Valentine Gold Project: Spring 2021 Caribou Survey – Remote Cameras

Final Report

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VALENTINE GOLD PROJECT: SPRING 2021 CARIBOU SURVEY – REMOTE CAMERAS

Executive Summary

Marathon Gold Corporation (Marathon) is proposing to develop an open pit gold mine near Valentine Lake, located in the central region of the Island of Newfoundland, southwest of the Town of Millertown, Newfoundland and Labrador (NL). On September 29, 2020, Marathon filed an Environmental Impact Statement (EIS) (Marathon 2020a) with the Impact Assessment Agency of Canada and Newfoundland and Labrador Department of Environment and Climate Change, assessing potential Project and cumulative effects of the Valentine Gold Project (the Project). The woodland caribou (*Rangifer tarandus*; hereafter caribou) assessment for the EIS and the Wildlife Division of the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture (Government of Newfoundland and Labrador [NL] 2019; Doucet and Morgan 2007 in Wells et al. 2011) have identified seasonal caribou migration paths within the Project Area.

Stantec Consulting Ltd. (Stantec) undertook a spring remote camera survey in 2021 to better understand the timing, distribution, and relative use of the migration paths within the Project Area. This work builds on similar caribou migration camera surveys that were completed in fall 2019, spring 2020, and fall 2020. The Spring 2021 Caribou Survey included 26 remote cameras deployed in April 2021, placed along identified migration paths, and along potential alternate migration paths in the study area. Cameras were retrieved from June 14 to 23, 2021. Photos of caribou moving past the remote cameras were analyzed by counting and classifying the caribou.

This report provides a summary of the Spring 2021 Caribou Survey for migration within the Project Area. This information will be used to refine the timing of caribou movement through the mine site and to inform mitigation measures.

The cameras detected more than 370 caribou during the spring 2021 migration period. Caribou were detected throughout the deployment period. A distinct peak was not detected but the period with the greatest number of events was from May 21 to June 13, 2021. Camera 13 is located at the north side of Valentine Lake and detected the greatest number of individual caribou and total caribou events.

Caribou were detected consistently throughout the deployment period, except for April 27 to April 29, 2021 when no caribou were detected. The greatest number of events (10 events/day) was on June 11 and 12, 2021, and the greatest number of individuals was on April 10, 2021.

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Abbreviations

cm	centimetre
dBBMM	dynamic Brownian bridge movement model
EIS	Environmental Impact Statement
IR	infrared
km	kilometre
LCP	least-cost path
LiDAR	Light Detection and Ranging
m	metre
NL	Newfoundland and Labrador
NLDFFA	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture
SE	standard error
ZOI	zone of influence

1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) is planning to develop an open pit gold mine south of Valentine Lake, located in the Central Region of the Island of Newfoundland, approximately 60 kilometres (km) southwest of Millertown, Newfoundland and Labrador (NL) (Figure 1-1). The Valentine Gold Project (the Project) will consist primarily 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. Approximately 73 km of this existing access road will be upgraded and maintained by Marathon as part of the Project (Figure 1-1).

The Project overlaps woodland caribou (*Rangifer tarandus*; hereafter caribou) range in central Newfoundland (Marathon 2020a). Stantec Consulting Ltd. (Stantec), on behalf of Marathon, is undertaking research into the movement of caribou within the Project Area and nearby surrounding area. 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 (IAAC 2019; Government of NL 2020). The EIS includes an analysis of caribou migration, their use of the Project Area, and an assessment of predicted Project and cumulative effects on the caribou herds that potentially interact with the Project Area (Marathon 2020a).

Remote cameras were previously used for the fall 2019, spring 2020, and fall 2020 migrations (Marathon 2020b; Stantec 2021b). This is the fourth report on the remote camera survey program.

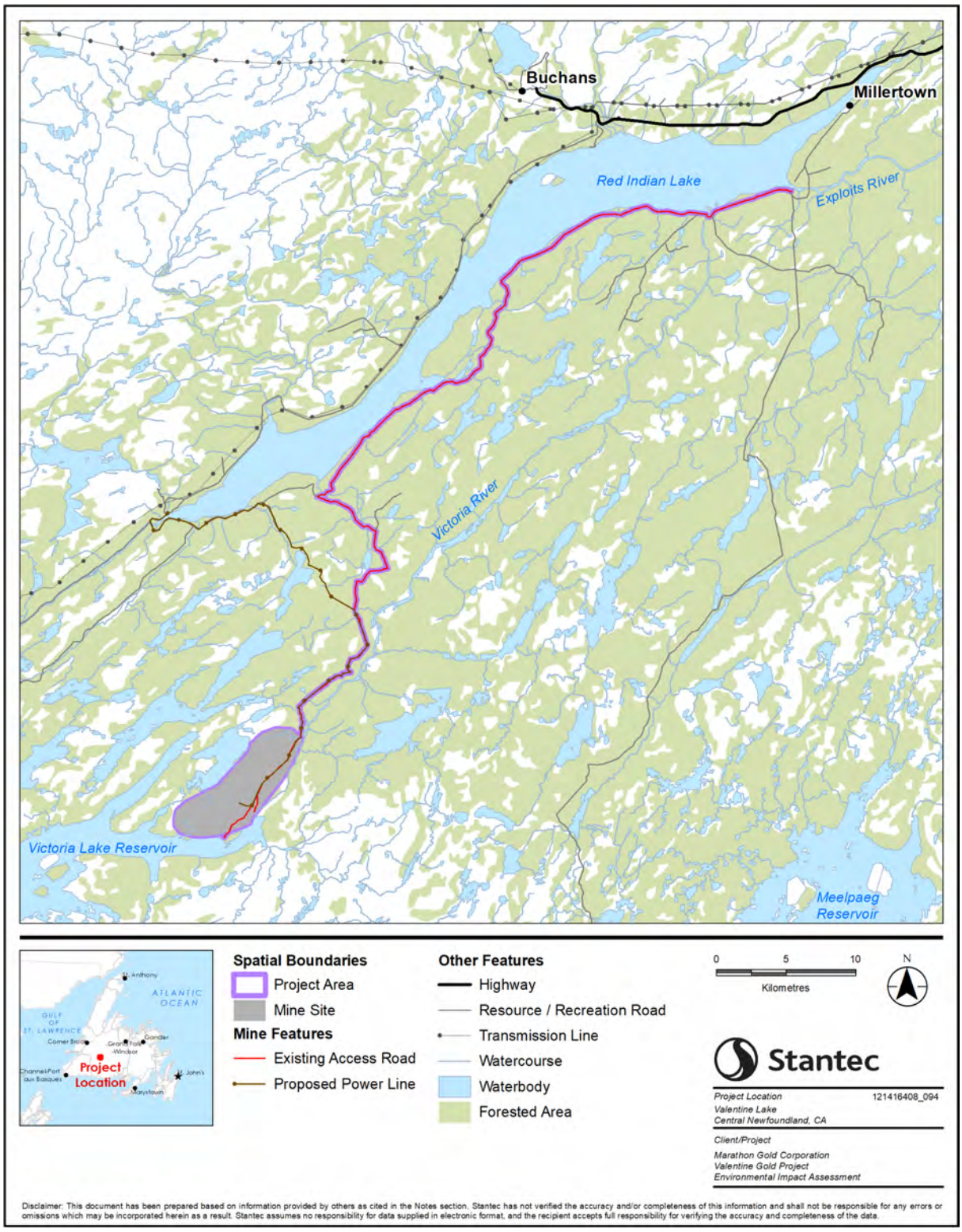


Figure 1-1 Project Area

2.0 BACKGROUND AND CONTEXT

2.1 PURPOSE

Remote cameras are being used to supplement existing baseline data which will be combined with other baseline monitoring and analyses (e.g., analysis of collar data, aerial surveys, on-site observations by Project personnel) as described in the Caribou Protection and Environmental Effects Monitoring Plan. The remote cameras are used to better understand caribou-Project interactions, to estimate the timing of caribou movement through the mine site and to inform mitigation measures. Remote camera data are also used to provide information on group composition for caribou detected by the cameras.

2.2 OBJECTIVES

The objectives of the Spring 2021 Caribou Survey were to:

- identify caribou entry and exit points to the mine site;
- evaluate the use of lesser used migration paths through the mine site and surrounding areas; and
- identify the timing of migration through the mine site and surrounding areas.

2.3 CONTEXT

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). On the Island of Newfoundland, the caribou population is composed of several sub-populations differentiated by annual movement patterns, spatial affiliations, and genetic structure (Wilkerson 2010; Government of NL 2015). Woodland caribou is not listed under the provincial *Endangered Species Act* (NL ESA). However, the federal *Species at Risk Act* was amended in 2021 to include the Newfoundland population of caribou on Schedule 1 as Special Concern (Government of Canada 2021).

The Project overlaps with, or is near the ranges of, the following herds within the South Coast sub-population: Buchans, Grey River, Gaff Topsails, and La Poile (Government of NL 2019). The South Coast sub-population is composed of several caribou herds that share winter ranges near the south coast between Burgeo and the Connaigre Peninsula (Weir et al. 2014), but have separate calving and summer ranges. Recent surveys of some of the South Coast herds (i.e., Buchans, Grey River, Gaff Topsails, La Poile) indicate that population trends may be stabilizing (Government of NL 2019).

Seasonal migration paths within the Project Area have been identified (Doucet and Morgan 2007 in Wells et al. 2011; Government of NL 2019; Marathon 2020a). The generalized dates for caribou seasons on the Island of Newfoundland (Table 2.1) indicate that caribou are most likely to migrate in the spring between April 1 and May 19, and in the fall between November 1 and December 15.

Marathon initiated the remote camera program in the fall of 2019 and since that time, some modifications have been made to the locations and number of cameras to broadly capture movement in the Project Area. Many of the locations used in spring 2021 are intended to become “permanent” monitoring

locations to analyze long-term trends. If shifts in movement are detected, such as through collar data, camera placements may be adjusted. Many of the current locations include the modelled routes that may become more heavily used over time if shifts occur. Information from the ongoing remote camera program combined with analysis of telemetry data will further help identify peak movement times through the mine site.

Table 2.1 General Seasons for the Island Caribou Population in Newfoundland

Season	Seasonal Dates
Winter	Dec 16–Mar 31
Spring Migration/Pre-calving	**Apr 1–May 19**
Calving	May 20–Jun 10
Post-calving Migration/Dispersal	Jun 11–Jun 30
Post-calving Rearing	Jul 1–Aug 31
Fall Rut	Sep 1–Oct 31
Fall Migration/Dispersal	**Nov 1–Dec 15**

Notes:
Bold text indicates migratory periods where caribou migrate through Marathon mine site
Source: Emera 2013

3.0 METHODS

3.1 MIGRATION TRAIL IDENTIFICATION AND REMOTE CAMERA DEPLOYMENT

Cameras for the Spring 2021 Caribou Survey (Figure 3-1) were strategically located based on their alignment with the following: wildlife trails through the proposed mine site that were identified using Light Detection and Ranging (LiDAR) data (Marathon 2020b) and ground-truthed in the field at the time of deployment; caribou migration paths identified by dynamic Brownian bridge movement models (dBBMMs) (Marathon 2021a); potential alternate migration paths identified by a least-cost path (LCP) (Stantec 2021a); and, input from NLDFFA-Wildlife Division. Except for two cameras (12 and 13), the locations selected for the Spring 2021 Caribou Survey differed from those used in the previous camera deployments (fall 2019, spring 2020, and fall 2020) (Appendix A).

For the Spring 2021 Caribou Survey, 26 remote cameras were deployed in the study area on April 9 and 10, 2021 (Figure 3-2). Two camera models were deployed: *Reconyx HS2X Hyperfire 2 Security Covert IR* (22 cameras) and *Browning Dark Ops HD Pro X* (4 cameras). Both models have similar settings, which include infrared (IR) night vision illuminators to allow photography at night (Table 3.1). Camera settings were selected to increase the probability of wildlife detection and identification (Stantec 2015).. Lithium-ion batteries and 64 gigabyte SD memory cards were used in the cameras.

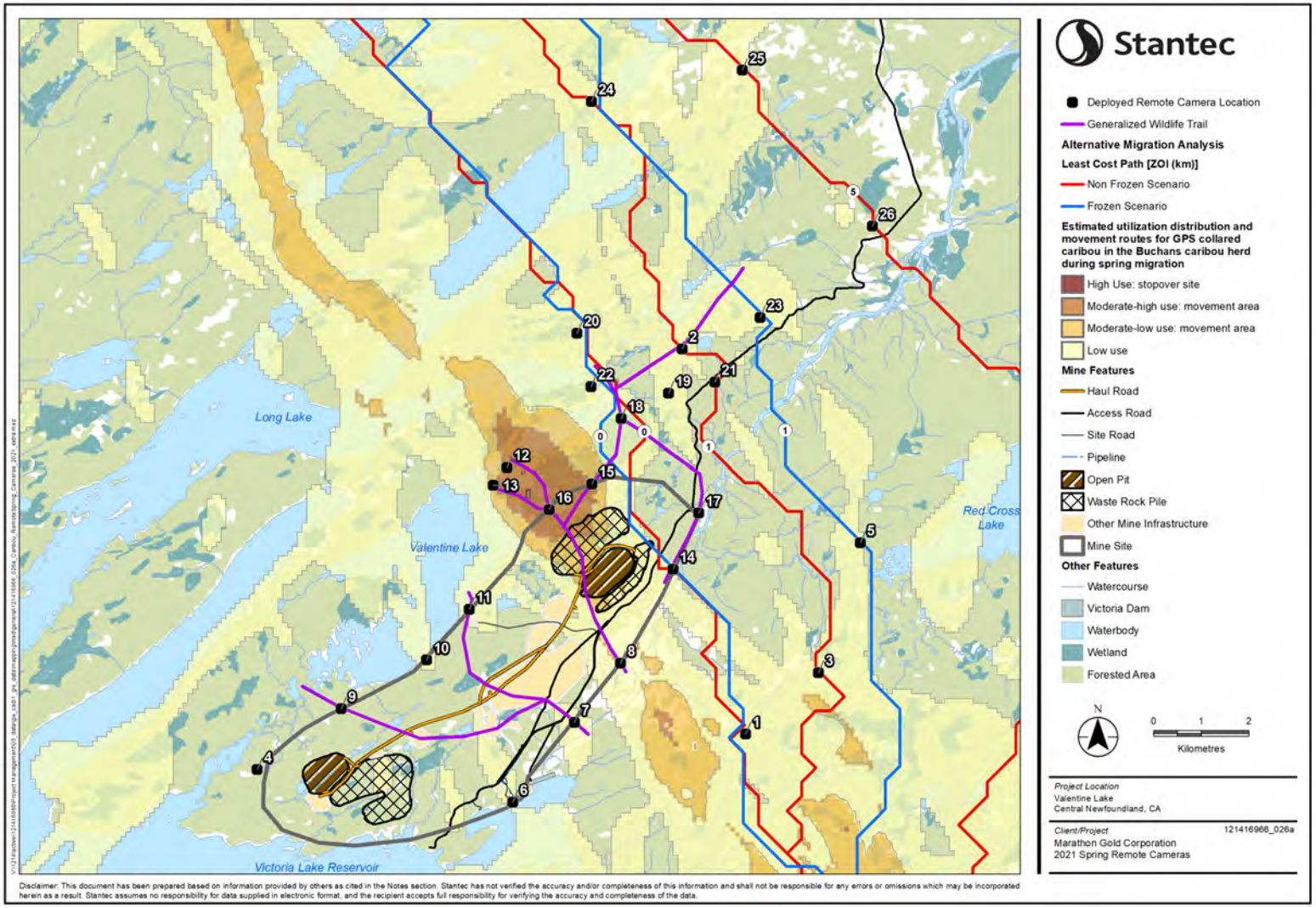


Figure 3-1 Remote Camera Deployment for Spring 2021 Caribou Survey (Study Area)

Table 3.1 Remote Camera Settings

Brand	Mode	Pictures/ Trigger	Picture Interval	Additional Settings Information
Reconyx HS2X Hyperfire 2 Security Covert IR	Motion sensor "On" with med/high sensitivity[1]	5	Rapidfire - no quiet period, no delay	Night mode (Balanced) resolution (3.1 MP)
Browning Dark Ops HD Pro X	"Trail"- photos in day and night medium sensitivity	5	Rapidfire - no delay	Capture delay – 1 second (lowest available)

Note:
[1] set to high sensitivity if a clear field of view

The cameras were deployed at each site using standardized set-up to allow for consistency among sites and to reduce potential effects of camera placement or setup on wildlife detection. Cameras were deployed at least 500 m from one another to maintain independence (Stantec 2015).

Cameras were mounted on trees with diameters of at least 20 cm. At sites where the camera mount needed additional stability, trees were braced with logs to reduce movement caused by wind. At sites with no suitable trees, tripods were installed as camera mounts. Cameras were placed approximately 1 to 1.5 m above ground to increase the probability of large mammal detection (Stantec 2015). Each camera was positioned facing a game trail to increase the path length of animals through the frame (Rovero et al. 2010). Deployment locations and additional information about the camera sites are provided in Appendix B.

To reduce the incidence of false positives (i.e., camera is triggered by something other than wildlife such as branches or grasses moving in the wind), visible vegetation within the camera's field of view was trimmed where necessary. A walk test was completed before leaving the site to assess camera angle, position, and path length along the game trail to improve likelihood of detection. For each camera, a Global Positioning System device was used to record the location (Appendix B). The camera height and orientation were also documented (Appendix B). A camera inspection was completed on April 16, 2021 to confirm cameras were functioning correctly. However, where caribou were observed relatively close to a camera (cameras 4, 9, 15, 20 and 23), those cameras were not checked to reduce disturbance. All cameras except camera 7 were retrieved on June 14, 2021; camera 7 was retrieved on June 24, 2021.

It was assumed that most caribou detected by the remote cameras are part of the Buchans herd because of the degree of overlap between the Buchans herd range and the Project Area, predominantly during the spring and fall migration periods (Marathon 2020a). There is the possibility that a small percentage (i.e., individuals or groups of two or three animals) could be resident Grey River caribou.

Table 3.2 Rationale for Spring 2021 Remote Camera Locations

Camera Location	Rationale		
	Aligns with wildlife trail identified from LiDAR data	Aligns with caribou migration paths identified by dBBMM	Aligns with potential alternate migration path identified by LCP analysis
Cameras Positioned to Gather Information about Entry and Exit Points to Mine Site			
6		✓	
7	✓	✓	
8	✓	✓	
9	✓		
10		✓	
11	✓	✓	
14	✓	✓	✓(0 km ZOI[1], spring migration, frozen and non-frozen conditions)
15	✓	✓	
16	✓	✓	
17	✓		
Additional Camera Locations			
1		✓	✓(0 km ZOI, spring migration, frozen conditions)
2	✓	✓	✓(1 km ZOI, spring migration, non-frozen conditions)
3		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
4		✓[2]	
5		✓	✓(1 km ZOI, spring migration, frozen conditions)
12	✓	✓	
13	✓	✓	
18	✓	✓	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
19		✓	
20		✓[2]	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
21		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
22		✓[2]	
23		✓	✓(1 km ZOI, spring migration, frozen conditions)
24		✓	✓(1 km ZOI, spring migration, frozen and non-frozen conditions)
25		✓	✓(5 km ZOI, spring migration, non-frozen conditions)
26			✓(5 km ZOI, spring migration, non-frozen conditions)

Notes:
[1] ZOI = Zone of Influence (as defined in the EIS (Marathon 2020a)
[2] Camera location modified to address comments from NLDFFA-Wildlife Division

3.2 REMOTE CAMERA DATA ANALYSIS

Remote camera photos were reviewed using the program Timelapse v.2.2.4.2, an image analysis software program that extracts photograph metadata and facilitates the management of photo results (Greenberg 2021). The number of camera days (sum of the number of deployment days for all cameras) was calculated. Photos were analyzed based on independent events identified from a photo series. An event was defined as beginning when an animal or group of animals (i.e., more than two animals) entered the frame and ending when the animal or group had exited the frame for more than two minutes (Stantec 2015; Rowcliffe et al. 2008). Group composition metrics were calculated (i.e., group sizes, sex ratios, and age classes) and collared caribou captured in the photos were noted. Direction of movement through the frame (e.g., northward, southward) was also recorded.

Detected caribou were classified as follows: calves (i.e., neonates); yearlings = one to two years; and adults > two years. The category of “unknown” included caribou of all age classes whose sex could not be determined. The category of “total caribou” included adults, yearlings, calves, and unknown. Caribou were classified based on presence of vulvae or penis, head and body size, and antler characteristics (e.g., present or absent, shape). “Total adults” included adults of known and unknown sex.

The following values were calculated: male:100 females, percent males (males/total caribou x 100), calf:100 females, percent calves (calves/total caribou x 100), and percent yearlings (yearlings/total caribou x 100). The classification data collected from the remote cameras is not intended to provide a population sex and age ratio estimate.

The generalized direction of movement across the frame was determined for each event based on the orientation of the camera: north, east, south, and west. For each camera location, the percentage of events moving in each direction was calculated. The primary direction of movement was that with the largest percentage of events was more than 10% greater than the next largest. Where the difference between the largest percentages was less than or equal to 10%, two primary directions were identified (e.g., north and south).

4.0 RESULTS

The 26 remote cameras (Figure 4-1) resulted in the collection of 1,588 camera days of photographs and a total of 3,949 photographs of caribou. The SD memory card in camera 10 ceased to record photos on April 13, 2021 due to a card malfunction, but did record photos for 5 days. Two cameras (7 and 25) were functional but did not detect caribou.

A total of 250 events were detected. The mean number of spring 2021 caribou events per day was 0.17 [standard error (SE) = 0.03] (Table 4.1; Figure 4-2). Remote cameras 3, 13, 16, 18, 22, and 24 detected the greatest number of caribou events, and cameras 3, 13 and 16 had the highest number of individual caribou (Table 4.2, Figure 4-3). Camera 13 recorded 23% of caribou events, followed by camera 3 which recorded 10% (Figure 4.2). Camera 13 (0.88 events/day) and camera 3 (0.38 events/day) had the greatest number of caribou events per monitoring day (Table 4.2; Figure 4-4).

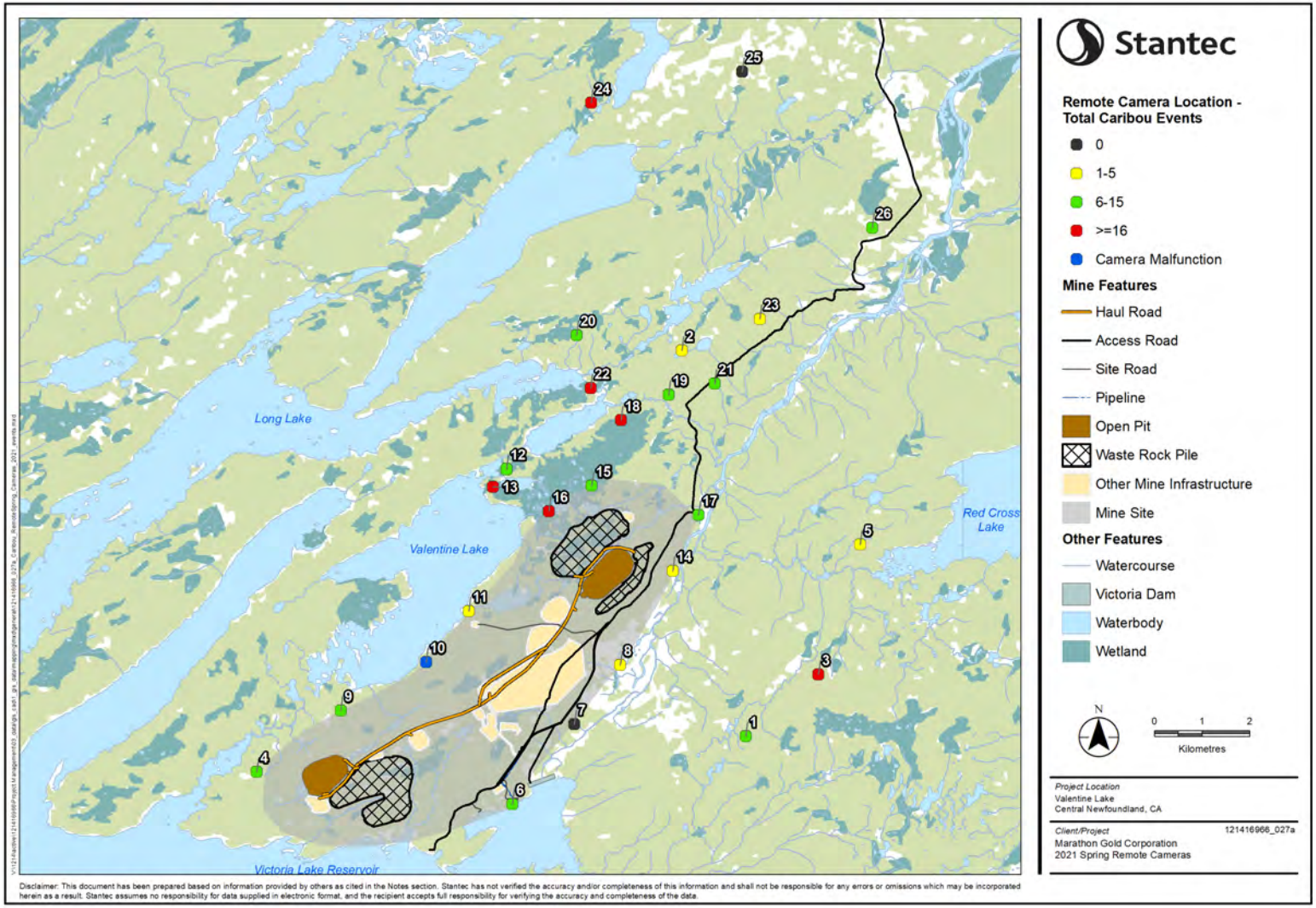
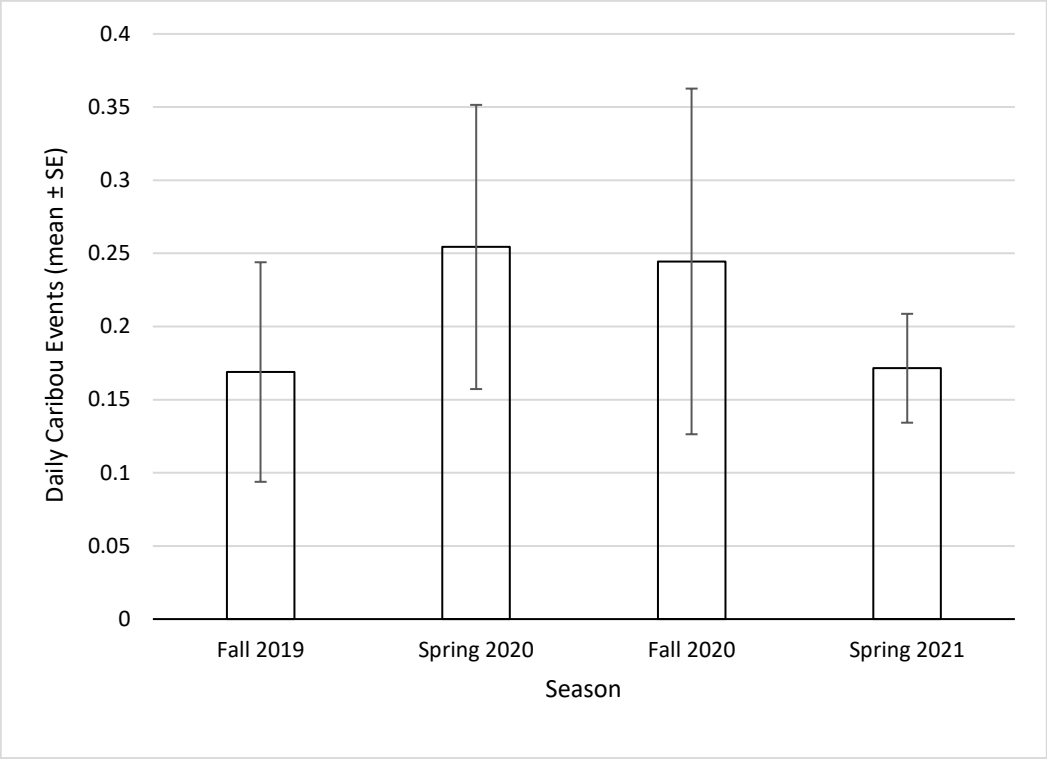


Figure 4-1 Total Caribou Events Detected from Remote Cameras, Spring 2021

Table 4.1 Caribou Events During Fall 2019, Spring 2020, Fall 2020 and Spring 2021 Caribou Surveys

	Fall 2019	Spring 2020	Fall 2020	Spring 2021
Number of Cameras	12	11	11	26
Camera Days	885	805	760	1,588
Total Number of Events	157	205	180	250
Mean Number of Events per Day	0.17	0.25	0.24	0.17
Standard Deviation	0.26	0.31	0.39	0.18
Standard Error	0.08	0.10	0.12	0.03

Notes:
Means calculated using the following dates:
Fall 2019 – October 5 to December 31, 2019
Spring 2020 – March 28 to June 18, 2020
Fall 2020 – September 27 to December 31, 2020
Spring 2021 – April 10 to June 20, 2021



Notes:
1. Means calculated using the following dates: Fall 2019 – October 5 to December 31, 2019; Spring 2020 – March 28 to June 18, 2020; Fall 2020 – September 27 to December 31, 2020; Spring 2021 – April 10 to June 20, 2021

Figure 4-2 Caribou Events During Fall 2019, Spring 2020, Fall 2020 and Spring 2021 Caribou Surveys

Table 4.2 Number of Caribou Events per Day at Remote Camera Sites

Camera Site[A]	Number of Events	Number of Caribou Detected	Mean Number of Events per Monitoring Day (range)	Standard Error	Number of Monitoring Days[B]	Direction of Movement (percentage of events)
1	6	12	0.09 (0-2)	0.04	66	N (67%)
2	2	2	0.03 (0-1)	0.02	66	S (50%) and W (50%)
3	25	32	0.38 (0-2)	0.08	66	E (52%)
4	7	10	0.11 (0-1)	0.04	66	W (100%)
5	5	7	0.19 (0-3)	0.12	26	S (100%)
6	7	10	0.11 (0-1)	0.04	66	S (57%)
7	0	0	0.00	0.00	75	
8	1	1	0.02 (0-1)	0.02	66	W (100%)
9	8	13	0.12 (0-1)	0.04	66	N (33%) and S (33%)
10	0	0	0.00	0.00	5	
11	4	6	0.06 (0-3)	0.05	66	N (50%) and S (50%)
12	11	20	0.17 (0-3)	0.06	66	N (81%)
13	58	83	0.88 (0-4)	0.14	66	N (52%) and S (48%)
14	1	2	0.02 (0-1)	0.02	49	N (100%)
15	8	10	0.12 (0-2)	0.05	66	E (63%)
16	16	55	0.24 (0-4)	0.10	66	N (69%)
17	6	10	0.12 (0-1)	0.04	52	N (83%)
18	18	21	0.27 (0-2)	0.07	66	N (44%) and S (44%)
19	6	7	0.09 (0-2)	0.05	66	S (67%)
20	7	8	0.11 (0-3)	0.06	66	E (71%)
21	6	10	0.09 (0-3)	0.05	66	W (67%)
22	17	20	0.26 (0-2)	0.06	66	S (41%)
23	5	5	0.08 (0-2)	0.04	66	N (60%)
24	20	23	0.30 (0-2)	0.07	66	N (40%) and S (30%)
25	0	0	0.00	0.00	66	
26	6	7	0.09 (0-3)	0.05	66	S (80%)

Notes:

[A] The SD memory card in camera 10 malfunctioned and no wildlife photos were recorded.

[B] Dates of recording for cameras 1-4, 6, 8-9, 11-13, 15-16, and 18-26 were April 10 to Jun 14, 2021. Camera 5 was April 10 to May 5, 2021. Camera 7 was April 10 to June 24, 2021. Camera 14 was April 10 to May 28, 2021. Camera 17 was April 10 to May 31, 2021.

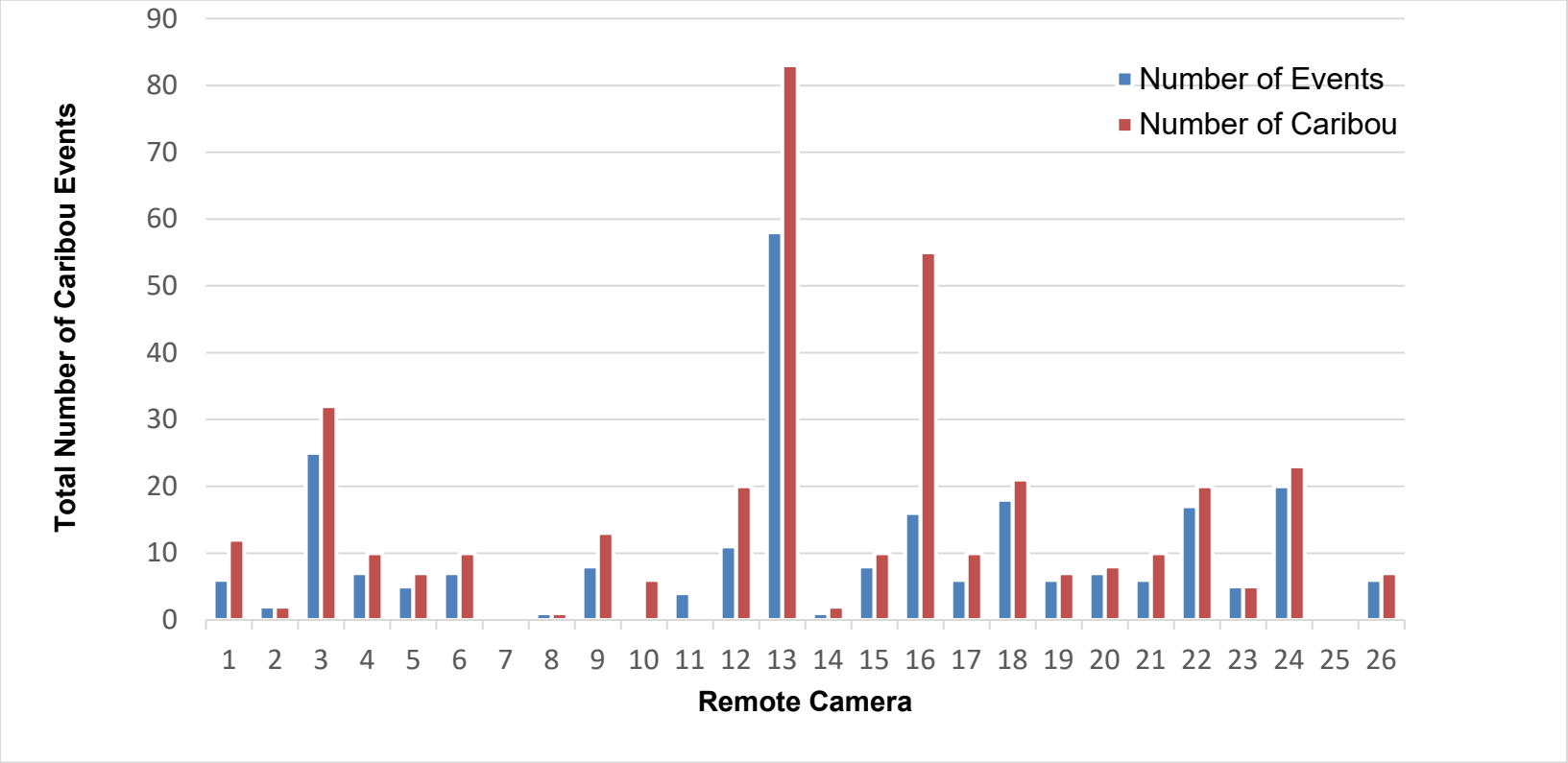
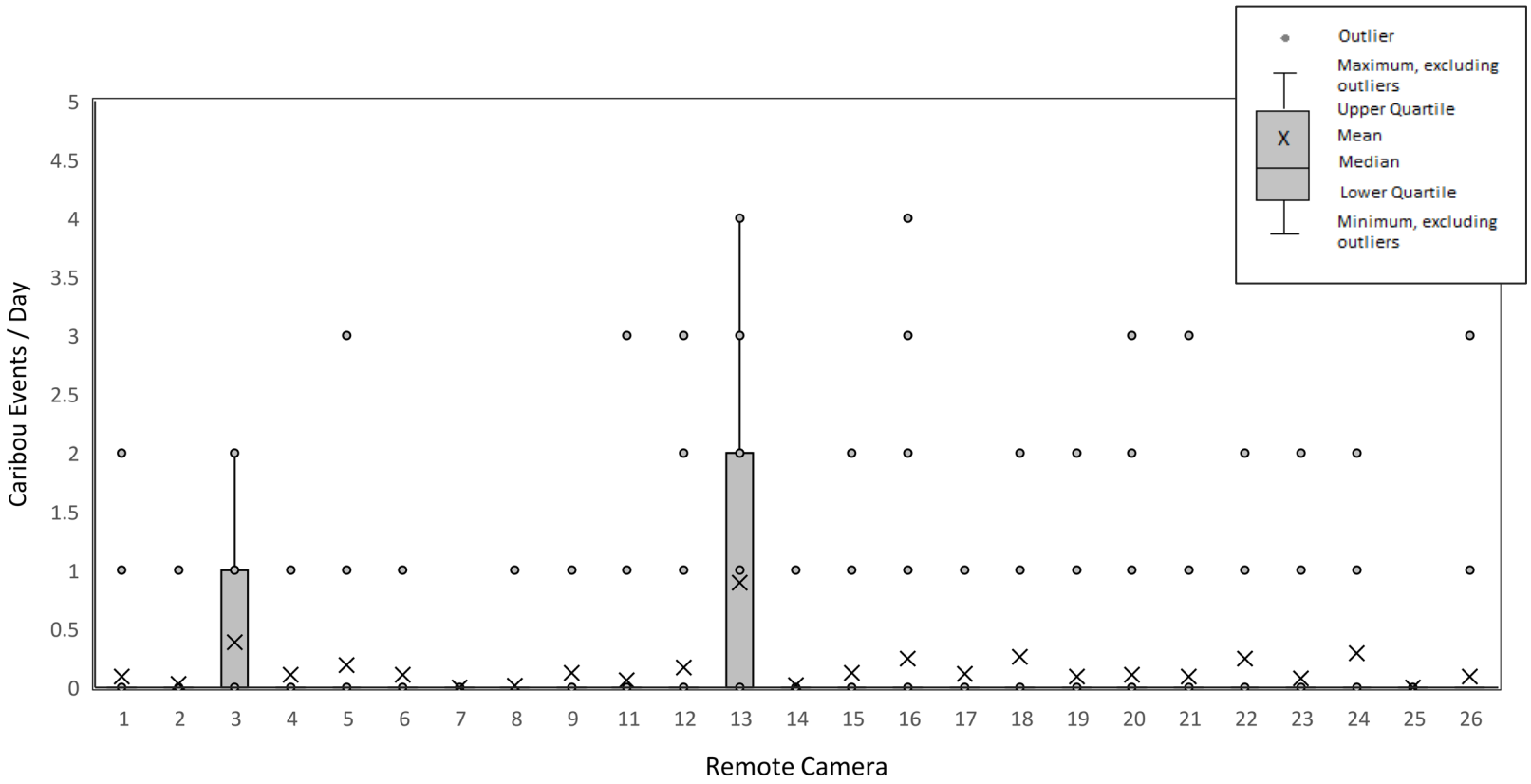


Figure 4-3 Caribou Events for each Remote Camera Site, Spring 2021



Note:
Dates of recording for cameras 1-4, 6, 8-9, 11-13, 15-16, and 18-26 were April 10 to Jun 14, 2021 (66 days). Camera 5 was April 10 to May 5, 2021 (26 days). Camera 7 was April 10 to June 24, 2021 (75 days). Camera 14 was April 10 to May 28, 2021 (49 days). Camera 17 was April 10 to May 31, 2021 (52 days).

Figure 4-4 Number of Caribou Events per Day for Spring 2021 Caribou Survey

The number of caribou events per day is illustrated in Figure 4-5. Caribou were detected between April 10, 2021 and June 14, 2021. Caribou were detected almost daily throughout the deployment period, except for April 12, April 19, and April 27 to April 29, 2021 when no caribou were detected (Figure 4-5). The greatest number of events (10 events/day) were detected on both June 11 and 12, 2021, however the greatest number of individuals were detected on April 10, 2021 (Figure 4-5). The mean number of caribou per group was 2 (range: 1-18). A distinct peak was not detected but the period with the greatest number of events was from May 21, 2021 to June 13, 2021 (Figure 4-5). More than 80% of total caribou events were detected by June 4, 2021. Female caribou were detected throughout the camera deployment period (i.e., April 10 to June 14, 2021) (Figure 4-6). Male caribou were not detected until April 19, 2021. The highest proportion of males were detected between May 24 and June 3, 2020 (mean: 53%, range 10-77%) (Figure 4-7).

Caribou were detected moving north in 38% of events, and south in 32% of events (Table 4.3). Movement east and west were detected in 13% and 17% of events, respectively (Table 4.3). For each camera, primary direction of movement was determined (i.e., most prevalent direction of movement). Although, a primary direction of movement was determined (Table 4.3), the cameras did not detect caribou movement in a consistent direction across the frame of the photo (e.g., not all individuals were detected moving in the primary direction). However, the photos only provide information for discrete moments in time during the migration period and do not offer any additional information on where the caribou move following the photo. Additional information on the direction of caribou events is presented in Appendix C.

Table 4.3 Direction of Caribou Movement Detected by Remote Cameras During Events

Direction of Movement	Number of Caribou Events (percent in brackets)
North	93 (38%)
East	33 (13%)
South	78 (32%)
West	41 (17%)
Total	**245[A]**

Note:
A. Only includes events where direction could be determined.

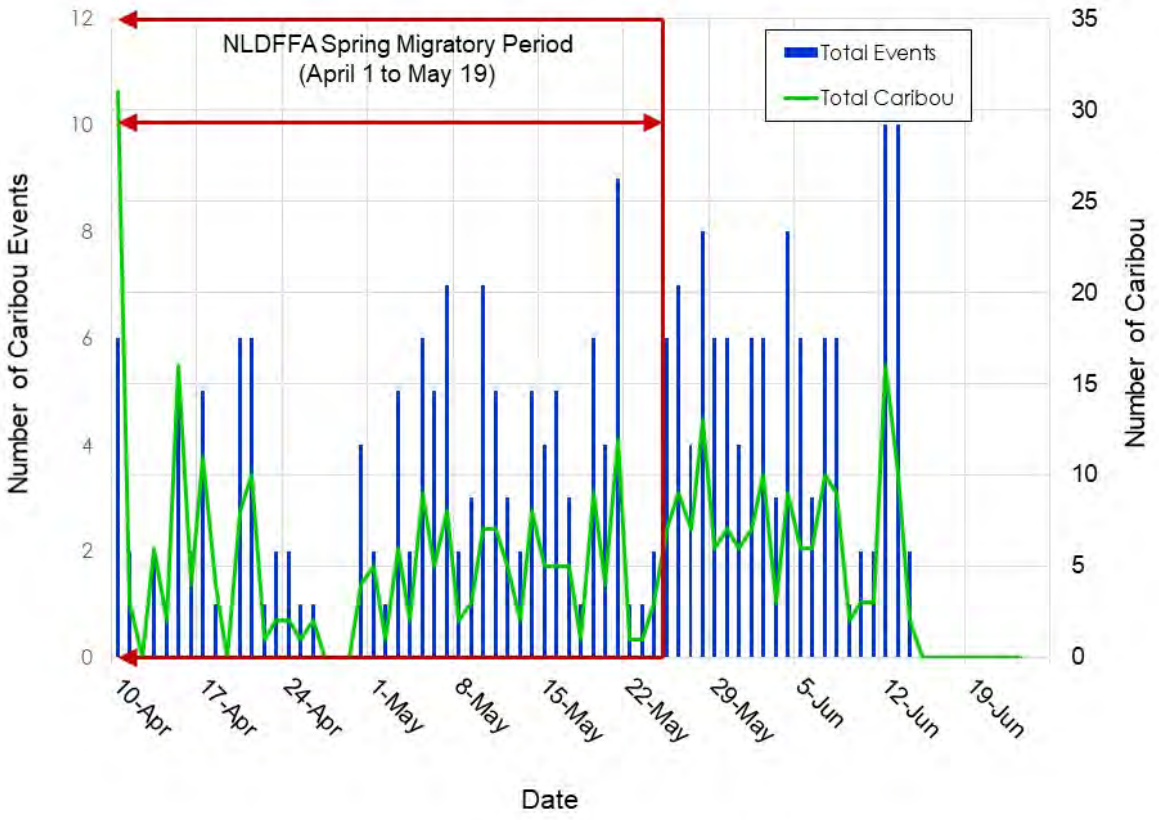


Figure 4-5 Number of Caribou Detected and Number of Caribou Events at Remote Cameras Sites in Spring 2021

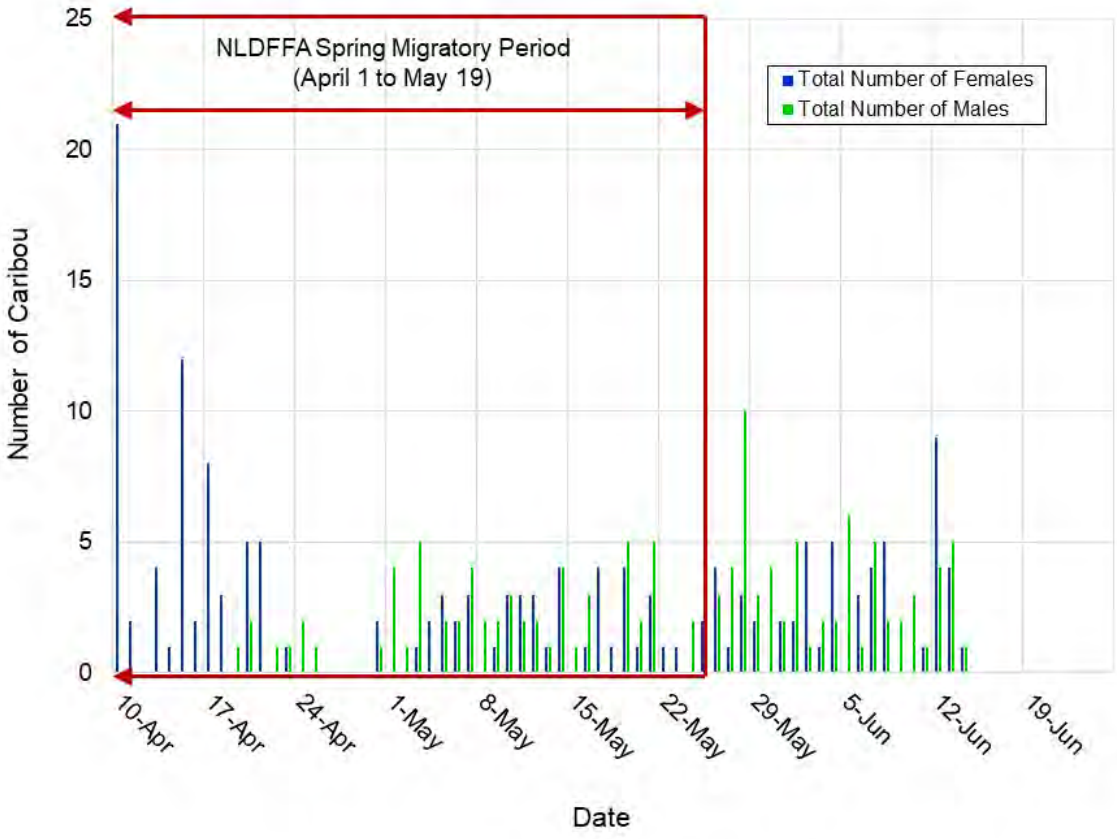


Figure 4-6 Number of Female and Male Caribou Observed at Remote Cameras Sites in Spring 2021

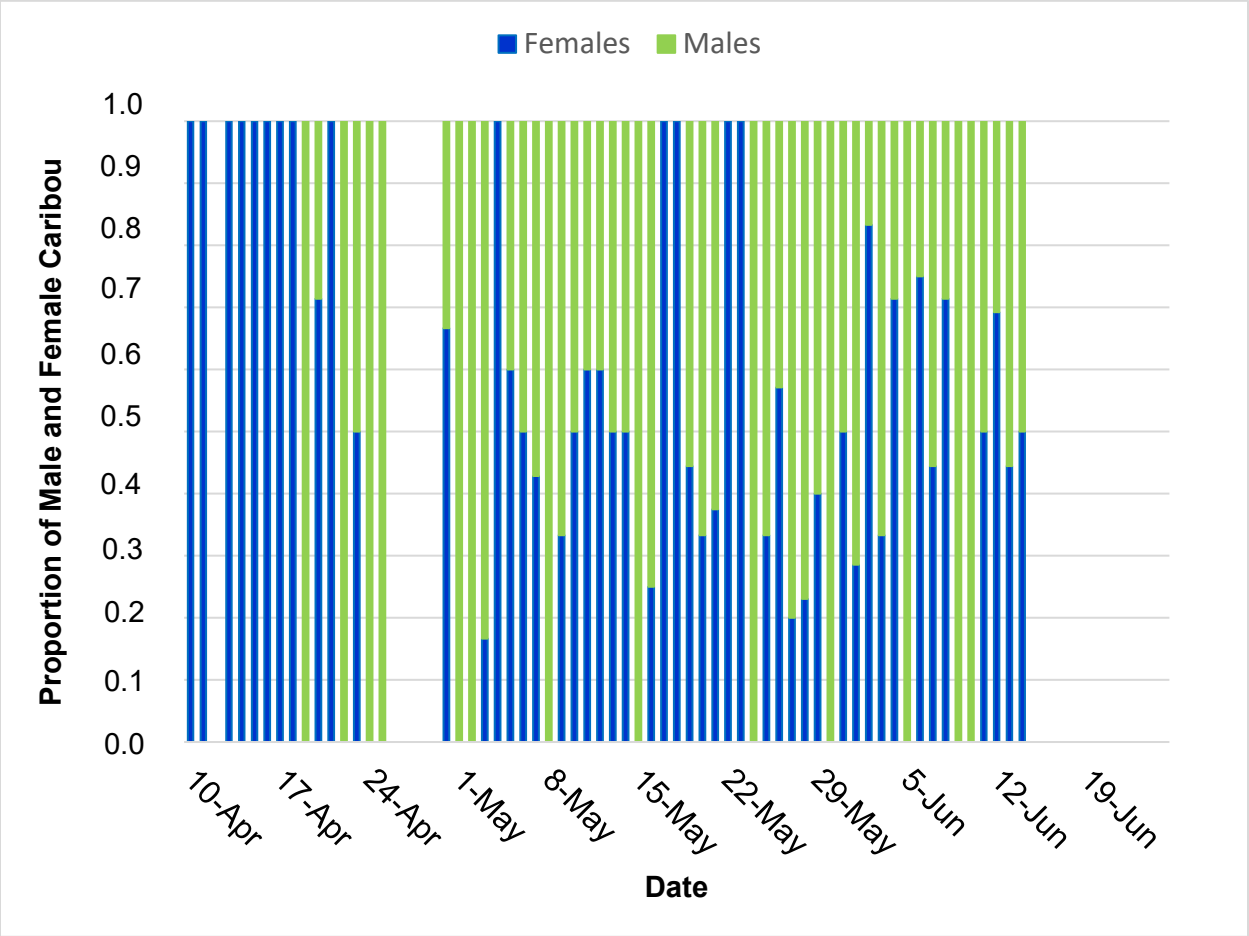


Figure 4-7 Proportion of Female and Male Caribou Detected at Remote Camera Sites

There were 347 caribou detected during the Spring 2021 Caribou Survey (Table 4.4). The ratio of males to females was 81 males:100 females (Table 4.4). There were 7 calves per 100 females, and calves accounted for 3% of caribou detected. Yearlings made up 5% of total caribou detected, and 9 caribou were classified as unknown age or sex. Four caribou with collars were detected.

Table 4.4 Caribou Group Composition based on Remote Camera Results for Spring 2020 and Spring 2021

	Total	
	Spring 2020	**Spring 2021**
Total Caribou	701	374
Total Adults[1]	638	333
Adult Females	351	162
Adult Males	189	131
Adult Unknown[2]	98	40
Yearlings	52	20
Calves	3	12
Unknown[3]	8	9
Male:100 Females[4]	54	81
Percent Males[4] (%)	27	35
Calf:100 Females[4]	1	7
Percent Calves[4] (%)	<1	3
Percent Yearlings[4] (%)	7	5
Mean Group Size[4, 5] (range)	6 (1-84)	2 (1-18)
Number of Collared Caribou	0	4

Notes:
1. Total adults = adult females + adult males + adult unknown
2. Adult Unknown = adults of unknown sex
3. Unknown includes caribou of unknown sex and/or age class
4. Numbers rounded to the nearest whole number
5. Mean group size and range

Other wildlife species detected by the remote cameras were moose (*Alces alces*), American marten (*Martes americana*), coyote (*Canis latrans)*, black bear (*Ursus americanus)*, snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), Canada jay (*Perisoreus canadensis)*, and American robin (*Turdus migratorius*). Additional information on incidental sightings is provided in Appendix D.

5.0 DISCUSSION

This report provides a summary of the Spring 2021 Caribou Survey for migration within the Project Area as part of ongoing baseline data collection and is not intended to provide a detailed analysis or comparison between remote camera data collected in previous years or seasons.

Analyses and baseline studies completed for the EIS (Marathon 2020a), and information from the Wildlife Division (Government of NL 2019), indicate a well-used spring and fall migration corridor in the Project Area and a well-defined series of pathways for the Buchans herd between the north end of Valentine Lake and the mouth of the Victoria River. The Spring 2021 Caribou Survey recorded the greatest number of caribou at cameras 3, 13, 16, 18, 22, and 24 (over 61% of events). These camera locations overlap with the wildlife trails identified from the LiDAR data (Marathon 2020b), the spring migration path identified by the dBBMM Marathon (Marathon 2020a), and the 0 km ZOI and 1 km ZOI paths identified by the LCP analysis (Stantec 2021a). Camera 13 is close to camera locations VAL1 and VAL2, which detected the greatest number of caribou events in the spring 2020 survey (Marathon 2020b). In this survey, nineteen of the cameras detected five or more events; cameras 7 and 25 detected no caribou. While these camera locations detected the most caribou and events, results from the aerial survey of the calving grounds (June 7-12, 2021) (Stantec 2021c) suggest a large portion of the caribou moved to their calving and post-calving grounds undetected by the cameras in and around the Project Area. This is also consistent with collar data, which indicates that alternate routes are used in addition to the primary corridor. Consistent repeated measures at these camera deployment locations will allow trends and changes to be detected over time. The placement of the Spring 2021 cameras were to meet the objectives of:

- identify caribou entry and exit points to the mine site;
- evaluate the use of lesser used migration paths through the mine site and surrounding areas; and,
- identify the timing of migration through the mine site and surrounding areas.

The remote cameras detected both northward and southward movement in spring 2021. Similar percentages of events moving north (38%) and south (32%) were detected and the same number of cameras had generalized northward movement as southward (five sites for each). Additionally, movements west and east were also detected. Based on the degree of overlap between the Project Area and the spring ranges of the Buchans and Grey River herds (Marathon 2020a), it is assumed that most caribou detected by the remote cameras are part of the Buchans herd with potential for a small number of resident Grey River caribou. The remote cameras detected northward movements that could be migration of the Buchans herd to the calving grounds. However, the cameras also detected similar amounts of southward movement, as well as some east and west movements. The east, south, and west movements that were detected provide information for discrete moments in time and do not offer any additional information on where the caribou move following the photo.

Caribou were detected between April 10 and June 14, 2021. The greatest number of caribou events were on June 11 and 12, 2021 and the greatest number of individual caribou were on April 10, 2021. Although

a peak movement period was detected in spring 2020 (females: April 25 to May 7, 2020; males: May 15–May 27, 2020) (Marathon 2020b), a clear peak movement period was not detected in spring 2021. Rather caribou were detected consistently throughout the camera deployment period. The difference between caribou spring movement periods between 2020 and 2021 suggest interannual variation in the timing of the spring migration. The timing of the fall migration of the Buchans herd has differed over time. The spring migration shifted from April in the 1960s to late-May and early-June in the late-1990s (Mahoney and Schaefer 2002), but had returned to late-April by the 2000s (Schaefer and Mahoney 2013). The timing of ungulate migration can be variable, possibly in response to precipitation and plant emergence (Rickbeil et al. 2019). The timing of spring migration of caribou in Labrador was correlated with weather conditions during the migratory period; spring migration occurred earlier following mild winters but occurred later in years with abundant spring rains (Le Corre et al. 2017). While caribou are capable swimmers [e.g., Peary Caribou do swim between 1-10 km between Arctic islands (Miller 1995)], caribou have also been shown to select ice and avoid large bodies of open water (Leblond et al. 2016). However, the timing of migration of caribou in Labrador was not influenced by the amount of ice cover (Le Corre et al. 2017). Variability around the timing of spring migration may be influenced by weather conditions immediately preceding the spring migration (LeCorre et al. 2017; Gurarie et al. 2019), snow conditions (Eastland 1991), and timing of spring green up (Mallory et al. 2020).

Classification results in both the spring 2020 and 2021 aerial surveys detected more females than males. Of those adult caribou that were sexed, 44% of detected caribou in spring 2021 were male, greater than that detected in spring 2020 (35%) (Marathon 2020b). The caribou sex ratio on the Island of Newfoundland is generally more females to males (Weir et al. 2014), with a “very low portion of males" following the population peak in the late 1990s (Government of NL 2015). However, the previously observed decline in the proportion of males may have slowed (Government of NL 2015), as an increase in the sex ratio has been observed since 2006 (Weir et al. 2014).

The calves:100 females ratio was greater in spring 2021 than in 2020 (2020 = 1:100; 2021 = 7:100). The percent calves observed in Spring 2021 Caribou Survey (3%; 12/347) was also greater than in spring 2020 (<1%; 3/701).

The Spring 2021 Camera Survey represents a continuation of baseline data gathered by Marathon Gold for the Valentine Gold Project. The camera studies are one of many sources of information that will be used to verify the EIS predictions of potential Project effects on caribou. Upon Project release and the initiation of construction and operations, data and information gathered from future camera surveys will be combined with other data collection methods for more comprehensive analysis. To date, as is presented in this report, the baseline data gathered through the camera surveys have been primarily descriptive in nature. The expanded spatial coverage and addition of supplementary remote cameras to the Spring 2021 Camera Survey are intended to gather a broader understanding of caribou movement in and around the Project Area and establish long-term monitoring locations for future contribution to monitoring initiatives described in the Caribou Protection and Environmental Effects Monitoring Plan.

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APPENDIX A

Comparison Between Spring 2021 Camera Deployment Locations and Earlier Deployment Locations

Appendix A COMPARISON BETWEEN SPRING 2021 CAMERA DEPLOYMENT LOCATIONS AND EARLIER DEPLOYMENT LOCATIONS

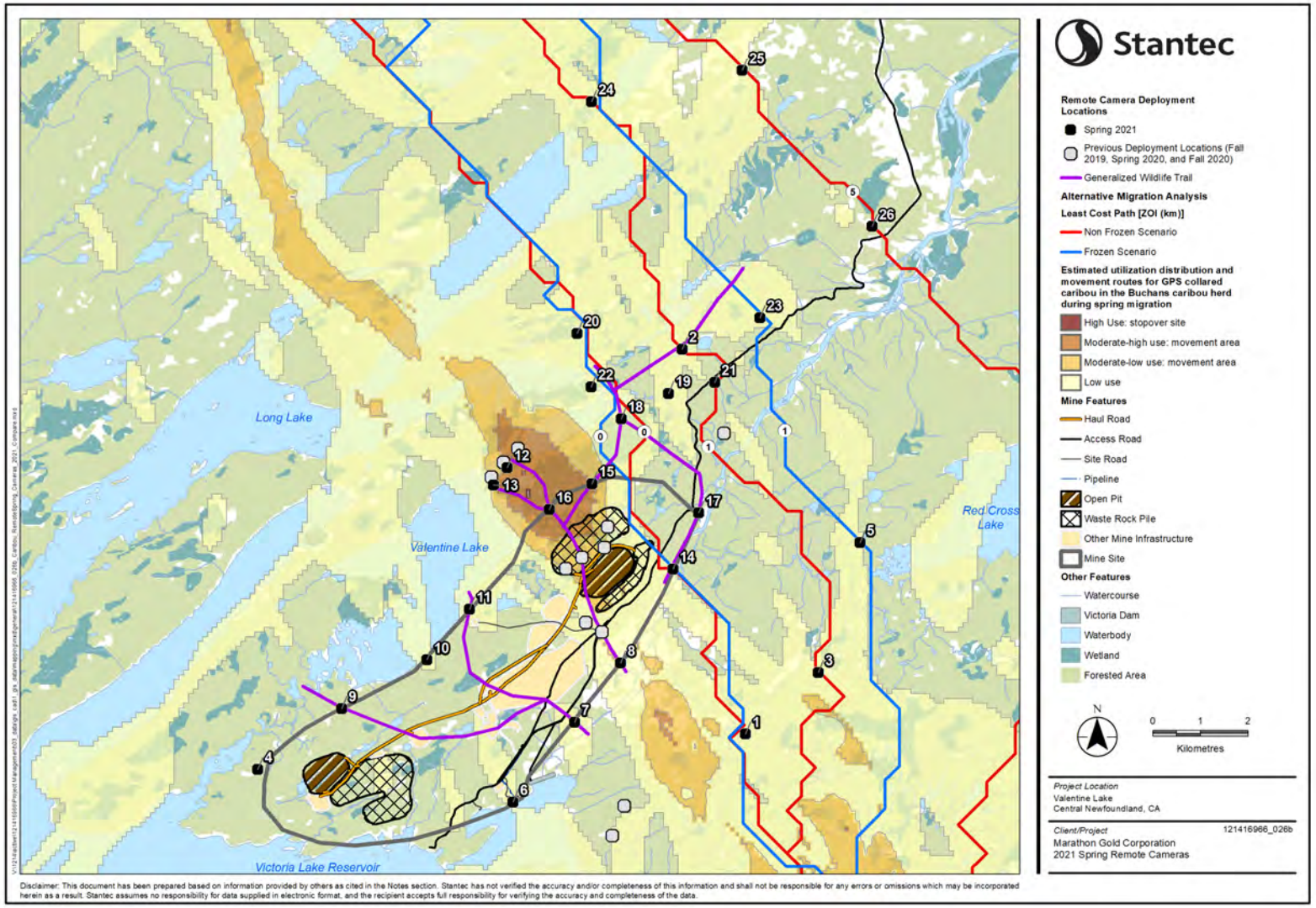


Figure A-1 Comparison of Remote Camera Deployment Locations for Spring 2021 Caribou Survey and Earlier Surveys

APPENDIX B

Remote Camera Site Metadata

Appendix B REMOTE CAMERA SITE METADATA

Table B.1 Remote Camera Site Metadata

Camera Name	**1**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	3ºC
Winds	SW Light
UTM Zone	21
UTM Easting	495264
UTM Northing	5357818
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Open treed bog. Larch and black spruce. Grasses/sedges.
Camera Height	~130 cm
Camera Orientation (degrees)	~340°
Rationale for Camera Location	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (0 km ZOI) identified by LCP analysis. Positioned along well-used game trail.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**2**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	493953
UTM Northing	5365217
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Trees: larch, spruce, low trailing juniper, black spruce. Shrubs: bog cranberry, leather leaf, sheep laurel
Camera Height	~140 cm
Camera Orientation (degrees)	~345°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR, caribou migration paths identified by dBBMM and with alternate migration path (1 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**3**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	496421
UTM Northing	5358387
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Open bog complex: larch, black spruce Shrubs: leather leaf, Labrador tea, pitcher plant, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~160°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (1 km ZOI) identified by LCP analysis. Positioned along well-used game trail.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**4**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	5ºC
Winds	S Moderate
UTM zone	21
UTM Easting	483726
UTM Northing	5357235
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Open bog complex: black spruce, larch Shrubs: grasses, sedges, pitcher plant
Camera Height	~150 cm
Camera Orientation (degrees)	~200°
Evidence of Caribou Use	Area aligns with alternate migration path identified by dBBMM. Caribou observed within 500 m on April 16, 2021 recheck
	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**5**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	498199
UTM Northing	5361562
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: Black spruce, larch, alder, trailing juniper Shrubs: leather leaf, Labrador tea, sheep laurel, pitcher plant and grasses/sedges
Camera Height	~15 cm
Camera Orientation (degrees)	~40°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (1 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**6**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	3ºC
Winds	SW Light
UTM zone	21
UTM Easting	490135
UTM Northing	5355485
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: Black spruce, larch, speckled alder Shrubs: Labrador tea, bog cranberry, bog rosemary, grasses/sedges
Camera Height	~140 cm
Camera Orientation (degrees)	~245°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**7**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	April 10, 2021
Retrieval Date	June 23, 2021
Team Members	Deployment - Staff from Marathon
	Retrieval - Staff from Marathon
Note	Deployment and retrieval were by Marathon staff. Information on camera site was not recorded.

Table B.1 Remote Camera Site Metadata

Camera Name	**8**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	3ºC
Winds	SW Light
UTM zone	21
UTM Easting	493013
UTM Northing	5358502
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, black spruce, alder sp. Shrubs: Labrador tea, sheep laurel, rose sp., grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~25°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM. Positioned along well-used caribou trail (caribou tracks in the snow).
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**9**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	5ºC
Winds	S Moderate
UTM zone	21
UTM Easting	487076
UTM Northing	5357514
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, black spruce, alder sp. Shrubs: Labrador tea, leather leaf, bog cranberry, bog rosemary, pitcher plant, grasses/sedges
Camera Height	~100 cm
Camera Orientation (degrees)	~10°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR. Caribou observer near camera during recheck (April 16, 2021).
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**10**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	488660
UTM Northing	5358570
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, balsam fir, larch, alder sp. Shrubs: Labrador tea, leather leaf, grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~20°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**11**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	489621
UTM Northing	5359529
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: low trailing juniper, birch, alder sp., spruce, fir Shrubs: Labrador tea, grasses/sedges Along edge of Valentine Lake
Camera Height	~140 cm
Camera Orientation (degrees)	~330°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**12**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	6ºC
Winds	SW Light
UTM zone	21
UTM Easting	490410
UTM Northing	5362481
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex Trees: larch, black spruce Shrubs: leather leaf, Labrador tea, grasses/sedges, bog rosemary, pitcher plant, bog cranberry
Camera Height	~130 cm
Camera Orientation (degrees)	~20°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM. Positioned along well-used caribou trails.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**13**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	7ºC
Winds	SW Light
UTM zone	21
UTM Easting	490487
UTM Northing	5361889
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex Trees: larch, black spruce Shrubs: leather leaf, Labrador tea, grasses/sedges, bog rosemary, pitcher plant, bog cranberry
Camera Height	~120 cm
Camera Orientation (degrees)	~80°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM. Positioned along well-used caribou trails.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**14**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	493459
UTM Northing	5360542
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: thick spruce/fir forest with small bog, black spruce, larch, balsam fir Shrubs: Labrador tea, sphagnum moss, grasses/sedges
Camera Height	~140 cm
Camera Orientation (degrees)	~310°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR, caribou migration paths identified by dBBMM, and alternate migration path (0 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**15**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	8ºC
Winds	SW Light
UTM zone	21
UTM Easting	492154
UTM Northing	5362085
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex. Trees: black spruce, larch. Shrubs: Labrador tea, leather leaf, pitcher plant, bog cranberry, sheep laurel, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~45°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM. Positioned along well used trail network.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**16**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	7ºC
Winds	SW Light
UTM zone	21
UTM Easting	491194
UTM Northing	5361888
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex Trees: black spruce, larch Shrubs: Labrador tea, leather leaf, pitcher plant, bog rosemary, grasses/sedges
Camera Height	~140 cm
Camera Orientation (degrees)	~330°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM. Positioned along well used trail network.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

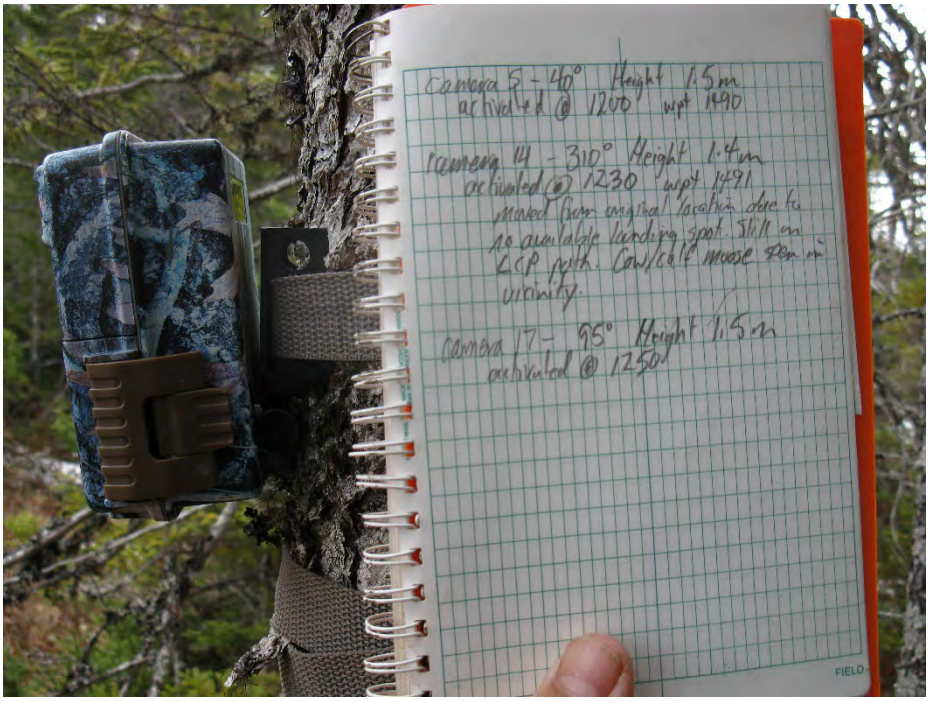
Camera Name	**17**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	494359
UTM Northing	5361382
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, larch, balsam fir Shrubs: Labrador tea, sheep laurel, leather leaf, sphagnum moss, grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~95°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration paths identified by dBBMM. Positioned along well used trail network.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**18**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	8ºC
Winds	SW Light
UTM zone	21
UTM Easting	493034
UTM Northing	5363603
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, larch Shrubs: Labrador tea, leather leaf, trailing juniper, pitcher plant, bog cranberry, grasses/sedges
Camera Height	~140 cm
Camera Orientation (degrees)	~120°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR, caribou migration paths identified by dBBMM, and alternate migration path (0 km ZOI) identified by LCP analysis. Positioned along wildlife trail.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**19**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	493204
UTM Northing	5364402
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Raised string bog complex Trees: larch, spruce, alder sp. Shrubs: leather leaf, sheep laurel, Lamb's kill, pitcher plant, bog cranberry, grasses/sedges
Camera Height	~140 cm
Camera Orientation (degrees)	~120°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM. Positioned along wildlife trail.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**20**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	6ºC
Winds	SW Light
UTM zone	21
UTM Easting	491567
UTM Northing	5365669
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, larch Shrubs: leather leaf, alder sp., grasses
Camera Height	~140 cm
Camera Orientation (degrees)	~70°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM. Caribou observed in vicinity.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**21**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	495072
UTM Northing	5363961
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, black spruce Shrubs: low trailing juniper with berries, Labrador tea, leather leaf, pitcher plant, grasses/sedges.
Camera Height	~150 cm
Camera Orientation (degrees)	~175°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (1 km ZOI) identified by LCP analysis. Positioned along wildlife trail network.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**22**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	6ºC
Winds	SW Light
UTM zone	21
UTM Easting	492208
UTM Northing	5364184
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Treed bog Trees: larch, black spruce, alder sp. Shrubs: Labrador tea, pitcher plant, grasses/sedges
Camera Height	~140 cm
Camera Orientation (degrees)	~80°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM. Positioned along wildlife trails.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**23**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	8ºC
Winds	SW Light
UTM zone	21
UTM Easting	495305
UTM Northing	5365780
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Raised bog complex Trees: larch, black spruce Shrubs: Labrador tea, leather leaf, pitcher plant, bog cranberry, sheet laurel, sphagnum moss, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~0°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (1 km ZOI) identified by LCP analysis. Positioned near wildlife trails.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**24**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	5ºC
Winds	NE
UTM zone	21
UTM Easting	491877
UTM Northing	5369708
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, spruce, speckled alder Shrubs: leather leaf, Labrador tea, pitcher plant, grasses/sedges, bog laurel, bog rosemary
Camera Height	~150 cm
Camera Orientation (degrees)	~120°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (1 km ZOI) identified by LCP analysis. Positioned near wildlife trails.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**25**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 9, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	9ºC
Winds	SW Light
UTM zone	21
UTM Easting	495147
UTM Northing	5370415
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, spruce, alder sp. Shrubs: Labrador tea, leather leaf, pitcher plant, grasses/sedges
Camera Height	~120 cm
Camera Orientation (degrees)	~150°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM and with alternate migration path (5 km ZOI) identified by LCP analysis. Positioned along wildlife trails.
Photo of Camera Location	 Photo: April 10, 2021

Table B.1 Remote Camera Site Metadata

Camera Name	**26**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	April 10, 2021
Retrieval Date	June 13, 2021
Team Members	Deployment - Tony Parr and C. Gosse (NL Helicopters)
	Retrieval - Tony Parr and C. Gosse (NL Helicopters)
Temperature	4ºC
Winds	SW Light
UTM zone	21
UTM Easting	498199
UTM Northing	5368041
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: spruce Shrubs: leather leaf, Labrador tea, pitcher plant, sphagnum moss, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~325°
Evidence of Caribou Use	Area aligns with caribou migration paths identified by dBBMM. Positioned along old wildlife trails.
Photo of Camera Location	 Photo: April 10, 2021

APPENDIX C

Direction of Caribou Movement

Appendix C DIRECTION OF CARIBOU MOVEMENT

Table C.1 Direction of Caribou Movement

Camera Site	North[A]	East[A]	South[A]	West[A]	Total
1	**4 (67%)**		1 (17%)	1 (17%)	6
2			**1 (50%)**	**1 (50%)**	2
3		**13 (52%)**	2 (8%)	10 (40%)	25
4				**7 (100%)**	7
5			**5 (100%)**		5
6	1 (14%)	1 (14%)	**4 (57%)**	1 (14%)	7
7					
8				**1 (100%)**	1
9	**2 (33%)**	1 (17%)	1 (17%)	**2 (33%)**	6
10[B]					
11	**2 (50%)**		**2 (50%)**		4
12	**9 (82%)**	2 (18%)			11
13	**29 (52%)**		27 (48%)		56
14	**1 (100%)**				1
15	3 (38%)	**5 (63%)**			8
16	**11 (69%)**		5 (31%)		16
17	**5 (83%)**		1 (17%)		6
18	**8 (44%)**		**10 (56%)**		18
19	2 (33%)		**4 (67%)**		6
20		**5 (71%)**		2 (29%)	7
21		2 (33%)		**4 (67%)**	6
22	4 (24%)	2 (12%)	**7 (41%)**	4 (24%)	17
23	**3 (60%)**			2 (40%)	5
24	**8 (40%)**	2 (10%)	4 (20%)	6 (30%)	20
25					
26	1 (20%)		**4 (80%)**		5
Total	**93**	**33**	**78**	**41**	**245[C]**

Notes:
Text in bold indicates primary direction of movement

Dates of recording for cameras 1-4, 6, 8-9, 11-13, 15-16, and 18-26 were April 10 to Jun 14, 2021. Camera 5 was April 10 to May 5, 2021. Camera 7 was April 10 to June 24, 2021. Camera 14 was April 10 to May 28, 2021. Camera 17 was April 10 to May 31, 2021.

A. Percentage of events in brackets. Percentages may not add up to the total due to rounding.
B. The SD card in camera 10 malfunctioned and no photos were recorded.
C. Only includes events where direction could be determined.

APPENDIX D

Incidental Wildlife Detections

Appendix D INCIDENTAL WILDLIFE DETECTIONS

D.1 INCIDENTAL WILDLIFE DETECTIONS

Incidental wildlife observations for moose are provided in Table D.1 Other wildlife species are provided in Table D.2. Photos of moose captured by the remote cameras are provided in Figures D-1 and D-2, and Figures D-3 to D-8 are photos of other wildlife species captured by the cameras.

Table D.1 Moose Detections from Remote Cameras Sites

Camera ID	Number of Events	Number of Moose	Number of Males	Number of Females	Number of Yearlings	Number of Calves	Number of Unknown
1							
2	17	30	2	16		7	5
3	4	4	3				1
4	1	1	1				
5	3	3		2			1
6	1	2		1	1		
7	8	8	8				
8	6	7	3	1		1	2
9	1	1	1				
10[A]							
11	14	18	2	10	1	3	2
12	1	1					1
13	1	1					1
14	4	4	3				1
15							
16							
17	7	19	5	6	4	1	3
18	2	3		2		1	
19	2	2		1			1
20	8	8	4	2			2
21	5	5		2			3
22	3	4		2			2
23							
24	5	9	1	4		4	
25	5	5	2	2			1
26	1	2		1		1	
Total	**99**	**137**	**35**	**52**	**6**	**18**	**26**

Notes:

Moose were detected from April 13, 2021 to June 23, 2021

[A] The SD card in camera 10 malfunctioned and no photos were recorded.

Figure D-2 Female Moose and Calf from Remote Camera 2, June 13, 2021

Figure D-3 Male Moose from Remote Camera 7, May 9, 2021

Table D.2 Other Incidental Wildlife Detections from Remote Cameras Sites

Species	Camera ID	Date	Number of Detections
American Marten	14	April 23, 2021	1
American Robin	7	May 25, 2021	1
Black Bear	3	May 4, 2021	1
Coyote	9	April 30, 2021	1
	17	May 5, 2021	1
	15	May 21, 2021	1
	17	May 26, 2021	2
	18	May 27, 2021	1
	17	May 29, 2021	1
Canada Jay	17	May 18, 2021	1
	17	May 19, 2021	1
	17	May 20, 2021	1
	14	May 21, 2021	1
	7	May 24, 2021	1
	17	May 24, 2021	1
Red Squirrel	7	May 1, 2021	1
	7	May 6, 2021	1
Snowshoe Hare	14	April 26, 2021	1
Unidentified Game Bird Species	17	May 25, 2021	1

Figure D-4 American Marten from Remote Camera 14, April 23, 2021

Figure D-5 American Robin from Remote Camera 7, May 25, 2021

Figure D-6 Black Bear from Remote Camera 3, May 4, 2021

Figure D-7 Canada Jay from Remote Camera 17, May 20, 2021

Figure D-8 Red Squirrel from Remote Camera 7, May 6, 2021

Figure D-9 Snowshoe Hare from Remote Camera 14, April 26, 2021

APPENDIX E

Caribou Photos from Remote Cameras

Appendix E CARIBOU PHOTOS FROM REMOTE CAMERAS

Figure E-1 Male Caribou from Remote Camera 4, May 21, 2021

Figure E-2 Caribou from Remote Camera 13, April 10, 2021

Figure E-3 Female Caribou and Calf from Remote Camera 21, June 6, 2021

Figure E-4 Caribou with Collar from Remote Camera 16, April 10, 2021

Valentine Gold Project: Fall 2021 Caribou Survey – Remote Cameras

Draft Report

October 6, 2022

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VALENTINE GOLD PROJECT: FALL 2021 CARIBOU SURVEY – REMOTE CAMERAS

This document entitled Valentine Gold Project: Fall 2021 Caribou Survey – Remote Cameras was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Marathon Gold Corporation (the “Client”). The conclusions in the Report are Stantec’s professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient’s own risk.

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Executive Summary

Marathon Gold Corporation (Marathon) is proposing to develop an open pit gold mine near Valentine Lake, located in the central region of the Island of Newfoundland, southwest of the Town of Millertown, Newfoundland and Labrador (NL). On September 29, 2020, Marathon filed an Environmental Impact Statement (EIS) (Marathon 2020a) with the Impact Assessment Agency of Canada (IAAC) and Newfoundland and Labrador Department of Environment and Climate Change, assessing potential Project and cumulative effects of the Valentine Gold Project (the Project). The Project was released from the environmental assessment process by the Newfoundland and Labrador Department of Environment and Climate Change on March 17, 2022 and by IAAC on August 24, 2022. The assessment of woodland caribou (*Rangifer tarandus*; hereafter caribou) for the EIS, and the Wildlife Division of the Department of Environment and Climate Change (formerly the Department of Fisheries, Forestry and Agriculture) (Government of Newfoundland and Labrador [NL] 2019; Doucet and Morgan 2007 in Wells et al. 2011), identified seasonal caribou migration paths within the assessment area that are likely to be affected by the Project.

Stantec Consulting Ltd. (Stantec) undertook a remote camera survey in fall 2021 to better understand the timing, distribution, and relative use of the migration paths within and near the Project. This work builds on similar caribou migration camera surveys that were completed in fall 2019, spring 2020, fall 2020, and spring 2021. The Fall 2021 Caribou Survey included 31 remote cameras deployed in October 2021, placed along identified migration paths, and along potential alternate migration paths in the assessment area. Cameras were retrieved on January 27 and 28, 2022. Photos of caribou moving past the remote cameras were analyzed by counting and classifying the caribou.

.

The cameras detected more than 910 caribou during the fall 2021 migration period. The greatest number of caribou were detected in three locations: near the outlet of Valentine Lake, north of Long Lake, and east of Victoria Lake Reservoir. Caribou were detected from November 2, 2021 to January 7, 2022, with peak movement detected from November 6 to December 7, 2021. The greatest number of events (13 events/monitoring day) and individuals (210 caribou) both occurred on November 14, 2021.

The information from the Fall 2021 Caribou Survey will be used to refine the timing of caribou movement through the mine site and to inform mitigation measures.

Abbreviations

cm	centimetre
dBBMM	dynamic Brownian bridge movement model
EIS	Environmental Impact Statement
IR	infrared
km	kilometre
LCP	least-cost path
LiDAR	Light Detection and Ranging
m	metre
NL	Newfoundland and Labrador
NLDFFA	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture
SE	standard error
ZOI	zone of influence

1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) is planning to develop an open pit gold mine south of Valentine Lake, located in the Central Region of the Island of Newfoundland, approximately 60 kilometres (km) southwest of Millertown, Newfoundland and Labrador (NL) (Figure 1-1). The Valentine Gold Project (the Project) will consist primarily 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. Approximately 73 km of this existing access road will be upgraded and maintained by Marathon as part of the Project (Figure 1-1). The Project Area encompasses the mine site, including Project infrastructure, and the access road plus a 20 metre (m) wide buffer on either side.

The Project overlaps woodland caribou (*Rangifer tarandus*; hereafter caribou) range in central Newfoundland (Marathon 2020a). Stantec Consulting Ltd. (Stantec), on behalf of Marathon, is undertaking research into the movement of caribou within and near the Project Area (refer to Section 3.1 for an overview of the Study Area). Woodland caribou was identified as a valued component in the Environmental Impact Statement (EIS) Guidelines for the Project issued by both the federal and provincial governments (IAAC 2019; Government of NL 2020). The EIS includes an analysis of caribou migration and their use of the Project Area, and an assessment of predicted Project and cumulative effects on the caribou herds that interact with the Project Area (Marathon 2020a).

Remote cameras were previously used for the fall 2019, spring and fall 2020, and spring 2021 migration periods (Stantec 2021b, 2022; Marathon 2020b). This is the fifth report on the remote camera survey program and is focused on the fall 2021 migration.

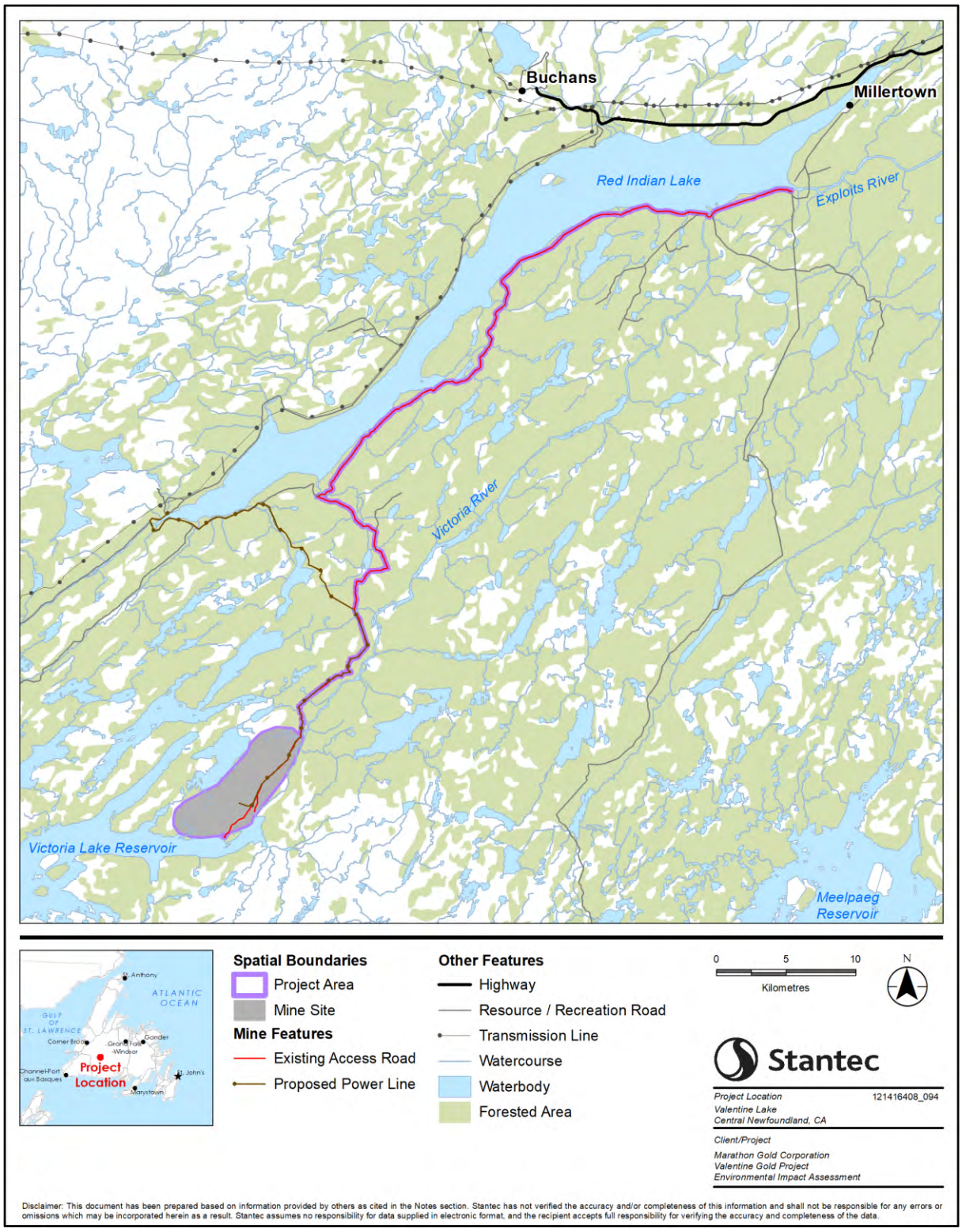


Figure 1-1 Project Area

2.0 BACKGROUND AND CONTEXT

2.1 PURPOSE

Remote camera data collected to date are pre-construction data to establish pre-construction conditions. The remote camera surveys and results are being used in combination with other pre-construction caribou surveys (e.g., analysis of collar data, aerial surveys, on-site observations by Project personnel), which are described in the Caribou Protection and Environmental Effects Monitoring Plan. The purpose of the remote cameras is to better understand the timing of caribou migration through the mine site, and to inform mitigation. Remote camera data are also used to provide information on group composition.

2.2 OBJECTIVES

The objectives of the Fall 2021 Caribou Survey were to:

- identify caribou entry and exit points to the mine site
- evaluate the use of lesser used migration paths through the mine site and surrounding areas
- identify the timing of migration through the mine site and surrounding areas

2.3 CONTEXT

The status of the Newfoundland population of caribou is Special Concern under the federal *Species at Risk Act*; however, it is not listed under the provincial *Endangered Species Act*. 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 decrease is attributed to a combination of density-dependent factors (e.g., food availability) and an increase in predation, which coincided with the introduction of coyote to the Island of Newfoundland (Government of NL 2015). The threat to the Newfoundland population of caribou has been ranked as High-Medium, based on the cumulative effects of medium threats (i.e., predation) and low threats (e.g., mining and exploration, forestry, hunting, recreation) (COSEWIC 2014). The population trend may have improved as adult body size and calf survival rates have increased (Government of NL 2015).

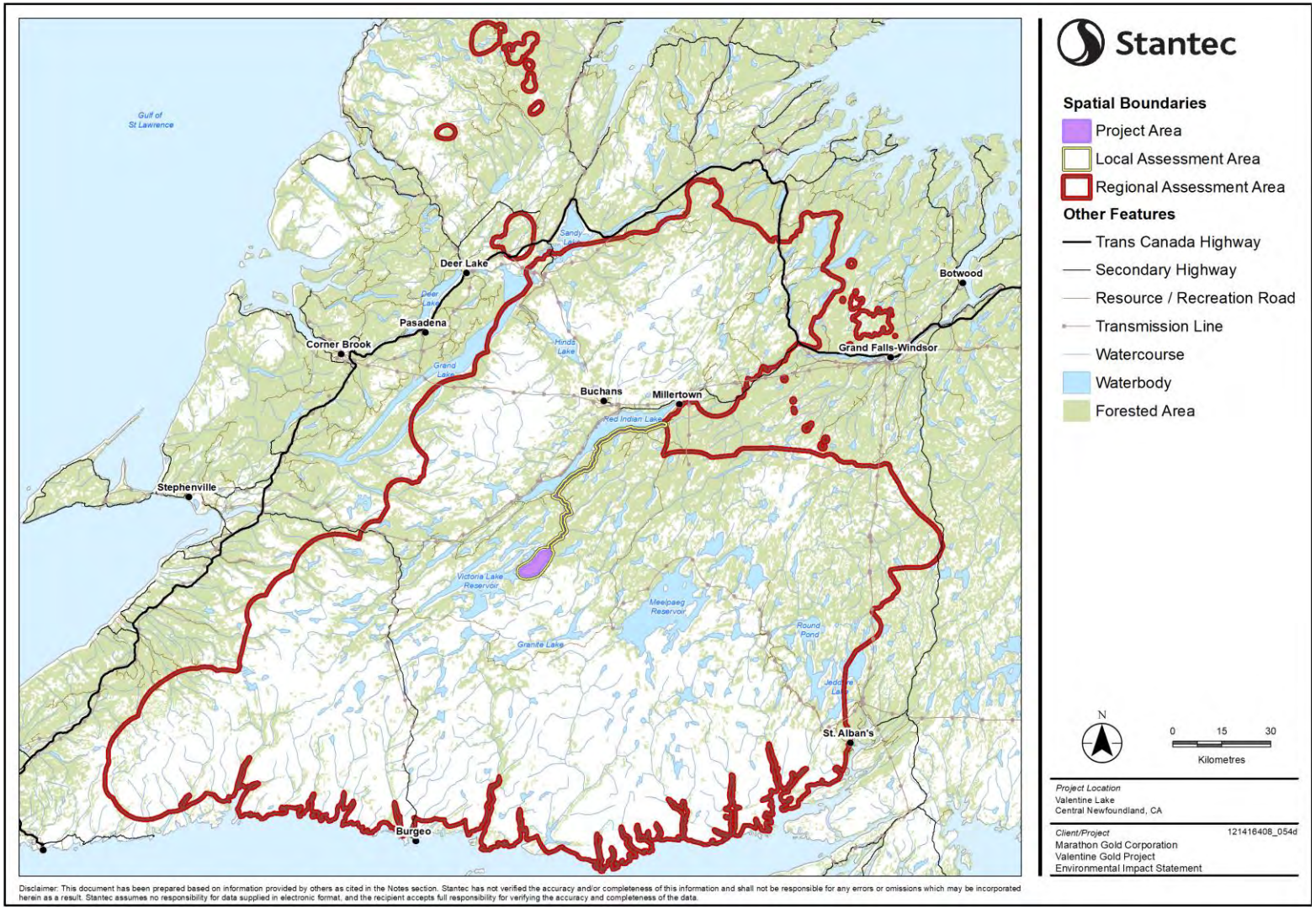


Figure 2-1 Regional Assessment Area

The Project overlaps with, or is near the ranges of, the South Coast sub-population, which comprises the following herds: Buchans, Grey River, Gaff Topsails, and La Poile (Government of NL 2019). The Regional Assessment Area used in the EIS represents the population ranges (28,809 km^2) of the Buchans, Gaff Topsails, Grey River, and La Poile Herds using combined 95% home range kernels (Figure 2-1) (Marathon 2020a). The South Coast sub-population is comprised of several caribou herds (which includes the Pot Hill herd (Government of NL 2022) in addition to the Buchans, Grey River, Gaff Topsails, and La Poile herds) that share winter ranges near the south coast between Burgeo and the Connaigre Peninsula (Weir et al. 2014), but which have separate calving and summer ranges. Recent surveys of some of the South Coast herds (i.e., Buchans, Grey River, Gaff Topsails, La Poile) indicate that population trends may be stabilizing (Government of NL 2019). The greatest risk is to the Buchans herd, because of the Project overlap with a primary migration corridor, and to the Grey River herd whose calving grounds are located to the south of Victoria Lake Reservoir. The Study Area for the Fall 2021 Caribou Survey was selected to identify caribou entry and exit points to the mine site, and to monitor likely migration pathways (Marathon 2020b) and potential alternate migratory pathways (Stantec 2021) in the vicinity of the Project (refer to Figure 3-1).

Seasonal migration pathways within and near the Project Area have been identified (Doucet and Morgan 2007 in Wells et al. 2011; Government of NL 2019; Marathon 2020a). The generalized dates for caribou seasons on the Island of Newfoundland (Table 2.1) indicate that caribou are most likely to migrate in the spring between April 1 and May 19, and in the fall between November 1 and December 15.

Marathon initiated the remote camera program in the fall of 2019 and, since that time, some modifications have been made to the locations and number of cameras to broadly capture caribou movement in the Project Area and vicinity. Many of the locations used in spring and fall 2021 are intended to become permanent monitoring locations to analyze long-term trends. If shifts in movement are detected, such as through collar data, camera placements may be adjusted. Many of the current remote camera locations include the modelled routes that may become used over time if shifts in migration occur. Information from the ongoing remote camera program combined with analysis of telemetry data will further help identify peak movement times through the mine site.

Table 2.1 General Seasons for the Island Caribou Population in Newfoundland

Season	Seasonal Dates
Winter	Dec 16–Mar 31
Spring Migration/Pre-calving	**Apr 1–May 19**
Calving	May 20–Jun 10
Post-calving Migration/Dispersal	Jun 11–Jun 30
Post-calving Rearing	Jul 1–Aug 31
Fall Rut	Sep 1–Oct 31
Fall Migration/Dispersal	**Nov 1–Dec 15**

Notes:
Bold text indicates migratory periods where caribou migrate through Marathon mine site
Source: Emera 2013

3.0 METHODS

3.1 MIGRATION TRAIL IDENTIFICATION AND REMOTE CAMERA DEPLOYMENT

Cameras for the Fall 2021 Caribou Survey (Figure 3-1) were strategically located based on their alignment with the following: wildlife trails through the proposed mine site that were identified using Light Detection and Ranging (LiDAR) data (Marathon 2020b) and ground-truthed in the field at the time of deployment; caribou migration pathways identified by dynamic Brownian bridge movement models (dBBMMs) (Marathon 2020a); potential alternate migration pathways identified by a least-cost pathway analysis (LCP) (Stantec 2021a); and, input from Wildlife Division of the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture (NLDFFA-Wildlife Division (Table 3.1). Locations 1-26 were used in the Spring 2021 Caribou Survey and locations 27-31 were additional locations used during fall 2021. Except for two cameras (12 and 13), the locations selected for spring and fall 2021 differed from those used in the previous camera deployments (fall 2019, spring 2020, and fall 2020) (Appendix A).

For the Fall 2021 Caribou Survey, 31 remote cameras were deployed in the Study Area on October 6 and 7, 2021 (Figure 3-1). Two camera models were deployed: *Reconyx HS2X Hyperfire 2 Security Covert IR* (27 cameras) and *Browning Dark Ops HD Pro X* (4 cameras). Both models have similar settings, which include infrared (IR) night vision illuminators to allow photography at night (Table 3.2). Camera settings were selected to increase the probability of wildlife detection and identification (Stantec 2015). Lithium-ion batteries and 64 gigabyte SD memory cards were used in the cameras.

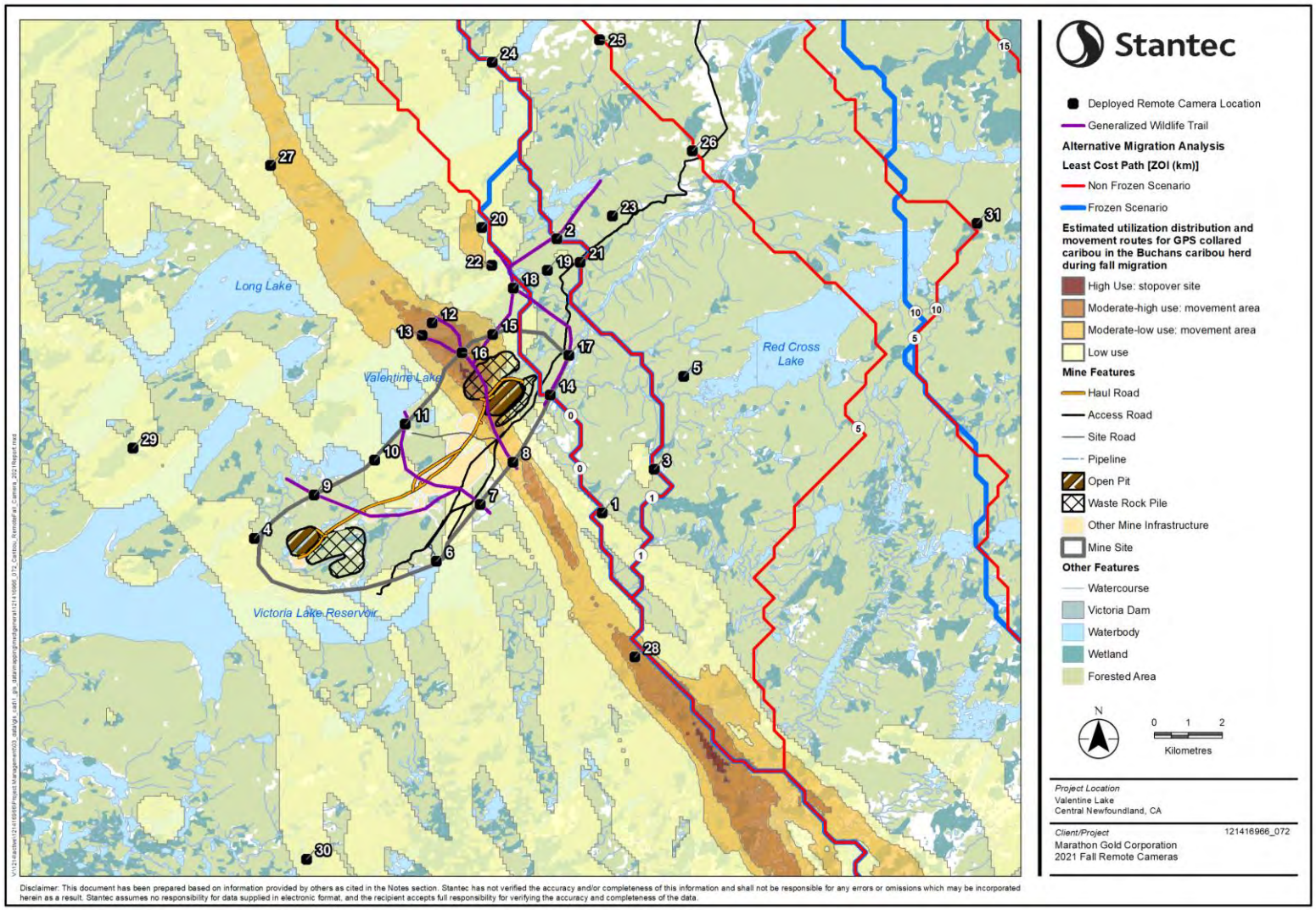


Figure 3-1 Fall 2021 Remote Camera Deployment in the Caribou Study Area

Table 3.1 Rationale for Fall 2021 Remote Camera Locations

Camera Location	Rationale		
	Aligns with wildlife trail identified from LiDAR data	Aligns with caribou migration pathways identified by dBBMM	Aligns with potential alternate migration pathways identified by LCP analysis
Cameras Positioned to Gather Information about Entry and Exit Points to Mine Site			
6		✓	
7	✓	✓	
8	✓	✓	
9	✓		
10		✓	
11	✓	✓	
14	✓	✓	✓(0 km ZOI[1], spring migration, frozen and non-frozen conditions)
15	✓	✓	
16	✓	✓	
17	✓		
Additional Camera Locations			
1		✓	✓(0 km ZOI, spring migration, frozen conditions)
2	✓	✓	✓(1 km ZOI, spring migration, non-frozen conditions)
3		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
4		✓[2]	
5		✓	✓(1 km ZOI, spring migration, frozen conditions)
12	✓	✓	
13	✓	✓	
18	✓	✓	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
19		✓	
20		✓[2]	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
21		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
22		✓[2]	
23		✓	✓(1 km ZOI, spring migration, frozen conditions)
24		✓	✓(1 km ZOI, spring migration, frozen and non-frozen conditions)
25		✓	✓(5 km ZOI, spring migration, non-frozen conditions)
26			✓(5 km ZOI, spring migration, non-frozen conditions)
27[3]		✓	

Table 3.1 Rationale for Fall 2021 Remote Camera Locations

Camera Location	Rationale		
	Aligns with wildlife trail identified from LiDAR data	Aligns with caribou migration pathways identified by dBBMM	Aligns with potential alternate migration pathways identified by LCP analysis
28[3]		✓	✓ (0 km and 1 km ZOI, fall migration, frozen and non-frozen conditions)
29[3]		✓[2]	
30[3]		✓	✓ (5 km ZOI, spring migration, frozen conditions)
31[3]		✓	✓ (5 km ZOI, fall migration, frozen conditions; 10 km ZOI, fall migration, non-frozen conditions)

Notes:
[1] ZOI = Zone of Influence [as defined in the EIS (Marathon 2020a)]
[2] Camera location modified to address comments from NLDFFA-Wildlife Division
[3] New deployment location for fall 2021

Table 3.2 Remote Camera Settings

Brand	Mode	Pictures/ Trigger	Picture Interval	Additional Settings Information
Reconyx HS2X Hyperfire 2 Security Covert IR	Motion sensor “On” with med/high sensitivity[1]	5	Rapidfire - no quiet period, no delay	Night mode (Balanced) resolution (3.1 MP)
Browning Dark Ops HD Pro X	“Trail”- photos in day and night medium sensitivity	5	Rapidfire - no delay	Capture delay – 1 second (lowest available)

Note:
[1] set to high sensitivity if a clear field of view

The cameras were deployed at each site using a standardized set-up to allow for consistency among sites and to reduce potential effects of camera placement or setup on wildlife detection. Cameras were deployed at least 500 m from one another to improve likelihood of independence (Stantec 2015), although some cameras are purposefully on the same trail at entry and exit points (e.g., cameras 7 and 11; cameras 8 and 16).

Cameras were mounted on trees with diameters of at least 20 cm. At sites where the camera mount needed additional stability, trees were braced with logs to reduce movement caused by wind. At sites with no suitable trees, tripods were installed as camera mounts. Cameras were placed approximately 1 to 1.5 m above ground to increase the probability of large mammal detection (Stantec 2015). Each camera was positioned facing a game trail to increase the path length of animals through the frame (Rovero et al. 2010). Deployment locations and additional information about the camera sites are provided in Appendix B.

To reduce the incidence of false positives (i.e., camera is triggered by something other than wildlife such as branches or grasses moving in the wind), visible vegetation within the camera's field of view was trimmed where necessary. A walk test was completed before leaving the site to assess camera angle, position, and path length along the game trail to improve likelihood of detection. For each camera, a Global Positioning System device was used to record the location (Appendix B). The camera height and orientation were also documented (Appendix B). All cameras were retrieved on January 27, 2022, except camera 7, which was retrieved on January 28, 2022.

It was assumed that most caribou detected by the remote cameras are part of the Buchans herd because of the degree of overlap between the Buchans herd range and the remote camera caribou Study Area, predominantly during the spring and fall migration periods (Marathon 2020a). There is the possibility that a small percentage (i.e., individuals or groups of two or three animals) could be resident Grey River caribou.

3.2 REMOTE CAMERA DATA ANALYSIS

Remote camera photos were reviewed using the program Timelapse v.2.2.5.1, an image analysis software program that extracts photograph metadata and facilitates the management of photo results (Greenberg 2022). The number of camera days (sum of the number of deployment days for all cameras) was calculated. Photos were analyzed based on independent events identified from a photo series. An event was defined as beginning when an animal or group of animals (i.e., two or more animals) entered the frame and ending when the animal or group had exited the frame for more than two minutes (Stantec 2015; Rowcliffe et al. 2008). Results are reported for the full camera deployment period, however mean number of events per day for fall were limited to December 31 for comparability among years.

Group composition metrics were calculated (i.e., group size, sex ratio, and age class) and collared caribou captured in the photos were noted. Detected caribou were classified as: calves (i.e., neonates); yearlings = one to two years; and adults > two years. The category of "unknown" included caribou of all age classes whose sex could not be determined. The category of "total caribou" included adults, yearlings, calves, and unknown. Caribou were classified based on presence of vulva or penis, head and body size, and antler characteristics (e.g., presence or absence, shape). "Total adults" included adults of known and unknown sex.

The following values were calculated: male:100 females; percent males (males/total caribou x 100); calf:100 females; percent calves (calves/total caribou x 100); and percent yearlings (yearlings/total caribou x 100). The classification data collected from the remote cameras is not intended to provide a population sex and age ratio estimate.

The start of the peak movement period was defined as the first Julian day when the proportion of caribou events exceeded 5% of the total observations for each season and the end was defined as when the cumulative total exceeded 80% of caribou events.

4.0 RESULTS

The 31 remote cameras (Figure 4-1) resulted in the collection of 3,523 camera days of photographs and a total of 3,780 photographs of caribou. Cameras 11-13, 15-18, 27-28, and 30 detected caribou; the other cameras were functional but did not detect caribou.

4.1 LOCATION OF DETECTIONS

The cameras detected 128 caribou events in fall 2021. The mean number of caribou events was 0.15/day [standard error (SE) = 0.07/day] (Table 4.1; Figure 4-2). Remote cameras 12, 13, 27 and 28 detected the greatest number of caribou events and individual caribou (Table 4.2, Figure 4-3). Camera 28 recorded 54% of caribou events (0.61 events/day), followed by camera 27, which recorded 17% of caribou events (0.19 events/day) (Table 4.2; Figure 4-4).

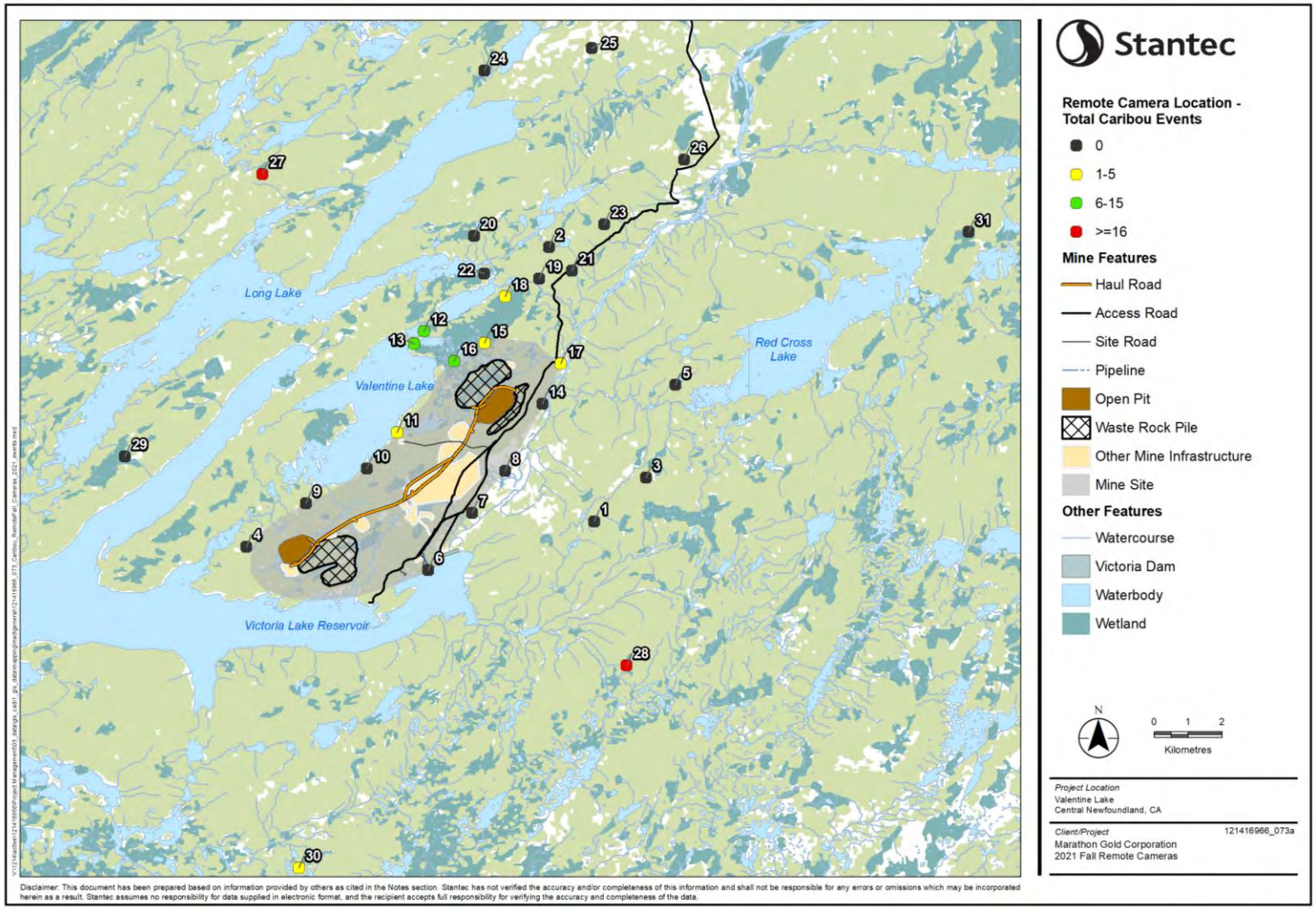


Figure 4-1 Total Caribou Events Detected from Remote Cameras, Fall 2021

Table 4.1 Seasonal Summary of Caribou Events from Remote Camera Monitoring Locations

	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021
Number of Cameras	12	11	11	26	31
Camera Days	885	805	760	1,588	3,521
Total Number of Events	157	205	180	250	128
Mean Number of Events per Day	0.17	0.25	0.24	0.17	0.15
Standard Deviation	0.26	0.31	0.39	0.18	0.23
Standard Error	0.08	0.10	0.12	0.03	0.07

Notes:
Means calculated using the following dates:
Fall 2019 – October 5 to December 31, 2019
Spring 2020 – March 28 to June 18, 2020
Fall 2020 – September 27 to December 31, 2020
Spring 2021 – April 10 to June 20, 2021
Fall 2021– October 6 to December 31, 2021

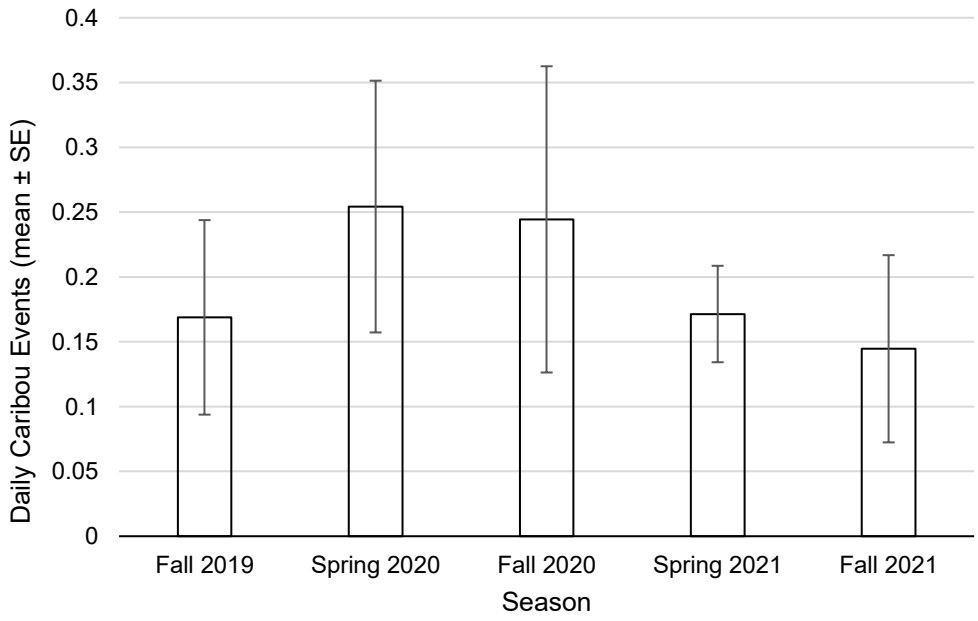
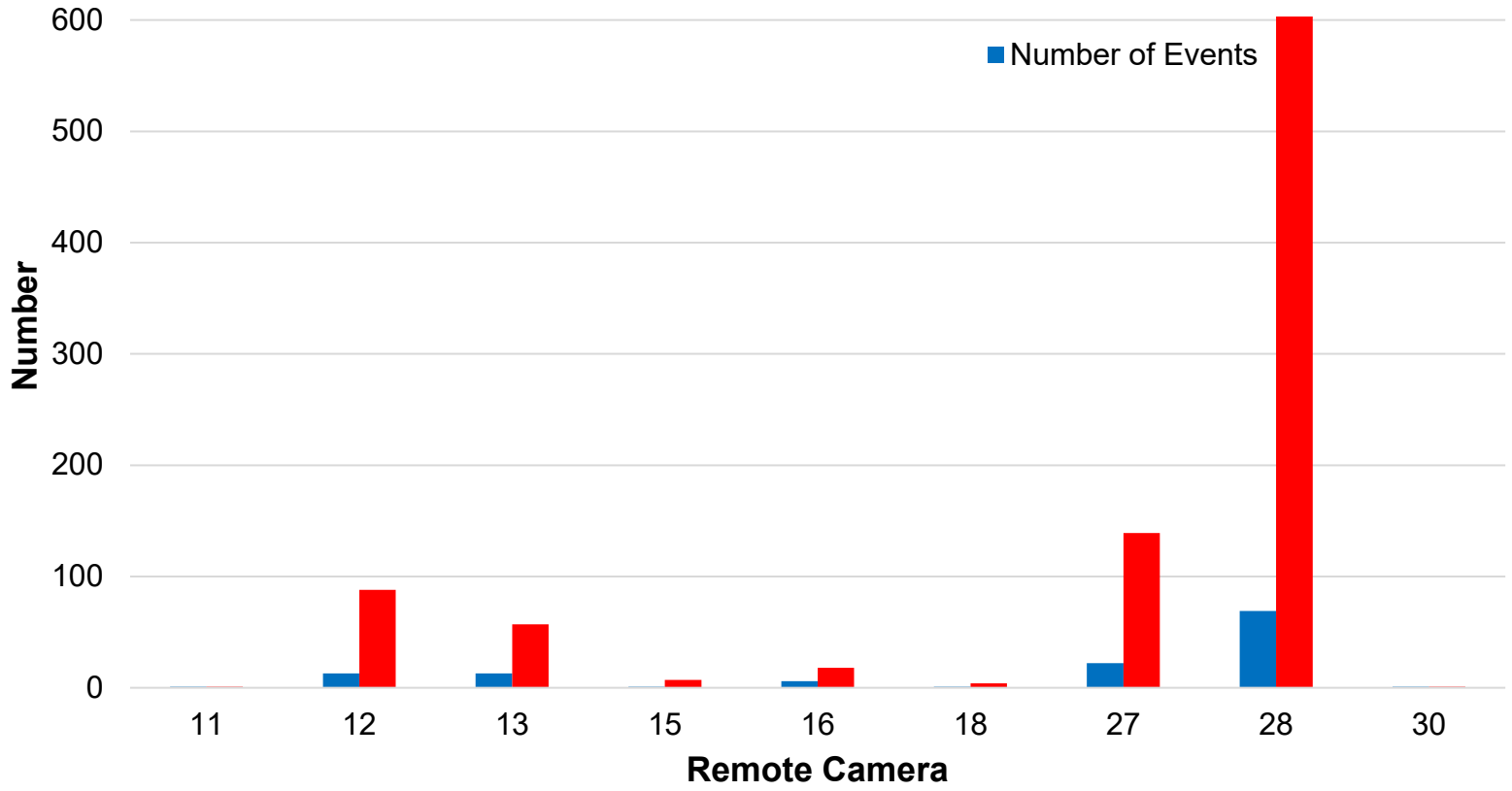


Figure 4-2 Seasonal Mean Daily Caribou Events (Fall 2019 to Fall 2021)

Table 4.2 Summary of Fall 2021 Caribou Events at Remote Camera Monitoring Locations

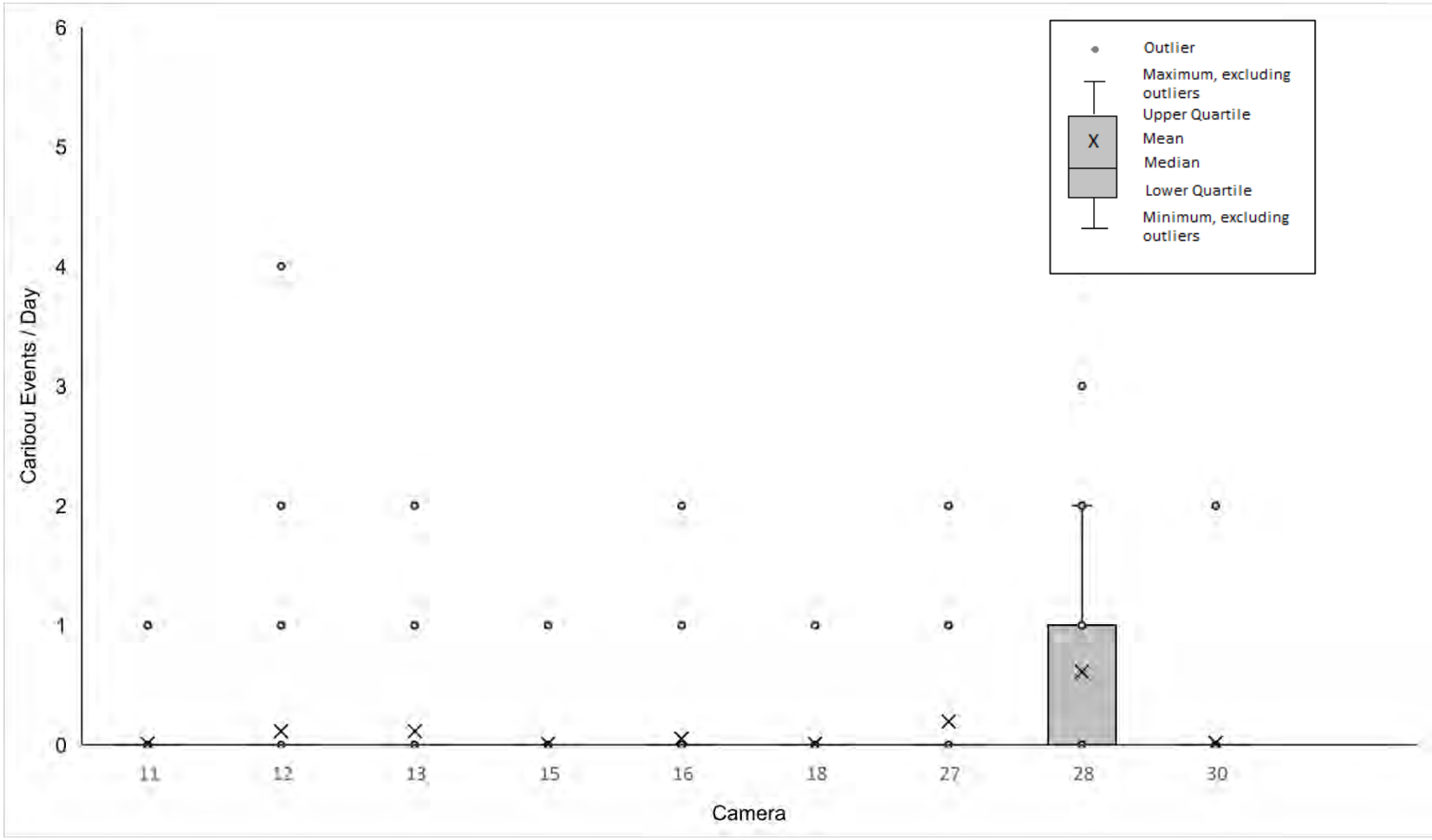
Camera Site	Number of Events	Number of Caribou Detected	Mean Number of Events per Monitoring Day (range)	Standard Error (±)	Number of Monitoring Days[A]
1	0	0	0.00	0.00	114
2	0	0	0.00	0.00	114
3	0	0	0.00	0.00	113
4	0	0	0.00	0.00	114
5	0	0	0.00	0.00	113
6	0	0	0.00	0.00	113
7	0	0	0.00	0.00	112
8	0	0	0.00	0.00	113
9	0	0	0.00	0.00	114
10	0	0	0.00	0.00	114
11	1	1	0.01 (0-1)	0.01	114
12	13	88	0.11 (0-4)	0.04	114
13	13	57	0.11 (0-2)	0.03	114
14	0	0	0.00	0.00	113
15	1	7	0.1 (0-1)	0.01	114
16	6	18	0.05 (0-2)	0.02	114
17	1	1	0.01 (0-1)	0.01	113
18	1	4	0.01 (0-1)	0.01	114
19	0	0	0.00	0.00	114
20	0	0	0.00	0.00	114
21	0	0	0.00	0.00	114
22	0	0	0.00	0.00	114
23	0	0	0.00	0.00	114
24	0	0	0.00	0.00	114
25	0	0	0.00	0.00	114
26	0	0	0.00	0.00	114
27	22	139	0.19 (0-2)	0.05	113
28	69	603	0.61 (0-9)	0.12	113
29	0	0	0.00	0.00	113
30	1	1	0.02 (0-2)	0.02	113
31	0	0	0.00	0.00	113

Notes: [A] Dates of recording for cameras 1-2, 4, 9-13, 15-16, and 18-26 were October 6, 2021 to January 27, 2022. Dates of recording for cameras 3, 5-6, 8, 14, 17, and 27-31 were October 7, 2021 to January 27, 2022. Dates of recording for camera 7 was October 9, 2021 to January 28, 2022.



Note:
Figure only includes cameras from which caribou were detected. Cameras 1 and 9 both detected a single caribou.

Figure 4-3 Number of Caribou and Caribou Events for each Remote Camera Monitoring Location



Note: Figure only includes cameras from which caribou were detected.

Figure 4-4 Number of Caribou Events per Monitoring Day for Fall 2021

4.2 TIMING OF DETECTIONS

Caribou were detected from November 2, 2021 to January 7, 2022. The peak movement period was from November 6 to December 7, 2021. The greatest number of events (13 events) and individuals (210 caribou) were detected on November 14, 2021 and the next highest numbers were on December 8, 2021 (7 events; 40 caribou) and December 9, 2021 (6 events; 127 caribou) (Figure 4-5). More than 80% of total caribou events were detected by December 7, 2021. Movement of female and male caribou were detected during the same period (e.g., females were not detected moving in advance of males) (Figure 4-6 and Figure 4-7).

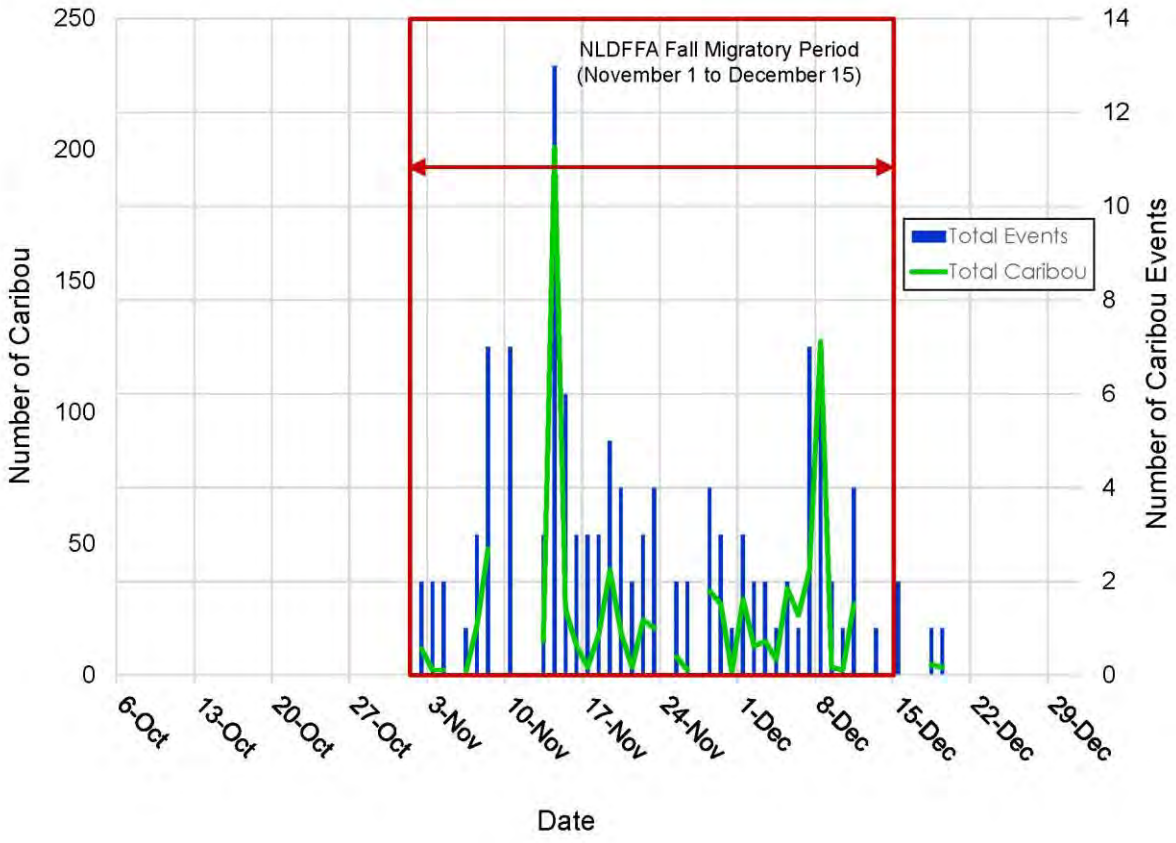


Figure 4-5 Number of Events and Caribou Detected at Remote Camera Monitoring Locations in Fall 2021

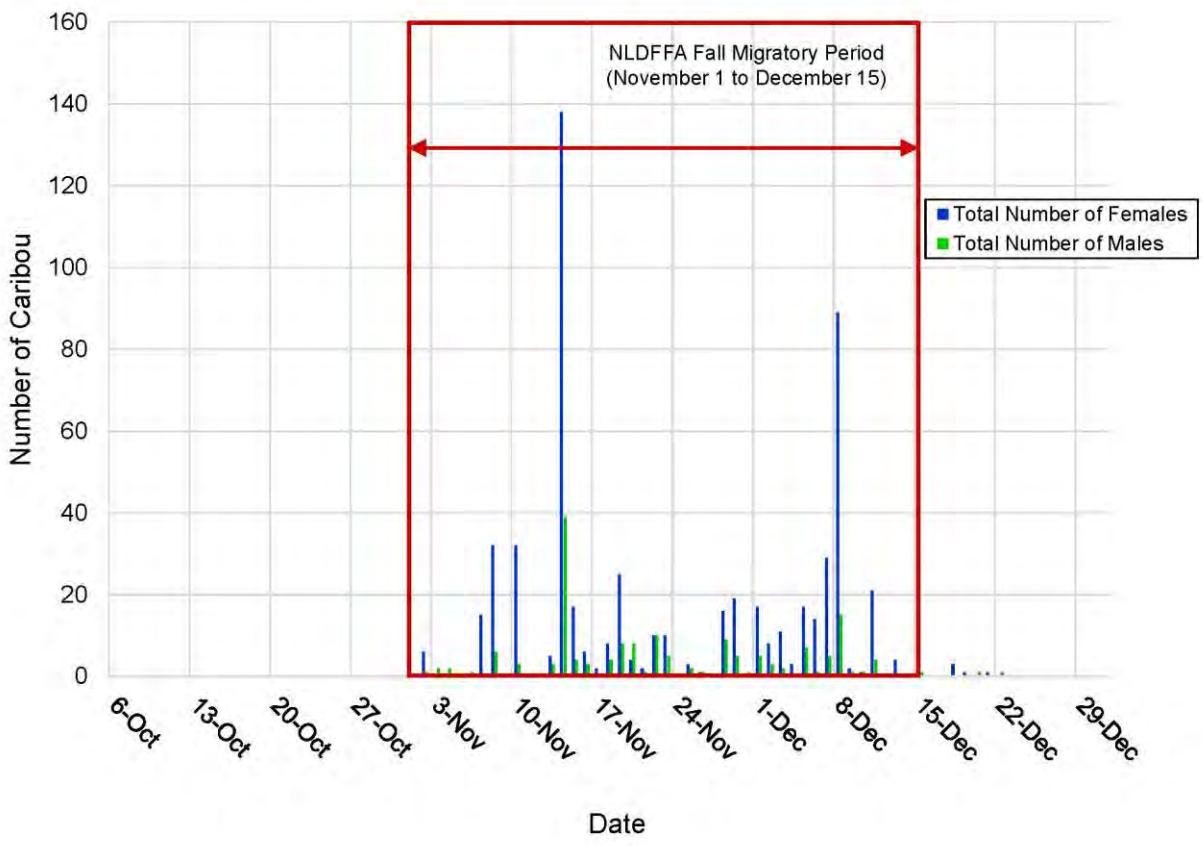


Figure 4-6 Number of Female and Male Caribou Detected at Remote Cameras Monitoring Locations in Fall 2021

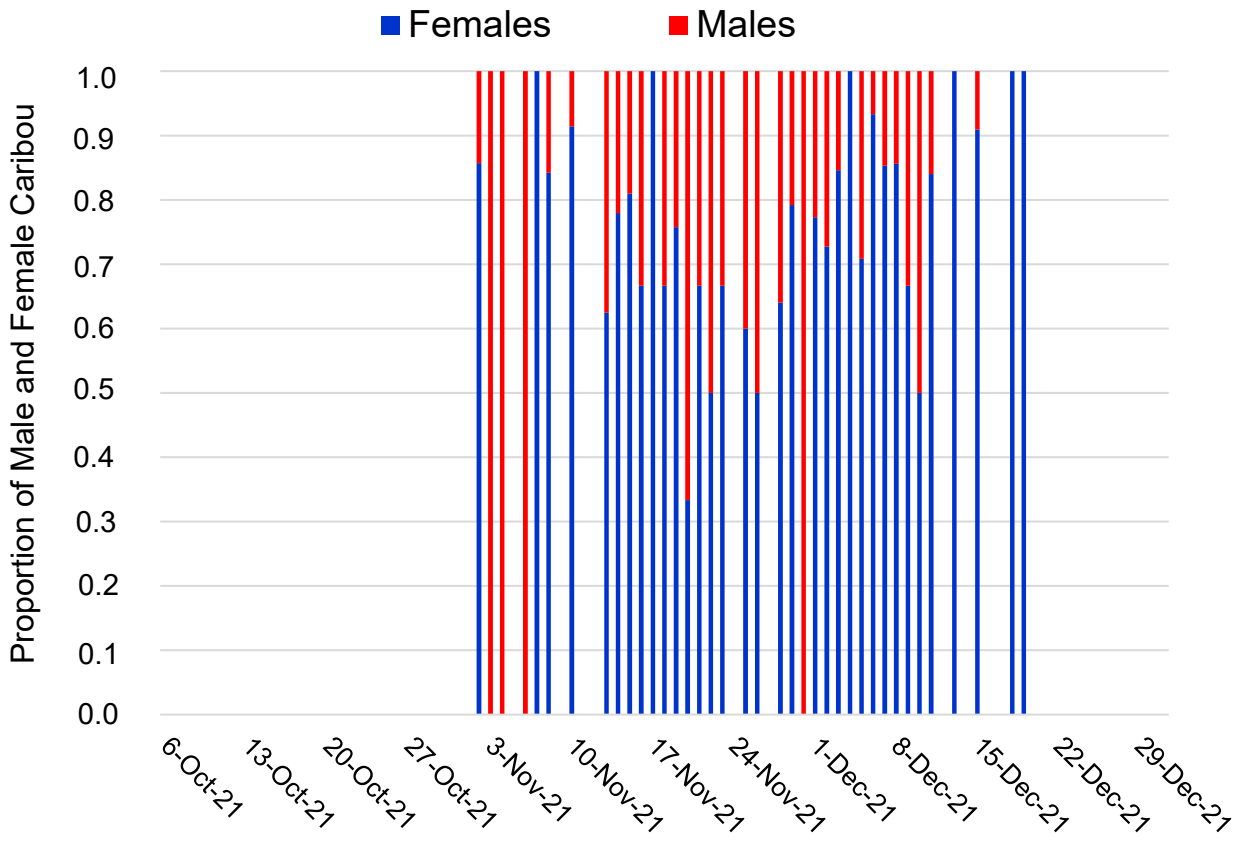


Figure 4-7 Proportion of Female and Male Caribou Detected at Remote Camera Monitoring Locations in Fall 2021

4.3 CLASSIFICATION

There were 918 caribou detected during the Fall 2021 Caribou Survey (Table 4.3). The mean number of caribou per group was 7 (range: 1-73). The ratio of males to females was 28 males:100 females (Table 4.3). There were 15 calves per 100 females, and calves accounted for 10% of caribou detected. Yearlings made up 3% of total caribou detected, and 29 caribou were classified as unknown age or sex. Thirty caribou with collars were detected.

Table 4.3 Caribou Group Composition based on Remote Camera Results for Fall 2019, 2020, and 2021

Classification	Fall Totals		
	2019	2020	2021
Total Caribou	2,071	1,847	918
Total Adults[1]	1,641	1,555	770
Adult Females	1,260	1,200	586
Adult Males	381	330	165
Adult Unknown[2]	N/A	25	19
Yearlings	7	42	30
Calves	203	198	89
Unknown[3]	220	52	29
Males:100 Females[4]	30	28	28
Percent Males[4] (%)	18	18	18
Calves:100 Females[4]	16	17	15
Percent Calves[4] (%)	10	11	10
Percent Yearlings[4] (%)	<1	2	3
Mean Group Size[4, 5] (range)	13 (1-164)	10 (1-178)	7 (1-73)
Number of Collared Caribou	3	10	30

Notes:
1. Total adults = adult females + adult males + adult unknown
2. Adult Unknown = adults of unknown sex
3. Unknown includes caribou of unknown sex and/or age class
4. Numbers rounded to the nearest whole number
5. Mean group size and range

Other wildlife species detected by the remote cameras were moose (*Alces alces*), coyote (*Canis latrans)*, black bear (*Ursus americanus)*, red fox (*Vulpes vulpes*), snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), and Canada jay (*Perisoreus canadensis*). Additional information on incidental sightings is provided in Appendix C.

5.0 DISCUSSION

This report provides a summary of the Fall 2021 Caribou Survey for migration within the remove camera caribou Study Area as part of ongoing caribou migration monitoring and is not intended to provide a detailed analysis or comparison between remote camera data collected in previous years or seasons.

Analyses and baseline studies completed for the EIS (Marathon 2020a), and information from the NLDFFA-Wildlife Division (Government of NL 2019), indicate a well-used spring and fall migration corridor in the Project Area and a well-defined series of pathways for the Buchans herd between the north end of Valentine Lake and the mouth of the Victoria River.

5.1 LOCATION OF DETECTIONS

The Fall 2021 Caribou Survey recorded the greatest number of caribou at cameras 12, 13, 27, and 28 (more than 92% of all caribou events). These four camera locations overlap with the fall migration pathway identified by the dBBMM (Marathon 2020a) and cameras 12 and 13 also overlap with wildlife trails identified from the LiDAR analysis (Marathon 2020b). Camera 28 is near the 0 km ZOI and 1 km ZOI pathways identified by the LCP analysis (Stantec 2021a). Camera 13 is close to camera locations VAL1 and VAL2, which detected a moderate number of caribou events in the fall 2019 and 2020 surveys (Marathon 2020b). During the fall 2021 survey, five of the cameras detected six or more caribou events, five cameras detected a single caribou event, and twenty-one cameras detected no caribou.

5.2 TIMING OF DETECTIONS

Caribou were detected from November 2, 2021 to January 7, 2022. The greatest number of caribou events and individual caribou were on detected on November 14, 2021. The timing of detection is similar to the peak movement period identified in fall 2019 (November 9 to November 11, 2019), however earlier that the peak movement period identified in 2020 (October 29 and November 3, 2020). The timing of fall migration for the Buchans herd has varied over time. For example, the start of fall migration shifted from mid-November in the 1960s to mid-October in the late-1990s (Mahoney and Schaefer 2002), however returned to mid-November by the 2000s (Schaefer and Mahoney 2013). The timing of fall migration of caribou in Labrador was correlated with weather conditions during the migratory period and precipitation at the arrival site (Le Corre et al. 2017). Variability around the timing of fall migration may be influenced by weather conditions (LeCorre et al. 2017), such as snow accumulation (Joly et al. 2020) and vegetation senescence (Cameron et al. 2021).

5.3 CLASSIFICATION

The Fall 2021 Caribou Survey detected 918 caribou; fewer than were detected during the fall 2019 (2,071 caribou) and fall 2020 (1,847 caribou) surveys (Stantec 2021b; Marathon 2020b). Compared to the fall 2019 and 2020 surveys, where cameras were positioned predominantly along identified wildlife trails either in the field or by analysis of LiDAR data, the camera locations for the Fall 2021 Caribou Survey were aligned with potential migration pathways identified by the LCP analysis (Stantec 2021a) (i.e.,

predictive pathways as compared to identified pathways). This most likely contributed to the lower number of caribou detected in this survey (fall 2021). The Fall 2021 Caribou Survey did identify similar percentages of males (18%) and calves (10%) as were observed in fall 2019 (18% males, 10% calves) (Marathon 2020b) and 2020 (18% males, 11% calves) (Stantec 2021b).

Thirty caribou with collars were detected during the Fall 2021 Caribou Survey. Marathon has purchased 60 GPS collars (Lotek Iridium 420w) to support the long-term monitoring program, which are being managed by NLDFFA-Wildlife Division, and 32 of these were deployed in fall 2021. The large number of caribou detected with collars in this survey compared to the fall surveys in 2019 (3 collars) and 2020 (10 collars) will be due to this collaring effort.

5.4 FUTURE WORK

The Fall 2021 Camera Survey represents a continuation of data gathering by Marathon Gold for the Valentine Gold Project. The camera studies are one of many sources of information that will be used to verify EIS predictions of potential Project effects on caribou and to implement mitigation and evaluate its effectiveness. To date, data gathered through the camera surveys have been primarily descriptive in nature. The expanded spatial coverage and addition of supplementary remote cameras to the Fall 2021 Camera Survey are intended to provide a broader understanding of caribou movement in and around the Project Area and to establish long-term monitoring locations for future contribution to monitoring initiatives described in the Caribou Protection and Environmental Effects Monitoring Plan.

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APPENDIX A

Comparison Between Fall 2021 Camera Deployment Locations and Earlier Deployment Locations

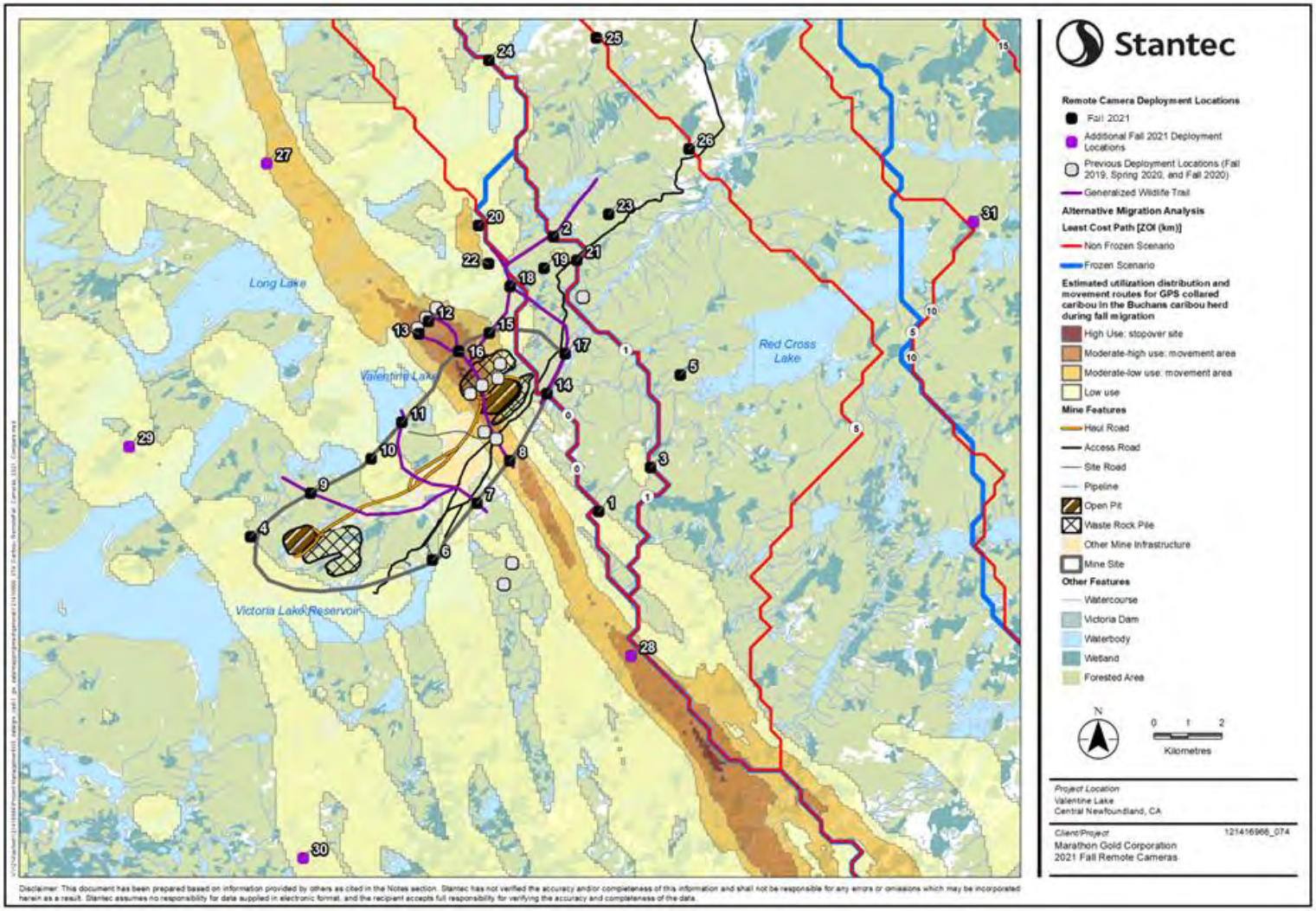


Figure A-1 Comparison of Remote Camera Deployment Locations for Fall 2021 Caribou Survey and Earlier Surveys

APPENDIX B

Remote Camera Site Metadata

Table B.1 Remote Camera Site Metadata

Camera Name	**1**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM Zone	21
UTM Easting	495264
UTM Northing	5357818
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Open treed bog. Larch and black spruce. Grasses/sedges.
Camera Height	~120 cm
Camera Orientation (degrees)	~330°
Rationale for Camera Location	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (0 km ZOI) identified by LCP analysis. Positioned along well-used game trail.
Photo of Camera Location	 Photo: Facing West, October 7, 2021

Camera Name	**2**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	493953
UTM Northing	5365217
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Trees: larch, spruce, low trailing juniper, black spruce. Shrubs: bog cranberry, leather leaf, sheep laurel
Camera Height	~120 cm
Camera Orientation (degrees)	~340°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR, caribou migration pathways identified by dBBMM and with alternate migration pathway (1 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: Facing North, October 6, 2021

Camera Name	**3**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	496421
UTM Northing	5358387
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Open bog complex: larch, black spruce Shrubs: leather leaf, Labrador tea, pitcher plant, grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~140°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (1 km ZOI) identified by LCP analysis. Positioned along well-used game trail.
Photo of Camera Location	 Photo: Facing South, October 7, 2021

Camera Name	**4**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	483726
UTM Northing	5357235
Habitat Composition (Tree and Shrub) (data from April 10, 2021)	Open bog complex: black spruce, larch Shrubs: grasses, sedges, pitcher plant
Camera Height	~140 cm
Camera Orientation (degrees)	~345°
Evidence of Caribou Use	Area aligns with alternate migration pathway identified by dBBMM.
	 Photo: Facing East, October 6, 2021

Camera Name	**5**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	498199
UTM Northing	5361562
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: Black spruce, larch, alder, trailing juniper Shrubs: leather leaf, Labrador tea, sheep laurel, pitcher plant and grasses/sedges
Camera Height	~180 cm
Camera Orientation (degrees)	~50°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (1 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

Camera Name	**6**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	490135
UTM Northing	5355485
Camera Height	~150 cm
Camera Orientation (degrees)	~255°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM
Photo of Camera Location	 Photo: Facing West, October 7, 2021

Camera Name	**7**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	October 6-7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Staff from Marathon
	Retrieval - Staff from Marathon
Note	Deployment and retrieval were by Marathon staff. Information on camera site was not recorded.

Camera Name	**8**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	493013
UTM Northing	5358502
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, black spruce, alder sp. Shrubs: Labrador tea, sheep laurel, rose sp., grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~345°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM. Positioned along well-used caribou trail.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

Camera Name	**9**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	487076
UTM Northing	5357514
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, black spruce, alder sp. Shrubs: Labrador tea, leather leaf, bog cranberry, bog rosemary, pitcher plant, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~65°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR.
Photo of Camera Location	 Photo: Facing East, October 6, 2021

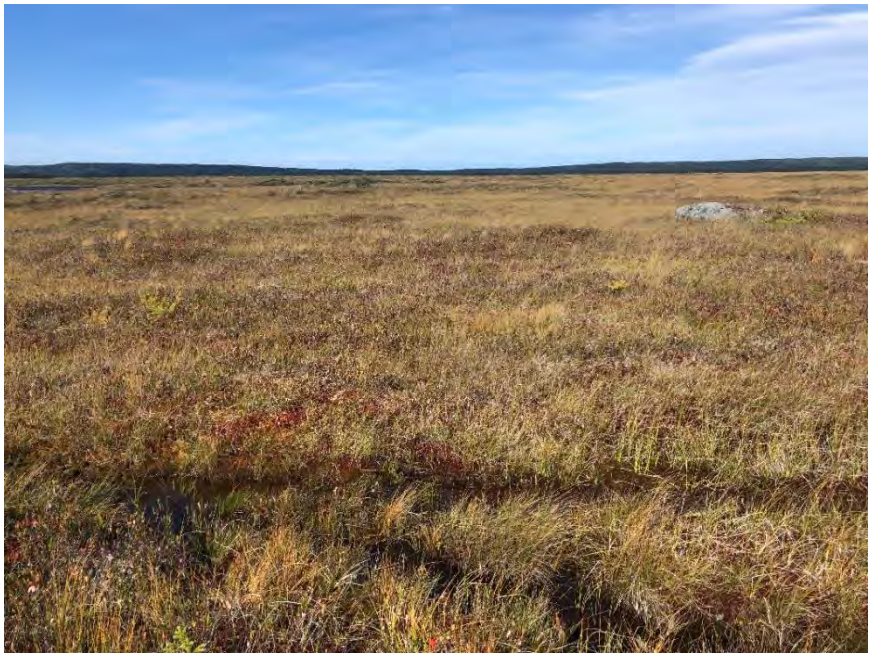
Camera Name	**10**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	488660
UTM Northing	5358570
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, balsam fir, larch, alder sp. Shrubs: Labrador tea, leather leaf, grasses/sedges
Camera Height	~180 cm
Camera Orientation (degrees)	~35°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM
Photo of Camera Location	 Photo: Facing North, October 6, 2021

Camera Name	**11**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	489621
UTM Northing	5359529
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: low trailing juniper, birch, alder sp., spruce, fir Shrubs: Labrador tea, grasses/sedges Along edge of Valentine Lake
Camera Height	~150 cm
Camera Orientation (degrees)	~310°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM.
Photo of Camera Location	 Photo: Facing North, October 6, 2021

Camera Name	**12**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	490410
UTM Northing	5362481
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex Trees: larch, black spruce Shrubs: leather leaf, Labrador tea, grasses/sedges, bog rosemary, pitcher plant, bog cranberry
Camera Height	~120 cm
Camera Orientation (degrees)	~350°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM. Positioned along well-used caribou trails.
Photo of Camera Location	 Photo: Facing North, October 6, 2021

Camera Name	**13**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	490487
UTM Northing	5361889
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex Trees: larch, black spruce Shrubs: leather leaf, Labrador tea, grasses/sedges, bog rosemary, pitcher plant, bog cranberry
Camera Height	~140 cm
Camera Orientation (degrees)	~80°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM. Positioned along well-used caribou trails.
Photo of Camera Location	 Photo: Facing east, October 6, 2021

Camera Name	**14**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	493459
UTM Northing	5360542
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: thick spruce/fir forest with small bog, black spruce, larch, balsam fir Shrubs: Labrador tea, sphagnum moss, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~330°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR, caribou migration pathways identified by dBBMM, and alternate migration pathway (0 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

Camera Name	**15**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	492154
UTM Northing	5362085
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex. Trees: black spruce, larch. Shrubs: Labrador tea, leather leaf, pitcher plant, bog cranberry, sheep laurel, grasses/sedges
Camera Height	~110 cm
Camera Orientation (degrees)	~40°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM. Positioned along well used trail network.
Photo of Camera Location	 Photo: Facing North, October 6, 2021

Camera Name	**16**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	491194
UTM Northing	5361888
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Open bog complex Trees: black spruce, larch Shrubs: Labrador tea, leather leaf, pitcher plant, bog rosemary, grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~30°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM. Positioned along well used trail network.
Photo of Camera Location	 Photo: Facing North, October 6, 2021

Camera Name	**17**
Camera Type	Browning Dark Ops HD Pro X
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	494359
UTM Northing	5361382
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, larch, balsam fir Shrubs: Labrador tea, sheep laurel, leather leaf, sphagnum moss, grasses/sedges
Camera Height	~150 cm
Camera Orientation (degrees)	~70°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR and caribou migration pathways identified by dBBMM. Positioned along well used trail network.
Photo of Camera Location	 Photo: Facing East, October 7, 2021

Camera Name	**18**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	493034
UTM Northing	5363603
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, larch Shrubs: Labrador tea, leather leaf, trailing juniper, pitcher plant, bog cranberry, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~120°
Evidence of Caribou Use	Area aligns with wildlife trail identified from LiDAR, caribou migration pathways identified by dBBMM, and alternate migration pathway (0 km ZOI) identified by LCP analysis. Positioned along wildlife trail.
Photo of Camera Location	 Photo: Facing East, October 6, 2021

Camera Name	**19**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	493204
UTM Northing	5364402
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Raised string bog complex Trees: larch, spruce, alder sp. Shrubs: leather leaf, sheep laurel, Lamb's kill, pitcher plant, bog cranberry, grasses/sedges
Camera Height	~100 cm
Camera Orientation (degrees)	~80°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM. Positioned along wildlife trail.
Photo of Camera Location	 Photo: Facing East, October 6, 2021

Camera Name	**20**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	491567
UTM Northing	5365669
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: black spruce, larch Shrubs: leather leaf, alder sp., grasses
Camera Height	~130 cm
Camera Orientation (degrees)	~280°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM. Caribou observed in vicinity.
Photo of Camera Location	 Photo: Facing West, October 6, 2021

Camera Name	**21**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	495072
UTM Northing	5363961
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, black spruce Shrubs: low trailing juniper with berries, Labrador tea, leather leaf, pitcher plant, grasses/sedges.
Camera Height	~120 cm
Camera Orientation (degrees)	~340°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (1 km ZOI) identified by LCP analysis. Positioned along wildlife trail network.
Photo of Camera Location	 Photo: Facing East, October 6, 2021

Camera Name	**22**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	492208
UTM Northing	5364184
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Treed bog Trees: larch, black spruce, alder sp. Shrubs: Labrador tea, pitcher plant, grasses/sedges
Camera Height	~130 cm
Camera Orientation (degrees)	~120°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM. Positioned along wildlife trails.
Photo of Camera Location	 Photo: Facing East, October 6, 2021

Camera Name	**23**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	495305
UTM Northing	5365780
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Raised bog complex Trees: larch, black spruce Shrubs: Labrador tea, leather leaf, pitcher plant, bog cranberry, sheet laurel, sphagnum moss, grasses/sedges
Camera Height	~120 cm
Camera Orientation (degrees)	~0°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (1 km ZOI) identified by LCP analysis. Positioned near wildlife trails.
Photo of Camera Location	 Photo: Facing North, October 6, 2021

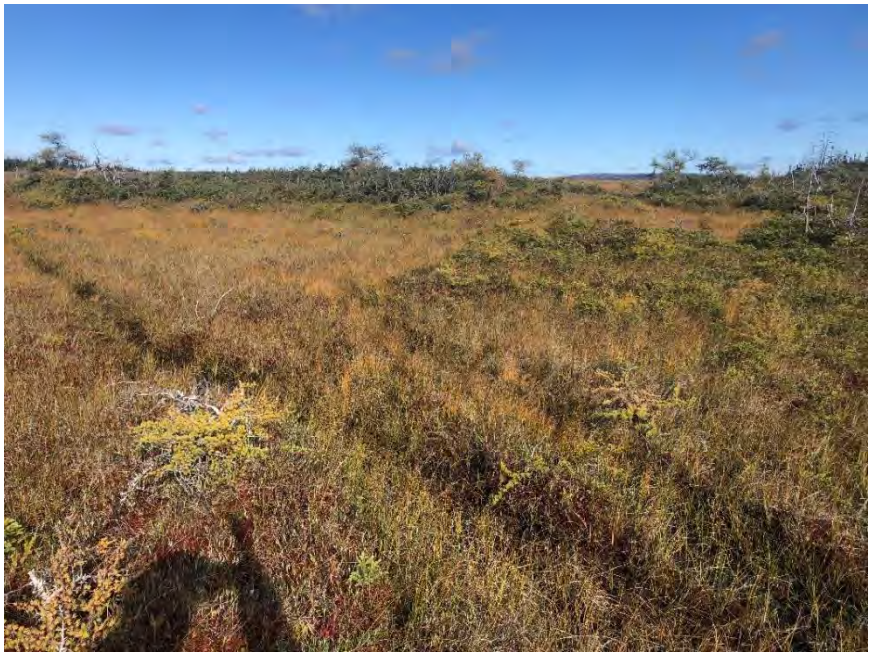
Camera Name	**24**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	491877
UTM Northing	5369708
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, spruce, speckled alder Shrubs: leather leaf, Labrador tea, pitcher plant, grasses/sedges, bog laurel, bog rosemary
Camera Height	~150 cm
Camera Orientation (degrees)	~140°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (1 km ZOI) identified by LCP analysis. Positioned near wildlife trails.
Photo of Camera Location	 Photo: Facing South, October 6, 2021

Camera Name	**25**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	495147
UTM Northing	5370415
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: larch, spruce, alder sp. Shrubs: Labrador tea, leather leaf, pitcher plant, grasses/sedges
Camera Orientation (degrees)	~140°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and with alternate migration pathway (5 km ZOI) identified by LCP analysis. Positioned along wildlife trails.
Photo of Camera Location	 Photo: Facing East, October 6, 2021

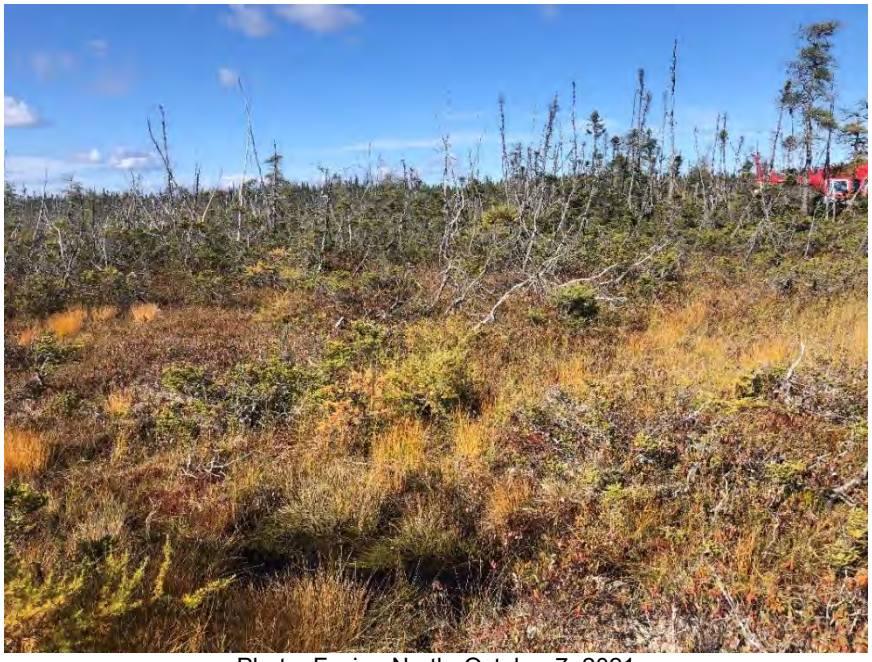
Camera Name	**26**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 6, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	498199
UTM Northing	5368041
Camera Height	~130 cm
Habitat Composition (Tree and Shrub) (data from October 5, 2019)	Trees: spruce Shrubs: leather leaf, Labrador tea, pitcher plant, sphagnum moss, grasses/sedges
Rationale for Location	Area aligns with alternate migration pathway (5 km ZOI) identified by LCP analysis.
Photo of Camera Location	 Photo: Facing South, October 6, 2021

Camera Name	**27**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	486039
UTM Northing	5367746
Camera Height	~140 cm
Camera Orientation (degrees)	~15°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM. Positioned along wildlife trails.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

Camera Name	**28**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	496287
UTM Northing	5352822
Camera Height	~130 cm
Camera Orientation (degrees)	~5°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and alternate migration pathway (0 km and 1 km ZOIs) identified by LCP analysis. Positioned along old wildlife trails. Positioned along old wildlife trails.
Photo of Camera Location	 hoto: Facing North, October 7, 2021

Camera Name	**29**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	483426
UTM Northing	5356627
Camera Height	~150 cm
Camera Orientation (degrees)	~0°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM. Positioned along old wildlife trails.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

Camera Name	**30**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	486764
UTM Northing	5346296
Camera Height	~140 cm
Camera Orientation (degrees)	~10°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and alternate migration pathway (5 km and 10 km ZOIs) identified by LCP analysis. Positioned along old wildlife trails.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

Camera Name	**31**
Camera Type	Reconyx HS2X Hyperfire 2 Security Covert IR
Deployment Date	October 7, 2021
Retrieval Date	January 27, 2022
Team Members	Deployment - Tony Parr and Richard Martin (NL Helicopters)
	Retrieval - Tony Parr and Les Phillips (NL Helicopters)
UTM zone	21
UTM Easting	504109
UTM Northing	5366347
Camera Height	~160 cm
Camera Orientation (degrees)	~50°
Evidence of Caribou Use	Area aligns with caribou migration pathways identified by dBBMM and alternate migration pathway (5 km and 10 km ZOIs) identified by LCP analysis. Positioned along old wildlife trails.
Photo of Camera Location	 Photo: Facing North, October 7, 2021

APPENDIX C

Incidental Wildlife Detections

C.1 INCIDENTAL WILDLIFE DETECTIONS

Incidental wildlife observations for moose are provided in Table C.1 Other wildlife species are provided in Table C.2. Example photos of moose captured by the remote cameras are provided in Figures C-1 and C-2, and Figures C-3 to C-8 are photos of other wildlife species captured by the cameras.

Table C.1 Moose Detections from Remote Cameras Sites

Camera ID	Number of Events	Number of Moose	Number of Males	Number of Females	Number of Calves	Number of Unknown
1	1	2	2			
2	3	5	2	2	1	
3						
4						
5	7	9	3		1	5
6						
7	5	8		5	3	
8						
9	1	1		1		
10	2	2		1		1
11	18	20	2	9	1	8
12						
13						
14	4	4		2		2
15	1	1	1			
16						
17	3	3				3
18						
19	1	1		1		
20	1	1		1		
21	1	1		1		
22	3	3		2		1
23	4	5		2		3
24	2	3		3		
25	6	8	3	3	1	1
26						
27	4	4	1	3		
28	1	2	2			
29	3	4		3	1	
30	1	1		1		
31						
Total	**72**	**88**	**16**	**40**	**8**	**24**

Notes:
Moose were detected from October 14, 2021 to January 23, 2022.

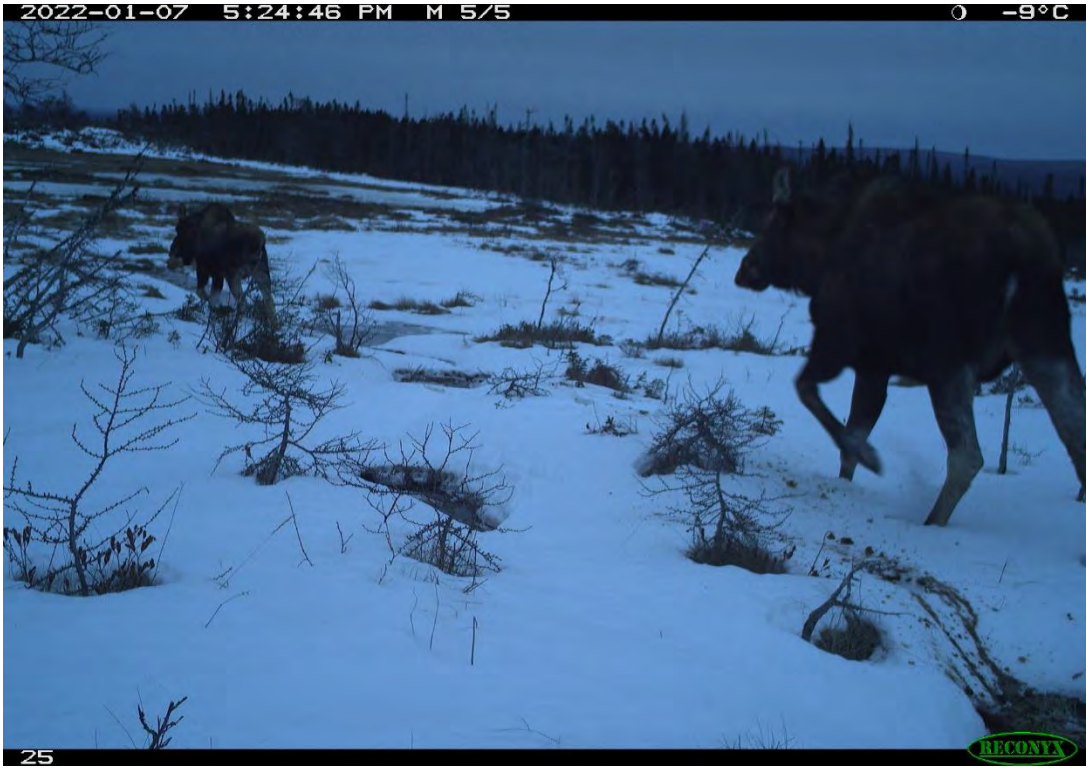


Figure C-1 Female Moose and Calf from Remote Camera 25, January 7, 2022

Figure C-2 Male Moose from Remote Camera 5, November 6, 2021

Figure C-3 Two Male Moose Rutting from Remote Camera 1, December 6, 2021

Table C.2 Other Incidental Wildlife Detections from Remote Cameras Sites

Species	Camera ID	Date	Number of Detections	Total Number
Black Bear	9	December 4, 2021	1	1
	22	November 2, 2021	1	1
Canada Jay	17	December 2, 2021 December 28, 2021	2	3
Coyote	10	January 11, 2022	1	1
	17	November 6, 2021 November 8-10, 2021 November 12-16, 2021 November 18-19, 2021 November 21-24, 2021 November 28-30, 2021 December 1-2, 2021 December 4, 2021 December 8-9, 2021 December 16, 2021 January 21-24, 2022	55[A]	60
	23	November 13, 2021	1	1
	24	November 13, 2021 January 22, 2022 January 23, 2022	3	3
Red Fox	17	January 12, 2022	1	1
Red Squirrel	7	October 27, 2021 October 28, 2021 November 4, 2021 November 11, 2021 November 21, 2021 January 13, 2022 January 16, 2022 January 18, 2022	8	8

Note:
[A] This was most likely the same two individuals detected over the 55 events, possibly a breeding pair.

Figure C-4 Black Bear from Remote Camera 22, November 2, 2021

Figure C-5 Two Canada Jays from Remote Camera 17, December 2, 2021

Figure C-6 Two Coyotes from Remote Camera 17, November 24, 2021

Figure C-7 Red Fox from Remote Camera 17, January 21, 2022

Figure C-8 Red Squirrel from Remote Camera 7, January 21, 2022

APPENDIX D

Caribou Photos from Remote Cameras

Figure D-1 Male Caribou from Remote Camera 13, November 20, 2021

Figure D-2 Caribou from Remote Camera 28, December 8, 2021

Figure D-3 Female Caribou and Calf from Remote Camera 15, December 15, 2021

Figure D-4 Caribou with Collar from Remote Camera 27, December 11, 2021

Valentine Gold Project: Spring 2022 Caribou Survey – Remote Cameras

Final Report

August 10, 2023

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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 remote camera monitoring of caribou during annual spring and fall migration periods. This report presents the results of the 2022 spring survey, which represents the sixth in a series of surveys beginning in 2019. The results of these and other ongoing baseline studies 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).

Introduction

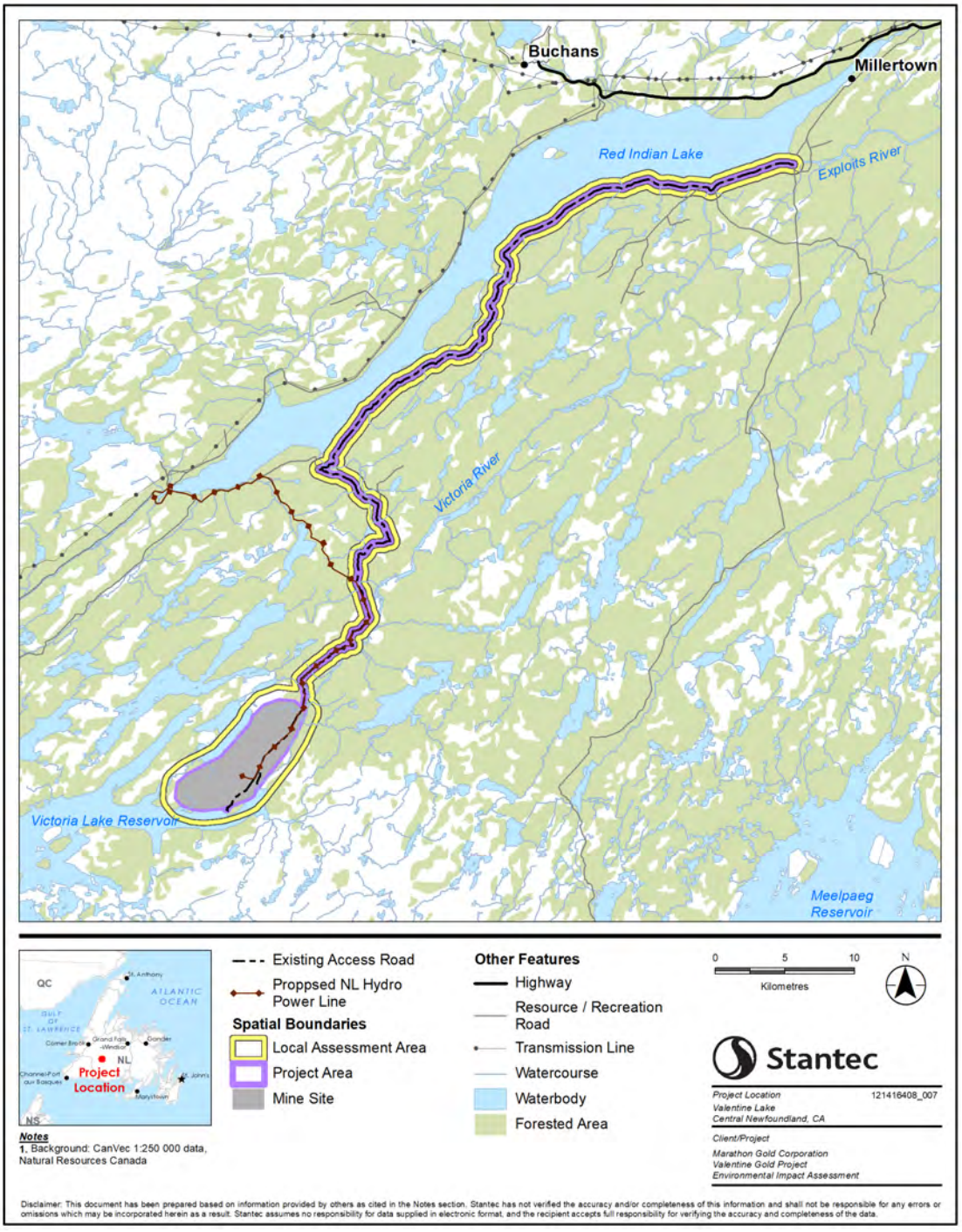


Figure 1-1 Project Location and Spatial Boundaries

1.2 BACKGROUND

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.

Generalized caribou migration dates (i.e., non-herd specific) for the island of Newfoundland indicate that caribou are most likely to migrate in the spring between April 1 and May 19, and in the fall between November 1 and December 15 (Table 1.1). Based on the identification of seasonal migration paths in the Project Area (Doucet and Morgan 2007 in Wells et al. 2011; Government of NL 2019; Marathon 2020a) remote cameras were deployed to gather additional baseline information on caribou movements in the vicinity of the Project and to inform mitigation. To date, remote cameras have been deployed during the 2019, 2020, and 2021 fall migration periods and the 2020 and 2021 spring migration periods (Marathon 2020b; Stantec 2021). The spring 2022 survey represents the sixth survey for the remote camera program.

Table 1.1 General Seasons for the Island Caribou Population in Newfoundland

Season	Seasonal Dates
Winter	Dec 16–Mar 31
Spring Migration/Pre-calving	**Apr 1–May 19**
Calving	May 20–Jun 10
Post-calving Migration/Dispersal	Jun 11–Jun 30
Post-calving Rearing	Jul 1–Aug 31
Fall Rut	Sep 1–Oct 31
Fall Migration/Dispersal	**Nov 1–Dec 15**

Notes:
Bold text indicates migratory periods where caribou migrate through Marathon mine site
Source: Emera 2013

1.3 SURVEY OBJECTIVES

The objectives of the Spring 2022 Caribou Survey were to collect additional baseline data related to:

- caribou entry and exit points to the mine site
- caribou use of lesser used migration paths through the mine site and surrounding areas; the timing of caribou migration through the mine site and surrounding areas
- caribou group size and composition
- supplementing collar information on the timing of spring and fall migration through the mine site

2.0 SELECTION OF SURVEY SITES (CAMERA LOCATIONS)

The remote camera monitoring program was initiated in fall 2019. Camera placement (n=12) in 2019 was aligned with well-defined migration paths through the mine site (identified using LiDAR data, and informed by input from NLDFFA-Wildlife Division) which had indicated a prominent caribou migration path through the Marathon pit (Government of NL 2019). Five general areas were selected for camera deployment: Valentine Lake outlet (VAL1, VAL2, VAL3), Marathon pit (MAR1, MAR2, MAR3, MAR4), Main Road (MAINRD, MARBOG), South Side of Victoria River (SS1 and SS2) and Victory pit (VIC1). The sites used for the fall 2019 program were also used for the spring 2020 and fall 2020 caribou programs to support a direct comparison (except SS2 because of challenges associated with retrieving the camera) and to inform subsequent camera monitoring initiatives.

In consultation with NLDFFA-Wildlife Division, the remote camera program was expanded in 2021 (Table 2.1). Locations for the deployment of additional cameras were based on LiDAR imagery, dBBMM outputs, and the results of the Caribou Alternate Migration Pathway Analysis. Locations 1-26 were used in the spring 2021 survey and locations 27-31 were additional locations established in fall 2021 (Figure 2-1). Except for two cameras (12 and 13), the locations selected in 2021 differed from those used in 2019 and 2020. Many of the current 31 camera locations are intended to become “permanent” monitoring locations to analyze long-term trends. If shifts in movement are detected, such as through collar data, camera placements may be adjusted.

Table 2.1 Current Remote Camera Locations and Rational

Camera Location[1]	Rationale		
	Aligns with wildlife trail identified from LiDAR data	**Aligns with caribou migration paths identified by dBBMM**	**Aligns with potential alternate migration path identified by LCP analysis**
Cameras Positioned to Gather Information about Entry and Exit Points to Mine Site			
6		✓	
7	✓	✓	
8	✓	✓	
9	✓		
10		✓	
11	✓	✓	
14	✓	✓	✓(0 km ZOI[2], spring migration, frozen and non-frozen conditions)
15	✓	✓	
16	✓	✓	
17	✓		

Table 2.1 Current Remote Camera Locations and Rational

Camera Location[1]	Rationale		
	Aligns with wildlife trail identified from LiDAR data	**Aligns with caribou migration paths identified by dBBMM**	**Aligns with potential alternate migration path identified by LCP analysis**
Additional Camera Locations			
1		✓	✓(0 km ZOI, spring migration, frozen conditions)
2	✓	✓	✓(1 km ZOI, spring migration, non-frozen conditions)
3		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
4		✓[3]	
5		✓	✓(1 km ZOI, spring migration, frozen conditions)
12[4]	✓	✓	
13[4]	✓	✓	
18	✓	✓	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
19		✓	
20		✓[3]	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
21		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
22		✓[3]	
23		✓	✓(1 km ZOI, spring migration, frozen conditions)
24		✓	✓(1 km ZOI, spring migration, frozen and non-frozen conditions)
25		✓	✓(5 km ZOI, spring migration, non-frozen conditions)
26			✓(5 km ZOI, spring migration, non-frozen conditions)
27[5]		✓	
28[5]		✓	✓ (0 km and 1 km ZOI, fall migration, frozen and non-frozen conditions)
29[5]		✓[3]	
30[5]		✓	✓ (5 km ZOI, spring migration, frozen conditions)
31[5]		✓	✓ (5 km ZOI, fall migration, frozen conditions; 10 km ZOI, fall migration, non-frozen conditions)

Notes:

1 Camera locations are presented in Figure 2-1

2 ZOI = Zone of Influence [as defined in the EIS (Marathon 2020a)]

3 Camera location modified to address comments from NLDFFA-Wildlife Division

4 Cameras 12 and 13 were the same locations as VAL2 and VAL1, respectively, previously used in 2019 and 2020,

5 New deployment location beginning fall 2021

Selection of Survey Sites (Camera Locations)

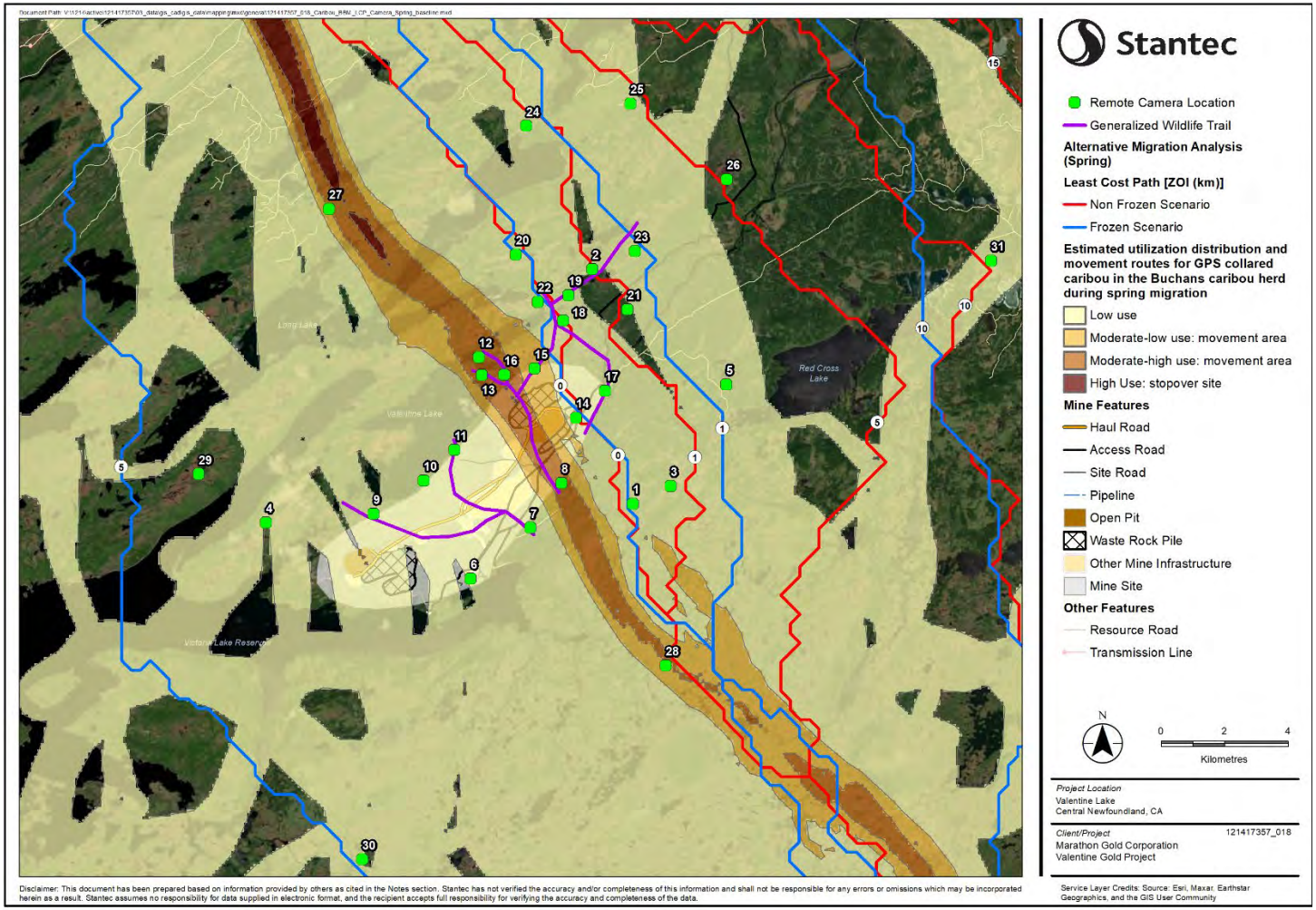


Figure 2-1 Camera Locations used during the Spring 2022 Remote Camera Monitoring Program

3.0 METHODS

3.1 REMOTE CAMERA DEPLOYMENT

Reconyx HS2X Hyperfire 2 Security Covert IR cameras were used during the spring 2022 survey. This model has infrared (IR) night vision illuminators to allow photography at night. Camera settings were selected to increase the probability of wildlife detection and identification (Stantec 2015). Lithium-ion batteries and 64 gigabyte SD memory cards were used in the cameras.

The cameras were deployed at each site using a standardized set-up to allow for consistency among sites and to reduce potential effects of camera placement or setup on wildlife detection. Cameras were deployed at least 500 m from one another to improve likelihood of independence (Stantec 2015), although some cameras are purposefully on the same trail at entry and exit points (e.g., cameras 7 and 11; cameras 8 and 16).

Cameras were mounted on trees with diameters of at least 20 cm. At sites where the camera mount needed additional stability, trees were braced with logs to reduce movement caused by wind. At sites with no suitable trees, tripods were installed as camera mounts. Cameras were placed approximately 1 to 1.5 m above ground to increase the probability of large mammal detection (Stantec 2015). Each camera was positioned facing a game trail to increase the path length of animals through the frame (Rovero et al. 2010). To reduce the incidence of false positives (i.e., camera is triggered by something other than wildlife such as branches or grasses moving in the wind), visible vegetation within the camera's field of view was trimmed where necessary. A walk test was completed before leaving the site to assess camera angle, position, and path length along the game trail to improve likelihood of detection.

3.2 DATA ANALYSIS

Remote camera photos were reviewed using the program Timelapse v.2.2.5.1, an image analysis software program that extracts photograph metadata and facilitates the management of photo results (Greenberg 2022). The number of camera days (sum of the number of deployment days for all cameras) was calculated. Photos were analyzed based on independent events identified from a photo series. For the analysis, an event was defined as beginning when one or a group of animals entered the frame and ending when they had exited the frame for more than two minutes (Rowcliffe et al. 2008, Stantec 2015). The likelihood of overestimating the number of individual caribou was reduced through a combination of camera placement and image classification techniques. Cameras were positioned perpendicular to the migration paths and, as such, most of the caribou captured by the cameras were moving across the frame. Additionally, most of the caribou moved across the frame either singly or in small groups, or in longer 'strings' comprised of many animals. When viewed in chronological order, it was possible to mark the progression of individual caribou across the frame based on their relative proximity to landmarks and other caribou. Only new animals entering the frame were counted and added to the total for that discrete

event (as opposed to summing the total number of caribou in each image). This technique reduced the likelihood of overestimating the number of individual caribou.

Summary metrics for caribou events and number of caribou detected were calculated for each season, including group size, sex ratio, age class, and any collared animals. Caribou events and number of caribou detected were also summarized daily within each season and among the pool of cameras. The mean number of caribou events (and associated standard error [SE]) was determined using data from all cameras and monitoring days (within the March 31-June 20, 2022, monitoring period [refer to Section 4.1]), including days with zero detections, using the descriptive analysis function in Microsoft Excel. Detected caribou were classified as: calves (i.e., neonates); yearlings = one to two years; and adults > two years. The category of “unknown” included caribou of all age classes whose sex could not be determined. The category of “total caribou” included adults, yearlings, calves, and unknown. Caribou were classified based on presence of a vulva or penis, head and body size, and antler characteristics (e.g., presence or absence, shape). “Total adults” included adults of known and unknown sex.

The following values were calculated (but not intended to provide an annual population, sex and age ratio estimate): male:100 females; percent males (males/total caribou x 100); calf:100 females; percent calves (calves/total caribou x 100); and percent yearlings (yearlings/total caribou x 100).

The start of the peak movement period was defined as the first Julian day when the proportion of caribou events exceeded 5% of the total observations for each season and the end as when the cumulative total exceeded 80% of caribou events.

4.0 RESULTS – SPRING 2022

4.1 SAMPLING DURATION

Thirty of the 31 remote cameras were deployed via helicopter on March 31, 2022. Due to accessibility, camera 7 was accessed by ground and deployed on April 5, 2022 by Marathon staff. A camera inspection was completed on April 13, 2022, to confirm cameras were functioning correctly. All cameras except camera 7 were retrieved on July 12, 2022 (camera 7 was retrieved on October 24, 2022), which is approximately a month (or more) later than previous spring sampling periods (Table 4.1).

It is largely assumed that most caribou detected by the remote cameras are part of the Buchans herd because of the degree of overlap between the Buchans herd range and the Project Area, predominantly during the spring and fall migration periods (Marathon 2020a), although there is the possibility that a small percentage could be resident Grey River caribou. To coincide with previous spring sampling periods (Table 4.1) and to avoid capturing additional non-migrating caribou, the cut-off date for the 2022 deployment period was adjusted to June 20.

Table 4.1 Spring Monitoring Period: 2020-2022 Remote Camera Programs

Year	Date Deployed	Date Retrieved[1]
2020[2]	March 26	June 12-18
2021[3]	April 9-10	June 14-24
2022[4]	March 31 and April 4	July 12 and October 24

Notes:

1. Retrieval dates were subject to suitable weather conditions and/or accessibility (i.e., camera 7 is typically retrieved later by ground vs. air).
2. Camera data analysis used the following dates: March 28 to June 18, 2020
3. Camera data analysis used the following dates: April 10 to June 20, 2021
4. To coincide with previous spring sampling periods and to avoid capturing additional non-migrating caribou, the camera data analysis used the following dates: March 31 to June 20, 2022

4.2 CARIBOU DETECTIONS AND EVENTS

Thirty remote cameras were deployed from March 31 to June 20 (82 days), and one camera (camera 7) from April 5 to June 20 (77 days), resulting in a total sample effort of 2,537 camera days (Table 4.2). A total of 601 caribou events were detected during this period, and the mean number of events per day was 0.24 (range 0-10) (Table 4.2).

Table 4.2 Summary of Caribou Detections and Events: Spring 2022

Parameter	Total[1]
Number of Cameras[2]	31
Total Camera Days	2,537
Total Number of Caribou Events	601
Mean Number of Caribou Events / Monitoring Day (range)[3]	0.24 (0-10)
Total Caribou Detected	2,447

Notes:
1. Camera data analysis based on the following dates: March 31 to June 20, 2022.
2. Camera locations are shown in Figure 2-1.
3. Mean number of caribou events per monitoring day is based on all sampling days and cameras (i.e., includes days with zero detections).

All cameras excepting cameras 7, 8 and 21 detected caribou during the March 31 – June 20 sampling period (Table 4.3, Figure 4-1). Cameras 27, 28 and 29 recorded the greatest number of caribou events (27%, 15% and 9%, respectively), and cameras 12, 13, 27 and 28 had the highest number of individual caribou (Table 4.3, Figure 4-1). Overall, cameras 27 and 28, which are new additions to the spring migration monitoring program (but were used in fall 2021), had the highest total events and total caribou: camera 27 detected 1,336 caribou over 146 caribou events and camera 28 detected 428 caribou over 92 caribou events (Table 4.3, Figures 4-1 and 4-2).

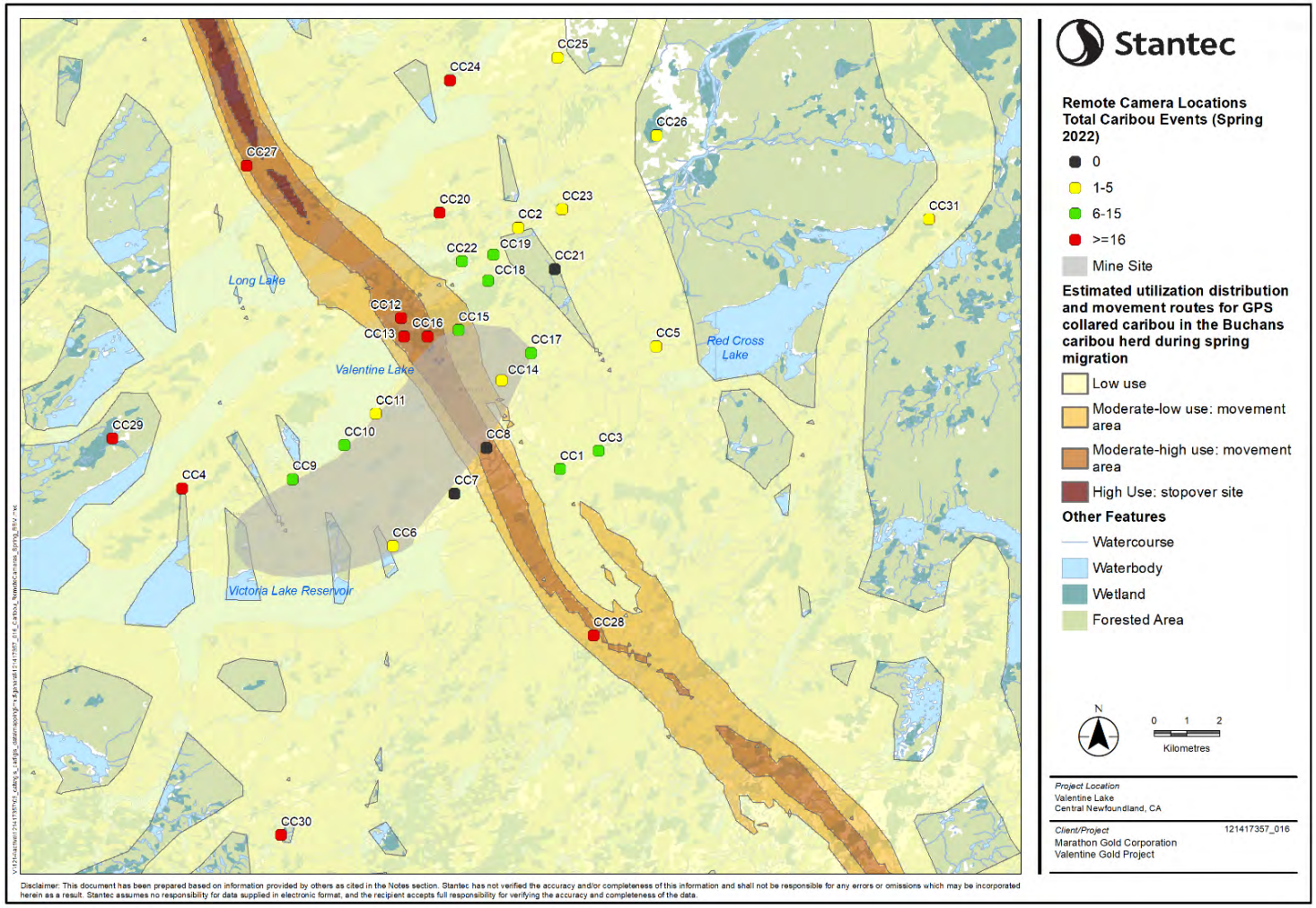
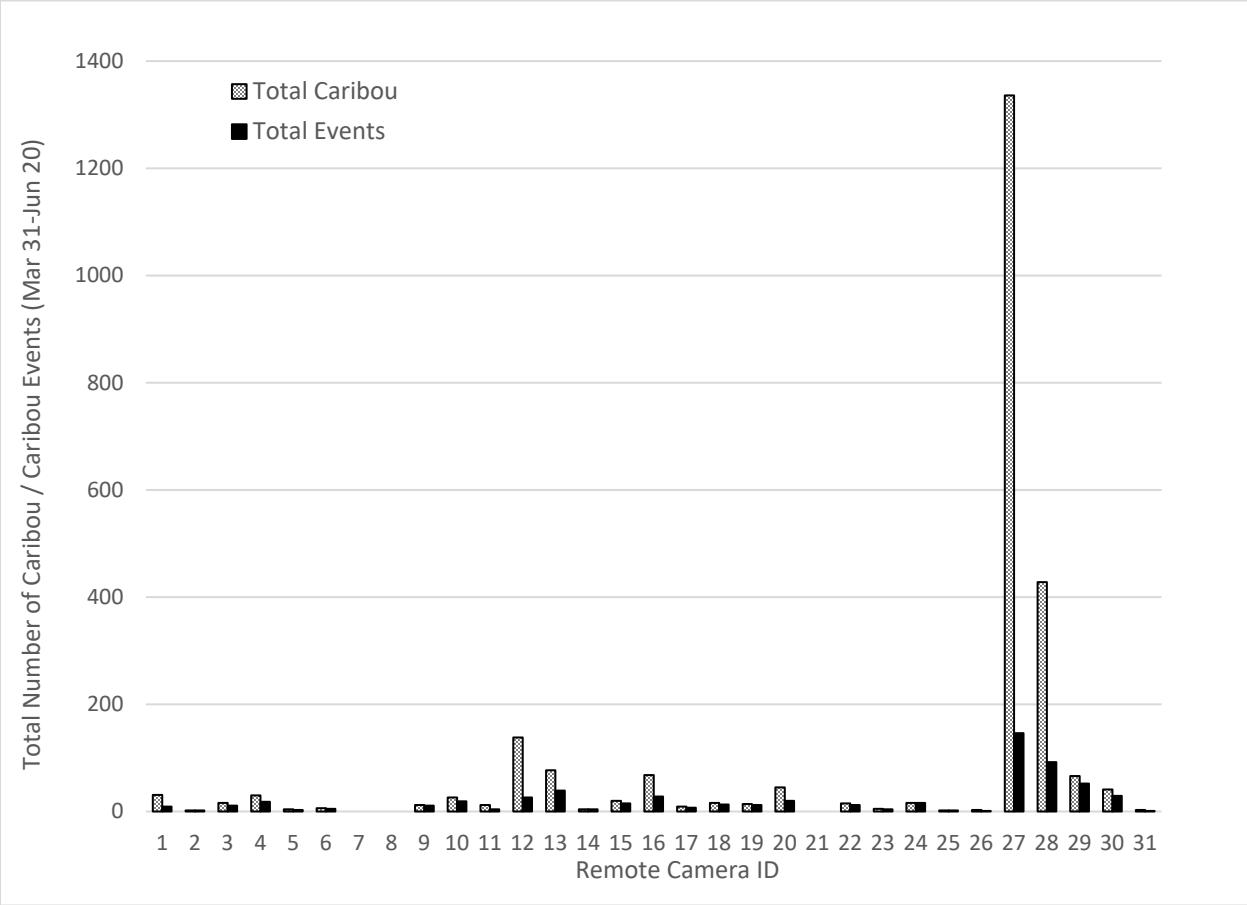


Figure 4-1 Total Caribou Events at Remote Cameras, Spring 2022

Table 4.3 Summary of Caribou Detections and Events per Remote Camera: Spring 2022

Camera	Number of Monitoring Days	Total Caribou Detected	Total Caribou Events	Mean Caribou Events / Monitoring Day (Range)	Standard Error
1	82	31	9	0.11 (0-2)	0.04
2	82	2	2	0.02 (0-1)	0.02
3	82	16	11	0.13 (0-2)	0.04
4	82	30	18	0.22 (0-3)	0.06
5	82	4	3	0.04 (0-1)	0.02
6	82	6	5	0.06 (0-1)	0.03
7	77	0	0	0	0
8	82	0	0	0	0
9	82	12	11	0.13 (0-2)	0.05
10	82	26	19	0.23 (0-5)	0.08
11	82	12	4	0.05 (0-1)	0.02
12	82	138	26	0.32 (0-7)	0.11
13	82	77	39	0.48 (0-7)	0.12
14	82	4	4	0.05 (0-1)	0.02
15	82	20	15	0.18 (0-2)	0.05
16	82	68	28	0.34 (0-5)	0.09
17	82	9	7	0.09 (0-1)	0.03
18	82	16	13	0.16 (0-2)	0.05
19	82	14	12	0.15 (0-2)	0.04
20	82	45	20	0.24 (0-2)	0.06
21	82	0	0	0	0
22	82	15	12	0.15 (0-2)	0.05
23	82	5	4	0.05 (0-1)	0.02
24	82	16	16	0.20 (0-2)	0.05
25	82	2	2	0.02 (0-1)	0.02
26	82	3	1	0.01 (0-1)	0.01
27	82	1,336	146	1.78 (0-9)	0.26
28	82	428	92	1.12 (0-10)	0.21
29	82	66	52	0.63 (0-8)	0.14
30	82	41	29	0.35 (0-4)	0.08
31	82	3	1	0.01 (0-1)	0.01

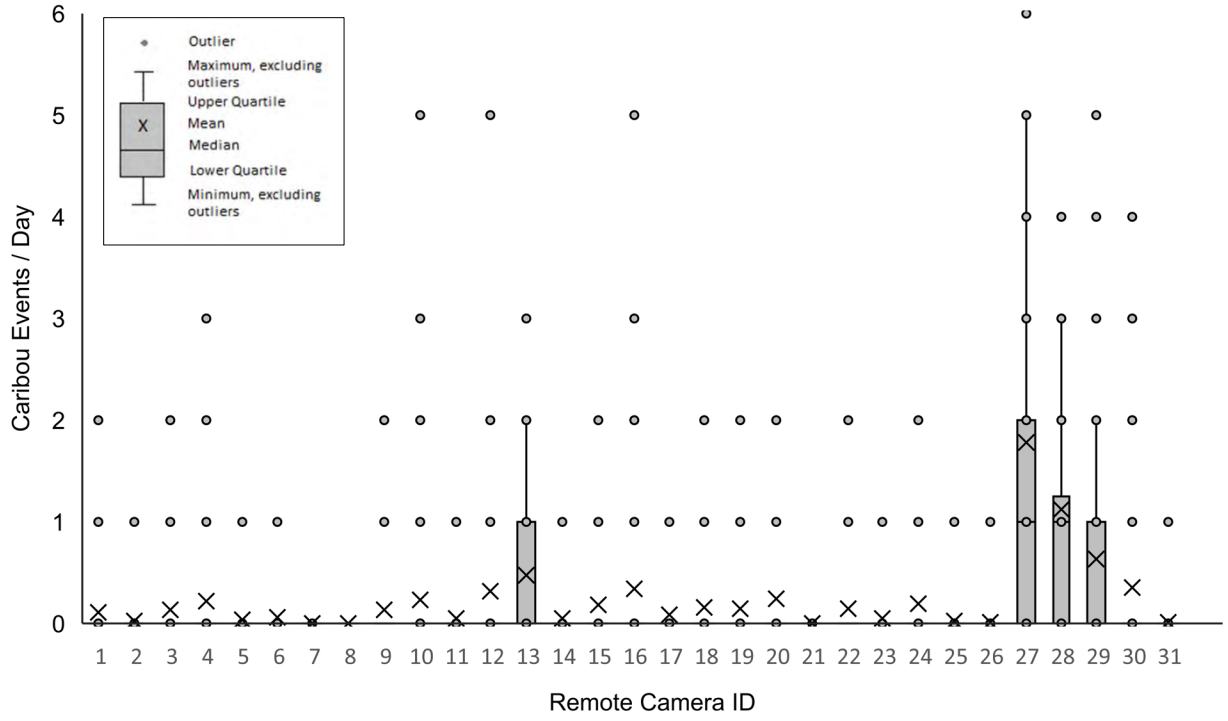


Notes:

1. The dates for analysis are April 5 – June 20, 2022 for camera 7, and March 31 – June 20, 2022 for all other cameras.
2. Camera locations are shown on Figure 2-1.

Figure 4-2 Total Caribou Detections and Events per Remote Camera: Spring 2022

Cameras 13 (0.48 events/day ±0.12 SE), 27 (1.78 events/day ±0.26 SE), 28 (1.12 events/day ±0.21 SE) and 29 (0.63 events/day ±0.14 SE) had the greatest number of caribou events per monitoring day (Table 4.1; Figure 4-3).



Notes:

1. The dates for analysis are April 5 – June 20, 2022 for camera 7, and March 31 – June 20, 2022 for all other cameras.
2. Camera locations are shown on Figure 2-1.

Figure 4-3 Caribou Events per Day per Remote Camera: Spring 2022

Caribou were detected almost daily from April 9 to June 20, 2022, excepting only one day, April 11, when no caribou were detected (Figure 4-4). Both the greatest number of events (30 events/day) and total number of caribou (n=337) was on April 16 (Figure 4-4). The mean number of caribou per event was four caribou (range: 1-133). Movement of female and male caribou were detected during the same period (e.g., females were not detected moving in advance of males) (Figure 4-5 and Figure 4-6).

While a singular distinct peak was not detected during the spring 2022 migration, the **peak movement period**, defined as the first Julian day when the proportion of caribou events exceeds 5% of the total and the end as when the cumulative total of caribou events exceeds 80%, was from **April 13 to June 7, 2022**. However, 80% of the total caribou detected were detected by May 8, 2022.

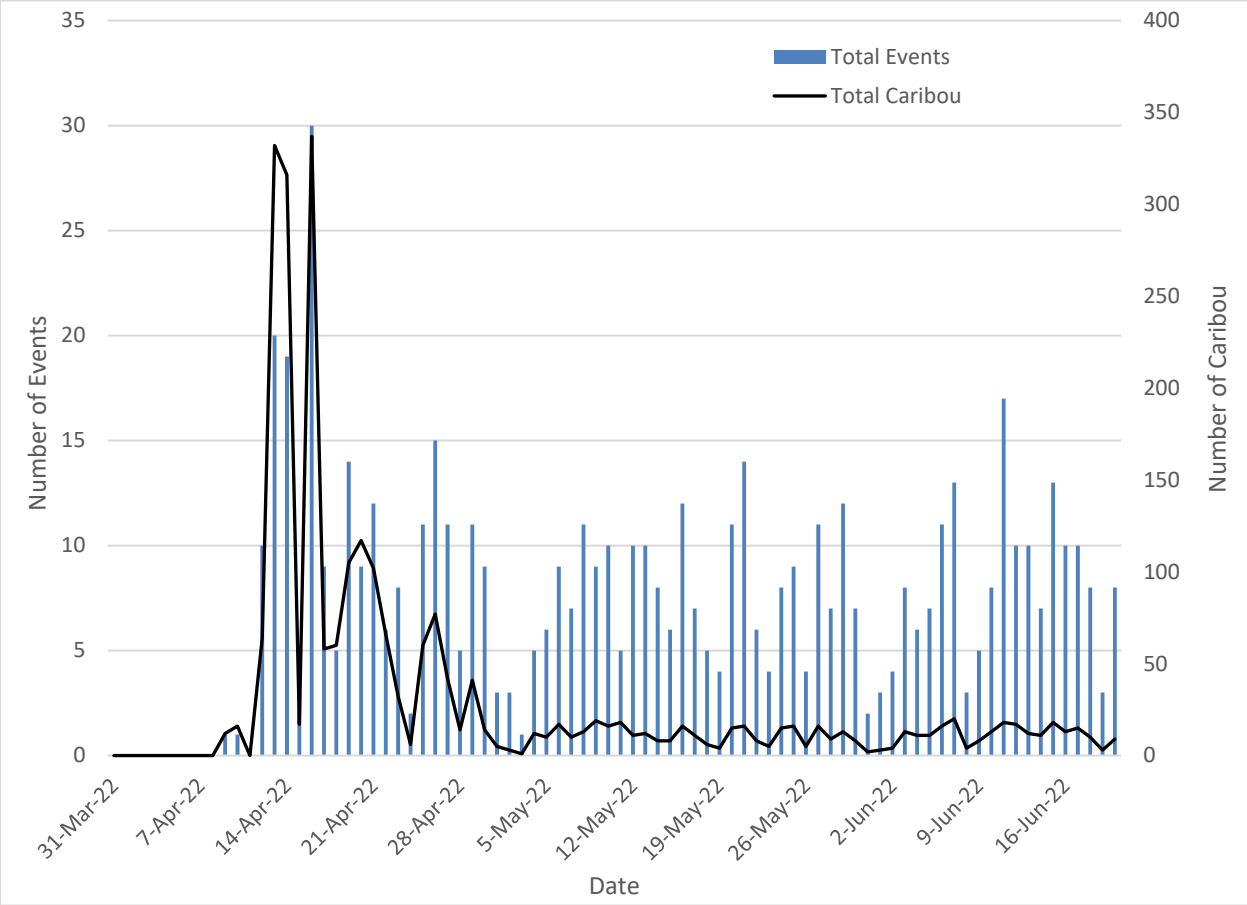


Figure 4-4 Seasonal Caribou Detections and Events: Spring 2022

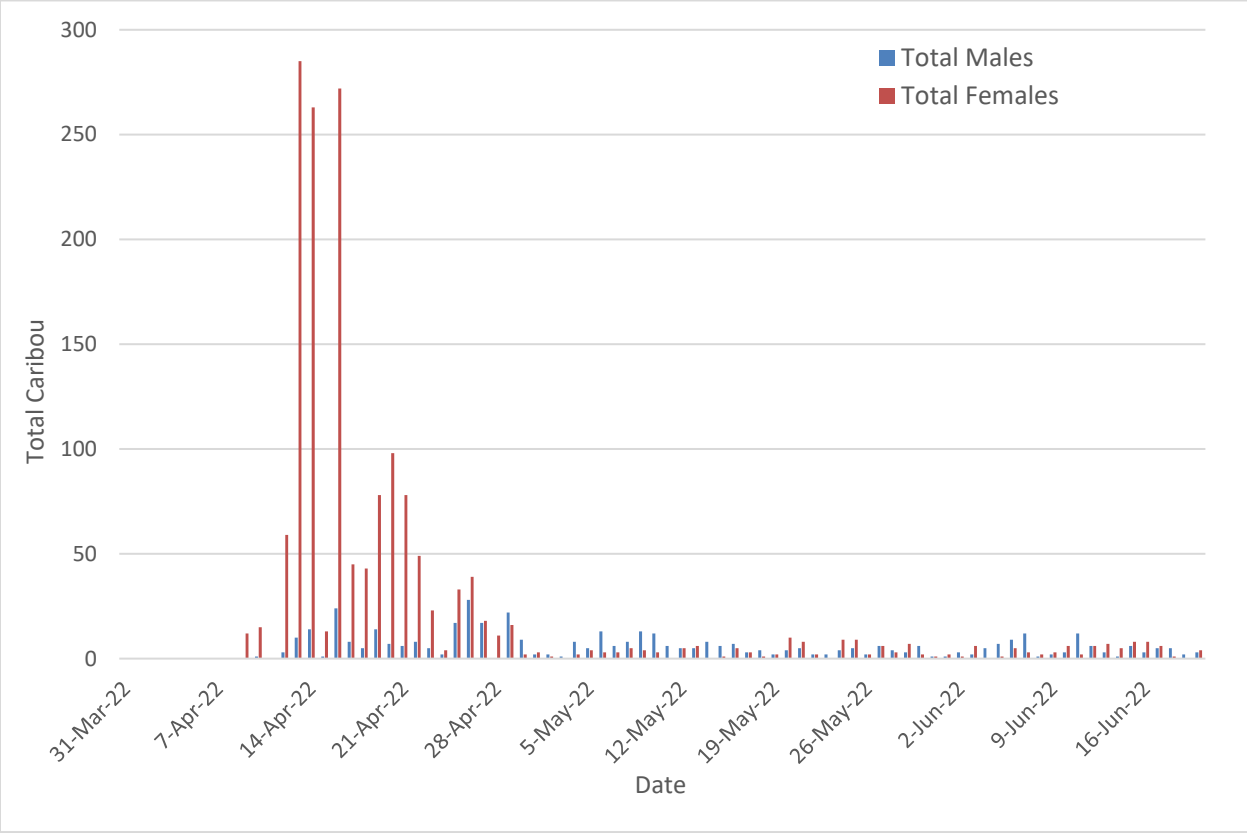


Figure 4-5 Seasonal Male and Female Caribou Detections: Spring 2022

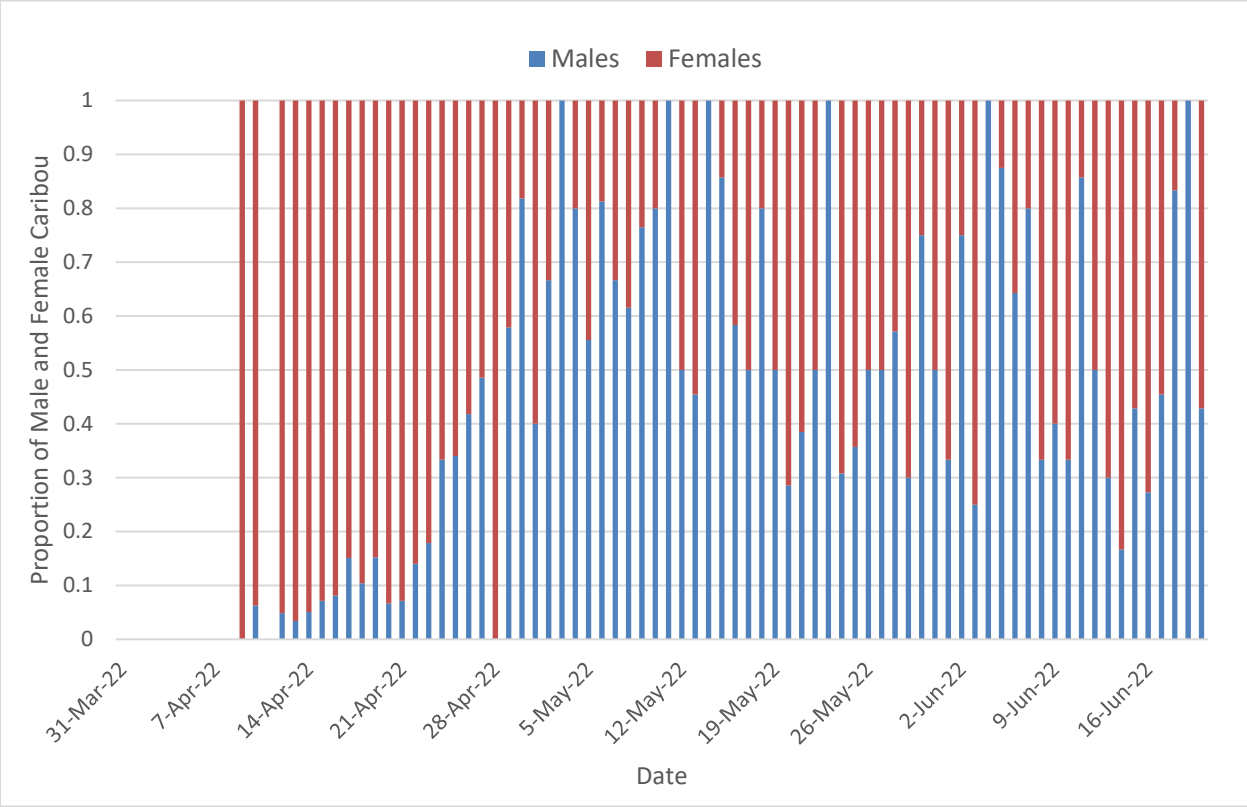


Figure 4-6 Proportion of Female and Male Caribou Detected: Spring 2022

4.3 GROUP COMPOSITION OF DETECTED CARIBOU

There were 2,447 caribou detected during the Spring 2022 Caribou Survey (Table 4.2). The ratio of males to females was 28 males:100 females (Table 4.4). There were 2 calves per 100 females, and calves accounted for 1% of caribou detected. Yearlings made up 9% of total caribou detected, and 39 caribou were classified as unknown age or sex. Sixty caribou collars were detected in the photos.

Table 4.4 Caribou Group Composition based on Remote Camera Results, Spring 2022

Classification	Caribou Detections[1]
Total Caribou	2,447
Total Adults[2]	2,160
Adult Females	1,642
Adult Males	452
Unknown Adults	66
Yearlings	223
Calves	25
Unknown Age or Sex[3]	39
Male:100 Females	28
percent males	18
Calf:100 Females	2
Percent Calves	1
Percent Yearlings	9
Total Collars	60

Notes:

1. Detections are based on the spring sampling period of March 31 to June 20, 2022
2. Total adults = adult females + adult males + unknown adults
3. Unknown Age or Sex includes caribou of unknown sex and/or age class

5.0 SUMMARY

This report provides a summary of the Spring 2022 Caribou Survey – Remote Camera Program as part of ongoing baseline data collection and is not intended to provide a detailed analysis or comparison between remote camera data collected in previous years or seasons.

The expanded spatial coverage via the addition of supplementary remote cameras that began in fall 2021 and continued in this survey (i.e., spring 2022), is intended to provide a broader understanding of caribou movement in and around the Project Area and to establish long-term monitoring locations for future contribution to monitoring initiatives described in the Caribou Protection and Environmental Effects Monitoring Plan.

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Valentine Gold Project: Fall 2022 Caribou Survey – Remote Cameras

Final Report

August 10, 2023

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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 remote camera monitoring of caribou during annual spring and fall migration periods. This report presents the results of the Fall 2022 Caribou Survey – Remote Cameras, which represents the seventh in a series of surveys beginning in 2019. The results of these and other ongoing studies will be analyzed with baseline caribou data for the Project as described in 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).

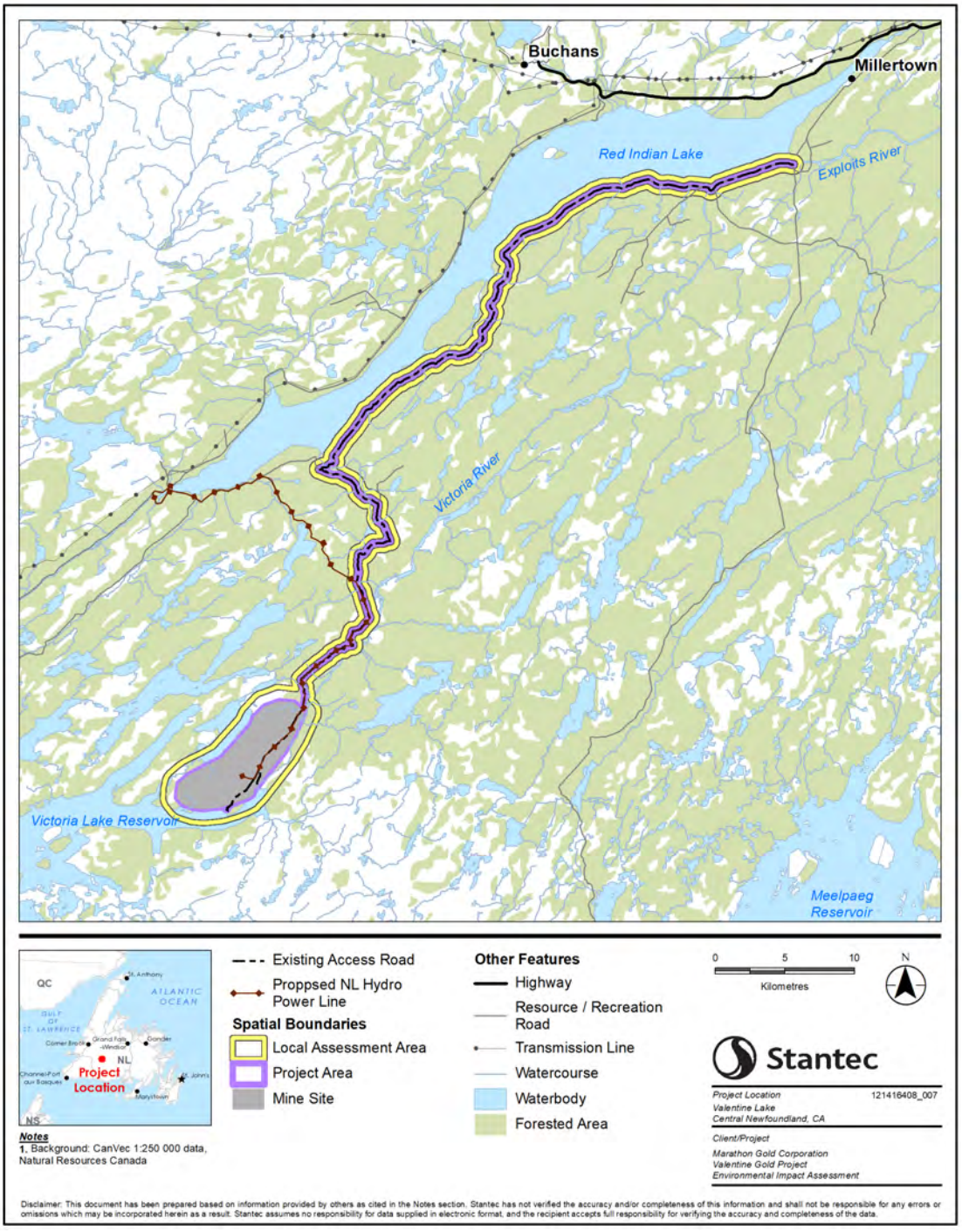


Figure 1-1 Project Location and Spatial Boundaries

1.2 BACKGROUND

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.

Generalized caribou migration dates (i.e., non-herd specific) for the island of Newfoundland indicate that caribou are most likely to migrate in the spring between April 1 and May 19, and in the fall between November 1 and December 15 (Table 1.1). Based on the identification of seasonal migration paths in the Project Area (Doucet and Morgan 2007 in Wells et al. 2011; Government of NL 2019; Marathon 2020a) remote cameras were deployed to gather additional baseline information on caribou movements in the vicinity of the Project and to inform mitigation. To date, data from remote cameras has been collected and analyzed for the 2019, 2020, and 2021 fall migration periods and the 2020, 2021 and 2022 spring migration periods (Marathon 2020b; Stantec 2021, 2022a, 2022b, 2022c). The Fall 2022 Caribou Survey – Remote Cameras represents the seventh survey in the series.

Table 1.1 General Seasons for the Island Caribou Population in Newfoundland

Season	Seasonal Dates
Winter	Dec 16–Mar 31
Spring Migration/Pre-calving	**Apr 1–May 19**
Calving	May 20–Jun 10
Post-calving Migration/Dispersal	Jun 11–Jun 30
Post-calving Rearing	Jul 1–Aug 31
Fall Rut	Sep 1–Oct 31
Fall Migration/Dispersal	**Nov 1–Dec 15**

Notes:
Bold text indicates migratory periods where caribou migrate through Marathon mine site
Source: Emera 2013

1.3 SURVEY OBJECTIVES

The objectives of the Fall 2022 Caribou Survey were to collect data related to:

- caribou entry and exit points to the mine site
- caribou use of lesser used migration paths through the mine site and surrounding areas; the timing of caribou migration through the mine site and surrounding areas
- caribou group size and composition
- supplementing collar information on the timing of fall migration through the mine site

2.0 SELECTION OF SURVEY SITES (CAMERA LOCATIONS)

The remote camera monitoring program was initiated in fall 2019. Camera placement (n=12) in 2019 was aligned with well-defined migration paths through the mine site (identified using LiDAR data and informed by input from NLDFFA-Wildlife Division) which had indicated a prominent caribou migration path through the Marathon pit (Government of NL 2019). Five general areas were selected for camera deployment: Valentine Lake outlet (VAL1, VAL2, VAL3), Marathon pit (MAR1, MAR2, MAR3, MAR4), Main Road (MAINRD, MARBOG), South Side of Victoria River (SS1 and SS2) and Victory pit (VIC1). The sites used for the fall 2019 program were also used for the spring 2020 and fall 2020 caribou programs to support a direct comparison (except SS2 because of challenges associated with retrieving the camera) and to inform subsequent camera monitoring initiatives.

In consultation with NLDFFA-Wildlife Division, the remote camera program was expanded in 2021 (Table 2.1). Locations for the deployment of additional cameras were based on LiDAR imagery, dynamic Brownian Bridge Movement Model (dBBMM) outputs, and the results of the Caribou Alternate Migration Pathway Analysis (Least Cost Path – LCP analysis). Locations 1-26 were used in the spring 2021 survey and locations 27-31 were additional locations established in fall 2021 (Figure 2-1). Except for two cameras (12 and 13), the locations selected in 2021 differed from those used in 2019 and 2020. Many of the current 31 camera locations are intended to become “permanent” monitoring locations to analyze long-term trends. If shifts in movement are detected, such as through collar data, camera placements may be adjusted.

Table 2.1 Current Remote Camera Locations and Rational

Camera Location[1]	Rationale		
	Aligns with wildlife trail identified from LiDAR data	**Aligns with caribou migration paths identified by dBBMM**	**Aligns with potential alternate migration path identified by LCP analysis**
Cameras Positioned to Gather Information about Entry and Exit Points to Mine Site			
6		✓	
7	✓	✓	
8	✓	✓	
9	✓		
10		✓	
11	✓	✓	
14	✓	✓	✓(0 km ZOI[2], spring migration, frozen and non-frozen conditions)
15	✓	✓	
16	✓	✓	

Table 2.1 Current Remote Camera Locations and Rational

Camera Location[1]	Rationale		
	Aligns with wildlife trail identified from LiDAR data	**Aligns with caribou migration paths identified by dBBMM**	**Aligns with potential alternate migration path identified by LCP analysis**
17	✓		
Additional Camera Locations			
1		✓	✓(0 km ZOI, spring migration, frozen conditions)
2	✓	✓	✓(1 km ZOI, spring migration, non-frozen conditions)
3		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
4		✓[3]	
5		✓	✓(1 km ZOI, spring migration, frozen conditions)
12[4]	✓	✓	
13[4]	✓	✓	
18	✓	✓	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
19		✓	
20		✓[3]	✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
21		✓	✓(1 km ZOI, spring migration, non-frozen conditions)
22		✓[3]	
23		✓	✓(1 km ZOI, spring migration, frozen conditions)
24		✓	✓(1 km ZOI, spring migration, frozen and non-frozen conditions)
25		✓	✓(5 km ZOI, spring migration, non-frozen conditions)
26			✓(5 km ZOI, spring migration, non-frozen conditions)
27[5]		✓	
28[5]		✓	✓ (0 km and 1 km ZOI, fall migration, frozen and non-frozen conditions)
29[5]		✓[3]	
30[5]		✓	✓ (5 km ZOI, spring migration, frozen conditions)
31[5]		✓	✓ (5 km ZOI, fall migration, frozen conditions; 10 km ZOI, fall migration, non-frozen conditions)

Notes:

1 Camera locations are presented in Figure 2-1

2 ZOI = Zone of Influence [as defined in the EIS (Marathon 2020a)]

3 Camera location modified to address comments from NLDFFA-Wildlife Division

4 Cameras 12 and 13 were the same locations as VAL2 and VAL1, respectively, previously used in 2019 and 2020,

5 New deployment location beginning fall 2021

Selection of Survey Sites (Camera Locations)

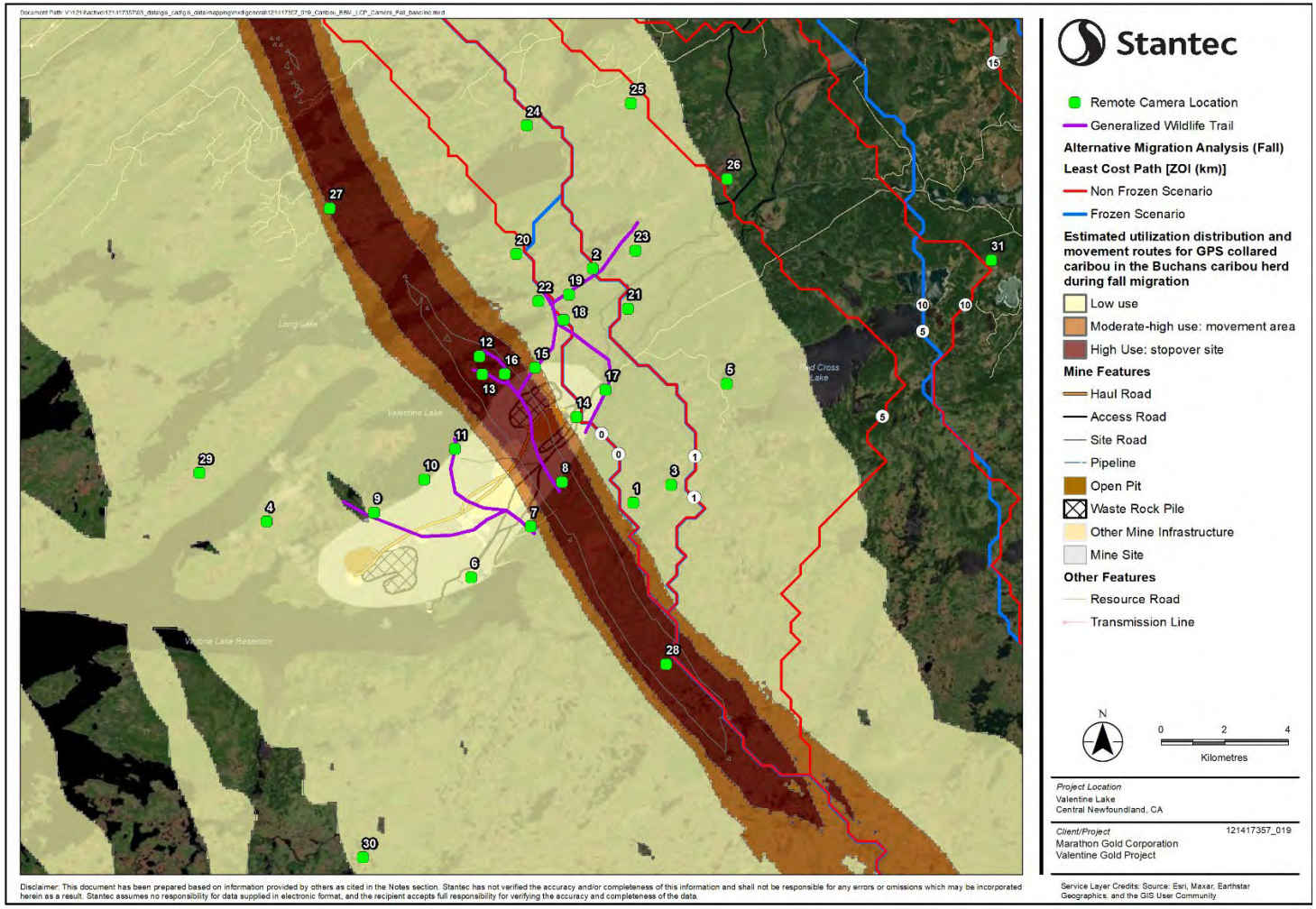


Figure 2-1 Camera Locations used during the Fall 2022 Remote Camera Monitoring Program

3.0 METHODS

3.1 REMOTE CAMERA DEPLOYMENT

Reconyx HS2X Hyperfire 2 Security Covert IR cameras were used during the fall 2022 survey. This model has infrared (IR) night vision illuminators to allow photography at night. Camera settings were selected to increase the probability of wildlife detection and identification (Stantec 2015). Lithium-ion batteries and 64 gigabyte SD memory cards were used in the cameras.

The cameras were deployed at each site using a standardized set-up to allow for consistency among sites and to reduce potential effects of camera placement or setup on wildlife detection. Cameras were deployed at least 500 m from one another to improve likelihood of independence (Stantec 2015), although some cameras are purposefully on the same trail at entry and exit points (e.g., cameras 7 and 11; cameras 8 and 16).

Cameras were mounted on trees with diameters of at least 20 cm. At sites where the camera mount needed additional stability, trees were braced with logs to reduce movement caused by wind. At sites with no suitable trees, tripods were installed as camera mounts. Cameras were placed approximately 1 to 1.5 m above ground to increase the probability of large mammal detection (Stantec 2015). Each camera was positioned facing a game trail to increase the path length of animals through the frame (Rovero et al. 2010). To reduce the incidence of false positives (i.e., camera is triggered by something other than wildlife such as branches or grasses moving in the wind), visible vegetation within the camera's field of view was trimmed where necessary. A walk test was completed before leaving the site to assess camera angle, position, and path length along the game trail to improve likelihood of detection.

3.2 DATA ANALYSIS

Remote camera photos were reviewed using the program Timelapse v.2.2.5.1, an image analysis software program that extracts photograph metadata and facilitates the management of photo results (Greenberg 2022). The number of camera days (sum of the number of deployment days for all cameras) was calculated. Photos were analyzed based on independent events identified from a photo series. For the analysis, an event was defined as beginning when one or a group of animals entered the frame and ending when they had exited the frame for more than two minutes (Rowcliffe et al. 2008, Stantec 2015). The likelihood of overestimating the number of individual caribou was reduced through a combination of camera placement and image classification techniques. Cameras were positioned perpendicular to the migration paths and, as such, most of the caribou captured by the cameras were moving across the frame. Additionally, most of the caribou moved across the frame either singly or in small groups, or in longer 'strings' comprised of many animals. When viewed in chronological order, it was possible to mark the progression of individual caribou across the frame based on their relative proximity to landmarks and other caribou. Only new animals entering the frame were counted and added to the total for that discrete

event (as opposed to summing the total number of caribou in each image). This technique reduced the likelihood of overestimating the number of individual caribou.

Summary metrics for caribou events and number of caribou detected were calculated for each season, including group size, sex ratio, age class, and any collared animals. Caribou events and number of caribou detected were also summarized daily within each season and among the pool of cameras. The mean number of caribou events (and associated standard error [SE]) was determined using data from all cameras and monitoring days (limited to December 31 [fall monitoring] for comparability among years), including days with zero detections, using the descriptive analysis function in Microsoft Excel.

Detected caribou were classified as: calves (i.e., neonates); yearlings = one to two years; and adults > two years. The category of “unknown” included caribou of all age classes whose sex could not be determined. The category of “total caribou” included adults, yearlings, calves, and unknown. Caribou were classified based on presence of a vulva or penis, head and body size, and antler characteristics (e.g., presence or absence, shape). “Total adults” included adults of known and unknown sex. The following values were calculated (but not intended to provide an annual population, sex, and age ratio estimate): male:100 females; percent males (males/total caribou x 100); calf:100 females; percent calves (calves/total caribou x 100); and percent yearlings (yearlings/total caribou x 100).

The start of the peak movement period was defined as the first Julian day when the proportion of caribou events exceeded 5% of the total observations for each season and the end as when the cumulative total exceeded 80% of caribou events.

4.0 RESULTS – FALL 2022

4.1 SAMPLING DURATION

Thirty of the 31 remote cameras were deployed via helicopter on October 4, 2022. Due to accessibility, camera 7 was accessed by ground and deployed on October 24, 2022, by Marathon staff. A camera inspection was completed on October 31, 2022, to confirm cameras were functioning correctly. All cameras except camera 7 were retrieved on December 21, 2022 (camera 7 was retrieved on January 7, 2023) (Table 4.1).

It is assumed that most caribou detected by the remote cameras are part of the Buchans herd because of the degree of overlap between the Buchans herd range and the Project Area, predominantly during the spring and fall migration periods (Marathon 2020a), although there is the possibility that a small percentage could be resident Grey River caribou. For consistency with previous fall data analysis, the end date for assessing means was set at December 31 (10 days after most cameras were retrieved).

Table 4.1 Fall Monitoring Period: 2020-2022 Remote Camera Programs

Year[1]	Date Deployed	Date Retrieved[2]
2019	October 5	December 18-February 11
2020	September 27-28	January 19-February 23
2021	October 6-7	January 27-28
2022	October 4 and 24	December 21-January 7

Notes:

1. Annual data analysis used the following dates: October 5 to December 31, 2019; September 27 to December 31, 2020; October 6 to December 31, 2021; October 4 to December 31, 2022
2. The larger range in retrieval dates is associated with camera 7, which is retrieved by ground (vs. air) and subject to suitable weather conditions and availability of Marathon staff.

4.2 CARIBOU DETECTIONS AND EVENTS

Thirty remote cameras were deployed from October 4 to December 21, 2022 (79 days), and camera 7 from October 24, 2022, to January 7, 2023 (76 days). Using the December 31 cut-off (consistent with previous analyses), the total sample effort is 2,439 camera days (Table 4.2). A total of 113 caribou events (592 caribou) were detected during the October 4 to December 31 period. The highest number of events recorded in a single day was 30 and the mean number of events per camera day was 0.05 (range 0-16) (Table 4.2).

Table 4.2 Summary of Caribou Detections and Events: Fall 2022

Parameter	Total[1]
Number of Cameras[2]	31
Total Camera Days	2,439
Total Number of Caribou Events	113
Mean Number of Caribou Events / Camera Monitoring Day (range)[3]	0.05 (0-16)
Total Caribou Detected	592

Notes:
1. Camera data analysis based on the following dates: October 4 to December 31, 2022.
2. Camera locations are shown in Figure 2-1.
3. Mean number of caribou events per monitoring day is based on all sampling days and cameras (i.e., includes days with zero detections).

Only 12 of the 31 cameras detected caribou during the October 4 to December 31, 2022, sampling period (6, 8, 12, 13, 15, 16, 18, 20, 23, 27, 28 and 30) and, of these, four cameras detected only a single caribou (Table 4.3, Figure 4-1). Cameras 13, 27 and 28 recorded the greatest number of caribou events (10%, 20% and 48%, respectively), and the highest number of individual caribou (Table 4.3, Figures 4-1 and 4-2). Consistent with findings during the spring 2022 remote camera program, cameras 27 and 28 had the highest total events and total caribou: camera 27 detected 139 caribou over 22 caribou events and camera 28 detected 379 caribou over 54 caribou events (Table 4.3, Figures 4-1 and 4-2).

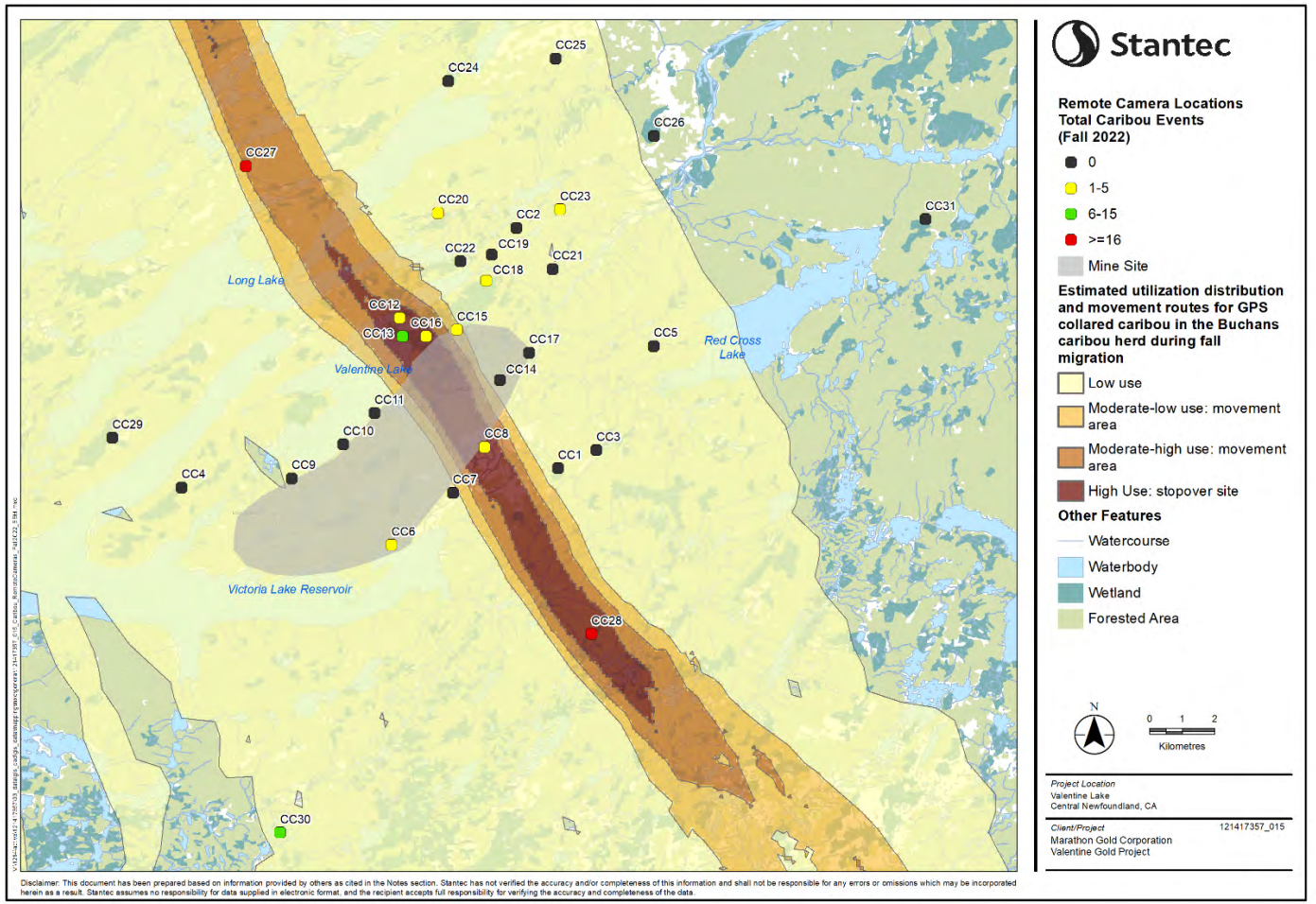


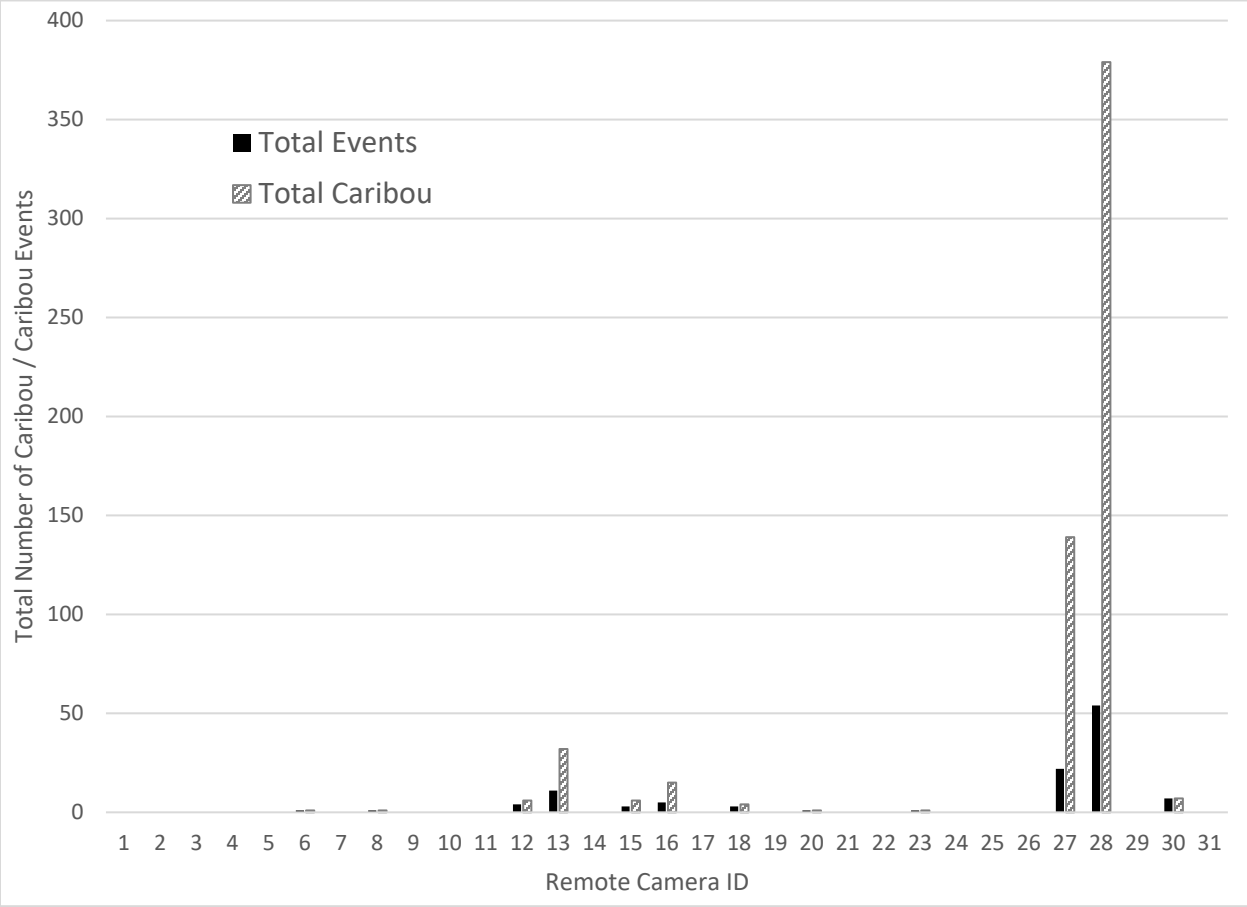
Figure 4-1 Total Caribou Events at Remote Cameras, Fall 2022

Table 4.3 Summary of Caribou Detections and Events per Remote Camera: Fall 2022

Camera	Number of Monitoring Days	Total Caribou Detected	Total Caribou Events	Mean Caribou Events / Monitoring Day (Range)	Standard Error
1	79	0	0	0	0
2	79	0	0	0	0
3	79	0	0	0	0
4	79	0	0	0	0
5	79	0	0	0	0
6	79	1	1	0.01 (0-1)	0.01
7	69	0	0	0	0
8	79	1	1	0.01 (0-1)	0.01
9	79	0	0	0	0
10	79	0	0	0	0
11	79	0	0	0	0
12	79	6	4	0.05 (0-2)	0.03
13	79	32	11	0.14 (0-2)	0.05
14	79	0	0	0	0
15	79	6	3	0.04 (0-3)	0.04
16	79	15	5	0.06 (0-2)	0.03
17	79	0	0	0	0
18	79	4	3	0.04 (0-1)	0.02
19	79	0	0	0	0
20	79	1	1	0.01 (0-1)	0.01
21	79	0	0	0	0
22	79	0	0	0	0
23	79	1	1	0.01 (0-1)	0.01
24	79	0	0	0	0

Results – Fall 2022

Camera	Number of Monitoring Days	Total Caribou Detected	Total Caribou Events	Mean Caribou Events / Monitoring Day (Range)	Standard Error
25	79	0	0	0	0
26	79	0	0	0	0
27	79	139	22	0.28 (0-6)	0.10
28	79	379	54	0.68 (0-16)	0.26
29	79	0	0	0	0
30	79	7	7	0.09 (0-3)	0.05
31	79	0	0	0	0

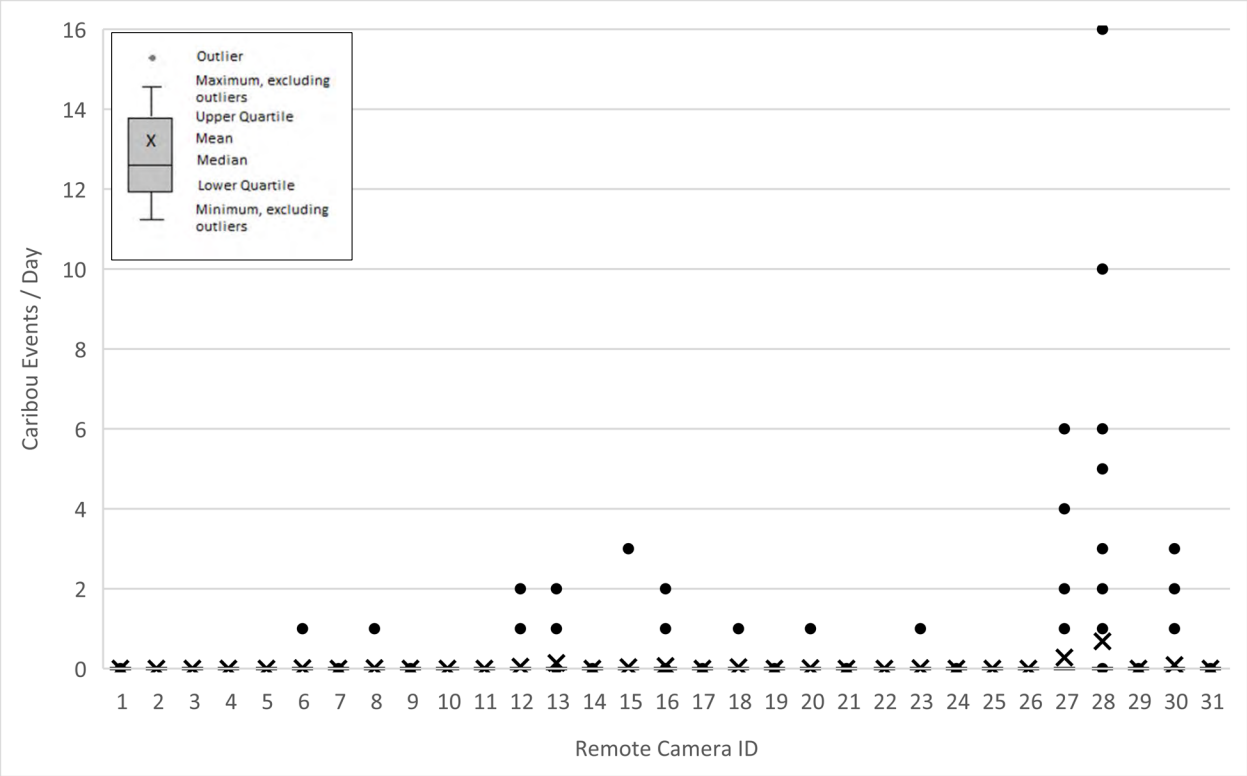


Notes:

1. The dates for analysis are October 24 to December 31, 2022, for camera 7, and October 4 to December 21, 2022, for all other cameras.
2. Camera locations are shown in Figure 2-1.

Figure 4-2 Total Caribou Detections and Events per Remote Camera: Fall 2022

Cameras 27 (0.28 events/day ±0.10 SE) and 28 (0.68 events/day ±0.26 SE) had the greatest number of caribou events per monitoring day (Table 4.1; Figure 4-3).



Notes:

1. The dates for analysis are October 24 to December 31, 2022, for camera 7, and October 4 to December 21, 2022, for all other cameras.
2. Camera locations are shown in Figure 2-1.

Figure 4-3 Caribou Events per Day per Remote Camera: Fall 2022

Caribou were detected almost daily from November 1 to November 18, 2022, excepting two days: November 2 and 10. Both the greatest number of events (30 events/day) and total number of caribou (n=266) was on November 15 (Figure 4-4), with most of these events (16) occurring at camera 28. The mean number of caribou per event was five caribou (range: 1-65). No caribou were observed after November 22, 2022.

The fall **peak movement period**, defined as the first Julian day when the proportion of caribou events exceeds 5% of the total and the end as when the cumulative total of caribou events exceeds 80%, was from **October 10 to November 15, 2022**. However, 90% of the total caribou detected were detected between November 1 and November 15. Male caribou (of known sex) were detected by cameras earlier than females, with only males detected between October 7 and October 14. The first two females were detected on October 22. Both males and females were detected throughout November (Figure 4-5 and Figure 4-6). The final observation on November 22 was of an adult of unknown sex.

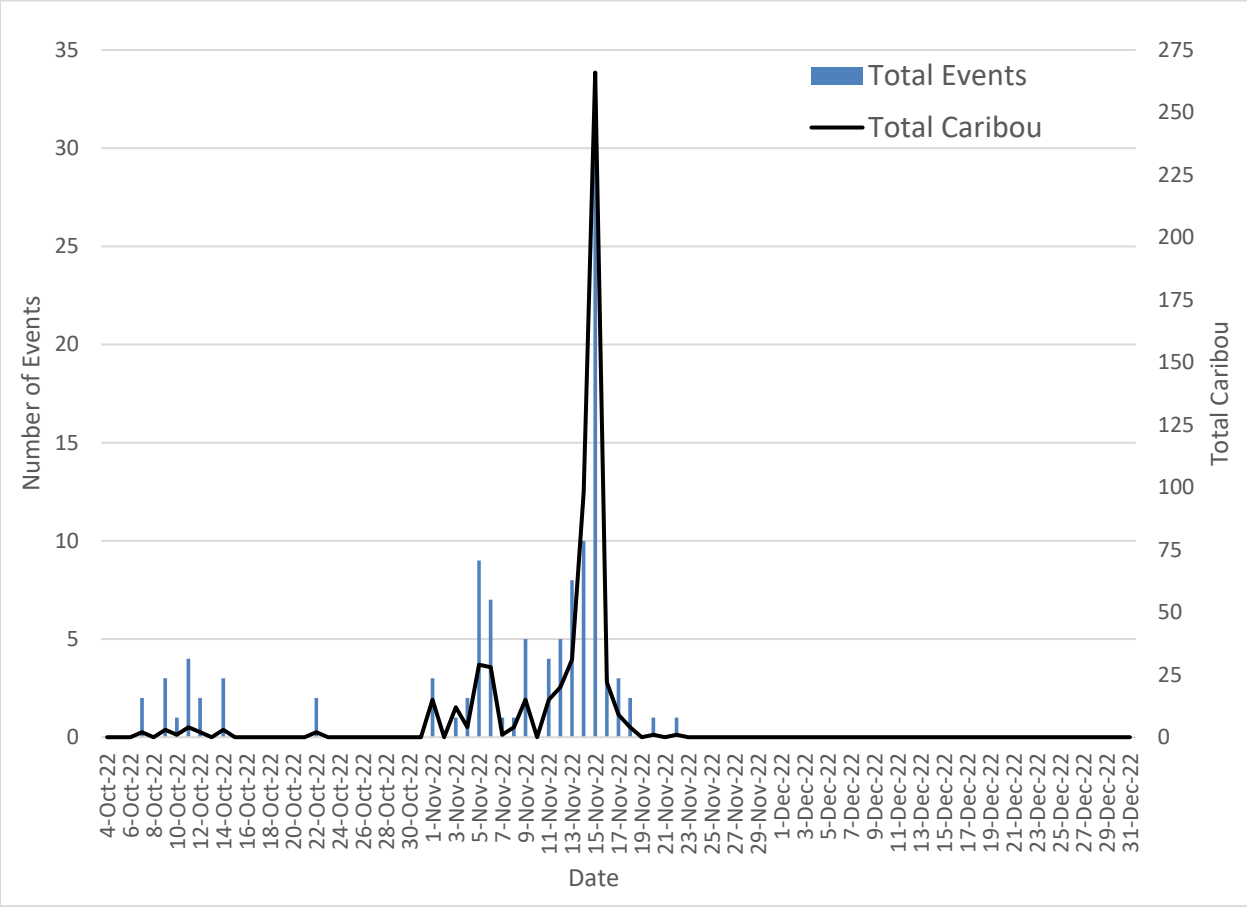


Figure 4-4 Seasonal Caribou Detections and Events: Fall 2022

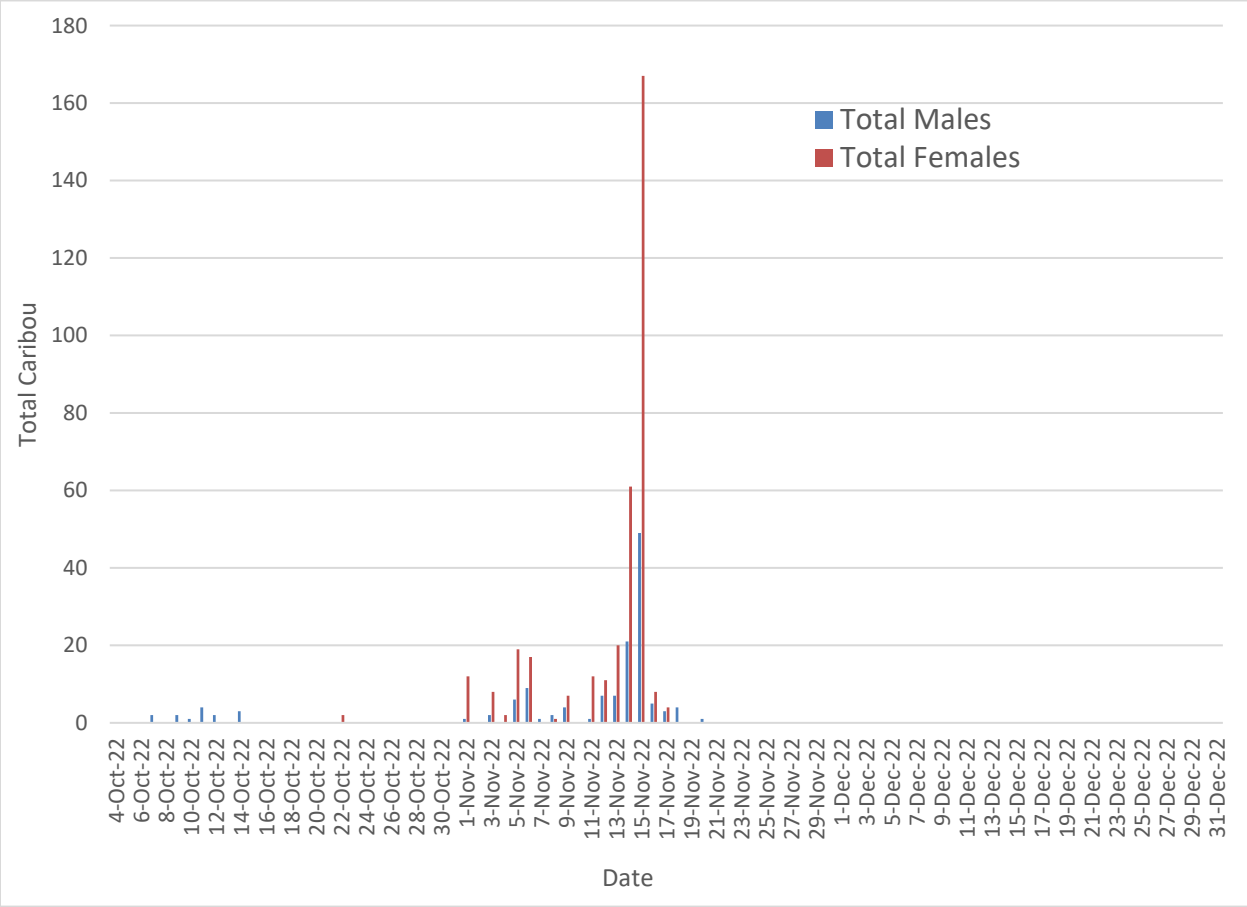


Figure 4-5 Seasonal Male and Female Caribou Detections: Fall 2022

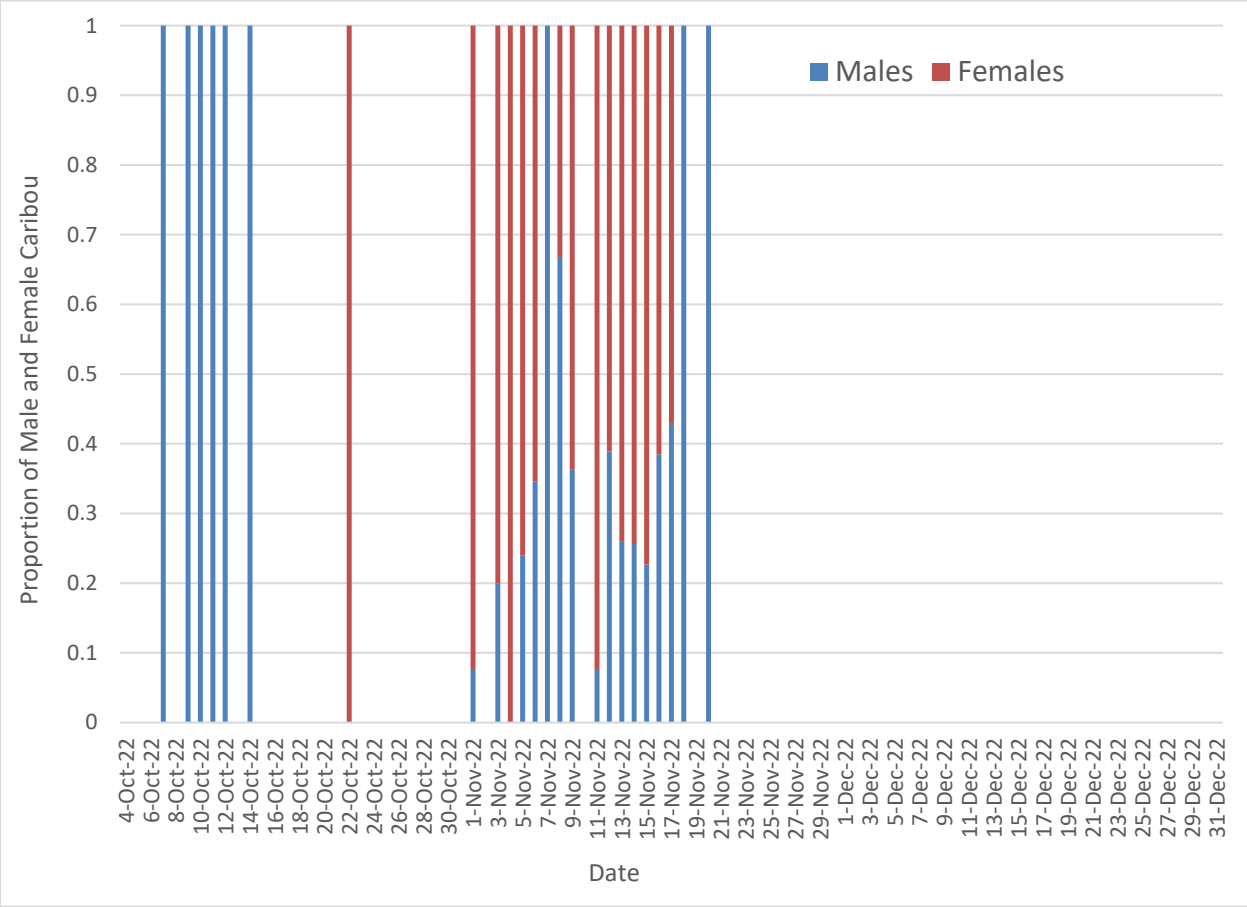


Figure 4-6 Proportion of Female and Male Caribou Detected: Fall 2022

4.3 GROUP COMPOSITION OF DETECTED CARIBOU

There were 592 caribou detected during the Fall 2022 Caribou Survey (Table 4.2). The ratio of males to females was 39 males:100 females (Table 4.4). There were seven calves per 100 females, and calves accounted for 4% of caribou detected. Yearlings made up 5% of total caribou detected, and four caribou were classified as unknown age or sex. Seven-teen caribou collars were detected in the photos.

Table 4.4 Caribou Group Composition based on Remote Camera Results, Fall 2022

Classification	Caribou Detections[1]
Total Caribou	592
Total Adults[2]	534
Adult Females	351
Adult Males	137
Unknown Adults	46
Yearlings	30
Calves	24
Unknown Age or Sex[3]	4
Male:100 Females	39
percent males	23
Calf:100 Females	7
Percent Calves	4
Percent Yearlings	5
Total Collars	17

Notes:

1. Detections are based on the fall sampling period of October 4 to December 31, 2022
2. Total adults = adult females + adult males + unknown adults
3. Unknown Age or Sex includes caribou of unknown sex and/or age class

5.0 SUPPLEMENTARY INFORMATION

Consistent with camera findings that most caribou were detected in November 2022, there were approximately 246 caribou observed by workers associated with the Marathon Project between November 9 and November 26, 2022 (Figure 5-1). This includes caribou observed along the main access road to the site and near or within the mine site. Also consistent with camera findings is the peak in observations on November 15, 2022, when approximately 144 caribou were reported (Figure 5-1). Of these, 120 were observed on an “outflow bog” using drones, and the remainder on the access road near kilometer markers 67 and 77.

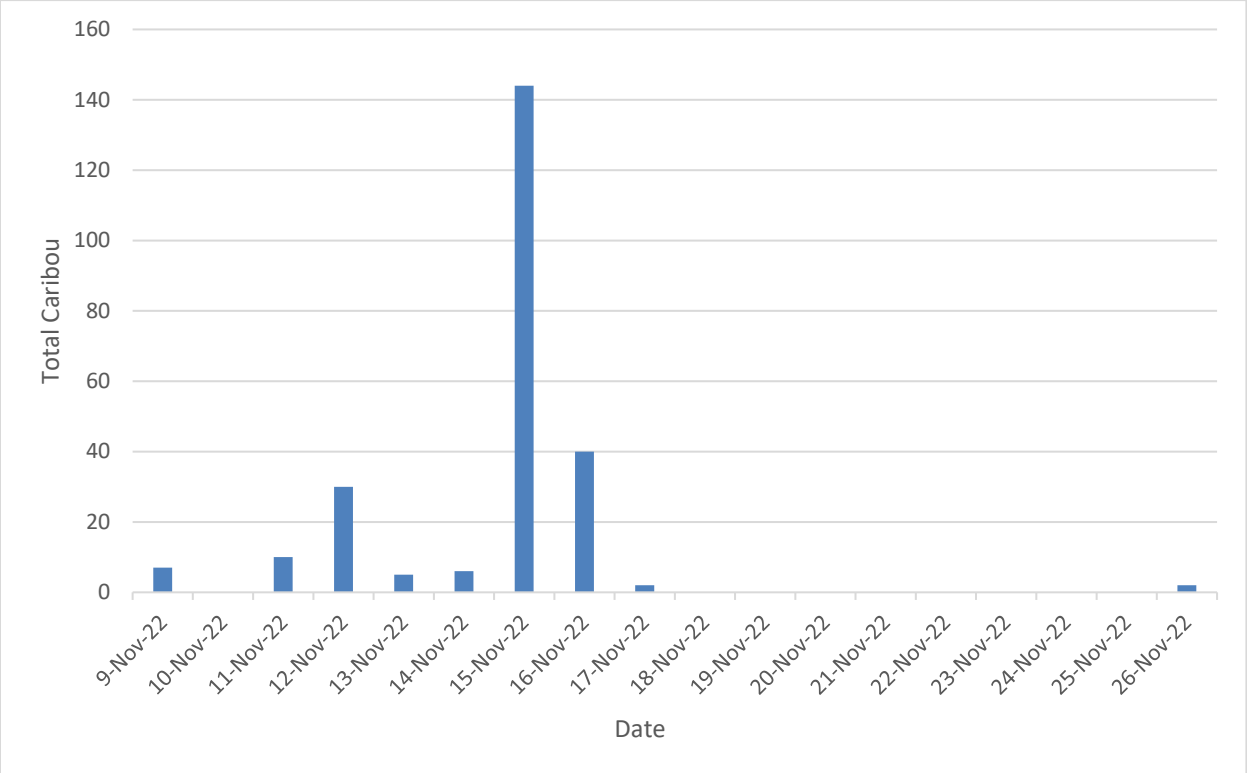


Figure 5-1 Approximate Number of Caribou Observed and Reported to Marathon: Fall 2022

Twenty of the approximate 246 caribou observed were classified by age and sex, with the remaining 226 caribou classified as unknown age or sex. Classified caribou were comprised of seven adult males, nine adult females and four calves. The largest group of caribou observed was estimated at 50 individuals.

6.0 SUMMARY

This report provides a summary of the Fall 2022 Caribou Survey – Remote Cameras program as part of ongoing baseline data collection and is not intended to provide a detailed analysis or comparison between remote camera data collected in previous years or seasons.

The expanded spatial coverage via the addition of supplementary remote cameras that began in fall 2021 and continued in this survey (i.e., fall 2022), is intended to provide a broader understanding of caribou movement in and around the Project Area and to establish long-term monitoring locations for future contribution to monitoring initiatives described in the Caribou Protection and Environmental Effects Monitoring Plan.

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