

Mobile Caribou Conservation Measures for the Kivalliq Region, Nunavut

Draft report for Kivalliq Inuit Association



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Executive Summary

Mobile caribou conservation measures are a flexible tool that can be used to reduce mining and exploration-related disturbance to caribou. Mobile measures ‘travel with’ the caribou, providing greater adaptability for protection and safeguarding caribou without unnecessary restrictions on land use activities. Here we propose Mobile Caribou Conservation Measures for use in the Kivalliq Region, Nunavut, to adaptively mitigate effects of industrial exploration on migratory barren-ground caribou. Mobile Caribou Conservation Measures, as have been called for in the past, link monitoring and site-specific mitigation with the susceptibility of caribou to disturbance, which varies seasonally. This seasonal variation in susceptibility coupled with period of exposure helps determine vulnerability and risk to caribou. For land and wildlife managers, understanding the likelihood of caribou encountering industrial exploration activities and experiencing negative effects from exposure to those activities is necessary to effectively manage disturbance to caribou without unnecessarily limiting economic development. The objectives of these proposed Mobile Caribou Conservation Measures are to reduce encounters and exposure of the caribou to disturbance and other impacts through avoiding and minimizing effects during industrial exploration activities. These proposed mobile measures can be implemented in concert with protected areas, and can also provide conservation of caribou regardless of distribution or season.

Mobile Caribou Conservation Measures are a rules-based approach with three main components:

- (i) Agreed-upon areas within which monitoring and mitigation is directed. These areas give predictability to the land-user and land-manager as to when caribou may encounter a site;
- (ii) When caribou actually encounter the site is determined through monitoring of distribution and movements to trigger the mitigation actions; and
- (iii) The mitigation actions that apply to the land use operation are to avoid or minimize (reduce) effects on caribou.

An outline to the development and application of these mobile Measures is:

1. Develop least risk timing windows for caribou based on seasonal difference in the predictability of caribou encounters, susceptibility and behaviour;
2. Identify seasonal Caribou Conservation Areas through collaborative mapping. These areas provide predictability as to where and when caribou are expected to occur;
3. Surveillance for caribou operates within three concentric zones, which are a hierarchy of increasing surveillance effort. The sizes of the zones are scaled to risk category as well as season, (speed and direction of movements vary seasonally);
4. Government and land use operator will establish monitoring and surveillance requirements for a proposed operation. The responsibility for monitoring will be with the operator. The monitoring may include aerial or ground-based (locally-hired) monitoring. The territorial government may provide caribou collar locations. The frequency of the monitoring influences the intensity of the mitigation – infrequent monitoring may require more intensive mitigation;

5. The mitigation thresholds or triggers will be based on season and area (susceptibility), and numbers and proximity of caribou to the operation, including monitoring thresholds for when mitigations will be stepped up or down;
6. Apply the hierarchy of mitigation — avoidance followed by minimization — to reduce encounters and exposure of caribou to operations to decrease sensory disturbance and risk of injury and death; and
7. The mobile Measures can be applied during all seasons, traditional migratory routes and water crossings.

List of acronyms

BQCMB	Beverly and Qamanirjuaq Caribou Management Board
CCA	Caribou Conservation Area
CPM	Caribou Protection Measures
DIAND	Department of Indian Affairs and Northern Development
DOE-GN	Department of Environment, Government of Nunavut
IQ	Inuit Qaujimajatuqangit
KivIA	Kivalliq Inuit Association
KRLUP	Keewatin Regional Land Use Plan
MCCM	Mobile Caribou Conservation Measures
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NIRB	Nunavut Impact Review Board
NLUP	Nunavut Land Use Plan
NPC	Nunavut Planning Commission
ZOI	Zone of Influence

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Introduction

Maintaining the integrity of seasonal migrations and habitat are an essential part of conserving migratory barren-ground caribou (*Rangifer tarandus groenlandicus*). Globally, many migratory mammals are struggling as agriculture and development encroach on their seasonal habitats and interrupt migration corridors (Berger 2004). For land and wildlife managers, understanding the likelihood of caribou encountering industrial exploration activities and experiencing negative effects from exposure to those activities is necessary to effectively conserve caribou without unnecessarily limiting economic development. It is also necessary to consider the susceptibility of caribou, which varies seasonally, during encounters and periods of exposure to exploration activities to determine the risk to caribou.

In this paper we propose Mobile Caribou Conservation Measures as a conservation tool to help protect caribou within the Kivalliq Region. We define Mobile Caribou Conservation Measures as those necessary to protect and minimize effects on caribou when exposed to human disturbance through linking monitoring with site-specific mitigation. We propose risk timing categories to identify when monitoring and mitigation should be intensified. The Mobile Caribou Conservation Measures detailed here provide examples of mitigation options, but recognizes that further operational details can be developed after collaborative refinements to the framework from industry, government, Elders, regional Inuit organizations, Hunters and Trappers Organizations and other interested parties. Mobile Caribou Conservation Measures have the advantage that they will accommodate trends in caribou distribution such as the change in size and location of fall and winter ranges as herd size changes. Additionally, the Mobile Measures accommodate unusual years; for example when the Qamanirjuaq herd calved outside the Caribou Protection Area after the unusual 2004–05 winter with severe icing in the fall, which influenced caribou movements and delaying some cows from reaching the calving ground (Gunn et al. 2007).

The Nunavut Planning Commission (NPC) has proposed a Draft Nunavut Land Use Plan (NLUP; NPC 2014) that provides categories of land designation, including a Protected Area Land Use Designation for core calving and post-calving habitat. The Mobile Caribou Conservation Measures proposed here are designed to conserve caribou use of seasonal ranges, whereas Protected Area designations can be used to conserve caribou habitat. Mobile Caribou Conservation Measures can work in concert with and provide additional buffer to Protected Areas, but can also provide conservation of caribou regardless of distribution or season.

Background

A key step in conserving migratory wildlife is to recognize which seasonal habitats and migratory corridors are important even if they are relatively small areas and/or occupied for a short time (Runge et al. 2014). Crucial habitats require special measures within an overall scheme of maintaining the integrity of all seasonal habitats. The susceptibility of caribou to disturbance seasonally changes depending on, for example, the presence of newborn calves, the degree of aggregation and dispersal, and other influences such as insect harassment (Table 1). Identifying the least-risk timing windows is used, for example, in northeastern British Columbia for managing development activities relative to caribou and

other wildlife (British Columbia Ministry of Environment 2009). Crucial and cautionary risk timing windows cover the time when a species is most susceptible to disturbance, and low risk timing windows are defined when species are less susceptible to disturbance.

Table 1. Summarizing seasons, risk category, timing, relative size and location predictability, and susceptibility of barren-ground caribou to disturbance based on life-history characteristics.

Season	Risk Category	Timing ¹	Relative size and location predictability	Caribou susceptibility and behaviour
<i>Spring migration/ pre-calving</i>	Cautionary	Apr - Jun	Narrow, predictable	Narrow corridors of cows often rapidly moving together with occasional staging in large aggregations
<i>Calving</i>	Crucial	May - Jun	Small area, predictable	High densities of cows at annually lowest part of condition cycle and with newborn calves so the cows are responsive to disturbances
<i>Post-calving/ insect season</i>	Crucial	Jun – Jul	Larger, less predictable	Cows and calves aggregating into large groups and calves susceptible to abandonment and loss from disturbance; aggregations susceptible to disturbance at traditional water crossings
<i>Summer/insect season</i>	Cautionary	Jul - Aug	Larger, less predictable	Cows and calves aggregating into large groups; aggregations susceptible to disturbance at traditional water crossings
<i>Fall migration/ pre-rut</i>	Cautionary	Aug - Sep	Larger, less predictable	Caribou often more dispersed and regaining body condition prior to breeding
<i>Rut</i>	Low	Oct	Smaller, less predictable	Caribou either migrating or staging
<i>Post-rut/fall migration</i>	Low	Nov - Dec	Larger, less predictable	Caribou either migrating or staging
<i>Winter</i>	Low	Dec - Apr	Larger, less predictable	Caribou in aggregations over a large area and less movement

¹ The actual dates differ among herds.

The crucial seasons for barren-ground caribou are calving and post-calving, and migratory pathways including water-crossings are also important. Calving grounds are the smallest seasonal ranges and are occupied by all the cows with their newborn calves of any one herd. During calving, caribou densities are high. Cows are initially dispersed and later start to aggregate into larger groups when the calves are a few days old. The locations of the calving grounds are mostly predictable and largely overlap between years. However, there are occasional larger-scale shifts (Nagy et al. 2011, Gunn et al. 2012) interspersed by decades of annually consistent use. Archaeological sites and knowledge of Inuit elders indicate that

many migratory pathways and summer water-crossings have persisted for 100s to 1000s of years (Gordon 2005).

In Nunavut, the protection of calving grounds and water-crossings for the Beverly and Qamanirjuaq herds go back to the 1970s when the people of Baker Lake took the government to court over industrial development. The result was DIAND's 1978 Caribou Protection Measures which are area-based measures applied seasonally to separate calving and post-calving caribou from land use activities. DIAND's Caribou Protection Measures have flexibility in that a land use inspector can designate areas that can be opened for land use activity if the caribou do not use the area, and provide protection for the caribou if they calve outside of normal calving areas because blasting, overflights and use of ATVs or snowmobiles are prohibited where caribou are located. The existing Caribou Protection Measures in the Keewatin Regional Land Use Plan (KRLUP) are based on those original Caribou Protection Measures.

Gunn et al. (2007) reviewed the 1978 Beverly and Qamanirjuaq Caribou Protection Measures and determined that, with few exceptions, they generally were effective in separating pre-calving, calving, and early post-calving (to 15 July) caribou from land use activities between 1980 and 2006. The original (DIAND) area-based measures were developed for cumulative calving grounds mapped over decades (within Caribou Protection Areas) for the Beverly and Qamanirjuaq herds. However, one problem is that any mapped protected areas have fixed boundaries which limit their protective role if caribou calve or use the area adjoining, such as if deep snow delays pre-calving migration or caribou altered their movement patterns as their abundance increases or decreases. The earlier DIAND Caribou Protection Measures relied on aerial surveys to map caribou distribution to determine if the boundaries were effective in protecting caribou, but due to the costs the surveys were halted in 1990 (Gunn et al. 2007). A second problem with fixed protected areas with limited monitoring was that large areas were seasonally closed to mineral exploration, which led to different opinions of how to protect caribou without unnecessarily constraining economic development. Wide-ranging consultations in 2000 led to proposed policies for management of human activities on caribou calving grounds (Weihs and Usher 2001). That report recommended an overall approach to managing human activities on caribou calving grounds, including land use planning, mobile caribou protection measures, and additional compliance and enforcement activities. However, the recommendations have not yet been implemented. Our approach to mobile measures addresses a portion of those recommendations.

Recently, the Government of Nunavut's Caribou Strategy Framework (Nunavut Department of Environment, undated) identified calving grounds as a sensitive habitat, and outlined seven action items, with a recommendation to develop and test mobile caribou protection measures based on satellite telemetry (e.g., short term area closures when caribou are in the vicinity) (Nunavut Department of Environment, undated, Action 3.2e). Similarly, the Beverly and Qamanirjuaq Caribou Management Board recommended in 2004 and again in 2014 that the Caribou Protection Measures be updated and improved to increase their effectiveness for protecting caribou, and that mobile caribou protection measures should be considered as part of a system of conservation measures that also includes prohibition of any new exploration and development activities and seasonal shutdown of ongoing exploration and mining activities on calving and post-calving areas (BQCMB 2004, 2014).

One of the original criticisms of the DIAND Caribou Protection Measures was that the Caribou Protection Areas were fixed, and given some mobility of calving and post-calving areas did not always afford effective protection from disturbance (Weihs and Usher 2001). Caribou in other seasons of the year, while not as susceptible as calving and post-calving cows and calves, also require protection to reduce disturbance and subsequent stress and energetic costs to individuals. However, mobile measures have not been yet formalized for caribou. A pilot project testing mobile measures was conducted on the winter range of the Bluenose-East herd in 2009 (Gunn and Poole 2009).

The Nunavut Planning Commission (NPC) proposed Draft Nunavut Land Use Plan (NLUP; NPC 2014) has two categories of land designation, a Protected Area Land Use Designation and a Special Management Area Land Use Designation (Fig. 1). The Protected Area Land Use Designation includes core caribou calving and post-calving areas that prohibits 'incompatible uses' (NPC 2014; Schedule A and Table 1 – Site # 47). Prohibited uses within Protected Areas 47 are mineral exploration and production; oil and gas exploration and production; quarries; hydro developments; all-weather roads; and related research. The Protected Areas include National Parks which provide permanent protection to caribou habitat as well as the caribou. In Nunavut, the Lorillard herd calves partially within Ukkusiksalik National Park (Campbell et al. 2012), established in 2003.

Adjacent to the Protected Areas 47 are Special Management Area Land Use Designations (NPC 2014; Schedule A and Table 1 – Site # 48). These areas include core caribou calving and post-calving areas which have been identified for high mineral potential (Fig. 1); it is not clear how protection for habitat will be addressed.

The Kivalliq Inuit Association (KivIA) has queried how the Draft Nunavut Land Use Plan will effectively deal with caribou management and issues at the community and regional scale of land use (KivIA 2013). Concerns include predicting future resource values and land use patterns overlap among proposed land use designations, overall balance among strict conservation areas, special management areas and the mixed use areas, and the balance between mineral exploration and mining as economic drivers, and caribou as a traditional food source.

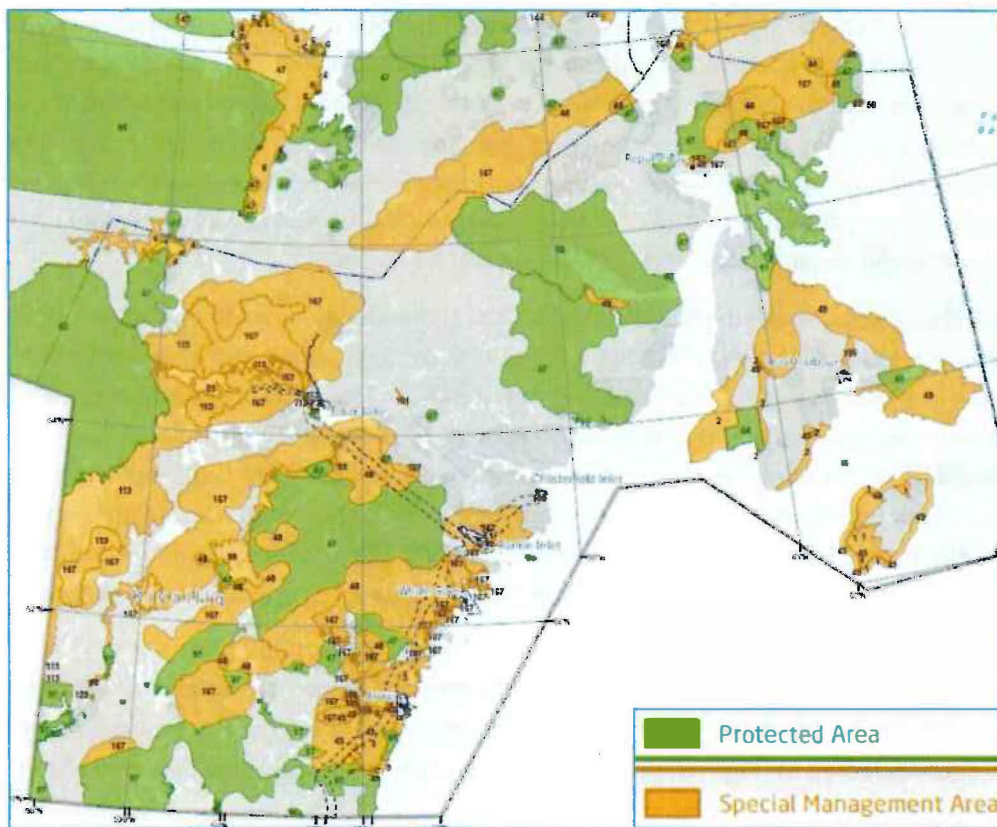


Figure 1. Kivalliq portion of draft Schedule A, Nunavut Land Use Plan Land Use Designations (NPC 2014). The protected areas includes calving and post-calving areas (designated as Site # 47) and Special Management Areas include core caribou calving and post-calving areas with high mineral potential (designated as Site # 48).

Given the previous suggestions of mobile protection measures and KivIA's concerns about safeguarding caribou and their habitat without unnecessarily restricting other land uses, our objective in this report is to propose **Mobile Caribou Conservation Measures** for the Kivalliq Region. Inuit have long had rules governing human behaviour to ensure respect for caribou, and our approach builds on that knowledge and respect.

We have used the term Mobile Caribou Conservation Measures to avoid confusion with the existing (DIAND) Caribou Protection Measures, as for example appended to the 2000 KRLUP (NPC 2000: Appendix H). We define Mobile Caribou Conservation Measures as those necessary to protect and minimize effects on caribou when exposed to industrial disturbance through linking monitoring with site-specific mitigation. We suggest these Measures are more conservative than the Caribou Protection Measures, as measures are not just applied to designated areas, but would, for example, follow with the caribou and provide protection for caribou outside of designated Protected or Special Management areas. We explain the background and how the Measures would provide for the collaborative conservation of caribou as well as flexibility to land-users. At this stage in discussions, the framework

and examples presented here are not yet an operations manual for in the field. An operations manual is a subsequent step after collaborative refinements to the framework.

The current approaches to managing industrial activity interaction with caribou attempt to spatially and temporally separating caribou and industrial activities. The emphasis of this management directive is on separating industrial exploration from calving and post-calving caribou, which are crucial time periods and places. At the highest level of protection, calving areas are designated as closed to both exploration and development activity, and protection of the habitat is year-round; an example would be Ukkusiksalik National Park. The second level of protection is similar in that there is a protected area but the restrictions are seasonal. The effect is seasonal separation of calving, but from industrial exploration only (thus habitat is not protected) and the question of development is not explicitly addressed. This approach is exemplified by DIAND's Caribou Protection Measures. The third level which is proposed here is that the measures 'travel' with the caribou rather being applied to a fixed area. In this case, even if deep snow delayed pre-calving migration, the calving cows would still be protected even if they did not reach their usual calving ground. These measures would also apply to other seasons outside of the pre-calving to post-calving period.

Mobile caribou conservation measures are a tool to separate exploration activities from caribou based on rules for the conduct of industrial activities that land managers can incorporate into a land use permit or other land use activities that may cause disturbance to caribou. Caribou vulnerability varies seasonally (Table 1); cows and calves often react more strongly and are more vulnerable during pre-calving, calving and post-calving or at water-crossings (Williams and Gunn 1982, Murphy and Curatolo 1987, Wolfe et al. 2000, Taillon et al. 2012). Similarly, as summers become warmer over years as a result of climate change and insect harassment increases, minimizing disturbance to caribou as they forage prior to the rut will become more important as caribou need uninterrupted foraging to compensate for lost foraging time during periods of insect harassment.

Proposed Mobile Caribou Conservation Measures for the Kivalliq Region

Mobile Caribou Conservation Measures for the Kivalliq Region can be used to adaptively mitigate effects of industrial exploration on migratory barren-ground caribou. Mobile Caribou Conservation Measures, as have been called for in the past, link monitoring and site-specific mitigation with the susceptibility of caribou to disturbance, which varies seasonally. This seasonal variation in susceptibility coupled with period of exposure helps determine risk to caribou. For land and wildlife managers, understanding the likelihood of caribou encountering industrial exploration activities and experiencing negative effects from exposure to those activities is necessary to effectively conserve caribou without unnecessarily limiting economic development. The objectives of Mobile Caribou Conservation Measures are to reduce encounters and exposure of the caribou to disturbance and other impacts during industrial exploration activities through avoiding and minimizing effects.

Most of the focus of minimizing disturbance is on industry, rather than considering how tourism or hunting (or scientific research) may be a disturbance (e.g., Golder 2014). In Norway, recreational tourism is an additional concern for wild reindeer (Nellemann et al. 2010). Our focus is industry-based activities such as when caribou are in the proximity of mineral or oil and gas exploration activities which may be fixed sites (e.g., a drill camp with aerial support), or a larger area (e.g., airborne geophysical survey). These Measures are intended to be applied as conditions of land use permits, and can also be adapted to exploration activities within caribou range that may not have triggered the requirement for a land use permit.

Mobile Caribou Conservation Measures have three main components:

- (i) Agreed-upon areas within which monitoring and mitigation is directed. These areas give predictability to the land-user and land-manager as to when caribou may encounter a site;
- (ii) When caribou actually encounter the site is determined through monitoring of distribution and movements to trigger the mitigation actions; and
- (iii) The mitigation actions that apply to the land use operation to avoid and minimize (reduce) effects on caribou.

The broad sequence of steps needed to develop and conduct Mobile Caribou Conservation Measures is listed below, with details provided in the following sections.

1. Develop least risk timing windows for caribou based on seasonal difference in the predictability of caribou encounters, susceptibility and behaviour;
2. Identify seasonal Caribou Conservation Areas through collaborative mapping. These areas provide predictability as to where and when caribou are expected to occur;
3. Surveillance for caribou operates within three concentric zones, which are a hierarchy of increasing surveillance effort. The sizes of the zones are scaled to risk category as well as season, (speed and direction of movements vary seasonally);
4. Government and land use operator will establish monitoring and surveillance requirements for a proposed operation. The responsibility for monitoring will be with the operator. The monitoring may include aerial or ground-based (locally-hired) monitoring. The territorial government may provide caribou collar locations. The frequency of the monitoring influences the intensity of the mitigation — infrequent monitoring may require more intensive mitigation;
5. The mitigation thresholds or triggers will be based on season and area (susceptibility), and numbers and proximity of caribou to the operation, including monitoring thresholds for when mitigations will be stepped up or down;
6. Apply the hierarchy of mitigation — avoidance followed by minimization — to reduce encounters and exposure of caribou to operations to decrease sensory disturbance and risk of injury and death; and
7. The mobile Measures can be applied during all seasons, traditional migratory routes and water crossings.

Caribou Conservation Areas

The proposed Mobile Caribou Conservation Measures for the Kivalliq Region require designation of seasonal **Caribou Conservation Areas** (CCAs) through mapping both Inuit Qaujimajatuqangit (IQ) and scientific data to the annual range of the caribou herds. These Caribou Conservation Areas will identify seasons and areas where caribou are likely to occur, thus providing a degree of predictability to both operators and regulators. We acknowledge that past movements and distribution do not necessarily predict future movements and distribution; however, mobile measures can address unexpected caribou distribution. The Mobile Caribou Conservation Measures can be used to provide buffers to Protected Areas as proposed in the draft Nunavut Land Use Plan (NPC 2014). Some of these seasonal Caribou Conservation Areas will overlap with Special Management Area Land Use Designations from the draft Nunavut Land Use Plan (NPC 2014).

The intensities and types of monitoring and mitigation will differ among the various seasonal Conservation Areas based on differences in caribou susceptibility, sensitivity and behaviour. For example, herds with larger annual ranges generally have higher rates of movements (Table 2). Mapping of seasonal Conservation Areas must be collaborative, use all information available, and be transparent; scientific and IQ data, methodology and analyses used in map production must be clearly described. Analyses of prior information on caribou distribution will estimate both annual variation and the change in distribution as abundance changes; updating seasonal Conservation Areas on a 3-year (as recommended in Taillon et al. 2012) or 5-year interval (similar to recommendations in Gunn et al. 2007) may be appropriate to capture broad changes in seasonal ranges and migration corridors, and to ensure that caribou are protected while land use activities are not unduly restrained. The Caribou Conservation Areas will be compatible with the NPC's draft land-use maps, but will have a broad information basis beyond satellite telemetry of caribou cows.

On post-calving, summer and fall ranges, caribou swim or wade across lake narrows and rivers at traditional water crossing sites (Williams and Gunn 1982). "Designated" water crossings were mapped within the Caribou Protection Map within the original DIAND Caribou Protection Measures. Water crossings were further mapped in the early 1980s (Williams and Gunn 1982) and through the Nunavut Atlas (Riewe 1992), and updated information is available from scientific and IQ reports and environmental assessments such as for AREVA (AREVA 2014a). The list of "designated" water crossings should be updated by the territorial government or regional Inuit organization; regional Inuit organizations and Hunters and Trappers Organizations should be consulted to develop current and updated maps of traditional ("designated") caribou water crossings.

Table 2. Daily movement rates (km/day (\pm SD)) by activity period for four caribou herds within the Kivalliq Region based on satellite telemetry of cows 1993–2009 (Nagy 2011). These seasons are provided as an example from the literature; further analysis is needed to amalgamate seasons that will be practical for mobile measures monitoring and mitigation.

Activity period	Beverly/Ahiak	Qamanirjuaq	Lorillard	Wager Bay
<i>Calving</i>	7 \pm 7.0	9 \pm 10.0	4 \pm 5.2	6 \pm 12.5
<i>Post-calving</i>	13 \pm 8.1	15 \pm 13.0	12 \pm 12.3	4 \pm 5.4
<i>Early summer</i>	23 \pm 12	28 \pm 21.8		
<i>Mid-summer</i>	14 \pm 10.3	18 \pm 18.7		
<i>Late summer</i>	7 \pm 5.5	10 \pm 11.5	5 \pm 7.9	3 \pm 4.2
<i>Fall, pre-breeding</i>	12 \pm 8.4	14 \pm 12.9	15 \pm 14.9	17 \pm 18.6
<i>Breeding</i>	12 \pm 8.1	16 \pm 14.8	18 \pm 18.3	27 \pm 19.5
<i>Post-breeding, late fall</i>	9 \pm 10.5	14 \pm 14.2	12 \pm 10.7	10 \pm 9.5
<i>Early winter</i>	5 \pm 4.9	8 \pm 10.2	5 \pm 5.2	4 \pm 6.1
<i>Mid-winter</i>	4 \pm 3.5	5 \pm 7.8		
<i>Late winter</i>	3 \pm 3.5	4 \pm 5.8	6 \pm 8.5	9 \pm 10.3
<i>Spring migration</i>	13 \pm 10.7	12 \pm 14.2		

Monitoring

Monitoring is an essential component of Mobile Caribou Conservation Measures (Weihs and Usher 2001), and is required both to know when the caribou are in the proximity of industrial activity (to trigger mitigation) and also to determine if mitigation is effective. Local knowledge (IQ, elder's knowledge), caribou trails, archaeological information and scientific information (aerial- and ground-based surveys, collar data) are required to determine the likelihood that caribou will be seasonally present, which provides relative certainty to the land-use activity that they will have to implement the mitigation measures. The mitigation measures will need to be more protective when monitoring is minimal or absent and uncertainty about caribou distribution is high.

The monitoring objective for the Mobile Caribou Conservation Measures is achieved through surveillance around an exploration site. While collared caribou may provide the first level of monitoring, the land use permit operator would be responsible for conducting and financing local monitoring. If there are caribou in the vicinity, the land use permit operator cannot open the camp. If the camp is in operation and there are caribou in the vicinity, the land use permit operator will modify or suspend exploration activities, or remove camp personnel, which will reduce disturbance and impose spatial separation between industrial exploration activities and caribou. If no information on caribou

distribution is collected or available close to the exploration site (see below), then the site cannot be released for activity during the season of likely caribou distribution.

The Mobile Caribou Conservation Measures operate with three concentric zones, as a hierarchy of increasing surveillance effort (Fig. 2). An outer 'Early Warning Zone' relates to the presence or absence of collared caribou, or an estimated likelihood of caribou presence based on local or scientific knowledge. The size of the Early Warning Zone is scaled to the caribou season as movement rates and directionality varies seasonally (Tables 1, 2). For example, a smaller Early Warning Zone is used during winter when movement rates are generally lower and less directional. A larger Early Warning Zone is used during spring migration/pre-calving when distances moved are generally larger and more directional.

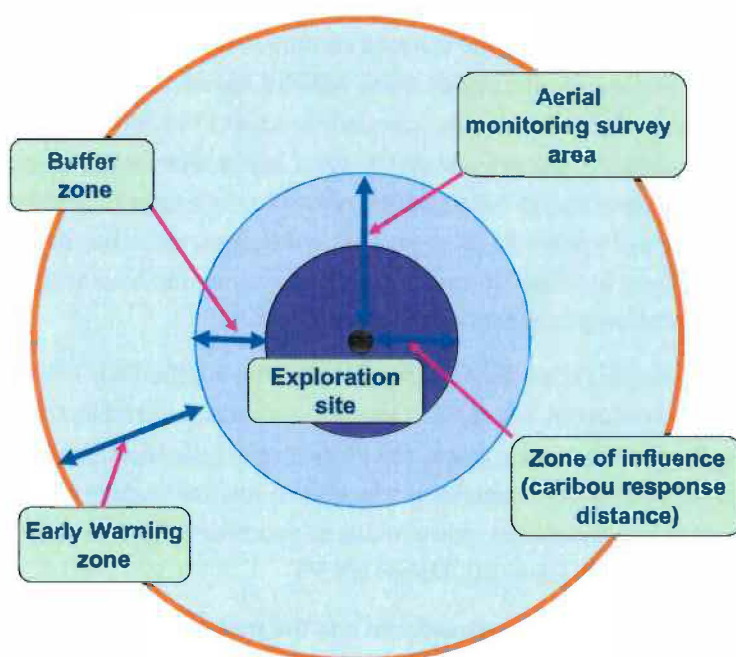


Figure 2. Schematic relationship between an exploration site, Zone of Influence, Buffer Zone, Early Warning Zone, and monitoring survey area.

Inside the Early Warning Zone, a 'Buffer Zone' is where aerial surveys, collared caribou or possibly ground surveillance 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 Zone of Influence is the area around a site of human activity where the behaviour and relative abundance of caribou may change in response to the site and its associated activities. The zone of influence for caribou around large-scale and operational diamond mines in the Northwest Territories has been estimated at 14 km (Boulanger et al. 2012). While the zone of influence for different types of exploration camps and activities have not been measured, a conventional extent for exploration sites is 5 km as applied in cumulative effects assessments (e.g., DDEC 2014).

The presence of caribou in the Buffer Zone would indicate to the exploration manager and the land use inspector of a potential requirement for mitigation should caribou enter the Zone of Influence. The presence of caribou within the Zone of Influence would initiate mitigation, ranging from altered or reduced activity to a temporary suspension of exploration activities and other mitigation methods to protect the caribou. The timing and number of caribou in the Zone of Influence would trigger increased or reduced mitigation for the site.

The size of the zones would be previously agreed upon between the land manager and the project operator prior to permitting, and determined from rules based on the season and daily rates of movements from satellite-collared caribou (Table 2). Suggested seasons and distances are provided in Table 3 to give an idea of relative areas among risk categories, acknowledging that there are different ways of defining and amalgamating seasons and that further analysis and discussion may be required to define seasons that are workable for mobile measures. During a pilot project in the Sahtu in April 2009 (Gunn and Poole 2009), the threshold was one collared caribou in the Early Warning Zone which was the trigger for an aerial survey. For the Kivalliq region there will also have to be a threshold for incidental sightings such as during supply flights to a camp, especially in areas of caribou distribution where the number of collars is low relative to herd size and distribution. In the late winter Sahtu pilot project, 50 caribou spotted in the Buffer Zone would have justified notice to the exploration manager and the land use inspector of the possibility of enhanced mitigation should caribou enter the Zone of Influence, and 25 caribou observed in the Zone of Influence from an aerial survey would have triggered modification or suspension of mineral exploration activities (Gunn and Poole 2009).

Although the use of satellite collars contributes to monitoring, this method has limitations that include location upload timing (how frequently the caribou locations are summarized by the satellites) and frequency (how often collar locations are transmitted to the project manager; generally the Government of Nunavut Department of Environment supplies the locations) relative to daily movement distances, availability of and access to the information, and variable support for collaring within communities (e.g., AREVA Kiggavik final hearings, Baker Lake, NU, March 2015¹).

Frequently, only adult cows in some herds are collared and the number of collars is few relative to the size of the herd, which raises a question of how well the satellite-collared caribou represent the entire herd's distribution. In the Sahtu project, collars were relatively predictive of caribou numbers within the inner zones (Gunn and Poole 2009) but this was in late winter when daily movement rates are low. The collar locations reveal where caribou are, but the absence of collared caribou does not necessarily reveal the absence of caribou. Experience at diamond mines in the Northwest Territories found that the incidental and remote camera sightings did not correlate with the encounter rates of collared caribou (Jay Project Developer's Assessment Report, Information Request Responses²). This suggests that at

¹ <ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/09MN003-AREVA%20KIGGAVIK/2-REVIEW/10-FINAL%20HEARING/08-TRANSCRIPTS/>

² DAR-MVEIRB-IR2-08; http://www.reviewboard.ca/upload/project_document/EA1314-01_ORS_Review_comment_table_IR2_and_Response.PDF

Table 3. Season, risk category, and suggested zone sizes and thresholds of caribou numbers counted in the Early Warning Zone, Buffer Zone, and Zone of Influence (ZOI) to trigger corresponding mitigation actions. Analysis of movement rates and local input are needed to refine the dates and number of seasons.

Season	Risk category	Timing ¹	Suggested zone radii (km)			Threshold number of adult caribou ²			Mitigation actions if thresholds passed in ZOI ⁴
			Early Warning Zone	Buffer Zone	ZOI	Early Warning Zone ³	Buffer Zone	ZOI ⁴	
<i>Spring migration/pre-calving</i>	Cautionary	Apr - Jun	50	20	15	5/25	50	25/50	Suspend flights and ground operations within 36 hrs/ Close camp within 48 hrs
<i>Calving</i>	Crucial	May - Jun	50	15	10	1/10	20	5/10	Suspend flights and ground operations within 24 hrs/ Close camp within 24 hrs
<i>Post-calving/insect season</i>	Crucial	Jun - Jul	50	15	10	1/10	20	5/10	Suspend flights and ground operations within 24 hrs/ Close camp within 24 hrs
<i>Summer/insect season</i>	Cautionary	Jul - Aug	30	15	10	5/25	50	10/25	Suspend flights and ground operations within 36 hrs/ Close camp within 48 hrs
<i>Fall migration/pre-rut</i>	Cautionary	Aug - Sep	30	10	10	5/25	50	10/25	Suspend flights and ground operations within 36 hrs/ Close camp within 48 hrs
<i>Rut</i>	Low	Oct	30	10	5	5/50	100	25/50	Reduce above-ground operations within 48 hrs/ Suspend above-ground operations within 72 hrs
<i>Post rut/fall migration</i>	Low	Nov - Dec	50	15	10	5/50	100	25/50	Reduce above-ground operations within 48 hrs/ Suspend above-ground operations within 72 hrs
<i>Winter</i>	Low	Dec - Apr	30	10	5	5/50	100	25/50	Reduce above-ground operations within 48 hrs/ Suspend above-ground operations within 72 hrs

¹ The actual dates differ among herds.

² Proposed numbers based on differences in relative risk during each season. Caribou thresholds (generally collared individuals or incidental sightings) within the Early Warning Zone would trigger surveys within the Buffer Zone and Zone of Influence. Caribou thresholds (generally from aerial surveys) in the Buffer Zone would justify notice to the exploration manager and the land use inspector of a potential suspension should caribou enter the Zone of Influence.

³ xx/yy represent number of collared/observed caribou within the Early Warning Zone.

⁴ xx/yy represent thresholds of number of collared/observed caribou to trigger main sets of mitigation responses.

most sites supplementary information will be required, such as aerial and/or ground monitoring of caribou distribution.

The Government of Nunavut has raised concerns about aerial surveys disturbing caribou and has consequently placed greater emphasis on using collars, mostly deployed on mature cows (e.g., Golder 2014:8). Although concerns must be balanced between potential disturbance resulting from collars or aerial surveys, well-designed aerial surveys provide accurate and instantaneous monitoring of distribution of all sex and age classes of caribou within a study area (as opposed to the distribution of selected collared individuals), as well as allowing mapping of track frequency and direction in winter, and can be conducted in ways to minimize potential disturbance. Aerial surveys to monitor caribou distribution could be flown at higher altitudes (perhaps 300 m agl) than normally used for population census counts (125 m agl) as an accurate count of individuals is not required. Responses to both fixed-wing and rotary-wing aircraft are less at higher flight altitudes of 300–400 m agl (Wolfe et al. 2000). Helicopters are often available but are noisier and at lower altitudes often cause greater reactions in caribou than fixed-wing aircraft (Wolfe et al. 2000). Reductions in noise production should be considered during selection of survey aircraft.

Technology is advancing such that use of remote drones may become feasible to monitor caribou. Drones have been tested in relation to mining projects in several areas of the Arctic (H. O’Keefe, Dominion Diamond Ekati Corp., pers. comm.), and have been used in other open habitats (e.g., Koh and Wich 2012, Hodgson et al. 2013). While there will be development costs and effort (as well as issues with permitting), over the long term proponents may realize significant cost savings using drones, and greatly reduce or eliminate concerns over disturbance of caribou from aircraft.

Ground surveillance may be feasible in some situations. Height-of-land surveys (essentially scanning from hilltops) can detect approaching caribou at some distances, although the scale needed for use with mobile Measures may not be adequate. Snowmobile surveys can provide good coverage and detect both tracks and animals, but bring their own issues with disturbance (Wolfe et al. 2000). As far as is practical, the coverage of the zones should be systematic and the intensity of coverage would reflect the risk category, with higher coverage in higher risk categories. For example, coverage within zones would be a minimum of 30% for crucial; 20% for cautionary and 8–10% for low risk categories. Approximately 8–10% represents reconnaissance survey coverage, while approximately 30% coverage has been used for visual estimates during calving ground surveys (Campbell et al. 2010, Poole et al. 2014).

The effectiveness of collared caribou to trigger mobile measures was tested in the Sahtu for the winter range only and found to be relatively efficient when combined with aerial surveys (Gunn and Poole 2009). The satellite-collared cow locations were, within the scale of the 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. Collars generally are predictive of regional, not site specific distribution at the scale of 10s of kilometres. Although all eight sites in the Sahtu pilot project had satellite-collared caribou within the Early Warning Zone, the aerial surveys showed that only three sites would have had enough caribou for temporary suspension of any exploration activities (Gunn and Poole 2009).

For the Mobile Measures the thresholds of caribou numbers in the Early Warning and Buffer zones would depend on the risk category (crucial, cautionary or low). The thresholds would change with caribou season and movement rates for the herd in that particular area (Table 2 provided as an example from the literature) and be higher, for example, when movement rates are low. But this would be offset by the need for more stringent thresholds (lower numbers of caribou) during the crucial risk windows of calving and post-calving (~mid-May – mid-July) (Table 3). The number of collared or observed caribou within the Early Warning Zone would be used to trigger aerial surveys of the two inner Buffer and Influence zones. Thresholds of the number of caribou observed within the Zone of Influence would trigger mitigation actions (Fig. 3).

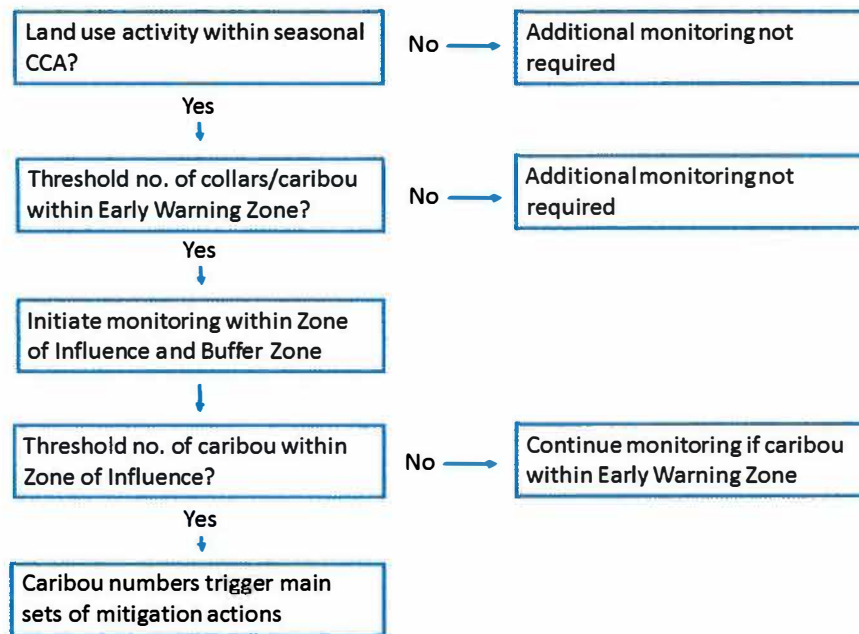


Figure 3. Monitoring and mitigation decision tree for Mobile Caribou Conservation Measures.

Operating conditions would be applied to seasonal Caribou Conservation Areas during specific seasons according to risk categories. Outside of these seasons the area would be open to exploration, recognizing that project operations may be reduced, suspended or prohibited when caribou are present.

Mitigation

Mobile Caribou Conservation Measures will reduce encounters and exposure of caribou to exploration camps, aircraft, roads, and related activities through avoiding and minimizing impacts. Although the hierarchy of mitigation is to avoid, minimize, rehabilitate, and offset (compensatory mitigation) (Jakle 2012, BBOP 2015), we have not included rehabilitation or restoration of sites and structures, as we assume the land use permits associated with exploration will include clauses to rehabilitate areas disturbed by exploration activities. We also have not addressed offsetting in mitigation options, as currently residual effects of development are not measured at the exploration stage (BBOP 2015).

In the following sections, we give examples of mitigation options, but recognize that further operational details will depend on a collaborative approach among industry, government, regional Inuit organizations and wildlife boards, Hunters and Trappers Organizations and other interested parties. It is important to be aware of industrial exploration practices and flexibility when designing mitigation effective for caribou. Generally, the first steps are to reduce then halt movement of vehicles and aircraft operations. The next step is to halt operations involving people moving around such as drilling and trenching, and camp operations. Removing camps or people would be used in some situations, but may involve more disturbance than simply suspending activities. Thus our proposed mitigations depend on risk timing (season, Table 1), with faster application and lower thresholds to trigger mitigations during higher risk seasons. For example, during calving fewer collars or individuals will trigger mitigation that will need to be conducted within a shorter time period.

Avoidance

Exploration sites

The first category of mitigation is *avoiding* effects through area and season-based measures such as reducing the size of the exploration footprint, and avoiding construction of structures and operational activities in certain seasonal ranges at certain times. The Mobile Measures would enable flexibility by allowing opening of exploration camps if caribou are not in the vicinity within a seasonal Conservation Area. However, exploration camps may not be activated or will be de-activated during a particular season if the thresholds for caribou numbers in the Zone of Influence are exceeded. The strongest avoidance is to not open the camp until the high-risk season, such as calving or post-calving, is finished and caribou are not present. The next levels of action taken to avoid effects on caribou from sensory disturbance are to eliminate movement of vehicles, aircraft, and other above-ground activities, and then to suspend camp operations (remove people and ensure that machinery is not operating beyond care and maintenance).

Water crossings

Caribou may abandon or postpone water crossings in response to disturbance (summarized in Williams and Gunn 1982; Baker Lake HTO 2015). Although Inuit have hunted caribou at water-crossings, they also have gone to considerable lengths to avoid disturbing caribou (Baker Lake HTO 2015). Based on interviews in the Baker Lake area in the late 1970s, recommendations were developed to prohibit exploration activity with 4.8 km (3 miles) of major water crossings (summarized in Gunn et al. 2007). The

Baker Lake HTO have recently recommended a 25 km buffer of no mining or exploration activity around water crossings (Baker Lake HTO 2015). We suggest that monitoring within wider Early Warning and Buffer zones would provide sufficient time to reduce exploration activity and eliminate sensory disturbance within 10 km of water crossings. Given the vulnerability of caribou at water-crossings and typically a rapid approach, the Early Warning Zone, Buffer Zone and Zone of Influence would be relatively large, such as a 25 km, 15 km, and 10 km, respectively. Mitigation to avoid altering migration patterns and fragmenting use of caribou seasonal ranges would include not constructing camps or permanent structures or caching fuel, or blasting conducted within 10 km of designated water-crossings between 15 May and 1 September, and not permitting exploration activities within 5 km of water-crossings between 15 May and 1 September. These are the same guidelines as the original DIAND Caribou Protection Measures, where “designated” crossings were mapped within the Caribou Protection Map; our Zone of Influence guidelines for water crossings matches the larger DIAND distance.

Minimization

The second broad category of mitigation of exploration is *minimizing* effects, with the intensification of the mitigation intended to reduce the frequency and duration of encounters and the exposure of caribou to exploration activities within Caribou Conservation Areas.

Sensory disturbance

To minimize effects on caribou movement and behaviour, mitigation is required to reduce the behavioural responses to an exploration site, structures and activities. Those activities can cause caribou to alter their behaviour and movements. Increases in walking or running and decreases in foraging have energetic costs which can accumulate to reduce the chance of a cow having enough body fat to become pregnant and to reduce calf survival:

- To minimize behavioural responses, direct movement of equipment and people toward caribou will be avoided;
- Vehicles including all-terrain vehicles and snow machines should neither approach caribou nor stop within the sight of caribou;
- Aircraft and helicopter flights over the pre-calving, calving and post-calving Caribou Conservation Area and near identified caribou water crossings when sites are active should be at least 610 m above ground level and avoid areas of known caribou concentrations when possible (subject to pilot discretion regarding aircraft and human safety) (e.g., AREVA 2014b). Outside of these seasons, lower altitudes, such as 300 m above ground level, could be imposed.

Non-vehicle mortality

Injury and mortalities to caribou can occur that are not related to vehicle movement. Examples include entanglement in fencing or wires, or hazardous terrain within the project footprint. Operators should ensure that best management practises are followed to minimize injury and mortalities (e.g., AREVA 2014b, Golder 2014). Minimizing caribou deaths includes ensuring that waste management reduces attractions to predators and that no feeding of wildlife and no-dog rules are strictly enforced. Any fences to exclude wildlife have to be maintained at sufficient tension to reduce chance entanglements with antlered caribou. The fences have to be constructed to allow escape routes as experience at other mines

is that wolves take advantage of structures such as fences or berms to ambush caribou. Wires used in seismic programs must also be picked up to reduce entanglement.

Mortality from vehicle collisions

Exploration roads are typically winter roads. Mitigation measures are designed to minimize caribou mortality from collisions (as well as reduce deflections on roads) such that drivers understand when and how they may encounter caribou on roads and what actions they take.

Mitigation from the vehicle driver's perspective:

- Provide caribou awareness training;
- Establish the predictability of encounters by zoning sections of any roads as low, moderate or high probability of caribou encounters based on available scientific and IQ data; this is more applicable to any permanent roads more so than winter roads.
- Design and modify road configuration to maximize sightlines for drivers and avoid blind spots (corners and steep berms onto the road surface);
- Set speed limits, use signage for known caribou crossings and always provide wildlife the right-of-way;
- Use driver-to-driver radio for updating information to drivers;
- Provide drivers with a set of pre-designed measures to implement including reduced speed or waiting at designated areas to allow caribou on or near the road to leave. These measures would include education about typical caribou behaviour on a road and crossing a road, including the tendency to move parallel to vehicles or cut across, and the reluctance of caribou to leave a hard packed surface;
- Managing snow clearing and height of snow berms so that they do not restrict vision for drivers and caribou to see each other; and
- During snow-clearing ensure that snow banks are maintained at less than 1 m (and preferably at less than 0.5 m based on research at the Ekati diamond mine; Rescan 2011) and are broken into sections with plowed out gaps so caribou are not 'trapped' on the roadbed.

Concluding comments

The proposed Mobile Caribou Conservation Measures offer considerable benefits to land users through their flexibility and through adding predictable rules for land use operations. However, the flexibility for land-users requires a commitment to monitoring and for land managers to have follow-up and enforcement capabilities. We also recommend that the Mobile Caribou Conservation Measures have annual reporting requirements to land and wildlife managers. The reports should ensure that details of monitoring, caribou numbers detected, and any land use decisions are documented.

The Mobile Caribou Conservation Measures can be conditions applied in federal land use permits and Inuit land use licenses to conserve caribou use of seasonal ranges, whereas protected area designations or conditions applied in permits and Inuit land use licenses can be used to conserve caribou habitat. The Mobile Caribou Conservation Measures are an example of adaptive management through monitoring relative to thresholds and subsequent actions. Experience with Mobile Caribou Conservation Measures

will also contribute to monitoring and mitigation as practiced at industrial developments such as mines and all-season roads. Conducting monitoring (surveys, whether aerial or ground based, and telemetry) relative to thresholds trigger enhanced or reduced intensity of mitigation, for example, in the Caribou Roads Mitigation Plan (CRMP) for the proposed Dominion Diamond's Jay project³. Proposed developments, primarily mineral developments and all-season roads, are subject to environmental assessment within the Nunavut Impact Review Board (NIRB) and Mackenzie Valley Environmental Impact Review Board (MVEIRB) processes within Nunavut and the NWT, respectively, and have associated detailed and comprehensive management and monitoring plans developed (e.g., Golder 2014; Dominion Diamond CRMP, cited above).

Summary of recommendations

1. Mapping of seasonal Caribou Conservation Areas must use all valid forms of information and be transparent; scientific and IQ data, and methodology and analyses used in map production must be clear. Updating seasonal Caribou Conservation Areas on a 5-year interval may be appropriate.
2. Analyses and inclusion of local knowledge are needed to refine the dates and number of seasons.
3. The list of "designated" water crossings should be updated by the territorial government or regional Inuit organization; regional Inuit organizations and Hunters and Trappers Organizations should be consulted to develop current and updated maps of traditional ("designated") caribou water crossings.
4. Aerial surveys to monitor caribou distribution could be flown at higher altitudes (perhaps 300 m agl) than normally used for population census counts (125 m agl) as an accurate count of individuals is not required.
5. Reductions in noise production should be considered during selection of survey aircraft.
6. Use of remote drones for monitoring should be further explored; over the long term proponents may realize significant cost savings using drones, and greatly reduce or eliminate concerns over disturbance of caribou from aircraft.
7. For monitoring, the coverage of the survey zones should be systematic and the intensity of coverage would reflect the risk category, with higher coverage in higher risk categories. For example, coverage within zones could be 30% for crucial; 20% for cautionary and 8–10% for low risk categories.
8. Examples of mitigation recommendations are provided in the appropriate sections.

³ http://www.reviewboard.ca/upload/project_document/EA1314-01_Jay_Project_WEMP_and_CRMP_July_31__2015.PDF

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