

Can woodland caribou and the forest industry coexist: The Ontario scene

Gerald D. Racey¹, K. Abraham², W. R. Darby³, H. R. Timmermann⁴ and Q. Day⁵

¹ Ontario Ministry of Natural Resources, RR#1 25 Sideroad, Thunder Bay, Ontario, Canada P7C 4T9

² Ontario Ministry of Natural Resources, 955 Oliver Road, Thunder Bay, Ontario, Canada P7B 5E1

³ Ontario Ministry of Natural Resources, 922 Scott Street East, Fort Frances, Ontario, Canada P9A 1J4

⁴ Ontario Ministry of Natural Resources, 435 South James Street, Thunder Bay, Ontario, Canada P7C 5G6

⁵ Ontario Ministry of Natural Resources, Box 970 Nipigon, Ontario, Canada P0T 2J0

Abstract: Ontario is in the process of developing a strategy to improve the likelihood of woodland caribou (*Rangifer tarandus caribou*) and the forest industry coexisting in the province. This strategy is described within a set of proposed *Timber Management Guidelines for the Provision of Woodland Caribou Habitat*. The proposed guidelines advocate managing for large blocks of suitable winter habitat across caribou range, large cutovers to regenerate caribou winter habitat and the protection of traditional calving areas and travel routes. Summer habitat will be provided by the resulting mosaic. The forest industry can provide a sustainable supply of woodland caribou habitat that was traditionally maintained by wildfire.

Keywords: caribou, forestry, Ontario, habitat, conflicting interests, Canada

Rangifer, Special Issue No. 7: 108—115

Introduction

Woodland caribou (*Rangifer tarandus caribou*) range in Ontario has receded northward since the late 1800's, probably as a result of a combination of factors including hunting, fire, land clearing, logging, increased predation by wolves (*Canis lupus*) due to increased densities of moose (*Alces alces*) and deer (*Odocoileus virginianus*), disease caused by brain worm (*Parelaphostrongylus tenuis*) and human disturbance (Darby *et al.* 1989). At present, the southern boundary of the zone of continuous distribution of woodland caribou in Ontario is approximated by the northern limit of large-scale timber management.

Ontario has made a commitment not to let any species decline provincially as a result of timber management activities. At the same time it recognizes the economic and social importance of the timber industry to well-being of the citizens of the province. As a result, Ontario has embarked on developing a set of guidelines that will enable the forest industry to coexist with woodland caribou.

This report describes, in general terms, the principles behind the proposed *Timber Management Guidelines for the Provision of Woodland Caribou Habitat*. It describes aspects of summer and winter biology which are considered significant for woodland caribou living in areas subject to timber management. In addition, it describes general concepts for timber management within woodland caribou range and explains the rationale for why we believe caribou and the forest industry can coexist.

Habitat requirements

Forest-dwelling caribou are found over most of Ontario's woodland caribou range. They are essentially solitary from just prior to calving in May until just prior to the rut in late September. They form small groups during and after the rut until late April. Maximum group size seldom exceeds 50 animals, and usually averages less than 10 throughout the September to April period. Average group size from May to September is less than two animals.

Table 1. Size of individual wintering areas^a for radio-collared woodland caribou that occupy boreal forest year-round.

Citation	Study area	No. of caribou	Size of wintering area Mean	Range (km ²)	No. of winters ^b
Shoesmith and Storey 1977	Reed L., N. Manitoba	2	253.4	124-383	1
Fuller and Keith 1981	N. E. Alberta	21	254.3	32-549	2
Darby and Pruitt 1984	Aikens L., S. E. Manitoba	1	34.0		1
Edmonds and Bloomfield 1984	W. Central Alberta	5	274.4	152-784	2
Mean value per caribou			250.0		

^a As determined by minimum convex polygon (Mohr 1947; Jones and Sherman 1983). This does not account for overlapping individual ranges.

^b Note additional studies are necessary over time to determine factors affecting range size utilization.

Winter habitat

In autumn and winter, woodland caribou feed on arboreal and terrestrial lichens, sedges (*Carex* spp.), and bog shrubs: woody browse is not a dietary staple (Simkin, 1965; Bergerud, 1972; Darby and Pruitt, 1984; Edmonds and Bloomfield, 1984). In late winter, caribou in northern Ontario feed primarily on terrestrial lichens (Simkin, 1965; Cumming and Beange, 1987; Bergerud, 1989a).

Early winter (October to January) habitat of woodland caribou is generally lowland black spruce-muskeg or open bogs (Fuller and Keith, 1981; Darby and Pruitt, 1984; Bergerud, 1989a). When snow depths in lowlands exceed about 50 cm, caribou move to upland coniferous forest (Stardom, 1975; Fuller and Keith, 1981; Darby and Pruitt, 1984; Bergerud, 1989a) where snow is usually less deep from January to March (Stardom, 1975; Darby and Pruitt, 1984). Caribou seek open jack pine (*Pinus banksiana* Lamb.) and black spruce (*Picea mariana* (Mill.) B.S.P.) uplands (less than 70% canopy closure) where they dig feeding craters for terrestrial lichens.

Generally, conifer stands are not useful as winter habitat until 40 years of age when stand density decreases and terrestrial lichens become abundant. Stands between 40 and 100 years of age may provide satisfactory lichen supplies when canopy closure is 70% or less. By about 100 years, their usefulness begins to diminish due to declining lichen productivity and the in-

creasing prevalence of bryophytes like feather-mosses (Ahti and Hepburn, 1967; Miller, 1976; Bergerud, 1989a). At this stage, fire and logging can serve to regenerate lichen supplies (Ahti and Hepburn, 1967; Miller, 1976). However, the standing crop and species composition of the lichens appear to be more related to differences in humidity, soil texture and depth, tree canopy, slope, drainage, aspect and past use by caribou than to stand age (Miller, 1976).

The amount of area occupied by woodland caribou in winter depends on the number of animals in a herd, forage availability and quality, snow conditions and predators. Studies of woodland caribou occupying boreal forest year-round show that individual caribou may occupy 32 to 784 km² in winter, 250 km² on average (Table 1). However, mean monthly group size in winter varies from 2.8 to 11.4 (Shoesmith and Storey, 1977; Fuller and Keith, 1981; Darby and Pruitt, 1984; Brown *et al.* 1986; Cumming and Beange, 1987; Bergerud 1989a). The wintering areas occupied by individual caribou in these groups are largely overlapping. Consequently, the wintering area of a population or "herd" of caribou needs to be considered for the purpose of managing habitat.

Table 2 shows the size of wintering areas reported for various herds of woodland caribou occupying boreal forest year-round in or adjacent to Ontario. The mean wintering area required per caribou on a "herd" basis is 16.1 km². Behaviour may vary but the main factors

affecting area occupied in winter are forage availability and quality, snow conditions and predators. For example, some caribou make long distance movements in mid-winter (Fuller and Keith, 1981; Edmonds and Bloomfield, 1984), sometimes in response to deep snow (Brown *et al.*, 1986) or to predators (Bergerud, 1989b).

Calving/summer habitat

Information from marked cows (Shoesmith and Story, 1977; Fuller and Keith, 1981; Brown *et al.*, 1986) indicates that individual forest-dwelling, cow caribou exhibit inter-year fidelity to certain geographic locations, including both calving sites and summer ranges.

Calving generally occurs at sites where security from predation is maximized (Bergerud and Page, 1989). For forest-dwelling caribou, these areas include islands in lakes, lake shorelines (especially those with rutted topography and/or peninsulas), and isolated or secluded islands in bogs and fens (Bergerud, 1974; Shoesmith and Storey, 1977; Darby and Pruitt, 1984; Brown *et al.*, 1986).

Caribou that occupy islands or shorelines often represent those forest-dwelling caribou with the greatest degree of cohesive behaviour and visibility during calving. This permits some

"herd" identification and has led to a preponderance of data on island and shoreline calving locations resulting in an emphasis on their management. Although justification for this is linked to visibility and the amount of data available, in most documented cases it is clear these locations are used annually by significant local or regional groups of caribou.

In contrast, mainland calving sites may represent the calving habitat of more dispersed cows. Identification of a "herd" or even association with a specific wintering area is difficult. Widely dispersed calving sites in isolated or secluded bogs, fens or in mainland forest stands are more difficult to identify, and less likely to attract human attention. This has resulted in the collection of little information, and a lack of emphasis on their management. However, 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.

Summer home range is generally the smallest seasonal home range for both sexes, compared to fall and winter. Females with calves often move back and forth to the mainland in July and August (V. Crichton, Manitoba Dept. Nat. Resources, pers. comm. 1990). Much of their activity occurs within 100 m of shore, possibly

Table 2. Estimated size of herd wintering areas for herds of woodland caribou that occupy boreal forest year-round, in or adjacent to Ontario.

Study area	No. of caribou	Size of wintering area Mean Range (km ²)	No. of winters ^a	Mean area per caribou (km ²)	Citation
Aikens L. S. E. Manitoba	35-37	235	2	6.5	b
Aikens L. S. E. Manitoba	35-40	117.5 95-140	2	3.4	c
Royd L.	22	332	1	15.1	d
Haggart L. N.W. Ont.	14-26	486	1	24.3	
Sesaganaga L., NW Ont.	31	969	1	31.3	c
Mean per Area	29.3	427.9		16.1	

^a Note additional studies are necessary over time to determine factors affecting range size utilization.

^b Stardom 1975

^c Darby and Pruitt 1984

^d Webruk 1986 and unpublished data

^e Harris 1990

because of the potential for escape to water when predators threaten. There is a significant risk of predation of calves and adult females at this time of year (Shoesmith and Storey, 1977). Island and shoreline habitats may also provide some relief from insects.

Caribou seek rapidly growing green plants in spring and summer, and their diet is probably most varied during this period.

Forest management practices compatible with woodland caribou

Timber Management Guidelines for the Provision of Woodland Caribou Habitat are currently under development in Ontario. Details have not yet been finalized. However, the general principles which may be supported biologically, are described in the following text.

One of the primary, non-economic objectives of timber management activities in woodland caribou range is to ensure a sustainable mosaic of year-round caribou habitat. To achieve this, caribou habitat must be managed on a very large temporal and spatial scale, often spanning more than 1,000 km², and more than 60 years. Timber management may be planned to partially replace the renewal role that wild fire has played in the past. This strategy would see large blocks of land, usually exceeding 100 km², and containing winter habitat, set aside until other winter habitat blocks become available nearby in the mosaic. This in turn would require large blocks of timber to be allocated for harvest so they could regenerate to provide suitable winter habitat approximately 40 years in the future. Although the clearcut harvest system would be expected to be employed, it would not necessarily mean the harvest blocks would be cut clear.

Regeneration objectives on dry to very dry, sandy or shallow soils should be to reestablish jack pine or black spruce stands with 50–70 percent crown closure at maturity, and with relatively few deciduous trees or tall shrubs. These soils include Northwestern Ontario Forest Ecosystem Classification (NWO FEC) soil types S1, S2, and SS1 to SS5 (Sims *et al.*, 1989). Treatment options that encourage lichen regeneration should be used where possible.

Access should be restricted in areas of existing or potential high quality winter habitat by making roads of a temporary nature. This means that the primary road network should be devel-

oped around and not through existing or potential high quality winter habitat. Winter roads may provide suitable access to winter habitat blocks during harvest.

Potential calving areas such as lakes with long irregular shorelines or islands, or open bogs and muskegs with dry hummocks or islands should be protected with a no-cut reserve. Where the sites are known to support caribou calving, the size and shape of the reserve may vary to suit the site. Small scale manipulation of the reserve may be desirable to provide a continuous supply of summer food for the cow calf group.

Timber management operations should be planned to avoid creating a barrier between calving areas and associated winter habitat. This could be done by either scheduling harvest to provide continuity of habitat between the two areas, or by leaving a 2 km wide travel corridor to traverse otherwise large cutovers or young reforested areas. Known migration routes should be protected in a similar way. Mineral licks should be protected by a no-cut buffer.

Rationale for forest management practices compatible with woodland caribou

Caribou and moose have different winter habitat requirements. Caribou prefer large expanses of mature lichen-rich coniferous forest and do not use woody browse as a dietary staple. Moose prefer an interspersed mature and early successional mixedwood stands that provide woody browse close to cover. Where caribou and moose overlap, high wolf densities supported by moose populations are likely to cause a reduction in caribou numbers. Thus, management for caribou and moose habitat on the same land base is counter-productive for caribou.

Sustaining the supply of caribou habitat is essential to maintaining caribou numbers. Management of access is equally important. Access development is a major contributor to increased mortality of caribou due to increased predator access, human harvest, road kills, and altered habitat use and suitability.

Habitat mosaic

The boreal forest has primarily been shaped by wildfire. The present abundance of old forest stands in the northern extremity of the commercial forest in Ontario is primarily due to the suppression of fire.

Fire size in the boreal forest is variable, with fires ranging in size from 0.1 ha to 1,000,000 ha. In northwestern Ontario, large wildfires are common (Table 3), with Ministry of Natural Resources (MNR) administrative districts of Red Lake, Sioux Lookout and Geraldton averaging at least one fire greater than 100 km² per year since 1976. If the present intensity of fire suppression persists, renewal of forest stands by timber management provides the best opportunity to sustain a supply of stands suitable for caribou winter habitat.

The purpose of creating a habitat mosaic is to ensure a sustainable supply of habitat. As younger stands with the attributes of desirable winter habitat become available, older winter habitat blocks may be allocated for harvest. Establishment of a sustainable mosaic of caribou winter and summer habitat will require long term, and large scale planning.

Caribou have behavioural adaptations for predator avoidance which manifest themselves in calving and winter habitat selection. Large areas of mature coniferous forest, particularly lichen-rich open jack pine or black spruce stands, are desirable winter habitat because they have an abundant winter food supply, a relatively low suitability for moose, and thus relatively low populations of wolves.

Any alterations to the habitat that encourage an increase in prey species for wolves within range quality is enhanced by patterns of timber harvest that produce abundant browse and edge. This is inappropriate in areas being managed for caribou.

There is an abundance of mature and overmature forest within existing caribou range. A sustainable mosaic of caribou habitat will require at least some large areas of land containing stands of each major age class. This condition cannot be realized within the first rotation of

timber management in northern Ontario when the forest has a very high proportion of stands greater than 80 years of age. Within the first timber management rotation, caribou habitat management may require that winter habitat blocks consisting of stands greater than 80 years of age be left unharvested for up to 40 years. The ideal target for forest age classes within caribou range would be a relatively even distribution of each of the following age categories: 0-20; 20-40; 40-60; 60-80; and 80-100. Habitat and access planning on a temporal scale of 60-100 years may be required to achieve this habitat mosaic.

In addition to access planning, fire planning may also be necessary. Timber management may reduce the inventory of mature stands suitable for caribou habitat to the level where losses to fire are less acceptable. Winter habitat blocks consisting of mature or overmature timber will have to be made a priority for fire suppression because both timber supply and caribou habitat are at risk.

Much of the rationale for managing habitat in caribou range is based on the premise that management for caribou and moose on the same land base will not benefit woodland caribou. At this time, almost all the productive forest lands in north western Ontario are managed for moose by applying the *Timber Management Guidelines for the Provision of Moose Habitat* (OMNR, 1988). Guidelines for moose habitat limit the size of cutovers to increase edge and provide cover and food in close proximity.

Woodland caribou take longer to reach sexual maturity than either deer or moose and do not have multiple births (Darby *et al.*, 1989). This low reproductive potential may be a life history adaptation which allows them to occupy the tundra and mature boreal forest niche. Predation and loss of mature coniferous forest are serious threats to Ontario caribou, especially where moose, deer, and wolf numbers increase to relatively high levels in caribou range after logging. Access provided by forestry operations can increase losses to predators, poachers, native hunters and vehicle collisions. A recent Alberta study, for example, showed 70% of mortality in winter range was human related along access routes (Edmonds, 1986).

The curious and often unwary nature of caribou, coupled with seasonal gregarious behaviour make caribou especially vulnerable to hun-

Table 3. Number of large fires in Red Lake, Sioux Lookout, and Geraldton MNR Districts from 1976 to 1989. Fire frequency decreases from west to east. All districts averaged at least one fire greater than 100 km² per year.

District	Fires > 100 km ²	Fires > 10 km ²
Red Lake	25	103
Sioux Lookout	18	102
Geraldton	13	49

ters and poachers where roads have accessed their range. Careful road planning to minimize access-related disturbance is an essential component of caribou habitat management.

Caribou are probably most sensitive to disturbance, including human activity, during the calving period (Bergerud, 1974; Klein, 1979; Valkenburg and Davis, 1986). Reaction to and avoidance of human-made obstructions such as roads differs between open habitats and forest habitats, and caribou appear more sensitive in the latter. Actual vehicular traffic may be a greater deterrent than the road alone.

Distribution of calving cows was altered by construction and use of a road system in Alaska (Dau and Cameron, 1986). Roads and human activity should be discouraged within about 1.5 km of calving areas.

Predator relationships

Forest dwelling caribou disperse or space themselves to avoid predators. The success of this predator avoidance strategy depends on the distance that they can space themselves from predators and alternate prey. When logging takes place it reduces the available space for caribou, thereby increasing caribou densities elsewhere and forfeiting the advantage of space (Bergerud and Page, 1989; Bergerud, 1989a). Forest fires also reduce space in the short term, but renew caribou habitat in the long term. Caribou have evolved to shift their range in response to fire and can likely shift it in response to logging. However, a given amount of cutting in different patterns can affect caribou differently. A pattern of small dispersed cuts likely increases edge, moose and deer density and over time, wolf and bear density. It also intersperses predators with caribou, increases number and length of roads and likely increases mortality of caribou. When logging and road access are concentrated in a single large cut, these negative effects on caribou are minimized.

Protection of calving habitat is particularly important for woodland caribou. The close association of calving and summer range, the risk of predation on productive components of the population, and the satisfaction of other habitat requirements (e.g. insect relief and food) are other strong arguments in favour of protection of identified areas of calving. Design of such ha-

bitat protection should minimize the likelihood of increased predation. For example, protecting a strip of forest that is too narrow would "trap" vulnerable animals in areas easily searched by predators.

Protection of these habitats has two important implications: 1) high value habitat of individuals which have been recruited into the reproductive segment of the population receives special treatment, and 2) the nature and location of secure calving habitat may be passed by association from mother to daughter so habitat of more than one generation is affected.

Travel corridors

Woodland caribou sometimes use traditional routes to move or migrate between summer (calving) and winter range. Distances between seasonal ranges may be large. In one study conducted over a year period, movement from summer calving habitat to winter range averaged 46 km (range 26–80 km) (Cumming and Beange, 1987). Migration distances between summer and winter ranges reflects the juxtaposition of shoreline, summer habitat (anti-predator strategy) and winter lichen supply (Bergerud, 1989a).

Spring movements of females from wintering to calving areas generally occur in April prior to mid-May peak calving. Travelling at this time of year often requires little effort since lakes, streams and bog areas remain frozen with minimal snow cover. Cumming and Beange (1987) described such a movement in the Whitesands River Valley adjacent to Lake Nipigon. Fall shifts to wintering areas occur at any time between late October and early January (Shoemaker and Story, 1977; Cumming and Beange, 1987).

Maintaining travel corridors is important to ensure continuity of caribou range. A 2 km wide corridor, consisting of stands greater than 3.0 m in height, between summer calving and winter range is recommended. This corridor should contain primarily coniferous trees and follow natural features such as streams, valleys, eskers and lichen-rich rock ridges. Its width will assist predator avoidance by increasing predation search time and reducing mortality compared to narrower corridors (Porter, 1983).

Acknowledgements

The majority of this text was compiled from a draft document describing the rationale for development of Timber Management Guidelines for the Provision of Woodland Caribou Habitat. The work of many people is recognized, especially B. Foster, J. McNicol and R. Stephanski.

References

- Ahti, T. and Hepburn, R. L. 1967. Preliminary studies on woodland caribou range, especially on lichen stands in Ontario. - *Ontario Department of Lands and Forests Research Report (Wildlife) No 74*. 134 pp.
- Bergerud, A. T. 1967. Food habits of Newfoundland caribou. - *Journal of Wildlife Management*. 36 (3): 913-923.
- Bergerud, A. T. 1974. The role of the environment in the aggregation, movement and disturbance behaviour of caribou. - In: Geist, V. and Walther, F. (eds.), *The behaviour of the ungulates and its relation to management. Vol. 2. IUCN New Series Publication 24*. Morges, Switzerland: 552-584.
- Bergrud, A. T. 1989a. Aerial census of caribou and wolves in Wabakimi Provincial Park. - Unpubl. Bergerud and Associates, Fulford Harbour, B. C. 41 pp.
- Bergerud, A. T. 1989b. The abundance, distribution and behaviour of caribou in Pukaskwa National Park, 1972-1988. - *Bergerud and Associates Contract Report No. 88-CPS-PUK, Scientific Review of Caribou Management Activities in Pukaskwa National Park, Fulford Harbour, B. C.* 57 pp.
- Bergerud, A. T. and Page, R. E. 1989. Displacement and dispersion of parturient caribou at calving as anti-predator tactics. - *Canadian Journal of Zoology*. 65: 1597-11606.
- Brown, W. K., Huot, J., Lamothe, P., Lutich, S., Pare, M., St. Martin, G. and Theberge, J. B. 1986. The distribution and movement patterns of four woodland caribou herds in Quebec and Labrador. - In: Gunn, A., Miller, F. L. and Skjenneberg, S. (eds.), *Proceedings of the Fourth International Reindeer/Caribou Symp. Rangifer. Spec. Issue No. 1*: 43-49.
- Cumming, H. G. and Beange, D. B. 1987. Dispersion and movements of woodland caribou near Lake Nipigon, Ontario. - *Journal of Wildlife Management*. 51 (1): 69-79.
- Darby, W. R. and Pruitt, W. O. Jr. 1984. Habitat use, movements and grouping behaviour of woodland caribou (*Rangifer tarandus caribou*) in south-eastern Manitoba. - *Canadian Field Naturalist*. 98 (2): 184-190.
- Darby, W. R., Timmermann, H. R., Snider, J. B., Abraham, K. F., Stephanski, R. A. and Johnson, C. A. 1989. *Woodland caribou in Ontario: Background to a policy*. Ont. Min. Nat. Resour., Wildl. Br., Toronto. 38 pp.
- Dau, J. R. and Cameron, R. D. 1986. Effects of a road system on caribou distribution during calving. - In: Gunn, A., Miller, F. L., and Skjenneberg, S. (eds.), *Proceedings of the Fourth International Reindeer/Caribou Symposium. Rangifer. Spec. Issue No. 1*: 95-101.
- Edmonds, J. 1986. *Draft restoration plan for woodland caribou in Alberta*. Alberta Fish and Wildlife Division, Edmonton, Unpubl. Rep. 74pp.
- Edmonds, J. and Bloomfield, M. 1984. *A study of woodland caribou (Rangifer tarandus caribou) in west central Alberta 1979-1983*. Alta. Energy and Nat. Res., Fish and Wildl. Div. Unpubl. Rep., Edmonton, Alta. 203 pp.
- Fuller, T. J. and Keith, L. B. 1981. Woodland caribou population dynamics in northeastern Alberta. - *Journal of Wildlife Management*. 45: 97-213.
- Harris, A. 1990. *Woodland caribou studies and habitat management plan for the Brightsand Forest*. Ont. Min. Nat. Resour., Ignace District. Unpubl. Rep. 90 pp.
- Jones, E. N. and Sherman, L. J. 1983. A comparison of meadow vole home ranges derived from grid trapping and radio telemetry. - *Journal of Wildlife Management*. 47: 558-561.
- Klein, D. R. 1979. Reaction of caribou and reindeer to obstruction - a reassessment. - In: *Proceedings of the Second International Reindeer/Caribou Symp*: 519-527.
- Miller, D. R. 1976. Biology of the Kaminuriak population of barren-ground caribou Part 3: Taiga winter range relationships and diet. - *CWS Rep. Series No. 36*, Ottawa, Ont. 42 pp.
- Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. - *American Midland Naturalist*. 37: 223-249.
- OMNR. 1988. *Timber management guidelines for the provision of moose habitat*. Ont. Min. Nat. Resour., Wildl. Br., Toronto. 33 pp.
- Porter, T. 1983. *1982 fall migration of Mount Peyton caribou*. Unpubl. Newfoundland Wildl. Div. Rep. St. John's. 43 pp.
- Shoemith, M. W. and Storey, D. R. 1977. Movements and associated behaviour of woodland caribou in Central Manitoba. - *Proc. Int. Congr. Game Biol.* 13: 51-64.
- Simkin, D. W. 1965. A preliminary report of the woodland caribou study in Ontario. - *Ont. Dept. of Lands and Forests Sec. Rep. (Wildl.) No. 59*, Toronto, Ont. 76 pp.

- Sims, R. A., Towill, W. D., Baldwin, K. A., Wickware, G. P. and Uhlig, P. 1989. Field guide to the forest ecosystem classification for Northwestern Ontario. - *Ont. Min. Nat. Resour. N. W. Ont. For. Tech. Dev. Unit, Thunder Bay*, 194 pp.
- Stardom, R. R. P. 1975. Woodland caribou and snow conditions in southeast Manitoba. - In: Luick, J. R., Lent, P. C., Klein, D. R. and White, R. G. (eds.). *Proceedings of the First International Reindeer/Caribou Symposium, U. of Alaska Biol. Pap. Spec. Rep. No. 1*: 436-461.
- Valkenburg, P. and Davis, J. L. 1986. Calving distribution of Alaska's Steese-Forty Mile caribou herd: A case of infidelity? - In: Gunn, A., Miller, F. L., and Skjenneberg, S. (eds.), *Proceedings of the Fourth International Reindeer/Caribou Symposium. Rangifer. Special Issue No. 1*: 315-324.
- Wepruk, R. 1986. Caribou investigations of Woodland Caribou Park, 1985. - *Woodland Caribou Park Tech. Rep. No. 3*, Ontario Ministry of Natural Resources, Red Lake, Ont. 41 pp.

Printed from manuscript after editorial review.