NORTH AMERICAN NATIVE HUNTING AND MANAGEMENT OF MOOSE POPULATIONS

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This paper presents an analysis of the system of moose management and conservation practiced by hunters in a James Bay Cree Indian community in northern Quebec, and sets these findings in a broader comparative perspective. It shows how Cree use available indicators of trends in moose populations to guide their hunting decisions. The data presented demonstrate that Cree practices do work to meet Cree objectives and to conserve moose populations. The paper also presents summaries of new evidence from research in other parts of northern North America which show that other Native peoples have similar systems of knowledge and use related methods of hunting and management. However, the lack of systematic data on how widespread such practices are, or on when and how such practices change is noted; and needs for future research are identified. The parallels between Native knowledge and practice and the practices of wildlife management are also noted, as is the need for joint management by government mandated and Native managers.

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Introduction

Wildlife management always involves social policy making as well as wildlife and habitat manipulation, and as a result it also always requires both biological and socio-cultural knowledge. The socio-cultural data bases of wildlife management are especially critical when there are major threats to the wildlife, or major conflicts over wildlife resource issues among politically significant sectors of a population, or when the diverse groups of resource users or managers do not share common cultural heritages. Under each of these conditions there is a danger that relevant socio-cultural information may be difficult to collect. These are all conditions which have prevailed for moose management during the last decade in parts of the northern North American moose range.

During this period cultural and political differences have separated the two groups with the greatest interest in the management and conservation of the wildlife resources, namely the government mandated wildlife managers and the Native peoples. The result is that each tends to operate with insufficient information about the knowledge, practices and degree of success of the other. Anecdotal stories prevail on all sides, where better information and dialogue are needed. This need is highlighted by the growing legal recognition of Native interests in wildlife resources, as a result of aboriginal rights

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claims, and the resulting establishment of legal and administrative procedures for joint wildlife management by government employed managers and Native representatives. This paper surveys what social science research can contribute to wider knowledge of Native use and management of moose populations, and to the dialogues which are now underway.

Recent studies of northern Native peoples by social scientists have been taking a fresh look at the relationship of those peoples to the environments in which they live, and in the process asking both more sophisticated questions and seeking more detailed answers to questions about those relationships. In particular there has been a determined effort to get away from the dual caricatures of Native peoples as wanton exploiters or ecological saints. Armed with a more sophisticated appreciation of the biological sciences, anthropologists have attempted to combine the former with social science approaches, and to ask new and basic questions about how Native peoples use environmental resources, and the conditions and consequences of that use.

The present paper presents part of the results of a study of the cultural ecology of a group of sub-arctic hunters in northern Quebec, the Waswanipi band of James Bay Cree Indians. It also reviews relevant data from other recent studies of sub-arctic Indian peoples extending across North America, in order to assess the generality of the results of the case study.

The first part of the paper examines Native hunting strategies, and the second the evidence of Native management and conservation of the game populations. In each section Native knowledge is analyzed, then actual practices are examined and then the consequences of those practices are assessed.

The Waswanipi Indian people are members of a cultural and political group known as the James Bay Cree. They number a thousand, and live between Matagami and Chibougamau in northern Quebec dispersed among 40 to 50 isolated bush camps from which most subsistence hunting and commercial trapping are conducted. The hunting area covers about 35 000 sq. km. In this paper I will use the term Cree to refer to the Waswanipi, unless context indicates otherwise.

Indigenous Systems of Knowledge and Hunting Strategies

Cree Ecological Knowledge and Hunting Strategies

Cree knowledge of moose and of moose hunting is best discovered by examining how hunters talk about their moose hunting practices and experience. The statements by Cree about moose hunting are derived from three major sources: general discussions of how to hunt moose; descriptions of specific hunts; and questions about the words and expressions which are used in the Cree language to discuss moose hunting.

Cree prefer to hunt moose during the fall rut, during the period of deep snow cover in mid-winter, and in late-winter when the snow is typically crusted. During the rut mating bulls can frequently be found by searching the shorelines, or by calling them out of the bush.

Waswanipi say that during early winter, after the rut, moose typically range

widely, move frequently and often run far when disturbed. As the snow cover accumulates it limits the mobility of moose. The Waswanipi say moose are affected when the snow cover reaches between 0.75 and 0.9 meter. At that time the moose increasingly concentrate where wind or other factors minimize snow accumulation, and where food is available, particularly on hills and highlands. Waswanipi say they hunt for moose in mid-winter primarily by searching the hills for signs of moose. Deep snow reduces the mobility of moose to less than that of active men with snowshoes. Thus a man in good physical condition with a steady snowshoe gait can exhaust a moose after several hours to the point where it will run no further, will stand its ground, and face the hunter to be shot.

Hunters make choices about when to search for or pursue animals. When signs are found pursuit may be immediate, or it maybe delayed several days or weeks, or it may never occur. Hunters say they prefer to try to hunt moose on what are called "moose days" in Cree. These are windy days with light snowfall and seasonable temperatures. The light wind rustles trees and shrubs and makes it harder for the moose to hear the hunters approach. The light snow is an aid in judging the age of tracks, and reduces the range of vision of the moose. Mild weather makes travel easier and, as opposed to bitter cold, stalking is quieter as both snow and branches are less brittle. Waswanipi say that the comportment of moose is generally calmer on such days as well. When hunting under such conditions an extended pursuit can often be avoided.

The third period of the year when Waswanipi say they prefer to hunt moose is in late winter when the snow has a crystalline structure right through and a thick ice crust has formed due to repeated thawing and freezing. Moose are still usually at maximum concentration, but their mobility is severely restricted. The Waswanipi say moose usually do not run because their legs penetrate deeply through the snow and get cut along the jagged edges of the crust. They usually restrict themselves to well-beaten trails, packed by repeated use. Even in full view of hunters and/or dogs they will usually not venture off the trails and will only run until cornered in a dead end, where they will then stand their ground.

In late winter the preferred days for pursuit of moose are cooler days following warm days, for which there is a special name, when crusts may remain hard throughout the daylight period.

In summary, the Waswanipi have a considerable knowledge of moose behavior in relation to environmental conditions and hunting, and this knowledge is used to identify culturally preferred times and methods for hunting moose. Such knowledge is said to be highly effective, and to make hunting a reliable and efficient activity.

Cree Hunting Strategies in Practice

The extent to which Waswanipi practices conform to their decision-making models was studied by examining separate data on their moose hunting activities. These data are derived from diaries and interviews from a variety of Waswanipi hunters, most not included in the interviews on Cree knowledge reported above. Two aspects of hunting behavior will be summarized: the distribution of moose hunting by seasonal conditions, and the relation of

hunting to daily weather conditions. The data refer to the hunting season of 1968–69, and cover approximately one-quarter of the moose harvests of the year. The initial unit for this analysis is the successful moose hunt, which counts as a single case no matter how many moose a hunter or a pair of hunters killed on a given day. Later analysis of data on all hunting days, successful and unsuccessful, confirms the patterns reported here.

Approximately one-sixth of recorded hunts occurred during the rutting season. Of the sixteen successful moose hunts recorded between the end of the rut and the middle of May, six occurred in a two-week period at the end of January and the beginning of February, and seven in March. One successful hunt occurred in the twelve weeks prior to the last week of January, one in the three last weeks of February, and one in the seven weeks following March 28. In short, moose hunts were heavily concentrated in three hunting periods.

Weather records from the nearest station (Chapais, Quebec) indicate that the snow cover was at least 0.75 meter on the morning of each successful winter hunt day, except the first, when the depth recorded at the station was 0.74 meter. The snow cover dropped below 0.75 meter three days after the last recorded successful winter moose hunt.

No direct observations of snow crusts and densities were made at weather stations in the Waswanipi region. However, available records indicate that above freezing temperatures occurred on two days in each of the last two weeks of January, and intermittent warming occurred again during the first four weeks of March. There is therefore evidence of a relationship between periods of probable occurrence of crusted snows and the dates of successful moose hunts. While the two periods of intensive winter hunting coincide with the times described in Waswanipi hunting recipes, the crusting of snow in January–February was considered atypical by Waswanipi hunters, and indicates the opportunistic use of fortuitous circumstances, consistent with the general patterns of Cree knowledge.

Examining the daily weather conditions on successful winter moose hunt days, light snowfall (2.5 to 25.4 mm) fell on eight of sixteen days. No snow fell on six other hunt days, and two successful hunt days had more than 25.4 mm of snowfall. During the two climatic periods in which the intensive winter hunting occurred,[1] hunts were successful on one-third of the days with light snowfall, one-sixth of the days with little or no snowfall, and one out of twelve days with heavy snowfall.

Wind speeds at noon on moose hunt days indicate that no successful hunts were made when winds were less than 8 k.p.h. Such days accounted for twenty percent of the periods. Eleven of twelve successful moose hunt days had maximum daily temperatures between 0° and minus 18°C, whereas 28 percent of the days during the climatic period had maximum daily temperatures above 0°C. Thus, during these periods of alternating above and below freezing temperatures, successful moose hunting occurred primarily on days with freezing temperatures. Hunts were therefore more successful on the types of

[1] These periods were identified by a climatologist, B. Hrebenyk, on the basis of the tracks and dates of the highs and lows which traversed the region, and the persistence of weather types (Feit 1978).

days the hunters said were preferred for hunting.

When the weather conditions of all days on which moose were hunted are examined, whether or not the hunt was successful, a similar pattern occurs, indicating that hunters tended to choose to hunt on days when conditions were consistent with those they say they prefer.

The hunting practices of Waswanipi men are therefore clearly guided by their knowledge of the ecological and biological conditions. Their hunting practices are not left to chance and are based on informed decision-making, guided by clearly articulated understandings, and responsive to changing circumstances (see below and Feit 1973 and 1978 for additional data which cannot be included here).

Comparative Studies of Indigenous Systems of Hunting

Observations similar to those above have been presented by researchers working in Native communities in other parts of northern North America. The details of hunting systems vary with habitat and resources, but the general effectiveness of hunting practices and their basis in local knowledge is a widespread conclusion.

For example, the Muskrat Dam Lake Cree of northern Ontario are reported to recognize two preferred periods for moose hunting, the fall rut and the late winter/early spring when crusted snow occurs more frequently (Winterhalder 1983). Annual harvests of moose have two peaks corresponding to those periods. The difference with the Waswanipi is that there is no preferred mid-winter hunting period. Furthermore, Winterhalder reports that moose are hunted in winter primarily in bushy areas, especially along small streams. Although snow depths are sufficient to reduce the mobility of moose, he states that the search for signs of moose is a relatively high risk activity in this region, and that deep snow reduces hunters chances of locating tracks because moose are less active. He also indicates that hunters do not pursue moose if the animals detect them during a stalk.

These differences with Waswanipi hunting strategies may be related to important environmental differences between the Muskrat Dam Lake and Waswanipi regions. Winterhalder cites an average mid-winter snow depth for northern Ontario of 60 cm, with considerable year to year variability, whereas at Waswanipi average mid-winter snow depths are approximately 90 cm. I interpret Muskrat Dam Lake hunting strategies as suitable for an environment in which average mid-winter snow depths are not usually sufficient to concentrate moose into a limited number of areas which are relatively easy to search, or to give hunters a decided advantage in mobility. The uncertain outcome of a mid-winter hunt in such an environment would not encourage concentration on hunting during that season.

The Kutchin people of interior Alaska have another pattern of moose hunting preferences which relates to environmental variables, including in this instance, mountainous terrain (Nelson 1973, 1983). Nelson described moose hunting knowledge and techniques which indicate that deep snows, crusted snow cover, wind and moderate cold all affect perceptions of hunting opportunities. In that case however, a critical factor is snow conditions in the mountains which can drive the moose down into the river valleys during some

winters. Such good winter conditions appear to be intermittent here, so in most years a single peak in moose harvests occurs. Up to half the annual kill is taken during the rut.

One common feature in all these studies is that hunters concentrate their hunting in periods which are most opportune for success. This is not surprising for hunters who depend on their harvests for subsistence, and for whom hunting is a major productive activity, and not a holiday.

The strategies used by subsistence hunters would be expected to be different from those of sport hunters, especially with respect to the reliability and efficiency of their hunting activities. Native hunters would be expected to optimize the reliability of their harvests by generally hunting game when chances of success are relatively high, in order to best assure subsistence for their families and communities. And, they would also be expected to optimize their efficiency both with respect to the choices among different moose hunting strategies, and the choices between moose hunting and other game harvesting activities. These expectations have been demonstrated in several studies.

Comparative Studies of the Efficiency of Moose Hunting

The data from both the northern Ontario and northern Quebec studies indicate the efficiency of moose hunting.

Winterhalder reports that during the rut three extended moose hunting trips took place, each involving several hunters, and all resulted in kills. The efficiency of these hunts, measured as the ratio of the energy cost or input of the hunters' work in kcal divided into the energy value of the edible meat harvested in kcal, was 53.2 units returned for each unit input. Late winter/early spring hunts during a particularly good period of crusted snow gave efficiency ratios of 46, whereas mid-winter hunting had an efficiency ratio of 22.3 (Winterhalder 1983).

Data from diary records kept by two Waswanipi hunting groups are not extensive enough to separate by season, but indicate efficiency ratios for the fall, winter and late winter hunting periods combined of 39.3 and 23.6 respectively. They killed a moose for every 3.6 and 5.9 mandays of hunting. These figures are for hunts conducted without snow machines, and new data suggest that efficiency ratios were marginally higher after snow machines came into regular use. These figures are therefore consistent with those from Ontario.

The significance of these figures from the hunter's point of view is that moose hunting is, during the preferred seasons, substantially more efficient an activity than alternative hunting choices.

At Waswanipi, averaged values for hunting efficiencies indicate that moose hunting is three times more efficient than beaver harvesting, six times more efficient than fishing, ten times more efficient than inland waterfowling, and fifteen times more efficient than small game hunting. At Muskrat Dam Lake, using seasonal data and comparing kcal acquired per hour of work to acquire the resource, moose hunting during preferred seasons is nearly twice as efficient as spring and fall fishing, three times as efficient as beaver harvesting and summer fishing, six times as efficient as waterfowl hunting in the upland interior, and seven times as efficient as winter fishing (calculated from data in Winterhalder 1983, Table 3).

While moose hunting provides very substantial returns on inputs it is not, on a comparative basis, as reliable an activity as it is efficient. That is, the likelihood of making a kill on any given day is lower than for some other harvesting activities. Winterhalder reports that during the mid-winter signs of moose were found on half the hunting trips, and pursuit was less frequently successful, with two of nine pursuits resulting in a kill. As indicated above, during the rut, hunting was substantially more reliable, although the hunts appear to have been longer, lasting from 5 to 10 days.

At Waswanipi a total of 16 hunts produced moose or signs of moose on six occasions, or 38% of the hunts. Pursuit occurred immediately in five of the six cases; on the other occasion hunters returned the next day to find the moose had moved out of the area. Moose were killed on four of the other five occasions. Most of the uncertainty was in searching, as opposed to pursuit which was successful three-quarters of the time. This is consistent with the finding that most Waswanipi hunting occurred during periods of preferred hunting conditions.

By comparison with other harvesting activities at Waswanipi moose hunting does not rank high in reliability. Fishing provides catches on 88% of fishing days, small game hunting on up to 58% of hunting days, beaver harvesting on 49%, waterfowl hunting on 35%, and moose hunting on an overall average of 28%. At Muskrat Dam Lake, Winterhalder ranks the short-term reliability of moose hunting below that of hunting for all the other resource species except caribou (1981).

Thus moose hunting is not the surest way to produce food for an immediate need on any given day, but the lower likelihood of immediate success in one day of moose hunting is offset by the quantity of food it produces. The high efficiency of moose hunting indicated above offsets its lower reliability relative to other game harvesting activities.

The very high efficiency makes moose hunting the most secure means of providing for long-term subsistence needs. This is confirmed by widespread statements in the ethnographic literature, and by the almost universal reports that moose is a species which ranks at or near the top of the preference lists of Native hunters.

Native Systems of Management and Conservation of Moose

Given the preference for moose hunting, and the efficiency of Native hunting, we might expect Native hunters to devote considerable time to moose hunting, at least during the preferred periods. But, because moose appear to sustain lower biomasses and be less productive than many of the alternative species that are harvested (including fish, small game, and beaver [see Feit 1978 and Winterhalder 1981]), Native hunters could easily deplete moose if they attempted to meet the great majority of their subsistence needs from that source. A first consideration is therefore whether the hunters regulate their hunting effort.

During the winter hunting period Waswanipi hunters spent 6% of hunting mandays hunting moose, as compared with 62% harvesting beaver, 14% harvesting small game, 8% fishing, 7% trapping fine fur, and 3% hunting waterfowl at the beginning and the end of the period. Was-

wanipi hunters do not therefore devote anywhere near the amount of effort to moose hunting which might be expected on the basis of only short-term efficiency considerations. Weather could be a factor limiting moose hunting efforts, but 65 % of winter days have appropriate snow conditions, and 75 % have preferred wind conditions.

The fact that such a limited percentage of time is spent hunting moose is a clear indication of self-regulation of hunting effort. The resulting harvest of moose accounted for approximately one-quarter of the total annual poundage of edible food produced by the Waswanipi from wildlife harvests in 1968–69 and 1969–70. Beaver accounted for a similar proportion, and fish harvests (including summer catches) accounted for over one-third of the available food harvest. Thus despite the preference for, and efficiency of moose hunting, Waswanipi put considerably more effort into hunting other wildlife resources, and derive more of their diet from those other resources.

The questions addressed in the remainder of this paper are whether decisions on moose hunting effort are related to long-term management considerations, in the view of the Crees, and in practice; and if so, how is this accomplished, and is it effective? As in the first half of the paper, Waswanipi statements and knowledge will first be considered, then data on actual practices and their consequences will be analyzed, and finally comparative data will be reviewed.

Cree Monitoring of Game Populations and of Hunting Effort

Hunters say that they could kill more moose than they do. The time a hunter devotes to hunting moose is in part a function of his expectations of how many moose he will kill in a given year. Each hunter learns about how many moose he will kill from a complex combination of signs he observes in the course of his daily activities in the bush, and of signs which he experiences and interprets in dreams. The significance of many signs encountered in the course of hunting is often only understood upon later reflection, in daytime thought.

Sightings of moose themselves are the clearest type of sign a hunter may experience. For example, sighting a moose with two young at a distance during summer fishing was interpreted as showing the hunter that maybe he would " get two or three moose this winter". Such interpretations are never final, and they may be confirmed, or refuted, by other sightings or signs of moose, or the lack thereof.

While this may seem odd at first, this way of thinking can be very practical. Hunters recount their observations to others, and their discussions on such occasions reveal the information which they are noting and think is important. One feature they note is the frequency of observations of moose or of signs of moose. But they are also careful to note the age and sex of any animals sighted, and to estimate these features from the signs when they do not see the animals themselves. Hoof impressions, height of browsing, disturbance to surrounding vegetation, angle of the trail of urine through the snow, all are observed and noted, along with other features. When an adult female is identified, people comment on whether it was accompanied by young, and if so, by how many. Information is also gathered in the course of butchering animals. If fetuses

are found they are treated with special respect, and their presence is discussed. Similarly the size of moose groupings is noted.

The information hunters gather about the moose populations of the regions where they hunt is synthesized and used in a variety of ways. The level of synthesis most accessible in conversation is an evaluation of the trends which the hunters note in important parameters of the populations. Most common here are comparative evaluations of the numbers of moose in a region over time. Mature hunters can usually state whether they think there are more moose now than a year ago or two years ago, or than five years ago, or when their first child was married, or when they first started hunting, possibly thirty or fifty years before.

In addition, hunters can often comment on whether the size of moose groups has been going up or down, on whether the females are having young more or less frequently, on the trends in the frequency of twinning, on trends in the survival rate of the young, and on changes in the age or sex composition of the population.

Hunters tend to hunt repeatedly over a lifetime on a limited number of hunting territories, which may range in size from about 250 to 1 500 sq. km. They therefore build up a detailed knowledge of the local moose populations, as well as those of other species.

The population parameters the Waswanipi hunters monitor are precisely those which biological scientists and wiidlife managers have found to be important indicators of the condition of the populations and important factors in determining appropriate levels of harvesting. But few biologists or managers have such long-term information on as wide a range of parameters as do Cree hunters. Nor do they often have such detailed knowledge of game populations on specific tracts of land as do the Cree. In this respect the Cree may be more like hunters in Europe who carefully watch the status of game animals on areas to which they have hunting rights.

The Cree hunters say that the trends in population parameters are signs of what their future harvests will be. However, the Cree are not scientists. They phrase their knowledge in a culturally distinctive system of concepts and values (Feit 1973). The Cree say that the animals they kill are a gift, and that they should only get animals which are willing to be caught. They also say that God and his various spirit helpers, particularly the winds which are associated with snow, have to be willing in order for the animals to be killed.

The many indicators the Cree monitor are understood as communications from the animals and the spirits. These communications are spiritually sacred, and morally powerful, and if they are not respected by hunters, the animals and spirits will be angry and the hunters will get less in the future. The signs noted by the Cree are therefore responses by animals and spirits to their previous hunting activities, to the numbers of moose they have killed, and the times, places and means by which they were killed. Even an increase in the "shyness" or "calmness" of the moose may indicate their response to previous hunts and their willingness to give themselves in the future.

The Cree therefore say that they should, and do, adjust their hunting efforts to the trends in the signs. Such a system of knowledge and action is poten-

tially highly responsive to the condition of the game populations, and could link decisions on intensity of hunting effort to conditions of the moose populations.

Cree Management in Practice— Hunting Territories

Waswanipi harvesting of moose is organized around the system of hunting territories. Each territory is under the supervision of a hunter, usually an active elder. The territory system has been recognized in recent decades by the governments for purposes of organizing beaver trapping, but the system pre-dates official recognition, and it serves the Waswanipi for a much wider range of harvesting activities than just fur-bearers. The men who supervise the use of each territory are called "owners" by the Cree. However, they cannot alienate the land and they exercise a spiritual authority, based on their ties to the spirits of the land, within a system of communal rights. Their role might better be described as one of stewardship.

There are approximately fifty stewards among the approximately 225 adult Waswanipi men. Stewards generally have the right and obligation to decide whether a hunting territory should be used for harvesting of big game and fur-bearers during any year or season. And they in effect allocate long-term rights and seasonal privileges to use the territories to hunters who do not have their own. They can thus decide, roughly or precisely, how many hunters will use a territory. And, they can indicate to those who do use the territory how many of each major kind of game they can harvest. They can direct where, when, and how game should be taken. Although this direction is normally kept to the minimum, and often takes the discret form of suggestions and providing information thus respecting the relative autonomy of each hunter, their supervision is usually respected.

It is the stewards who, by repeatedly returning to the same tracts of land over the course of many years, have the best opportunity to observe and assess the condition of the game populations on the territory. And, because they are also deciding, or at least usually informed of, the numbers of big game that are killed each year, they are in a good position to relate the trends in game population parameters to the impacts of hunting as well as other factors. Stewards use this knowledge to direct hunting of major game populations on the territory.

They recognize game which responds to such management decisions, and other game that do not. They say, for example, that moose and beaver respond to how they hunt them, but that variations in hare and grouse populations are not generally responsive to how many the hunters take. Similarly, they say that otters are hard to find, and that the populations do not respond to the levels of hunting intensity the Cree practice.

Several types of evidence were gathered to examine whether this system of management is actually put into practice, and whether it works to regulate harvests and manage game populations, at the territory level and at the regional level.

One indicator of stewards management is that approximately three-quarters of the hunting territories are used on a rotational fallowing basis in order for the game to "grow" between harvests. On average, regularly hunted territories were not used for 1.7 years out of the five years for which data were available during the present

study. Furthermore, about one-quarter of these stewards report that they divide their territories into sections, and use these on a rotating basis, so although their territories are used each year the same sections are not hunted in successive years.

The harvests themselves are clearly related to these patterns of use. I grouped territories and sections for analysis into three categories, those which had been hunted the year previous to the recorded harvest of moose, those which had not been hunted for one year previous, and those which had not been hunted for two or more years previous. The average moose harvest per square kilometer was found to increase from the first to the last category, averaging 0.010 moose per sq. km. for areas hunted the previous year, 0.014 for areas not hunted the one year previous, and 0.016 for those areas not used for two or more years previous to the recorded harvest. While not statistically significant the differences in average kill rates indicate that after letting a hunting territory go unharvested for one or more years hunters take more intensive harvests of moose per unit area. A similar pattern was found for beaver harvests (Feit 1978).

The mechanism by which this increased harvest occurs involves both the actual increases in the densities of the moose populations, and the decisions made by the stewards on the basis of their perception and interpretation of these changes. The stewards thus regulate the harvests in response to the periods of fallow, and presumably to the actual and perceived changes in the densities of game.

While many territories are fallowed on a regular basis, the size of some territories and/or the size of the families of the stewards who use them, make planned rotational use of some other territories more difficult and infrequent. On the territories which are not regularly fallowed, stewards will initially respond to indicators of over harvesting by reducing the harvest of the affected species.

Nevertheless, there are some of these territories where multi-year declines in the condition of game populations do occur, despite the efforts of stewards to reduce harvests to levels which will permit game to "grow again". These territories represent about 16 percent of Waswanipi hunting territories. Demographic indicators generally show that these territories have above average human population densities. I do not have measures of trends in animal populations at the level of individual hunting territories, but stewards of some of these territories reported downward trends which extended over several years despite their initial efforts to alleviate the problem. These cases present a critical test of Waswanipi management practices.

I recorded eight cases where people said game populations were declining over much of a territory during a several year period, five where both moose and beaver were said to be declining and three where only beaver were affected. Hunters reported that the game populations were not completely depleted, but the declines were perceived either in total numbers or in the breeding populations.

The reasons for these declines were without exception said to be over-harvesting. In seven of the eight cases the level of the harvests of the affected species had been reduced to below the average for the region, but the decline was reported to be continuing, and clearly the initial reduc-

tion of harvest levels was not sufficient. I do not have data on the responses on the last of the eight territories.

Six of these eight hunting territories were fallowed for one or more years when the hunters said that it was clear that the effort to reduce harvests the previous year had not been sufficient to permit game populations to "grow". On a seventh the hunters continued reduced harvests of big game but stayed on the territory.

In the five cases where I was able to monitor the effect of the Cree decision to let the territory go fallow, the game populations on each territory were reported to have been re-established so that hunting could resume after one to three years. And, in fact, later harvest research questionnaire data showed that normal harvest levels were again achieved in succeeding years on all eight territories. The relative speed of the recovery of harvests, and presumably of game populations, indicates that Waswanipi hunters respond to indicators of game population declines before those trends proceed so far that recovery by the game populations is endangered, or considerably lengthened. In summary, when territories which are not fallowed on a regular rotation show signs of over-hunting, the use of an ad hoc fallow, or reduced harvests, appear to be fully effective responses.

Cree Management in Practice— Regional Effectiveness

The region-wide effectiveness of these territorial management strategies is best assessed by examining the available information on regional moose populations and moose harvests.

The first aerial survey of moose populations which covered portions of the region hunted by the Waswanipi was conducted by the Government of Quebec, Ministère du Loisir, de la Chasse et de la Pêche in January, 1968 (eight months before the first year of data collected for the present research). A second survey was conducted in the winter of 1971–72, slightly more than one year after completion of the initial quantitative parts of the present study. Since then the results of two additional surveys have been completed, in the winters of 1975 and 1976.

Recalculating the numbers and densities of moose for the area of the Waswanipi territories, and for the standardized assumptions adopted in the later survey reports about the size of yarding groups, the estimated densities of moose were 20 percent higher in 1971–72 (Brassard 1972) than in 1968 (Brassard 1968). The data from the 1975 and 1976 studies cannot be recalculated to provide direct estimates, but the author of the 1976 survey concluded that his results were generally comparable to those of the 1971–72 survey (Audet 1976; see Feit 1978 for discussion). The maps of zones of relative moose densities published in these last two studies also confirm the general distributions found in the 1971–72 survey (Morasse 1975, Audet 1976).

There is therefore some evidence that moose population densities in the Waswanipi region were relatively stable during the period of this research and over a period of nine years between 1968 and 1976.

The estimated moose harvests by Waswanipi hunters on their own hunting territories in 1968–69 and 1969–70 were 157 and 123 respectively, for an average of 140 moose per year. A study of harvesting by James Bay Cree hunters in the 1970s esti-

mated harvest levels from 1972–73 to 1975–76 of 154, 123, 129 and 153 moose (see reports of the James Bay and Northern Quebec Native Harvesting Research Committee, 1976, 1978, and 1982).[2] Thus Waswanipi hunters were able to maintain a relatively stable range of harvests over the same nine year period.

The relative stability of both moose harvests and moose densities are the best evidence of the success of Waswanipi management practices, as well as of the potential sustainability of the harvests. In the longer term, the very presence of the moose populations themselves attest to long-term conservation of game populations by the Waswanipi.

Native Management and Conservation of Moose in Other Regions

Recent studies of Native hunting from across the North American sub-arctic indicate similar systems of understanding and means of regulating harvests of moose, as well as other possible techniques for management and conservation.

Systems of wildlife management are composed of both measures to control population dynamics and measures to improve habitat, and this is true for Native techniques as well. For example, Nelson (1983) has reported how when Koyukuk villagers in Alaska perceived problems with their harvests of moose and bear they limited their hunting by restricting it to particular seasons.

Another means for managing wildlife resources which is at the disposal of Native peoples is the use of selected burning. Highly restricted today, there is growing evidence that fire was widely used up until quite recent times, and that its use is not entirely a thing of the past (Lewis 1982, Brody 1981, Pyne 1982).

Lewis (1982) reports that Native people in northern Alberta would set fires in meadows and brush in order to improve the habitat for both game and stock. They say that this was done in part because moose were often attracted to recent burns, where they were relatively easy to see and hunt. He was told by Native hunters that in some areas burning was a regular part of annual hunting patterns, and that it had a positive effect on moose populations when properly done (Lewis 1982).

Systems of thought and knowledge similar to those held by the Waswanipi have been reported from various other populations of Native people stretching across North America. The neighboring Mistassini Cree have an essentially similar system of cultural knowledge and value (Tanner 1979) and the nearby Wemindji Cree of northern Quebec use similar understanding to organize and manage their hunting, including geese hunts (Scott 1983).

Strikingly parallel systems of knowledge are reported from north-western Canada and Alaska among peoples linguistically and historically distinct from the eastern Cree (Nelson 1983, McClellan 1975, Ridington 1982). And the extent and importance of Native knowledge has increasingly been noted by northern researchers (see

[2] The Waswanipi are not the only hunters harvesting on their territories, both sports hunters and Cree from other communities take harvests on their lands, but a consideration of these complexities goes beyond this article (see Feit 1978). During the period covered by this research, the levels of these other kills was not so large as to undermine the effectiveness of Waswanipi practices.

Berkes 1981, Freeman 1979; Ridington 1982, and Feit 1984).

McClellan (1975), for example, indicates that people from several Native groups in the southern Yukon territory say they must respect the animals if the supply is to continue, and that mistreatment will result in "bad luck", and a poor hunt. Yukon hunters develop spiritual ties to animals, much as the Cree do, and draw metaphorical analogies between the life and death of animals and of the humans whose lives the animals make possible. In one Tutchone myth, McClellan reports, moose was once a huge man-eating animal with carnivore teeth, until the Animal Mother spirit chastened the moose for continually fighting and killing humans and not obeying her warnings. Treated as a parable, the story could be interpreted as conveying a message that excessive abuse of men by moose, or of moose by men, will lead to serious consequences for the means of sustenance of the transgressor.

While Native understandings may appear somewhat odd at first, this paper has shown that they make sense, and that they provide a framework for both organizing the extensive experience of the hunters and for practical action.

Before completing this survey of comparative data, it is also important to note some comparisons between Native knowledge and our own. It would not be inappropriate to claim that the widespread similarities in understanding among Native peoples constitute systems of ecological knowledge, which have striking parallels with the findings of biological scientists. Thus the Native view that there are extensive communications and complex reticulate relationships between men, animals and other features of the environment, is very close in its basic structure to the view of ecological science that the world can be conceived as a complex series of relationships among phenomena of different orders.

The Native understanding that men must respect animals, is very similar to what we call a conservation ethic (Leopold 1949). The understanding that hunters must regulate their present harvests in order to assure future harvesting has important similarities to the concept of sustained yield management (Dasmann 1964). And the process of managing by means of monitoring and responding to the impacts of earlier management actions is very close to the cyclical implementation process of management described in recent textbooks (Bailey 1984).

It is not surprising that these similarities should occur because Native hunters and wildlife biologists are both interacting, observing, and trying to understand the same animals and environments. They often speak with different languages, idioms and cultures but each incorporates similar practical knowledge and wisdom in their understandings. And both use their knowledge to try to effectively manage and conserve wildlife. Neither is always successful, but game would not have survived had Native hunters not regulated their harvests, nor can it survive if industrial societies do not regulate their impacts.

Historical Assessment and Conclusions

This paper has presented a case study of the use and management of moose popu-

lations by a community of Native hunters. It has also presented comparative data from other Native communities indicating the existence of similar hunting strategies, of various potential means to manage moose populations, and of similar systems of knowledge concerning moose in particular and man/environment relationships in general.

However, the paper does not include any evidence concerning how widespread Native management is in practice, because comparative research on the management practices used by Native peoples is just beginning to be undertaken. Nevertheless, before concluding it is important to indicate how this question might be addressed in future, and to indicate why it is important. This will involve a brief summary of the environmental and social history of Waswanipi management practices during this century, which demonstrates the complex issues which must be addressed in order to reach conclusions concerning the distribution and continuation of Native wildlife management practices.

The descriptions of the Waswanipi region in the reports and journals of geologists, biologists, fur traders, surveyors, and missionaries who have visited the area throughout this century provide a useful account of the environmental history of the region. With respect to the history of moose populations, these reports are consistent with the views of Waswanipi elders, namely that moose populations were very low or non-existent at the turn of this century, and that moose numbers increased sharply in the first decades of the century, following extensive forest fires. They also agree that moose have not experienced any dramatic declines since the initial increases, although some slow decline has occurred as the forests have aged.

This suggests that Waswanipi management practices have been effective over many decades, and also that they can be highly flexible and adaptive, since management appears to have been effective throughout a period of rapid changes. In particular there have been rapid Native population increases, important changes in hunting and transportation technology, increased access to commercial markets and commercial food supplies and consumer goods, more sedentary life-styles, and the introduction of formal education systems.

Nevertheless, the historical record is not simply one of success. In the late 1920's and early 1930's the beaver populations of the entire region were depleted. The Waswanipi attribute the depletion in their area to over-hunting on their own part. The reasons for their over-hunting are indicated in correspondence of the period from Waswanipi leaders, fur traders and missionaries, found in government archives. These sources indicate that outside non-Native trappers began to enter the region and to deplete one hunting territory after another of valuable fur bearers, returning to different territories each year. Unable to stop the progressive depletion of the fur resources, the Waswanipi appear to have over-trapped the beaver and marten rather than let the outside trappers take them all. The Waswanipi however petitioned the government to close the fur bearer trapping in the area, and set up a closed season of their own to aid the recovery of the fur-bearer populations once the area was relatively free of outside trappers. Throughout the period, the

Waswanipi continued to maintain the management and conservation of moose and other game resources not sought by the outside commercial trappers.

This historical evidence shows one of the sets of conditions under which Native management and conservation systems can be expected to encounter difficulties, namely when outside intervention makes the practical task of management impossible. Similar disruption of management practices might occur today in some regions as a result of too intensive a sport hunt, or as a result of the short-term impacts of extensive forestry clear-cutting practices. A key point is that such disruptions are specific to particular historical and environmental conditions, and to particular species, and that as conditions change the opportunities for Native wildlife management also change.

Research is therefore needed both on contemporary practices and on historical conditions in order to better understand: 1) how Native management and conservation has been responsive to a complex interplay of changing ecological, biological, demographic, technological, economic, political, and socio-cultural conditions; 2) how under certain combinations of these conditions Native wildlife management of specific species has not succeeded, or has been abandoned; and 3) under what conditions Native wildlife management has been continued or re-established.

What has been learned so far makes it clear that the often anecdotal stories of the success or failure of Native wildlife management, with which the lore of both some wildlife managers and of some of the publicists of the Native cause are replete, are insufficient for developing an accurate picture of how Native management works, how extensive it is in practice today, how extensive it was in the past, or how extensive it might be in the future. What is known is that Native management can work, it can be adaptive, it is not always successful, and that it can be re-established following periods of breakdown. We need to learn more about the specific ways these processes occur, and how widespread these practices are today.

This may look like a rather scholarly or arcane problem, but I think that the future management of moose and other wildlife populations in extensive parts of North America now depends on the effective joint participation of government mandated wildlife managers and Native wildlife managers. Native people can no longer use or manage the resources without extensive and effective means of participating in the decisions taken in the wider society which profoundly affect the future of the resources and their use. And government wildlife managers cannot protect or manage the wildlife resources without effective means of participating in the decisions taken in Native society which profoundly affect the future of the wildlife resources and their use. Joint management seems to be essential, despite the fact that some government wildlife managers and some Native wildlife managers would each claim exclusive rights of management.

The form of such joint management will be one of the major challenges in wildlife management in the next several years. The findings of the new research reported in this paper show that Native hunters can have a real and practical interest in the management and conservation of wildlife. Recognition of this conclusion could pro-

vide a basis for efforts to establish communication, and practical cooperation between government wildlife managers and the Native managers. The need for cooperation among all groups has been pressed on everyone in recent decades by the increasing dangers to the wildlife resources. These new findings show that there is a basis for mutually respectful cooperation.

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