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Caribou Co-Management Needs From Research: Simple questions - Tricky answers

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Abstract: Over the past decade, northern Canada has experienced a substantial increase in government reliance on advisory co-management organizations to manage caribou populations. Such groups, which are usually composed of government and local representatives, constantly require information about caribou upon which to base their recommendations. However, the standard 'scientific' approach to obtaining and presenting such information is in many cases no longer appropriate. In order to readjust the scientific focus on caribou research so that it is better attuned to co-management, this paper examines the role that research plays in the Canadian management of the Porcupine Caribou Herd as practiced by the Porcupine Caribou Management Board - a co-management advisory organization with a majority of native representatives.

Key words: *Rangifer tarandus*, Porcupine Caribou Herd, Yukon-Alaska

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The Changing North

Wildlife management in the Canadian north is changing - again. Following the second world war, wildlife research was done by federal biologists and management decisions were made for the Northwest Territories (NWT) and the Yukon by federal administrations. After the administrations were transferred to the territories, the reliance on federal research gradually diminished during the 1970's as territorial departments hired their own research staff. Although this marginally increased consultation with the public, basically the governments continued to operate internally by determining the management issues, designing the research, analyzing the results and making the decisions.

But, eventually, this began to change with the creation of Hunters and Trappers Associations in the NWT and the James Bay Agreement in Quebec (1976), which provided for the first wildlife co-management board - the Hunting, Fishing and Trapping Coordinating Committee. Since then, wildlife co-management organizations have proliferated, either in conjunction with land claims settlements, such as the Inuvialuit Final Agreement (1984) and the Gwich'in Comprehensive Land Claim Agreement (1991), or separately, such as the Beverly and Qamanirjuaq Caribou Management Board (1982) and the Porcupine Caribou Management Board (1985). With respect to barren-ground caribou alone, there could eventually be a separate co-management board for each major herd in Canada.

So Many Questions, So Little Time

Co-management boards were designed to function differendy from governments and so they do. In particular, they are assigned specific species or populations which they are expected to monitor and advise on their management. To do so, such groups require relevant information and, in most cases, the major source is government research agencies. In the past, such agencies dealt with management issues on a scale of priorities that they alone established, but this is becoming no longer possible with the avalanche of requests from all the co-management groups that want information and want it now!

Given the limitations of research agencies to accommodate an ever increasing list of management questions that will not go away, it is necessary to critically reexamine just what kinds of information are needed and how they can reasonably be provided for this new age of co-management.

A Simple Model

A prime example of what types of research are required by co-management is provided by the Porcupine Caribou Management Board (PCMB) because it is a

simple system that deals with only one population of one species with the best information available. The only major complicating factor is that the Porcupine Caribou Herd is shared with Alaska which requires additional management coordination.

Nevertheless, how the PCMB uses research information should provide basic clues to understanding other co-management situations where the problems and information needs are less clear cut.

So, How Is The Herd Doing?

Whether it is in the bar, at the grocery store or the gas station, whenever a member of a caribou co-management board appears, the first question is, "So, how is the herd doing?" And, in fact, this deceptively simple enquiry comprises most of what the co-management board needs to know itself, which is basically: How big is the herd?, Is it threatened? and Is it healthy?

Part One: How Big Is The Herd?

The Census Conundrum

Ever since the second world war, caribou managers have operated under the premise that caribou could be accurately counted and, moreover, that they cannot be properly managed until they have been counted. This belief arrived with the modern bush plane because it was so compelling to see caribou from the air spread out across the open tundra and, apparently, so easy to count.

Thus, whenever caribou management was undertaken, the first demand for research has always been, "How big is the population?" And, in response, the biologist's have always strapped on their latest technology and ridden off to battle with caribou statistics.

Beginning in the late 1940's, researchers laboured to perfect the strip census technique which, in its crudest form, consists of visually counting caribou in aerial swaths of known width and extrapolating for total coverage. Some 30 years later, it was clear that the method would never yield satisfactory results for the barren-ground herds. In an effort to overcome the many inherent errors of visual counting, biologists began to experiment with photographic counts and, although they too have evolved in sophistication, the results are often greatly compromised in accuracy and precision.

Considering the time and expense required for such methods, it is necessary to reconsider the assumption that precise population information is feasible and, in fact, necessary for co-management.

A Test Case

The best exception to the general census conundrum is the Porcupine Caribou Herd (PCH) because, under conditions of severe fly harassment, it will form massive aggregations that can be photographed in their entirety which enables a much higher level of accuracy in counting than the standard aerial photo methods afford. Since the herd also has its own co-management board, this provides the only opportunity to observe how co-management actions are related to the nearly ideal condition of knowing the size and trend of the caribou population.

After nearly a decade of tinkering, the photo method for the Porcupine Caribou Herd had been significantly refined so that, throughout the 1980's, biologists were able to quite accurately document an increase in the total population (adults and calves) from 110 000 in 1979 to 178 000 in 1990, which works out to about 5% a year.

In 1987 - two years after the Porcupine Caribou Management Agreement was signed - the herd numbered 165 000 and was still increasing. Given such good population data, what did the Board do? Because the herd was increasing, there was no concern about overharvesting. Although the harvest at the time was not well known, there was obviously no negative impact on the herd. As it continued to increase throughout the decade, the Board did nothing to intervene because, in general, people were pretty happy about the growing population.

In 1983, prior to the Board's inception, the bag limit for non-native hunters in the Yukon was doubled to 2 caribou of either sex. Recently, the Board has been considering an extension of the season for non-native hunters in order to decrease hunting pressure on other woodland herds in the territory. Meanwhile, the NWT increased their bag limit to 5 to be consistent with other barren-ground herds and Alaska has maintained the subsistence bag limit of 25 and export limit of 10. Native hunters in all jurisdictions continued to hunt without restriction and in 1990 the community of Fort McPherson sent 40 caribou to Banks Island in accordance with Trade and Barter provisions of the Porcupine Caribou Management Agreement. It should be noted that all of these actions were taken not to control the PCH per se but to capitalize on its abundance.

By 1989, the population had reached 178 000 and some concerns were being expressed about how big it would get. Would it continue to grow until it exceeded the carrying capacity of its range and crash as the George River Herd was reputed to be doing? The Board considered such fears but recognized that there was nothing that could be done because, with somewhat better harvest data, it was clear that hunting could never be increased enough to check the herd's expansion. Besides nobody, including the scientists, knew how big was too big.

Prediction Up - Population Down

Although it was predicted that the 1991 PCH population would be about 200 000, the 1992 census only counted 160 000 - a drop of 18 000 from 1989 (PCMB 1992, 1993). This was a surprise to everybody, including the biologists who revisited their data and concluded that severe winters could have increased female mortality enough to cause the change.

Since the Board is the focus of the public's scientific knowledge and opinion about the PCH, it's initial concern was whether or not the drop of 18 000 represented a significant decline. Biologists replied that only because the estimates were so accurate could such a small drop be detected and this small a change would never show up with the cruder estimates for other herds. The Board accepted this interpretation and therefore informed the public that the decrease was no cause for alarm.

However, in view of the extreme threat posed by oil development on the herd's calving grounds, the Board strongly urged a repeat census in 1994 to determine whether the decline was definitely a trend or just a hiccup. Otherwise, the Board may have taken the biologists' advice to wait another year before censusing to give more time for a significant change to occur.

Seven Year Summary

Over the past 7 years the co-management response to accurate information on the size and trend of the PCH may be summarized as follows: a) As long as the herd is big and increasing, maintain 'normal' harvests and consider increases. b) If the average harvest is considered to be well below the sustainable level, encourage shifts of hunting pressure from other herds and provide caribou to disadvantaged communities (Note: commercial sales are prohibited by the Porcupine Caribou Management Agreement, 1985). c) When a drop in the population is first recorded do not consider management changes until a downward trend has been confirmed, which may reduce the population below the average sustainable harvest. d) Unless the herd is seriously threatened (eg. by oil development) do not recommend a recount until enough time has passed to make a significant decline obvious.

From the preceding account, it seems that as long as the caribou population is well above the sustainable harvest, the co-management response to population management remains pretty much the same. This is because once the herd grows beyond the ability to control it through harvests, there is nothing else that can be done except capitalize on the situation.

Under this scenario, there are no other basic requirements from research. Even if biologists could - at great expense - determine how big was too big, there is nothing that could be done about it. A classic example is the muskox eruption on Banks Island which has never been resolved scientifically and is beyond management control in any case.

'Lots' And 'Really Lots'

People on the land do not count caribou. Rather, their opinions on the status of a herd are expressed in relative terms. Although these terms vary across the north, some common ones in the Western Arctic are, 'lots', 'not so many' and 'few'. Further refinements to this include 'really lots', 'too many' and 'few few'. Such terms are used, for instance, when hunters are being interviewed at their camps. In conversations about hunting success and caribou numbers, these people do not refer to animals in hundreds of thousands with confidence limits but according to their experience over a lifetime and the memories of their elders.

This approach may seem crude by modern standards but it can serve as a valid management model since, based on the PCMB example and judging from other similar situations, caribou are not managed by number so much as they are managed by categories akin to 'lots', 'not so many' and 'few'.

For the past 7 years there have been 'lots' to 'really lots' of caribou on the Porcupine Caribou Range and this is reflected in liberal harvest controls that will not change significantly until a serious decline becomes indisputable. Thus, whether the herd is 135 000 or 160 000 or 178 000, the actual number and accurate tracking of the increase had little effect on management which lumps all such figures into the 'lots' to 'really lots' categories for which there is one basic management strategy (Fig. 1). And even though the herd has dropped 18 000 in the past 3 years, there are still 'really lots' for management purposes and could remain so despite a further decline until the sustainable harvest level is approached.

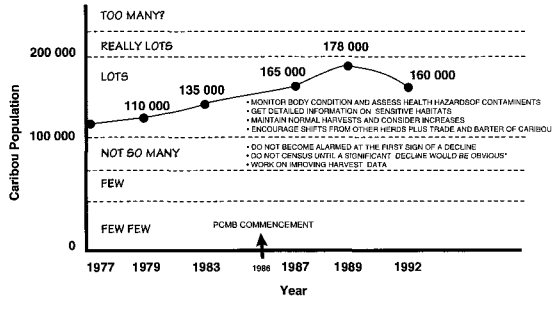

Fig. 1. Mangement response of the Porcupine Caribou Management Board to "Lots" category of Caribou population status.

'Too Many'

In developing this model, it is necessary to consider the other categories as well. What if the PCH had continued to increase as predicted to 200 000 and beyond? Already in 1989, some users were talking about there being 'too many' caribou' - that is, more than they had ever seen before. If the herd continued to grow there would have been more talk about 'too many' caribou and a controversy would undoubtedly have developed, as with the George River Herd, about what is 'too many'. But the bottom line for co-management is that whether there are 'lots', 'really lots' or 'too many' caribou, the response remains the same, i.e. liberal hunting, trade and barter and, where legal, commercial quotas (Fig. 2).

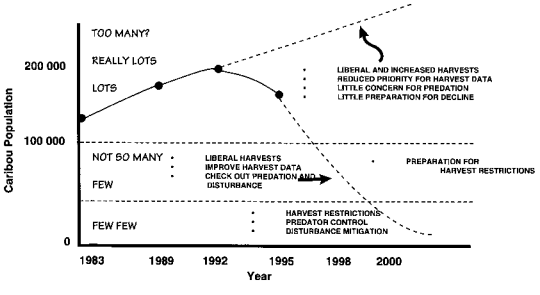

Fig. 2. Possible management responses to various categories of PCH population status in the future.

'Not So Many' And 'Few'

The reverse situation for the PCH is a continued downward trend from 1992. Judging from similar experiences with other barren-ground and woodland herds, if the PCH continues to decline, there will be a prolonged period during which the decline will be monitored and management actions will be debated. Since it is very difficult to restrict harvesting, especially where subsistence needs are paramount, comprehensive harvest restrictions may not be invoked until the population has dropped substantially. This scenario corresponds to the categories of 'Not so many caribou' - when discussions will concentrate on means of controlling the harvest plus the timing and allocation of such controls, and 'few caribou' - when the need for controls will be so apparent that nearly full cooperation can be expected. Hopefully such controls will be undertaken before the herd reaches 'few few', although there is considerable evidence to the contrary (Urquhart and Farnell, 1988, Farnell in press).

So What?

The purpose of considering broad categories for management is to reexamine the preoccupation with caribou numbers, which implies that knowing exactly how many caribou there are is essential to proper management. This can be a pitfall when government departments control management because they tend to become preoccupied with getting a good number without considering how necessary such a number is for decision-making. Co-management, on the other hand, is an opportunity to establish more practical guidelines for population research.

The PCMB example shows that, as long as the abundance of the herd is known in relation to the harvest, having accurate population information is not essential for good management. This does not mean that such information is not greatly appreciated, but it does demonstrate that, for other situations where accurate population data are not available, either due to cost or technique, it is still possible to make appropriate management recommendations as long as some relative measure of abundance can be made that can be related to harvest.

In such cases the basic co-management requirement from research is to determine whether accurate population data are realistically feasible and, if not, to work on providing other means of tracking population status that can be used by co-management. Such means may require some unorthodox 'seat of the pants' approaches that classical scientists resist but nothing is worse than perpetually banking on a method that is expensive, risky, ambiguous and often disappointing.

How Do Population Dynamics Fit In?

'Dynamics' involve energy and activity and every day the PCH is energetically involved in the activities of living and dying. By understanding how such dynamics determine population size and trend, classical researchers have always felt that such knowledge could be used to refine management. But understanding caribou population dynamics has proven to be a Pandora's box of statistics and complexities, whose solutions always seems to move just beyond the capacity of available data to resolve them. This, in turn, sets researchers on an endless quest for more and better information. Ultimately, however, such information may be unobtainable at any reasonable cost.

A good example is the population dynamics monitoring of the PCH which predicted an increase in the population of 178 000 in 1989 to around 200 000 in 1991 (PCMB, 1991). However, during that period, the herd decreased to 160 000 by 1992. In retrospect, biologists believe that harsh winters increased the mortality of adult females (Fancy in press). Also, in determining this, they found from their computer model that as little as a 3% change in

Table 1. Major research and management questions based on the general population status of the caribou herd.

	POPULATION SIZE	HARVEST	HABITAT	PHYSICAL CONDITION
TOO MANY		• CAN HARVESTS BE USED TO REDUCE POPULATION SIZE?		
REALLY LOTS		• COULD AND SHOULD HARVESTS BE USED TO TRY AND CONTROL THE POPULATION?		
LOTS	• MEASURE OF ABUNDANCE THAT A) IS AFFORDABLE B) CAN BE RELATED TO HARVESTS	• WHAT IS THE RANGE OF TOTAL ANNUAL HARVESTS? • HOW IS THE HARVEST DISTRIBUTED AMONG COMMUNITIES? • GUIDELINES FOR HARVESTING A HEALTHY POPULATION • HOW MUCH IS WOUNDING LOSS? • HOW MUCH POACHING? • WHAT METHODS ARE HARMFUL?	• WHAT ARE THE HERD'S SEASONAL HABITATS? • WHICH HABITATS ARE MOST IMPORTANT AND SENSITIVE? • WHAT ACTIVITIES CONSTITUTE DISTURBANCE AND WHAT ARE THE PROBABLE IMPACTS? • COULD DISTURBANCE ACTIVITIES BE MITIGATED?	• ARE THE CARIBOU IN REASONABLE PHYSICAL HEALTH? • IS POOR CONDITION DUE TO ANYTHING THAT COULD BE MITIGATED? • ARE CARIBOU CONTAMINATED? • WHAT IS THE CONTAMINATION AND HOW COULD IT AFFECT HUMAN HEALTH? • ARE CONTAMINATION LEVELS DANGEROUS AND IF SO WHAT STEPS SHOULD A USER TAKE? • CAN CONTAMINATION BE MITIGATED?
NOT SO MANY	• IS THE POPULATION DECLINING DUE TO HARVESTS, PREDATION OR DISTURBANCE?	• WHAT IS THE TOTAL ANNUAL HARVEST? • GUIDELINES FOR HARVESTING A DECLINING POPULATION	• IS DISTURBANCE A FACTOR IN THE DECLINE? • CAN DISTURBANCE BE MITIGATED? • IS THERE INTERSPECIFIC COMPETITION?	• IS POOR CONDITION A FACTOR IN THE POPULATION DECLINE?
FEW	• IS A CRISIS IMMINENT? • WILL PREDATOR CONTROL OR DISTURBANCE MITIGATION HELP?	• HOW CAN HARVESTS BE CONTROLLED (QUOTA)?		
FEW FEW	• IS THIS A CRISIS?	• SHOULD HARVEST BE PROHIBITED?		

female mortality could cause the herd to decline but the bad news is that such a change is undetectable with current monitoring methods (D.Russell, Canadian Wildlife Service, Whitehorse, pers. comm.).

One such method is the composition count which is undertaken to determine the percentages of various age and sex classes of caribou. The reliability of such counts is almost always compromised by sample size and accurate identification plus the fact that caribou are never uniformly distributed but grouped in different age and sex classes so that samples are almost always skewed, especially in the spring.

Such information provides many opportunities for fascinating analyses (by researchers) and intense conversations (at management meetings) about what the herd might be doing. But the information is not utilized for making management recommendations since it only applies to a specific year and moreover, is often presented as being inaccurate. Regardless of what such data show or do not show about the dynamics of the population, co-management of a caribou herd does not react on a seasonal

or even annual basis but on major trends over periods of years.

Perhaps the greatest lesson from the study of population dynamics is that most of them have little or no management value. No better example exists than the PCH for which there is undoubtedly more population information than for any other barren-ground caribou herd. Yet, the complex analyses of this data have exposed a virtual chaos theory where subtle changes (like female mortality) can have major population repercussions in an unpredictable way. Thus, although all the major barren-ground herds increased during the 1980's no one ever determined why. And, if some of these herds now begin to decline, it is likely that the causes will also be buried so deeply in ecosystem dynamics that they will never be known - meanwhile engendering endless scientific debate and consequent management dithering.

When this view is coupled with the acknowledged difficulty of obtaining accurate data on any of the known factors, the co-management conclusion may be to simply count caribou, wait, and count them again, or where even that is unfeasible, to rely on some measure of abundance without delving deeply into the whys and wherefores.

From the co-management perspective, population studies should be geared toward providing answers that can be acted upon (Table 1). Thus the initial question should not be: 'Why is the herd declining?' but, 'Are there aspects of the herd's decline that can be mitigated?' If factors such as overharvesting, disturbance and predation can be ruled out through appropriate research, then the causes of the herd's decline become more or less academic since nothing can be done to influence it.

Part Two: Is The Herd Threatened?

Overharvesting

a) When there are 'Lots'

The first co-management concern about a caribou herd is whether it is being overharvested. In everybody's mind there is a large (hopefully) population of caribou from which a certain number can be taken each year without causing a decline. Thus, determining how much can be taken depends on 3 factors: population size, recruitment and adult mortality. Theoretically, this will show if the herd is being overharvested or not. In practice, however, such a number is not so obvious.

Throughout the 1980's, and ever since the PCMB was created, the PCH was increasing. The PCMB, therefore, was not preoccupied with harvest data since whatever was being taken was obviously not harming the herd. This does not mean that the Board ignored harvest information and, in fact, a great deal of time and effort has been spent to improve harvest collection methods. But the total annual harvest has not been a prime concern as long as the herd was increasing. Instead, the Board and governments have been content to rely on a general impression of the 'average' annual harvest which is considered to be in the neighbourhood of several thousand (PCMB, 1993; IPCB, 1992).

The underlying concept for this approach is the sustained yield. Although this has never been formally established by the Board, it is thought of as the number of caribou that can be taken each year without reducing the overall population. This is not determined by specific studies however, but on basic population theory as generally accepted by caribou biologists. For many years, the figure often given in this context was 5% of the total population but lately 3% is being quoted more often.

Suffice to say that such figures are largely a matter of opinion rather than hard science and are relevant only to a 'stable' population which is an oxymoron in caribou biology. Furthermore, it is likely that each population has a characteristic combination of parameters that would determine what a 'harvestable surplus' could be depending on the management goals for the herd. If research could shed light on such factors, this would give more relevance to the presently vague concepts of sustained yield and harvestable surplus that co-management has to deal with.

b) When there are 'not so many' or 'few'

There is even less certainty about what the harvest should be for a declining herd, which is what co-management needs to know most. All caribou populations decline at some time and when that happens the hunters in the communities will look to the co-management board to recommend a course of action. Given that it is very difficult to reduce subsistence harvests, both ethically and legally, it is essential that co-management be given the very best advice on what can be taken from a declining herd so that it causes no more hardship than is absolutely necessary on the users while at the same time convinces them that curtailing harvests is indeed the best solution.

But to date research has been relatively silent on strategies for harvesting declining herds. Of course, biologists will offer advice based on their understanding of population dynamics but here opinions differ greatly and what co-management needs is a solid body of research that can be called upon to make and promote their decisions. This then is a field of population research that requires much more attention than it is currently receiving.

c) The harvest data myth

Management on the basis of sustained yield requires accurate monitoring of the total annual harvest. Harvest information is one of the most deceptive components of wildlife management because, in theory, it should be readily obtainable but, in practice, it is rarely satisfactory. Also, for some reason, it is not considered as a valid field of serious research but rather as a nagging administrative problem to be addressed through trial and error. Thus, although many methods have been tried, apparently no one has rigorously examined their effectiveness. There is, in fact, a chronic need for serious harvest data research since, in the co-management world, harvest control is a real tool but a very tricky one to operate.

Disturbance

a) The habitat "bible"

Whether it is a road, a uranium mine, a pipeline or an oil field, every caribou range is subject to development proposals that could have negative impacts on the herd. In such cases, the co-management board is often the focus of coordinating a response to such proposals. To be sure, government also plays a large role, but it is often compromised by conflicting policies whereas co-management is seen as wildlife's foremost friend and champion.

Unless it is a megaproject, there is usually little time for co-management to respond to development proposals and thus it is essential that a backlog of material be available to draw upon for a submission that has to be made within a week. The best backup is information on the range, movements and, especially, habitats of the herd. Without this it is difficult to relate development proposals to the herd and impossible to be convincing about potential impacts. Such information is expensive and time consuming to produce but, unarguably, the most important research of all to equip co-management to do its job.

Ever since the Arctic National Wildlife Refuge was created in 1980, the PCH has been faced with the most devastating of all disturbances - oil development on its core calving grounds. For the past 14 years researchers have been working on this problem and it is largely because of the vast resources and high quality of work that the calving grounds, so far, remain undisturbed. In particular, this research has shown that cows with young calves avoid development facilities and that for the PCH this would force them into the foothills of the British Mountains where calf mortality, due to predation, is so much greater, that a decline would be inevitable.

Such information and a great deal more has been synthesized into a report from the International Porcupine Caribou Board titled "Sensitive Habitats of the Porcupine Caribou Herd" (1994). This is the finest co-management document of its kind because it is designed for use by decision makers who are not biologists. The report is, in fact, an operating manual for the herd's range including straightforward maps, simple explanations and a ranking of importance for each major habitat. Geared as it is for public comprehension and use, this document will undoubtedly become the caribou 'bible' for both co-management and industry in assessing future proposals for the herd's range.

Every co-management group should have such a reference and, because it is such a huge undertaking, research should be dedicated annually to filling in the blanks until the picture is completed. This could take many years but the salvation is that basic habitats do not change much over time and a calving ground or mineral lick or river crossing will be just as important in 10 years as it is now.

b) Impact information

The companion for habitat designation is impact information. This is another major research need for co-management since development proposals must be judged according to their impact on the animals and extrapolated to the population as a whole. Without the knowledge that cows with young calves avoid development, there would be less of a case for saving the '1002' section of the Arctic Refuge.

In Canada, the Dempster Highway was completed in 1979 but there is still no clear perception of how it affects the PCH and whether or not the existing 1 km no-hunting corridor is satisfactory for management.

This is because there is no useful information on how roads and related hunting activities affect caribou movements and energetics.

Impact analyses are probably the most difficult and frustrating of all caribou studies and consequently not too popular for research projects. Still, researchers should be encouraged to undertake such challenges because development pressure will only increase on caribou ranges and there is a critical need for fundamental understanding of impacts from generic forms of disturbance - roads, pipelines, aircraft, heavy equipment etc. Such information could be applied by any co-management organization as, at least, a first step in their assessment of a proposal. By the same token, co-management must relate the need for such information to certain research methods, such as radio-collaring, which may not be popular with all concerned.

Predation

The role of predation on caribou populations has received considerable attention and remains the

subject of much debate in a theoretical sense. From the co-management perspective, the role of predation is important when there is competition with hunting or when a population appears to be in trouble. In such cases it is important to thoroughly investigate this factor because there is a potential, albeit politically volatile, opportunity to take some action. Therefore, some basic information on predators should be obtained when a population is high for future comparison when the population may be declining.

Predation should also be a first priority for investigation when a population is in trouble - if only to rule it out and thus spare co-management the endless debates that keep it from taking effective action on the real problem. In most cases, however, where predation is deemed a contributing factor, the management value of each predator study must be ruthlessly evaluated against the time and costs of this notoriously difficult field of research.

Part Three: Is The Herd Healthy?

Body Condition

At meetings of the PCMB, hunters often report on the health of the herd based on their assessments of the condition of animals that they harvest. The health of the caribou is a constant concern in the user communities, although it is also recognized that the physical condition of caribou naturally varies considerably during each year and relatively from year to year.

Originally begun in 1987 as a research project to relate the physical condition of cows in various seasons to annual productivity, the Porcupine Caribou Body Condition Study has been maintained as a monitoring program which involves the collection of about 20 cows 3 times a year. The collections are always made by local hunters in cooperation with the regional biologist who takes the samples and the meat is distributed to the communities. Ultimately, this program will rely on samples from hunter kills rather than collections and, according to the Board's management plan, will be continued indefinitely.

The body condition program is popular with the PCMB because it is a scientific undertaking involving close cooperation between users and biologists. It is also rewarding for both parties to agree on the condition of the animals and the significance to the herd. In addition, the program provides an opportunity to collect samples for related work such as contaminants monitoring.

From a research perspective, gathering data on body condition, when the herd is large and apparently 'normal', could prove invaluable in years to come should a major development occur on the herd's range that affects the condition of the animals or if a natural decline occurs which is related to nutrition. Thus, body condition research and monitoring is a priority as far as co-management is concerned, since it incorporates all of the basic co-management criteria, viz. cooperative, affordable, understandable, and useful.

Contamination

Increasing preoccupation with environmental contamination has had a profound impact on northern communities and the co-management organizations which deal with such issues in relation to wildlife. With respect to caribou, the 2 major contaminants that have caused public alarm are radio-cesium and cadmium.

As far as the Porcupine Caribou Herd is concerned, neither substance is a health hazard but both were initially perceived as such due to a combination of scientific bungling and poor public communication by government agencies. In both cases, the Porcupine Caribou Management Board became the focus for concerns expressed by the users and hence, interpretations of scientific data and health assessments that had some relevance in the real world.

Although contaminants research is continually increasing its sophistication in detecting and tracking contaminants, it is woefully deficient in relating such information to realistic assessments of health risks for users. Such deficiencies include, accurate information on the consumption of various country foods, cumulative effects of contaminants, health implications of using alternative commercial food sources, useful advice on how much can be safely consumed, and explanations of physiological effects of contaminants on the human body.

Parasites And Diseases

In addition to concerns about contaminants, people on the land occasionally find unhealthy animals about which they request information. In most cases, the causes can be attributed to known diseases or parasites but the breakdowns occur in: a) obtaining a good sample for examination and b) explaining the problem in understandable terms to the public. Therefore as far as research is concerned, co-management needs are: a) reliable field techniques for collecting samples by hunters and b) straightforward accounts of parasites and diseases for public education.

Summary

The greatly increasing reliance by governments on co-management organizations for management direction has profound implications for wildlife research both in the way it is approached and the way it is utilized. Researchers who fail to recognize

the true requirements of co-management are in real danger of becoming irrelevant unless they fully comprehend just what kind of information co-management groups need (Table 1).

To successfully refocus wildlife research so that it is compatible with co-management approaches to problem solving is more of a challenge than might first appear. Many of the classic approaches must be sacrificed in favour of more down-to-earth methods that are affordable, understandable, useful and acceptable to northern communities. Whereas such methods may be judged as 'unscientific' by the academic, this is of far less importance to co-management groups than having something they can understand and use.

Of course, the bottom line for research is funding, and as one biologist commented at a recent conference," Who pays the piper calls the tune". Hopefully, recent land claim settlements in the North will enable co-management organizations to pay more pipers and, more hopefully, such groups will have the courage to demand research that will be useful to them rather than being persuaded into extravagant programs of little practical value. At the same time, government funding organizations should also recognize co-management needs and not perpetuate highly sophisticated studies which as one PCMB member commented," Tell you everything except how to fix the problem".

In the past, many wildlife populations in the North were largely unmanaged because governments had limited research capabilities which could only focus on a few issues with the standard repertoire of expensive and esoteric research techniques. Under co-management, however, most wildlife populations will get much more attention because that is the sole responsibility of such organizations. But it would be silly to imagine that standard research resources could be expanded to meet escalating demands for information from co-management groups and thus it is imperative that wildlife research be completely restructured to accommodate the new ways of managing wildlife.

Ultimately, co-management approaches to wildlife management and research should benefit all - from the peripheral wildlife populations that were formerly ignored, to the user groups that become intimately involved with both management and research and, finally, to the researchers themselves who have an opportunity both to develop a rapport with the people who rely on wildlife and also to enjoy having their research put into practice rather than collecting dust on a shelf.

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