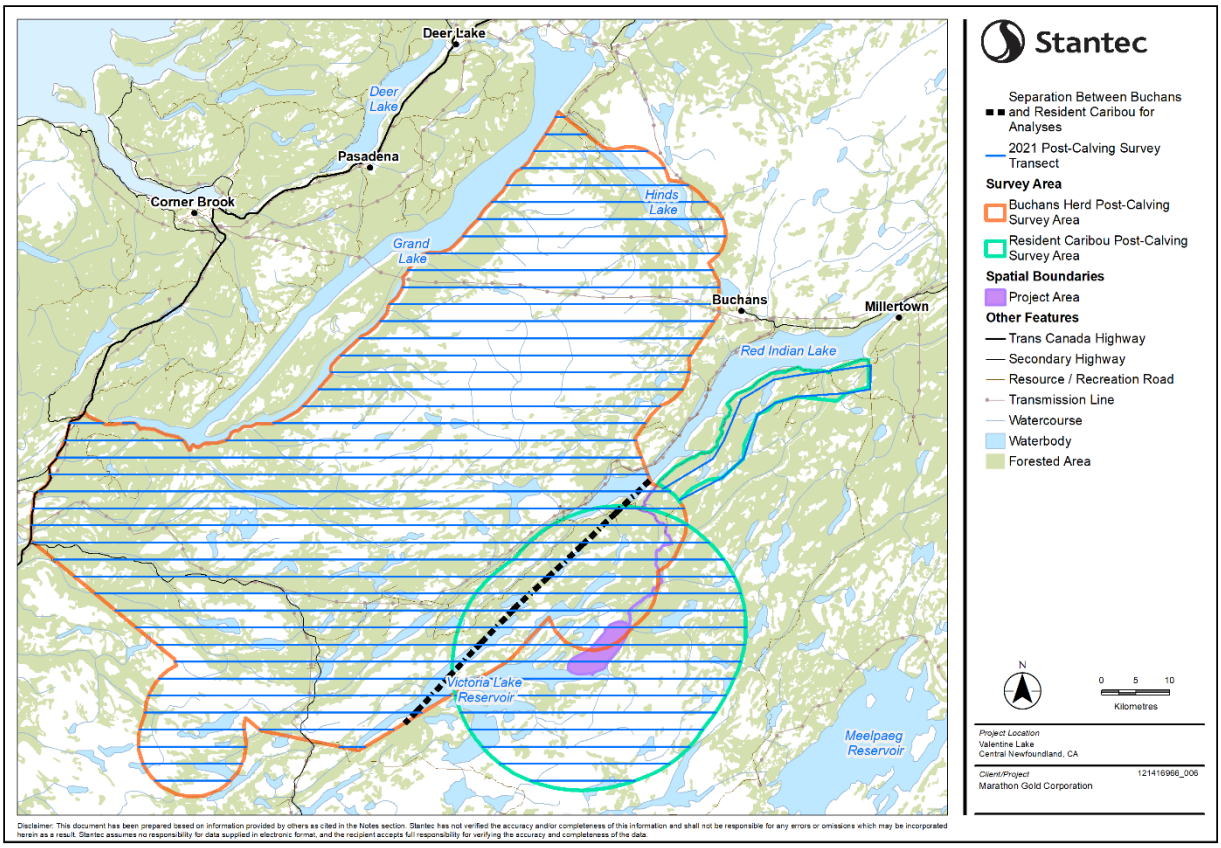


Figure 1 Proposed Survey Area and Transects for the 2022 Aerial Survey of Caribou Calving Grounds

Resident Caribou who Calve within the Zone of Influence

The survey area for resident caribou includes a 17-km buffer around the mine site in addition to a 4-km buffer along the south side of the access road (Figure 1). The 17-km buffer was selected based on results from noise modelling conducted for the Project, which predicted a return to baseline sound pressure levels 5 km from the mine site; and ZOIs presented in the literature that show caribou avoidance of mines between 2 and 11 km (Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012; LeBlond et al. 2014; Johnson et al. 2015; Pigeon et al. 2016; Eftestøl et al. 2019). Transects were established within the survey area at 2.5-km intervals. Additionally, a 4-km survey area was added around the access road. Caribou exhibit avoidance of roads up to 4 km (Dyer et al. 2001; Vistnes and Nellemann 2001; Nellemann et al. 2003; Polfus et al. 2011). Within the survey area of the access road, the transects from the 2020 survey will be reused. The two transects will be at a 3-km interval (i.e., transects will be positioned 1 and 4 km from the road) (Figure 1).

Note: the area of overlap between the Buchans Herd and resident caribou survey areas (Figure 1) will only be surveyed once.

2022 AERIAL SURVEY OF CARIBOU CALVING GROUNDS

The aerial survey is scheduled to occur in early June and will involve the following:

- Preparation and review of safety and survey protocols with all members of the Survey Team prior to the start of the field program, including COVID-19 protocols
- Close collaboration with the NLDFFA-Wildlife Division in survey design and completion.

Methods

A Bell 206L Long Ranger helicopter (with 'bubble' rear windows to enhance observer visibility) will fly along the transect lines at approximately 100-120 km/hr and an altitude of approximately 100 m above ground level. The Survey Team will include a navigator (positioned in the left front seat of the helicopter), and two rear seat observers who will switch viewing positions halfway through each survey day. All observations will include the name of the observer, distance/angle and group size, in addition to other relevant information; aircraft direction will be recorded for each transect. The individuals from Stantec who may participate are: Truman Porter, Karen Rashleigh, Doug Rimmer and Wayne Tucker. It has been confirmed that NLDFFA-Wildlife Division will have an individual in the helicopter as was the protocol for the entirety of the in 2021 survey.

Distance sampling will be used to estimate the population of the caribou on the Buchans and resident herd calving grounds. The same pre-established transects (2.5 km apart) will be flown as were in 2021. At the start of each transect, the Survey Team will record temperature, wind direction and speed, cloud cover and precipitation, and estimate visibility and percent snow cover on field data sheets. Caribou will not be handled during the survey. Observations of caribou individuals and tracks will be recorded as geo-referenced waypoints using a handheld GPS unit.

Distance sampling methods require that the perpendicular distance between detected animals and the transect line is determined. When a group of caribou is observed, the Survey Team will

record the location of the helicopter on the GPS unit (which will also record altitude). A laser rangefinder will be used to measure the distance to the detected caribou. Should the rangefinder not be able to adequately 'target' the detected caribou such that a distance can be measured, the sighting angle between the helicopter and the caribou will be measured. During analysis, this information will be used to calculate the perpendicular distance between the caribou and the transect line. In addition to measuring the distance to the caribou (or sighting angle), the Survey Team will estimate the perpendicular distance of the caribou from the transect line using calibrations on the helicopter windows. Prior to the survey, the Survey Team will calibrate the windows at 100 m above ground level by marking horizontal lines on the helicopter window that correspond to distance classes (e.g., 1 = 0-200 m; 2 = 200-400 m; 3 = 400-600m; 4 = 600-800 m; 5 = 800-1,000 m; 6 = 1,000-1,200m; and 7 > 1,200 m). For this survey, the perpendicular distance will be calculated during analysis for all detected caribou using trigonometry. Other information related to the detection (e.g., whether the habitat is open or closed, visibility) will also be recorded on field data sheets.

After flying all transects for the census, a sample of the observed herds will be classified (e.g., numbers of males, females, calves, yearlings) based on a variety of larger and smaller groups, animals in different areas, and with an optimal classification sample of approximately 400 caribou / herd, if possible. The number of observed caribou and group composition will be recorded on field data sheets. Locations of other wildlife species or tracks observed on transects will be recorded on the GPS unit and on the data sheets as incidental. Wildlife that are observed while ferrying between transects (e.g., tracks or sightings of caribou or other wildlife species) will be recorded on the GPS unit. Professional judgment/discretion of experience field staff will be applied in the field to determine if transects need to be modified to accommodate presence/absence of caribou observed in the field.

The survey is scheduled to occur in early June and is anticipated to take approximately six days.

MITIGATION

The Study Team will implement measures to avoid or reduce disturbance associated with helicopter use. These include:

- Maintaining a minimum flight altitude of 100 m above ground along transects.
- Increasing altitude and distance if animals show signs of stress from the helicopter
- Avoiding hovering and circling where possible
- Maintaining a minimum flight altitude of 200 m above ground outside of transects
- Limiting helicopter activity to that necessary to locate, count, and classify caribou
- Limiting herding caribou for the purpose of repositioning to facilitate classification to five minutes

REPORTING

Stantec will prepare a report to summarize the findings of the 2022 survey and will submit the report to Marathon for approval and further release to the Wildlife Division.

SUBMISSION

Blair Adams
Director – Fisheries, Forestry and Agriculture
Email: BlairAdams@gov.nl.ca
Phone: (709) 256-1450

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APPENDIX C

Transect Lengths

Table C.1 Transect Lengths in the Survey Area

Transect Number	Transect Length in Buchans Herd Calving Grounds Survey Area (km)	Transect Length in Resident Caribou Survey Area (km)	Total Length (km)
1	1.3		1.3
2	5.9		5.9
3	16.7		16.7
4	21.0		21.0
5	26.7		26.7
6	31.7		31.7
7	36.0		36.0
8	38.6		38.6
9	43.0		43.0
10	44.8		44.8
11	46.5		46.5
12	48.4		48.4
13	49.0		49.0
14	50.4		50.4
15	51.4		51.4
16	52.6		52.6
17	53.5		53.5
18	52.5		52.5
19	61.3		61.3
20	77.6		77.6
21	85.9		85.9
22	87.9		87.9
23	92.8		92.8
24	95.7		95.7
25	96.5		96.5
26	95.1	4.2	99.3
27	90.8	7.6	98.5
28	85.8	11.1	97.0
29	82.5	12.5	94.9
30	78.5	14.0	92.5
31	70.7	18.9	89.6
32	60.2	26.1	86.3
33	49.0	34.1	83.1
34	46.8	37.7	84.5

Table C.1 Transect Lengths in the Survey Area

Transect Number	Transect Length in Buchans Herd Calving Grounds Survey Area (km)	Transect Length in Resident Caribou Survey Area (km)	Total Length (km)
35	44.8	39.9	84.8
36-W and 36-E	40.7	37.4	78.1
37-W and 37-E	35.0	34.3	69.3
38-W and 38-E	19.6	30.5	50.0
39	14.5		14.5
40	11.1		11.1
41		25.0	25.0
42		15.3	15.3
43 (road)		38.3	38.3
44 (road)		35.4	35.4
Total Transect Length (km)	2,092.8	422.3	2,515.1

Notes:
1. W = west (Buchans herd post-calving survey area) and E = east (resident caribou post-calving survey area)
2 Numbers are rounded to one decimal place. Transects may not add up to total amounts due to rounding.

APPENDIX D

Aerial Census Survey Effort and Weather Conditions

Table D.1 2022 Aerial Census Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time	End Time	Helicopter Heading	Habitat Description (% Open / % Closed)	Temperature	Wind Direction / Speed	Cloud Cover (%)	Visibility	Precipitation
		Right Front Seat (Pilot)	Left Front Seat	Left Rear Seat	Right Rear Seat									
1	June 6, 2022	LP	TP	DR	AC	9:04	9:11	W	50 / 50	18	NNE / 17 km/hr	0	unlimited	0
2	June 6, 2022	LP	TP	DR	AC	9:12	9:17	E	N/A	18	NNE / 17 km/hr	0	unlimited	0
3	June 6, 2022	LP	TP	DR	AC	9:18	9:25	W	50 / 50	18	NNE / 17 km/hr	0	unlimited	0
4	June 6, 2022	LP	TP	DR	AC	9:26	9:36	E	90 / 10	18	NNE / 17 km/hr	0	unlimited	0
5	June 6, 2022	LP	TP	DR	AC	9:37	9:52	W	60 / 40	18	NNE / 17 km/hr	0	unlimited	0
6	June 6, 2022	LP	TP	DR	AC	9:59	10:31	E	50 / 50	18	NNE / 17 km/hr	0	unlimited	0
7	June 6, 2022	LP	TP	DR	AC	10:32	10:44	W	70 / 30	18	NNE / 17 km/hr	0	unlimited	0
8	June 6, 2022	LP	TP	DR	AC	10:46	11:01	E	60 / 40	18	NNE / 17 km/hr	0	unlimited	0
9	June 6, 2022	LP	TP	DR	AC	11:02	11:23	W	60 / 40	18	NNE / 17 km/hr	0	unlimited	0
10	June 6, 2022	LP	TP	DR	AC	11:24	11:45	E	50 / 50	18	NNE / 17 km/hr	0	unlimited	0
11	June 6, 2022	LP	TP	DR	AC	11:46	12:06	W	60 / 40	18	NNE / 17 km/hr	0	unlimited	0
12	June 6, 2022	LP	TP	DR	AC	12:07	12:27	E	40 / 60	18	NNE / 17 km/hr	0	unlimited	0
13	June 6, 2022	LP	TP	DR	AC	13:07	13:34	W	70 / 30	18	NNE / 17 km/hr	0	unlimited	0
14	June 6, 2022	LP	TP	DR	AC	13:35	14:00	E	50 / 50	18	NNE / 17 km/hr	0	unlimited	0
15	June 6, 2022	LP	TP	DR	AC	14:01	14:33	W	70 / 30	18	NNE / 17 km/hr	0	unlimited	0
16	June 6, 2022	LP	TP	DR	AC	14:34	14:59	E	30 / 70	18	NNE / 17 km/hr	0	unlimited	0
17	June 6, 2022	LP	TP	DR	AC	15:00	15:28	W	40 / 60	18	NNE / 17 km/hr	0	unlimited	0

Table D.1 2022 Aerial Census Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time	End Time	Helicopter Heading	Habitat Description (% Open / % Closed)	Temperature	Wind Direction / Speed	Cloud Cover (%)	Visibility	Precipitation
		Right Front Seat (Pilot)	Left Front Seat	Left Rear Seat	Right Rear Seat									
18	June 6, 2022	LP	TP	DR	AC	15:30	16:06	E	50 / 50	18	NNE / 17 km/hr	0	unlimited	0
19	June 6, 2022	LP	TP	DR	AC	16:40	17:17	W	50 / 50	18	NNE / 17 km/hr	1	unlimited	trace
20	June 7, 2022	LP	TP	AC	DR	8:35	9:13	E	50 / 50	18	N / 20km/hr	0	unlimited	0
21	June 7, 2022	LP	TP	AC	DR	9:14	9:49	W	50 / 50	18	N / 20km/hr	0	unlimited	0
22	June 7, 2022	LP	TP	AC	DR	9:51	10:29	E	50 / 50	18	N / 21km/hr	0	unlimited	0
23	June 7, 2022	LP	TP	AC	DR	11:08	11:45	W	50 / 50	18	N / 21km/hr	0	unlimited	0
24	June 7, 2022	LP	TP	DR	AC	11:46	12:24	E	40 / 60	18	N / 20km/hr	0	unlimited	0
25	June 7, 2022	LP	TP	DR	AC	12:55	13:34	W	40 / 60	18	N / 21km/hr	0	unlimited	0
26	June 7, 2022	LP	TP	DR	AC	13:35	14:24	E	40 / 60	18	N / 20km/hr	0	unlimited	0
27	June 7, 2022	LP	TP	DR	AC	15:01	15:40	W	50 / 50	18	N / 20km/hr	0	unlimited	0
28	June 7, 2022	LP	TP	DR	AC	15:41	16:15	E	30 / 70	18	N / 20km/hr	0	unlimited	0
29	June 7, 2022	LP	TP	DR	AC	16:19	16:52	W	20 / 80	18	NE / 20km/hr	0	unlimited	0
30	June 8, 2022	LP	TP	DR	AC	8:43	9:21	E	30 / 70	20	NNE / 15km/hr	0	unlimited	0
31	June 8, 2022	LP	TP	DR	AC	9:23	10:08	W	30 / 70	20	NNE / 15km/hr	0	unlimited	0
32	June 8, 2022	LP	TP	DR	AC	10:10	10:46	E	40 / 60	20	NNE / 15km/hr	10	unlimited	0
33	June 8, 2022	LP	TP	DR	AC	11:38	12:14	W	40 / 60	20	NNE / 15km/hr	10	unlimited	0
34	June 8, 2022	LP	TP	AC	DR	12:15	13:15	E	50 / 50	20	NNE / 15km/hr	30	unlimited	0

Table D.1 2022 Aerial Census Survey Effort and Weather Conditions

Transect	Date	Observer				Start Time	End Time	Helicopter Heading	Habitat Description (% Open / % Closed)	Temperature	Wind Direction / Speed	Cloud Cover (%)	Visibility	Precipitation
		Right Front Seat (Pilot)	Left Front Seat	Left Rear Seat	Right Rear Seat									
35	June 8, 2022	LP	TP	AC	DR	13:20	13:48	W	60 / 40	20	NNE / 15km/hr	30	unlimited	0
36	June 8, 2022	LP	TP	AC	DR	13:50	14:18	E	60 / 40	20	NNE / 15km/hr	50	unlimited	0
37	June 8, 2022	LP	TP	AC	DR	15:17	15:50	W	50 / 50	20	NNE / 15km/hr	80	unlimited	0
38	June 8, 2022	LP	TP	AC	DR	15:52	15:59	E	50 / 50	20	NNE / 15km/hr	80	unlimited	0
39	June 8, 2022	LP	TP	AC	DR	16:00	16:06	W	50 / 50	20	NNE / 15km/hr	80	unlimited	trace
40	June 8, 2022	LP	TP	AC	DR	16:07	16:43	E	50 / 50	20	NNE / 15km/hr	0	unlimited	0
41	June 8, 2022	LP	TP	AC	DR	16:45	16:56	W	70 / 30	20	NNE / 15km/hr	0	unlimited	0
42	June 8, 2022	LP	TP	AC	DR	16:58	N/A	E	70 / 30	20	NNE / 15km/hr	0	unlimited	0
43 (Road)	June 9, 2022	LP	TP	AC	DR	8:56	9:10	E	N/A	20	N / 8km/hr	90	unlimited	trace
44 (Road)	June 9, 2022	LP	TP	AC	DR	9:12	9:27	W	10 / 90	20	N / 8km/hr	90	unlimited	trace

APPENDIX E

Data Sheet for Aerial Survey

121417357 – Marathon Caribou Post-Calving Aerial Survey Data

Page ____ of _____ for transect_____ Data Recorder/Navigator (Front Left): _____

Date:_____ Pilot (Company): _____ Helicopter:_____ Rear Left:_____

Rear Right: _____

Habitat, Effort, and Survey Conditions

Habitat Description (% open/% closed on transect)	Time		Helicopter Heading	Temperature	Wind Speed/ Direction	Cloud Cover	Visibility	Precipitation	Snow Cover	Date of Last Snow Fall
	Start	End								

Observations

Waypoint	Species		Observer (Initials)	RANGE FINDER S (Sighting Dist) or H (Horiz. Dist) or I (Inclination)	Bin (Perp. Distance)	Open (O) / Closed (C) Habitat	Slope (1 = flat, 2 = sloped or rolling, 3 = steep)	NO CALF		Cow:Calf Pairs	Calf - Single	Male (Bald)	Male (Antlered)	Adult – Unknown Sex	Yearling	Collars Observed	Number of Passes	Comments / Photos
	Caribou	Other						Female (Bald)	Female (Antlered)									

APPENDIX F

Incidental Mammal Detections

Table F.1 Incidental Mammal Detections from the 2022 Aerial Survey

Transect #	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
14	June 6	123	Black Bear	48.7866	-57.5123	1	
3	June 6	381	Moose	49.0357	-57.1169	1	
5	June 6	501	Moose	48.9897	-57.2926	1	
5	June 6	511	Moose	48.9892	-57.2772	2	
6	June 6	521	Moose	48.9670	-57.2868	1	
6	June 6	601	Moose	48.9677	-57.1068	1	
7	June 6	611	Moose	48.9465	-56.9282	1	
8	June 6	691	Moose	48.9237	-57.0564	1	
8	June 6	711	Moose	48.9234	-56.8909	1	
9	June 6	72	Moose	48.9011	-56.9978	2	
9	June 6	73	Moose	48.9012	-57.0168	1	
9	June 6	75	Moose	48.9018	-57.0616	2	moose with calf
9	June 6	76	Moose	48.9012	-57.1303	2	moose with calf
10	June 6	84	Moose	48.8772	-57.0982	2	moose with calf
12	June 6	93	Moose	48.8319	-57.4683	1	
12	June 6	100	Moose	48.8328	-56.9979	1	
13	June 6	118	Moose	48.8098	-57.4387	1	
14	June 6	147	Moose	48.7885	-57.0072	1	
14	June 6	148	Moose	48.7882	-56.9413	1	
15	June 6	151	Moose	48.7675	-57.0695	1	
15	June 6	172	Moose	48.7654	-57.5015	1	
16	June 6	174	Moose	48.7417	-57.5119	1	
18	June 6	201	Moose	48.6963	-57.6932	1	
19	June 6	251	Moose	48.6746	-57.6466	1	
2	June 6	341	Moose	49.0563	-57.1490	1	
21	June 7	267	Black Bear	48.6296	-57.2389	3	bear with 2 cubs
22	June 7	288	Black Bear	48.6074	-57.2995	1	
25	June 7	307	Black Bear	48.5378	-57.4918	3	bear with 2 cubs
20	June 7	265	Moose	48.6534	-57.1678	1	
22	June 7	279	Moose	48.6031	-57.9577	1	
23	June 7	290	Moose	48.5890	-57.0005	1	
23	June 7	295	Moose	48.5822	-57.4951	1	
25	June 7	302	Moose	48.5414	-56.9813	1	
25	June 7	311	Moose	48.5374	-57.6882	1	
26	June 7	325	Moose	48.5177	-56.9955	1	

Table F.1 Incidental Mammal Detections from the 2022 Aerial Survey

Transect #	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
27	June 7	330	Moose	48.4931	-57.4007	1	
27	June 7	337	Moose	48.4920	-57.7979	1	
28	June 7	342	Moose	48.4708	-57.2583	1	
29	June 7	349	Moose	48.4497	-57.0159	1	
29	June 7	350	Moose	48.4495	-57.1147	1	
29	June 7	351	Moose	48.4488	-57.3501	1	
off transect	June 8	395	Black Bear	48.5362	-56.8344	1	at Buchans during refueling
40	June 8	451	Black Bear	48.2420	-57.6718	1	
30	June 8	354	Moose	48.4247	-57.8409	1	
31	June 8	380	Moose	48.4047	-57.4371	2	moose with calf
32	June 8	390	Moose	48.3842	-57.2415	2	
32	June 8	392	Moose	48.3844	-57.2052	2	
32	June 8	393	Moose	48.3832	-57.0718	1	
33	June 8	403	Moose	48.3594	-57.1356	1	
35	June 8	418	Moose	48.3158	-57.0593	1	
36	June 8	429	Moose	48.2895	-58.0093	1	
36	June 8	432	Moose	48.2909	-57.6756	1	
36	June 8	433	Moose	48.2928	-57.4012	2	
37	June 8	442	Moose	48.2699	-57.6182	1	
38	June 8	448	Moose	48.2456	-57.8483	1	
39	June 8	449	Moose	48.2227	-57.9213	1	
41	June 8	463	Moose	48.2269	-56.9873	1	
41	June 8	466	Moose	48.2255	-57.3264	1	
42	June 8	467	N/A	48.2054	-57.0585	0	
44 (Road)	June 9	477	Black Bear	48.6626	-56.8315	1	bear on road
off transect	June 9	522	Black Bear	48.7303	-57.2755	3	bear with 2 cubs
off transect	June 9	601	Black Bear	48.8033	-57.4212	1	
43 (Road)	June 9	470	Moose	48.6871	-56.8678	1	
43 (Road)	June 9	471	Moose	48.7119	-56.8363	1	
43 (Road)	June 9	472	Moose	48.7199	-56.8162	1	
43 (Road)	June 9	473	Moose	48.7336	-56.7696	1	
44 (Road)	June 9	475	Moose	48.7140	-56.7111	1	
44 (Road)	June 9	476	Moose	48.6921	-56.8100	2	moose with calf
44 (Road)	June 9	478	Moose	48.6468	-56.8406	1	

Table F.1 Incidental Mammal Detections from the 2022 Aerial Survey

Transect #	Date	GPS WPT	Species	Latitude	Longitude	Total Detected	Comments
44 (Road)	June 9	480	Moose	48.5928	-56.9193	2	moose with calf
44 (Road)	June 9	481	Moose	48.5807	-56.9611	1	
off transect	June 9	483	Moose	48.6788	-57.0730	1	
off transect	June 9	575	Moose	48.6823	-57.2006	1	female
off transect	June 9	599	Moose	48.7757	-57.4862	1	
off transect	June 9	604	Moose	48.7962	-57.5074	1	
off transect	June 9	621	Moose	48.8921	-57.0702	1	
off transect	June 12	644	Black Bear	48.4347	-57.2317	1	
off transect	June 12	648	Black Bear	48.4691	-57.1627	1	
off transect	June 12	681	Moose	48.2461	-57.0417	1	
off transect	June 12	626	Moose	48.5374	-57.2063	2	moose with calf
off transect	June 12	633	Moose	48.3784	-57.3246	2	moose with calf
off transect	June 12	644	Moose	48.4621	-57.2169	1	
off transect	June 12	650	Moose	48.4892	-57.1155	1	
off transect	June 12	667	Moose	48.5025	-56.9156	1	
off transect	June 12	679	Moose	48.2999	-56.9532	1	
off transect	June 12	682	Moose	48.2402	-57.0646	1	
off transect	June 12	689	Moose	48.4973	-57.8151	2	moose with calf
off transect	June 12	691	Moose	48.5270	-57.6867	1	

APPENDIX G

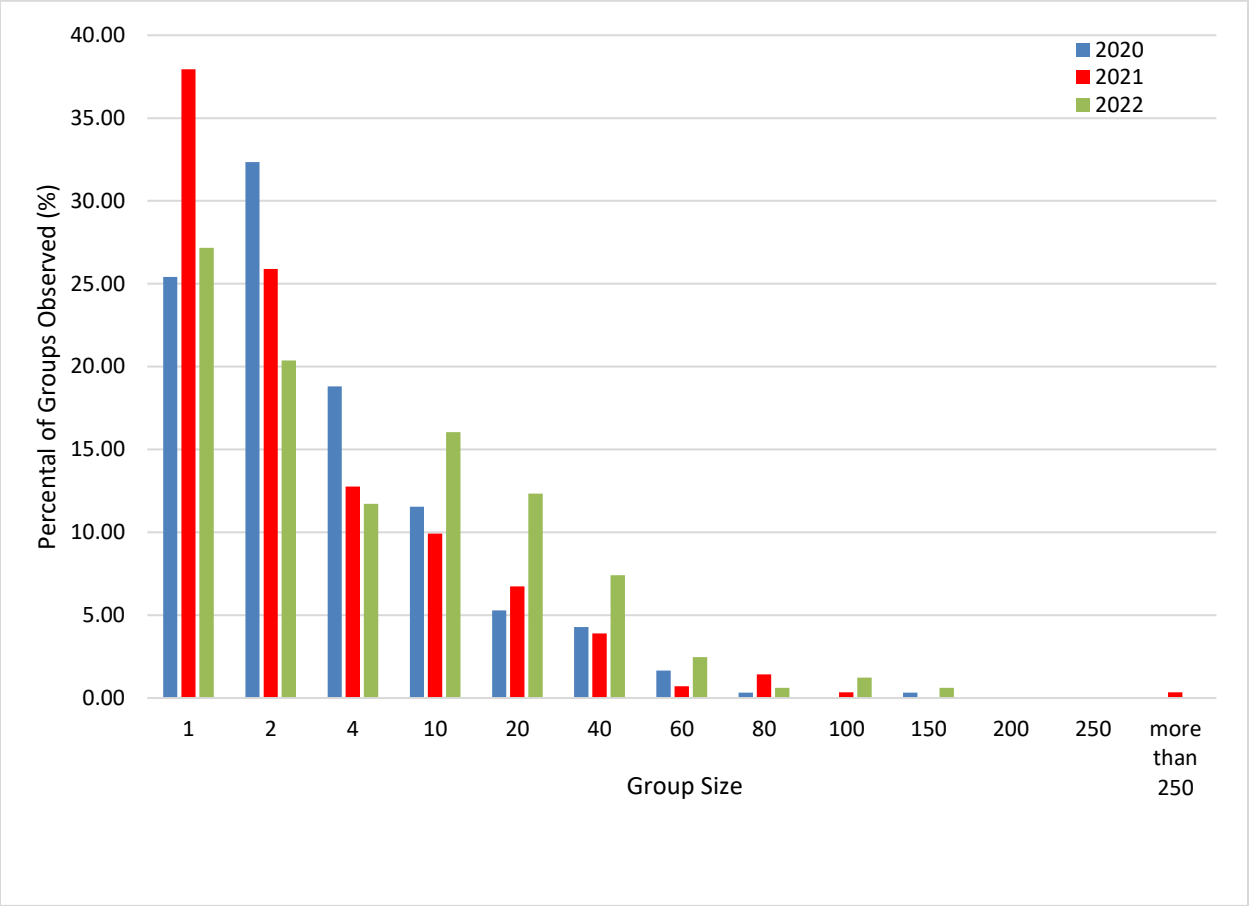
Caribou Classification Summary, 2020-2022

Table G.1 Frequency of Buchans Herd Caribou Group Sizes, 2020 – 2022

Group Size	Frequency (Percent of Total Groups Detected)		
	2020	2021	2022
1	77 (25%)	107 (38%)	44 (27%)
2	98 (32%)	73 (26%)	33 (20%)
3-4	57 (19%)	36 (13%)	19 (12%)
5-10	35 (12%)	28 (10%)	26 (16%)
11-20	16 (5%)	19 (7%)	20 (12%)
21+	20 (7%)	19 (7%)	20 (12%)
Total Groups	303	282	162
Largest Group	108	259	103

Notes:

1. Boundary of Buchans herd calving grounds survey area differed in 2020.
2. Percentages may not add up to 100% due to rounding.



Notes:

1. Includes caribou detected in the Buchans Herd calving grounds survey area.
2. Survey area is shown in Figure 3-1
3. Boundary of the survey area differed in 2020

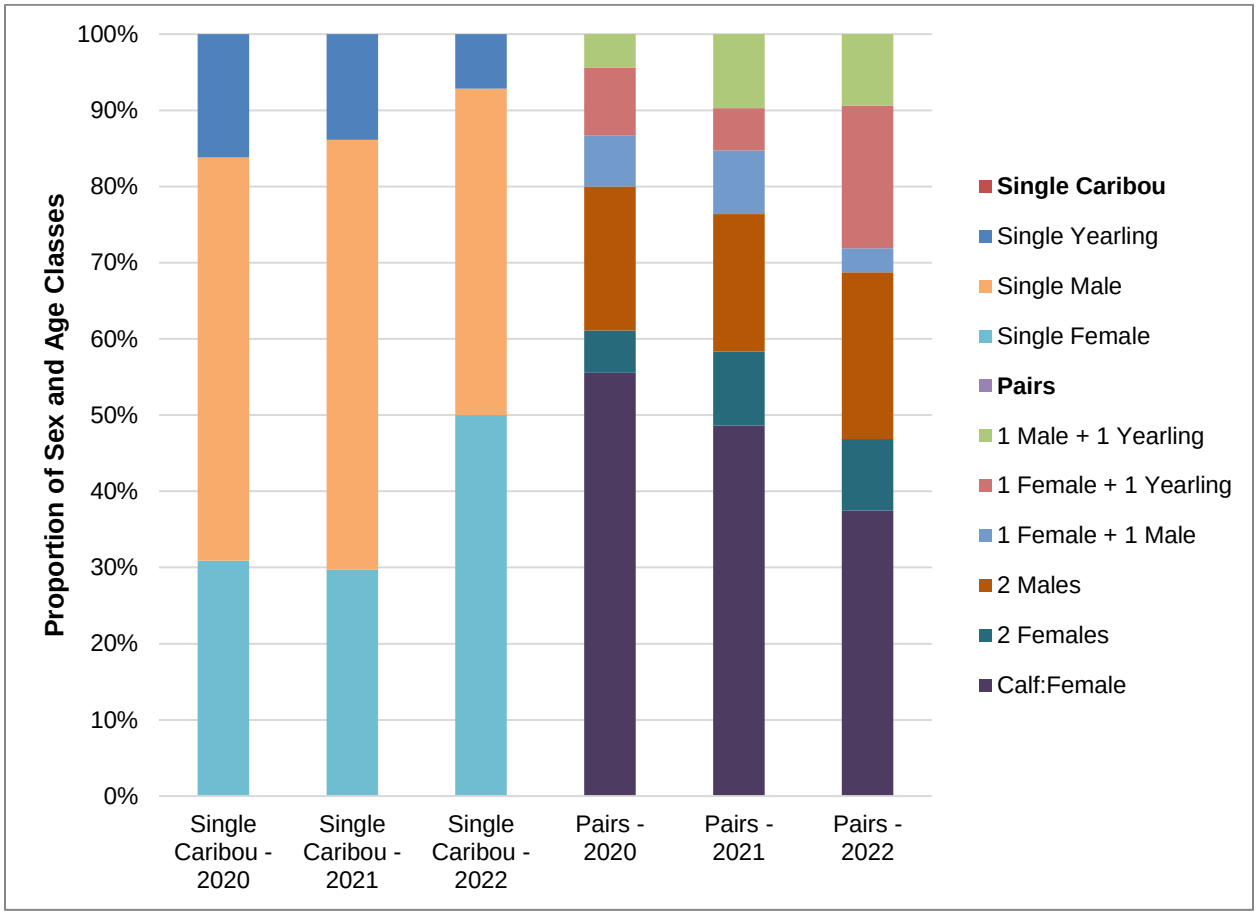
Figure G-1 Frequency of Buchans Herd Caribou Group Sizes, 2020 – 2022

Table G.2 Group Demographics of Buchans Herd Caribou, 2020 – 2022

Classification	2020	2021	2022
Total Number of Groups	303	282	162
Mean Group Size (Range)	6 (1-108)	7 (1-259)	9 (1-103)
Total Caribou Detected from Classification	1,700	1,837	1,504
Total Adults	1,075	1,268	964
Adult Females	798	862	820
Adult Males	171	382	103
Unknown Adults	106	24	41
Yearlings	109	145	100
Calves	516	424	440
Calf:Female Pairs	516	422	436
Female:100 Adults	74	68	85
Male:100 Adults	16	30	11
Calf:100 Females	65	49	54
Percent Females (%)	47	20	55
Percent Males (%)	10	21	7
Percent Calves (%)	30	23	29
Percent Yearlings (%)	6	8	7
Number of Collars Observed	4	20	21
Transect Distance (km)	1,765	2,093	
Survey Area (km^2)	4,840	5,230	

Notes:

1. Boundary for the Buchans herd calving grounds survey area differed in 2020.
2. All values are rounded to the nearest whole integer.



Notes:

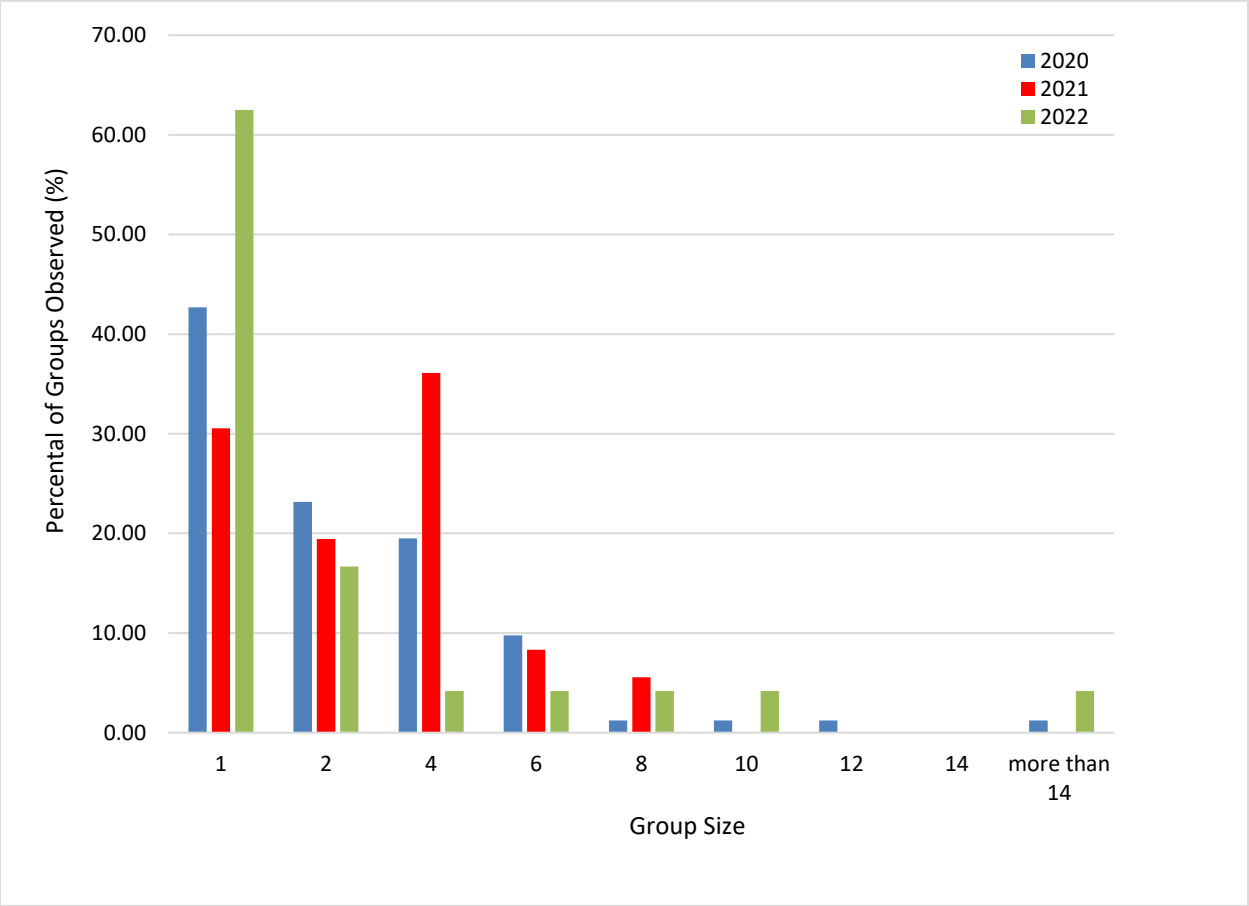
1. Includes caribou of known sex and age only (i.e., adults of unknown sex were omitted from the analysis)
2. Survey area is shown in Figure 3-1
3. Boundary of the survey area differed in 2020

Figure G-2 Frequency of Age and Sex Classes of Buchans Herd Caribou (Single Caribou and Pairs), 2020 – 2022

Table G.3 Frequency of Resident Caribou Group Sizes, 2020 – 2022

Group Size	Frequency (Percent of Total Groups Detected)		
	2020	2021	2022
1	35 (43%)	11 (31%)	15 (63%)
2	19 (23%)	7 (19%)	4 (17%)
3-4	16 (20%)	13 (36%)	1 (4%)
5-6	8 (10%)	3 (8%)	1 (4%)
7-8	1 (1%)	2 (6%)	1 (4%)
9-10	1 (1%)	n/a	1 (4%)
11-12	1 (1%)	n/a	n/a
13-14	n/a	n/a	n/a
15+	1 (1%)	n/a	1 (4%)
Total Groups	82	36	24
Largest Group	15	7	17

Notes:
1. Boundary of the survey area differed in 2020.
2. Percentages may not add up to 100% due to rounding.



Notes:

1. Includes caribou detected in the ZOI / resident caribou calving grounds survey area.
2. Survey area is shown in Figure 3-1
3. Boundary of the survey area differed in 2020

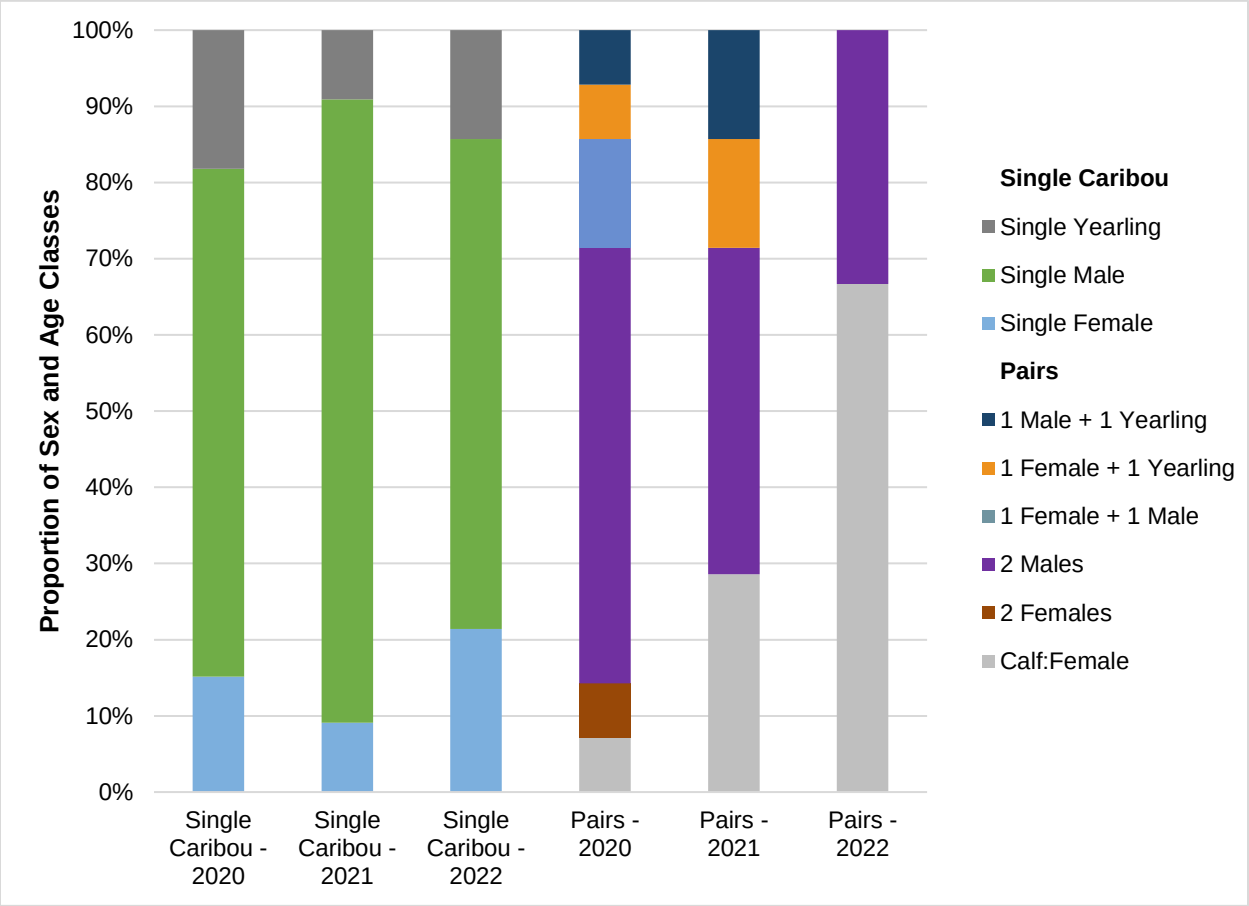
Figure G-3 Frequency of Resident Caribou Group Sizes, 2020 – 2022

Table G.4 Group Demographics of Resident Caribou, 2020 – 2022

Classification	2020	2021	2022
Total Number of Groups	82	36	24
Mean Group Size (Range)	3 (1-15)	3 (1-7)	3 (1-17)
Total Caribou	212	98	66
Total Adults	154	74	50
Adult Females	77	41	29
Adult Males	67	31	19
Unknown Adults	10	2	2
Yearlings	34	8	5
Calves	24	30	11
Calf:Female Pairs	24	30	11
Female:100 Adults	50	55	58
Male:100 Adults	44	42	38
Calf:100 Females	31	73	38
Percent Females (%)	36	42	44
Percent Males (%)	32	32	29
Percent Calves (%)	11	31	17
Percent Yearlings (%)	16	8	8
Number of Collars Observed	1	0	0
Transect Distance (km)	575	423	
Survey Area (km^2)	1,262	871	

Notes:

1. Includes all caribou detected in the resident caribou calving grounds survey area. Boundary of the survey area differed in 2020.
2. Means calculated from raw data. All values are rounded to the nearest whole integer.



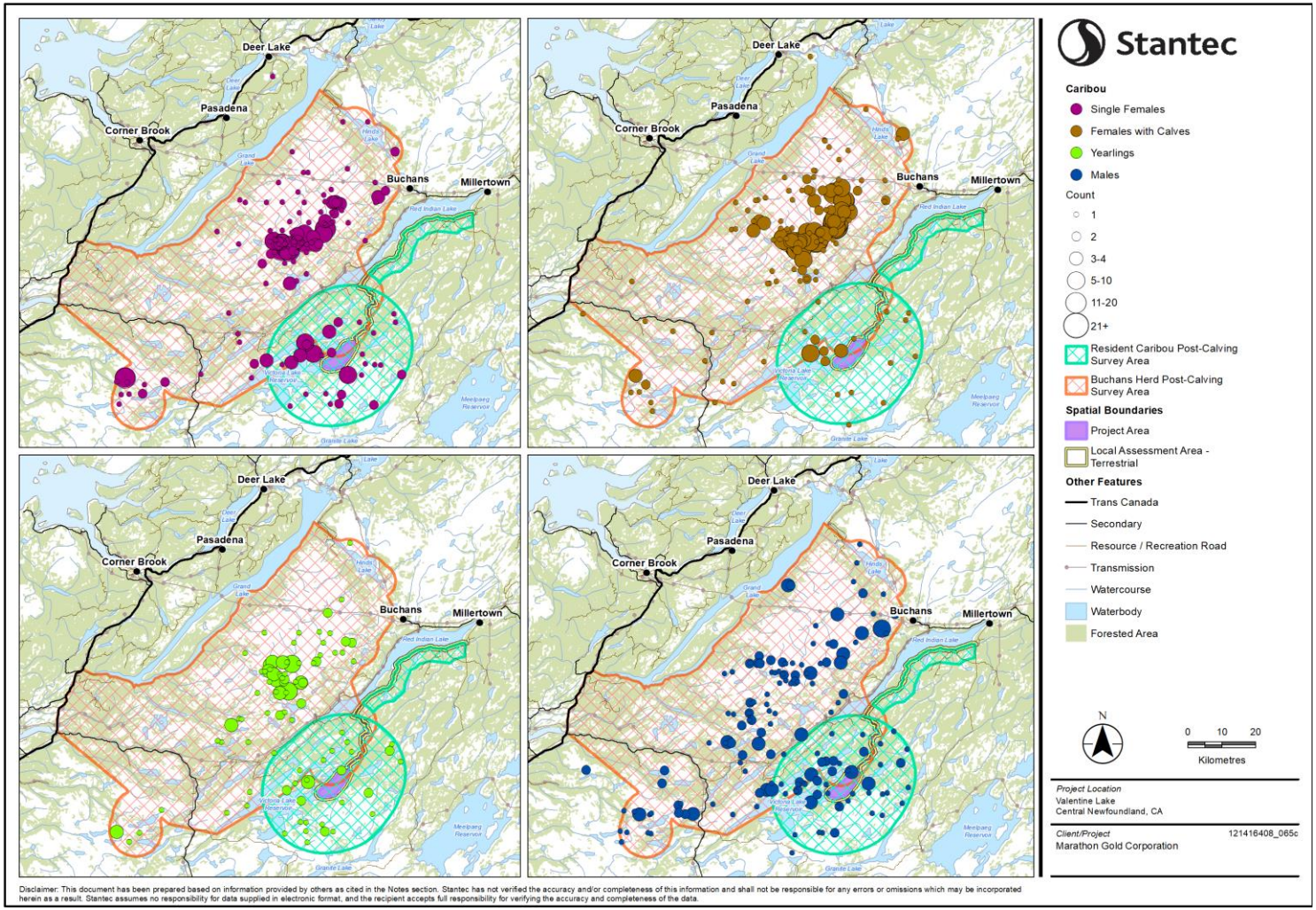
Notes:

1. Includes caribou of known sex and age only (i.e., adults of unknown sex were omitted from the analysis)
2. Survey area is shown in Figure 3-1
3. Boundary of the survey area differed in 2020

Figure G-4 Frequency of Age and Sex Classes of Resident Caribou (Single Caribou and Pairs), 2020 – 2022

APPENDIX H

Caribou Distribution – 2020 and 2021 Surveys



(Source: BSA.2 Appendix 2)

Figure H-1 Distribution of Caribou Age and Sex Classes from 2020 Aerial Survey of Caribou Calving Grounds

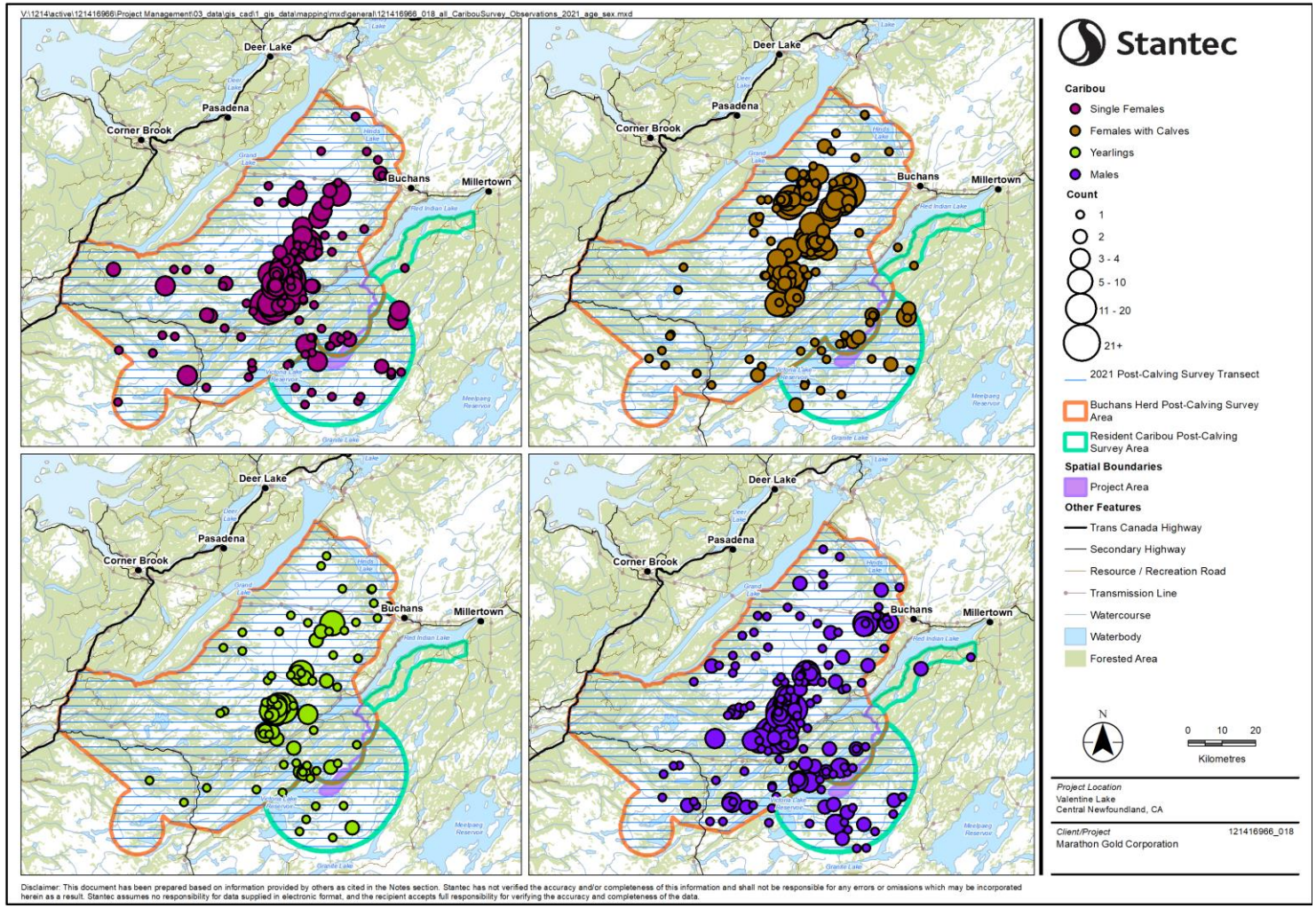


Figure H-2 Distribution of Caribou Age and Sex Classes from 2021 Aerial Survey of Caribou Calving Grounds