Historical and Present Status of Woodland Caribou *(Rangifer tarandus*) in Pukaskwa National Park, Ontario and Implications for Metapopulation Management, a Review

Keith Wade
Pukaskwa National Park

Abstract

Population numbers of Woodland Caribou in Pukaskwa National Park have been regularly monitored from 1972 to the present. Fluctuations in numbers have been characterized as typical of a stable population regime (Bergerud, 1989). Nevertheless, the probability of extirpation of this disjunct local population may be high. Bergerud (1989) has elaborated on circumstances leading to such an event. Metapopulation theory poses challenges to protected area managers. Monitoring techniques, accumulated data and implications of metapopulation and minimum viable population size theory are elaborated upon for park managers mandated to maintain the woodland caribou in Pukaskwa National Park and resource managers in adjacent jurisdictions.

Introduction

Pukaskwa National Park and its greater ecosystem are within the southern boreal forest along the northeast corner of Lake Superior (Figure 1). Woodland Caribou are endemic to the area. Within Pukaskwa National Park the species is categorized as a high priority for conservation. Population levels have in recent history been low, ranging from a high of 31 animals in 1972 to a low of six in 1997 (Table 1, Figure 2). Managers always consider the possibility of extirpation with such a small population. Monitoring of population levels is important in this context but equally important is an understanding of some of the theory of population dynamics. A short summary of Pukaskwa caribou population monitoring and how it fits into the regional picture of a caribou metapopulation, as well as a discussion of two models proposed to explain the current situation are included in this paper.

Metapopulation theory and the concept of minimum viable metapopulation size in dissected landscapes have become increasingly sophisticated concepts used by ecologists. Pukaskwa National Park has a vulnerable population of woodland caribou for which there are large historical and current data sets. Habitat around the park is increasingly dissected by an elaborate and dense road network built by Domtar Forest Products Incorporated to access the White River Forest, Sustainable Forest License (SFM) in the Ontario Ministry of Natural Resources (OMNR) Wawa District (Promaine, in progress).

Historical and Present Status

Woodland Caribou numbers have been monitored and the species' behaviour and habitat needs studied in Pukaskwa National Park since 1972 (Table 1, Figure 2). All population counts have been minimum population counts using aerial line transect techniques, (Burnham, 1980). Counts include animals seen by

observers and estimates of additional animals from track and other physical signs. Survey methods have been consistent year to year with some refinement over time (Moreland, 1991; Wade, 1995).

Caribou are native to the Greater Pukaskwa National Park Ecosystem. Bergerud (1989) has discussed and summarized historical population levels and has theorized that they were never at high densities. Bergerud estimated that the pristine – up to the early 1900s – density of caribou was 0.06 to 0.12 /km^2 or approximately 200 caribou for the area now within Pukaskwa National Park. Since the early 1900s caribou have been declining in numbers in the Pukaskwa area and their predominant range has retreated to the point where it is apparently concentrated on the coastal corridor along the shore of Lake Superior. This coincides with a similar trend of range contraction on the provincial scale. Generally caribou in the greater Pukaskwa ecosystem are found within five kilometres of the shore. Bergerud (1989) has characterized this as a predator avoidance strategy and suggests it is not controlled by lack of suitable habitat and food resources elsewhere in the Pukaskwa ecosystem.

Figure 1: Pukaskwa National Park and its Greater Ecosystem

Year	Total Number Estimated	Actual Number Observed	Recruitment	Comments
1972	15	12	unknown	Revised estimate
1973	14	8	12.5%	Revised estimate
1974	15		13.3%	
1975	19		16.0%	
1976	21		33.0%	
1977	21		14.3%	
1978	26		10.7%	
1979	31	16	16.1%	
1980	19	16	18.8%	
1981	28		28.6%	
1982	16		6.7%	
1983	22	13	22.7%	
1984	no count		19.3%	T. Bergerud estimate
1985	22		7.7%	
1986	no count		12.5%	T. Bergerud estimate
1987	27	12	13.9%	
1988	no count		22.9%	T. Bergerud estimate
1989	14		12.5%	
1990	14	7	21.0%	Seasonal monitoring
1991	20		25.0%	
1992	no count		unknown	
1993	14	14	0%	
1994	no count		unknown	
1995	6	1	0%	
1996	12	8	33.0%	Telemetry data
1997	11	8	27.0%	

Table 1: Pukaskwa National Park Minimum Woodland Caribou Population Size

Caribou do range widely within the ecosystem. There are a growing number of confirmed observational records in the park data base that suggest that our view of the animals as being strongly attached to the coastal habitat is not a completely accurate picture. Genetic exchange between Pukaskwa caribou, Pic Island/Coldwell Peninsula (Neys Provincial Park) caribou and perhaps the Slate Islands animals has been suggested by Bergerud, and may be confirmed by current work (Neale, ongoing). Bergerud (1989) documented the emigration from the Slate Islands and eventually to Pukaskwa by one ear-tagged male. He states that genetic exchange occurs among these disjunct populations at a low rate.

However it appears that what were thought to be separate disjunct populations – one in Pukaskwa National Park and another along the Lake Superior coast between Michipicoten River and the Pukaskwa River – might now have to be considered one local disjunct population as the result of accumulating data (Neale, ongoing; Pukaskwa National Park Data Base). Winter range for the southern shore disjunct population has historically been centred on Mountain Ash Hill, approximately 17 kilometres to the east of Point Isacor and 13 kilometres west of Michipicoten Harbour within the Ontario Ministry of Natural Resources Wawa District, (OMNR records; Eason, personal communication).

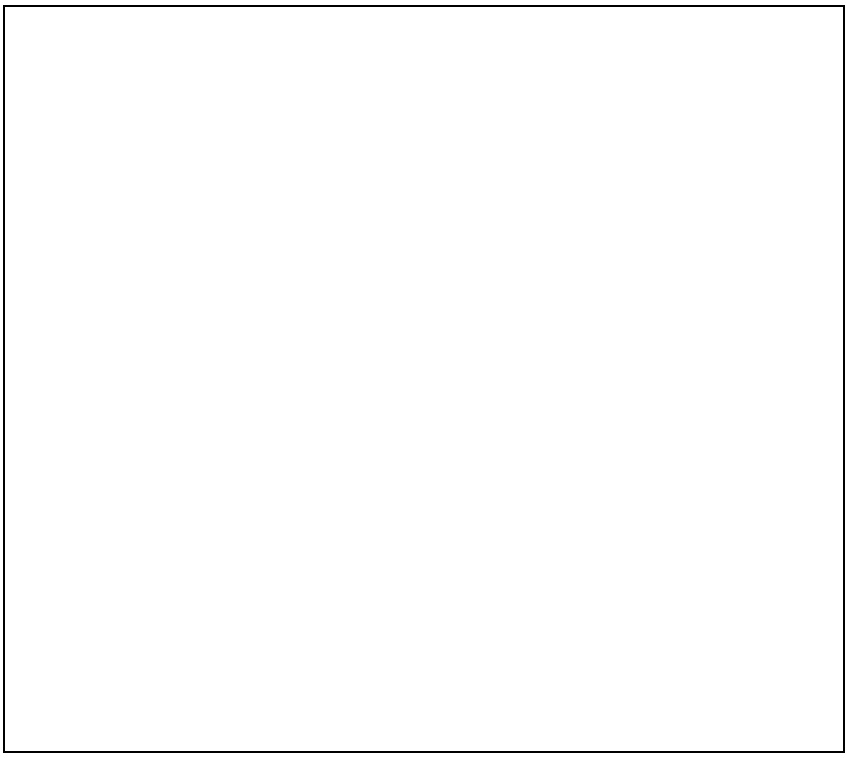

Figure 2: Minimum Woodland Caribou Population Size – Pukaskwa National Park

Long distance seasonal movements by caribou along the coast are documented as occurring over several days during the spring and fall (Neale in progress; Wade, 1993). A number of caribou have travelled outside their winter/spring range near Otter Island and Otter Head within Pukaskwa National Park to summer range more than 70 kilometres distant near the area south of the Eagle River Mine at Floating Heart Bay. The inference is that the caribou in the greater ecosystem may have greater exchange through immigration and emigration than previously thought or that they may actually be one population. This will remain speculative until more genetic interpretation can be done from existing blood samples.

Theoretical Probability of Extirpation

It has been suggested that possible extirpation of the Pukaskwa disjunct local population could occur as a consequence of several concurrent events (Bergerud, 1989). Bergerud reasoned that should deep snows in the interior of the ecosystem cause moose (*Alces alces*) to seek areas of lesser snow accumulation they would naturally migrate to the coastal zone of Lake Superior with lower snow depths. Since moose are the principal prey species of timber wolves (*Canis lupus*) this animal would follow its prey base and while hunting moose would encounter caribou at a higher rate than during winters of lower

interior snow pack depth when moose would theoretically be less inclined to move.

Bergerud (1989) states that the presence of solid shore-fast ice over extensive distances of coastline provides wolves an easy travel corridor in winters when this type of ice forms. Caribou are a more easily killed prey than moose and would suffer higher mortality rates during such winters as wolves moved through caribou winter range along the coast.

Bergerud argues that the controlling factor on this caribou population is predation by wolves. When the number of animals reaches 20 to 25 the population becomes more of a predation target for wolves than during those years when the population is at a low ebb of perhaps 10 to 15 animals. Thus Bergerud believes that the local disjunct population of Pukaskwa caribou are an example of a group in a classic *predator pit* cycle (Bergerud, 1984). Should there be three successive winters when the above described conditions coincide, caribou mortality could be high enough to cause a decline beyond the ability of the population to recover (Bergerud, 1989).

During the winter of 1993 known mortality of the Pukaskwa caribou population was 28.6% and recruitment was apparently 0%. In 1994, mortality was 20.0% with unknown recruitment, in an estimated population of 10 (Wade, 1995). Bergerud (1989) estimated population mortality averaged 15% from 1972 through 1988 and considered this a high mortality rate compared to other North American populations. Recruitment during this same 17-year period was estimated to be 16%. Recruitment during 1995 was 0% again but increased to 33% in 1996 and 27% in 1997 (Wade, 1997). Continued monitoring by radio telemetry relocation and other observational work suggest that recruitment will be relatively high again in 1998 and that mortality appears to have been very low since 1995. This follows a pattern well described by Bergerud (1989) of a stable population with changing equilibria

Hanski (1997) has addressed another approach to determining the degree of extinction risk for the disjunct population(s) of caribou. He has discussed the relation between metapopulation dynamics and increasing habitat dissection and what this can tell us about the minimum viable metapopulation size and the minimum amount of suitable habitat necessary to perpetuate a metapopulation. Although it is arguable whether the Pukaskwa greater ecosystem has experienced or will experience the degree or type of dissection that could threaten the existence of the local caribou population there is accelerating dissection by roads of the landscape surrounding the park (Promaine, in progress). Pukaskwa may not fit the definition exactly, however important points to consider in Hanski's analysis are that metapopulations with a high immigration rate will lower the rate of local extinctions. Further, metapopulations with multiple population size equilibria may go abruptly extinct even in those landscapes that are only slowly degrading and once they are gone, reestablishment may be difficult.

Generally metapopulations respond to the changes in landscape or habitat with a lag. Thus a rapidly changing habitat makes it problematic for a metapopulation to reach new equilibria. It is still unclear at present whether the populations we are discussing fit the criteria of a metapopulation as defined by Wells and Richmond

(1997). Woodland Caribou within Pukaskwa National Park are a local population (Wells and Richmond, 1995) in the sense that they are a group of individuals within an area delimited by park managers which is smaller than the geographic range of the species in Ontario. They might be considered a disjunct population of a metapopulation – a set of spatially disjunct populations with probable immigration (Wells and Richmond, 1995). However to fit the definition and model there must be definite evidence of significant movement and subsequent genetic exchange between the greater ecosystem's local disjunct populations.

Some of the assumptions of Bergerud's model are currently being tested in the Pukaskwa Predator Prey Process Project. Neale (in progress) is investigating the spatial separation of moose and caribou on a seasonal basis. Are moose indeed in higher densities in the preferred coastal habitat of caribou during the winter months and is this the result of a general shift in the moose population to areas of lesser snow depths from zones in the interior with high snow depths? Is there, in any given winter a sufficient differential in snow depth gradient between interior highland areas and the coast to cause moose to move coastward? Preliminary results of this work suggest that there is not a significant correlation between moose densities along the coast in winter and caribou mortality.

Is the landscape of the greater ecosystem changing rapidly? Current information suggests that it is (Landsat TM image, 1984 and 1991/94). Is immigration high in this metapopulation? Although unknown, existing data suggests that immigration may be high (Pukaskwa National Park data base, 1972-1998). Can the greater ecosystem local disjunct populations be considered part of a metapopulation? I believe that the evidence is sufficient to conclude that they are part of a metapopulation. However, this is a question for debate, and hopefully some degree of consensus.

Management Implications

What are the implications for managers? Both Bergerud's model and Hanski's theory as related to our case of caribou in the Pukaskwa greater ecosystem suggest that local extinction or extirpation of caribou is possible.

Managers need to be aware of the genetic makeup of animals in a metapopulation. The question in the case of Pukaskwa greater ecosystem caribou is whether they have experienced any demographic bottlenecks resulting in decreased heterozygosity. Richards and Leberg (1995) caution that this genetic drift is likely to be underestimated in populations experiencing the most severe bottlenecks. They also caution application in management decisions when using small sample sizes, as is the case in the examples they cite and the current instance. It is therefore very important to obtain more data on the degree of immigration and presumably, genetic transfer, that may be occurring in this metapopulation. Currently genetic analysis is being done on Pukaskwa caribou blood samples taken during three capture projects in 1991,1993 and 1996.

Parks Canada policy allows for direct intervention in a species' status, including reintroduction, if the reasons for the extirpation are well understood. The *Reintroduction of Native Animal Species* Parks Canada Directive states in part: "Native animal species once present but now absent are to be reintroduced into a National Park". Questions to be asked should extirpation occur and reintroduction

of a local population be attempted are complicated by intergovernmental – Federal, Provincial and First Nations – and interagency – Parks Canada, Ontario Ministry of Natural Resources and Ontario Parks – policies as well as the current genetic makeup of other potential donor local populations.

Caribou have been reintroduced by OMNR to areas in the greater ecosystem to the south and east of Pukaskwa National Park on Michipicoten Island, Montreal Island and Cape Garqantua in Lake Superior Provincial Park. Stockwell et al. (1995) found that refuge populations, such as a local reintroduced population, had significantly lower levels of heterozygosity or variability than the parent population. In a literature review of translocation projects worldwide they found that a translocated reindeer population (*Rangifer tarandus*) in Iceland had reduced heterozygosity (Roed et al., 1985) albeit on a very small sample. They recommend that reintroduced or translocated populations be periodically surveyed for genetic diversity. This in itself presents an expensive logistical problem to managers that must be considered in planning for any reintroduction.

In conclusion we as park mangers are left with many scientific questions about the existing status of the caribou metapopulation and what to do about it, and how to do it in the event of an abrupt extirpation which current theory tells us is a distinct possibility.

We need to:

1. know what degree of immigration is occurring in the metapopulation, particularly to the local disjunct populations;
2. know what are the population limiting factors – i.e., disprove or support Bergerud's hypothesis or suggest a different hypothesis. This is currently being addressed by PNP Predator Prey Process Project;
3. further sample the several local disjunct populations in the metapopulation for genetic variability; and,
4. develop an integrated recovery or salvage plan with the several political jurisdictions and confirm the triggers that will activate such a plan, or, alternately, put forward a cogent argument for not interfering.

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