Managing second-growth forests as caribou habitat

Susan K. Stevenson

Silvifauna Research, 101 Burden St., Prince George, British Columbia, Canada V2M 2G8.

Abstract: Habitat management for woodland caribou *(Rangifer tarandus caribou)* in southeastern British Columbia has generally focussed on protecting old-growth forests from logging. As that strategy becomes more difficult to maintain, biologists are beginning to explore opportunities to manage second-growth stands to provide arboreal lichens and other habitat resources important to caribou. Special harvesting and stand management practices are being developed and formulated into strategies for maintaining caribou populations in managed stands.

Key words: woodland caribou, British Columbia, habitat management, arboreal lichens, forestry

Rangifer, Special Issue No. 3, 1990: 139-144

Introduction

The woodland caribou of southeastern British Columbia typically winter in old-growth forests, where their primary forage is arboreal lichens. Habitat management for those caribou has generally been directed at trying to protect old-growth forests from logging. As the demand for timber increases, that strategy becomes more and more difficult to maintain. Researchers and managers have begun to ask whether second-growth forests can be managed so that they will function as caribou habitat before they are logged again.

That question has become urgent in some caribou ranges east of Prince George. Spruce bark beetle attacks have resulted in extensive salvage logging over the last seven years. Low- and mid-elevation ranges formerly used by caribou are now in an early seral stage. Because so much of the low-elevation timber has been removed, logging companies are beginning to harvest high-elevation stands formerly considered unprofitable. Wildlife managers are asking how this logging is affecting caribou, and what can be done to make the cut areas into future caribou habitat. To address those questions, the British Columbia Ministry of Environment, in cooperation with the Ministry of Forests and the forest industry, is initiating a research and management project centred east of Prince George. The purpose of this paper is to present some of the ideas that are to be developed and implemented in that project.

Caribou studies in southeastern British Co-

lumbia (Antifeau 1987; Rominger and Oldemeyer 1989; Scott and Servheen 1985; Simpson 1985; Simpson et al. 1985) have suggested a number of attributes that are important to caribou on winter ranges: standing crop of lichens on accessible portions of trees, arboreal lichens available through litterfall and blowdown, canopy modification of snow depth and snowpack characteristics, availability of vascular forage, and remoteness from vehicle access. In this paper, I will focus on management practices for stands in which the principal objective is to encourage the development of arboreal lichen forage (mainly *Bryoria* spp. and *Alectoria sarmentosa*) while producing merchantable timber.

The habitat management strategies proposed here must be integrated with an overall plan for population management, which includes consideration of direct mortality factors. Providing an extensive habitat base by managing second growth is expected to allow caribou to disperse sparsely over large areas, reducing the risk of mortality from predation and poaching.

Factors limiting arboreal lichen forage in young stands

The development of management strategies for enhancing arboreal lichens should be based on an understanding of the factors that limit their abundance in young stands.

Source of propagules

The early establishment of lichens in some young stands is limited by the presence of lichen propagules. Lichen dispersal can be accomplished by spores, soredia, or thallus fragments, but thallus fragments account for nearly all the early colonization of second growth (Stevenson, 1988).

Studies conducted on Vancouver Island, British Columbia have shown that beyond about 400 m from the edge of the mature timber, young twigs in second-growth stands support almost no lichens (Fig. 1; Stevenson, 1988).

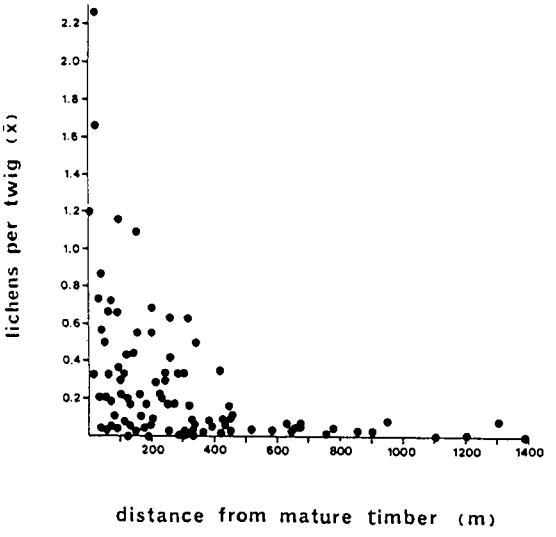

Fig. 1. Lichen fragment on two-year-old twigs in second-growth and distance from mature timber in several Vancouver Island studies (Stevenson 1988).

Lichen abundance in second-growth stands also depends on lichen abundance in the adjacent mature timber. The maximum values shown in Figure 1 are from stands adjacent to mature timber with high lichen abundance. The low values are mostly from stands adjacent to mature timber with moderate or low lichen abundance. The data suggest that managers should only count on natural dispersal for early lichen colonization within about 350 m of a mature timber stand with high lichen abundance.

Substrate

Lichen fragments that land on suitable substrate become attached by entanglement with twigs, needles, or bark scales, and by the formation of hapters (fungal holdfasts). Of the many substrate characteristics potentially affecting lichen colonization, texture seems to be particularly important. In Douglas fir, lichen fragments are retained poorly on the longest twigs (the ones that have grown the fastest), despite their greater surface area (Stevenson and Palmer 1988). That probably occurs because twigs that have grown rapidly tend to have

smooth slippery bark, which offers few attachment sites, and widely separated needles, which limit opportunities for entanglement of fragments. In Douglas fir, young trees that are growing at an average or below-average rate seem to offer better substrate for lichen colonization than rapidly-growing trees. The applicability of those observations to tree species growing on caribou ranges has not yet been evaluated.

Microclimate

Changes in stand structure that occur during succession result in changes in stand microclimate, and those changes affect the suitability of a stand as lichen habitat (Fig. 2; Stevenson and Palmer 1988).

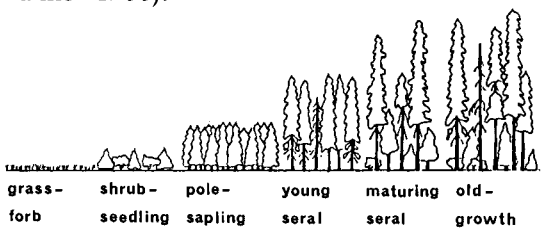

Fig. 2. Hypothetical development of an unmanaged, fully-stocked stand.

In the *grass-forb stage*, the tree seedlings are surrounded by a layer of grasses, herbs and shrubs, which affect the microclimate of the site. The microclimate is more severe than it is within a forest, but less severe than it is over bare grond. Arboreal lichens are generally absent.

In the *shrub-seedling stage*, the trees have grown above the ground vegetation, but the canopy has not yet closed. The crowns of the young trees are exposed to light, and they have an open-grown form. If a dispersal source is present, lichen fragments colonize the branches and trunks on suitable sites. However, the microclimate is still relatively severe, and on some sites, conditions may be too dry or warm for lichen development at the shrub-seedling stage, even though lichens may do well in adjacent mature timber stands.

At the beginning of the *pole-sapling stage*, canopy closure occurs. Solar radiation below the level of canopy closure is much reduced. The lower branches begin to die back. Although lichen development at the pole-sapling stage has not been studied, it seems likely that in many cases the microclimate in the lower part of the canopy is not suitable for *Bryoria* and *Alectoria* unless the stand is opened. Lichen establishment continues in the lighted portion of the crown, but the branches are quickly overtopped and shaded.

At the *young seral stage*, a branchless trunk zone is present, and the process of natural thinning begins. Many snags are produced, but they are small and usually bear little lichen. The microclimatic zones characteristic of a mature forest are present, although the shaded crown zone is likely to be even more shaded than it is later in succession. Lichen biomass is typically very low, although it may be moderate if for some reason (such as topography, rootrot disease, or thinning) the stand is exposed to light.

At the *maturing seral stage*, the rate of natural thinning declines and stabilizes. Fewer snags are produced, but they are larger, and may bear some lichen. Natural thinning increases light levels in the main canopy. The whipping action of windblown branches also contribute to the development of spaces among the crowns ot the trees. A regeneration layer may become established and affect the microclimate in the lower part of the stand. The lichens respond to the increased light in the canopy, and may become abundant.

At the *old-growth stage*, tree growth slows and most stand characteristics are stable. The horizontal zones offer a gradient of potential habitats for arboreal lichens, but the characteristics of those habitats depend on the regional climate. In a wet regional climate, *Bryoria* and *Alectoria* are well-adapted to the upper part of the canopy, which receives high levels of light and precipitation, but is subject to high water

loss and to extremes of temperature. In a dry regional climate, *Alectoria* is likely to be sparse or absent, and *Bryoria* distributed lower in the canopy, where the extreme regional climate is moderated. Most caribou ranges in southeastern and central British Columbia fall between those two extremes, and intermediate distribution patterns are seen.

In summary, the canopy in fully-stocked stands in dense through the pole-sampling and young seral stages, usually resulting in conditions that are not exposed enough for good lichen development. On dry sites, however, lichens may not benefit from increased exposure.

Accessibility to caribou

Managers need to consider not only the standing crop of arboreal lichens, but also their accessibility to caribou. In high-elevation winter ranges, lichens are typically present in the lower part of the canopy, and caribou gain access to them when the snowpack is deep and settled. Thus, the accessibility of the lichens is limited mainly by snow conditions.

When the snowpack is soft, many caribou use low- and mid- elevation forests. The standing crop of lichens within reach of caribou is relatively low, and the lichens are available mainly as litterfall or on windthrown trees. Thus, in low- and mid- elevation winter ranges, the accessibility of the lichens is limited by stand characteristics.

Managers have wondered whether rates of litterfall and blowdown in second-growth stands might restrict the availability of arboreal lichens to ungulates, even if they could develop methods to enhance the standing crop of lichens. An analysis of the available data for Douglas fir stands suggests that, given equal biomass, lichen litterfall rates might be about 2/3 lower in second-growth stands than they are in old-growth stands, because overall litterfall rates are lower (Stevenson 1986a). However, the methods that are available for enhancing lichen development may themselves result in reduced rates of litterfall and blowdown. That problem is discussed further below.

Opportunities to enhance lichen production in young stands

Limitations of lichen forage due to propagule source, stand microclimate, and rates of litterfall and blowdown can be addressed through special management practices.

Maintaining natural dispersal.

There are several approaches to providing mature, lichen-bearing trees as a source of propagules. Diameter-limit logging and the harvesting of very small patches can maintain opportunities for lichen dispersal onto young trees; the tradeoffs associated with those harvesting practices have been discussed elsewhere (Stevenson 1986b). Alternatively, the size and configuration of cutblocks can be planned with consideration to the dispersal limitations of lichens. In a three-pass system (a logging system in which all the merchantable timber within a planning unit is removed in three successive cuts, equally spaced throughout the rotation), it is theoretically possible to maintain a large proportion of the area within 350 m of mature timber during the first half of its rotation. Patches of unmerchantable timber, such as swamp fringes and inaccesssible areas, contribute to the area that functions as a dispersal source. If the advanced regeneration in the cut areas can be retained during harvesting, lichen recovery will occur more rapidly. Harvesting alternatives such as these require special planning and cooperation between wildlife biologists and foresters.

Inoculating young stands with lichen propagules

The modified harvesting methods disussed above may be feasible where there is still flexibility in harvesting plans, but they cannot be used in places where extensive harvesting has already occurred. To meet the need for lichen propagules in second-growth stands that are

distant from mature timber, an inoculation technology is being developed (Palmer 1988). The method involves first spraying the trees with an adhesive agent, then with mechanically chopped lichens. Handheld equipment has been used to spray trees up to 7.5 m, and aerial application may be practicable.

Modifying stand microclimate to enhance lichen development

An important microclimatic limitation to lichen developments believed to occur in fully-stocked stands on moist sites after the time of canopy closure. On those sites, a carefully planned thinning program could be applied to maintain better conditions for lichen development (Stevenson and Palmer 1988). A thinned stand has fewer trees, longer and wider crowns, and maximum foliage biomass located closer to the ground than an unthinned stand. Those differences in stand structure affect stand microclimate. Light intensity and throughfall precipitation in the lower canopy are increased. Temperatures are expected to be intermediate between those of open areas and uncut forests. Summer humidity is expected to be lower in thinned than in unthinned stands.

On sites where lichen abundance in the canopy is limited by light, increased stand openness should result in a larger portion of the canopy providing suitable habitat for arboreal lichens. On drier or warmer sites, however, thinning may result in summer temperatures that are too high or humidity levels that are too low for optimum lichen development. Observations of the vertical distribution of lichens in existing stands can be used to predict how lichens will respond to thinning, but those predictions must be refined and tested.

Managing for litterfall and blowdown

Litterfall and blowdown are the major sources of arboreal lichen forage for caribou on low- and mid- elevation winter ranges. Thinning dramatically reduces the rates both of litterfall and of tree mortality, which is related to blowdown (Bray and Gorham 1964; Gessel and Turner 1976). Thus, the methods that are used to increase the standing crop of lichens in the canopy could prevent them from becoming accessible.

That problem could be addressed in either of two ways. A harvesting system that leaves a residual stand of older trees will ensure not only a source of lichen propagules, but also a source of litterfall and blowdown over many years.

Partial cutting is unacceptable to foresters on some sites for economic or silvicultural reasons. An alternative approach to ensuring litterfall production is to use thinning techniques that result in standing dead trees, rather than felled trees. Early in stand history thinning is carried out in the usual way with chainsaws, but when the trees are larger and support more abundant lichens, alternate thinning techniques are used. One potential method, which is increasingly used in British Columbia, is thinning by chemical injection (e.g. monosodium methanearsenate or glyphosate). That technique should not be used operationally for lichen enhancement until its effects on the arboreal lichens have been determined; it is possible that the herbicides would either kill the lichens or cause them to accumulate substances that are toxic to wildlife. Another option that does not carry those risks is the use of girdling tools. In either case, the objective is to produce standing dead trees which provide a substrate for lichen growth and a source of litterfall and blowdown.

Conclusions

The special management practices that have been suggested here are ideas that are being tested for use in an overall management strategy. That strategy will encompass a number of variations. Sites differ in the importance to caribou of various habitat attributes, in climatic limitaions on the potential of the site to produce those habitat attributes, and in the constraints of silviculture and forest economics. The stra-

tegy must take into consideration the relationships between management of caribou habitat and populations; for example, practices intended to enhance lichen production may lead to increased disturbance and poaching unless access control is practiced. Potentially, it could provide alternatives to the preservation of old growth as the primary mode of managing habitat for caribou in southeastern British Columbia.

References

Antifeau, T.D. 1987. *The significance of snow and arboreal lichen in the winter ecology of mountain caribou* (Rangifer tarandus caribou) *in the North Thompson watershed of British Columbia.* - M.Sc. thesis, Univ. B.C., Vancouver, B.C. 142 p.

Bray, J.R. and Gorham, E. 1964. Litter production in forests of the world. - *Advances in Ecological Research* 2:101-157.

Gessel, S.P. and Turner, J. 1976. Litter production in western Washingon Douglas-fir stands. - *Forestry* 49:63-72.

Palmer, K.A. 1988. Transplants of *Alectoria sarmentosa* in the Mount Cain second-growth winter range. - *Report prepared for Canadian Forest Products, Ltd., Woss, B.C. and B.C. Min. Forests and Lands, Vancouver, B.C.* (Available from Larkspur Biological Consultants, 966 Snowdrop Ave./V8Z 2NY, Victoria, B.C. Canada.)

Rominger, E.M. and Oldemeyer, J.L. Early-winter habitat of woodland caribou, Selkirk Mountains, British Columbia - *Journal of Wildlife Management.* 53:238-243.

Scott, M.D. and Servheen, G. 1985. *Caribou ecology.* - Idaho Dep. Fish and Game Job Completion Report, Pittman-Robertson Project No. W-160-R-11. 136p.

Simpson, K. 1985. The effects of snowmobiling on winter range use of mountain caribou. - *Caribou research and management in British Columbia: proceedings of a workshop.* B.C. Min. Forests and Lands and B.C. Min. Environ. and Parks, Victoria, B.C. pp. 58-70.

Simpson, K., G.P. Woods and Hebert, K.B. 1985. Critical habitats of caribou *(Rangifer tarandus caribou)* in the mountains of southern British Columbia. - *McGill Subarctic Research Paper* 40:177-191.

Stevenson, S.K. 1986a. Litterfall rate as a limitaion on the availability of forage lichens in second-growth stands. - *Problem analysis prepared for MacMillan Bloedel Ltd.,* Nanaimo, B.C. 41 p. (Available from Silvifauna Research, 101 Burden St., Prince George, B.C. V2M 2G8 Canada.)

Stevenson, S.K. 1986b. Review of forestry practices in caribou habitat in southeastern British Columbia, Canada. - *Rangifer, Special Issue No.* 1:289-295.

Stevenson, S.K. Dispersal and colonization of arboreal forage lichens in young forests. - *B.C. Min. Forests and Min. Environ. IWIFR-38.* 58 p.

Stevenson, S.K. and Palmer, K.A. 1988. Integrating lichen enhancement with programs for winter range creation. - *Report prepared for MacMillan Bloedel Ltd., Nanaimo, B.C. and B.C. Min. Forests and Lands,* Vancouver, B.C. Stet. (Available from Silvifauna Research, 101 Burden St., Prince George, B.C. V2M 2G8 Canada.)