A pilot project to test the use of aerial monitoring to supplement satellite collared caribou for mobile caribou protection measures

Prepared for:

Déline Renewable Resources Council

by:

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Introduction

Caribou are fundamentally important to the community of Déline. People are concerned about the future of caribou and in particular, are concerned about any effects of industrial exploration and development on caribou. The Déline Renewable Resources Council (DRRC) is working on two approaches to protect caribou. First is a longer-term approach, which is to protect Edaiila (Caribou Point - the peninsula on northeast Great Bear Lake). Protecting Edaiila is necessary as caribou of the Bluenose East herd frequently use the area (Nagy et al. 2005). However the benefits of protecting caribou use on Edaiila will be lost unless human activities, especially industrial development, are managed to minimize effects on the herd across its entire annual range. Additionally, measures are needed that can be implemented rapidly as resource exploration in the Déline District is already underway.

The more immediate approach for DRRC to protect caribou is through the cooperative development of "Mobile Caribou Protection Measures" (MCPMs) to protect caribou while exploration goes ahead in Edaiila and the Déline District. To test the approach of mobile protection measures, DRRC proposed a "Pilot Project" which can be refined as experience grows, and which could later (if effective) be applied throughout the Bluenose East herd's range (Gunn and Nishi 2008). The development of the Mobile Caribou Protection Measures is a cooperative project involving DRRC, Sahtu Renewable Resources Board, Department of Environment and Natural Resources (ENR, Government of Northwest Territories [GNWT]), and Department of Indian Affairs and Northern Development (DIAND).

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The Mobile Caribou Protection Measures were adapted from caribou protection measures originally developed for the Beverly and Qaminuriaq barren ground caribou herds in the late 1970s and 1980s in Nunavut (Gunn et al. 2007). The measures were conditions on land use permits and prohibited exploration work in calving and post-calving grounds for the Beverly and Qaminuriaq herds from May 15 to July 15 of any year, as well as at designated river crossings during migration, while caribou were at or near those areas. Flexibility came from an air- and ground-monitoring program, which informed land use inspectors and others about caribou distribution relative to the exploration camp and could allow release of the camp from the measures or their imposition depending on caribou distribution. The monitoring program has lapsed, although the measures are still in force. The Beverly and Qaminuriaq Caribou Management Board and the draft Kitikmeot Land Use Plan have called for Mobile Caribou Protection Measures. As far as we are aware, a design to implement Mobile Caribou Protection Measures has yet been developed. Our intent of this Pilot Project is to test the field operations for Mobile Caribou Protection Measures.

Like the original caribou protection measures, Mobile Caribou Protection Measures would have the legal force of conditions as they would apply to activities that require a new land use permit or water license under the *Mackenzie Valley Regulations* and the *NWT Water Regulations*. However, Mobile Caribou Protection Measures would not apply to exploration activities that fall below the "threshold" of activities requiring a land use permit under these regulations. This — and particularly below-threshold helicopter use — is a matter of concern to the DRRC and Déline's elders (T. Nesbitt, workshop facilitator/chair. Report on the February 2&3 2009 mobile caribou protection measures workshop in Déline. 11 March 2009).

The intent of the mobile measures is that they would move with the herd, would be applied wherever the caribou are, and would require exploration work to temporarily suspend operations whenever caribou are in the vicinity. The application of the measures depends on knowing the whereabouts of the caribou and following rules to make decisions about exploration activities. The general whereabouts of the caribou is known through the use of satellite collars (ENR, unpubl. data). However as only cows are collared and the number of collars is few relative to the size of the herd, there is the question of how well the satellite-collared caribou represent the herd's distribution. The information about caribou distribution is not symmetrical – the collar locations reveal where caribou are but the absence of collared caribou does not necessarily reveal the absence of caribou. This suggests that at specific sites supplementary information will be required, such as aerial and ground monitoring of caribou distribution.

The objective for the Mobile Caribou Protection Measures is to minimize disturbance to caribou from industrial exploration activities. The objective is achieved through surveillance around an exploration site; if there are caribou in the vicinity the land use permit operator will suspend exploration activities, which will impose spatial separation between industrial exploration activities and caribou. The Mobile Caribou Protection

Measures have three concentric zones, which operate as a hierarchy of increasing surveillance effort (Fig. 1). An outer 'Early Warning Zone' relates to the presence or absence of collared caribou. Any collared caribou within the Early Warning Zone would trigger aerial surveys of the two inner zones (Zone of Influence and Buffer Zone). Inside the Early Warning Zone is a 'Buffer Zone' where aerial surveys or collared caribou are used to assess the presence of caribou. These two outer zones operate as information zones, indicating the possibility of caribou moving into the third, most inner 'Zone of Influence'. The presence of caribou within the Zone of Influence would initiate a temporary suspension of exploration activities to protect the caribou. The Zone of Influence is the area around a site of human activity where caribou change their behaviour in response to the site and its associated activities. The presence of caribou in the Buffer Zone would indicate to the exploration manager and the land use inspector of a potential suspension should caribou enter the Zone of Influence.

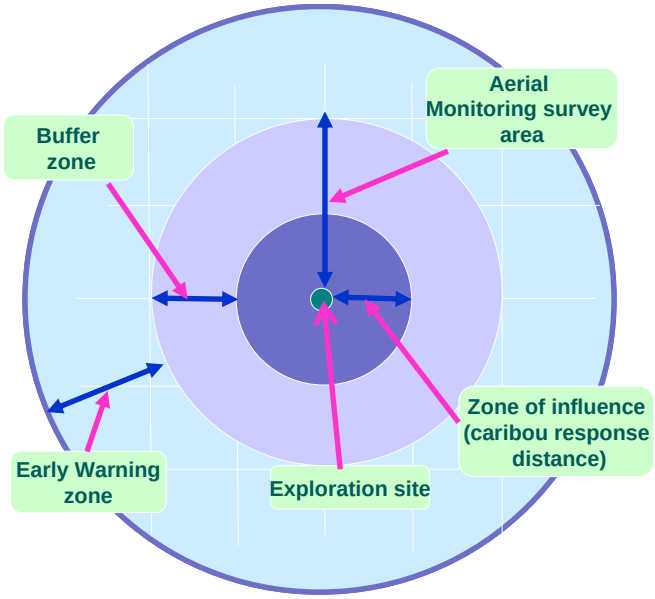


Figure 1. Schematic relationship between an exploration site, Zone of Influence, Buffer Zone, Early Warning Zone, and monitoring survey area.

This first phase of the Pilot Project for the Mobile Caribou Protection Measures was to use test sites to run through how the measures may work in practice. We used these test sites to evaluate the procedures and provide training to DRRC observers. Our objectives were:

1. To test and refine the experimental design of the Pilot Project, including obtaining the satellite collar information, the practicalities to undertake the aerial surveys, and communicating the results to the DRRC, DIAND, and ENR;
2. To provide training for the DRRC in aerial caribou surveys; and
3. To evaluate the practicality of the Mobile Caribou Protection Measures and present options to refine them.

Methods

We contacted ENR (via e-mail and telephone) on 23 March 2009 to request satellite collar locations for our area of interest, and received the locations on 24 March. As this was a test, we also used information from ENR's reconnaissance transects flights in late February and early March 2009, which delineated the relative distribution of caribou south and southeast of Great Bear Lake (ENR, unpubl. data). We used that information to help us chose test sites that would cover a range of caribou distribution.

We selected our test development sites to be within reasonable ferry distance of Déline, south of Great Bear Lake and west of Hottah Lake (Fig. 2). We positioned the test sites in and around collar locations to examine a likely range of situations for caribou distribution relative to collar locations. The zones out from each test site were a 13 km radius Zone of Influence, followed by an 8 km radius Buffer Zone, and a 60 km Early

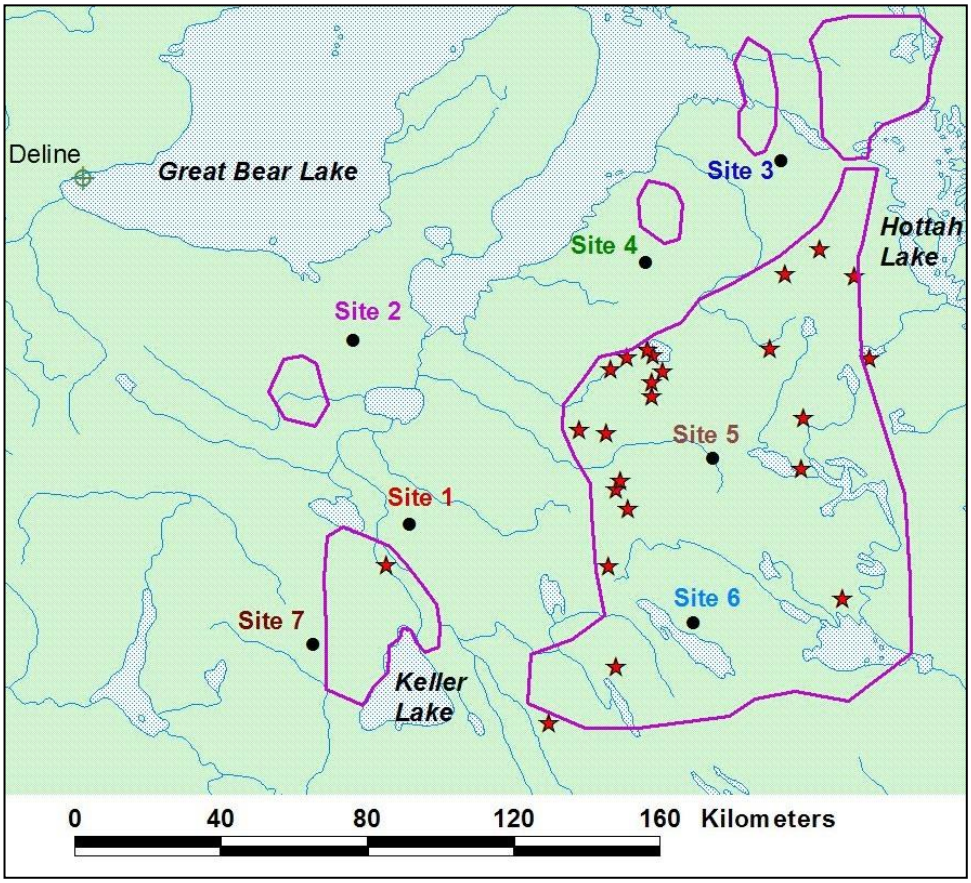


Figure 2. Distribution of satellite (red stars) collars on caribou south of Great Bear Lake, 23 March 2009, and of seven test survey sites (black dots) flown 25–28 March 2009. The purple polygons are the approximate distribution of caribou from reconnaissance transects flights in late February and early March 2009 (ENR, unpubl. data).

Warning Zone. We divided the Early Warning Zone into an Inner (first 30 km) and Outer (second 30 km) zone for the purposes of this project to facilitate describing possible conditions. These series of circles were placed around each test site, and the number of collars within each of the four zones was summarized. Sites were established primarily with varying numbers of collars in the Inner and Outer Early Warning Zones.

The study was designed to map caribou numbers within the Zone of Influence and Buffer Zone and for this we used transects aligned north-south. The Zone of Influence and Buffer Zone totalled 21 km radius and covered 1385 km^2 (531 km^2 in the ZOI, and 854 km^2 in the BZ). We spaced transects at 5 km intervals aligned on the UTM Zone 10 grid. Start and end points of each transect were loaded into a hand-held GPS (Garmin 76Cx) and a survey route was built for each site. Observers were instructed to focus on a 500 m strip on each side of the aircraft (which would provide equal 20% coverage of both zones), but to note all caribou observed, regardless of distance from the aircraft.

The transects were to ensure systematic coverage of the Zone of Influence and Buffer Zone. We tried two modifications to the full transects. For two sites we stopped the transects 1 km from the outer boundary of the survey zone, in effect providing a 20 km radius to the flight lines. We also flew a 'daisy wheel pattern' at one site (shown below).

We flew in a Cessna 206 at 160 km/hour at an altitude of 160 m agl. The survey crew was the pilot, a front seat navigator and recorder (KGP), and two rear seat observers (Fig. 3). All the survey crew participated in reporting caribou sightings. Prior to the survey, we explained the survey protocol in detail to the observers.

During the surveys and on ferry flights to and from the sites, we recorded the numbers and location of caribou. During the first two days caribou sign (tracks, beds, and craters) were recorded as Few, Some, and Many for relative numbers. The last snow and wind weather was approximately one week prior to the start of the survey, but in some light conditions it was difficult to determine relative age of the sign. Light new snow occurred on the evening of 26 March, and no sign was recorded on 27 and 28 March. We also noted additional wildlife observations.

Figure 3. Observers Norman Betsina (L) and Joe Blondin

Results

We surveyed the Zone of Influence and Buffer Zone for seven test sites, one of which was flown twice, for a total of eight surveys. Sites had between 2 and 22 satellite-collared caribou within the Early Warning Zone, which is the condition to trigger an aerial survey (Table 1). We rated the sites as to whether they were within or on the edge of the caribou distribution mapped in February–March: six were on the edge and two were within, which was also mostly reflected by a higher number of collars in the Early Warning Zone.

We flew the surveys 25–28 March in generally good weather ranging from clear skies to high overcast. Including ferry from and to Déline, we flew 27.1 hours over 4 days, with an additional 1.5 hours ferry from and to Norman Wells. Only two sites were surveyed each day because of the distance from refuelling in Déline. Each survey took just under 2 hours to complete, and averaged 1:58 for the standard (21 km radius) transect survey, 1:50 for the single daisy survey, and 1:51 for the shortened (20 km radius) transect survey (see *Survey design* below for further descriptions).

We counted 2,347 caribou during the flights, including 2,073 caribou during survey of the test sites, and 274 during ferry to and from the sites. We also saw four moose (*Alces alces*) and two wolves (*Canis lupus*).

Each evening after the flights we discussed the survey results with DDRC. We did not discuss our flights with DIAND land use inspectors, as we had limited time for contact, and we had not enough lead time to establish a contact protocol. We also did not pass on flight information to ENR, other than to ensure that survey areas did not overlap with other on-going surveys (safety issue).

The position of each test site relative to the location of the collared caribou affected the number of caribou observed in the Zone of Influence and Buffer Zone (Fig. 4, Table 1). There were comparatively few caribou within the survey areas when there were collars in the Outer Early Warning Zone but few or no collars in the Inner Early Warning Zone (e.g., Sites 1, 2 and 7). When there were greater numbers of collars in the Inner Early Warning Zone, more caribou were observed in the survey area (e.g., Sites 4 and 5). The site with the most collars in the Inner Early Warning Zone had the greatest number of caribou present (Site 5).

Most of the sites were on the edge of the distribution of the main herd, which was generally southwest of Hottah Lake. Sites within the distribution of collars detected generally high numbers of caribou (Site 5), but in one case a large burn and poor winter habitat resulted in few caribou present in the survey area (Site 6). Habitat varied over the area, from open to largely closed canopy forests (Fig. 5). Caribou were often observed on lakes and open wet areas (bogs, swamps), but were seen within the more dense forest matrix.

Table 1. Summary of Pilot Project Mobile Caribou Protection Measures flights, 25–28 March 2009. Caribou distribution was established during distribution flights, which occurred 25 February to 5 March 2009 (ENR, unpubl. data).

Site no.	Date	Survey pattern	Collar location 23 March 2009	Relative distribution	No. of caribou	Land use decision[1]
Site 1	25 Mar	5 km transects to 21 km radius	1 on ZOI/BZ edge; 0 in Inner EWZ; 15 in Outer EWZ	W **edge** of main distribution; N side of Keller L	0 in ZOI; 14 in BZ	No action
Site 2	25 Mar	5 km transects to 21 km radius	0 in Inner EWZ; 5 in Outer EWZ	W **edge** of main distribution	0 in ZOI; 0 in BZ	No action
Site 3	26 Mar	5 km transects to 21 km radius	4 in Inner EWZ; 9 in Outer EWZ	N **edge** of main distribution	28 in ZOI; 188 in BZ	Suspension
Site 4	26 Mar	5 km transects to 21 km radius	11 in Inner EWZ; 7 in Outer EWZ	N **edge** of main distribution	0 in ZOI; 556 in BZ	Potential suspension
Site 4D	27 Mar	Daisy pattern	11 in Inner EWZ; 7 in Outer EWZ	N **edge** of main distribution	2 in ZOI; 44 in BZ	No action
Site 5	27 Mar	5 km transects to 20 km radius	17 in Inner EWZ; 5 in Outer EWZ	**Within** main distribution	412 in ZOI; 693 in BZ	Suspension
Site 6	28 Mar	5 km transects to 20 km radius	7 in Inner EWZ; 12 in Outer EWZ	**Within** S edge of distribution	17 in ZOI; 92 in BZ	Potential suspension
Site 7	28 Mar	5 km transects to 20 km radius	1 in Inner EWZ; 1 in Outer EWZ	W **edge** of Keller L caribou	35 in ZOI; 0 in BZ	Suspension

ZOI = Zone of Influence (13 km radius)
BZ = Buffer Zone (8 km radius beyond ZOI)
Inner EWZ = Inner 30 km of the Early Warning Zone
Outer EWZ = Outer 30 km of the Early Warning Zone
[1] 25 caribou observed in the Zone of Influence will justify a temporary suspension of mineral exploration activities and 50 caribou spotted in Buffer Zone will justify notice to the exploration manager and the land use inspector of a potential suspension should caribou enter the Zone of Influence.

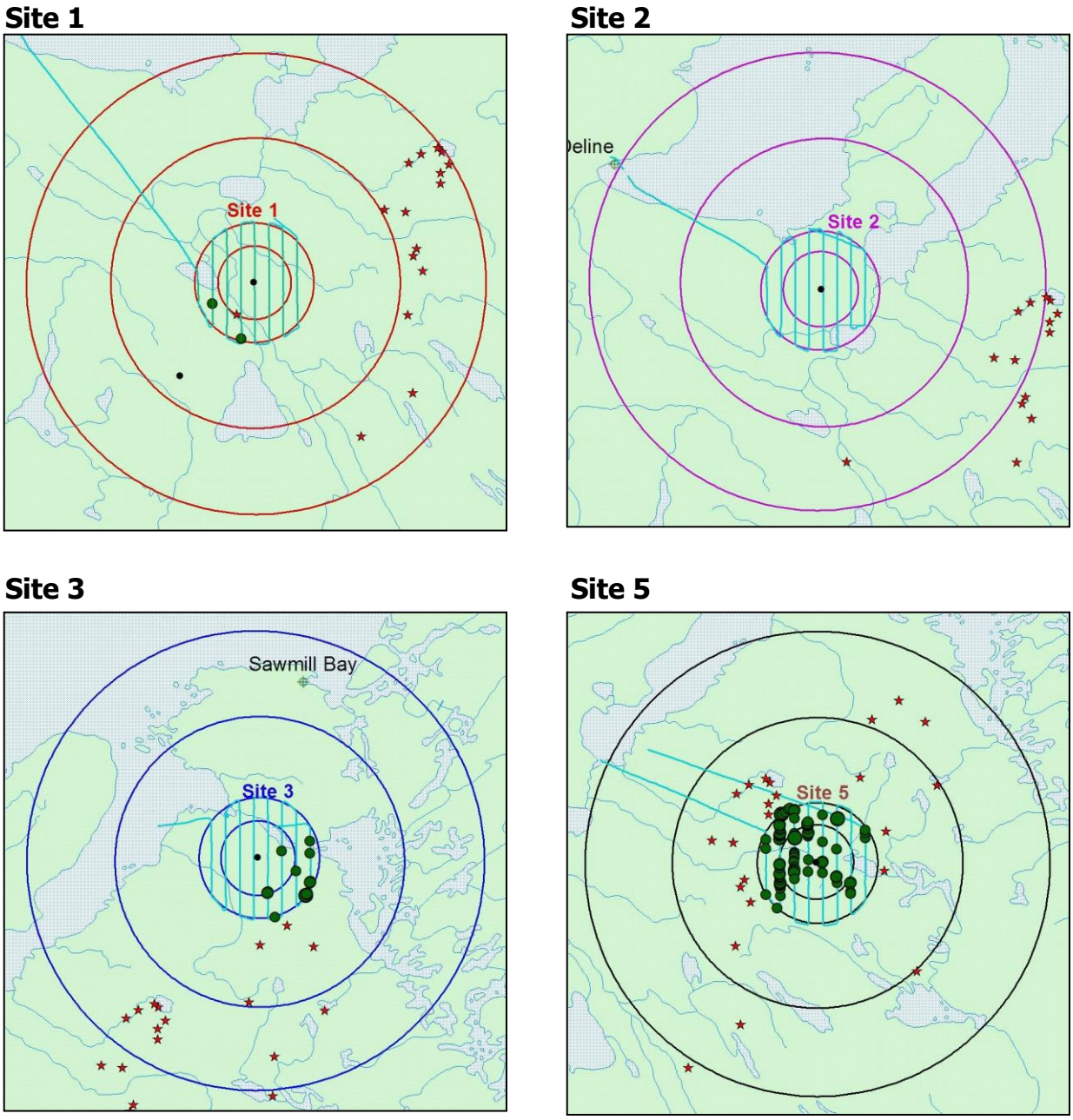
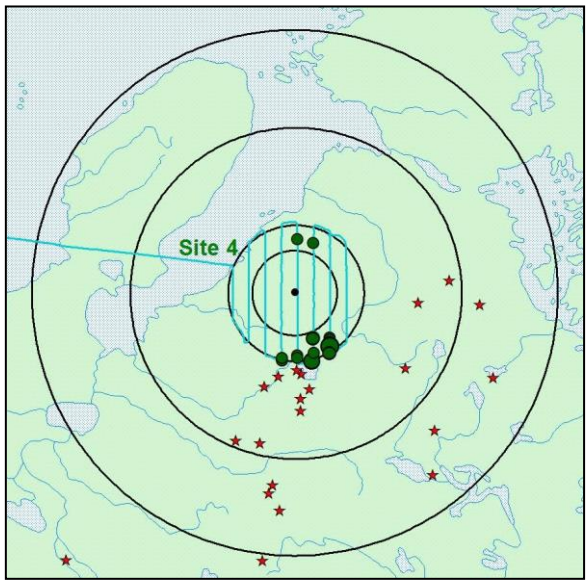
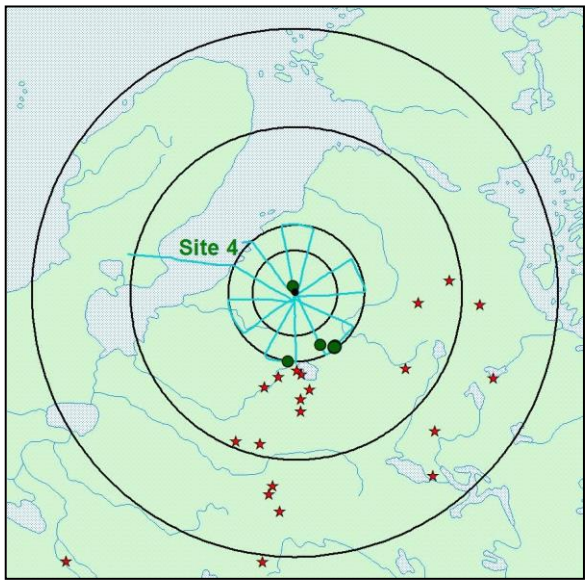


Figure 4. Caribou observed (green dots, scaled from 1 to 200 animals), collar locations (stars), and survey flight lines (blue lines) during pilot Mobile Caribou Protection Measures flights, 25-28 March 2009.

Site 4



Site 4D



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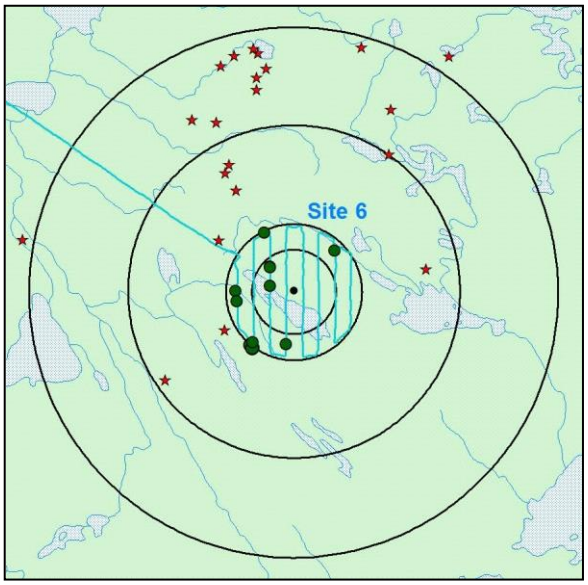

Site 7

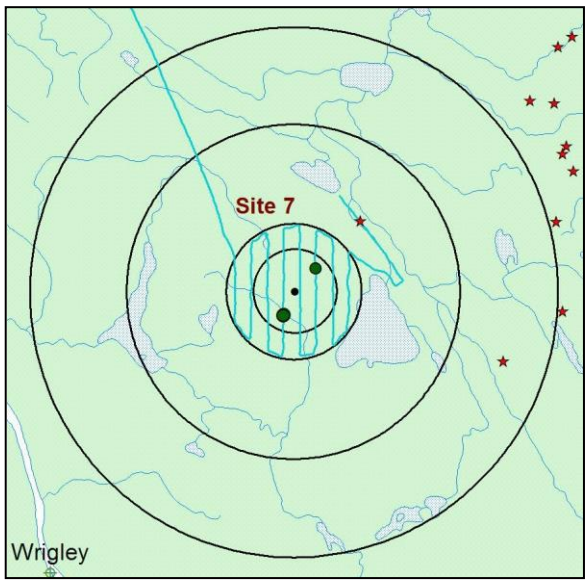

Figure 4 (cont.). Caribou observed (green dots, scaled from 1 to 200 animals), collar locations (stars), and survey flight lines (blue lines) during pilot Mobile Caribou Protection Measures flights, 25-28 March 2009.

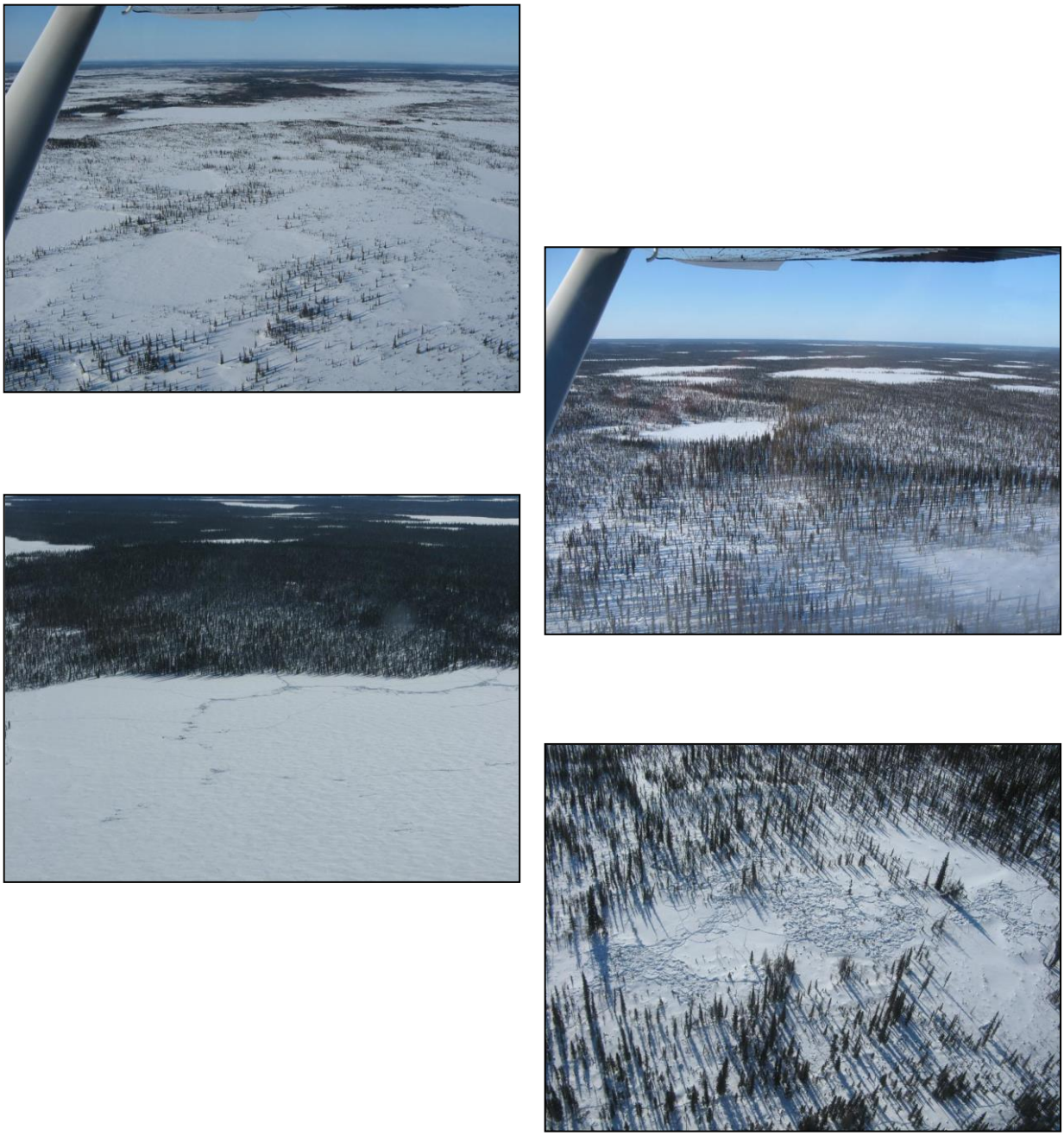

Figure 5. Winter caribou habitat south of Great Bear Lake, March 2009.

The threshold for temporary suspension of land use activities (25 caribou in the Zone of Influence) was exceeded for Sites 3, 5, and 7 (28, 412, and 35 caribou, respectively) The threshold of 50 caribou in the Buffer Zone were exceeded at four sites, and for two of those sites those caribou numbers would have justified notice to the exploration manager and the land use inspector of a potential suspension should caribou enter the Zone of Influence. For the other two sites with more than 50 caribou in the Buffer Zone, there were also enough caribou in the Zone of Influence, that operations would be temporally suspended.

Time to threshold and approach of the transects

Three sites exceeded the threshold for temporary suspension of land use activities. Each full survey took approximately 2 hours to complete. We examined the time it took to reach the threshold of 25 caribou observed within the Zone of Influence that would trigger a temporary suspension of land use activities, using either an approach from the west (as was conducted) or a hypothetical approach from the east. As expected, all examinations resulted in reduced time to observe the threshold number of caribou for temporary suspension of activities (Table 2). Also as would be expected, surveys of sites with the greatest number of caribou reached the threshold faster than sites with fewer caribou. There was no clear advantage to approaching the survey from the west or the east, although one would assume that in general, approach from the side of the survey closest to the bulk of herd distribution would result in shorter time to reach the threshold.

Table 2. Time to complete full surveys, and time taken to survey until a minimum of 25 caribou were observed in the Zone of Influence while running transects from west to east (W-E) or from east to west (E-W).

Site no.	Caribou observed	Time to complete survey	Time to observe >25 caribou in ZOI: W-E	Time to observe >25 caribou in ZOI: E-W
3	216	2:01	1:15	0:46
5	1105	1:58	0:17	0:36
7	35	1:51	1:22	1:08

Survey design

Standard 5 km transects within 21 km radius: The 5 km-spaced transects provided even and equal coverage of both the Zone of Influence and Buffer Zone (Fig. 4, Sites 1–5). Eight transects bisected each survey area. These transects were straight forward to set up assuming familiarity with using a GPS, and were generally easy for a pilot to follow. The route to cover the transects was generally loaded into two portable GPS units, one for the navigator, and one for the pilot.

Daisy pattern within the 21 km radius: The daisy flight pattern was appealing as it provided comparatively higher coverage within the Zone of Influence and lower coverage within the Buffer Zone (Fig. 4, Site 4D). However, considerably greater effort was required for navigating, resulting in less focus looking for caribou, and slightly less

even coverage of the study area. Given the outline of the circle and a rough centre point, our first pilot was able to catch on to the pattern. However, our second pilot did not have his own portable GPS (the on-board GPS was rudimentary), the lack of which would have made navigating a daisy flight pattern more challenging. In addition, this flight pattern required more turns, which in some circumstances may increase the discomfort for passengers.

Standard 5 km transects within 20 km radius: For the last two sites we shortened the transects to remove 1 km inside the 21 km radius (Fig. 4, Sites 6, 7). This had the effect of concentrating the survey within the 21 km radius, rather than transiting between transects mostly on the edge or outside of the 21 km radius. Survey time was shortened by about 7 minutes.

Caribou sign

Caribou sign (tracks, craters, and beds) were recorded during survey of the first four sites. Caribou sign showed a much wider area of occupancy than did observations of animals (Fig. 6). However, it was difficult to estimate sign age, which appear to vary with light conditions and forest density (more open areas showed the effects of wind drift more than closed canopy stands). It is likely we were varying our recorded sign from a day or two to several weeks.

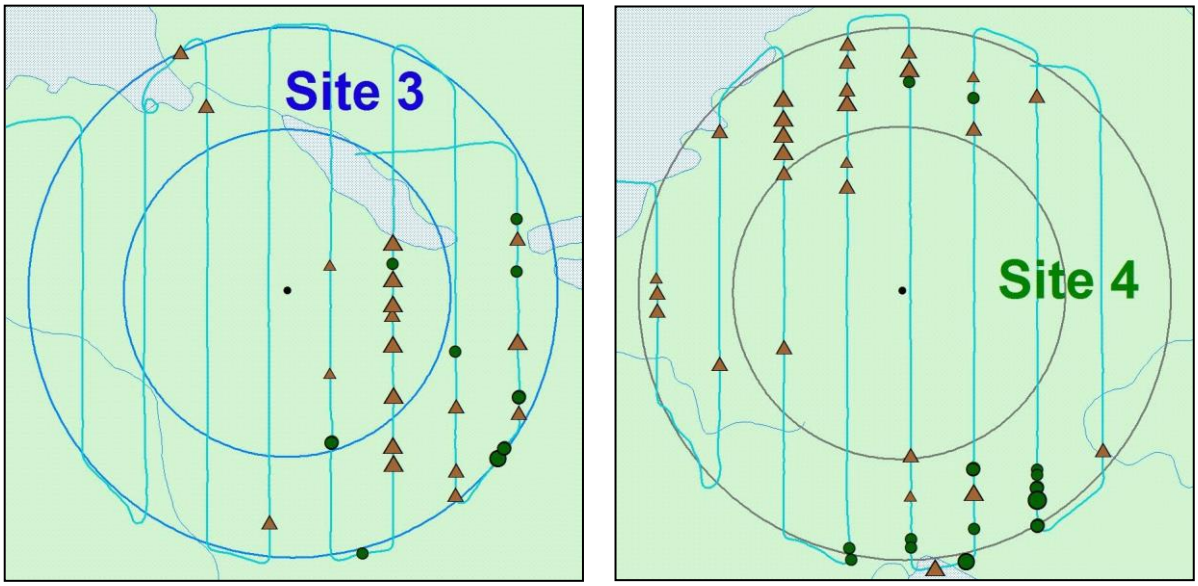

Figure 6. Caribou observed (scaled green dots) and tracks observed (scaled brown triangles) during surveys of Sites 3 and 4, March 2009.

Discussion

The Pilot Project revealed that the design of the Mobile Caribou Protection Measures for at least the late winter season is relatively efficient. The satellite-collared cow locations were, within the scale of our pilot project, relatively predictive of the overall numbers of caribou within the Buffer Zone and the Zone of Influence. However, the use of the collars alone without aerial surveys could result in either unnecessary restrictions or loss of protection for caribou.

The collars are predictive of regional, not site specific distribution at the scale of 10s of kilometres. Although the eight sites all had satellite-collared caribou within the Early Warning Zone, the aerial surveys showed that only three sites would have led to the temporary suspension of any exploration activities. The time to fly the Zone of Influence for each survey to reach the threshold of 25 caribou averaged about 50 min - the cost of each survey obviously depends on aircraft type and hourly rate but for this survey averaged $700 for a Cessna 206. It is the most efficient to fly the Zone of Influence at the same as the Buffer Zone as it reduces the number of turns.

The relative sizes (diameters) of the three zones were based on a balance between known rates of caribou movement in late winter, the need for repeated information (to verify caribou presence or absence) and survey costs (size of area).[3] We did not systematically compare the efficiency of different search patterns, but our experience does suggest that systematically spaced transects are the most straightforward design to implement for both pilots and observers. Not all pilots are equally versed in use of a GPS to fly complex search patterns, thus it is prudent to select a simple pattern that will effectively and systematically cover the study area.

The Pilot Project was effective at training DRRC observers and familiarizing the DDRC manager with the study design and rationale. However, despite the best intentions, few people in the community were available to participate in the test surveys. We did not feel that we were able to train anyone to the extent that they could yet run the project. To run the project, we suggest that someone should be readily available to free up the necessary time, and have familiarity with using GPS units to direct a pilot and record the track and observations. One possibility to help DRRC achieve the capacity to manage a Mobile Caribou Protection Measures Program is an interim step of greater involvement of ENR. We suggest that ENR as well as providing satellite collar locations, would work with the land use permit operator (e.g., exploration company) and DRRC to take the Land Use Permit site coordinates and draw up the transects for the Zone of Influence and Buffer Zone, and provide a GPS route that could be handed to a pilot if an aerial survey is necessary. ENR would also, after the survey, receive the track log (lines flown) and observations and produce them as a map to transmit to DRRC, the DIAND land use inspector, and the land use permit operator (Figure 7). (Once the

[3] [We wanted to compare the size of the Zone of Influence with the rate of the movements of the collared cows from the Bluenose East herd but we have not yet received the data from ENR; 24 April 2009]

permit site is known, ENR can build the zones and transects, in anticipation for any evaluation with collared animals, and thus respond rapidly if surveillance flights are needed).

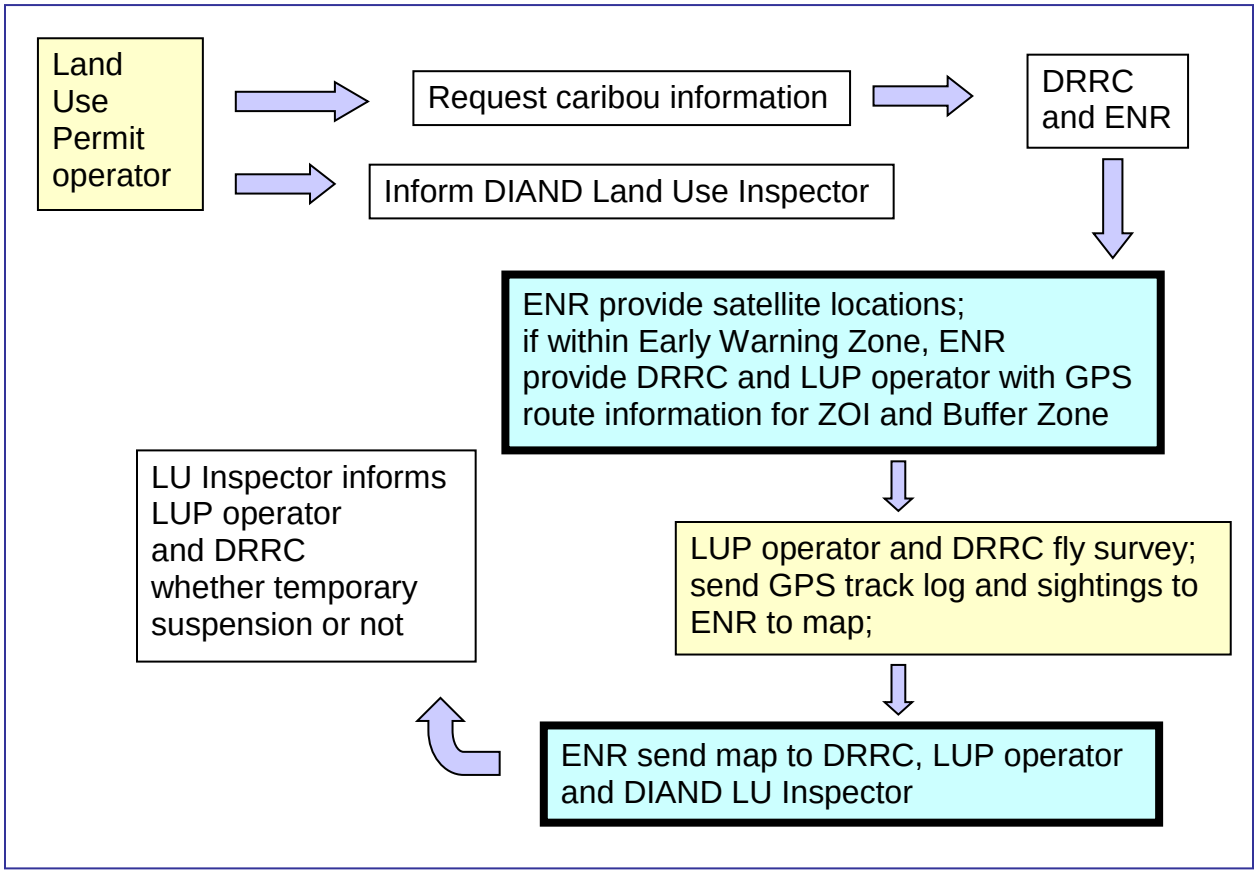

Figure 7. Suggested flowchart for implementation of Mobile Caribou Protection Measures.

Acknowledgements

We thank the elders of Déline for initiating the project and the members of the Working Group for their help in securing funds and support. We thank D. Livingstone (DIAND) for his efforts to ensure funding was available and Tom Nesbitt for support and encouragement. J. Blondin, N. Betsina, and D. Schear generously provided keen and attentive eyes during the survey. E. Reeves, DRRC, provided logistical and administrative support and we are grateful to his enthusiastic help. We thank P. Spencer, ENR, for providing caribou collar locations and a digital grid layer. B. Laye and P. Dzilums, North-Wright Airways, provided excellent piloting.

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Appendix 1. Data sheet used to test the MCPM.

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MCPM CARIBOU FIXED-WING SURVEY FORM

Aurora Wildlife Research, Nelson, BC

Date: _____ Site number: _____ Area: _____

Pilot: _____ Aircraft: _____ Navigator: _____ Observers: _____

Temp: _____ Cloud cover: _____ Wind: _____ Lighting: _____

Start time: _____ End time: _____ Elapsed time: _____

Obs #	Wpt #	On/Off Transect	Species	Side	Animals	Sign (trks, beds, craters) F, S, M	Comments, sex/age, photos

F, S, M = Few, Some, Many for relative sign