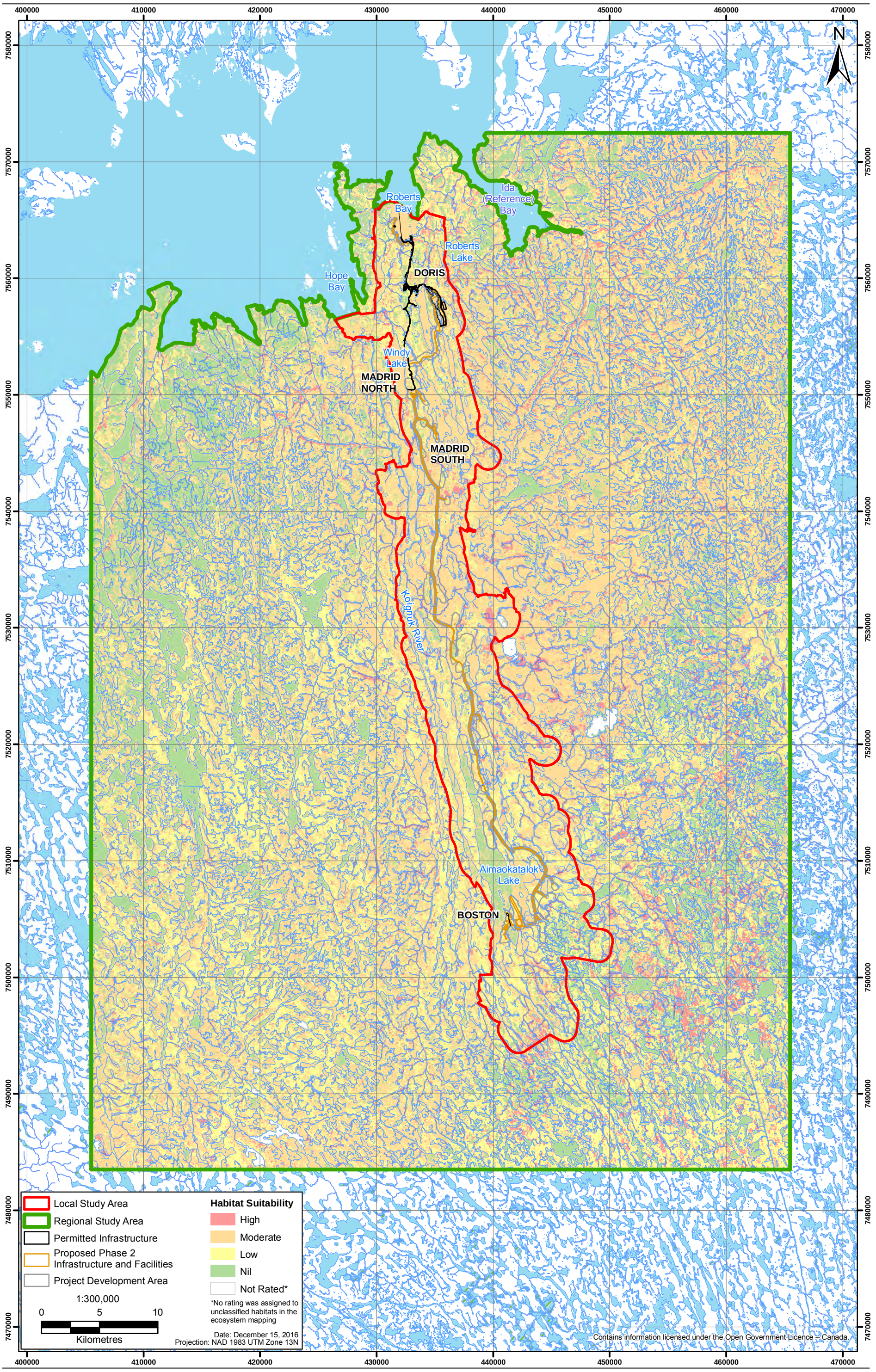
Figure 9.2-22
Muskox Summer / Fall (Rutting) Habitat Suitability in the Local Study Area and Regional Study Area



Direct Mortality

Any wildlife mortality observed by onsite personnel are reported immediately to the ESR Department and in the annual WMMP report. Mortality of VECs or larger fauna, or mortality resulting from potential interaction with Doris Project activity is reported directly to GN DOE and KIA, as necessary.

In the years that personnel have been at the Doris Project site (2006-2016), there have been no reports of any muskox morality of any sort, including from vehicle and aircraft strikes. The on-site speed limits for vehicles is a maximum of 50 km/h, thereby limiting the chance for direct mortality to muskox (Jalkotzy, Ross, and Nasserden 1997). These results indicate that there has been no effect of direct mortality on muskox due to the Doris Project (Golder 2007, 2008a, 2009; Rescan 2010, 2011c, 2011f, 2013e; ERM Rescan 2014a; ERM 2015b, 2016a).

Environmental Media Quality

The human health and ecological risk assessment (Volume 6, Section 5) evaluated potential changes in the quality of environmental media (e.g., soil, vegetation, and water) due to the Doris Project. This assessment determined that effects of the Doris Project on environmental media quality were negligible, thus there is no potential increase in risk of adverse health effects on muskox due to Doris Project activities.

9.2.8 Characterization of Baseline Conditions for Grizzly Bear

9.2.8.1 Introduction

Barren-ground grizzly bears (*Ursus arctos horribilis*) inhabit the northern extent of the grizzly bear range in North America. Barren-ground populations of grizzly bears are designated as a species of Special Concern by COSEWIC, but are not listed under *SARA* (COSEWIC 2012b). In Nunavut and the Northwest Territories, the Canadian Endangered Species Conservation Council lists grizzly bears as Sensitive (CESCC 2006; GNWT ENR 2006; CESCC 2010).

Grizzly bears are respected by Inuit and many legends and stories exist about them (Banci and Spicker 2016). Traditionally, grizzly bears were hunted for meat and fat typically in spring or fall before denning (Banci and Spicker 2016).

Population Trends and Conservation

In the Canadian Arctic, the most recent analysis of population trends for grizzly bears indicated a stable or slightly increasing population (McLoughlin, Taylor, Cluff, Gau, Mulders, Case and Messier 2003). There is no official estimate on grizzly bear population sizes for the West Kitikmeot region of Nunavut where the Hope Bay Project is located; however, a rough estimate of 800 grizzly bears was determined for a 200,000 km^2 portion of the northwestern mainland of Nunavut, which includes the RSA (which is 4,918 km^2) (Ross 2002).

Grizzly bears are long lived animals characterized by low reproductive rates due to a late age of maturity, small litter sizes, and long intervals between litters (McLoughlin, Taylor, Cluff, Gau, Mulders, Case and Messier 2003). These life history traits generally limit the resilience of grizzly bear populations to human disturbance (McLoughlin, Taylor, Cluff, Gau, Mulders, Case and Messier 2003). The stability of grizzly bear populations in the Arctic may be dependent on several factors including mortality due to hunting and human-related activities, low reproductive productivity, and general health of individuals. Productivity and general health of grizzly bears may in turn be influenced by access to high value habitat and nutritional sources, exposure to contaminants, and climate change.

Barren-ground grizzly bear populations may be at risk of decline if annual harvests and human activity are increased (McLoughlin, Taylor, Cluff, Gau, Mulders, Case and Messier 2003). The GN DOE recommends a total annual harvest (TAH) of six grizzly bears, including problem kills, from the Bathurst Inlet population (GN DOE 2005). Grizzly bears may be harvested in a ratio of two males to one female, but harvest is not recommended for females accompanied by cubs given poor survival rates of orphaned cubs (GN DOE 2005).

Climate change may affect populations of barren-ground grizzly bears. One of the most important changes in the Arctic as a result of recent warming trends, is an increase in the biomass of shrub species, such as birch, willow, and alder (Myers-Smith et al. 2011; Tremblay, Lévesque, and Boudreau 2012; Frost et al. 2013), which will have important implications for the structure and function of Arctic ecosystems. The increase in plant cover may provide additional nutritional resources for ungulates and other species on which grizzly bears prey. However, it is unclear how climate change may interact with other human-related activities such as industrial development, changes in contaminant exposures and the viability of barren-ground populations of grizzly bears (Parmesan, Root, and Willig 2000; Parmesan 2006).

Distribution and Movement Patterns

Grizzly bears are distributed across the tundra in the Canadian Arctic. Barren-ground grizzly bears have large home ranges and exist at low densities compared to other grizzly bear populations in more productive southern ecosystems (McLoughlin 2000). Average home range sizes derived from satellite collar data varied from 2,100 km^2 for females to 7,245 km^2 for males, and home ranges of individuals overlapped more than those reported in southern latitudes (McLoughlin, Ferguson, and Messier 2000; McLoughlin, Taylor, Cluff, Gau, Mulders, Case, Boutin, et al. 2003). Density estimates of grizzly bears in Northwestern Nunavut are approximately 4 bears per 1,000 km^2 (Ross 2002).

Traditional knowledge indicates that grizzly bears are found throughout the RSA (Banci and Spicker 2016). Traditional knowledge also indicates that major grizzly bear movements occur within the RSA in association with major river systems, watersheds and coastal areas (Thorpe et al. 2001; Banci and Spicker 2015, 2016).

Inuit TK indicates that grizzly bears in the Hope Bay Project area build their dens in slopes of river banks and around the coast. Most of the denning habitat indicated by TK occurs just south of the Elu Peninsula, as well as areas close to the Perry River and Omingmaktok (Banci and Spicker 2016).

Habitat Use

9.2.8.2 Baseline Data for Grizzly Bears

Five baseline studies were conducted to document the activity of grizzly bears in the RSA:

1. population-estimation using DNA mark-recapture protocols;
2. motion triggered camera monitoring;
3. carnivore den surveys;
4. habitat plot surveys; and
5. habitat suitability modelling.

In addition, observations of grizzly bears were reported incidentally by field staff during other studies conducted in the RSA and by Hope Bay Project personnel. Grizzly bears were detected in the RSA between 1996 and 2015.

DNA Mark-Recapture

Methods

DNA fingerprinting using hair has been used extensively to estimate bear populations through mark and recapture techniques (Woods et al. 1999; Mowat and Strobeck 2000; Poole, Mowat, and Fear 2001; Apps et al. 2004; Boulanger, McLellan, et al. 2004; Proctor et al. 2005). Roots of mammalian hair contain sufficient DNA for analysis (Higuchi et al. 1988) and bears frequently leave hair on rub trees, in beds, and at foraging sites (Taberlet et al. 1993). Bears are readily attracted by scent lures, permitting methods to obtain hair samples from free-ranging bears using systematic sampling regimes necessary for many ecological studies, such as animal censuses (Woods et al. 1999).

In mark-recapture studies, an initial population sample is "marked", which corresponds to the bears detected in the first round of hair sampling. The population is then resampled one or more times (Woods et al. 1999). The ratio of newly captured animals to recaptures is used to compute a population estimate (White et al. 1982). The benefits of this method are that 'marking' of bears through live capture or other invasive methods is unnecessary, individuals can be identified with a small risk of error, and hair capture sites are faster to set up and are checked less often than live-capture sites (Woods et al. 1999; Mowat and Strobeck 2000; Poole, Mowat, and Fear 2001; Apps et al. 2004; Boulanger, McLellan, et al. 2004).

Bears traverse in and out of the study area over the period of the study which violates the assumption of geographic closure in most studies that use mark-recapture or related methods (Miller et al. 1997). In these cases, abundance estimates are derived from mark-recapture analysis that calculate a "super-population" based on detection frequencies, under the model assumptions that movement is random across grid boundaries (Kendall 1999). In the context of mark-recapture DNA studies, the super-population is defined as the number of animals that inhabit the sampling grid and surrounding area (as opposed to the grid alone; Boulanger, McLellan, et al. 2004). The population estimate is only the number of animals estimated to be on the study area during the sampling period, and is not intended as a true population estimate or for the calculation of population density. Under a trend monitoring objective, however, an absolute abundance or density estimate is not necessary, and the assumptions of population closure can be relaxed (Apps 2010).

A DNA based mark-recapture program for grizzly bears was conducted in 2010 and 2011 using scent-baited hair capture stations arranged in a grid of cells surrounding the Hope Bay Project (Rescan 2012a). In 2010, the study area consisted of 37 cells (10 km by 10 km, cells 1 - 37) surrounding the Doris Site (Figure 9.2-23). During the last two sampling periods in 2010, an additional 12 cells were added to incorporate the Boston area (cells 38 to 49; Figure 9.2-23), increasing the study area to approximately 5,000 km^2. In 2011, the study area increased to 6,500 km^2 (65 cells) to accommodate the potential future activities around the Boston area (Figure 9.2-24).

Each cell within the DNA grid contained a baited post to attract bears, which would investigate the post and leave hairs on barbed wire wrapped around the post. Posts were placed near to the center of each cell, in locations likely to intercept bears, based on experience and input from Inuit assistants. The posts were checked and re-baited six times during each summer. Individual bears were identified from their DNA in the sampled hairs and a super-population estimate was calculated from the proportion of bears that returned to the posts during the summer (Rescan 2012a). As a result of changes to the grid between years, the super-population estimate was calculated only for the original northern portion (37 cells) of the study area (Doris). Details of the methods, including model assumptions about mortality and emigration, are reported in the 2011 interim Grizzly Bear DNA Report (Appendix V4-9B) (Rescan 2011a) and the 2012 Final Grizzly Bear DNA Report (Appendix V4-9C) (Rescan 2012a).

Results

A total of 411 hair samples were collected from the Doris sampling grid (37 cells) during the 2010 field program. DNA was successfully extracted from 163 (40%) of the 411 samples and assigned to 31 individuals; 17 males and 14 females (Rescan 2011a). In 2011, a combination of increased study area, improved bait, improved sampling locations and drier weather (which minimizes DNA degradation) led to a four-fold increase in samples collected (1,623 samples). Stricter sub-selection rules resulted in a lower proportion of samples analyzed by microsatellite genotyping. Of the samples submitted in 2011, 241 samples were successfully extracted and assigned to 39 individuals (17 males and 22 females), of which 18 were recaptures (7 males and 11 females) from 2010 (Rescan 2012a).

Within the entire study area, a total of 52 grizzly bears (27 males and 25 females) were identified over the two year program (Rescan 2012a). One grizzly bear from this study was also sampled at another development project 200 km southwest of the Hope Bay Project area (Rescan 2014). Within the Doris study area (37 cells) 41 grizzly bears were detected (2010 and 2011) and the super-population was estimated to be 45 bears (25 males, and 20 females) in 2010 and 31 bears (13 males and 18 females) in 2011. Population analyses based on the DNA based mark-recapture inventories reflect a more reliable indication of population status relative to incidental observations, which are a poor reflection of population status because a single individual or family unit may be recorded on multiple occasions, and only those animals that are close to mine infrastructure are likely to be observed.

Camera Monitoring

Methods

Grizzly bear activity in the RSA was monitored using motion triggered remote cameras from September 2012 to August 2015. Methodology regarding camera deployment locations and analyses are identical to those conducted for caribou and are described in Section 9.2.6.2.

For grizzly bear, camera monitoring data were used to:

1. Characterize grizzly bear use of the RSA;
2. Examine seasonal grizzly bear use of areas within the RSA; and
3. Document the potential existing interaction with Doris Project infrastructure

Results

Between September 2012 and August 2015, 44 to 59 cameras were deployed in the RSA, recording a total period of 1,041 days. Cameras recorded 332 grizzly bear observations (Table 9.2-21). It is important to note that the total individuals recorded across events do not necessarily represent unique individuals, as it is very likely that the same individual(s) were recorded in multiple events.

A detailed spatiotemporal statistical analysis of the August 2014 to August 2015 camera data was conducted in 2016 for the purpose of detecting a project-related effect of the Doris Project, and was reported in the 2015 WMMP Report (ERM 2016a). Analysis indicated that grizzly bear events declined with latitude, indicating that higher numbers of grizzly bears were recorded along the coast than further inland to the south. This finding is supported by the results of the grizzly bear DNA study that indicated the northern coast of Nunavut is a productive area for grizzly bears, with an estimated detection rate of 8 to 11 bears per 1,000 km^2 (Rescan 2012a). Coastal areas may support more grizzly bears for several reasons, including productive vegetation resources, seasonal access to caribou, fish resources in the streams along the Arctic coast. In addition, grizzly bears have been observed hunting seals on the sea ice during the spring (M. Dumond, GN-DOE, pers. Comm.).

Figure 9.2-23
Grizzly Bear DNA Survey Grid and Capture Frequency in 2010