Abstracts

Indigenous knowledge and caribou management: the terms of a new alliance

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Abstract: Since the beginning of the 1980s, interest in regards to indigenous knowledge has only grown. As aboriginal populations have established themselves as partners who cannot be ignored on the national and international scene, this knowledge has become a strong identifying marker and a new avenue for cultural and political affirmation. Moreover, its legitimacy as a source of pertinent information for the protection of ecosystems and the management of land and natural resources (more specifically, the caribou) and the understanding of environmental phenomena has been recognized on numerous occasions by governments of various countries and most notably, by Canada. This recognition is also seen in the specific provisions in international conventions aimed at their protection and transmission. The present conference will allow us, in the first instance, to shed light on this emerging field of study and to clarify the main theoretical and methodological issues from a social science and environmental sciences viewpoint. In the second instance, the discussion will focus on the specific case of the caribou and will examine the meeting of indigenous knowledge and scientific knowledge.
Published in: Lévesque, C. 2002. Les savoirs des Autochtones: questions, défis et enjeux. – *In*: Baillargeon, J-P. (ed.). *Transmission de la culture, petites sociétés, mondialisation,* pp. 201-212. Presses de l'Université Laval/Les Éditions de l'IQRC, Québec.

Cumulative impacts of hydro-electric power development on the distribution and productivity of wild reindeer

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Abstract: Monthly systematic snowmobile surveys during winter and ground surveys during summer of approximately 1500 reindeer were annually conducted prior and following the construction of the Blue lake hydroelectric reservoir in south-western Norway 1977-1987. We analyzed pre- and post development distributions in relation to location of constructed 300 and 420 kV power lines, roads and dams on 54 sites, each 25 km^2. Infrastructure was present in 17% of the sites in 1977, increasing to 71% of the sites in 1987. Following development after 1980, annual reindeer density was reduced by 72% within the study area, the far majority as a result of an 88% reduction in use of developed sites in winter, without changes in undeveloped controls. During summer, distribution of reindeer away from power lines resulted in a 53% reduction in use in near half of the sites, and a subsequent 137% increase in use of remaining undisturbed sites. The proportion of large insect-harassment-related aggregations of reindeer also declined significantly in developed sites and increased in undeveloped formerly low-use sites. Production 3-10 years after development was, in spite of near absence of predators, ca. 30-40 calves/100 females in June, corresponding well with very low body weights in spite of relatively stable herd size, giving some of the lowest reproductions in wild reindeer in the world. The Blue lake development resulted in: 1) Reduced availability of winter ranges; 2) physical barriers and reduced availability of summer ranges; 3) possible lower availability of insect relief habitat; 4) enhanced use of remaining scattered undeveloped sites, and 5) most likely lowered production.

Cumulative impacts of human development on wild reindeer

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Abstract: We investigated the effects of infrastructure on wild reindeer in five major reindeer ranges in southern Norway, including some of the most intensively developed *Rangifer* habitats in the world. The investigation was based on systematic aerial and ground based surveys, including over 200 000 reindeer observations 1977-1998, snow measurements and vegetation surveys on >500 vegetation sites. During winter, reindeer abundance was 50-97% lower within 2,5-5 km from roads, power lines and ski resorts compared to comparable habitat in undisturbed areas. During summer, patterns were more diffuse, mainly due to varying sensitivity caused by insect harassment, although a 30-50% reduction in use also was observed in summer. Redistribution of reindeer away from development resulted in a 137-470% increase in use of the few remaining, scattered undisturbed sites, with apparent resultant overgrazing. Smaller groups of animals, mainly bulls, could be observed under all levels of disturbance. Combinations of linear structures, such as two power lines in combination or a road and a power line combined generally resulted in not only avoidance but also barriers to migration. Exceptions existed mainly for periods of starvation. No apparent habituation had occurred up to 30-80 years after construction, in spite of short distances to available forage in demand. Overall, range availability in southern Norway, and hence, carrying capacity, has been reduced by 50-70% in the last half of the 20th century due to human development.

Isolation and genetic diversity of caribou ecotypes in Québec, Canada

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Extended abstract: Three caribou ecotypes are present in eastern North America: the mountain caribou which is found in the Chic-Choc mountains (Gaspésie Peninsula) and, possibly in the Torngat mountains, the barren-ground caribou which calves in the tundra and the forest-dwelling ecotype which lives all year long in the boreal forest. In this study, 226 blood and muscle samples were collected from seven locations and characterized at eight microsatellite loci to test the hypotheses that forest-dwelling and barren-ground ecotypes constitute a single metapopulation and that geographical isolation results in reduced genetic diversity through genetic drift. The highest mean number of alleles per locus was found in the barren-ground population while the lowest value was observed in the smallest forest-dwelling population. Expected heterozygosity did not vary among populations, whereas genetic differentiation was detected between all pairs of populations, confirming that they were genetically distinct. Correspondence analysis showed three groups of samples, corresponding to the three ecotypes. Gene flow estimates were moderate or high among all forest-dwelling populations and particularly between those <200 km apart. Our results suggest that the three caribou ecotypes represent three distinct genetic entities. Our findings also indicate that the forest-dwelling populations form a metapopulation and that barren ground caribou are not part of this metapopulation. The mean number of alleles per locus and heterozygosity of the studied populations were similar to or greater than those measured in other caribou populations or other cervid species. Genetic drift was noticeable in isolated populations but does not seem to be of immediate concern for conservation. However, we propose that management strategies should favor increase in caribou numbers in order to avoid extinction due to stochastic events and to maintain local biodiversity, particularly in isolated populations. In the boreal forest caribou range, conservation strategies of populations must be planned on large scales and should favour maintenance of occasional exchanges among populations, thus preserving genetic diversity.

Environmental variability and live body mass of reindeer calves at weaning

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Abstract: Factors which influence variation in the body mass of ungulates may be classified according to whether they are (i) largely dependent on or (ii) largely independent of prevailing environmental conditions. Given that reindeer in Arctic and sub-Arctic habitats experience substantial annual variation in both population numbers and the weather conditions which affect quality and availability of forage, we predicted that the live body mass of reindeer calves at weaning (September, calves=4 mo. old; LBM4) would be influenced principally by factors dependent of prevailing environmental conditions. Body mass data were collected from 1992 to 2000 in a herd of approximately 400 individually marked semi-domesticated reindeer which grazed all year round at natural mountain pasture in northern Norway. Body mass was highly variable (mean=37.5 kg, $s_{between\ year}$=1.3 kg, $s_{within\ year}$=4.6 kg, n=789). A general linear model of a sub-sample revealed that (i) calves' sex (β=1.9, $F_{1,450}$=33.9, P<0.0001), (ii) mothers' body mass in late winter (β=0.4, $F_{1,450}$=243.1, P<0.0001) and cohort year of birth ($F_{1,450}$=10.8, P<0.0001) together explained 45% of this variation after controlling for date of weighing. Neither mothers' age nor mothers' reproductive status in the preceding year had any significant additional effect on LBM4. The results suggest environmental conditions in the current year are important for the growth of male and female reindeer calves directly by changing abundance or quality of forage and indirectly by changing resource allocation from their mothers.

Urinary creatinine ratios in snow samples as a non-invasive nutrional monitoring tool for caribou

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Abstract: Nitrogen (N) balance can be critical for caribou in winter. Low nitrogen content, especially in lichens, can induce severe protein mobilisation under natural conditions. Efficient monitoring tools are needed to properly assess animal nutritional status in the wild. Biochemical indicators of catabolism would simplify appraisal of the physiological status and food limitation during the winter months. Previous studies have shown that purine derivatives, lost through urine, are reliable indices of ruminant nutritional status. The Urea Nitrogen:Creatinine (UN:C) and Potassium:Creatinine (K:C) ratios have showed promising results in nutrition quality monitoring. A newly developed method was tested using urine samples collected from fresh snow. As little experimentation has been done to date on caribou, the present study tests hypotheses related to this technique wirh a group of caribou under controlled conditions. It was carried out in captivity at the Saint-Félicien "Wild" Zoo on caribou recently captured from the Leaf River Herd in N. Québec. Less than one week after a gradual reduction in N intake (from a 14%-protein pellet formula to a 3%-protein lichen diet), UN:C and K:C ratio results declined and echoed the deterioration of nutritional condition of the study individuals. Five weeks later, still under reduced N intake, both ratio values started to rise slightly again, probably due to the onset in protein catabolism. This U-shape tendency was similar to previous results obtained from other species of ungulates and represents a problem in the application of the snow-sampling technique in the wild. No circadian differences in ratio values were found even though ratio variability increased as diet conditions deteriorated. Under a high protein diet, UN:C for fawns did not differ from that of adults. However, K:C seemed higher for fawns than for adults under the same high protein diet. This could be used in the wild to differentiate fawn from adult snow urine samples, as age effect was pointed out as a possible drawback for the snow sampling method. Although preliminary results suggest that snow-urine sampling shows some potential as a nutrition monitoring tool, further studies are required to establish baseline values for caribou.

Genetic relatedness of caribou herds in Northwest Territories, western Nunavut and the northern Yukon Territory

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Abstract: We studied nine herds of caribou in northern Canada. Five herds, Porcupine, Cape Bathurst, Bluenose-West, Bluenose-East and Bathurst (*Rangifer tarandus granti* and *R. t. groenlandicus*) occupy ranges on the mainland. Three herds, Melville Island, Banks Island, and Minto Inlet (*R. t. pearyi*) occupy ranges on the arctic islands. The Dolphin-Union herd (*R. t. pearyi*) occupies both mainland and island ranges. Preliminary analysis of microsatellite loci showed more genetic differentiation amongst caribou on arctic islands than those on the mainland, a small genetic difference between Banks and Melville Island caribou and that Banks Island and Minto Inlet herds were not genetically distinct. Subsequently, additional genetic material has been analyzed to increase sample size so we could elaborate on the preliminary results and further elucidate the relatedness of caribou found on arctic islands and the mainland.

Patterns of seasonal range use of Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou and its implications for management

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Abstract: Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds occupy parapatric ranges in northern Northwest Territories and western Nunavut. Since March 1996, we have obtained information on the movements of satellite-tracked radio-collared caribou in these herds. Collars provided location data on the same days and months over multiple years. For those caribou with >1 year of movement data, we measured all possible distances between locations on a given day and month to provide a measure of fidelity to areas used during the year. Caribou in all three herds showed as high a degree of fidelity to areas used during early August to early October as they did to those used during calving and post-calving. The lowest degree of fidelity occurred during winter. The relative importance of ranges used by barren-ground caribou during seasons other than calving and post-calving need to be considered in light of current and proposed development activities

The effects of sample interval on estimating movement rates, habitat use, and home ranges: a case study employing GPS technology on overwintering caribou

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Abstract: GPS-based animal tracking systems are well suited for a variety of spatio-temporal investigations. While researchers have traditionally struggled to collect sufficient data with conventional radiotelemetry, GPS technology can quickly amass large samples of relocation data. To optimize the use of GPS systems, we need to understand effects of sampling interval, and therefore sample size, on ecological estimates we obtain. We investigated the effects of sampling interval on estimates of movement rate, habitat use, and home range size by sub-sampling hourly relocation data collected from three GPS collars deployed on female caribou in the Fortymile Herd during October 1998-April 1999. We also evaluated diurnal patterns of habitat use to compare "round-the-clock" sampling via GPS technology with "daylight only" sampling characteristic of conventional aerial radiotelemetry. Our results will provide some insight into the ramifications of and difficulties associated with estimating ecological parameters using different data collection schemes.

Is the metapopulation theory useful in caribou herds conservation? - A test with the Québec-Labrador caribou

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Abstract: Since the 1950s, North American caribou herds have been defined and named on the basis of their calving ground locations. As most censuses are conducted at or near calving time, this herd definition is appropriate for short-term management decisions. However, over larger time and spatial scales, the herd may not be the most effective conservation unit. The metapopulation theory may prove to be useful in the area of long term caribou conservation. Metapopulation is a system of geographically or ecologically isolated populations whereby there is sufficient emigration among populations to have a significant impact on either the demography or genetic profile of each component population. In the large mainland area west of Hudson Bay, caribou herd ranges overlap in a continuum of varying caribou abundance, small-scale exchanges may occur between neighbouring herds. The ranges of the migratory and sedentary caribou ecotypes also overlap, a fact that requires study of the ecological factors involved, and more importantly, of the long-term conservation effects on the fragile sedentary ecotype. East of Hudson Bay, on the Québec-Labrador Peninsula, a similar caribou population continuum exists but on a smaller spatial scale. This situation provides an opportunity to test the metapopulation theory. This paper will use this new approach to formulate hypotheses for better management of caribou herds and metaherds. Satellite monitoring data have recently confirmed emigration of caribou from the George River Herd (GRH) to the Leaf River Herd (LRH). Data also confirmed that after a fourfold increase from 1971 to 1993, the GRH contracted its annual range by 40% from 1994 to 2000. The LRH calving ground, first surveyed in 1975, has gradually shifted so that by 1992 it had moved 400 km to the north, from low altitude landscape south of the tree line to a 530-metre high tundra plateau-habitat. Since 1993, this herd has used the same area with little annual variability. As revealed by Inuit traditional ecological knowledge, the current (1992-2000) LRH calving ground was used in the late 1880s at the metaherd's previous population peak. This paper will suggest that emigration plays an important role in Québec-Labrador caribou herd dynamics and that annual small-scale changes to calving grounds are one of the mechanisms involved. Emigration from the GRH may have led to the creation and the growth of the LRH in the 1970s. Throughout history, caribou herds have fit into the source-sink metapopulation system, whereby one-source populations, typically large in size or occupying prime habitat (*i.e.*, GRH), produce an excess of individuals that disperse to smaller sink populations in less than optimal habitats (*i.e.*, LRH). Very little is known about the genetics of Québec-Labrador caribou, and it should be investigated further to better understand gene flow between the herds and within the metaherd.

A North American caribou database – a step in assessing impacts of climate change and industrial development

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Abstract: In recent years much focus has been directed to the fate of our large migratory caribou herds. Climate change and numerous development projects combine to pose a potential threat to the well being of these herds. Management agencies and co-management bodies need to have the best information possible to generate effective policy decisions related to the mitigating possible impacts. A recent survey across the north indicates that there is a wide disparity in the amount of baseline data that is available for these herds. We feel that by integrating all the data that exists for the populations and their habitats, we can create herd specific datasets that can be input for an integrated assessment tools. To that end, a MS Access database is being developed for mainland migratory caribou in North America. In this presentation we discuss the structure of the database, provide a few examples of comparisons among herds and outline a process to use the database as an integrated assessment tool.

A 'rediscovered herd' - the Ahiak (Queen Maud Gulf) herd of barren-ground caribou in Canada's central arctic

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Abstract: In 1996, the Ahiak herd numbered about 200 000 barren-ground caribou *Rangifer tarandus groenlandicus* which makes it the fourth largest herd in the Northwest Territories and Nunavut, Canada. Yet the herd is almost unrecognized outside its range because its numerical increase and re-occupation of seasonal ranges is recent. The herd's recognition was confirmed when we fitted five cows with satellite collars in April 1996 and flew calving surveys in 1986 and 1996. The collared cows calved along the Queen Maud Gulf (Ahiak) coast and their winter range extended to below the treeline. The Ahiak herd's seasonal ranges overlap with ranges of the Bathurst herd, the Beverly and the Dolphin and Union herd.

Is a park a guaranty for the survival of the Gaspésie caribou?

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Abstract: The regression of caribou distribution in North America is well known and unfortunately irreversible. In the East, the last individuals of the herds that once occupied the Atlantic Coast are now restricted to the area of the *Parc de la Gaspésie* (Gaspésie Park). The word "park" might lead to think that every possible conservation step has been carried out. A closer look at the park's history shows that the status of herd is still precarious. Many protection measures for the caribou were taken over the last century. Caribou hunting was prohibited; the forestry reserve was modified to a Conservation Park in 1981; a recovery plan was implemented from 1990 to 1994; an essential habitat area was established in 1993; and a forestry plan was concluded in 1999 for a 293 km^2 area outside the park. In spite of all these conservation efforts, a recent telemetry study shows that the caribou population is smaller than expected. From a population size of 273 in 1983, the herd steadily declined to 126 in 2000 (y=-7.2932x+244.29; R^2=0.5029). Previous efforts probably slowed, but did not stop, the caribou decrease. The situation of naturally isolated small populations, such as the Gaspésie caribou, will always be precarious. Apart from a conservation park, constant survey studies and research programmes are essential if we ever want to have a chance to preserve these relic populations.

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ISSN 0801-6399
Print: Lundblad Media AS, Tromsø, Norway