Debate article

An examination of recovery planning for forest-dwelling woodland caribou (*Rangifer tarandus caribou*) in Ontario, Canada

Christopher J. A. Wilkinson

Office of the Environmental Commissioner of Ontario, Toronto, Ontario, Canada (chris.wilkinson@eco.on.ca).

Abstract: Ontario's population of forest-dwelling woodland caribou is listed both federally and provincially as a species at risk. It is estimated that 20 000 woodland caribou remain in Ontario, of which approximately one quarter inhabit the boreal forest and are described as the sedentary forest-dwelling population. This paper examines the recovery strategy for this population developed by the Ministry of Natural Resources, as well as discussing the implications of provincial forestry policy on woodland caribou management. Commercial timber harvesting will likely soon be allowed in parts of the northern third of the province, in which woodland caribou habitat currently is relatively unimpaired by industrial development.

Key words: critical habitat, fire, forestry, hunting, monitoring, policy analysis, predator-prey dynamics, protected areas, species at risk.

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Introduction

In 2006, the Ministry of Natural Resources (2006a; 2006b) released a draft recovery strategy for the forest-dwelling population of woodland caribou in Ontario, Canada. This population of woodland caribou is listed as a "threatened species" under the federal Species at Risk Act and it currently has a similar status in provincial policy (Ministry of Natural Resources, 2006c). The Canadian Council of Forest Ministers (2006), which includes representation by Ontario's Minister of Natural Resources, also has recognized this species as an indicator of forest sustainability. It is well established that the populations of woodland caribou are in decline across Canada (Thomas & Gray, 2002).

Population declines of woodland caribou are characterized by a pattern of range fragmentation accompanied by an immediate population decline, followed by a period of persistence of isolated populations exhibiting slow decline and eventual extirpation (Ministry of Natural Resources, 2006b). Much of the range recession of woodland caribou over the past century in Ontario is coincident with landscape-level fragmentation of habitat caused by logging, land clearing, and roads, and the subsequent isolation of caribou populations (Ministry of Natural Resources, 2006b). Timber harvesting also has been linked to a series of related threats to this species at risk including changes to forest composition, increased forest fire suppression, and elevated levels of predation (Ministry of Natural Resources, 2006b).

In Ontario, woodland caribou now are found mainly north of 50°N, north of Hearst and Dryden, with isolated populations occurring along the north shore and some islands of Lake Superior. The northern extent of their range bisects the Hudson Plain at about 53°N latitude (Thomas & Gray, 2002). Woodland caribou have disappeared from much of their southern historical range across Canada (Fig. 1), with an estimated loss of half of their range in Ontario in the last century (Schaefer, 2003). Boutin *et al.* (2006:3) note that "there is no evidence of a woodland caribou herd successfully recolonizing an area after industrial activity has occurred."

As recently as the late 19th century, woodland

Fig. 1. Map of historical and projected range recession of forest-dwelling woodland caribou (*Rangifer tarandus caribou*) in Ontario, Canada (adapted from Cumming & Beange, 1993; Perara & Baldwin, 2000; Schafer, 2003). This map reflects Schaefer's (2003) analysis of data from the Ministry of Natural Resources, historical data, and other sources. Schaefer (2003) posits that Ontario's forest-dwelling caribou population will be extirpated from the province by the year 2094. The 2094 line on the map reflects the northern limit of the tree line. The "AOU" lines represent the area where commercial timber harvesting currently is allowed.

caribou ranged as far south as central Ontario to approximately 46°N around North Bay (Darby *et al.*, 1989). It is estimated that 20 000 woodland caribou remain in Ontario, of which approximately one quarter inhabit the boreal forest and are described as the forest-dwelling population. The Ministry of Natural Resources (2006:18) speculates that about 3000 forest-dwelling woodland caribou remain in the area south of roughly 51°N where commercial forestry is currently allowed. However, available estimates of the numbers of woodland caribou in Ontario "are essentially guesses" (Thomas & Gray, 2002:42).

Schaefer (2003) concludes that woodland caribou have lost an average of almost 35 000 km^2 of range per decade in Ontario over the last century, causing a northward recession of range of roughly 34 km per decade. At this continued rate, and in the absence of substantive action, Schaefer (2003) hypothesizes that forest-dwelling woodland caribou will likely be extirpated from Ontario by the end of this century (Fig. 1). Further, Boutin *et al.* (2006:2-4) conclude that the "entire woodland caribou range, across all herds, should be designated as critical habitat."

This paper will examine the Ministry of Natural Resources' (2006b) recovery strategy for woodland caribou. Recovery may be understood as "the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats removed or reduced to improve the likelihood of the species persistence in the wild" (National Recovery Working Group, 2005:3). In general terms, this paper will assess whether the recovery strategy "correctly recognizes the root causes of the problem and offers real solutions" (Clark, 1994:337). This examination of government policy is guided by the *Environmental Bill of Rights, 1993*, including several of its key purposes in subsection 2(2) that are intended to serve as a policy orientation for government decision-making in Ontario:

- The protection and conservation of biological, ecological and genetic diversity.
- The protection and conservation of natural resources, including plant life, animal life and ecological systems.
- The encouragement of the wise management of our natural resources, including plant life, animal life and ecological systems.
- The identification, protection and conservation of ecologically sensitive areas or processes.

This examination is significant, as commercial timber harvesting will soon be allowed in parts of the northern third of the province, in which woodland caribou habitat is relatively unimpaired by industrial development (Ministry of Natural Resources, 2001a). The management of woodland caribou illustrates the tension between the goals for conservation and development in northern Ontario.

Policy context

Ontario's population of forest-dwelling woodland caribou is listed both federally and provincially as a species at risk. Schedule 1 of the federal *Species at Risk Act* lists the boreal populations of woodland caribou in the Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland and Labrador as a "threatened species." However, the *Species at Risk Act* only applies to a small percentage of Ontario that includes "national parks, federal agricultural lands, Indian reserves, military bases, airports, post offices, coast guard stations or other federal land" (Sierra Legal Defence Fund, 2003:25). A "national" recovery strategy is required to be prepared under subsection 37(1) of the *Species at Risk Act*, but Environment Canada (2007) has delayed its release.

Historically, Ontario's population of for-

est-dwelling woodland caribou was listed as a "threatened species" in provincial policy and, as such, the development of any recovery strategies was discretionary (Ministry of Natural Resources, 2006c). In May 2007, the *Endangered Species Act, 2007* passed Third Reading in the Ontario Legislature and was given Royal Assent. This new law will come into force by June 30, 2008. Threatened species, such as the forest-dwelling population of woodland caribou, will now be specifically afforded legal protections by the Ontario government for the first time. This new law will prohibit the damage or destruction of the habitat of threatened or endangered species, unless allowed by exception through a special permit. The habitat of each of these species is to be prescribed by regulation within five years of the Act coming into force. The *Endangered Species Act, 2007* defines habitat as "an area on which the species depends, directly or indirectly, to carry on its life processes, including life processes such as reproduction, rearing, hibernation, migration or feeding."

Forestry policy has a direct bearing on the management of woodland caribou in Ontario as its "direct and indirect effects" are key variables (Ministry of Natural Resources, 2007a:i). Commercial forestry currently is not yet permitted in the northern third of Ontario, north of approximately 50°N to 51°N. The *Crown Forest Sustainability Act, 1994* and Declaration Order MNR-71 under the *Environmental Assessment Act*, R.S.O. 1990, are the primary legal basis for permitting commercial forestry in Ontario. This legal framework operates under the assumption that commercial forestry in the prescribed "area of the undertaking," including the southern parts of the boreal forest, is an ecologically sound activity. Arguably, the forest management planning process is the "*de facto* land use planning" mechanism for the middle third of the province covering approximately 39 million hectares (see Ontario Professional Planners Institute in Commission for Environmental Cooperation of North America, 2006:64).

In 2000, the Ministry of Natural Resources (2001a) established its Northern Boreal Initiative for the portion of the boreal forest to the north of the current area of the undertaking for commercial timber harvesting. The purpose of the Northern Boreal Initiative is to open up this area to new commercial timber harvesting and other forms of resource development, and to facilitate economic renewal, employment opportunities and resource stewardship for First Nation communities in the far north. One of the rationales to opening up this intact forest to commercial harvesting is to address a perceived, yet unrealized, future shortfall of wood supply in the province (Environmental Commissioner of Ontario 1997:42).

In June 2006, the Ministry of Natural Resources adopted the first regionally-specific land use strategy using the Northern Boreal Initiative planning process. The Community-based Land Use Strategy for the Whitefeather Forest and Adjacent Areas (Pikangikum First Nation and Ministry of Natural Resources 2006) is the first of an expected 15 land use strategies to be developed under the Northern Boreal Initiative (2001a). The Ministry of the Environment must give approval under the *Environmental Assessment Act* to the Ministry of Natural Resources before commercial timber harvesting is allowed to begin in the Whitefeather Forest or other areas covered by the Northern Boreal Initiative.

It appears that the forestry guidelines that apply to the area of the undertaking have been effectively applied to the Community-based Land Use Strategy for the Whitefeather Forest and Adjacent Areas. For example, the Community-based Land Use Strategy for the Whitefeather Forest and Adjacent Areas Strategy (Pikangikum First Nation and Ministry of Natural Resources, 2006:60) applies a one-ki-

lometer forest-harvesting buffer around most caribou calving lakes, which reflects current guidance for the area of undertaking (see Ministry of Natural Resources 2001b). However, an analysis by Vors *et al.* (2007) concluded that a surrounding zone of intact forest of at least 13 km is needed to maintain woodland caribou in Ontario's northern boreal forest. The analysis has significant implications for woodland caribou management as it "contrasts starkly with current prescriptions for forest harvesting" (Vors *et al.*, 2007:1253).

It is noteworthy that the federal Senate Subcommittee on the Boreal Forest (1999:8) recommended that "in those parts of the boreal forest approaching the tree line, where adequate silvicultural methods have not been developed, logging should not be allowed... [and] cutting should be limited in old-growth sections of the boreal forest." The Environmental Commissioner of Ontario (2003:95) made a similar recommendation that the Ministry of Natural Resources "should carry out a thorough assessment of forest management approaches that are ecologically suited to the northern boreal forest and make the research results available to the public." No such assessment has yet been made public.

Subsequent to the release of this recovery strategy, the Minister of Natural Resources (2007) committed to regulating the habitat of Ontario's forest-dwelling population of woodland caribou by June 2009 under the new *Endangered Species Act, 2007*. The scope of genuine protection prescribed for their habitat will be a measure of the effectiveness of the new law, as well as a benchmark to assess the environmental sustainability of policy choices by the Ontario government for northern Ontario.

Discussion

The goal of the Ministry of Natural Resources' (2006b:iv) recovery strategy is to "maintain self-sustaining, genetically-connected forest-dwelling woodland caribou populations where they currently exist; ensure security for, and (reproductive) connections among, currently isolated mainland populations; and re-establish caribou in strategically selected landscape units to achieve self-sustaining populations and ensure connectivity." Five recovery zones (Northwest, Northeast, Lake Nipigon, Lake Superior Coast and the Central Highlands) are proposed based on differences in caribou distribution, ecological conditions, and threats. Specific guiding principles are proposed for each recovery zone to assist with the creation of these yet-to-be developed action plans. To meet the recovery goal, 11 recovery objectives have been identified by the Ministry of Natural Resources (2006b):

- Establish benchmarks for range occupancy and population health of woodland caribou across Ontario in order to track changes.
- Establish and maintain a woodland caribou range occupancy database and related map to track changes in occurrence and connectivity of populations.
- Maintain or enhance the status and health of woodland caribou populations consistent with the strategic approaches for specific Recovery Zones across Ontario.
- Reduce known threats associated with range recession and population decline in the area of continuous woodland caribou range, specifically that of the Northwest and Northeast Recovery Zones.
- Reduce known threats associated with range recession and population decline of woodland caribou through immediate action within the Lake Nipigon, Central Highlands, and Lake Superior Coast Recovery Zones.
- Identify, evaluate, protect and manage habitat features and landscapes essential to caribou survival and recovery.
- Define metapopulations, refine Recovery Zones and identify recovery priorities by

investigating genetic relationships among woodland caribou populations in Ontario.

- Protect and manage current caribou range and habitat, including future connections and rehabilitation areas by creating plans at multiple spatial and temporal scales.
- Better understand populations, meta-populations, habitat, threats, genetics, and other knowledge gaps by conducting scientific research.
- Generate support and partnerships for recovery implementation by promoting education and awareness of woodland caribou and boreal forest ecosystems.
- Develop policies and legislation to promote the protection and recovery of woodland caribou.

The recovery strategy also recommends that "a comprehensive provincial woodland caribou policy" be developed to address the overall management of the forest-dwelling population, the forest-tundra population, the few isolated populations on islands on Lake Superior, and in Pukaskwa National Park (Ministry of Natural Resources, 2006b:49). The ministry is indeed working on a yet-to-be-released "caribou conservation framework" that will address actions that are needed to conserve all of Ontario's herds of woodland caribou (Wildlands League, 2006:4). When the Ministry of Natural Resources completes its proposed version of a caribou conservation framework, the ministry will be required under subsection 15(1) of the *Environmental Bill of Rights, 1993* to provide at least a 30-day public comment period before the implementation of this new policy.

Targets for Population Recovery

Rates of change in the population size, either positive (increases) or negative (decreases), are central to determining the effectiveness of recovery efforts. However, the Ministry of Natural Resources (2006b:9) admits that "little information is available on the rates of [population] growth of Ontario caribou." Further, the ministry takes a proverbial hold-the-line approach, essentially deeming the strategy successful if the numbers of woodland caribou do not drop. For example, the Ministry of Natural Resources (2006b:9) states that the strategy will be "successful" if:

- Population numbers do not continue to decline on a constant basis;
- Population numbers only decline for a small portion of the population;
- Population numbers remain the same or increase for a large proportion of the population at the edge of current caribou range; and,
- Population numbers remain the same or increase for the small isolated populations that are confined to Pukaskwa National Park and the Slate Islands.

The central goal of a recovery strategy should be to actually recover the population in question, boosting its numbers to the point where it is no longer considered a species at risk and "its long-term persistence in the wild is secured" (National Recovery Working Group, 2005:3). This paper posits that the strategy sets unambitious, and arguably defeatist, objectives that likely create a best-case scenario for forest-dwelling woodland caribou to remain as a "threatened species."

Targets for Habitat Recovery

The Ministry of Natural Resources (2006b:v) states that the success of the strategy will be evaluated by a number of indicators, with range occupancy acting as the overall measure of caribou recovery. Currently occupied range, as defined by the present zone of continuous distribution and current use patterns of known populations, will serve as a baseline for recovery initiatives (Ministry of Natural

Resources, 2006b:8). However, again, the ministry is resigned to holding the line and focuses almost exclusively on existing range. The strategy seeks to maintain the species, rather than to reverse its loss of range:

> "Full recovery of former range southwards to Lake Nipissing is unfeasible. Biological, social and economic constraints dictate that even the maintenance of currently occupied range and populations will be a tremendous challenge. Recovery of former range will likely be limited to (i) specific locations along the southern limit of continuous occupied range and (ii) the establishment of linkages with isolated populations. Recovery will be an extremely difficult, expensive and long-term initiative, at a spatial and temporal scale not previously required under other provincial species recovery strategies" (Ministry of Natural Resources, 2006b:29).

The apparent lack of will to restore this threatened species to its former range is underscored by the fact that the five proposed recovery zones are almost exclusively limited to existing woodland caribou range (Ministry of Natural Resources, 2006b:48). These zones were based on ecoregional or ecodistrict boundaries, as well as "social and ecological factors" (Ministry of Natural Resources 2006b:25). These zones largely appear to cover existing range with few areas of historical range included and, therefore, the strategy states that "recovery of former habitat will take decades to achieve" (Ministry of Natural Resources, 2006b:29).

Forest Management Practices

The Ministry of Natural Resources (2006b:12) states that it has been modifying forest management practices to mitigate the effects of timber harvesting on woodland caribou habitat since the mid-1970s, but early attempts were unsuccessful according to the ministry. In 1994, the ministry began applying its Forest Management Guidelines for the Conservation of Woodland Caribou (Ministry of Natural Resources, 2001b). This guideline, under the authority of the *Crown Forest Sustainability Act, 1994*, prescribes that forestry operations should harvest timber in 10 000 ha or greater blocks to minimize forest fragmentation, while ensuring the maintenance of comparable sizes of undisturbed old-growth forest for woodland caribou habitat. This guideline only applies to northwestern Ontario and, according to the Ministry of Natural Resources (2006b:12), regional direction for forest management plans in woodland caribou range in northeastern Ontario is being developed.

The Environmental Commissioner of Ontario (2002a:53), in reporting to the Ontario Legislature pursuant to the *Environmental Bill of Rights, 1993*, reviewed the caribou guidelines and the Ministry of Natural resources was urged "to use the boreal population of woodland caribou as a measurable indicator of forest sustainability." Further, the Environmental Commissioner (2002b:189) encouraged the ministry to consider woodland caribou habitat and range occupancy in the creation of new protected areas. The Environmental Commissioner of Ontario (2002c:2) also commented that the Forest Management Guide for Natural Disturbance Pattern Emulation (Ministry of Natural Resources, 2002), which has enormous implications for a range of species, was a "grand experiment."

All forest management units must be independently audited at least once every five years, as required by Ontario Regulation 160/04 under the *Crown Forest Sustainability Act, 1994*. It is important to note that the Ministry of Natural Resources (2006b:27) relies on its woodland caribou guidelines "to protect caribou habitat." Independent audits reveal multiple commonalities with regard to Crown forest management and woodland caribou: the general lack of data

on range occupancy and species occurrence, the decline of available habitat in future forest conditions, confusion over government direction for the management of this species, and a general perception that the conservation of this species results in a decline in commercial wood supply.

Table 1. Status of woodland caribou and their habitat as reported in independent forest audits in Ontario, Canada.

Cochrane Moose River Management Unit, Independent Forest Audit, 2000-2005 (Arbex Forest Resource Consultants Ltd., 2006:26): "Due to inadequate caribou habitat and population information OMNR and Tembec had cooperated by modifying access and harvest activities when new information became available…. The auditor notes information with respect to caribou is limited."

English River Forest, Independent Forest Audit, April 1, 2000 – March 31, 2005 (ArborVitae Environmental Services, 2006a:40-41): "Appendix 27 of the plan, which was written by MNR staff, also portrays the tension on the planning team: '….the basic premise of wildlife habitat retention was consistently disputed by Bowater. As a result it wasn't possible to examine the potential for additional management actions during this plan'. While the MNR author's frustration is evident in this quote, Company personnel presented a similar level of frustration at what they characterized as intransigence on the part of MNR members on the planning team to consider their perspectives on wood supply management…. MNR staff in Ignace have collected data which provide good evidence of caribou inhabiting areas south of the caribou line. MNR has not identified a corporate approach as to how to deal with such situations, other than to acknowledge that the Class EA and FMPM require them to accommodate the habitat needs of species at risk… The present FMP (Table FMP-5) predicts a decline in caribou winter habitat of more than 20% at the time of the Desired Future Forest Condition, calling the sufficiency of present management somewhat into question…. Corporate MNR should develop a strategy for dealing with the integration of caribou habitat requirements and forest management in instances where caribou are present south of the caribou line."

Kenogami Forest, Independent Forest Audit, 2000-2005 (KBM Forestry Consultants Inc., 2006a:21): "The audit team learned that years of survey information on woodland caribou winter habitat and calving areas was not entered into NRVIS because provincial data standards were not finalized. It would seem prudent for MNR to finalize the data standards and enter these data as soon as possible to ensure these values are properly addressed through the AOC planning process and to make data provincially available for use in the woodland caribou recovery strategy…. Company was active supporter of woodland caribou research project."

Ogoki Forest, Independent Forest Audit, April 1, 2000 – March 31, 2005 (ArborVitae Environmental Services, 2006b:7): "Nevertheless, the amount of caribou habitat will fall by 57% over the next 100 years. The Audit Team is aware that the present management guidelines represent the Ministry's good advice on management of caribou habitat. However given evidence that caribou are a sensitive species, and that their habitat is projected to decline markedly, the Audit Team believes the Ministry must provide strong objective evidence that the projected decline in habitat will not further endanger caribou. The Audit Team recommends that the Ministry conduct an objective assessment of the viability of the caribou population on the Forest, and that the results of the assessment be incorporated into subsequent forest management plans."

Red Lake Forest, Independent Forest Audit Report, 2000-2005 (KBM Forestry Consultants Inc., 2006b:18-19): "The woodland caribou mosaic is a significant landscape impact that influences wood supply (social and economic objectives)…. Clearly, the Red Lake Forest is challenged in its future ability to maintain the DEMAND wood supply targets while at the same time implementing the landscape objectives as they relate to woodland caribou and marten. There is no margin that allows for the potential risks of any future fire or

catastrophic wind events without further worsening the wood supply outlook."

Smooth Rock Falls Forest, Independent Forest Audit, 2000-2005 (KBM Forestry Consultants Inc., 2006c:19): "Corporate Ministry of Natural Resources must make every effort to finalize woodland caribou values information data standards."

Wabigoon Forest, Independent Forest Audit, 2000-2005 (KBM Forestry Consultants Inc., 2006d:20): "The 2003-2008 FMP states that, "The Woodland Caribou (foraging and winter) can be a locally featured species, however the Forest is located south of the Caribou's range, therefore habitat for the species will be reported a regionally select species but not actively managed as a locally featured species". This was consistent with the direction of the FMPM."

Caribou Forest, Independent Forest Audit (April 1, 1999 – March 31, 2004) (ArborVitae Environmental Services, 2005:32-37): "The Audit Team is concerned that progressive weakening of the habitat targets may lead to excessive population reduction in the longer term…. Given the marked declines in caribou habitat, it is certainly reasonable to ask whether caribou will be maintained on the forest…. The fact that the planned future forest will be less hospitable for caribou and that it will provide considerably less habitat for most indicator species suggests that a re-examination of the desired age-class structure of the future forest may be in order… Management measures which will foster a more caribou-friendly future on the Caribou Forest may well involve trade-offs between wood supply and caribou habitat."

An Independent Audit of the Forest Management on the Armstrong Forest for the Period of 1995-2001 (Callaghan and Associates Inc., 2001:18, 82): "The auditors are concerned about how draft woodland caribou forest management guidelines were incorporated into the strategic modeling of the 2000 forest management plan…. There is very little information on woodland caribou habitat and presence over most of the Armstrong Forest."

Independent Forest Audit, Kenora Forest, 1998-2003 (KBM Forestry Consultants Inc., 2005: 18): "Little is known about the specific habitat preferences for the provincially threatened woodland caribou."

An Independent Audit of Forest Management on the Nagagami Forest for the Period 1997 to 2002 (BioForest Technologies Inc., 2003:21): "Regional input regarding caribou was included in the preparation of the 2001 FMP, but provincial or regional strategies to address woodland caribou populations in fringe areas south of the "caribou line" were lacking…. Although the measures taken on the NF to account for caribou appear reasonable, the adequacy of this approach cannot be determined because of the poor understanding of caribou habitat requirements on the Forest…. The OMNR should improve its collection of fisheries and caribou values data to support forest management planning and ensure the protection of these values."

An Independent Audit of Forest Management on the Lake Nipigon and Auden Forests for the Period 1996 to 2001 (Callaghan and Associates Inc., 2002:16, 120): "Combined with a lack of data on caribou distribution, habitat relations, and abundance on the Auden Forest, it was difficult for the audit team to determine the potential effectiveness of the caribou mosaic from that plan…. The audit team, however, is concerned with the continuing lack of effort to collect the necessary and outstanding values information required to support forest management planning…. Establishment of a full caribou management mosaic on the Lake Nipigon Forest was not appropriate, given the small proportion of the Forest that is north of the caribou line."

Protection of habitat

The proposed recovery strategy does not identify the critical habitat that is necessary for the survival of forest-dwelling woodland caribou. Instead, the recovery strategy defers the identification of critical habitat to the five action plans that are to be developed at some future

date. This delay in protection is similar to what is allowed under the federal *Species at Risk Act*, which allows critical habitat to be identified in an action plan rather than in a recovery strategy itself. It is noteworthy that the Government of Canada can order the Government of Ontario to actually protect the critical habitat of forest-dwelling woodland caribou if it is of "the opinion that the laws of the province do not effectively protect the species or the residences of its individuals" under subsection 34(3) of the federal *Species at Risk Act*.

Monitoring and research

The recovery strategy astutely recognizes that the persistence of woodland caribou in Ontario will depend on an adaptive management process that incorporates long-term research. As woodland caribou numbers are poorly suited to direct population assessment, research initiatives "must investigate direct measures of population health (i.e., measures of population growth) to the pattern, quantity, and distributions of various habitats, especially related to habitat attributes used in forest management planning" (Ministry of Natural Resources, 2006b:32).

The recovery strategy states that "the major research objectives must include an examination of the effects of landscape disturbances created by commercial forestry operations on woodland caribou populations in Ontario" (Ministry of Natural Resources, 2006b:32). Specifically, it cites the need for increased research on caribou occurrence and density; (ii) forest landscapes, densities of other ungulates, and predation; (iii) caribou habitat dynamics and habitat selection; (iv) the ability of forest harvesting and silvicultural practices to create a managed forest suitable for caribou; and (v) the cumulative impact of direct and indirect threats to woodland caribou.

The Ministry of Natural Resources (2006b:14) is in the process of consolidating all woodland caribou observations and satellite telemetry locations to create a provincial database. The recovery strategy states that "the database will be a critical component of the long-term monitoring process required to effectively track range occupancy." The ministry states the need to develop standards for monitoring range occupancy, including a detailed survey protocol, frequency (i.e., inter-survey interval), intensity (degree of coverage), and criteria for selecting survey areas. The lack of data was a concern raised in numerous independent forest audits (Arbex Forest Resource Consultants Ltd., 2006; KBM Forestry Consultants Inc., 2006a; KBM Forestry Consultants Inc., 2006c; Callaghan and Associates Inc., 2001; BioForest Technologies Inc., 2003; Callaghan and Associates Inc., 2002).

The Role of Fire

Fire has been an integral component in the dynamics of the boreal forest for thousands of years. The forest-dwelling boreal population of woodland caribou depends upon fire as an ecological process to renew their habitat. However, over the last century, human fire suppression and timber harvesting have significantly altered natural fire regimes in Ontario (Environmental Commissioner of Ontario, 2005). The recovery strategy makes little mention of this issue other than to suggest that "input into the review of provincial and regional fire strategies in the interest of maintaining current or creating future caribou range" will be provided (Ministry of Natural Resources, 2006b:54).

In reviewing the ministry's Forest Fire Management Strategy, the Environmental Commissioner of Ontario (2005:76) raised concern that "there are serious inconsistencies… with landscape-level ecological implications." For example, specifically with regard to woodland caribou, the Ministry of Natural Resources was cautioned that "it is not known how this policy choice – to replace naturally occurring

fires with forest harvesting – will affect this species at risk" (Environmental Commissioner of Ontario, 2005:77).

Forest species composition and age class imbalance

Older conifer forests provide caribou with a source of arboreal and terrestrial lichens, which is an important component of the winter diet for this population (Ministry of Natural Resources, 2006b). Mature conifer forests are generally used less by other ungulate species, which are more reliant on early successional forests. The recovery strategy acknowledges that "habitat change resulting from forestry activities often leads to improved habitat conditions for deer and moose and other prey species, which can lead to greater predator densities" (Ministry of Natural Resources, 2006b:20).

Predator-prey dynamics

Low population densities and the use of large tracts of older conifer forest and peatlands allow caribou to isolate themselves from other ungulates, such as moose (*Alces alces*) and white-tailed deer (*Odocoileus virginianus*), and their associated predators. However, the recovery strategy states that as disturbances occur, such as logging or severe forest fires, moose populations increase in the short-term in response to an increase in early successional forest and edge. The recovery strategy suggests that moose populations within caribou range should remain at levels similar to those occurring under a natural fire regime (Ministry of Natural Resources, 2006b:15). It recommends the development of "species-specific management objectives and alternate habitat and landscape management prescriptions for caribou, moose and deer in areas of overlapping range" (Ministry of Natural Resources, 2006b:51).

Woodland caribou and wolves naturally coexist in a viable predator-prey dynamic (Peterson & Ciucci, 2003; Fuller *et al.*, 2003). However, that balance may be upset when landscape disturbances occur and other ungulates – moose and deer – migrate into an area, causing an increased prey base for wolves that increases their population density (Mech & Peterson, 2003). North of approximately 49°N latitude, estimates of wolf density are 6 to 7.5 wolves per 1000 km^2 in occupied woodland caribou range (Ministry of Natural Resources, 2004:8-9). These wolf densities correspond with the tolerances described for woodland caribou in the ministry's forest management guidelines (see Ministry of Natural Resources, 2001b:9), although, higher tolerances previously have been reported (see Fuller *et al.*, 2003:167).

Generally, in areas that have historically been intensively logged, estimated wolf densities rise to 15 to 28 wolves per 1000 km^2 (Ministry of Natural Resources, 2004:8-9). The application of the moose guidelines in unoccupied historic range virtually guarantees that woodland caribou will not re-occupy these lands due to the elevated moose and wolf numbers alone.

The apparent conflict between two guidelines under the *Crown Forest Sustainability Act, 1994* makes a difficult situation even worse for the forest-dwelling woodland caribou. The Ministry of Natural Resources' (2001b) Forest Management Guidelines for the Conservation of Woodland Caribou: A Landscape Approach prescribes logging in very large blocks of 10 000 ha or more to minimize forest fragmentation and edge in order to decrease moose habitat. The Ministry of Natural Resources' (1988) Timber Management Guidelines For the Provision Of Moose Habitat prescribes cutting in small blocks to maximize forest fragmentation and edge to increase moose habitat. Consequently, the moose guidelines alter landscape patterns causing increased wolf densities and unsustainably high mortality risks for caribou. Even if the moose guidelines are not applied

in occupied caribou range, their application encourages a northward range expansion that pressures woodland caribou.

The Ministry of Natural Resources does not consider impacts on other species when managing moose populations through regulated hunting (T. Armstrong, pers. comm. 26th Oct. 2006). It is estimated that there are approximately 99 000 moose in harvestable areas in Ontario, of which only a small fraction are found south of the French River or 46°N (Ministry of Natural Resources, 2006d:36). According to the Ministry of Natural Resources' (2006d:36) hunter survey, almost 7550 moose were harvested in 2004 which translates to an approximate annual yield of 7% of the overall moose population. The ministry uses a lottery system to allocate moose tags and the quota for available tags varies by wildlife management unit (WMU) depending on local moose population levels. In 2005, almost 15 000 tags were issued province-wide, although the number of individual tags issued varies drastically between wildlife management units (Ministry of Natural Resources, 2006d:37). It is logical that the ministry should try to achieve pre-European colonization population levels of moose when setting quotas within occupied woodland caribou range and where re-colonization of woodland caribou is feasible (see Ministry of Natural Resources, 2007b). The Ministry of Natural Resources (in Environmental Commissioner of Ontario, 2007b:214) acknowledges that "moose management must consider implications to caribou" in the development of new forestry guidelines, although the ministry finds it "socially unacceptable" to limit moose populations where none have historically been present.

The role of protected areas

Protected areas serve an integral role in conserving biodiversity and protecting species at risk (Wilkinson & Eagles, 2001). However, there is consensus that even the largest protected areas in Ontario in which woodland caribou are present – Woodland Caribou Provincial Park (4500 km^2) and Wabakimi Provincial Park (8920 km^2) – are insufficient in of themselves for maintaining this species at risk (see Vors, 2006; Vors *et al.*, 2007; Weirsma & Nudds, 2006). Woodland caribou require ranges in the order of thousands of square kilometres of little disturbed or undisturbed boreal forest (Rettie & Messier, 2001; Brown *et al.*, 2003). The only action that the recovery strategy suggests is that management planning for protected areas within caribou range should explicitly consider woodland caribou. However, that is a moot point as management planning is mandatory and the maintenance of ecological integrity is the first management priority in both the *Provincial Parks and Conservation Reserves Act, 2007* and the *Canada National Parks Act*.

South of their continuous range, isolated populations of woodland caribou exist in several provincial parks and one national park. These protected areas include Slate Islands Provincial Park (67 km^2), Michipicoten Island Provincial Park (367 km^2) and Pukaskwa National Park (1878 km^2). These protected areas contain unique habitats that allow woodland caribou to avoid high levels of predation. However, as these populations are reproductively isolated, the recovery strategy states that "their long-term survival is in question" (Ministry of Natural Resources, 2006b:27).

While protected areas may sometimes serve as small safe havens for species such as woodland caribou, adjacent land uses can compromise this protection. For example, the Environmental Commissioner of Ontario (2006:74) reported that "…in 2003 Parks Canada specifically warned MNR that proposed forestry operations adjacent to Pukaskwa National Park were a direct threat to the park's wolf population and to the ecological integrity of this protected area, but the ministry approved

the forest management plan with only a minimal modification." The strategy does attempt to address such concerns in stating that land practices should be modified "in a delineated zone in vicinity of Pukaskwa National Park and including portions of managed forest," but no details as to how or when this would occur are provided (Ministry of Natural Resources, 2006b:67).

It is alarming that the recovery strategy makes no mention of the need for new protected areas in northern Ontario. Protected areas only cover 7.7% of northern Ontario, north of the area of the undertaking. Numerous independent studies have concluded that a network of protected areas, including some areas that are at a minimum 9000 to 13 000 km^2, are necessary to have a minimal prospect of maintaining viable herds of woodland caribou (see Boutin et al., 2006; Schaefer & Mahoney, 2003; Weirsma & Nudds, 2006). Further, there is a broad consensus among many non-governmental, First Nations, and industry groups that upwards of 50% of the boreal forest and northern tundra must be within protected areas to maintain its ecological processes (Canadian Boreal Initiative, 2003:1).

Hunting

The hunting of woodland caribou by non-First Nations has been banned since 1929 in Ontario (Ministry of Natural Resources, 2006b:22). Subsistence hunting by First Nations with treaty rights does currently take place, although no data exist on the annual harvest levels. The Ministry of Natural Resources (2006b:22) estimates that 610 to 730 woodland caribou are harvested annually, of which roughly a quarter are from the forest-dwelling population. MNR hypothesizes that the number of animals that are illegally hunted by non-First Nations is low based on the fact that there are few legal prosecutions. However, this assertion is questionable logic due to the minimal surveillance by enforcement staff (Environmental Commissioner of Ontario, 2007:63-66).

The hunting of woodland caribou is not as steadfastly "banned" as stated by the strategy. A mammal should be listed as "specially protected" under Schedule 6 of the *Fish and Wildlife Conservation Act, 1997* for it to be effectively banned from hunting. In fact, woodland caribou are listed as a "game mammal" under Schedule 2 of that law, which allows the species to be hunted under the authority of a licence issued by the Ministry of Natural Resources. However, Ontario Regulation 670/98 under the *Fish and Wildlife Conservation Act, 1997*, which prescribes open seasons for hunting, lists woodland caribou as possessing a year-round closed season. The use of such a minor technicality to prohibit the hunting of a threatened species at risk is not reassuring.

Climate change

The recovery strategy does not substantively address the impacts of climate change on this species at risk, despite its habitat in the boreal forest being at substantial risk due to ecological change (see Stewart *et al.*, 1998). The recovery strategy states that "climate change leading to changes in precipitation, decreased fire return intervals, or increased severity of fires could affect caribou by changing vegetation communities" (Ministry of Natural Resources, 2006b:23). Beyond the impacts of resource development, climate change is likely to be one of the most critical threats to many species at risk in Ontario and it is alarming that the recovery strategy gives minimal treatment to it. The recovery strategy does state that there is a need for predictive models "to assist in evaluating the ways in which landscapes can be modified to maintain and improve caribou population persistence (probability of survival and reproduction) under increased economic activities and climate change" (Ministry of Natural Resources, 2006b:32).

The strategy does acknowledge that the present pattern of climate change may continue to favour the expansion of white-tailed deer range (Ministry of Natural Resources 2006b:22). This is of particular concern to recovery efforts as populations of deer and woodland caribou rarely overlap. Woodland caribou are very susceptible to a parasite that is naturally hosted in deer, the meningeal worm (*Parelaphostrongylus tenuis*), and they suffer high mortality rates due to infection (see Bergerud & Mercer, 1989; Cumming, 1992).

Public consultation in developing the recovery strategy

The Ministry of Natural Resources posted this recovery strategy as an information notice with a comment period on the Environmental Registry (www.ebr.gov.on.ca), rather than as a proposal notice as required by Ontario's *Environmental Bill of Rights*. By not adhering to the *Environmental Bill of Rights* in this case, the ministry did not have to legally consider public comments, consider its Statement of Environmental Values (SEV), nor post a decision notice describing the final course of action. In September 2006, the Environmental Commissioner of Ontario (2007b:160) advised the ministry that it should re-post the recovery strategy as a regular proposal notice on the Environmental Registry to ensure a proper public consultation process.

The ministry took the position that recovery strategies are "advice to government" by a given recovery team and that they are not government policies (Environmental Commissioner of Ontario, 2007b:160). The ministry also used the rationale that recovery strategies are "science" and, as such, do not require proper public consultation. The Ministry of Natural Resources also stated that it is under no obligation to implement the recovery actions that are recommended, therefore, recovery strategies are not government policy. Lastly, the ministry stated that any public consultations that may potentially occur under the federal *Species at Risk Act* related to this at risk population are sufficient.

The *Environmental Bill of Rights* defines a policy as any "program, plan or objective and includes guidelines or criteria to be used in making decisions." By that legal definition, recovery strategies are government policies and must be properly posted on the Environmental Registry to ensure government accountability and transparency. Further, the federal *Species at Risk Act* is not a timely or equivalent public participation process given the prominent role of the Ministry of Natural Resources in conserving Ontario's species at risk (Environmental Commissioner of Ontario, 2007c:103).

The improper posting of recovery strategies has been a systemic problem that the Environmental Commissioner of Ontario has repeatedly requested that the government resolve. Recovery strategies are government policies, regardless of the composition of a recovery planning team. In this case, 15 of the 16 recovery team members were staff of the Ministry of Natural Resources. Further, other rationales put forward by the ministry, such as a policy being "science-based" or containing actions that may not be implemented, are not cause to exempt the ministry from adhering to the *Environmental Bills of Rights* (Environmental Commissioner of Ontario, 2007b:161). Indeed, the very policies that drive this systemic problem were not posted for proper public consultation or scrutiny (see Environmental Commissioner of Ontario, 2004:23-24).

The Ministry of Natural Resources received 16 written comments on the recovery strategy from a wide array of stakeholders groups. The ministry also received 282 form letters calling for increased protection for woodland caribou, as well as hundreds more after the unofficial 56-day comment period ended. This high degree of public interest also underscores the value of treating the recovery strategy as a

regular policy proposal on the Environmental Registry. The Ministry of Natural Resources (in Environmental Commissioner of Ontario, 2007b:214) stated that it made "significant changes" to the final recovery strategy based on the public comments, but a revised version of the strategy still had not been made public as of January 2008.

Table 2. Stakeholder comments on the "Draft recovery strategy for forest-dwelling woodland caribou (*Rangifer tarandus caribou*) in Ontario.

A forest industry association did not support the approval of this strategy and stated that additional consultation with the forest industry was necessary (see Environmental Commissioner of Ontario, 2007c:103). This association suggested that the approval of the recovery strategy be "suspended" as it "needs to be simplified and streamlined to ensure that recovery initiatives are not only effective, but efficient (i.e. consider and minimize impacts on social and economic values)." In particular, this association sought to ensure that any recovery strategy "dovetails" with existing forest management direction.

A multi-national forestry company provided extensive comments on the strategy (see Environmental Commissioner of Ontario, 2007c:103). This forestry company commented that much of the information on which the strategy relies is "circumstantial" evidence, including historical population sizes and range occupancy. Indeed, this forestry company posed the rhetorical question, "Are woodland caribou in Ontario truly a species at risk?" Among their many other concerns was the need for the ministry to dispel the notion that "caribou are in immediate danger from forest management activities and that nothing is being done to protect caribou and their habitat." This forestry company also stated that the prohibition on commercial forestry and mining within protected areas "may in fact be detrimental to caribou habitat in the long-term."

An organization representing hunting interests expressed numerous concerns about the recovery strategy, including that the harvest of woodland caribou by First Nations was "not sustainable" (see Environmental Commissioner of Ontario, 2007c:104). This organization believes that "predation and Aboriginal caribou harvests are significantly limiting caribou populations and these factors must be actively minimized." Further, this organization also expressed concern that the ministry would be prioritizing this species at risk over others, as "caribou provide few social or economic benefits for Ontario residents while both moose and deer provide significant recreational opportunities and generate significant economic wealth for the province." This organization also criticized the recovery strategy for calling for the decommissioning of forest access roads as this proposed action would cause "losses of hunting and angling opportunities."

A non-profit group with expertise in forestry supported the objectives of the strategy to recover woodland caribou, but it expressed serious concerns with its content and timing (see Environmental Commissioner of Ontario, 2007c:104). This non-profit organization stated that the ministry was responsible for the "unconscionable delay" in recovering the species, as well as failing to adequately consult the public due to its "distorted use" of the Environmental Registry. Of key concern to this non-profit group was the failure of the strategy to identify and legally protect critical caribou habitat. This organization recommended that the ministry put "a halt to all development north of the Area of Undertaking (AOU) until a comprehensive, conservation based land use planning process" is implemented that ensures the protection of woodland caribou.

A non-profit legal advocacy group also took issue with the "distorted public process" that the ministry used to consult the public on its proposed strategy (see Environmental Commissioner of Ontario, 2007c:104). This legal advocacy group was "gravely concerned" that the ministry had not adhered to its obligations under the *Environmen-*

tal Bill of Rights to post the strategy as a proposal notice on the Environmental Registry. This legal advocacy group stated that the "draft recovery strategy should be considered MNR policy and thus should trigger the public's right to comment and to have those comments duly considered."

A non-profit group specializing in conservation biology expressed concerns that there has been a "protracted delay in moving forward on meaningful recovery actions" for Ontario's woodland caribou (see Environmental Commissioner of Ontario, 2007c:104). In particular, this non-profit group was critical of the proposed recovery strategy's failure to define and delineate critical habitat for this species at risk. This non-profit group also stated that it is "alarming" that no new legal measures to protect habitat were proposed in the recovery strategy given that the sizes of existing protected areas are regarded as insufficient to adequately protect woodland caribou. This non-profit group also suggested that the northern boundaries of the recovery area be extended all the way to Hudson Bay, as the ranges of forest-dwelling and forest-tundra woodland caribou types are based on outdated "best guesses" that are increasingly in question.

A coalition of non-profit groups, representing a wide range of interests, jointly submitted a comment on the strategy (see Environmental Commissioner of Ontario, 2007c:104). They expressed concern that the strategy fails to implement on-the-ground actions to protect the species as it "allows the *status quo* to continue in terms of logging, road building and other human development in woodland caribou habitat." These groups criticized the strategy for failing to identify and protect critical habitat, as well as voicing the urgent need to develop a provincial road strategy to mitigate the effects of logging on woodland caribou.

A non-profit group specializing in forestry issues commented that the strategy's "apparent lack of urgency is unacceptable" as it effectively promotes a "business as usual" approach (see Environmental Commissioner of Ontario, 2007c:104). This non-profit group also criticized the strategy's failure to consider the impact of climate change on woodland caribou, including predictions and scenarios addressing population size and habitat supply. This non-profit group also took exception to the strategy's reliance on the ministry's Forest Management Guidelines for Woodland Caribou due to the lack of evidence of caribou re-colonizing habitat that has been logged, the absence of monitoring to determine the effectiveness of the guidelines, and the use of questionable baseline information to determine existing range occupancy. This non-profit group recommended that the ministry immediately defer all forestry operations in woodland caribou range in the Area of Undertaking (AOU), as well as declare a moratorium on all development activities north of the AOU pending a comprehensive land use plan.

A private scientific consulting firm, which conducts work for proponents of mineral development, submitted comments on the strategy (see Environmental Commissioner of Ontario, 2007c:105). This firm commented that the strategy does not sufficiently address the migrations of woodland caribou, particularly the movement of the forest-dwelling population between Ontario and Manitoba. In monitoring radio-collared woodland caribou, this firm has noted that some individual caribou from the Attawapiskat area travel upwards of 500 km between summer and winter ranges. This firm also stated that the delineation between the forest-dwelling and the forest-tundra populations is based on dated information and should be updated as it has major conservation implications. As well, they also expressed concern that the recovery team had no First Nation representatives and the recovery plan "will not be of much value" if it does not have the support of First Nations.

Conclusion

Woodland caribou epitomize why significant changes should be made to the way in which the Ontario government regulates and plans for northern Ontario, particularly within the boreal forest. The Environmental Commissioner of Ontario (2006:138) has recommended that the Ontario government should "consult the public on an integrated land use planning sys-

tem for the northern boreal forest, including detailed environmental protection requirements that reflect the area's unique ecology." The continued lack of big picture thinking and a comprehensive land use planning process are serious barriers to environmental protection in northern Ontario (Environmental Commissioner of Ontario, 2007b:51-81).

Woodland caribou represent the "hard-to-perceive, slow-motion crisis" that faces many species at risk (Ehrlich, 2002:33). Woodland caribou also are a species that exhibits an extinction debt; there is a lag time of approximately twenty years between when their habitat is impacted by human activity and when a population may undergo local extirpation (Vors *et al.*, 2007). Given that the Canadian Council of Forest Ministers (2006) has recognized woodland caribou as an indicator of forest sustainability, concerted and sustained action regarding this species at risk is essential.

After waiting more than five years for this "draft" recovery plan to be developed, there are few reassurances that this species at risk will survive until the next century. In reviewing independent forest audits required by the *Crown Forest Sustainability Act, 1994,* this paper argues that a clear pattern emerges that current forestry policies are not preventing the decline of woodland caribou in Ontario (Environmental Commissioner of Ontario, 2007b:5). The Auditor General of Ontario (2007:145-146) also raised similar concerns,

> "At the completion of our audit, the recovery strategy was still at the draft stage and the Ministry still needed to obtain information about caribou habitat requirements, predation (natural predators), response to development activities, encroachment by other species into caribou habitat, and the effects of disease. Biologists say that if the recovery strategy is not implemented on a timely basis, there is a risk that the woodland caribou population and its critical habitat could further deteriorate, resulting in a more serious classification on the list of species at risk in Ontario, such as endangered or extirpated."

The recovery strategy can be described as an endorsement of the *status quo* and it is a further delay in taking tangible action. The strategy describes some pressures, but it fails to genuinely tackle threats to the species, such as forestry or climate change. It also fails to identify the habitat necessary for the survival of the species nor does it express the need for new protected areas as a conservation mechanism. It does not meet the basic needs of this species at risk to maximize its chance of survival. In general terms, it is what Livingston (1981) eloquently described as the "fallacy of wildlife conservation."

The Ministry of Natural Resources takes a hold-the-line approach, essentially deeming the strategy successful if the numbers of woodland caribou do not drop. It is unreasonable that the ministry's primary measure to "protect" this species at risk are forestry guidelines on how to progressively log its habitat (Ministry of Natural Resources, 2006b:27). The central point of a recovery strategy should be to actually recover the population in question, boosting its numbers to the point where it is no longer considered a species at risk. This paper argues that the recovery strategy sets unambitious, and arguably defeatist, objectives that creates a best-case scenario for forest-dwelling woodland caribou to remain as threatened species.

The recovery strategy states that conserving this threatened species "will be an extremely difficult, expensive and long-term initiative, at a spatial and temporal scale not previously required" (Ministry of Natural Resources (2006b:29). This assessment is accurate. However, this paper speculates that the recovery strategy's lack of effective measures to con-

serve woodland caribou appears to be influenced more by such economies, despite the ministry's assertion that recovery strategies are purely science-based (Environmental Commissioner of Ontario, 2007b).

The *Crown Forest Sustainability Act, 1994* legally binds the Ontario government to ensuring that the commercial harvesting of timber in publicly owned forests is sustainable. This law states in subsection 3(1) that "large, healthy, diverse and productive Crown forests and their associated ecological processes and biological diversity should be conserved." That is the vision and the ideal. Perhaps, the recovery of woodland caribou is the ultimate test of that vision. However, the failure to adequately protect this species should not occur due to the lack of a sincere and competent effort.

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References

ArborVitae Environmental Services. 2005. *Caribou Forest, Independent Forest Audit (April 1, 1999 – March 31, 2004)*. Queen's Printer, Toronto, Ontario. 158pp.

ArborVitae Environmental Services. 2006a. *English River Forest, Independent Forest Audit, April 1, 2000 – March 31, 2005*. Queen's Printer, Toronto, Ontario. 199pp.

ArborVitae Environmental Services. 2006b. *Ogoki Forest, Independent Forest Audit, April 1, 2000 – March 31, 2005*. Queen's Printer, Toronto, Ontario. 174pp.

Arbex Forest Resource Consultants Ltd. 2006. *Cochrane Moose River Management Unit, Independent Forest Audit, 2000-2005*. Queen's Printer, Toronto, Ontario. 191pp.

Auditor General of Ontario. 2007. *2007 Annual Report of the Office of the Auditor General of Ontario*. Queen's Printer, Toronto, Ontario. 494pp.

Bergerud, A.T., & Mercer, W. E. 1989. Caribou introductions in eastern North America. – *Wildlife Society Bulletin* 17: 111-120.

BioForest Technologies Inc. 2003. *An Independent Audit of Forest Management on the Nagagami Forest for the Period 1997 to 2002*. Queen's Printer, Toronto, Ontario. 145pp.

Boutin, S., C. Carlson, S. Elgie, J. Ouellet , K. Parker, J. Ray, J. Schaefer, F. Schmiegelow & J. Weaver. 2006. Canadian Boreal Institute/Wildlife Conservation Society Woodland Caribou Expert Workshop Summary. Unpubl. 5pp.

Brown, G. S., Mallory, F. F., & Rettie, W. J. 2003. Range size and seasonal movement for female woodland caribou in the boreal forest of northeastern Ontario. – *Rangifer* Special Issue No. 14: 227-233.

Callaghan and Associates Inc. 2001. *Caribou Forest, Independent Forest Audit (April 1, 1999 – March 31, 2004)*. Queen's Printer, Toronto, Ontario. 92pp.

Callaghan and Associates Inc. 2002. *An Independent Audit of Forest Management on the Lake Nipigon and Auden Forests for the Period 1996 to 2001*. Queen's Printer, Toronto, Ontario. 137pp.

Canadian Boreal Initiative. 2003. The Boreal Forest Conservation Framework. Unpubl. www.borealcanada.ca/framework_document_e.cfm

Canadian Council of Forest Ministers. 2006. *Criteria & Indicators of Sustainable Forest Management in Canada*. Natural Resources Canada, Canadian Forest Service, Ottawa, Ontario. 162pp.

Clark, T. 1994. Creating and using knowledge for species and ecosystem conservation: science, organizations, and policy. – *In*: E. R. Grumbine (ed.). *Environmental Policy and Biodiversity*. Island Press, Washington, pp. 335-364.

Commission for Environmental Cooperation of North America. 2006. *Factual Record. Ontario Logging Submission (SEM-02-001) & Ontario Logging II Submission (SEM-04-006). Prepared in Accordance with Article 15 of the North American Agreement on Environmental Cooperation*. Commission for Environmental Cooperation of North America, Montreal, Quebec. 272pp.

Cumming, H. G. 1992. Woodland caribou: facts for forest managers. – *Forestry Chronicle* 68: 481-491.

Cumming, H. G. & D. B. Beange. 1993. Survival of woodland caribou in commercial forests of northern Ontario. – *Forestry Chronicle* 69: 579-588.

Darby, W.R., Timmermann, H.R., Snider, J.B., Abraham, K.F., Stefanski, R.A., & C. A. Johnson. 1989. *Woodland caribou in Ontario. Background to a policy*. Queen's Printer, Toronto, Ontario.

Ehrlich, P. R. 2002 Human natures, nature conservation, and environmental ethics. – *Bioscience* 52: 31-43.

Environment Canada. 2007. *Woodland Caribou, Boreal Population Recovery Strategy - Justification for delayed posting (2007)*. Environment Canada, Ottawa, Ontario. 1 pg.

Environmental Commissioner of Ontario. 1997. *1997 Annual Report*. Queen's Printer, Toronto, Ontario. 100pp.

Environmental Commissioner of Ontario. 2002a. *Developing Sustainability. Environmental Commissioner of Ontario 2001-2002 Annual Report*. Queen's Printer, Toronto, Ontario. 191pp.

Environmental Commissioner of Ontario. 2002b. *Developing Sustainability. Environmental Commissioner of Ontario 2001-2002 Annual Report Supplement*. Queen's Printer, Toronto, Ontario. 320pp.

Environmental Commissioner of Ontario. 2002c. *Remarks. 2001/2002 Annual Report*. Unpublished. www.eco.on.ca/english/newsrel/02sep26c.pdf

Environmental Commissioner of Ontario. 2003. *Thinking Beyond the Near & Now. Environmental Commissioner of Ontario 2002-2003 Annual Report*. Queen's Printer, Toronto, Ontario. 220pp.

Environmental Commissioner of Ontario. 2004. *Choosing Our Legacy. Environmental Commissioner of Ontario 2003-2004 Annual Report*. Queen's Printer, Toronto, Ontario. 213pp.

Environmental Commissioner of Ontario. 2005. *Planning Our Landscape. Environmental Commissioner of Ontario 2004-2005 Annual Report*. Queen's Printer, Toronto, Ontario. 228pp.

Environmental Commissioner of Ontario. 2006. *Neglecting Our Obligations. Environmental Commissioner of Ontario 2005-2006 Annual Report*. Queen's Printer, Toronto, Ontario. 228pp.

Environmental Commissioner of Ontario. 2007a. *Doing Less with Less: How shortfalls in budget, staffing & in-house expertise are hampering the effectiveness of MOE & MNR. A Special Report to the Legislative Assembly of Ontario*. Queen's Printer, Toronto, Ontario. 83pp.

Environmental Commissioner of Ontario. 2007b. *Reconciling Our Priorities. Environmental Commissioner of Ontario 2006-2007 Annual Report*. Queen's Printer, Toronto, Ontario. 228pp.

Environmental Commissioner of Ontario. 2007c. *Reconciling Our Priorities. Supplement to the Environmental Commissioner of Ontario 2006-2007 Annual Report*. Queen's Printer, Toronto, Ontario. 319pp.

Fuller, T. K., Mech, L. D., & J. F. Cochrane. 2003. Wolf Population Dynamics. – *In*: L. D. Mech & L. Boitani (eds.). *Wolves: Behaviour, Ecology, and Conservation*. University of Chicago Press, Chicago, Illinois, pp. 161-191.

KBM Forestry Consultants Inc. 2005. *Independent Forest Audit, Kenora Forest, 1998-2003*. Queen's Printer, Toronto, Ontario. 131pp.

KBM Forestry Consultants Inc. 2006a. *Kenogami Forest, Independent Forest Audit, 2000-2005*. Queen's Printer, Toronto, Ontario. 132pp.

KBM Forestry Consultants Inc. 2006b. *Red Lake Forest, Independent Forest Audit Report, 2000-2005*. Queen's Printer, Toronto, Ontario. 102pp.

KBM Forestry Consultants Inc. 2006c. S*mooth Rock Falls Forest, Independent Forest Audit, 2000-2005*. Queen's Printer, Toronto, Ontario. 138pp.

KBM Forestry Consultants Inc. 2006d. *Wabigoon Forest, Independent Forest Audit, 2000-2005.* Queen's Printer, Toronto, Ontario. 106pp.

Livingston, J. A. 1981. *The Fallacy of Wildlife Conservation.* McClelland & Steward Inc., Toronto, Ontario. 117pp.

Mech, L. D. & P. O. Peterson. 2003. Wolf-Prey Dynamics. – *In*: L. D. Mech & L. Boitani (eds.). *Wolves: Behaviour, Ecology, and Conservation*. University of Chicago Press, Chicago, Illinois, pp. 131-160.

Minister of Natural Resources. 2007. *Hansard of the Legislative Assembly of Ontario. Official Records for May 16, 2007*. Queen's Printer, Toronto, Ontario.

Ministry of Natural Resources. 1988. *Timber Management Guidelines for the Provision of Moose Habitat*. Queen's Printer, Toronto, Ontario. 17pp.

Ministry of Natural Resources. 2001a. *Northern Boreal Initiative. A Land Use Planning Approach*. Queen's Printer, Toronto, Ontario. 15pp.

Ministry of Natural Resources. 2001b. *Forest Management Guidelines for the Conservation of Woodland Caribou: A Landscape Approach*. Ministry of Natural Resources, Thunder Bay, Ontario. 70pp.

Ministry of Natural Resources. 2002. *Forest Management Guide for Natural Disturbance Pattern Emulation*. Ministry of Natural Resources, Thunder Bay, Ontario. 18pp.

Ministry of Natural Resources. 2004. *Backgrounder on Wolf Conservation in Ontario.* Queen's Printer, Toronto, Ontario. 56pp.

Ministry of Natural Resources. 2006a. *Draft Recovery Strategy for Forest-dwelling Woodland Caribou (*Rangifer tarandus caribou*) in Ontario*. Environmental Bill of Rights Registry Number: XB06E6016. Unpubl. www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=Mjc5MTQ=&statusId=Mjc5MTQ=&language=en

Ministry of Natural Resources. 2006b. *Draft Recovery Strategy for Forest-dwelling Woodland Caribou (*Rangifer tarandus caribou*) in Ontario*. Species at Risk Unit, Biodiversity Section, Fish & Wildlife Branch, Ministry of Natural Resources, Peterborough, Ontario. 70pp.

Ministry of Natural Resources. 2006c. *Species at Risk in Ontario List. June 30, 2006.* Queen's Printer, Toronto, Ontario. 9pp.

Ministry of Natural Resources. 2006c. *2006 Hunting Regulations*. Queen's Printer, Toronto, Ontario. 85pp.

Ministry of Natural Resources. 2007a. *Forest-Dwelling Woodland Caribou: CNFER Research Workshop Report.* Queen's Printer, Toronto, Ontario. 37pp.

Ministry of Natural Resources. 2007b. *Province to Review Moose Program. Engaging The Public To Ensure A Sustainable Moose Population.* Queen's Printer, Toronto, Ontario. 1 pg.

National Recovery Working Group. 2005. *Recovery Guidance Handbook*. Environment Canada, Ottawa, Ontario. 93pp.

Perara. A. M. & D. J. B. Baldwin. 2000. Spatial patterns in the managed forest landscape of Ontario. – *In*: A. H. Perara, D. L. Euler & I. D. Thomson (eds.). *Ecological of a Managed Terrestrial Landscape*. University of British Colombia Press, Vancouver, British Colombia, pp. 74-99.

Peterson, R. O. & P. Ciucci. 2003. The Wolf as a Carnivore. – *In*: L. D. Mech & L. Boitani (eds,), *Wolves: Behaviour, Ecology, and Conservation*. University of Chicago Press, Chicago, Illinois, pp. 104-130.

Pikangikum First Nation and Ministry of Natural Resources. 2006. *Community-based Land Use Strategy for the Whitefeather Forest and Adjacent Areas*. Queen's Printer, Toronto, Ontario. 108pp.

Rettie, W. J., & Messier, F. 2001. Range use and movement rates of woodland caribou in Saskatchewan. – *Canadian Journal of Zoology* 79: 1933-1940.

Schaefer, J. 2003. Long-term range recession and the persistence of caribou in the taiga. – *Conservation Biology* 17 (5):1435-1439.

Schaefer, J. A., & S. P. Mahoney. 2003. Spatial and temporal scaling of population density and animal movement: a power law approach. – *Ecoscience* 10: 496-501.

Senate Subcommittee on the Boreal Forest. 1999. *Competing Realities: The Boreal Forest at Risk. Report of the Sub-Committee on the Boreal Forest of the Standing Senate Committee on Agriculture & Forestry*. Government of Canada, Ottawa, Ontario.

Sierra Legal Defence Fund. 2003. *A Guide to Canada's Species at Risk Act*. Sierra Legal Defence Fund, Toronto, Ontario. 63pp.

Stewart, R. B., E. Wheaton, & D. L. Spittlehouse. 1998. Climate change: implications for the Boreal forest. – *In*: Legge, A.H. & L. L. Jones (eds.). *Emerging Air Issues for the 21st Century: The Need for Multidisciplinary Mangement, Proceedings of a Speciality Conference*, Sep. 22-24, 1997, Calgary, Alberta. Air and Waste Management Assoc., Pittsburg, Pennsylvania, pp. 86-101.

Thomas, D. C., & Gray, D. R. 2002. Update COSEWIC status report on the woodland caribou (*Rangifer tarandus caribou*) in Canada. – *In*: *COSEWIC assessment and update status report on the woodland caribou (*Rangifer tarandus caribou*) in Canada*. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. 98pp.

Vors, L. S. 2006. *Woodland Caribou Extirpation and Anthropogenic Landscape Disturbance in Ontario*. Master of Science dissertation. Watershed Ecosystems Graduate Program Trent University, Peterborough, Ontario, Canada. 146pp.

Vors, L. S., J. A. Schaefer, B. A. Pond, A. R. Rodgers, & B. R. Patterson. 2007. Woodland Caribou Extirpation and Anthropogenic Landscape Disturbance in Ontario. – *Journal of Wildlife Management* 71 (4): 1249–1256.

Weirsma, Y. F. & T. D. Nudds. 2006. "Conservation targets for viable species assemblages in Canada: are percentage targets appropriate?" – *Biodiversity and Conservation* 15 (14): 4555-4567.

Wildlands League. 2006. Wildlands League's submission on "Recovery Strategy for Forestdwelling Woodland Caribou (*Rangifer tarandus caribou*) in Ontario (draft February 3, 2005). Unpubl.

Wilkinson, C. J. A & P. F. J. Eagles. 2001. Strengthening the Conservation of Biodiversity: Reforming Ontario's Provincial Parks Act. – *Natural Areas Journal* 21 (4): 330-336.

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Planlegging for bevaring av skogsøkotypen av *Rangifer tarandus caribou* i Ontario, Canada

Abstract in Norwegian / Sammendrag: Skogsvillreinen av skogsøkotypen i Ontario er vurdert som sårbar både føderalt og på provinsnivå. Av provinsens rundt 20 000 skogsvillrein hører omtrent en fjerdepart til den stasjonære skogsboende skogsøkoypen. Artikkelen ser på bevaringsstrategien som er utarbeidet av naturressursdepartementet i Ontario for denne spesielle bestanden og diskuterer konsekvensene for villreinen av provinsens skogpolitikk. Kommersiell hogst vil mest sannsynlig og snart bli tillatt i deler av Ontarios nordlige tredel der skogvillreinens leveområder er relativt upåvirket av industriell virksomhet.