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Source: *Wildlife Society Bulletin (1973-2006)*, Summer, 1999, Vol. 27, No. 2 (Summer, 1999), pp. 488-498

Published by: Wiley on behalf of the Wildlife Society

Stable URL: <https://www.jstor.org/stable/3783918>

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# Contrasts in use and perceptions of biological data for caribou management

*David R. Klein, Lisa Moorehead, Jack Kruse, and Stephen R. Braund*

**Abstract** Attitudes and perceptions toward caribou (*Rangifer tarandus*) management practices held by users and managers of the Western Arctic Herd (WAH) in Alaska and the Beverly and Qamanirjuaq herds (BQH) in Canada were compared through structured interviews with both users and managers. Collection of population dynamics data received highest priority by managers in both Alaska and Canada, with aerial photocensuses, recruitment surveys, and calving-ground surveys emphasized. Alaskan managers also emphasized making natality and mortality surveys and plotting herd movements, whereas in Canada, range-use patterns, wildfire effects on movements, delineation of calving grounds, and access of caribou to traditional users are important in management. Differences in priorities to collect biological data to manage the WAH and the BQH resulted from the larger range for the BQH, complications of monitoring 2 herds with overlapping ranges in Canada, somewhat greater funding and logistic resources available in Alaska, and the greater number of jurisdictions in Canada. Indigenous hunters, who are the primary users of the caribou of the WAH and the BQH, found herd monitoring practices used by managers, such as radiocollaring and aerial surveys, more acceptable in Alaska than in Canada. In Alaska, hunters indicated a greater willingness to accept restrictive hunting quotas, if they were to be imposed, than was the case in Canada. Managers are increasingly recognizing that indigenous knowledge has a role to play in caribou management; caribou users are including, with their traditional views of the ways of the caribou, information derived from biological investigations.

**Key words** Alaska, Canada, co-management, population data, *Rangifer tarandus*

Managing wildlife as a sustained annual crop had its roots in Western Europe, but it was in North America, where wildlife is a common-property resource, that wildlife management evolved as a professional science. By the 1930s, most states and provinces had established agencies to oversee the well being of resident wildlife, enhanced by Leopold's textbook on wildlife management (Leopold 1933). It was only after the late 1940s that the large migratory herds of caribou (*Rangifer*

*tarandus*) in northern North America had become the focus of extensive biological surveys to assess their status and determine harvest levels. At that time, there was general concern in Alaska and northern Canada over apparent decline of these migratory herds, and intensive hunting by indigenous people was an often cited cause for the decline, especially in Canada (Banfield 1954, Sonnenfeld 1960). Subsequent studies also noted the possible influences on caribou population dynamics

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of fires on winter range (Leopold and Darling 1953, Kelsall 1968), winter weather extremes (Skoog 1968), and predation (Bergerud 1974).

Following recovery by the 1960s of the large caribou herds (Davis et al. 1980), wildlife management agencies infrequently monitored these herds. Traditional subsistence hunting was no longer considered a threat to the herds, and management efforts were largely directed toward wildlife at lower latitudes, hunted primarily by sport hunters. Not until the mid-1970s did management again focus on caribou in Alaska and Canada, when aerial counts indicated that several of these northern herds were declining rapidly (Parker 1972, Davis and Valkenburg 1978). The remoteness of these herds and the limited governmental support that was available for their management have plagued biologists' efforts to collect data on these herds and brought into question the priorities for data collection.

Managers and local users of caribou often have disagreed on the status of the herds and resulting management proposals. Efforts by the managing agencies to curtail harvest by indigenous hunters in the mid-1970s were initially unsuccessful, demonstrating the lack of understanding and trust that existed between managers and users of caribou (Davis et al. 1985). Consequently, a major revision of the existing systems to manage these herds was needed. In Canada, a co-management board was established in 1982 to guide management of the Beverly and Qamanirjuaq caribou herds (BQH) (Figure 1) (Thomas and Schaefer 1991). Eight representatives of the indigenous users constituted most of the board's membership. Remaining members included biologists, managers, and administrators from the wildlife management agencies involved. The board usually met biannually, with one meeting a year in a user community. The board heard recommendations of biologists and managers, and, although operating under democratic procedures, attempted to achieve consensus in reaching management or policy decisions. Although the board has only advisory authority to the govern-

ments of the Northwest Territories, Manitoba, and Saskatchewan, which have legal jurisdiction over the herds, there is a record of acceptance of the board's recommendations. Within the constraints of operating budgets, these recommendations have primarily focused on management policy, regulation enforcement, and public education.

Soon after the decline of the Western Arctic Herd (WAH) (Figure 1) in the late 1970s and early 1980s, Alaska increased efforts to involve indigenous hunters in wildlife management by activating local advisory committees consisting of users of caribou and other wildlife (John Coady, Alaska Department of Fish & Game, personal communication). Provision for advisory committees existed in state statutes from the time of Alaska's statehood in 1959, but few had been established. An increased effort also was made by the state biologists and wildlife managers to interact with caribou users. Results of these interactions were provided to the Board of Game that sets hunting regulations and wildlife policy for the entire state. In 1978, Alaska passed a subsistence priority law, which established regional councils with representatives from local advisory committees. These councils made recommendations to the State Boards of Fisheries and Game, which also considered recommendations from other citizen groups, individuals, and Alaska Department of Fish and Game managers and biologists. The Kotzebue Fish and Game Advisory Committee and the Arctic Regional Council became the primary groups representing user interests in management of the WAH. Unlike the Beverly and Qamanirjuaq Caribou Management Board, which dealt solely with managing the BQH,

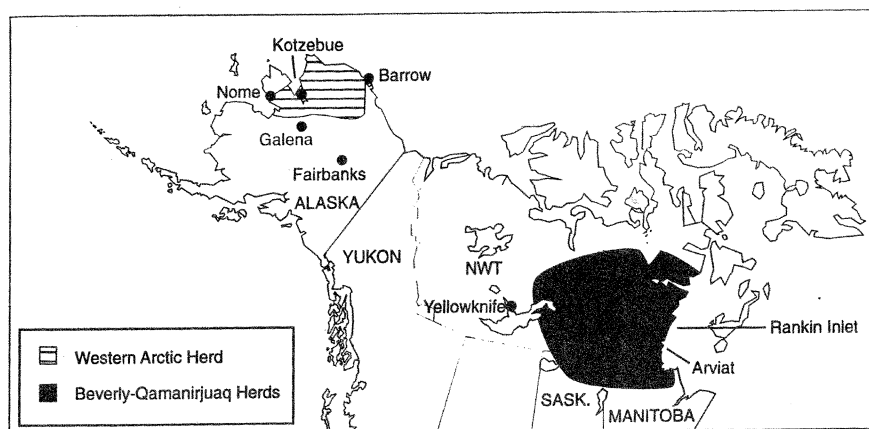


Figure 1. Location of the caribou herds that were the focus of the study and places mentioned in the text.

the focus of the regional advisory groups in Alaska included all fish and wildlife management issues, and the Board of Game's responsibility was statewide.

In this paper, we compare the biological data in each of the 2 management systems, priority for types of data collected, how these data were collected and applied, and the resulting quality of these data. Thus, we compared the effectiveness of the 2 management systems in meeting their goals of caribou management and user satisfaction. We expected that the system with more direct user involvement would have better biological data available for management (Osherenko 1988). Other factors expected to affect the types of biological data collected and their quality included funding available, size of the range area occupied by the caribou, and ecological conditions. Our research questions about user involvement and the priorities to collect biological data and their quality reflected an expectation that traditional users, through their participation in the management system, would place increasing weight on the value of biological data (Usher 1987). We also expected that government managers, again through interaction with traditional users, would place increasing weight on the value of indigenous knowledge.

## Methods

Numbers of caribou ( $\pm 500,000$ ) were similar in the 2 areas, whereas nearly twice as many subsistence households were involved in Alaska ( $\pm 2,870$ ) as in Canada ( $\pm 1,955$ ). We interviewed 48 biologists, supervisors, conservation officers, and enforcement personnel. This constitutes a virtual census of government managers and is thus not subject to sampling error. We surveyed approximately 200 traditional users of caribou in each of the study regions. Users were selected so that each household and each adult in each household had a known probability of selection. In Alaska we selected 11 of 31 user communities and in Canada 7 of 16 user communities. We used face-to-face interviews structured around a set of open- and closed-ended questions. Interviews took between 1 and 5 hours to complete. We coded closed-ended responses into an SPSS (Statistical Package for the Social Sciences) file format for analysis. Response rates were 85% in Alaska, 90% among Canadian Inuit, and 61% among Canadian Dene and Metis. For each traditional user survey, we estimated that

results were subject to a maximum sampling error of  $\pm 7$  percentage points at a 95% level of confidence. We used contingency table analysis to test for significant differences between responses of Canadian and Alaskan users to the same interview questions.

Biologists and managers working with the WAH and the BQH were contacted and interviewed to determine data gathering and monitoring practices used. Specific information on methodologies used to collect biological data also was obtained for the WAH from a review of Federal Aid in Wildlife Restoration Annual Performance Reports of the Alaska Department of Fish and Game (ADF&G); The Western Arctic Herd Strategic Management Plan, ADF&G and Board of Game 1984; and other Federal Aid in Wildlife Restoration Project Reports of ADF&G. For the BQH, File Reports and other reports of the Department of Renewable Resources of the Government of the Northwest Territories (GNWT) dealing specifically with collecting biological data and management for the BQH were reviewed, along with similar reports of the Canadian Wildlife Service (CWS) and the Beverly and Qamanirjuaq Caribou Management Board draft report on fire management. A measure of the quality of data collected was the degree of satisfaction with the data expressed by managers. Preliminary drafts of the tabular comparisons of data collection methods and priorities (ultimately resulting in Table 1), and the accompanying text were then presented to regional management supervisors for the WAH and BQH for critical review by them and their staffs. Their assistance, constructive review, and ensuing discussions were essential to develop this comparative analysis.

## Results

### *Training and background of biologists*

Methodology to collect data on herd welfare and ecology, human harvest, and habitat status for the WAH and the BQH has in both situations been developed by professionally trained biologists employed by the responsible government agencies. Most biologists received their professional training in universities of the country where they were employed, although the GNWT and the CWS have employed several biologists who are Americans, as well as Canadians with training in American universities. The basic biological training received by biologists trained in American and

Table 1. Priorities for collection of biological data to manage Western Arctic (WA) and Beverly and Qamanirjuaq (BQ) caribou herds (Reflects situation in 1994 and 1995 and does not include past one-time studies).

	Priority				Use in management	Problems
	Highest	Interme	Low	None		
<u>Population Dynamics</u>						
Photocensus	WA/B Q				Provides trend information, traditional management tool	High cost, variable accuracy, weather often not favorable
Recruitment surveys	WA/B Q				Provides index to herd welfare indicator of population trend	Difficult to classify animals, variable accuracy
Timing of calving (For BQ tied to photo census)	WA/B Q				Variation in peak of calving reflects herd condition	Long flight time=high cost, weather often not favorable
Natality estimates	WA		BQ		Reflects actual natality and physiological condition of herd	Accuracy poor unless large samples of radioed females
Summer calf surveys			WA	BQ	Measures survival past period of heaviest mortality	Costly, variable results
Harvest estimates	WA		BQ		Partly political, intensive education program required, data little used	Poor cooperation from hunters results poor in spite of large effort
Adult survival		WA		BQ	Indicates calf survival	Requires large sample of radioed animals, costly
Calf survival via radio collars				WA/B Q	Indicates survival data	Requires large sample of radioed calves, handling effects, costly
Predator, population surveys		WA		BQ	Assessment of predation potential	Wolves difficult to survey, variable accuracy
Survey of alternate prey				WA/B Q	Relates to predator populations	Baseline research on role of alternate prey contradictory
<u>Body Condition and Nutrition</u>						
Body condition		BQ	WA		Indicator of physiological condition	Requires weighing animals, other techniques poorly developed
Calf birth weights				WA/B Q	Indicator of physiological condition	Costly, disrupts female-calf bonding
Calf fall/winter condition	WA			BQ	Relates to physiological condition and parasitism	Small sample size, no historical baseline
Disease and parasitism	WA/BQ				Indicator of herd welfare	Limited sample size, lack base studies
Assessment of contaminants		BQ	WA		Response to user concerns	Difficulty in assessing risk to users
Hunter opinions		BQ	WA		Response to user interest, little used at present	No methodology established, difficult to evaluate hunter reports
Monitor human disturbance		WA/BQ			Provide basis to minimize conflicts with development	Subjective criteria for assessment, limited funding for monitoring of BQ
Insect effects				WA/BQ	Relate to energetics and physiological condition	Poor techniques for monitoring, difficult to evaluate effects
Habitat Use and Range Status Movements/herd identity	WA	BQ			Control harvest if herds are mixed on wintering grounds	Requires radiotracking collared animals, increased use of satellite collars, small sample size
Range use patterns	BQ		WA		Relate range use to habitat protection	Inadequate baseline vegetation maps
Effects of wildfire	BQ		WA		Affect caribou distribution for harvest	Low likelihood of fire control in remote areas, political/emotional issue, long-term studies

(Table continues on next page)

Table 1. continued.

	Priority				Use in management	Problems
	Highest	Interme	Low	None		
Assess forage reserves			WA/BQ		Predict herd use patterns and herd carrying capacity	Management agencies do not employ botanists, labor intensive and costly, long-term studies
Delineate calving grounds	BQ	WA			Identify and protect calving grounds from development/disturbance	Interannual variation, require long-term monitoring
Delineate insect relief areas		WA	BQ		Identify and protect critical habitat units	Interannual variation due to weather, varies in relation to topography
Habitat loss to development		BQ	WA		Planning to minimize or mitigate effect of development	Difficult to assess effects, long-term studies
Snow effects		WA	BQ		Relate to survival surveys and hunter access	Requires ground-based surveys, difficult to evaluate effects, from hydrographic surveys for BQ
Access by traditional users for hunting	BQ		WA		Access may determine harvest levels, mapping access routes	Varies in relation to timing of hunting and snow characteristics

Canadian universities has been similar; however, many American universities offering degrees in wildlife management emphasize principles and practices of wildlife management (based on review of college catalogs).

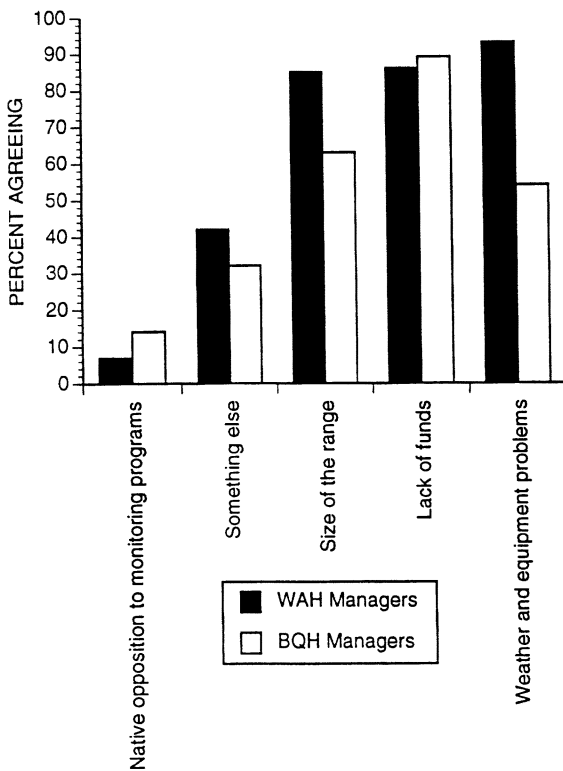


Figure 2. Managers' perceptions of factors limiting quality of biological data collected for caribou management.

Although geographically isolated, biologists from the WAH and BQH regularly interact at professional meetings where they present papers, serve on discussion panels together, and exchange views and ideas. This has most commonly occurred through the North American Caribou Workshops, held about biennially in either Alaska or Canada, and the International Reindeer-Caribou Symposia (since 1991 incorporated in the International Arctic Ungulate Conference), held about every 4 to 5 years since the first in Alaska in 1972. In addition, biologists often meet at wildlife conferences and workshops not specifically oriented toward caribou. Occasional short-term exchange visits occur between Alaskan and Canadian caribou biologists to share experience and new techniques. Biologists also publish in and read the same professional journals.

*Herd profiles*

*Western Arctic Herd.* The WAH occupies a vast range area of about 300,000 km<sup>2</sup> at the current high population level (Figure 1). Biologists with primary responsibility for working with the herd are based at Kotzebue. This town has been the staging location for most caribou survey work, which frequently also involves biologists based in Nome, Barrow, Fairbanks, and Galena. Some aerial tracking of radiocollared caribou is conducted from Barrow, and plotting winter distribution of caribou in relation to reindeer herds on the Seward Peninsula is done from Nome. Kotzebue lies on the western

periphery of the herd's range, closer to wintering areas, which are mostly within 200 km to the east and south, than to calving grounds and summering areas, 300 to 400 km or more to the north and northeast.

Financial support available to collect biological data on the WAH is largely through the Division of Wildlife Conservation of ADF&G. The annual operating budget available for this work in 1994 was about \$100,000. This is over and above salaries of biologists involved and annual maintenance costs of ADF&G aircraft used in the work. Funds are from the Federal Aid in Wildlife Restoration Program (Pittman-Robertson Act). Collecting data on hunter harvest for the WAH has been done by personnel from the Division of Wildlife Conservation and the Division of Subsistence of ADF&G. The Division of Wildlife Conservation uses a harvest reporting system requiring harvest tickets and postcard reports of harvest for hunters who are not residents north of the Yukon River. Residents north of the Yukon River, which encompasses the range of the WAH, are required to report their estimated harvest of caribou to license sale vendors in the villages. Compliance with this requirement is poor, thus harvest data obtained from this source is considered unreliable. The Division of Subsistence periodically collects wildlife harvest data from all or a sample of households in a chosen community, resulting in estimated community total and mean per capita harvests of various species. However, the Division of Subsistence does not have a specific mandate to collect harvest data to use in assessing welfare of fish and wildlife populations, although a particular concern about an animal population may prompt harvest research. The Division's responsibility is to investigate the role of subsistence hunting and fishing in the lives of Alaska residents. Accordingly, the university education of most employees of the Division of Subsistence has stressed anthropology and other social sciences, rather than biology. The low operating budget derived from the state's general fund and established priorities of the Division do not permit annual data collecting in all WAH communities concerning harvest of caribou.

*Beverly-Qamanirjuaq Herds.* Rangelands occupied by the BQH encompass nearly 700,000 km<sup>2</sup>, over twice that of the WAH. Yellowknife, the base for most biologists working with these 2 herds, lies west of the ranges of these herds, with calving grounds 600 to 800 km distant and with major win-

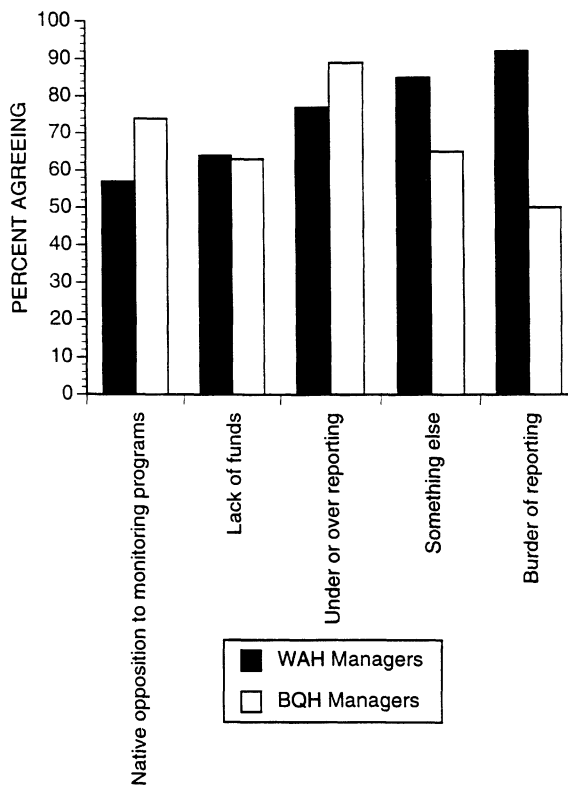


Figure 3. Managers' perceptions of factors limiting quality of harvest data.

tering areas extending into Saskatchewan and Manitoba, up to 1,000 km away.

The GNWT obtains most biological data from the BQH with Yellowknife as the base for work with the Beverly Herd and work with the Qamanirjuaq Herd conducted out of Rankin Inlet and Arviat. One full-time biologist with primary responsibility for the respective herd is based in each community. Technicians or other biologists are involved when additional assistance is required for intensive surveys, radiocollaring, or other field activities.

Financial support to collect biological data on the BQH is primarily through the Department of Renewable Resources of the GNWT, although federal moneys are involved. The annual allocation of funds for research and monitoring for the BQH by the GNWT in 1993 was \$98,000 Canadian, exclusive of salaries. Comparable amounts provided for this purpose in Manitoba and Saskatchewan were \$10,000 and \$1,850, respectively; Manitoba also has provided one aircraft and pilot for the photo censuses, except for the repeat census in 1994. Although the Beverly and Qamanirjuaq Caribou Management Board does not normally provide funds for

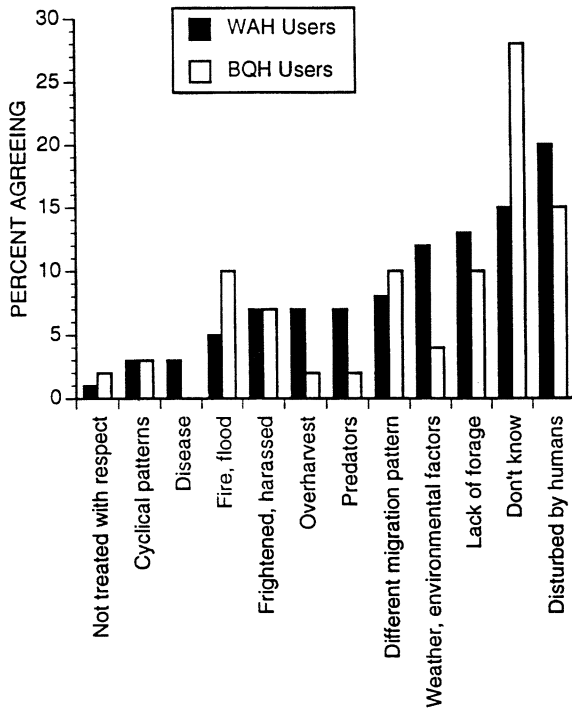


Figure 4. Caribou user perceptions of why caribou were not available during periods of scarcity.

research and monitoring, the board did contribute some money and strongly supported the biologists' request to do a repeat photo census of the Beverly Herd in 1994 because of the unexpectedly low population estimate from the 1993 census.

#### *Efforts to obtain critical biological data*

A direct quantitative comparison of the effort expended to collect biological data considered important to manage the WAH versus the BQH is difficult. Nevertheless, the larger range area, the requirement to collect data on 2 herds, lack of availability of wildlife agency aircraft and pilots, and lower number of employed biologists associated with the BQH result in less effort expended to collect biological data for these herds than for the WAH. These differences presumably are reflected in managers' perceptions of factors limiting quality of biological data collected for the 2 caribou populations. Canadian managers indicated lack of funds (89%) as the major factor limiting quality of biological data (Figure 2), with size of the range (63%) and weather and equipment problems (54%) of secondary importance. In contrast, Alaskan managers cited weather and equipment problems (93%), lack of funds (86%), and size of the range (85%) as of near-

ly equal importance in limiting quality of biological data collected. User opposition as a factor limiting quality of biological data was seldom mentioned by government managers in either system.

Collecting harvest data is considered important to manage the Alaskan and Canadian caribou populations and is tied closely to public relations activities. However, quality of harvest data obtained has been considered inadequate for caribou management in Alaska and Canada. The importance of factors limiting quality of harvest data varies between the WAH and the BQH (Figure 3). WAH managers cited the burden of reporting (92%) as the major obstacle in obtaining high quality harvest data, whereas BQH managers believed under-reporting or over-reporting (89%) was the major problem. Burden of reporting was the least significant limitation for BQH managers.

In Alaska, an activity occupying considerable time and effort of management biologists is aerial monitoring of distribution of wintering caribou that move onto the Seward Peninsula where reindeer herding is practiced. Reporting on distribution and movements of caribou is done as a service to reindeer herders to reduce conflicts that occur when reindeer and caribou interact.

### Management options

With caribou herds currently at high levels, no incentive exists for managers to control hunting by subsistence users of the herds. Nevertheless, managers in Alaska and Canada believe that any future efforts to impose harvest quotas will require intensive educational and decision-sharing efforts to achieve a significant degree of compliance. Controlling hunting is potentially more readily available in Alaska, where enabling legal structures are in place, than in Canada. When users and managers were questioned about user compliance with harvest quotas, if they were to be imposed in the future, WAH users were more optimistic than the WAH managers, with only 31% of WAH managers believing that users would comply with restrictions on numbers of caribou that could be harvested, compared with 61% of users saying that they would comply with restrictions on harvest ( $P < 0.05$ ). In Canada, managers were more optimistic than users: 64% believed users would comply with restrictions on harvest, whereas 47% of users believed they would abide by restrictions ( $P < 0.05$ ).



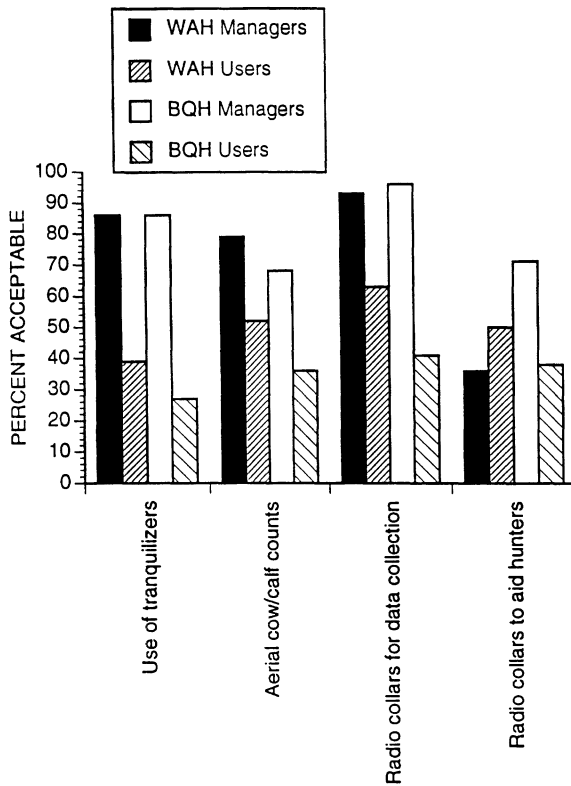


Figure 5. Attitudes of managers and users of the caribou toward herd monitoring practices. User and manager attitudes were significantly different ( $P < 0.05$ ) in all cases.

### *Native perspectives on biological data*

Concerning scarce caribou numbers in the past, users in both systems were as likely to say that they did not know, or that they were absent in the past because of human disturbance, than they were to mention reasons commonly offered by biologists, such as predators, overharvest, disease, range conditions, and weather (Figure 4). Thirty percent of Alaskan managers said that user reports are hard to interpret compared with 50% of Canadian managers. Thirty percent of Alaskan managers and 42% of Canadian managers said that such reports could be useful.

Regarding acceptance of biologists' practices for monitoring caribou populations, users did not differ in their support of such practices ( $P > 0.05$ ) (Figure 5). Managers in both countries agreed on using radiocollars and using tranquilizers in live capture, but varied in their support of aerial cow:calf counts and in using radiocollars to aid in locating animals for hunters.

The ability to obtain accurate harvest data is a concern for biologists attempting to quantify all

forms of mortality within the herd. In a caribou population decline, one of management's tools is to attempt to reduce mortality through harvest restrictions and predator control. Native opposition to harvest reporting appears to be more of a problem for Canadian managers (74% cited this reason) than Alaskan managers (57% cited this reason).

## Discussion

Interviews with caribou users and managers in both systems suggest divergent perspectives on caribou ecology and management. We believe that these differences contribute significantly to survey results that were, at times, inconsistent with our expectation that greater user involvement in management would be associated with shared beliefs about changes in caribou populations, one of our measures of management effectiveness. We expected that direct involvement of traditional users in a management board, as reflected in the Canadian BQH system, would be generally associated with indicators of a more effective management system, with more shared perceptions of managers and users. We have focused in this paper on 2 measures of management effectiveness: (1) the quality of biological data as assessed by managers and (2) shared perspectives on biological data between government managers and users.

### *Quality of biological data*

We assessed quality of biological data collected to manage the 2 herds on the extent of data collected in each category and the degree of satisfaction expressed by the biologists and managers in the adequacy of the data for management. Our comparison of the biological data in the 2 systems suggests that factors other than direct user involvement primarily account for differences in the quality of these data. For example, we expected that managers in Canada would have found user reports of caribou body condition and behavior more useful than in Alaska. However, managers in Canada had at least as much difficulty interpreting and using hunter reports as did Alaskan managers. It is apparent from comparisons made in Table 1 that specific methods used to gather biological data on the WAH and the BQH, associated priorities, as well as quality of the data obtained, vary in response to the many differences that characterize the 2 management systems. Most differences may result from the opportunities and constraints associated with

geographical, governmental, societal, and financial differences that exist. These include: (1) the BQH collectively occupied larger range areas than the WAH (Figure 1), and the travel distances required to monitor those herds were thus greater; (2) similarly, the degree of effort required to monitor population variables of 2 herds in Canada is greater than for one herd in Alaska; (3) financial and logistic resources available are somewhat greater in Alaska; (4) more governmental entities are involved in Canada (the range of the BQH overlaps 2 provinces and the Northwest Territories, whereas the WAH ranges are entirely within Alaska); and (5) user involvement in approval of methodology employed is somewhat greater in Canada.

Techniques used to collect management data for the WAH and the BQH (Table 1) are usually developed by biologists who have been or currently are responsible for the work. These techniques, such as photo censuses and counts of sex and age composition, do not require approval of the Alaska Board of Game, but approval is required of the Beverly and Qamanirjuaq Caribou Management Board. Priorities to collect specific types of data are set by the biologists rather than the management boards, although the Beverly and Qamanirjuaq Caribou Management Board has endorsed frequent photo censuses to establish population trends. It is often necessary to reach a compromise between what is the best or most ideal method to use and that which can be accomplished within constraints imposed by environment, governmental systems, time and money available, and other factors unique to each system. In such situations, pragmatism prevails over idealism.

Government managers in both systems do not think that opposition to herd monitoring programs by the users is a major factor limiting the reliability of most biological data collected because it is collected by the biologists. However, opposition by traditional users to harvest monitoring programs is seen as a substantial problem for both systems, although results indicate opposition may be more widespread for BQH. Thus, where we expected better compliance in Canada due to greater user involvement in the management system via the degree of user involvement in the board, there appears to be more resistance to harvest reductions there than in Alaska, where traditional users are more accustomed to hunting restrictions and managers interact more directly with the users at the village level.

It was surprising to us that the Canadian system, with greater direct user involvement in the management board, has not produced more widespread support of management activities and management actions. This points to an important finding of the study: the cooperation felt by managers and users on the management board does not extend to the villages where most users reside.

Study results suggest that in Canada and Alaska, administrative changes have improved communication from traditional users to government managers. However, communication in the other direction, and therefore the ability to implement management changes, remains problematical. Our ideal notion of representative government (i.e., that of citizens and policy makers) is that a few people can identify and negotiate the concerns of their constituencies. While user representatives effectively bring concerns to management, they do not believe that they have authority to negotiate. These powers reside with the community. The representative model of the Beverly and Qamanirjuaq Caribou Management Board is made more problematic by the fast pace of intensive 2- to 3-day meetings. The press of time does not allow user representatives to become comfortable enough with new information to relate the issues to people at home. The result is a break in communication between management and traditional users at the village level.

While conducting our study, we found that in Alaska and Canada, a significant change in the management system at a more local level pre-dated the broader administrative responses, which were the major focus of the study. These changes offer insights about what may be missing from the overarching systems selected for study. In 1975, the Province of Manitoba had sought to directly involve user communities in management issues regarding the Qamanirjuaq Herd (Kearney 1977). During the next 4 years, the area biologist held 71 meetings involving 3 caribou-user communities (Kearney 1980). This level of village involvement appears to be without precedent in the management systems of either Canada or the United States.

In Alaska, regional managers in the Division of Wildlife Conservation of the Department of Fish and Game made a concerted effort to recruit area biologists who viewed postings in rural communities within the caribou range as desirable rather than, as was traditionally the case, as a necessary but undesirable step in one's career (John Coady

personal communication). Consequently, area biologists have established good working relationships with traditional users. Both of these examples emphasize the importance of ongoing direct contacts with individual users.

## Summary

Options potentially available for active management of the large migratory caribou herds of North America influence where effort is directed for biological data collection. Options and priorities for management of the WAH and BQH are basically similar. However, there are significant differences that may stem from differences in legal structures, user involvement in management, and ecological relationships of the herds. Public relations activities are very important to managers of both herds and require a balance of efforts with those directed toward collection of biological data. Contrary to our expectations, in at least one dimension of user involvement—meetings between managers and community groups—the Alaska system appeared to have a higher level of user involvement. Proximity of managers to users appears to be an important factor to account for the higher frequency of interaction between managers and users for the WAH. Many of the constraints imposed on collecting biological data to manage caribou in the WAH and the BQH relate to the remoteness of these northern regions. However, recent advancements in technology for live capture, handling, monitoring of movements, and recording other population parameters of caribou offer the potential for continued improvement in the quality of biological data collected for caribou management.

For these northern herds, there is little opportunity for direct management of the habitat or rangelands through manipulative practices, as there is for other wildlife species at lower latitudes where agriculture, forestry, and other human activities dominate the landscape. Although fire is a natural feature of the ecology of caribou winter range, control of fire in these remote regions is not considered a feasible management tool (Saperstein 1993, Beverly and Qamanirjuaq Caribou Management Board 1994, Thomas et al. 1996). Habitat-related management efforts, therefore, have been primarily directed at minimizing the potential disturbance effects of mining or other development activities through regulatory constraints and predevelopment planning. Wolf control has met with such strong public

opposition in recent years that its use in ungulate population management may no longer be acceptable (Miller et al. 1994, National Research Council 1997).

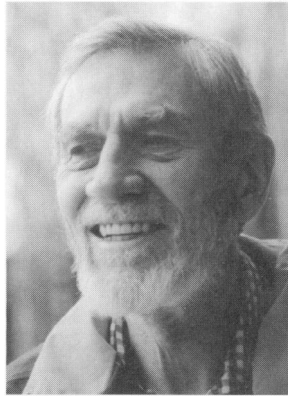
Common to both management systems is the recognition that user involvement is critical for effective management of these large migratory caribou herds. However, achieving user involvement requires interaction between managers and users at the local level independent of formal administrative structures.

*Acknowledgments.* Funding for this study was provided by the United States Man and the Biosphere Program through the High Latitude Ecosystem Directorate. We thank William Simeone, R. Terry Bowyer, Dennis Griffith, Robert Bromley, Harry Jacobson, and 2 anonymous reviewers for their constructive comments on early drafts of the manuscript.

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**Associate editor:** *Jacobson*