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Brief Communication

Observation of Arctic island barren-ground caribou (*Rangifer tarandus groenlandicus)* migratory movement delay due to human induced sea-ice breaking

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Abstract: The seasonal migration of the Dolphin and Union caribou (*Rangifer tarandus groenlandicus)* herd between Victoria Island and the mainland (Nunavut/Northwest Territories, Canada) relies on the formation of sea-ice that connects the Island to the mainland from late-October to early-June. During an aerial survey of the Dolphin and Union caribou herd in October 2007 on southern Victoria Island, Nunavut, Canada, we documented the short-term effects of the artificial maintenance of an open water channel in the sea-ice on caribou migratory movements during staging along the coast.

Key words: caribou; ice breaking; migration; movements; *Rangifer*; sea-ice.

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Introduction

In the context of observed changes in sea-ice conditions and the increase in maritime shipping activity, the impact of sea-ice breaking is of great concern for the movements and viability of Arctic wildlife and particularly of caribou (*Rangifer tarandus)* populations using sea-ice to migrate from one island to the other (Miller *et al.,* 1977; Miller & Gunn, 1978) or between an island and the mainland (Gunn *et al.,* 1997; Poole *et al.,* 2010). Connectivity between islands or between islands and the mainland is key to the viability of Arctic island caribou populations (Miller et al. 2005; 2007), and maritime traffic and sea-ice breaking has been a concern for local communities who rely on caribou and other wildlife for subsistence, cultural, and economic activities. While caribou are good "swimmers", and water-crossings between islands have been documented (Miller, 1995), it is unlikely that it happens when the distance to cross is more than a few kilometres or when air temperature is well below freezing. Although the documentation of sea-ice crossings (Miller *et al.,* 2005; Poole *et al.,* 2010) and seasonal habitat and forage use (Hughes, 2006) provide some support for the assumptions of demographic effects if the connectivity between the islands or between islands and the mainland is affected (COSEWIC, 2004), there is limited information on verified and quantified impacts on caribou movements due to anthropogenic alteration of the sea-ice.

Changes in sea-ice conditions and increased maritime traffic were part of the justification for the Dolphin and Union caribou (R. t. groen-

landicus) herd to be currently listed as Special Concern under the Species at Risk Act (Canada Gazette, 2011).The Dolphin and Union herd is somewhat unique as its annual range encompasses Victoria Island for calving, post-calving, and rut, and the mainland as its main winter ground (Gunn & Nishi, 1998; Poole *et al.,* 2010).This implies annual migrations (fall and spring) across the sea-ice between Victoria Island and the mainland. The fall migration across the sea-ice is preceded by a staging period (Poole *et al.,* 2010) when caribou aggregate along the south coast of Victoria Island waiting for the ice to form between the Island and the mainland. As soon as the ice is strong enough, the crossing happens very rapidly with, in some areas, pauses on islands along the way (Poole *et al.,* 2010). We describe the short-term effects on the Dolphin and Union caribou herd migratory movements due to the temporary maintenance of an open channel through the sea-ice in the fall 2007, at Cambridge Bay, Victoria Island, Nunavut.

Materials and Methods

The reported observation was made during an aerial stratified strip transect survey of the Dolphin and Union caribou herd using a Helio-Courier H-295 on wheel skis at an altitude of 100 meters above the ground at a speed of 160 km/h between October 24 and October 30, 2007, following the method described in Nishi & Gunn (2004). Transects extended 500 m on each side of the plane with the 500-meter line indicated by a streamer below each wing. The calculation of caribou density was estimated using the caribou counted within the 500 m strip on each side of the plane. A channel in the sea-ice between Cambridge Bay (N69.13, W105.07) and the open water at the mouth of the bay was maintained artificially by a tug-boat every 12 hours between October 20 and October 28, 2007, in an attempt to allow the tug-boat and barges to navigate back to their base in the Northwest Territories. All aerial caribou observations on and off transects and during ferry flights were recorded and areas on both side of the channel were flown during the ice breaking period on October 26, 2007, and the day after it stopped. We used a Mann–Whitney U test (corrected for large sample size; Sokal & Rohlf, 1995) for a local change in caribou density observed on the east of the channel between October 26 and October 29, 2007. Flight tracks were divided into 1 km transect segments to obtain a number of 1 km^2 blocks with associated caribou density as the sample unit.

We calculated average daily temperature based on the hourly temperature data for Cambridge Bay from October 20 to October 31, 2007 (Environment Canada, 2008).

Results

On October 26, 2007, we estimated 1000 stationary caribou on the point of land and on the ice at the west edge of the open water channel maintained by the barge tug-boat (Fig. 1). Only a few caribou trails were observed on the east side of the boat channel and very few caribou were observed on the land or ice east of the channel (Fig. 2).

On October 29, 2007, we flew over the area again (Fig. 2) and only observed three caribou near the frozen boat channel but many caribou trails were going east past the frozen channel. Only a few caribou were still present on the point west of the channel. Local density of caribou on the land east of the channel increased significantly between October 26, 2007, and October 29, 2007, (t_s = 3.284, P = 0.001) from 5.9 ± 7.0 caribou/100 km^2 on October 26, 2007, to 54.2 ± 92.7 caribou/100 km^2 on October 29, 2007 (Fig. 2).

Average daily air temperature started to fall between October 23 and 24, 2007, and remained between -14°C and -18°C from October 24 to October 31, 2007 (Fig. 3).

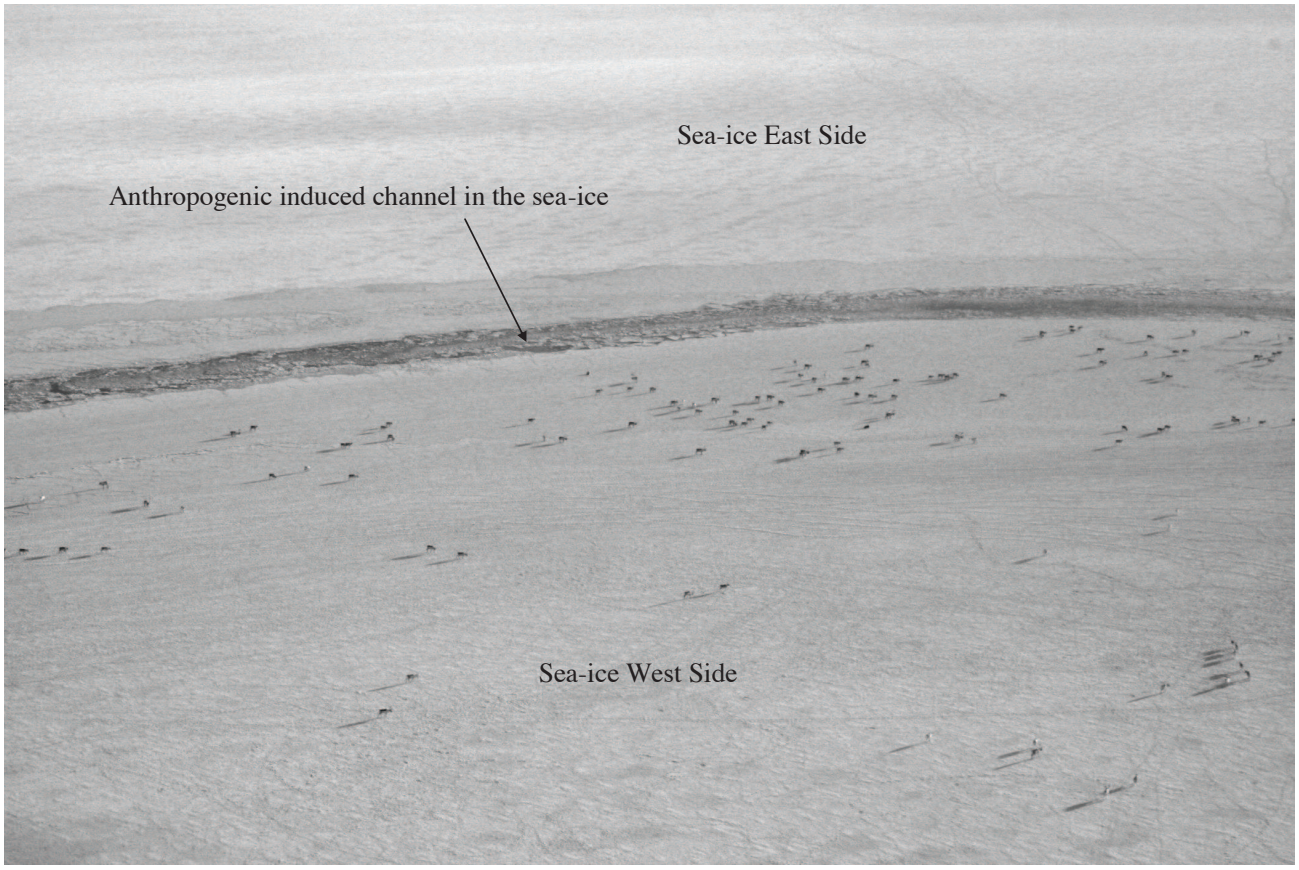

Figure 1. Dolphin and Union caribou aggregated on the west edge of an anthropogenic ice breaking channel near Cambridge Bay, NU, on October 26, 2007.

During our two flights over the channel we did not observe any caribou drowned or dead on the ice or in the water. It is possible that between ice breaking, the ice had the time to get thick enough for some caribou to cross the channel but it remained a barrier to the movement eastward for the majority of the caribou at least between October 22 and October 26, 2007. During the whole survey, we observed only three caribou that had drowned through the ice along the coast.

Discussion

It seems that overall, because it was stopped rapidly, the impact of the ice breaking resulted only in a few days delay for caribou movements. The cold temperature likely decreased the risk of caribou breaking through thin ice. It is unknown what level of impact it had on the condition of the animals or would have had if the ice breaking had resulted in a wider channel or if temperature would had been milder (*i.e.*, ice does not thicken as fast).

Caribou do die naturally from going through the ice (Miller & Gunn, 1986) and, during the fall migration of the Dolphin and Union caribou herd, reports of individuals that have gone through the sea-ice are common. The low number observed during our survey compared to the 1997 survey (Nishi & Gunn, 2004) and local observations could be related to the late but very fast ice formation this year which reduced the likelihood of caribou breaking through the ice during staging. In recent years, hunters also reported several animals on the mainland with a thick coat of ice on their fur indicating that a portion of the animals going through the ice managed to survive at least to reach the mainland. The impact of falling through the ice on the overall survival rate is unknown. Never-

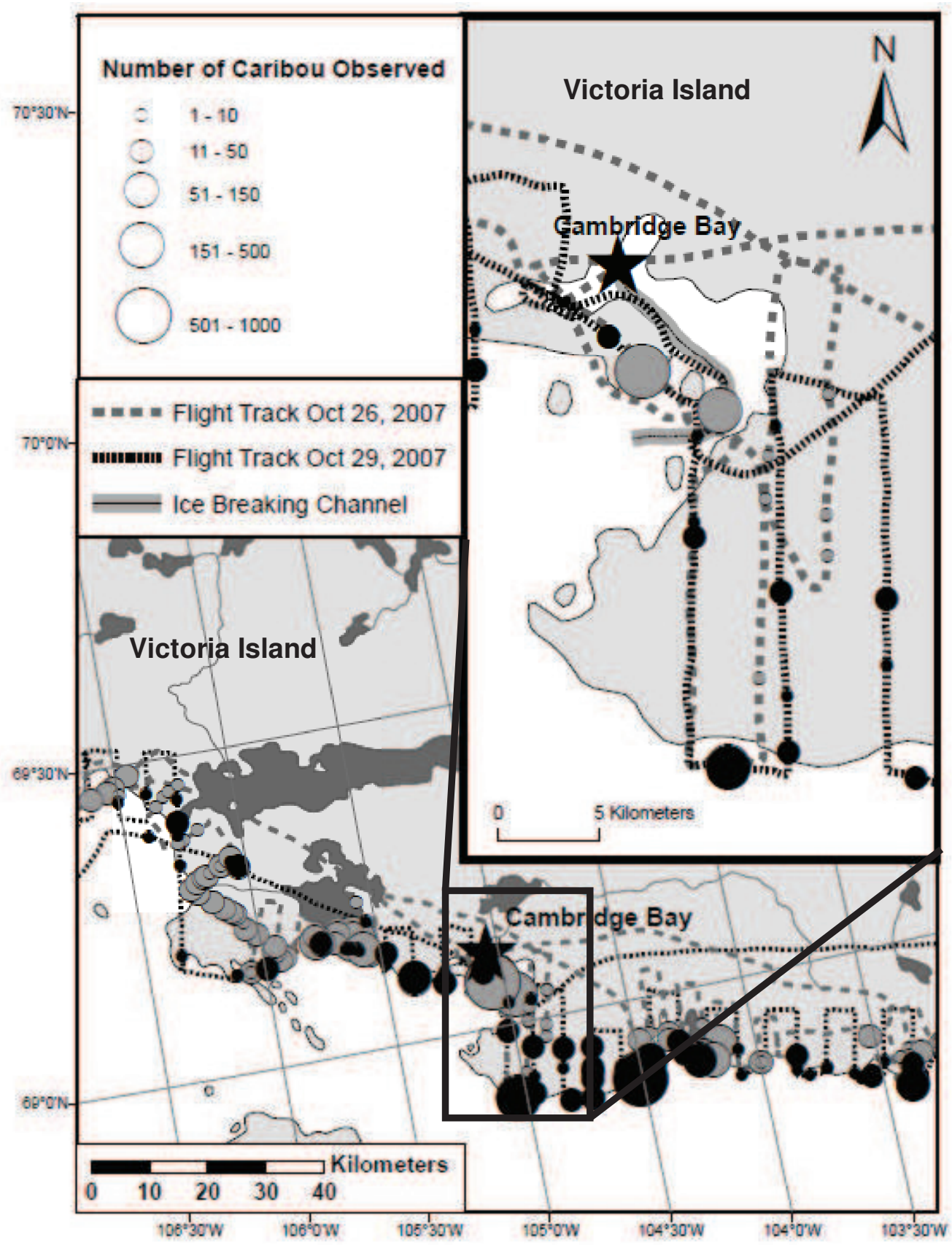

Figure 2. Flight tracks around Cambridge Bay, NU, on October 26 and 29, 2007, with caribou observations (dot size is proportional to caribou group size; October 26 in grey and October 29 in black) and the approximate barge tug-boat ice breaking channel.

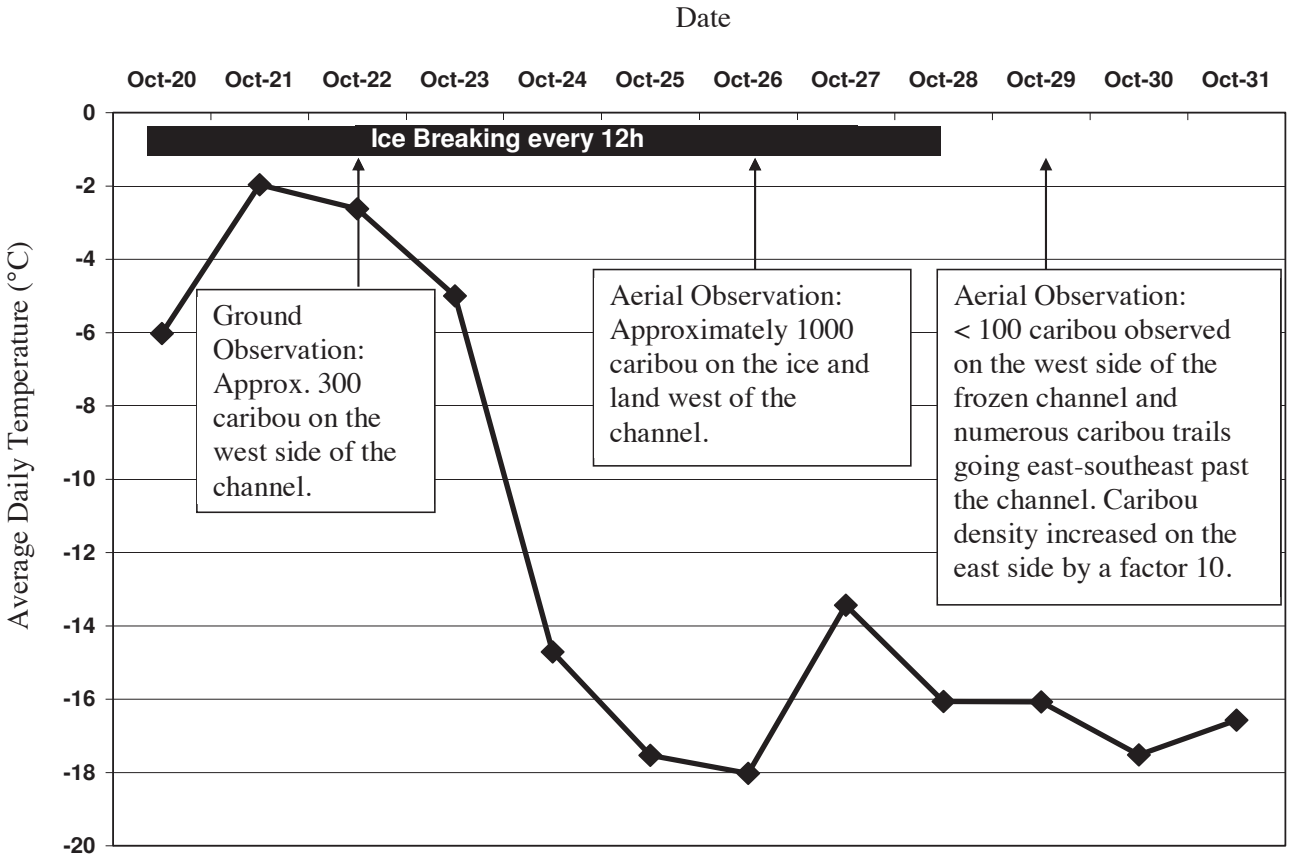

Figure 3. Chronology of observed events and average daily air temperature at Cambridge Bay, NU (from Environment Canada, 2008).

theless, in the spring of 2010, over two dozen caribou carcasses were found frozen in the ice around small islands near the mainland as well as on the islands, obviously having died shortly after getting out of the water (Allen Niptanatiak and Dustin Fredlund, pers. comm.; M. Dumond, pers. obs.). During the survey in October 2007 the ice was just starting to form away from the shore and this may explain the small number of caribou that were observed drowned (the number likely increased as they ventured further out).

Fall migration and winter are the periods of highest natural mortality in adult females of the Dolphin and Union caribou herd (Poole *et al.,* 2010). While causes are likely linked to individuals falling through the ice and predation, data are insufficient to rank natural mortality causes. The addition of new stress during the fall migration through anthropogenic disruption of the sea-ice formation could have cumulative impacts on the herd with unknown consequences for the herd survival.

Past low density and seclusion on Victoria Island resulted in the Dolphin and Union caribou herd being the most genetically differentiated of the barren-ground caribou herds (Zittlau, 2004) and may become more isolated as sea-ice formation is delayed, preventing migration to the mainland (Poole *et al.,* 2010). Increased disturbance of the sea-ice could precipitate the isolation of the Dolphin and Union caribou herd on Victoria Island. Forage availability, quality, and biomass are generally

lower on Victoria Island than on the mainland (Hughes, 2006), and the seclusion of the herd on Victoria Island would likely result in a lower viable population size.

The increasing number of resource extraction projects and the domestic needs of Arctic communities are calling for an increase in maritime traffic and increasing pressure to extend the shipping season through ice breaking. Already some resource extraction projects are proposing year around maritime shipping. Information on the short- and long-term effects of sea-ice breaking on wildlife (including terrestrial wildlife) is crucial for the management of this source of impact, especially in the context of observed and projected changes in sea-ice formation and degeneration.

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