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Managing for Caribou Survival in a Partitioned Habitat

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Abstract: Forest management guidelines for woodland caribou (*Rangifer tarandus caribou*) in Ontario need to be re-examined in light of the finding that caribou partition habitat with moose (*Alces alces*), partly to find virtual refuges from predation by gray wolves (*Canis lupus*). Forest-wide guidelines seem inappropriate for a species that is widely scattered and little known. Management should concentrate on and around currently used virtual refuges to ensure their continued habitability. Cutting these areas may force the caribou into places with higher densities of predators; winter use of roads might bring poachers, increased wolf entry, and accidents. A proposal for 100 km^2 clear-cuts scheduled over 60+ years across the forest landscape would probably minimize moose/wolf densities in the long run as intended, but because of habitat partitioning might forfeit any benefits to caribou in the short-term. Sharply reducing moose densities near areas where caribou have sought refuge might incline wolves to switch to caribou. Cutting beyond caribou winter refuge areas should aim at maintaining current moose densities to prevent wolves from switching prey species. Operations level manipulation of the forest around each wintering area should provide winter habitat for the future, while treatment replications with controls across the whole forest would provide reliable knowledge about which approaches work best. The remainder of the forest should be managed to maintain suitable densities of all other species.

Key words: forest harvesting, guidelines, habitat partitioning, moose, gray wolf

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Woodland caribou ecology has progressed to a stage where useful generalizations are available to managers. Perhaps most widely recognized is Bergerud's (e.g., 1974a, 1985a, 1992) insistence that predation is the crucial factor to consider in managing caribou populations. Support for his position has come from numerous other authors (Gauthier & Theberge, 1986; Edmonds, 1988; Elliot, 1989; Hayes *et al.*, 1989; Seip, 1989). The consensus is that only plans minimizing predation will succeed in perpetuating caribou populations.

One of the most common causes of increased predation has been the presence of alternate prey species, especially the moose. Simkin (1965) suggested that caribou in Ontario declined because higher wolf densities resulted from immigration of moose after 1900. He was followed by other authors, mostly in British Columbia (e.g. Bergerud, 1974a; 1985a; 1985; Bergerud & Elliot, 1986; Seip, 1985; 1990; 1991; 1992). In view of these studies, agreement has grown that the goal of caribou management in the presence of moose and wolves should be to reduce moose densities and keep them low. Following this logic, Racey *et al.* (1991) described forest management guidelines for northern Ontario aimed at minimizing the suitability of newly harvested forest areas for moose to reduce the density of wolves that might prey on caribou.

But ecology of woodland caribou in Ontario differs in some respects from ecology described in most other places (except, perhaps, Wells Gray Park; Seip, 1990). Survival of caribou in the face of apparent competition from moose appears to depend on habitat partitioning in the patchy forest (Cumming *et al.*, 1996). The question arises, "what difference should the knowledge of habitat partitioning make to management strategies for caribou survival?" In this paper, I examine that question in the Ontario context to critique guidelines presented by Racey *et al.* (1991) and to present alternatives. The question has application outside Ontario since similar management alternatives require resolution in any place with habitat partitioning between caribou and some other prey species in the presence of shared predators. Furthermore, the problem necessitates drawing implicitly or explicitly on a range of basic issues to

address the single problem of managing landscapes for caribou survival.

General questions

What is the goal of management?

Management goals must relate to the size of the population to be managed. Darby *et al.* (1989) estimated 15 000 woodland caribou in Ontario, an estimate slightly higher than the 13 000+ estimated by Simkin (1965). These figures give the appearance of a substantial number of caribou at least holding their numbers, and, perhaps, increasing slightly. But timber management guidelines are necessary only for the portions of commercial forest of northern Ontario where caribou live. The size of the area to be managed is difficult to estimate because the southern limits to caribou distribution remain indefinite. By inspection (Fig. 1, Cumming & Beange, 1993), it would seem to be at least 1/4 of the commercial forest or about 100 000 km^2. Darby *et al.* (1989) reported data that would have allowed differentiation between caribou populations in the commercial forest and those farther north in Ontario, but they did not make use of the information. Cumming & Beange (1993) estimated only about 800 caribou in the actual commercial forest area. Some 13 000 caribou living in the Hudson's Bay Lowlands, 800 caribou in parks and 400 in a timber reserve are irrelevant for purposes of designing timber management guidelines. Management for sustained yield of 15 000 caribou would be quite conceivable; the goal for managing 800 caribou must be to ensure survival. The landscape scale planning proposed by Racey *et al.* (1991) would be suitable for 15 000 caribou, but stand level planning is necessary to ensure survival of 800 animals.

What is the planning/management area?

The idea of dividing the forest between areas where moose are featured species and areas where caribou are featured ignores the reality that even in those parts of the boreal forest inhabited by caribou, the portions actually used by caribou are relatively small. Cumming & Beange (1987) found <10% of the forest used by caribou in winter. Even the 20% projected by the draft guidelines would imply vast expanses with no apparent use by caribou. Some justification might be found for retaining a row of 100 km^2 polygons next to caribou wintering areas to keep moose and wolf densities low near caribou, following the logic of Racey *et al.* (1991), but large unused areas would remain. Furthermore, pockets of caribou might be located south of that line, or might return, or be re-introduced there.

Areas to be managed specifically for woodland caribou should be those with caribou potential. Although the draft guidelines discuss potential habitat, they do not distinguish it from habitat currently used. Present winter habitat can be determined by mapping tracks in snow from the air (Cumming & Beange, 1987); potential areas can be found by combining satellite imagery available for fire prediction purposes with Forest Resources Inventory data (Antoniak, 1993). Thus, it should be possible to delineate both currently used stands and areas of caribou potential from the forest in general. These areas, rather than everything north of a prescribed line, should be the areas designated for special caribou management.

What is the general management strategy?

In their review of woodland caribou biology, Darby *et al.* (1989) overlooked a striking difference between caribou in Ontario and those described elsewhere. Bergerud (1985a, p. 221) referring to British Columbia states, "Winter ranges are more variable for caribou than (ranges) at any other season", but Cumming & Beange (1987) provided evidence that caribou in Ontario return to the same general areas each winter, much the way white-tailed deer (*Odocoileus virginianus*) use winter yards (Taylor, 1956). The behaviour is probably dictated by the patchy nature of the forest where ground lichen stands supply food for caribou. These forest types are found only in definable locations (Antoniak, 1993). Once caribou locate such places they live there throughout the winter and return annually for many years. Nearly all the wintering areas located by Cumming & Beange (1987) are still in use (Cumming & Beange, 1993); caribou have been known to occupy one area each winter since at least 1956, and they were reported in the same vicinity by a Conservation Officer in 1910. Thus, these are traditional wintering areas that should not be ignored in management plans. Their presence allows managers to avoid dispersing their efforts over vast areas and, instead, concentrate them on the stands currently used by caribou, and those with future potential.

Racey *et al.* (1991) agree with Bergerud (1985a) that caribou will easily shift from a currently used wintering area to a new one: "Caribou have evolved to shift their range in response to fire and can likely shift it in response to logging." (p. 113). This statement assumes that caribou have suitable alternate range. Schaefer & Pruitt (1991) showed that on a small scale and short time period caribou were not able to shift their range in response to fire. Cumming & Beange (1993) showed similar evidence for cutting. It may be that all suitable winter range (i.e. available food and few predators) is already occupied. At any rate, it would seem imprudent to base the future survival of caribou on the

assumption that caribou will be able to shift their range and survive.

These wintering areas may be more important than just food sources if Cumming *et al.* (1996) are correct in their contention that caribou use them as virtual refuges also. If that is true, destruction of the refuge, or any disturbance that forced caribou to leave it, might increase predation risks to levels that could terminate the local caribou band. Where a patchy habitat provides the possibility of virtual refuges the first and most important management step for preserving caribou appears to be ensuring that these refuges remain habitable for caribou.

Unfortunately, the guidelines to maintain a patchy forest would not assure continuation of wintering areas that are currently providing refuge for caribou (Fig. 1). Prescriptions for a matrix of harvest and leave blocks, as proposed by Racey *et al.* (1991), might, or might not, delay harvesting areas currently used by caribou. Eventually these areas would certainly be cut, hoping that suitable habitat had been prepared by the scheduled cutting somewhere else. Such dependence on extensive management is not reliable enough where caribou survival is at stake. More specific direction must be applied to localized areas to maximize benefits of forest management planning for caribou.

Management of caribou wintering areas is much like managing for old forests (Harris, 1984). Racey *et al.* (1991) maintain that 20% of the forest should be in caribou winter habitat at any one time. Thus, they propose cutting 20% of the timber in each of the age categories 0-20, 20-40, 40-60, 60-80, and 80-100, similar to the example provided by Hunter (1990, p.69). However, as Hunter (1990) points out, the trouble with this approach is that it occupies so much forest land, in this case, all the commercial forest north of the yet-to-be-determined line dividing caribou forest from moose country. A reserve system would tie up much less forest land.

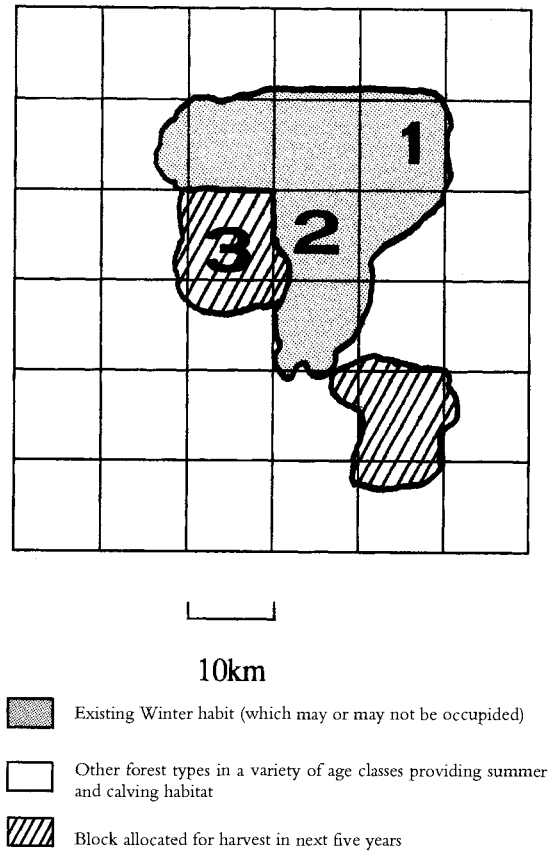

Fig. 1. Management at the landscape level may not ensure survival of caribou with partitioned habitat. If caribou were currently wintering in Area 1, the distant cutting would do them no harm. If they were using Area 2, adacent cutting might cause disturbance, reduce moose densities, incline wolves to switch from moose, and lead individual wolves along ecotones directly to the caribou. If caribou were using Area 3, cutting would probably cause caribou to leave and that would likely result in the demise of the local caribou band (Cumming & Beange, 1993)

Specific questions

Should virtual refuge areas be cut?

Cumming & Beange (1993) provided evidence that forest harvesting in caribou wintering areas resulted in the caribou leaving. In 3 places where portions of wintering areas were cut, caribou did not use those areas again for 12 years. Thus an important requirement for retaining virtual refuge areas would be to exclude them from forest harvesting until the caribou prove that suitable alternate stands are available by moving to them. However, reserving wintering areas themselves from cutting might not be enough. Cumming & Beange (1993) reported 2 monitored areas that caribou abandoned even though actual harvesting activities were 1 and 3 km distant. Nearby disturbance that drives out the caribou would eliminate the benefits of these special patches as effectively as would cutting them. Therefore, in addition to prohibiting cutting in areas occupied by caribou, the same prescription would have to be extended to a buffer zone surrounding them. On the basis of this one example, it appears that a buffer against disturbance from forest harvesting would need to be at least 3 km wide.

Another possible threat associated with forest harvesting might be the presence of roads through wintering areas. Whether or not traffic by itself has any effect on caribou, roads might increase incursi-

ons by wolves, provide access for poachers, and introduce the possibility of road kills. Caribou mortality would probably increase reducing the value of these areas as refuges.

What is the significance of fire?

Since the time of Cringan (1957) the role of fire in caribou ecology has remained controversial. Some biologists have emphasized the destructive power of fire (e.g., Scotter, 1972) while others have pointed out its necessity for renewing conditions that will support lichens (e.g., Miller, 1979). Racey *et al.* (1991) recognize the threat of fire in blocks of mature timber providing winter habitat and suggest that their protection from fire will have to be made a priority. Support for this view has been provided by Schaefer & Pruitt (1991).

Espousing the view that fires in the past have been good for caribou, Racey *et al.* (1991) model their forest management guidelines on these fires. They claim that to do so requires 100 km^2 harvest cuts. Although some fires undoubtedly exceeded 100 km^2, many smaller fires must have accompanied them. A better mimic of natural conditions would be to cut areas of varying sizes. Furthermore, it does not follow from the observation of early fires producing caribou range that they did so in the best way. In a 32000 km^2 study area, Cumming & Beange (1987) found the overall gross area used by caribou was 9% of the forest north of the Canadian National Railway (where there has been little recent disturbance by humans) and 6% to the south. Over 90% of the range produced by fire is not being used. Specific management directed at caribou wintering areas and their surroundings should be able to do better.

What procedures will minimize predation on calving grounds?

The importance of calving refuges to caribou has long been established (e.g., Bergerud *et al.,* 1984; Bergerud, 1985b; Bergerud *et al.*, 1990). But disagreement remains concerning what constitutes a calving ground for caribou in Ontario. Racey *et al.* (1991) suggest that calving sites may be dispersed "in isolated or secluded bogs, fens or in mainland forest stands" and that "a much higher proportion of Ontario's caribou may give birth to calves in this type of site and collectively they may be more important than islands or lake shorelines" (p. 110). This statement has implications for management strategy. If caribou use the entire forest for calving, a matrix of cutting areas would seem to be the only way of maintaining some calving grounds. But if most caribou calve on islands and shorelines a series of shoreline reserves could protect all of them. Racey *et al.* (1991) support their assertion by referring to studies in Newfoundland (Bergerud, 1974b), northern Quebec (Brown *et al.*, 1986) and Manitoba (Shoesmith & Storey, 1977; Darby & Pruitt, 1984 - only the latter suggested that most caribou calve inland). On the other hand, Racey *et al.* (1991) overlooked five references specific to caribou in Ontario, all of which agree that caribou calve on islands or along shorelines (Bergerud, 1974a; 1985b; Bergerud *et al.*, 1990; Cumming & Beange, 1987; & Simkin, 1965). Simkin (1965), with a research assistant and two native trappers, searched for caribou calving grounds by canoe, and by foot up to 1 km inland (Simkin, pers. comm.), during four summers, and supplemented these ground surveys with two helicopter flights. He concluded that caribou cows with calves, at calving time, were found only on certain types of islands and similar shorelines. Future research may support the views of Racey *et al.* (1991), but current information does not warrant protection of the entire forest for calving.

Even a designation of islands and shorelines as caribou calving areas is not specific enough for recommendations concerning management of summer habitat. At the present state of knowledge, managers cannot predict in advance which islands and shorelines caribou will use. Summer habitat has to be within migration distance of suitable winter habitat (or vice versa), but travel distances between winter and summer range vary greatly (from 26 to 80 km, mean 46 km (Cumming & Beange, 1987). In abundantly watered northern Ontario, many lakes will not be used. Bergerud *et al.* (1990) show that summer presence of caribou can be discerned along shorelines, even where sand beaches are not available. Summer reconnaissance should be undertaken to determine which lakes require shoreline protection for caribou cows with calves. Once these lakes have been identified, the recommendations for reserves put forward by Racey *et al.* (1991) seem adequate: shoreline reserves ranging from 400-900 m varying in size and shape to suit individual sites should be designated. As Racey *et al.* (1991) point out, care needs to be exercised to ensure that narrow reserves do not become "traps" for vulnerable animals in areas easily searched by predators (a consideration common among caribou biologists but not yet addressed by theory, Holt, pers. comm.).

What measures are necessary to retain travel corridors?

With winter and summer grounds protected, final consideration for year-round caribou habitat protection must include routes followed by caribou moving between winter and summer ranges. For some caribou bands, this is not a problem.

Cumming & Beange (1987) reported 1 caribou band that did not move at all. Similarly, the caribou described by Cumming *et al.* (1996) rarely ranged outside the area occupied in winter to find summer habitat (unpublished data). However, many other caribou do move substantial distances, and for these the travel routes between summer and winter refuge areas may be the most hazardous portions of their habitat.

But prescriptions to minimize predation along these routes are difficult to specify. In some cases, the travel area is so diffuse that it can scarcely a be called a "route" (Cumming & Beange, 1987). In such circumstances, the best course would be to remove the entire travel area from the forest land base as some kind of reserve. If that is not possible, the alternative would seem to be scheduled cutting to retain some standing tree cover along the way at all times. In places where the travel route is well defined, prescriptions can be more specific. Racey *et al.* (1991) suggest a 2 km wide corridor of (mainly) conifers >3 m height. This provision should be adequate in most places.

How can winter predation be minimized?

Possibly, the most controversial recommendation of the guidelines proposed by Racey *et al.* (1991) concerns their method for minimizing winter predation. Since direct wolf control would be publicly unacceptable in Ontario, the draft guidelines propose forest harvest scheduling to form matrices of 100 km^2 cut and uncut blocks. The provisions would be applied throughout the entire >100 000 km^2 of the northern commercial forest occupied by caribou. The objective is to keep moose densities low so that their biomass would not support high enough wolf densities to threaten caribou. This strategy should be successful in producing poor moose habitat since it is designed to approximate the opposite of that produced by moose guidelines (Ont. Min. Nat. Res., 1988) . Over the long term, numbers of moose should decline, and with them numbers of wolves, thus reducing the threat to caribou.

However, Racey *et al.* (1991) give no consideration to the short term. As Holt & Lawton (1994) point out short-term effects may differ markedly from those of the long term. Forest harvesting generally produces clear-cut areas where escape cover for moose has been removed and road access for hunters improved (Eason, 1989). A dangerous situations might arise if this practice were carried out in mixed-wood stands with relatively high moose and wolf densities. Eason (1989) reported a reduction from 0.40 - 0.27 moose/km^2 in the first 2 years after such an area was cut, due mainly to hunting. If this scenario were re-enacted adjacent to a caribou wintering area, prey switching would be almost inevitable (Bergerud, 1983). With their normal prey base greatly reduced and no time for numerical response, wolves could be expected to show a functional response by turning to caribou.

Perhaps these short term effects could be avoided. Two possibilities explored by Eason (1985, 1989) were to prescribe block cuts rather than clear cuts or prohibit hunting after the area had been cut. These alternatives might prevent a sharp decrease in moose numbers but they would leave the elevated densities of moose that Racey *et al.* (1991) are trying to avoid. A gradual decrease might be achieved by cutting blocks near caribou wintering areas and then gradually liberalizing hunting over a period of several years. That way moose numbers might be reduced without the short term adverse consequences. Unfortunately, such a carefully timed reduction of moose densities would require more intensive management than currently practiced in Ontario. Intensive management of this kind, though a desirable objective, appears a possibility far in the future.

A final possibility for avoiding dangerous short-term reductions of moose near caribou might be to leave uncut buffers around caribou wintering areas. But documented long range movements of wolves (Fritts *et al.*, 1984) suggest that such a buffer would have to be very wide; translocations in Minnesota to distances of 50-317 km were largely unsuccessful at keeping problem wolves out of livestock production areas. Establishing wide enough buffers to keep out hungry wolves would amount to reserving large tracts of land from forest harvesting.

Any efforts short of the careful management explored in these options would run the risk of abruptly decreasing moose densities, with consequent prey switching by wolves, and heightened predation on caribou. Few, if any, caribou might remain to benefit from planned long term reductions in predation.

The solution would seem to be to avoid reducing moose densities. Caribou are surviving with current moose densities; presumably they could continue to do so in the future if, as recommended earlier, currently used virtual refuges were retained. As long as moose remained at current levels, more practical buffer widths should prove effective (Fig. 2). Unpublished data for 7 flights during 3 winters in a recent study of a small wintering area (40 ha, as *per* Jones & Sherman, 1983) showed only 3 wolf tracks inside the caribou wintering area (2 in year 1, 1 in year 2), 6 within the first surrounding kilometer, 7 in the second, and 6 in the third (B. Hyer, pers. comm.). The 19 tracks in surrounding areas represent wolves that could have preyed on caribou if they had chosen to do so. Since they rarely entered

the caribou occupied area, it seems unlikely that wolves beyond 3 km would be so inclined. Therefore, as long as moose densities remain about the same, the 3 km buffer width recommended for protection from forest harvesting disturbance would seem sufficient for protection from predation also, as long as moose densities remain unchanged. Managers must manage wolf motivation, not travel ability.

In view of the uncertainty of present knowledge, the safest course of action in managing for caribou survival would seem to be maintenance of moose densities at about present levels. If they should accidentally increase, they could always be reduced by more liberal hunting seasons.

How should the rest of the forest be managed?

If moose densities are best kept at present levels, cutting in the forest outside caribou wintering areas could follow moose guidelines (Ont. Min. Nat. Res., 1988). However, in these locations there seems no reason to specialize on moose. The far north areas which are virtually the only places where caribou still survive are too remote from human populations centres to be considered prime moose management areas. In these places, management for species richness might be more suitable than management for featured species. Such an objective would not imply increasing numbers of species beyond those originally present. It means attempting to maintain all the species found in the area at suitable population levels. But these approaches are not mutually exclusive. "The two management systems can also be used together to insure species richness while favouring selected species in specific locations for particular purposes." (Thomas, 1979, p. 17). A combined system might be best in view of the complexities already discussed. A general objective would be to manage the forest for species richness; specific objectives might then include managing for caribou where site conditions permit, and for moose where site conditions favour them. Species richness could be retained by managing for a "diversity of diversities" (Hunter, 1990). The objective would be to diversify not only forest types, but also cut sizes as discussed earlier, by prescribing many small cut areas, a substantial number of larger cuts, and a few very large harvest areas. These could be arranged to retain all current caribou wintering areas, produce experimental new ones, encourage high moose densities in suitable places remote from caribou, and retain all other species native to the boreal forest.

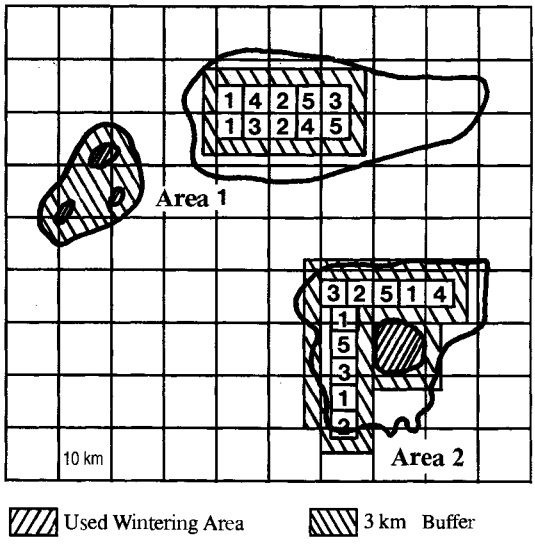

Fig. 2. Proposed forest management strategy for winter caribou refuges in partitioned habitat. Area 1 is a complex of small currently used wintering areas with a 3 km buffer; since no adjacent potential sites are available, replicated operations-level treatments for stand renewal are carried out on a nearby area (numbered small squares represent treatments or controls). Area 2 is a single currently used wintering area surrounded by a larger potential area with treatments; numbers represent same treatments as in Area 1 to allow determination of within-site and between-site variation.

A basic question - is the use of guidelines appropriate?

The analysis thus far assumes that forest harvesting guidelines to benefit woodland caribou are acceptable and necessary. But perhaps a more fundamental questions needs to be asked: in view of the known wide dispersion of caribou and uncertain state of knowledge concerning their ecology, is the writing of guidelines the most appropriate approach to habitat management? Walters & Holling (1990, p. 2060) point out that "every major change in harvesting rates and management policies is in fact a perturbation experiment with highly uncertain outcome, no matter how skillful the management agency is in marshaling evidence and arguments in support of the change" Walters & Holling (1990) maintain that this "passive adaptive" approach to management is only one step better than evolutionary or trial and error management. Using the best data available at the time, the passive adaptive approach constructs a single best estimate or model for response (in this case, the guidelines) and bases subsequent decision choices on the assumption that this model is correct. Walters & Holling (1990, p. 2064) warn that although some might argue that we can "learn from experience" (in this case, improving the guidelines as better understanding becomes

available) "there is a long history of sad experience with the false premise that it is possible to 'learn by doing' through sequential application of different policies to whole systems". Furthermore, this approach may lead to overlooking opportunities for improving system performance in the future.

Walters & Holling (1990) emphasize that the balance between knowledge gained and risks incurred often does not favour experimental disturbances in single, unique, managed systems, but they point out that this conclusion changes drastically for a collection of similar units (lakes, distinct populations, areas). The semi-isolated bands of caribou still scattered across northern Ontario constitute such a collection. A key question then, according to Walters & Holling (1990), is how large an experiment to conduct. Again, Walters & Holling (1990) put the problem concisely: "The challenge is to develop a nested experimental design that will permit clear separation of the effects of as many of these changes as possible, so that a sensible balance of management tools and policies can be developed" (p.2065). An alternative caribou management proposal along these lines would attempt to provide future winter habitat for caribou, not by general guidelines, but by a series of replicated experimental perturbations located in potential caribou habitat near presently used stands. For example, where ground lichens are being lost due to crown closure, a variety of treatments might be attempted to set back succession without opening the canopy enough to affect snow conditions.

This scheme would be similar to the reserve system proposed for retaining old Douglas fir (*Pseudotsuga menziesii*) forests by (Harris, 1984).The "core" reserve of old forest would be the area currently used by caribou. Surrounding the core would be a series of stands harvested in long rotations (perhaps 100 years) using the experimental cutting techniques that would provide answers on how best to produce new caribou habitat (Fig. 2). Currently used caribou habitat would receive maximum protection for as long as necessary while active adaptive cutting alternatives attempted to produce replacement winter habitat.

Summary of strategies for managing caribou habitat in a partitioned forest

A sound management strategy for caribou survival in northern Ontario must begin with the virtual refuges that allow the caribou to survive apparent competition with moose. These areas, with at least 3 km buffers, should be located and reserved from forest harvesting and from road-use during winter. Without such immediate action, the time would soon come when the only caribou remaining in the forested portion of northern Ontario would be those in 4 national and provincial parks. Since these parks are separated by hundreds of kilometers, caribou habitat would be fragmented and caribou numbers reduced to levels approaching minimum population sizes. Saving the smaller caribou bands outside the parks would allow individual caribou to trade among bands, greatly enhancing the genetic viability of the whole local group. In places where caribou wintering areas are sufficiently large and close so that boundaries of winter reserves overlap, consideration should be given to removing the entire area from the commercial forest land base, either through establishing more parks or by declaring them caribou habitat areas. Reserves should also be placed around calving lakes and along travel routes.

Having taken care of the most immediate and dangerous threat to caribou, management should turn to activities that would replace currently used caribou wintering areas when they become no longer habitable though successional changes. To achieve this objective, currently used wintering areas should be mapped and designated "areas of concern" where habitat renewal would be attempted through specialized forest harvesting. Once alternate areas proved sufficiently attractive for the caribou to move to them, original wintering areas could be cut.

No one can predict with certainty that recommendations will ensure the future of caribou, but following these suggestions should contribute toward continuation of woodland caribou populations in their ancestral forest habitats into the next century, and, hopefully, beyond.

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