

Wildlife Co-management defined: The Beverly and Kaminuriak Caribou Management Board

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Abstract: A comparison of indigenous and scientific forms of wildlife data gathering and conservation/management reveals similarities and differences. The two systems are needed to effectively manage wildlife in northern Canada, particularly migratory, trans-boundary species. The Beverly and Kaminuriak Caribou Management Board brought multi-jurisdictional caribou users and managers together to co-manage two large herds of caribou (*Rangifer tarandus groenlandicus*). The advisory Board's principal duties and responsibilities are communication and to maintain the two herds at population levels that will meet user needs. Goals, objectives, and principles are set out in a management plan. Board activities are structured in 15 action plans under major categories of communication, supply of caribou, use of caribou, and habitat. Board successes are attributed to use of the plan to guide actions; to the Chairmen and vice-Chairmen; to the quality of founding members and their continuity; to effective vehicles of communication such as a newspaper, radio, video, and community meetings; to a spirit of cooperation; and to high caribou numbers because of high productivity combined with poor accessibility. Problem areas include technical limitations, members' decreasing powers and increasing turnover, inadequate communication of Board objectives and activities within the communities, and accountability. Future challenges include the management of caribou shortages, obtaining better herd data, and the need for more intensive management as user populations grow.

Keywords: caribou, caribou management board, conservation, management

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Introduction

Management of the great caribou herds that migrate between forests and tundra of the Canadian mainland and across political boundaries poses a great challenge. Traditional user groups include many different cultures of Inuit, Chipewyan, Cree, and Metis and a few white trappers with special hunting licenses in the Northwest Territories (NWT). These groups have unrestricted use of the caribou resource by treaty, aboriginal rights, special licences, and tradition. Southern forms of wildlife management had limited application. They are based to a large extent on regulating the kill by hunters. Regulations were foreign to users and their imposition unacceptable for several reasons. Enforcement of any rules was difficult to impossible.

A further serious problem was obtaining reliable scientific data on the herds. Costs were extremely high and difficult to justify unless management was

possible. Data obtained in the late-1940s and 1950s indicated a serious decline in caribou numbers (Banfield 1954, Kelsall 1968). Inter-government committees were established to coordinate research and look for management solutions. Regulations on use of caribou, educational programs, and wolf poisoning were introduced to stem the decline in caribou numbers (Kelsall 1968). From 1967 through 1972, an attempt was made to fight fires on the winter range of the Beverly herd. After apparent recovery of caribou numbers in the 1960s and 1970s, a serious decline in the Kaminuriak herd was indicated by survey data in 1980. The native people disagreed with the survey data. In 1979–80, the Beverly herd wintered in northern Saskatchewan in areas accessible by road and 15,000–20,000 were killed. Native users were blamed for caribou declines. A confrontational atmosphere developed between users and wildlife biologists/managers.

In the late 1970s, it became obvious to government managers that the native people must be part of the solution to management of the Beverly and Kaminuriak herds of caribou. The first step was to get native users and government managers around the same table to discuss the problem and seek solutions. This led to the first co-management caribou board described herein.

How can co-management work best? First of all, native users must learn about scientific forms of management and biologists and managers must learn about native culture and attitudes towards wildlife. The scientific form of wildlife management was virtually unknown by native users of caribou. In the 1980s, papers began to appear on indigenous forms of conservation and management (Freeman 1985; Usher 1986, 1987; Feit 1988; Osherenko 1988; Riewe and Gamble 1988; Therrien 1988). The best aspects of both systems will be needed to improve northern wildlife management in general and caribou management in particular.

In this paper we compare scientific and indigenous forms of wildlife conservation/management; discuss co-management as an integrated approach; and examine one attempt at co-management: the Beverly and Kaminuriak Caribou Management Board (BKCMB). We then express personal views on current problem areas in the BKCMB and future challenges.

The scientific system of management

Scientific wildlife management was developed in the U.S.A. and southern Canada. The system is based on obtaining, storing, handling, manipulating, analyzing, and applying technical data. The goals of scientific wildlife management are to maintain wildlife populations at some level or between certain stated levels or densities. Populations must not be allowed to exceed the carrying capacity of their habitat or a rapid decline will occur. Often the management level is set to provide a certain level of sustained harvest. Historically, scientific management was aimed at providing a "harvest" surplus for hunters who are termed "consumptive users". As habitat was lost and populations declined, a greater emphasis was placed in just maintaining wildlife populations. Thus, conservation and endangered species programs are now part of some federal and provincial/territorial agencies. Provisions are also made for increasing proportions of non-consumptive users, e.g., bird watchers.

The major technical management tools are control or modification of hunting, predator control,

and safeguarding or enhancing habitat. Hunting regulations are the major tool. Predator control is little used because of public opposition and, in some cases, the need to protect predators. The primary statistics used in management are estimates of population size or trend; population age and sex structure, particularly additions of young to the population; and deaths from hunting and natural causes.

The system has worked well in southern Canada and the U.S.A., including some large Indian reservations in the west. It has not worked well when applied to northern caribou herds. The main managerial problems in northern Canada are insufficient or unreliable data on the caribou herds, management tools are limited, habitat management is costly, and land management decisions consider other resources. The costs are enormous to obtain reliable data on herd distributions and numbers; recruitment (addition of 1-year-old caribou to the herds), natural mortality rate, and harvest level. Treaty rights guarantee hunting rights and equivalent rights are extended to non-treaty native people through General Hunting Licences (NWT) or by not enforcing laws and regulations.

Wolf control using poison and predator control officers was discontinued in the early 1960s because of its cost, its questionable effectiveness, and opposition to it from people outside northern Canada. A wolf bounty was discontinued in the early 1970s. Control of forest fires is exceedingly costly and of questionable effectiveness. Roads are developed in caribou range to access mineral resources and provide cheaper goods to northern settlements.

Indigenous forms of wildlife management

Native wildlife management termed "indigenous tradition", "traditional knowledge", "customary law", and "self-management" (articles in Freeman and Carbyn 1988) have not been explained in any detail. One view, held or inferred by many northern zoologists, is that no historical evidence exists for active wildlife management of caribou in northern Canada (Banfield 1954; Kelsall 1968; Cowan 1969; Macpherson 1981; Theberge 1981; Thomas 1981; Miller 1982). The hunters and the caribou were in approximate balance before the introduction of modern equipment. Shortages of wildlife resulted in periodic starvation and management was by default. Native users were nomadic and shifted from one species to another as one became scarce, e.g., from caribou to sea mammals or from caribou to muskoxen or fish. The key point is whether there was active

ve management or not. Was the kill of a species deliberately reduced when populations of that species were low? Aboriginal hunters and societies were most likely to survive if they took as many animals as possible when the opportunity arose. Meat was stored in various forms but if fresh meat was obtained some of the stored meat would not be used. Surplus meat was shared with other groups in the area that were less fortunate. Hunting restraints were unlikely for any sparse migratory population of animals in a hunting territory. The status of a hunter was proportional to his success at obtaining food. Thus, much behaviour relates more to survival than to conservation or management.

Many traditions concerning wildlife took the form of beliefs, myths, legends, and taboos that arise when favourable or unfavourable events were associated with a hunting incident or use of animals or, perhaps, in dreams. Myths and legends were handed down by oral tradition and no doubt changed through time. Our perceptions of people-caribou systems therefore are based on recent history. The Dene and Inuit believed that caribou had souls that lived on after death and these must not be offended (Arnold 1989). This translated into respect for the animals. Spiritual links developed over time between the aboriginal hunters and their prey and these are particularly strong for caribou.

At the other extreme we occasionally hear almost mystical views of harmony between native hunters and their prey. Arguments for active management are articulated mostly by social scientists (Freeman 1985; Usher 1986, 1987; Feit 1988; Osherenko 1988; Riewe and Gamble 1988; Therrien 1988). In most cases, a few recent examples of harvest restraint of largely non-migratory species are extrapolated to other cultures with the assumption that active management was universal. Explanations of indigenous systems of wildlife management often include assumptions and general statements that are supported by few data. These assumptions are repeated by others until they are regarded as fact. Aboriginal societies had to develop conservation measures to survive but such practices should not be confused with active management. The problem may be semantics (language). There would be less confusion if "management" was replaced by "conservation" in many of the articles on indigenous societies-wildlife relationships. To a biologist, the term "overhunting" may mean that there are too many hunters for the number of caribou available for sustained harvest; to the hunter it may infer that he, as an individual, is taking too many caribou. Clear definitions of

terms are needed to avoid misinterpretation and unnecessary conflict.

Pre-19th century, northern, indigenous societies must be admired for their ability to survive in a severe environment with an unstable resource base. We should not burden them with proof that they actively managed migratory wildlife resources. After Europeans arrived, the need for trade goods was so great that caribou were shot just for their hides as recently as 1960. What is lacking are explanations from native elders of where conservation or management occurred and how it was effected. With no written history, we must rely on oral accounts of human-wildlife relationships. No one disagrees that native users of wildlife are keen observers who detect changes in animal behaviour, health, and physical condition. Native hunters knew where caribou were likely to be at various times of the year but only within their territory or from conversations with neighbouring bands. Knowledge of caribou behaviour was a great asset in the hunting of caribou. For example, some caribou would be allowed to cross a river before some were killed. Otherwise all the caribou might use another crossing. The people learned through trial and error to avoid diseased parts of animals, although the major prey species were free of parasites obtained from eating meat. They were familiar with all the anatomical parts of animals. The use of all parts of caribou was a conservation and survival strategy. There was and is strong selection for the age and sex classes of caribou that are fattest during annual cycles of condition. Such selection favours human survival but not conservation because losses of adult females has the greatest impact on the growth of a population. Adult females are fattest over a greater proportion of the annual cycle than males. There are complications to any form of management where other groups hunted the same herd of caribou that ranged unpredictably over vast areas. Expanding native populations and modern support systems, hunting equipment, and transportation add new dimensions to equilibria between hunters and prey.

Traditions, beliefs, legends, folklore, and taboos change much more slowly than the introduced technology. Some beliefs influence indigenous peoples' attitude towards wildlife management: (1) that abundant animals will be provided by God, spirits, or other; (2) that ani-

mal populations are cyclic (e.g., Thomas 1981, Gunn *et al.* 1988); and (3) that animals can be offended by certain human actions. Thus, Chipewyan in northern Manitoba and Saskatchewan believe that caribou should not be handled or disturbed outside of hunting them (Bone *et al.* 1973, Müller-Wille 1974). If not disturbed, there will be plenty of caribou for all time. Hunting with rifles, snowmobiles, aircraft, and motorboats creates much more disturbance to the caribou than in the "old days" before Europeans arrived. Many wildlife populations have been eliminated through hunting with modern equipment. Caribou have not fully adapted to the rifle.

Differences between traditional and indigenous management

There are always interpretation problems and in particular when two or more languages are involved. The term "management" is interpreted differently by different groups. Management in indigenous systems usually means some form of harvest restraint or conservation. This is also the major tool of technical managers who use it to maintain sufficient numbers in a hunted population. In indigenous management there was, with a few recent exceptions, no accounting of numbers or achieving some balance between harvest and annual addition of young to populations.

Technical management may arbitrarily but functionally be divided into six steps: data collection, accumulation, analysis, interpretation, transfer; and management action. Gunn *et al.* (1988) divided the process into three steps. Hypothesis making and testing focuses the process particularly for theoretical questions. The six steps reveal similarities and differences in indigenous and scientific systems.

Data collection

Both methods of data collection are based on observations and the indigenous method is partly scientific. ("Science: knowledge; comprehension or understanding; knowledge coordinated, arranged, and systematized...", The New Webster Encyclopedic Dictionary). Scientists tend to formalize and standardize their quantitative observations. They tend to rely, excessively we might add, on proven methods of other scientists. This permits them to directly compare

their data with those of the previous worker. Often the methods of study are changed to suit the new study. The best scientists devise new methods of collecting data and set a new standard. The scientist gathers quantitative and qualitative information from throughout the range of a caribou population, whereas the observations of indigenous hunters tends to be more localized and mostly qualitative. Nevertheless, the indigenous hunter may detect things and subtle differences that a scientist would overlook. Such observational data are termed "empirical" as opposed to theoretical.

Data accumulation

Indigenous "scientists" accumulate knowledge in their brain. Scientists accumulate observations in memory and in notebooks, on data forms, in computers, and summarize the observations in reports and publications of standard format. The accumulated written material becomes what is termed baseline information on a subject to which new written observations are compared. Transmission is mostly by reports and publications, although there is transfer of information orally at meetings, workshops, and individually.

Data analysis

Another major difference in the two systems is that scientists are bound by certain conventions of how data are processed and presented. There are arbitrary limits on whether observations or data are real or are due to chance. They use statistics to make decisions about their observations. Generally, they attempt to collect large amounts of data to meet criteria for information adequacy. A high degree of variability occurs in biological data and there are additional errors associated with collecting it. Certain arbitrary levels of certainty (probability) are used to make decisions about data. For example, indigenous hunters would know that caribou were fat in a certain winter based on observations of carcass fat. The scientist reports that adult cows had 10 mm of back fat plus or minus 5 mm at a certain probability level, usually 95%. There are complicated statistical methodology to describe data, compare them with other data, and determine if relationships exist among variables (e.g., age, sex, and depth of back fat). These are termed quantitative (amount) analyses of data. Indigenous people describe things in

more-general categories termed qualitative. There is a potential for scientists to dwell excessively on data analysis and manipulation and lose sight of some basic relationships. That is, scientists may rely too much on quantitative data and overlook obvious qualitative differences. For example, Geist (1991) argues that subspecies criteria for caribou should be based on qualitative differences in coat (pelage) patterns in autumn and verified by quantitative molecular data. Indigenous people can contribute data on the coat patterns of caribou in different populations.

Data interpretation

An important step is the interpretation of data. The scientist and the indigenous person may come to the same conclusion but by different processes. For example, fatness in caribou may be caused by an early spring and low number of flies. The indigenous hunter may know from many years of experience what environmental conditions result in fat caribou. It may take scientists many years of painstaking work and large budgets to arrive at the same conclusion. Scientists use statistics and computers to sort out which environmental variables are most important. Experience is also valuable in coming to correct conclusions. The results of other researchers must be drawn upon to fill gaps in information. However, care must be exercised in transferring data among populations and regions.

Data transfer

Information on wildlife was spread orally in indigenous societies. It was important for survival. Technical data are transferred in reports and publications. Information is also transferred orally in talks, lectures, and interviews. The accumulated information on a subject is termed baseline data and all new data are discussed in terms of previous work.

Management action

Wildlife management must involve a mix of technical and indigenous knowledge where indigenous people are the primary resource users. This is the step where co-management is most effective. The technical information is presented and the indigenous users see how it fits with their observations. If there is consensus on the validity of the data, then solutions to problems

are solved jointly through discussion. The indigenous members know what types of management actions may be successful in their communities and hunting areas. Imposition of solutions by technical managers will not work unless the local people support them.

The evolution of co-management

Why did co-management solutions not arise until recently? The biologists, with a few exceptions, did not believe that the natives could help them gain knowledge. In turn, the natives often believed that they knew more about caribou than any biologist. Both were correct: the biologists knew certain facts unknown to the natives and vice versa. There were and are language barriers. The scientific managers did not think that hunters were interested in the complicated technical methodology used to arrive at management decisions. Co-management could not work until both parties had an understanding of the value of each others' contribution. Their methods of obtaining information (Table 1) and solutions to management problems are similar.

The minimum requirement for co-management is: (1) direct involvement of indigenous people in management decisions and means of acting on them; and (2) direct involvement of native people in data gathering. Wildlife management boards are a means of achieving the first requirement. Native people were involved in many wildlife studies, but mostly as assistants. They should be more involved in project planning and interpretation of results. Furthermore, scientists and resource managers should devise systems of collecting data and ecological information from indigenous people. There may be no proof of ecological relationships suggested by the local people but repeated observations from different groups would suggest relationships and these could be tested scientifically. Some types of monitoring such as fatness and general health of caribou populations and sub-populations can largely be done by the hunters.

It is true that the native people have had to adapt to the scientific form of data gathering and the solving of management problems in semi-formal meetings. There was no apparent alternative considering the large number of native communities involved and no system of collecting adequate traditional information.

Table 1. Major similarities and differences between the indigenous tradition and the scientific method of data gathering and processing and major conservation/management methods.

Process	Indigenous tradition	Scientific method
Data collection	Qualitative, empirical observations	Formalized, empirical, quantitative observations
Data accumulation	Brain, oral tradition (stories, legends)	Forms, tables, computer data bases, reports, publications
Data analysis	Discussion	Statistics, computers, brain predictive models
Data interpretation	Inductive reasoning	Results vs. those of others; induction and deduction
Data transfer	Oral	Reports, publications, oral
Conservation/management method	Consensus to reduce kill through social pressure, taboos	Regulations to reduce kill, predator control, habitat protection, education

Adaptive management

McDonald (1988) suggests use of adaptive management techniques to aid wildlife management in the North. The essence of the method is trial and error management. Such methodology appears to have little application to caribou management because: (1) the system is more stable than suggested even though it is a rather simple system: essentially one prey and two predators including humans; (2) there is little scope for experimentation (e.g., wolf control or altered harvest); (3) measuring the effects of any "tinkering" is exceedingly difficult and expensive (e.g., effect of wolf control in the 1950s and early 1960s); (4) the key indicators (hunting and wolf mortality) are known; (5) experimentation with habitat can have long-lasting effects (e.g., experiments of minimum winter habitat requirements could have 50-70-year effects). These techniques are more applicable to closed systems such as lakes where the effects of manipulating ecological and human factors can be readily measured. The co-management aspects in adaptive management techniques are good.

The first caribou management board

The first major study of caribou between Hudson Bay and the Mackenzie River in 1949-51 indicated there were 677,000 caribou, far fewer than at the turn of the century (Banfield 1954).

Numbers dwindled during the 1950s and led to the first caribou "crisis". Predator controls were initiated. By 1957, numbers in what is now known as the Beverly herd were estimated at 100,000 (Kelsall 1968). We know from comparisons between visual and photographic surveys (Heard 1985) that numbers were probably 2-3 times larger than the estimates. They had to be to support the annual kill. The first crisis led, in 1957, to formation of the Technical Committee on Caribou Preservation (TCCP). Members were from the Department of Indian Affairs and Northern Development (DIAND), the Canadian Wildlife Service (CWS), and wildlife agencies in Saskatchewan and Manitoba. The members from CWS and Saskatchewan joined forces in May 1967 to mount a 17-month study of the Saskatchewan herd (part of the Beverly herd) (Kelsall 1968). Research on fire (Scotter 1964) and discussions at the TCCP led, in 1967, to a 5-year program of firesuppression on the winter range of the Beverly herd in the NWT. Field stations were established at Porter and Sandy lakes. In spite of having crews on the range, large areas of the herd's winter range burned in the NWT in 1970 and 1971.

Beginning in 1958, the caribou herds began to recover and by 1967 the estimate was about 160,000 for the Beverly herd (Thomas 1969). Still, numbers were relatively low in the Kaminiak herd leading in 1966-88 to a major stu-

dy of that herd by CWS. The herd was believed to be stable at 63,000 (Parker 1972). By 1973, the TCCP could not justify its further existence and it disbanded. There was, at the same time, an Administrative Committee for Caribou Conservation that was inactive.

The second caribou board

Increasing concerns for caribou management in the 1970s led to formation of the Caribou Management Group (CMG) in 1978. Membership of the CMG was the management agencies of NWT, Saskatchewan, and Manitoba, plus DIAND, the native affairs agency and land manager in the NWT. Observer status was conferred to CWS in 1979 and membership in 1980. Several events combined to spark formation of the CMG and its successor, the Beverly and Kaminuriak Caribou Management Board (BKCMB). Survey data indicated that the Kaminuriak herd was declining. Native people in Baker Lake blamed mining explorations for changes in caribou distributions and some decline in numbers. In 1977, they launched a court case against the mining companies and the Government of Canada to stop the mining explorations. In 1978, controls were placed on mining explorations within caribou protection areas on the calving grounds of the two herds. In 1979–80, concern was extended to the Beverly herd because of the large kill in Saskatchewan. In 1979, the CMG decided that herd management was not possible unless the user groups were involved and supportive of management plans. In this paper "user" refers to mostly native people that use the caribou resource within the historical ranges of the Beverly and Kaminuriak herds. Native leaders, Gunther Abrahamson (DIAND), and Rich Goulden (Manitoba) spearheaded formation of a board with native and government representation.

Interviews with native users in 1981 and 1982 editions of *Caribou News* indicated that causes of caribou declines and possible solutions were similar to those proposed by government managers. The users tended to place more emphasis on the effects of fire and industrial activities; the biologists on the effects of hunting. It was clear, however, that management by quotas or other restrictions would be impossible unless the users were involved in the decision-making process. Voluntary reductions in the kill would not occur as long as responsibility for caribou

rested with governments. Nor was token representation by users acceptable. Trade-offs often were mentioned: if users were to be restricted then they must receive some concessions in return. These concessions might include increased fire protection, predator management plans, or intersettlement trade of caribou and other "country" foods.

The Beverly and Kaminuriak Caribou Management Board

Inception, composition, and function

The main landmarks in formation of the BKCMB were: (1) a ministerial meeting in Winnipeg in December 1980 where a crisis situation was acknowledged; (2) user meetings in Snowdrift, NWT (April 1981); and user-government meetings in Thompson, Manitoba (June 1981), and Prince Albert, Saskatchewan (August 1981); and (3) negotiations between users and governments in Yellowknife in October 1981. In response to a ministerial letter to native groups that cooperative action was needed, the users decided in the Snowdrift and Thompson meetings they would form their own caribou management board. The DIAND Minister agreed to fund only a joint user-government board. The final agreement saw government participation in a board dominated in numbers by users.

The Board became official on June 3, 1982, with ministerial signing of a 10-year agreement. The agreement was among four governments with Canada represented by the ministers of DIAND and Environment. Users agreed to a joint board provided they could have two representatives from each of the geographical areas of South Slave and southern Keewatin (NWT), Manitoba, and Saskatchewan. User representatives are appointed by the respective jurisdiction ministers and most of their Board-related expenses are paid by those agencies. Meeting locations rotated and included a user community about every second meeting. Each agency contributes \$15,000 per year to fund Board activities. Beginning in 1989, the board decided to hold two of the three meetings per year in the user settlements.

The Board functions largely through consensus or near-consensus achieved through modification of a position through considerable discussion. A motion is raised and voted on by raise of hands. A few key issues such as com-

mercial quotas were determined by secret ballot. The Chairman votes only in the case of ties. A Secretary/Treasurer was hired by the Board and that person is essentially an Executive Secretary who handles many of the administrative functions. Written operating procedures of the Board are updated periodically. The process, including the need for audited financial statements, seems unnecessarily structured to user representatives. However, much of the "bureaucracy" is a condition of government grants to operate the board.

Objectives, duties, and responsibilities of the Board

Board objectives (condensed) as specified in the Beverly-Kaminuriak Barren-Ground Caribou Management Agreement are to: (1) coordinate management of the herds in the interests of traditional users; (2) establish a process of shared responsibility for the development of management program; (3) establish communications to further conservation and habitat protection; and (4) discharge management responsibilities collectively (Beverly and Kaminuriak Caribou Management Board 1987). The objectives clearly indicate that coordinated, cooperative management (co-management) of the herds is primarily for the benefit of the users. This was an ideological change from earlier emphasis on conservation. This point is important because it places the emphasis on managing at a high sustained yield rather than imply preventing the herd from dropping below a certain population size. A summary of the Board's duties and responsibilities are to: (1) recommend measures that will restore the herds to a size that will meet the requirements of traditional users; (2) maintain habitat; (3) communicate Board functions to user groups; (4) discuss management plans with governments and users; (5) submit annual reports on the state of the herds and Board activities; and address other matters affecting the herds. The duty of the Board clearly is to maintain the herds at population levels that will meet the requirements of the traditional users. The actions of the Board are guided by terms of the agreement and a management plan.

The Beverly and Kaminuriak Caribou Management Plan

Background

The need for a plan to guide the Board was rea-

lized as early as 1979 and various groups drafted preliminary editions of the plan. After formation of the Board, subcommittees that included user representatives worked on the plan and it passed through many revisions. The Board hired an academic to bring the plan to a conclusion in 1986 and printing in 1987 (Beverly and Kaminuriak Caribou Management Board 1987). The plan was developed slowly because the Board wanted all parties to be satisfied with its contents. The plan received approval at a user assembly held in Eskimo Point and it was widely distributed throughout Canada.

Goals, objectives, and principles

The mandate, goals, objectives, principles, and actions of the Board are outlined in the plan. The goals are to safeguard the herds: (1) for the traditional users and (2) for Canadians and others. There are important objectives: (1) to maintain each herd above a crisis level of 150,000; (2) to achieve optimum herd sizes of 330,000 (BH) and 300,000; (3) to ensure herd accessibility to users; (4) to increase knowledge of caribou ecology; (5) to encourage wise use; (6) to involve local people in management; and (7) to strengthen public support for caribou conservation.

Ten Board principles relate to cooperation, communication, co-management, herd conservation, the food and cultural value of caribou, efficient use of caribou, local participation, maintenance of habitat, the central role of the Board, and to ensure that caribou are considered in all land-use plans.

Action plans

The manner in which the Board will attempt to achieve its goals, objectives, duties, and responsibilities are set out in 15 action plans. They are outlined under the headings: (1) information, education, and communication; (2) supply of caribou; (3) use of caribou; and (4) protection and habitat management. Each plan is discussed under the headings: background; problem statements; objectives; methods; schedule; budget; evaluation; and lead role. Most of the action plans are ongoing such as *Caribou News*, Board liaison, competitions and awards, herd size and recruitment, spoilage of meat, crippling losses, fire management, protection measures, and caribou-human relationships. The schools program was completed but work is underway on improving its implementation. The study of

herd definition (Kaminuriak) was completed but more work is needed. The requirement for caribou must be revised periodically; priorities for demand were established in 1987. The study of the effects of fire is nearing an end but additional monitoring is needed.

The Board reviewed the progress of the action plans in August, 1988. However, responsibility for the plans rests with the Board or the jurisdiction heading the plan and accountability is not rigorous. The plan for the Porcupine herd includes specific management objectives (e.g., obtain recruitment data in March/April) throughout the year (Porcupine Caribou Management Plan n.d.). Cized (n.d.) and Scotter (in press) provide additional details on Board functions and processes.

Board accomplishments

Communication within the Board

The Board is a forum for the views of user and government representatives and various observers who attend meetings. Data obtained on the herds is presented at meetings and discussed. Observation of user members are brought forward to complement the reports of biologists. These range from information on movements and the fatness of different groups of caribou to behaviour of caribou in response to various activities on the land. This exchange is probably the most important function of the Board, at least in the short term.

Communication among governments, users, industry, and others

The Board serves as an important communication link among the four governments and their agencies as well as between them and the various user groups. Perhaps more valuable are the exchanges among the native groups. They realize that harvests in one area can affect the take in another region. Fires in northern Manitoba may affect the distribution of caribou in the Keewatin. One group may have abundant caribou; another group little or none. Native representatives exchange information on factors that affect the caribou throughout the range rather than in their own particular area. In user communities, an evening session of the Board is devoted to communication between the Board and the users. The meetings are vital to conveying the purposes of the Board and the major concerns of the community elders. The Board

was used by industry to attempt to bring changes to regulations affecting mineral exploration on the calving grounds of the herds. Hunting associations make requests to the Board concerning caribou quotas for non-native residents. Thus, the BKCMB is a clearinghouse for communications concerning the two herds.

Caribou News

Caribou News was first issued in May 1981 before the Board was established and largely through the influence of officials in DIAND who financed a large proportion of the costs. Current costs for six issues are \$100,000 per year. The management agencies contribute to costs in proportion to the number of issues sent to communities in each jurisdiction. The original intention was to publish the bimonthly *Caribou News* for 2 years to inform users about the purposes of the board, to inform the interested public, and to attempt to change attitudes. The paper proved to have popular appeal as well as great value and continued to publish for 10 years. Prevailing financial restraints may see *Caribou News* come to an end in 1992. The paper maintains an independent stance from the Board. The paper includes information on Board activities, research efforts, settlement activities, and stories of general interest of caribou managers and users.

Schools program

A major initiative and expenditure, that began in 1984, was development of a Schools Program consisting of four modules. Each unit contains written materials, tapes, and slides. It was intended for use in each school within the range of the two herds. An independent evaluation of the schools program indicated that it was successful (Nortext 1987). It was found by field representatives to receive enthusiastic use by some teachers in some schools. A survey of use in 1989-90 in northern Saskatchewan indicated that 13-20% of teachers used the kits for 4-5% of instructional time (Nicholls pers. comm.). An educator invited to a Board meeting suggested ways to improve use of the material. The prime problem was that use was discretionary; the program was not integrated in the curriculum. Steps are now being taken by the Board to remedy the problem. There appears to be need for new content and material aimed at lower grades.

School competitions/awards and scholarships

The Board realized that the future lay with youngsters in school. A schools competition was started in 1988 with the objective of making the Board known to youngsters and to get children thinking about caribou, their uses, and management. Prizes are awarded after judging is done by Board members. Many members were amazed by the quality of the art, poetry, and prose. Some of it was published in *Caribou News*, which then makes the paper interesting to the students.

The Board also supports studies of caribou and related subjects through a scholarship fund established by the Board and augmented by a grant from the NWT government. The fund legally is separate from the Board but its trustees sit on the Board. About \$3,000 are awarded annually to one to three recipients.

Video and radio programs

The Caribou Management Group commissioned production of videos in 1980 that explored all sides of the caribou management problem. This approach was new in the north and its success was due to involvement of Inuit and Inuit groups in its production. The videos were shown to Inuit communities in 1981 and 1982. The high costs prevented its extension to communities in northern Manitoba and Saskatchewan. In 1989, the Board supported production of tapes that were broadcast on northern radio stations. The tapes were information items by biologists and managers.

Cooperative research

The Board has facilitated cooperative studies of the two herds. For example, a user Board member has piloted an aircraft containing surveyors from the governments of Manitoba and the NWT. The timing of caribou surveys by biologists of Manitoba, Saskatchewan, and CWS was coordinated so that coverage was complete from Yellowknife to northern Manitoba. The Board supported financially a values-at-risk study that incorporated fire maps into a computer-based geographical information system (GIS). The management agencies will be able to update the GIS annually. Analysis of burn trends and how they will affect caribou and other wildlife will be facilitated by GIS capabilities. The GIS will aid decision making if fires are

fought on the caribou range. Cooperative research is not an action plan but it is implied in Board objectives.

Priorities for use of caribou

In April 1987, the Board formally established priorities for use of the two herds. The order is as follows: (1) traditional users, domestic use; (2) resident users, domestic use; (3) traditional users, intersettlement trade; (4) traditional/resident use for non-resident hunting; (5) commercial, local; and (6) commercial, export. These priorities are important because they focus on the importance of caribou for subsistence by traditional users (mostly natives) and they formalize a reverse order of removal when caribou numbers decline. Priorities may have to be re-ordered in the future. For example, sports hunting could generate millions of dollars into local economies with no adverse effect on the caribou population. Native corporations must be major stakeholders in such developments.

Caribou protection: stands on developments

The BKCMB has lobbied DIAND to retain the Caribou Protection Measures that began in 1978 and provide for minimum disturbance of caribou in the two herds during spring migration (May 15–June 15), on the calving grounds (June 1–30), in post-calving areas (June 15–July 15), and at major water crossings. Funding from DIAND for monitoring the regulations currently is \$65,000 per year.

The Board keeps an eye on and reviews new developments that could affect the caribou. For example, in 1985, members reviewed the proposal for a powerline from Beaverlodge (Lake Athabasca) to Wollaston Lake. The Board reviewed the plans for fighter aircraft training runs at low level from the region of Artillery Lake to Fort Chipewyan. The Board has taken strong stands against opening the Thelon Game Sanctuary to mining and to development of an uranium mine (Kiggavik) west of Baker Lake.

Fire management

The Board, in 1984, requested that government agencies fight fires on the winter range of the two herds. The agencies responded that they had insufficient funds to extend fire control. Several millions of dollars would be needed to establish the infrastructure for effective fire suppression on the winter range of the Beverly

herd in the NWT. Results of a fire study indicated that fire suppression was not needed at the caribou population level (Thomas 1991). However, the distribution of the Beverly herd was affected by burns in the past 50 years or longer. A management objective is to ensure access to the herds by traditional users. This cannot be accomplished unless a high proportion of the forests around villages is maintained in ages older than about 70 years. Priority areas for the users are their traditional hunting and trapping areas. Users in all southern communities, such as Fond du Lac, Black Lake, Wollaston Lake, Brochet, Lac Brochet, and Tadoule Lake have to go further and further north to obtain caribou.

Accomplishments relative to goals and objectives

In general terms, all Board objectives, duties, and responsibilities (p. 6 & 7) were attained. Management plan goals were satisfied. Some of the management plan objectives were met: maintaining the herds above 150,000 (objective 1); to encourage wise use (objective 5); and to involve local people in management (objective 6). Objective 2 of achieving herd sizes of 330,000 and 300,000 may have been reached in the mid 1980s. The latest estimates of 190,000 \pm 71,000 (standard error) (Heard *et al.* 1990) and 220,000 \pm 72,000 (Heard and Jackson 1990) for the Beverly and Kaminuriak herds fall below that value. The confidence limits of the estimates (ca. double the standard errors) overlap the population goals. No actions were taken on ensuring herd accessibility to users (objective 3). Accessibility generally was good for Inuit communities and for Snowdrift. Herd accessibility to communities in northern Manitoba and Saskatchewan has eroded with forest fires being the apparent primary cause. The objective of increasing knowledge of caribou ecology (relationship to the environment) was met to some degree by the results of the fire study. Ecology of caribou in the spring, summer, and autumn is poorly understood. The degree to which public support for caribou conservation was strengthened remains unknown.

Reasons for board successes

The management plan

The management plan even in draft stages served as a guide for Board actions. The plan gives

timetables for various actions. It provides a constant reminder of the goals, objectives, and responsibilities of the Board as spelled out in the agreement and the management plan.

Chairmen and vice-chairmen

The Chairman has a great responsibility to attempt to achieve consensus on issues. He must understand viewpoints of users, scientists, managers, governments, and the general public. Traditionally, users avoid snap decisions and generally prefer decision by consensus. Their decision making is based on serious thought of all the consequences of a certain action. They prefer prolonged discussion that includes elders in each community. The Chairman must be patient and draw comments from user representatives. Decisions often are postponed to provide sufficient time for discussion and consensus. Much of the success of the Board is because Chairmen and Vice-Chairmen were able to weld the diverse representatives into a common purpose through prolonged discussion.

Native representation

Success of the BKCMB is largely due to the user's choice of their representatives. On certain issues, such as commercial use of caribou, they tolerate majority decisions that go against their personal convictions and those of communities they represent. They have shown great patience in how long it takes to obtain action on certain issues. For example, since 1982 native representatives from treed regions of the range have requested that the management agencies fight forest fires. Little action was taken. The representatives generally are deeply concerned about the caribou and their proper management.

Membership continuity

Turnover of members was low: the first Chairman served for 8 years; two user members for 9 years; and each government or department was represented by 2-4 members. Continuity is important and alternate members should receive a good briefing before attending meetings. Detailed minutes record board discussions and decisions. A brief summary of major decisions and discussions relative to each action plan and to "other business", updated after each meeting, would be useful to continuing members and particularly to alternate and new members.

Spirit of cooperation

Cooperation has been good because agency representatives and users realize that they have the same objectives. The agencies have other clients when herd numbers are high. For example, in 1988, the Board approved a request that the quota for residents of the NWT be increased from two to five caribou. Two user groups sought from the Board and received approval to sell caribou within the NWT. Commercial use was allowed in the NWT for many years but only among holders of General Hunting Licences. The selling of caribou to others in the NWT was restricted to trial quotas of 200 and 350 caribou for Hunters and Trappers Associations in Fort Smith and the Keewatin, respectively. Later, the Board approved export of up to 100 caribou in the Keewatin quota for Inuit consumption in southern hospitals. The requests for commercial quotas were approved only after the population trends indicated that the herds could withstand limited commercial use. The quota was not used in Fort Smith. Generally, user members from Saskatchewan and Manitoba are opposed to any commercial use of caribou and hunting by "residents" and "non-residents". Thus, there is no non-resident hunting of the two herds, whereas non-resident hunting on the adjacent Bathurst herd generates \$1.4 million. The replacement value of meat obtained from the Beverly and Kaminuriak herds is \$13–14 million. Cultural, recreational, biological, and intrinsic values are incalculable.

The herd's productivity and distribution

The BKCMB has not had to address caribou shortages except locally. Recruitment in the Beverly and Kaminuriak herds in the late-1970s and 1980-s has averaged 17.4 (Bh) and 17.6% (BKCMB 1987, Williams *et al.* 1990) compared with 16% in the 1950s and 60s (Kelsall 1968). Large numbers of caribou have not migrated far into Saskatchewan or Manitoba since the early 1960s with the exception of 1 or 2 years (e.g. 1979–80 in Saskatchewan, 1987/88 in Manitoba). Therefore, the estimated average annual retrieved kill from the two herds (20,000) was much reduced from what it might have been. The actual mortality to hunting is 25,000 caribou if 20% is added to account for crippling and unretrieved animals.

Problem areas

Technical problems

Technical problems identified by Therrien (1988) for the Porcupine Caribou Management Board also apply to the BKCMB: little control of techniques used; no control of budgets; no control of implementation; no guarantee of user involvement; and no independent research capability. The precursor CMG (1978–82) was supported by a technical committee comprised of biologists from each agency. There was no provision for such a committee upon formation of the BKCMB. The Board has requested advice from ad hoc meetings of agency biologists on two or three occasions. Technical aspects generally are handled by each jurisdiction. Problems arise from this arrangement. The Board is not certain if the data obtained for the herd are adequate for management purposes. For example, management may be impossible if population (excluding calves) estimates are obtained every 5–6 years, as proposed, with population estimates subject to large confidence limits, e.g., 190,000 \pm 142,000 for the Beverly herd in 1988. The change from visual surveys to photographic-based surveys improved herd estimates but the large confidence intervals remain. The solution may lie in use of post-calving photographic estimates as used on the Bluenose and Porcupine herds.

Population trends could be followed if better data were available on retrieved kill, the extent of wounding, the natural mortality rate, changes in age structure, and recruitment. Not much has changed since Fuller (1979) stated that the quality of the data was wholly inadequate for the management of caribou. The factors that influence caribou health, physical condition, and natural mortality are poorly understood because a comprehensive, long-term study that evaluated the importance of all ecological factors has never been done. Every 2–3 years, the BKCMB should seek independent advice from recognized authorities from outside the Board on the adequacy of data being obtained in support of Board objectives. The best format would be a structured yet informal workshop where users would be represented and contribute. The scientists, with the assistance of users, have the capability to produce data that could be used to effectively manage the caribou herds primarily for the benefit of traditional users. Lack of ade-

quate funding and perceived restrictions on techniques prevent them from doing so.

Membership

A complaint of user groups is that the representatives from government have no power. The government representatives usually are either biologists or first or second-level managers. While they may be knowledgeable of caribou, they are unable to commit their agencies to new actions. Conversely, user representatives typically are Chiefs or heads of user associations. They are part of, or close to, the decision making level in their communities or region. The problem is that few senior managers in government are familiar with caribou ecology and management. This is solved to some extent by having agency biologists present to support the manager. User members sometimes believe that the government members are not free to use their best judgement on certain issues and must adhere to policy established by their department or governments.

Attendance generally is good at most meetings despite two problems. Self-employed members lose revenue during the 4–6 days needed to attend meetings. Travel costs can run as high as \$2,500 per meeting for some members. Cost could be reduced by meeting Thursday–Saturday and scheduling informal tours and events on Sunday.

Communication

The greatest communication gap between the board and the user community appears to be between user representatives and the communities they serve. The function of the Board is not understood in the communities as revealed at public meetings. How this problem can be resolved is not readily apparent. One possibility is weekly local or regional radio shows devoted to wildlife and including the latest information on location of wildlife, hunter success, as well as wildlife research and management. The show would have to be locally produced in local languages. User representatives may need the advice or assistance of educators in finding ways of getting the message out. Further, *Caribou News* is unlikely to exist after June 1992. It is the main communication vehicle between the Board and the users. The Board would like to have every resident in user communities famili-

ar with its purpose and function. That may be an unrealistic goal. Few southern residents are familiar with the wildlife management programs that affect them.

The Board has not addressed mechanisms to systematically obtain the user's knowledge. This knowledge should include the collective wisdom of elders and current information about the distribution, movements, health, fitness, and reproduction of caribou. Additional information could be accumulated on the behavioral responses of caribou to burns, snowmobiles, aircraft, and other forms of disturbance. One possibility is to process the data using "expert systems" computer technology.

Accountability

There is little accountability for seeing that action plans are completed on schedule. The Executive Secretary sees that outstanding issues are placed on meeting agenda. There is provision in the Plan for an annual review at the March/April meeting.

Looking into the future

Expiry of the Agreement, June 1992

Budgetary cycles mean that a decision on whether the agreement will be renewed in June 1992 will be made by autumn 1991 or earlier. In December 1990, the Board contracted a consultant to review the success of the BKCMB in meeting its goals and objectives. Reporting dates are March (interim report) and August, 1991. The review will not be an audit or value-for-dollars exercise. Most Board members appear to favour an extension of the Board's mandate.

Land settlements and other wildlife management boards

Some members see the Board's function being replaced by wildlife management boards arising from land claims settlements. Others see a continuing or greater need for an inter-jurisdictional board on caribou management, as the caribou ranges are further subdivided along political lines. The Board could encompass all inter-jurisdictional wildlife management with caribou being the most important trans-boundary species. The logical solution is for some representatives to be on two or more boards concerned with wildlife management and land use. Some

members of the BKCMB currently sit on other boards. There is increasing communication among boards through visitations: invited, requested, and casual. Ideally, the political units should correspond with herd boundaries as they did before Europeans arrived (Gordon 1975).

Politics: Imbalance of government and "User" representatives

If they so desired, the users through their majority could dictate all deliberations of the Board. This has not occurred to date because issues have not divided along user-government lines. Users realize that the Board is only advisory and members have accepted the futility of confrontations. The goal of both groups is the same - to maintain and possibly enhance a major, natural, sustainable, renewable resource. Members must strive to keep the Board as apolitical as possible. The Porcupine Caribou Management Board has balanced government and user representation, however the user population is much smaller than that encompassed by the BKCMB.

The next caribou crisis

The first board, the TCCP was disbanded in 1973 because the herds increased during the 1960s. Within a few years, caribou apparently declined once again and the Caribou Management Group was formed. A repeat of history could happen if the Board disbands in 1992. Caribou numbers fluctuate in response to weather and weather-related factors as well as to the level of the kill and predation. The question is not if the herds will decline again but when. The present kill appears to be the maximum that the herds can support. Calf production has been high in the 1980s and wolf numbers relatively low. Wolf numbers were relatively low on the winter ranges of the two herds in the 1980s. Any downturn in recruitment caused by weather factors, directly or indirectly, or an increase in wolf numbers could result in caribou declines. The test of the Board will be its ability to manage the herds when the next crisis arrives.

Better herd data

The best-possible monitoring of the herds and their utilization will be necessary if they are to

be maintained at a high and valuable level. As mentioned earlier, more-precise data are needed on population size, recruitment (including standard errors), and kill (e.g., no data for Snowdrift). Data are needed on movement patterns, winter distributions, natural mortality factors and rates, behaviour to disturbances, spring and summer ecology, and genetic differences among populations, among others. The Chipewyan elders believe that caribou should be left alone. These beliefs currently inhibit data collection in support of technical forms of wildlife management. For example, radio collars on caribou would help to define herd boundaries; to measure herd interchange and gene flow; to support survey techniques based on post-calving photography; to measure natural mortality rates; to record behaviour towards burns, roads, aircraft, skidoos, mining developments; etc.

Intensity of herd management

There is little active management of the herds. There are no restrictions on most native users except Metis users in the provinces. The quota for "residents" of the NWT (minimum 2 years residence) is adjusted from time to time from two to five caribou. The take of caribou from the Beverly and Kaminuriak herds by non-native residents is minor or insignificant. Caribou hunted along the winter road to Contwoyto Lake may belong to the Beverly or Bathurst herds. There is no "sports" hunting except by residents in Manitoba (150 tags). The information campaigns sponsored by the BKCMB, including preventing wastage of meat, "pick your target", etc. has unknown influence on users out on the hunt. Other factors such as herd distribution and movements, the cost of air charters, the availability of winter roads, snow conditions and other weather factors, the price of furs, and the number of wolves, has more to do with the size of the harvest than the management actions.

A time will come when increased kill and/or high natural mortality will cause herd reductions. The user communities are presently doubling in numbers in 18-24 years (3-4% annually) (Hamelin 1979, Fuller and Hubert 1981, Special Committee on the Northern Economy 1989). Minimum user needs are in the order of 3 caribou per person or 20 caribou per family.

Retrieved kill per successful hunter, per hunter, and per person in the Kitikmeot (Central Arctic) Region in 1982–84 were 42, 15, and 3.1, respectively (Jingfors 1986). The estimated total harvest was 3.6 caribou per person in the first year of the study. Jingfors (1986) calculated that per capita harvest was 3.2 and 2.8 caribou per year in a similar harvest study in Keewatin Region in 1981–83 (Gamble 1984). Wants are listed as high as 5–7 caribou per person (Miller 1982) and 30–40 caribou per family. There may soon be a need to manage the herds more intensively as suggested by Fuller and Hebert (1981). There are two major options that will challenge the Board: (1) reduce or change the age/sex structure of the kill; and /or (2) reduce predation. Minor options include safeguarding habitat and reducing disturbances. These are important but currently have little effect on herd numbers. *The main challenge is to not allow the herds to sink below present levels because recovery takes many years and it will be painful to the users.*

User requirements must be projected and caribou population sizes managed to support the required level of use to limits imposed by the environment (forage/snow).

Habitat loss/modification

The greatest long-term threat to the two herds is loss or modification of habitat. Loss of habitat is most likely to be caused by greater burn rates because of changes in weather. The global warming trend could have such an effect. Modification of habitat is caused by a variety of developments including roads, pipe and power lines, mines, and tourism as it may affect harassment particularly at water crossings. Of these, the most potentially damaging are roads that increase access to the herds and increase the kill. Hunting along roads could affect movement patterns over time. Potentially as serious as roads are global air pollutants that could damage lichens or make caribou meat unfit for consumption. Prevailing winds mean that contaminants from the U.S. and southern Canada are a problem only for short periods each summer. Global pollutants are a concern. Radio-cesium from the Chernobyl accident in the U.S.S.R. was deposited throughout Canada. Lichens in Finland are affected significantly by pollutants from other countries.

Conclusions

1. Effective management of the large migratory populations of caribou was not possible until mechanisms of co-management were established.
2. Wildlife management decisions and mechanisms should occur with technical and user groups sitting around the same table.
3. If caribou management occurred before Europeans arrived in Canada, the ways were lost because of lack of a written history and changes wrought by the immigrants. Conservation measures such as use of all the carcass were tied more to survival than to modern concepts of management.
4. No benefit is gained from attacking the indigenous and scientific forms of data gathering and management; clearly the best elements of both should be united in a system of management that will work in the North.
5. There are similarities in indigenous and scientific systems of data collection and interpretation and in decisions about how conservation/management may be effected.
6. Major differences in the two systems relate to reliance on qualitative and quantitative data by indigenous people and scientists, respectively; to traditional scientific methodologies of data accumulation, analysis, interpretation and transfer; and to greater use by scientists of deductive as opposed to inductive reasoning.
7. An advisory caribou management board comprised of eight Dene, Metis, and Inuit members and five representatives from three governments has, since 1982, achieved many of its goals, objectives, and responsibilities.
8. Board successes are attributed to development of a management plan; to the quality of founding members; to relatively low turnover of members; to understanding Chairmen/Vice-Chairmen; to a spirit of cooperation; and, perhaps most importantly, to excellent cooperation by the caribou herds.
9. Board shortcomings include lack of control on technical matters; lack of a strong technical committee to guide the Board; inadequate communication within many of the communities; failure to establish a process whereby information on the herds is consistently obtained from the many users;

and limited power to ensure that action plans are completed.

10. The future of the Board depends on its: renewal of the agreement in 1992; links with other wildlife management boards; ability to remain apolitical yet pro-active; ability to stave off harmful developments; ability to manage at low population size; ability to better monitor the herd's status; and ability to manage more intensively to meet, as far as possible, the needs to traditional users.

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