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Arctic Borderlands Ecological Knowledge Cooperative: can local knowledge inform caribou management?

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Abstract: While quantitative analyses have traditionally been used to measure overall caribou herd health, qualitative observational data can also provide timely information that reflects what people on the land are observing. The Arctic Borderlands Ecological Knowledge Co-op (ABEKC) monitors ecological change in the range of the Porcupine Caribou Herd (PCH). The community-based monitoring component of the Co-op's mandate involves the gathering of local knowledge through interviews with local experts in a number of communities.

We analyzed the responses to interviews collected during 2000–2007 related to caribou availability, harvest success, meeting needs and caribou health during fall and spring. Interviews revealed 1) caribou greater availability during the survey period, 2) an increasing trend in the proportion of harvesters that met their needs 3) no trend in animals harvested or proportion of successful hunters and 4) improving overall caribou health throughout the period.

There was no population estimate for the herd between 2001 and 2010. In 2001, 123,000 caribou were estimated in the herd. Based on an estimated 178,000 in 1989, a declining trend of ~ 3% annually occurred at least until 2001. In the interim agencies and boards feared the herd continued to decline and worked towards and finalized a Harvest Management Plan for the herd. In contrast, from the Co-op interviews all indications suggested improving herd conditions throughout most of the decade. A successful survey in 2010 determined the herd had grown to 169,000 animals. We conclude that the community-based interviews provided a valid, unique information source to better understand caribou ecology and express community perceptions of overall herd status and could provide a valuable contribution to management decision making. We recommend that ABEKC results become standard input into Porcupine Caribou harvest management decisions and serve as a model of integrating community based monitoring data into resource management decision making throughout the north.

Key words: caribou; community interviews; harvest; local knowledge.

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Introduction

Monitoring the status of migratory caribou populations remain challenging given that current methods to estimate population size often fall victim to inclement weather and caribou distributions that are difficult or impossible to survey because of mountainous terrain and/or fragmentary groups. The Porcupine Caribou Herd (PCH) (*Rangifer* tarandus granti) increased in the early 1970s from 100,000 to over 178,000 by 1989 (PCMB, 2012). Five population estimates after 1989 indicated the herd declined by ~3% per year to 123,000 by 2001http://www.taiga.net/pcmb/population.html). Between 2001 and 2010 there were no successful population estimates of the PCH. Fearing continued decline of the herd, governments and the Porcupine Caribou Management

Board (PCMB) worked on a Harvest Management Strategy (HMS). The Strategy was ratified in early 2010 and management actions revolved around imposing restrictions or relaxing restrictions based on the current population levels in the herd (PCMB, 2010). A major action proposed in the HMS is the monitoring of a number of indicators on an annual basis to help guide annual management actions and to assess the status of the population in the absence of a population estimate (PCMB, 2011). The HMS was developed in the absence of a recent population estimate of the herd, while assuming a continuing population decline due to presumed high harvest and high adult cow mortality. Using these conservative assumptions, ecological models indicated the herd was likely still declining and estimates of around 100,000 were suggested. A successful estimate was obtained in late 2010 which indicated the herd increased since the last census and numbered 169,000 animals.

In the last few decades the involvement of local communities in better understanding caribou status, ecology, and management needs has received considerable attention (*i.e.*, Ferguson & Messier, 1997; Berkes *et al.,* 2000; Kofinas *et al.,* 2000; Kofinas, 2002; Kendrick & Manseau, 2008). Aboriginal involvement in Canada has been driven largely by the legal need to consider traditional knowledge as stipulated in current land claim settlements, the desire by co-management boards to make decisions that reflect everyone at the table, and uncertainty that conventional monitoring systems accurately reflect current caribou status (Kofinas, 2002; Lyver & Dene First Nation, 2010). Moreover, efforts to integrate both western science and community knowledge has often resulted in a better understanding of current environmental conditions than would have been possible if either source of knowledge were considered in isolation (Berkes, 1999; Kofinas, 2002).

Initiated in the mid 1990s, the Arctic Borderlands Ecological Knowledge Cooperative (ABEKC) was designed to monitor changes, from a community perspective, within the range of the PCH (Eamer, 2006). The annual interviews in a number of communities were one avenue to inform the ABEKC of what people on the land were observing. Although the focus was the range of the PCH, interview questions also asked about observations regarding other land resources and weather. Kofinas (2002) described the experience with ABEKC's ongoing ecological monitoring program. He concluded that the monitoring program provided a richly detailed holistic account of environmental conditions that extended beyond the single community to represent a regional picture. Further, the results of the community-based monitoring can serve to fill the knowledge gap left by the limitations of western monitoring program methodologies, particularly with respect to the status of the PCH (Kofinas, 2002).

In the absence of a PCH population estimate from 2001–2011, we analyzed the responses to a number of caribou-related questions from 2000-2001 onward to determine if the results of the community interviews could have helped inform managers and the PCMB regarding the status of the herd from the perspective of availability, meeting subsistence needs, harvest levels, and caribou health and condition. More importantly, we aimed to determine if the continuation of these interviews could be valuable as an integral part of the annual monitoring of the herd, in support of the HMS.

Methods

Interview Process

Kofinas (2002) described the process in conducting the community interviews for the ABEKC. Interviews were conducted in the spring by locally hired individuals selected by the local organizations. The reporting period for each interview included the previous spring, fall, and current winter observations.

Table 1. Number of interviews analyzed by interview year.

Year	Interviews
2000-01	57
2001-02	56
2002-03	43
2003-04	57
2004-05	37
2005-06	85
2006-07	78

Thus, interviews in spring 2001 represented the 2000-2001 interview year. A three-day training session prepared the interviewers to conduct interviews and report on their work. Annually, between 10 and 15 local experts were selected by the local organization to be interviewed in each community. Although not all communities participated throughout the study period, communities included in the analysis were Aklavik, Fort MacPherson, Tsiigehtchic, and Tuktoyuktuk in the Northwest Territories, Old Crow in Yukon, and Arctic Village and Kaktovik in Alaska. Local experts were identified as those with the most extensive and current knowledge of conditions on the land. Thus, for example, elders who no longer went on the land were not selected. Interviews took place in person at the most convenient location and questions were both closed and open-ended with experts allowed to elaborate on their categorical answers when necessary. Between 2000 and 2007 a total of 413 people were interviewed. There were on average 59 interviews conducted each year with a low of 37 (2004-2005) and a high of 85 (2005-2006) that provided responses related to the data analyzed in this paper (Table 1).

Data analysis

The basis of this summary and comparative analysis is the percent frequency of responses to questions posed to the interviewees. Therefore it was necessary to determine a limited number of categorical (*e.g.*, "good", "average", "bad") responses. The frequency of responses in each class were converted to a percentage and plotted for each year of the study. Trends during the survey period were tested with a Spearman correlation (SAS version 9.1; SAS, 2006)

Caribou availability

Interviewees were asked how available caribou were to their community using categories "close", "not close", or "not available" for fall, winter, and spring. In many instances, the respondents qualified their answer often related to weather factors, personal ability to travel or difficult terrain. Thus the answer cannot directly be interpreted as a quantifiable distance from community, but rather a synthesis of distance with meaning to the interviewees themselves. To directly compare from one interview session to the next, an index of caribou availability was developed (*i.e.*, collapsing all responses into one metric). The caribou availability index (CAI) was calculated as:

CAI = 3*(%close) + 2* (%not close) + (%not available);

where "close", "not close", and "not available' were the percentage of those responses for an interview session.

Meeting needs

The interviewees were asked whether they met their needs for caribou for the fall and spring hunting periods with answers of "yes" or "no". What that question meant to the interviewee was captured when they qualified their answers. Their qualifications ranged from personal ability to hunt, to caribou availability, to whether they were able to share some of their kill.

Hunting activity

For the fall and spring periods, the interviewees were asked whether they hunted or not and, if not, why they didn't hunt. The percent of respondents that actively hunted was compared among periods.

Harvest

Those hunters that responded that they hunted were asked how many animals they killed. An

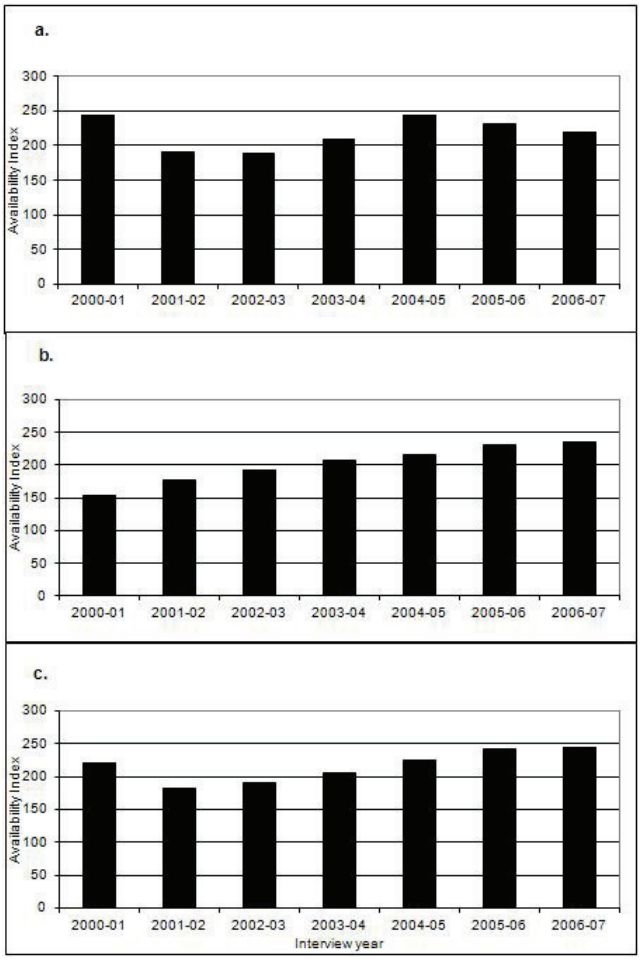

Fig. 1. Annual (2000–2007) fall (a), winter (b), and spring (c) availability index values of the Porcupine caribou herd based on community interviews.

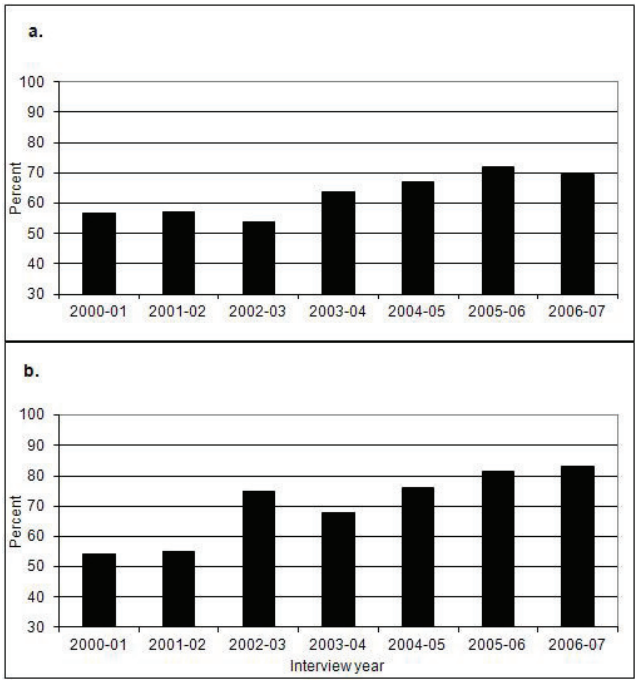

Fig. 2. Percent of respondents that met their Porcupine caribou needs in fall (a) and spring (b), 2000–2007, based on interviews in user communities.

index of harvest was calculated by multiplying the average number of caribou taken by the percent of respondents that indicated they hunted. Thus if the average take was 5 animals and the proportion of respondents indicating they hunted was 0.70, then the harvest index (HI) was 5*0.70 = 3.5. This index was used to compare HI among years.

Unusual health

During interviews, people were asked whether or not there was anything unusual in the health of the PCH in the previous fall and spring. We have used the response to this question as an annual index of the health of individuals in the PCH. If the interviewees responded "yes" to unusual health, respondents were asked what was unusual. Although most indicated negative reasons (*e.g.*, disease sign, skinny) some of those interviewed indicated positive conditions (*e.g.*, many fat animals). The health index is simply the percent of "no" responses and positive plus neutral "yes" responses, the higher the index the better the health of the herd.

Results

Caribou availability

Caribou availability in the fall showed no noticeable pattern (r = 0.07, P = 0.88) in contrast to winter (r = 0.99, P < 0.0001) and spring (r = 0.78, P = 0.04) when caribou were increasingly available beginning in 2000-2001 in winter and 2001-2002 in spring (Fig. 1). Availability based on combining all three periods shows a steady increase from 2000-2001 for the three periods (r = 0.75, P = 0.05).

Meeting needs

On average, 63% of respondents indicated that they met their needs for caribou in the fall hunting season and 70% met their needs

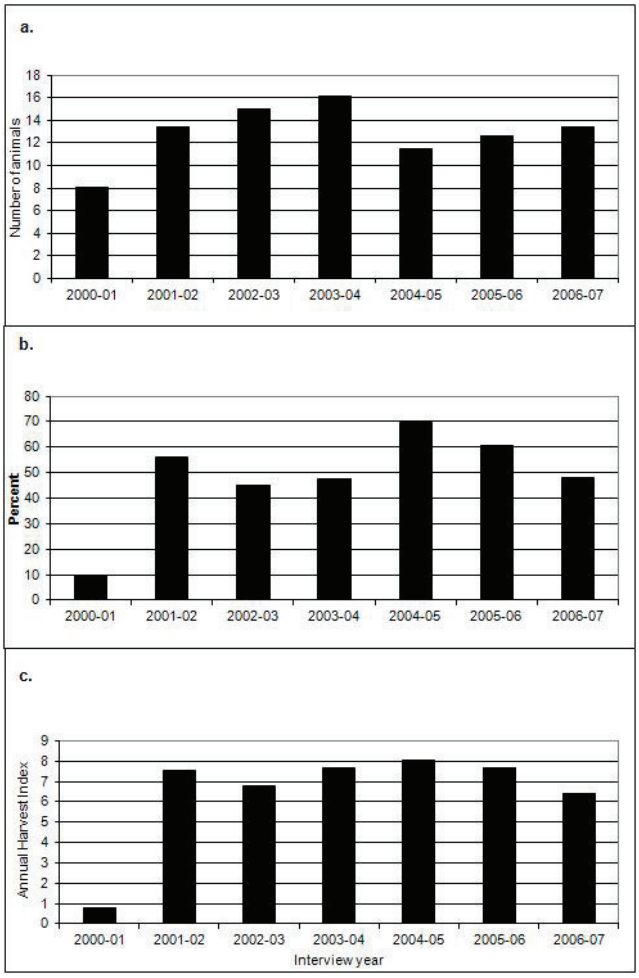

Fig. 3. Summary of harvest information of Porcupine caribou, 2000–2007, based on interviews in user communities: average number harvested per successful hunter (a), percent of interviewees that harvested caribou (b), and annual harvest index – the proportion of interviewees that hunted/average number of caribou harvested, HI (c).

in the spring hunting season. There was an increasing general trend from 2001–2007 during both spring (r = 0.96, P = 0.005) and fall (r = 0.86, P = 0.01). In the latter three years of the surveys, on average, 70% and 80% of the respondents met their needs in fall and spring, respectively (Fig. 2). We noted a positive correlation between CAI and the percent of hunters that met their needs in spring (n = 7, r = 0.83).

Hunting activity

On average, 48% of the respondents annually reported that they harvested animals and of those successfully taking animals, the average number of animals taken was 13.2+12.8, range 1-120. There was no significant trend in average number of animals harvested during the study (r = 0.17, P = 0.79; Fig. 3a). Additionally, there was no trend in the percent of respondents indicating they harvested animals (r = 0.57, P = 0.18; Fig. 3b) and no trend in HI (r = 0.32, P = 0.48; Fig. 3c). Of those that did not hunt, the majority indicated they did not hunt because animals were unavailable to them, based on their ability to access areas occupied by caribou. Beyond availability, responses were equally scattered among other response categories (*e.g.*, no means to hunt, meat obtained elsewhere, no time to hunt, never hunt in the particular season, and bad weather). The latter reason, bad weather was much more important during the spring season than the fall season.

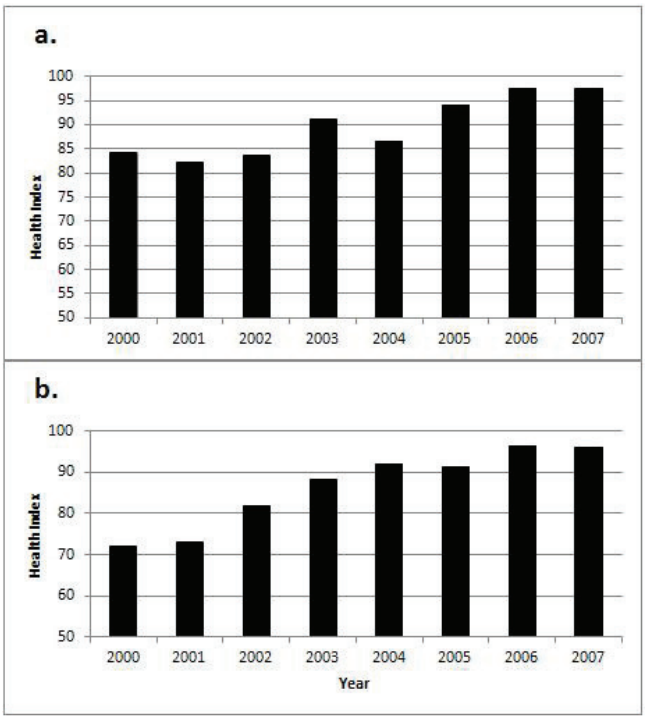

Fig. 4. Annual index of fall (a) and spring (b) Porcupine caribou herd health from 1999–2007 based on Arctic Borderlands interviews.

Unusual health

For the fall period, of 454 interviews, 99 (22%) respondents indicated there was something unusual, of which 11 (11%) gave neutral, 27

(27%) positive, and 61 (62%) negative reasons. The latter three years (2005–2007) had the highest health index among the years analyzed and there was a general increasing trend since 2001 (r = 0.90, P = 0.002; Fig. 4a). Of the 439 people who answered regarding any unusual health of caribou in spring between 2001 and 2007, 94 (21%) indicated there was something unusual and 345 (79%) said there was nothing unusual. Of those who answered "yes" to unusual, 14 (15%) indicated a positive reason (*e.g.*, unusually fat, very good condition), 53 (57%) gave a negative reason (*e.g.*, skinny, looked unhealthy, disease), and 27 (29%) gave a neutral reason (*e.g.*, many wounded animals, animals didn't come close). There was an increasing trend in the spring (r = 0.95, P = 0.0003) health index from 2000–2007 (Fig. 4b).

Discussion

During the period when aerial photo-census surveys to determine population estimates for the PCH were ineffective, community people reported an increasing availability, increased ability to meet their harvest needs, a stable harvest, and an increasing trend in caribou health. We conclude therefore that based on these interviews with community members between 2001 and 2007, conditions for the PCH and the ability of communities to access caribou apparently improved, especially for the spring period. Similarly there was a positive trend in the number of respondents indicating they had met their needs, which was related to caribou availability.

Although caribou tended to be more available throughout the period and a greater proportion of hunters met their needs, these factors did not translate into a higher harvest of caribou. The results of the percent of successful hunters and the average number of caribou taken indicate that HI remained constant throughout the period, with the exception of a low harvest in 2000-2001. In that year fewer people hunted (9.8% versus 48%) and those that did harvested fewer animals (8.1 versus 13.0) compared to the long-term average. This also suggests that this HI may not be sensitive enough to detect subtle changes in caribou availability, because the group targeted for interviews were community experts who may be able to compensate for reductions in 'herd availability' while other less experienced hunters may be affected by changes in availability.

There is a myriad of factors that can influence the health and condition of caribou in fall and spring. Fall condition is related to lactation status and probability of pregnancy (Cameron *et al.,* 1993; Gerhart *et al.,* 1997; Russell & White, 2000), condition entering in the summer, timing of green-up, level of summer insects (Weladji *et al.,* 2003) as well as parasite load and disease (Albon *et al.,* 2002). Snow characteristics play a primary role in the condition of caribou in the spring (Weladji & Holand, 2003), although lactation status and pregnancy (primarily in late-spring) also are important. Thus, community perception of caribou health integrates all these factors and more (Lyver & Dene First Nations, 2010). Parlee et al. (2005) noted a number of indicators that aboriginal hunters use to determine the health and physical condition of caribou, including not only overall appearance and chest girth, for example, but also behavioural characteristics.

Existing knowledge about caribou is frequently uncertain. The learning process involved in making management decisions includes mutual acknowledgement among co-management participants of the limitations of what is known about caribou systems (Kendrick, 2003). Co-management boards cannot make effective management decisions when information about population levels and harvest rates are lacking. The only way to address this lack of information is to develop multiple methodologies for collecting information about

herd status from the multiple perspectives and knowledge that are held by people sitting at the co-management table (Kendrick, 2003).

The HMP calls for an annual assessment of herd status by considering a number of biological indicators, as well as several caribou-related questions from the ABEKC questionnaire. However, for the first annual assessment, results of the ABEKC interviews were not requested so ABEKC information was not available for consideration during those discussions. One of the objectives of this manuscript was to identify information sources to the PCMB and management agencies, especially during the period when little scientific data are available on harvest levels and trends in the population.

The development of ABEKC's indicators of caribou population condition presented here are significant for resource managers. First, the requirement to integrate community-based knowledge into decision making has been hindered by our ability to monitor local knowledge and integrate results to address management concerns. This paper is a start to address that challenge. Second, knowledge gaps related to conventional ecological monitoring in the north (*e.g.*, population estimates), leave decision makers with no alternative or parallel monitoring information. In fact, at the writing of this manuscript, the planned 2012 photo-census was cancelled due to poor weather and failure of the PCH to congregate during the calving/post calving period. At the same time, preliminary results from the ABEKC interviews for 2011 were already shared with government agencies, aboriginal governments, and co-management boards at the ABEKC data validation gathering in March 2012.

The next logical step would be to better understand and integrate ABEKC interview results with climate data, vital rates, and satellite collar movement and distribution data. These observations by expert community members need to be considered as an integral component in understanding the status of the PCH and thus should be presented, circulated, and utilized based on their own merit.

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