

A fire suppression model for forested range of the Beverly and Qamanirjuaq herds of caribou

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Abstract: A fire suppression model was developed for forested winter range of the Beverly and Qamanirjuaq (formerly Kaminuriak) herds of barren-ground caribou (*Rangifer tarandus groenlandicus*) in north-central Canada. The model is a balance between total protection, as voiced by some aboriginal people, and a let-burn policy for natural fires advocated by some ecologists. Elements in the model were caribou ecology, lichen recovery after fire, burn history, community priorities for caribou hunting, and fire cycle lengths. The percent ratio of current productive caribou habitat to the goal for that habitat determines whether fire should be suppressed in a specific area. The goals for productive caribou habitat, defined as forests older than 50 years, were scaled by fire cycle length and community priority ranking. Thus, the model is an example of co-management: traditional knowledge combined with science in a joint forum, the Beverly and Qamanirjuaq Caribou Management Board.

Key words: caribou management board, co-management, fire, *Rangifer*

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Introduction

Caribou flesh is an important staple in the diet of aboriginal people living within the ranges of the Beverly and Qamanirjuaq herds in north-central Canada. The herds' combined economic-cultural value is incalculable. Understandably, then, fire suppression has always been a major concern of caribou hunters and those who speak on their behalf within the Beverly and Qamanirjuaq Caribou Management Board. Developing a fire management strategy has resulted from the successful marriage of traditional knowledge with government science and policies (co-management).

Co-management began with the Board's inception in June 1982; in 1992 its mandate was renewed for another 10 years. It is composed of five representatives from governments and eight members from aboriginal communities. The structure and functions of the Board are detailed in several reviews (Beverly and Kaminuriak Caribou Management Board, 1986; 1987; Scotter, 1991; Thomas & Schaefer, 1991; Usher, 1991). The Board is strictly advisory but its advice generally is accepted by the relevant jurisdictions.

The two caribou herds that the Board oversees occupy range west of Hudson Bay that includes

winter habitat in the transitional boreal-tundra forest in northern Manitoba, northern Saskatchewan, northeastern Alberta, and the south-central Northwest Territories (NWT) (Fig. 1). Summer range is on the tundra in the NWT to about 66° N and some caribou spend all or part of the winter there as well.

Population estimates in June 1988 were 190 000 for the Beverly herd and 221 000 for the Qamanirjuaq herd (Heard & Jackson, 1990a; 1990b). The Beverly herd was estimated at about 286 000 in June 1994 (A. Gunn, pers. comm.).

The two herds are used by 12 000-15 000 people in 19 communities (Fig. 1). The annual kill is 14 000-18 000 caribou but an estimated 26 000-33 000 caribou would be killed if the herds were fully accessible to all communities in any 1 year (Thomas, 1994). There is concern that future needs for caribou will increase because human populations on the range are doubling in 16-20 years and new roads into the region potentially will expose the herds to hunters from outside the range of the herds.

The economic value of the two herds in the 1980s, in terms of the replacement value of meat, was about \$13.5 million (Government of the

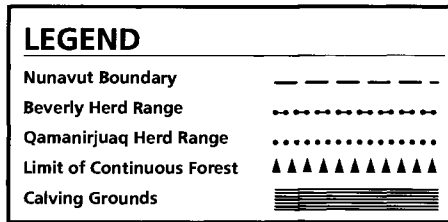
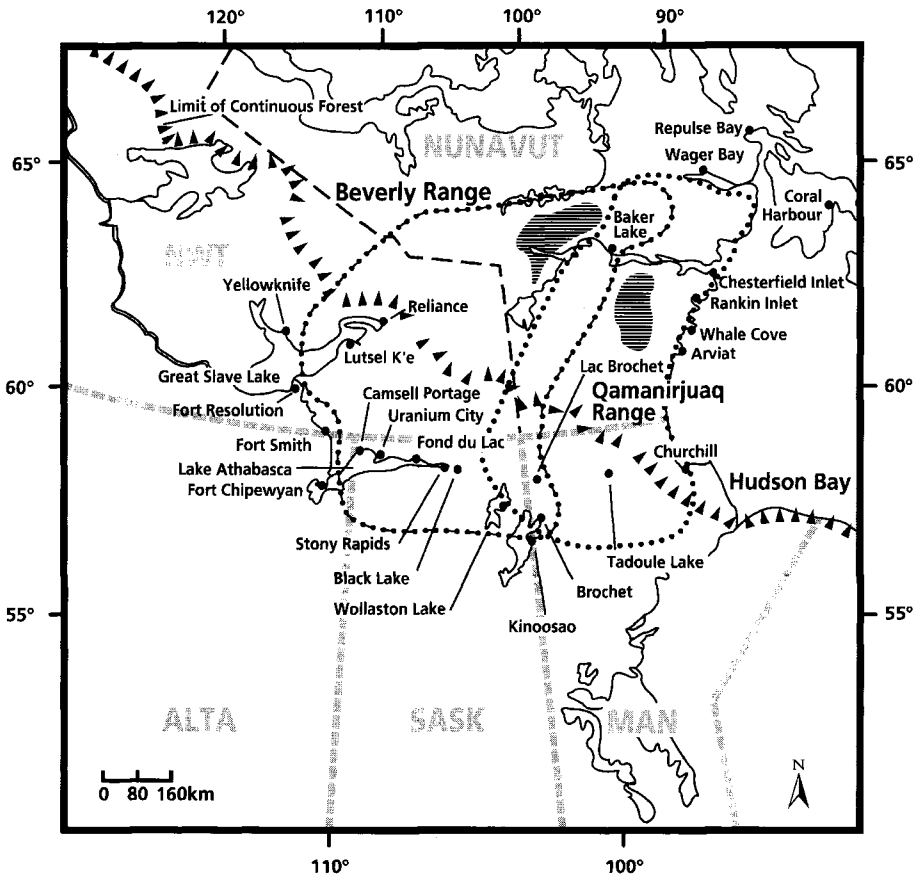


Fig. 1. Ranges of the Beverly and Qamanirjuaq herds of caribou and caribou-using communities. Generalized ranges, since about 1955.

Northwest Territories, 1990). In Manitoba, the average harvest is valued at \$1.9–2.4 million annually in replacement value of red meat. Corresponding numbers for Saskatchewan and the NWT are \$2.5–3.1 million and \$7.6–9.5 million. These values would double or triple if caribou were accessible to all communities and the herds could be managed at a higher sustained yield. With effective caribou and land management, the resource is sustainable at present population sizes of caribou and humans. However, the optimum and maximum sustained yields are not known and they would vary according to the weather.

The cultural, social, and spiritual value of the caribou in the two herds is incalculable but it is immense in the opinion of the Board. Other eco-

nomics and cultural activities such as trapping and fishing are closely linked to caribou hunting. The herds also have considerable intrinsic value not only to Canadians but to the people of all nations.

Fire suppression relates directly to Objective 3 of the Board's management plan:

Access and availability: to ensure that caribou are accessible and available to traditional users. (Beverly and Kaminirjuaq Caribou Management Board 1987).

It also concerns Principle 8 of that Plan:

The maintenance of suitable caribou habitat, including preservation of calving grounds and

migration routes and pursuit of improved fire management, is essential.

Usher (1991), in a review of the Board, found that fire management was of high priority for hunters and trappers in forested portions of the range. Progress in development of fire suppression guidelines was too slow.

There is no justification for fire suppression based on the natural ecosystem, fire suppression capabilities, or caribou conservation. Fire is a natural component of the ecosystem as almost all of the burned area is lightning-induced (Johnson & Rowe, 1973; Johnson, 1979). The justification for fire suppression is based strictly on the food and socio-economic requirements of local communities.

The purpose of this report is to provide background information on two caribou populations and the Board established to help manage them, to outline the steps that were necessary to develop a fire suppression strategy, and to briefly report the recommendations that resulted.

Methods

The development of fire management recommendations occurred in several stages.

1. Scientists and aboriginal people jointly conducted a study of the winter ecology of the Beverly herd of caribou with emphasis on: (a) the adequacy of the forested winter range to support the population (Thomas & Kiliaan, 1994a); (b) the effect of burns on the regional and local distribution and movements of the herd (Thomas, 1991); (c) the recovery sequence of "caribou lichens" after fire; and (d) relative use of forests at time periods after fire (Thomas & Kiliaan, 1994b).
2. The burn history in the preceding 50-60 years was mapped from: a) burn maps provided by each jurisdiction and various other sources; (b) satellite imagery first obtained in 1972; and (c) dating of burns in field studies (Beverly and Qamanirjuaq Caribou Management Board, 1994a; 1994b).
3. The BQCMB sponsored a survey by the Prince Albert Tribal Council to obtain priorities for fire suppression on traditional hunting areas of 13 communities (Dantouzie, 1991; 1992).
4. The burn history, priority hunting areas, fire suppression priority areas and current proportions of productive caribou habitat and goals for such habitat within them were incorporated into a Geographic Information System (GIS - SPANS).

5. Fire suppression recommendations were developed after a technical review (Beverly and Qamanirjuaq Caribou Management Board, 1994a) examined the winter ecology of caribou, fire history of caribou ranges, past fire suppression on the range of the herd, fire management policy in each jurisdiction, and community priorities for hunting areas.
6. A brief report was drafted (Beverly and Qamanirjuaq Caribou Management Board, 1994b) containing all the information that was needed to implement the recommendations.
7. A fire suppression priority map was drafted that simplified information necessary for fire agencies to address goals for productive caribou habitat within each fire suppression area (Beverly and Qamanirjuaq Caribou Management Board, in prep.).
8. Consultation took place with communities and fire managers. As stated previously, communities within the forested range of the two herds mapped priority areas for caribou hunting and fire suppression. Board representatives discussed the draft recommendations and priority areas, and provided fire history maps and the fire management zones at scales of 1:250 000 and 1:1 million (National Topographic Series). Fire managers were provided draft reports for review and met with the Board to discuss the recommendations.

Some of those steps require further elaboration. The maps for 13 communities were simplified to one map by removing overlapping zones, simplifying the priority ratings, and accepting the highest rating for any area of overlap. The resultant composite map of community priority ratings was modified into fire suppression areas by: (1) adding fire cycle boundaries; (2) adding jurisdictional boundaries; (3) including only areas within the limit of continuous forest; (4) subdividing large community-priority areas and grouping small areas into larger ones and averaging the priorities; and (5) removing small areas created by fire cycle boundaries within fire suppression areas and including them in the adjacent area.

Fire cycles of three lengths (short = <80 years, medium = 81-140 years, and long = >140 years) were mapped (Fig. 2) to account for widely different fire return intervals across the range. The mapping was based on field observations of the return interval of fire and fire statistics over the past 20-40 years (Beverly and Qamanirjuaq Caribou Management Board, 1994a). The boundaries are arbitrary, however. These fire cycles are viewed as average, centuries-long disturbances and they cannot

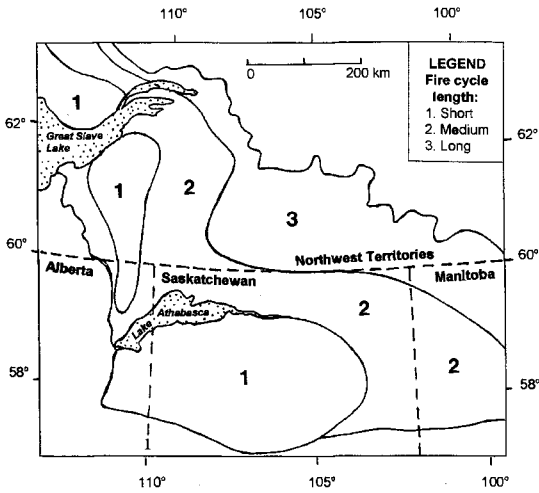


Fig. 2. Fire cycle lengths on the forested range of the Beverly and Qamanirjuaq herds of caribou as estimated from fire statistics and observed fire return intervals.

be estimated by just using burn statistics for the past 20 or 30 years.

Goals for productive caribou habitat were established for each priority rating. These goals are proportions of productive habitat for caribou feeding (herein shortened to "productive caribou habitat" and defined as forests older than 50 years). Lowland spruce bogs and small lakes (<10 km²) were included in the forest category. The original goal for maximum percentage of productive caribou habitat was arbitrarily set at 80% and decreased by absolute units of 10% as community priority rankings decreased from 1 to 4 and as the fire cycle length decreased from long to short. The 80% maximum value was predicated on maximum use by caribou of forests older than 150 years, the relationships between fire cycle length and percentage of productive caribou habitat (Beverly and Qamanirjuaq Caribou Management Board, 1994a), and the need to maintain forest diversity.

The preliminary goals were found to place too much emphasis for fire suppression on caribou range outside the core and commonly-used areas and in areas with a short fire cycle. Therefore, they were revised. The estimate for the long-term, average proportions of productive caribou habitat was set as the goal for community priority rank #3 within each fire cycle zone, and the goals were scaled upward and downward from there (Table 1).

Goals were scaled to long-term, average fire cycle lengths recognizing that any attempt to greatly modify fire cycles is not ecologically tenable. Moreover, it would be prohibitively expensive and

Table 1. Goals for the proportion of forest older than 50 years (productive caribou habitat) by communities' priority rank for caribou hunting and by length of the fire cycle.

Communities' priority rank	Goal for proportion of forest >50 Years (%)		
	Short cycle (<81 years)	Medium cycle (81-140 years)	Long cycle (>140 years)
1	35	60	85
2	30	55	80
3*	25	50	75
None	20	45	70

* Goals in this line correspond to the estimated long-term, average proportions of productive caribou habitat in each fire cycle zone.

perhaps counterproductive. Recent burns act as fire breaks and forests, particularly pine forests, are more susceptible to fire as they age and fuel builds (Rowe *et al.*, 1975). Successful fire suppression over a long period could result in loss of diversity and loss of large areas of productive caribou habitat in a severe-fire-year.

Decisions on whether fires should be suppressed depends on the present proportion of productive caribou habitat (P) relative to goals for productive caribou habitat (G) in a particular zone. The ratio of the two percentages determines suppression priority. For example, the notation "30P/70G" in a fire suppression area means that 30% of the range presently is productive foraging habitat for caribou and the goal is 70%. In theory, all fires would be suppressed in that area. A notation of 80P/70G means that goals are exceeded and no suppression is required.

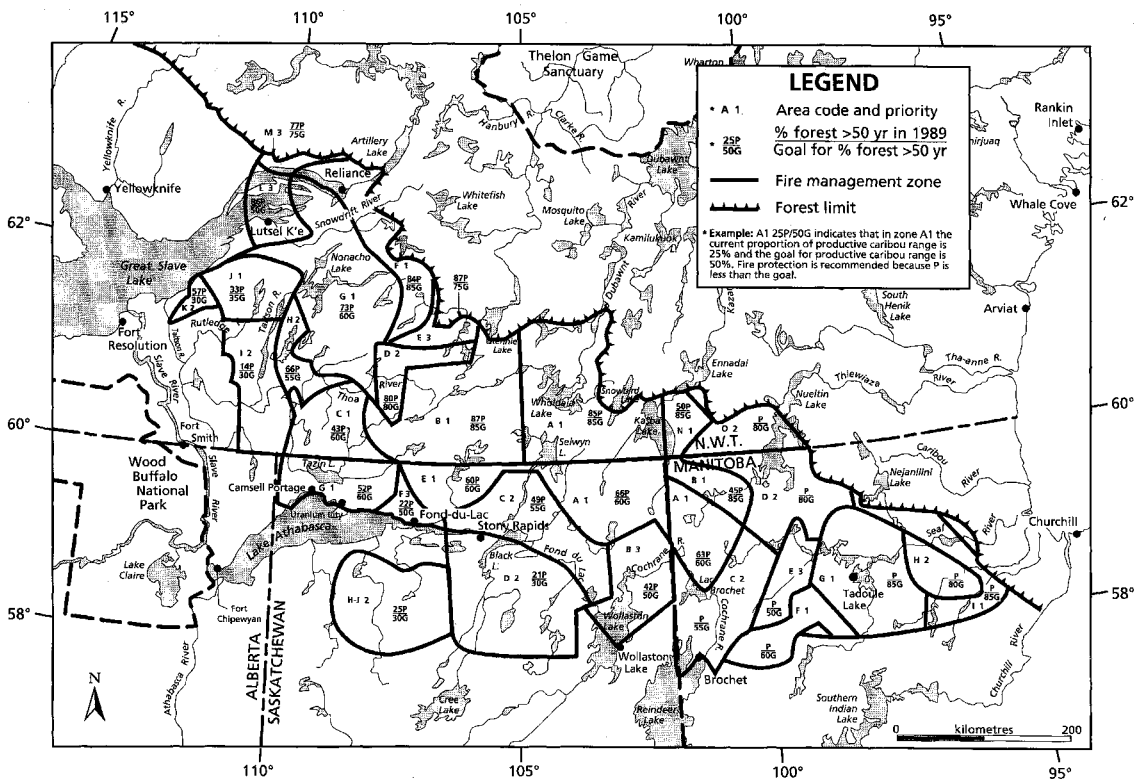
Results

Recommendations were developed to guide fire suppression on the range of the Beverly and Qamanirjuaq herds (Beverly and Qamanirjuaq Caribou Management Board, 1994a; 1994b).

1. That fire management agencies in each jurisdiction attempt to meet goals for productive caribou habitat within fire suppression areas (Fig. 3).
2. That fire management agencies attempt to meet goals for productive caribou habitat within caribou habitat protection areas beyond the community priority areas, if new data indicate the need. In future, the Board may recommend different boundaries and priorities for fire suppression as:

- (1) the herds are managed more intensively at a higher population size; or (2) new data indicate overuse of winter range by caribou; or (3) conservation of the herds becomes a concern.
3. That fire management agencies develop administrative structures that will permit cooperative and cross-jurisdictional fire suppression operations. Agreements should be established between and among jurisdictions such that detection and suppression operations are shared. For example, reciprocal agreements could mean that suppression costs by one jurisdiction in another would be repaid in kind at a later date.
4. That fire management agencies enhance resource user participation in fire suppression. Greater participation by caribou hunters is requested for all stages of fire suppression within the caribou range. Enhanced roles include the setting of priorities in their chosen areas, suppression strategies, training of crews, and local management. Experienced crews trained

- in initial attack should be available in each large community. Such crews could attempt to suppress fires within hours of their detection, if warranted.
5. That fire management agencies obtain burn maps annually and that the fire history be updated periodically in a Geographic Information System. The updating interval for fire history will depend on discussion and negotiation among fire management agencies. The updating interval for present proportions of productive caribou habitat could range from 1 to 10 years but every 5 years is feasible.
6. That field checks be made to establish ages of all burns of unknown age and that attempts be made to map and classify mature (51-100 year), old (101-200 year), and ancient (>200 year) forests.
7. That for all large fires (>10 000 ha), data be obtained on burn characteristics, including percentage of unburned inclusions within each burn.



The present (P) (in 1989) proportions of productive caribou range and the goals (G) for each fire management zone, which were delineated from grouped community priority zones, fire cycle boundaries, jurisdictional boundaries, and forest limits, then simplified.

Fig. 3. Coded (A, B, etc.) simplified fire management areas based on composite priority (1, 2, etc.) areas of communities, fire cycle lengths, jurisdictional boundaries, forest limits; each containing preliminary estimates percent of productive (P) (>50 year forests) caribou habitat in 1989, and preliminary goals (G) for productive caribou habitat.

Discussion

The objectives, goals, and principles of fire suppression were defined in the detailed technical report (Beverly and Qamanirjuaq Caribou Management Board, 1994a). The recommendations call for recognition of cultural values by fire managers and greater participation by local caribou resource users at all stages of fire suppression. However, the recommendations also reflect the realization that fire is necessary to sustain the existing ecosystem. In the long term, fire can be modified only slightly by human intervention in remote, fire-dependent forests. A system of priorities is necessary to focus fire suppression activities.

Although the recommendations were passed by the Board, support was not unanimous. Opposition to the model was expressed by some aboriginal members, and Manitoba was not prepared to suppress fires on the range of the Qamanirjuaq herd. Consensus is highly unlikely for an issue as complex and emotional as fire suppression. However, the Board was committed to developing a strategy. The result is a balance between attempts at complete suppression of all fires on the forested range, as advocated by some aboriginal members and community residents, and no suppression, as proposed or inferred by some ecologists (e.g., Johnson & Rowe, 1973; 1975; Rowe *et al.*, 1975). Winter habitat was considered to be adequate in the mid-1980s and the local and scientific evidence suggests that, if one area is extensively burned, the caribou will use adjacent less-burned areas.

Some elements of the strategy are still being developed. For example, the Board is reviewing the goals for productive caribou habitat and is considering ways to simplify the model for greater understanding of it by the communities and fire managers. One map expresses, by colours, three levels of the departure of current proportions of productive caribou habitat from the goal within each fire suppression area. There is still debate whether priority for fire suppression should be proportional to the degree of deviation from the goal. There is need to update the burn map and statistics as they are 5 years out of date and many large burns occurred on the range in 1994.

When should a fire be suppressed? For fire management agencies it depends on the values that may be lost if the fire is allowed to burn naturally. Scale is important. In the case of caribou, values may be partitioned into regional values of the herds and local values within traditional hunting areas. Some tangible values are known for the herds as a whole, by jurisdiction, and by community based on the average number of caribou killed. If winter range limited herd numbers, it would be possible to

calculate the value of winter habitat that burned in terms of the reduced sustainable yield of caribou. The herd was not limited by the quantity and quality of the winter range in the 1980s so no such losses can be calculated.

The value of caribou to a community is a local issue related to the distribution and movements of the caribou. Absence or scarcity of caribou for part or all of a winter causes nutritional, economic, and social hardship. It may be due to natural variation in movement patterns of the herds, reduced caribou population size, and/or loss of winter range because of fire. In the latter case, the values are partly economic due to increased travel (time and money) and loss of cabins and equipment. But there are also largely unmeasurable social costs. Costs could include hardships that influence the social fabric of a community, as well as some loss of cultural identity.

The fire model provides guidance to maintain sufficient winter range within traditional hunting areas such that, potentially, the caribou resource can be sustained in the traditionally-hunted areas of each community. A key point is the weight given to the cultural value of caribou in assessments of values-at-risk. Such values cannot be expressed in conventional cost-benefit analyses. Nevertheless, the Board has requested that they be given considerable weight.

Conclusions

The fire suppression model is a first attempt by the Board at welding scientific and local knowledge on caribou, caribou ecology, caribou-fire relationships, caribou hunting, fire history, and fire suppression into a strategy that will focus fire suppression into areas of socio-economic importance to communities dependent on caribou for sustenance. The model is still being revised and it will require periodic updating. Whether there will be sufficient funds or human resources to implement the strategy remains to be seen. Fire suppression generally is allocated to other areas where values-at-risk are perceived to be higher. However, a fire suppression strategy was an essential first step. And thanks to the involvement of hunters in the caribou-fire studies, the use of local knowledge in the setting of priorities, and a co-management forum that allowed the strategy to be developed, such a model was successfully created.

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