Recovery Strategy for the Woodland Caribou *(Rangifer tarandus caribou),* Boreal Population, in Canada – Proposed August 2011

Submission to Environment Canada and the SARA Public Registry

From: The Scientific Advisors to the Boreal Caribou Science Management Committee, Environment Canada, Wildlife and Landscape Science Division

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As scientists and advisors to the *Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou, Boreal Population, in Canada* (2011), and the earlier *Scientific Review for the Identification of Critical Habitat for Woodland Caribou, Boreal Population* (2008), we feel our collective experience places us in a unique position to comment on the proposed Recovery Strategy for the Woodland Caribou, Boreal Population (herein Recovery Strategy or RS). In particular, we are able to provide detailed comments on the translation of the science embodied by the above work into the Recovery Strategy, and to advise on the likely outcomes of the measures outlined in the RS with respect to achieving the stated recovery goal of maintaining or recovering self-sustaining local populations of boreal caribou throughout their distribution in Canada. We offer these comments as an expression of our continued willingness to contribute to the development of scientifically-grounded approaches to the conservation and recovery of this species. We are encouraged by the release of the Recovery Strategy, and commend Environment Canada for their efforts to compile this document. This marks an important step in the provisions afforded this species under the Canadian Species at Risk Act, and represents a key component of the federal commitment under the National Accord for Species at Risk.

Overview

Overall, we are pleased to see obvious efforts to incorporate aspects of the science work with which we were involved into the RS. We do, however, feel that options within the RS are unnecessarily constrained, and the likelihood of successful recovery (that is, achieving the stated recovery goal) is compromised by either inappropriate or incomplete application of the underlying science in some key places in the RS, and by failure to explicitly recognize and address uncertainties. Both the 2008 Scientific Review and 2011 Scientific Assessment were based on best available knowledge, using conceptual and analytical frameworks to support decision-analysis and adaptive management. Assessment of the ability of ranges to support self-sustaining caribou populations (the interpretation of the recovery goal in relation to critical habitat) and explorations of disturbance thresholds acknowledged uncertainties arising from (a) the availability and quality of information about current conditions, (b) variation in observed responses to existing stressors, as well as future response to additional and often interacting stressors, and (c) stochastic processes characteristic of the natural systems occupied by boreal caribou that are inherent to their population dynamics. Addressing uncertainty was an essential component of both processes. Resultant population assignments are expressed not in absolute terms, but as probabilistic likelihoods, and were intended to be interpreted that way. This approach was designed to enable subsequent stages of recovery and action planning (decision analysis), and implementation of recovery actions (adaptive management), through the effective use of the science to improve certainty in the management strategies necessary to achieve desired conservation and recovery outcomes. This potential is not realized in the proposed RS, but it could be. Many of our concerns as outlined below arise from this unrealized use of robust, scientifically-grounded approaches for improving certainty in the RS.

Rather than providing detailed editorial comments on the proposed Recovery Strategy, we focus primarily on broader issues concerned with the interpretation of the science and associated recommendations from the 2008 Scientific Review and 2011 Scientific Assessment, and the application of this work to an evaluation of the provisions in the RS for achieving caribou recovery. In particular, we focus on scientific considerations and concerns associated with the population and distribution objectives (Section 5) and identification of critical habitat (Section 6). We consider Sections 1-4 of the RS to be comprised principally of background information, and comment on the material in these sections only as it relates to issues arising in subsequent sections, including the appendices.

Section 5. Population and Distribution Objectives

The recovery goal of achieving self-sustaining local populations throughout their distribution in Canada was fundamental in framing the scientific review and assessment to support critical habitat identification. The RS confirms this as the *long-term* goal, but presents variable population and distribution objectives for different categories of local populations. These categories become *de facto* units for assigning conservation priority and identifying critical habitat, and thus play an essential role in the RS. We have three major scientific concerns with these categories:

1) The self-sustaining (SS) and not self-sustaining (NSS) local population (LP) designations, which form the basis for the categories, are treated as fixed qualities rather than as likelihood statements. The NSS/SS LP’s, with which the greatest uncertainty is associated, are grouped with NSS.

2) Representation and connectivity are used as criteria for prioritization of NSS LP’s, with no methodological elaboration, yet 28 LP’s are identified as “not essential” for achieving associated distribution objectives (hereafter referred to as the grey populations).

3) The population objectives assigned to the grey populations are not based on the underlying science, do not respect the ecology of the species, and imply certainty in population information that is unwarranted.

Self-sustaining / Not Self-Sustaining Designations

A wide range of habitat and population conditions, and availability of information, contributed to the likelihood statements associated with the SS and NSS assessments for each LP, and served as important context in the interpretation of the assignments (summarized in Table 11 of the 2011 Scientific Assessment). Although Figure 3 in the RS recognizes the probabilistic nature of these assessments, text throughout the RS presents them as deterministic or known conditions of each LP, and the groups are treated as relatively homogenous for recovery planning (with the essential/non-essential distinction elaborated below). The associated lack of context to the population designations is illustrated by the treatment of NSS/SS local populations.

In the 2011 Scientific Assessment, 7 LP's were identified as being "as likely as not" to be self-sustaining, based on habitat and population criteria applied in the integrated risk assessment. While the NSS/SS category is identified in Section 5 (see Figure 3) of the RS in (p.15), these LP's dissolve into NSS. A footnote to 5.1.2 later indicates they were counted as NSS in the recovery strategy; no justification is provided. There were a variety of ecological and range-specific reasons for the NSS/SS population assignments (see "*Notes on interpretation*", Table 11 of the Scientific Assessment), and it is inappropriate to simply lump them with NSS (which itself should not be treated as a homogenous group, as earlier noted), particularly given the implications of this decision for subsequent recovery planning. Most become part of the grey population grouping, and are either functionally discounted with respect to conservation value (see comments here and under Section 7), or assigned potentially unrealistic population targets in conjunction with allowable reductions in the quantity and quality of remaining habitat. As an example of these pitfalls, we consider the case of the North Interlake population in Manitoba.

Current disturbance on the range of the North Interlake population is low (17% total), but the small population size (est. 50-75 animals), in conjunction with a reported stable state in the absence of an estimated lambda, resulted in a NSS/SS assignment. Under the proposed strategy, this population is a) considered not self-sustaining, b) identified as non-essential for representation and connectivity (see below), and c) placed in the grey category. Due to the estimated small population size, a requirement to increase the population to at least 100 or more animals with a stable or increasing trend is stipulated (Section 5, p.17), while Section 7 (p. 29) allows for reduction of the amount of undisturbed habitat to 65% (from the present value of 83%). The North Interlake LP is a small, isolated population adjacent to populations with a high likelihood, at present, of being self-sustaining. Thus while North Interlake LP *may not* be essential for connectivity across the distribution of boreal caribou in Canada (the issue of connectivity assignment is addressed below), its conservation may be dependent on connectivity with adjacent areas.

The Scientific Assessment identifies additional factors that should be considered to increase certainty in the NSS/SS assessment for the North Interlake population and others. However, range-specific considerations are not incorporated into the RS here or elsewhere, nor are there specific provisions to improve the knowledge base through structured application of a variety of recovery measures related to these considerations, and associated monitoring of population responses over appropriate time periods. This is a lost opportunity that could result in both expensive and unnecessary measures, and reduced conservation outcomes relative to the stated objective.

Representation and Connectivity Assignments

There are repeated references throughout the RS to the importance of maintaining representative, replicated and resilient populations of caribou across the range of ecological conditions that exists within their distribution in Canada. Maintenance or restoration of connectivity between populations is also identified as important for the conservation of the species. These are scientifically-grounded conservation principles with both theoretical and empirical support.

The RS identifies three categories of populations (green, blue and grey; Figure 4) that are assigned different population and distribution objectives, and varying priority for recovery, for the first 50 years of the recovery process. There is no reference to the significance of the 17 presumed self-sustaining (green) LP's to representation or connectivity, but the 40 populations labeled NSS are further subdivided into 12 LP's (blue) deemed necessary to maintain connectivity and represent ecological conditions across the current distribution, and thus prioritized for recovery to self-sustaining levels, and 27 LP's (grey) identified as not essential for connectivity and representation of ecological conditions across the distribution of the species, for which stabilization, rather than recovery to self-sustaining, is the objective.

We are aware of no scientific studies to support the "non-essential" population status; none is presented in the RS, and there were no analyses or discussions of this status category conducted as part of the Scientific Review or Assessment. To the contrary, scientific evaluations indicate that some of the grey populations in Quebec (#51, #50; Boulet et al. 2007) and in Alberta (#14, #16, #17; Weckworth et al. in review) classified as not essential for connectivity in the RS are actually connected to adjacent blue herds that are considered essential (#53 in Quebec, #13 in Alberta). The term 'connectivity' has specific scientific meanings, which are unspecified in the RS. Usage of the term with respect to prioritization of populations for recovery in the RS implies that an objective evaluation was undertaken, which does not appear to be the case.

Similarly, the assessment of ecological representation is unsubstantiated. Various ecological criteria, at many different scales, could be evaluated. For illustrative purposes, we examine the representation of broad ecological strata based on the National Ecological Framework for Canada (the ELC). Figure 1 illustrates the proportional representation of ecozones (the coarsest strata) based on historic, current and revised distribution, where the revised distribution excludes all "non-essential" (grey) populations.

Historic range contraction has contributed to a total loss in representation of boreal caribou in several ecozones across Canada. Further loss of representation at this very coarse scale occurs with exclusion of the grey populations – note the substantial reduction in the extent of boreal plains to 13% of the historic occupancy, which included nearly 100% of the ecozone (the current distribution covers 41%). At the next strata in the nested hierarchy of the ELC, this translates into total loss of representation of the boreal foothills ecoprovince, which comprised ~ 120,000 km^2 of the historic distribution, and ~32,000 km^2 of the current distribution (analyses available on request). One can anticipate additional loss of ecological representation at the next more detailed level of ecoregions, a unit commonly employed in representation analyses. Further erosion of the distribution (i.e. range contraction) is also likely, given the lower recovery requirements for "non-essential" LP's (discussed below). Figure 2 illustrates the spatial pattern of changes in representation and distribution described above. Based on this analysis, we are concerned that the provisions in the RS are unlikely to meet the stated objective of maintaining representative populations of caribou across the full range of ecological conditions that exists within their distribution in Canada.

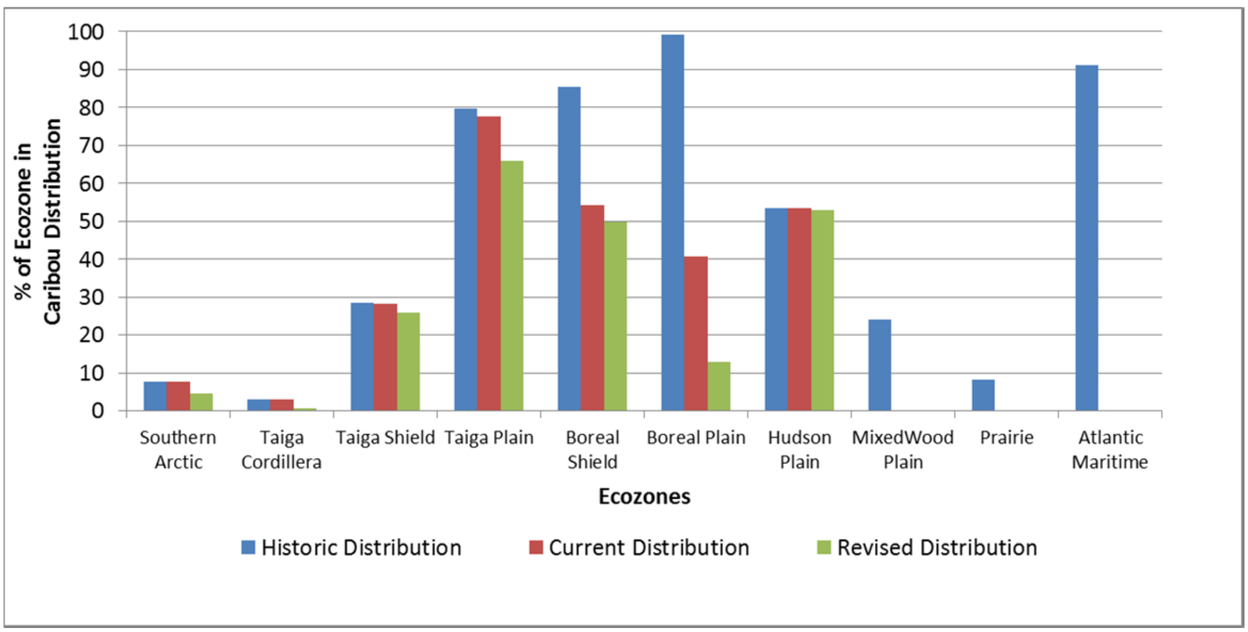

Figure 1. Proportional representation of ecozones across the distribution of boreal caribou in Canada, under historic, current and projected (revised) conditions, based on the National Ecological Framework.

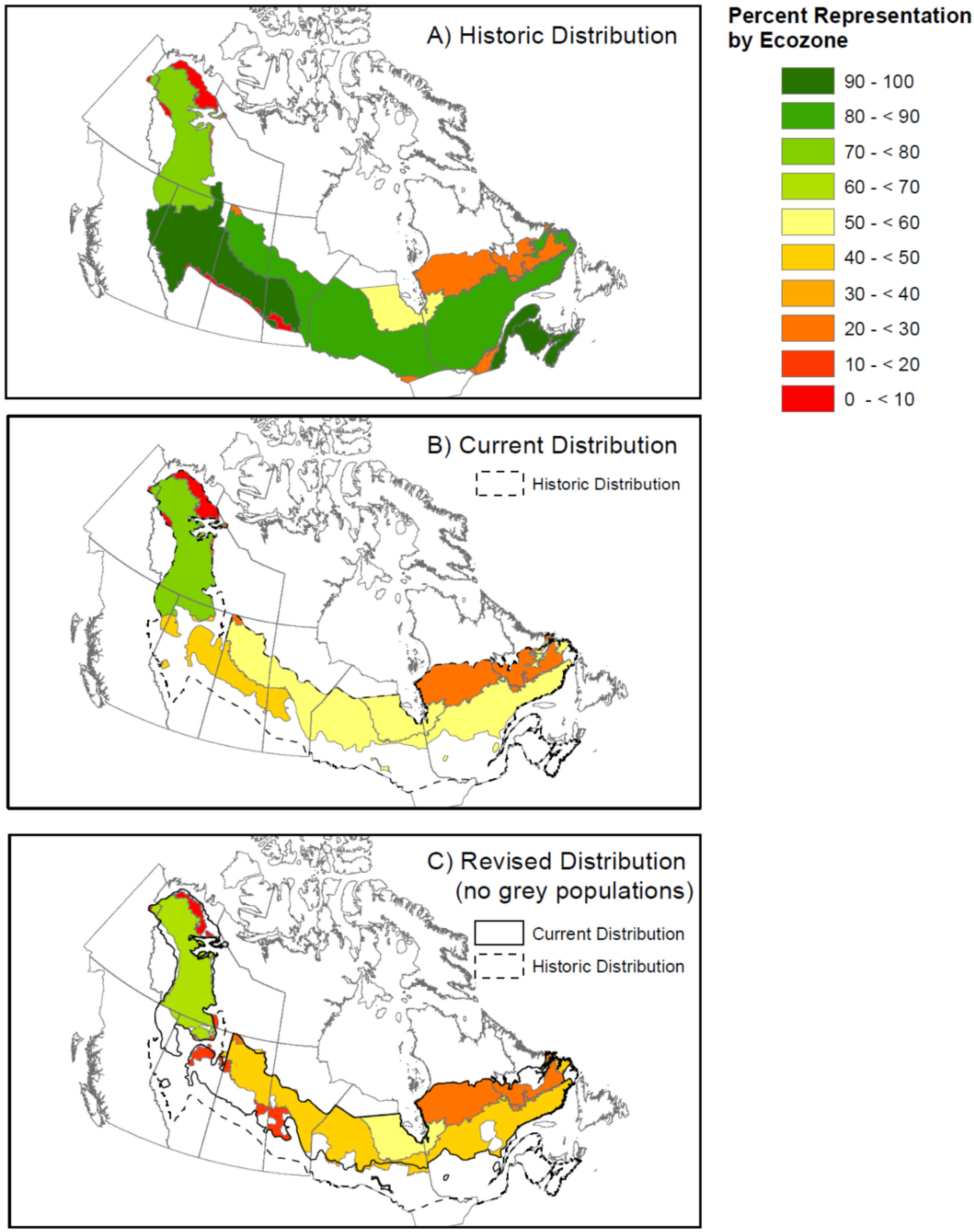

Figure 2. Changes in ecological representation (percent) and population distribution of boreal caribou in Canada under historic, current and potential (revised) conditions, as per the proposed Recovery Strategy.

Population Objectives for Grey LP's

Having deemed the grey populations non-essential based on unspecified connectivity and representation criteria, a lower bar appears to be set for their recovery with respect to both population objectives and identification of critical habitat (Section 7; addressed subsequently). There is no scientific basis for this determination, or for reduced requirements for the recovery of these 28 LP's, and it is misleading to suggest this. Further, to require that estimated current population sizes become a fixed target for stabilization "(*e.g. the population size for local population #24 – Smoothstone-Wapawekka in Saskatchewan will not be permitted to drop below the reported size estimate of 700 animals*)", is contrary to our understanding of natural population dynamics, and suggests a level of certainty in population estimates that is unwarranted. In the absence of habitat protection measures, achieving this target may require extensive population management of multiple species. This is a prime example of where the available science has not been properly used to support the recovery process, and where recognition of uncertainty and application of decision analysis and adaptive management could advance the state of knowledge and lead to more informed decisions.

There are many criteria that could be used to prioritize action in caribou recovery in the face of limited resources. While the RS may present information on criteria such as connectivity and representation, it should not use that information as a basis for revising the objectives, given that there is no evidence that recovery of local populations is not biologically and technically feasible. Rather, this information should be used to evaluate the consequences and risks to caribou conservation associated with different management strategies, and to identify key uncertainties that prevent choosing between policy options, in order to inform priorities at the action planning stage. The role of the RS under SARA is to provide a scientifically defensible ecological baseline for policy decisions that occur later in action planning. Clear distinction of scientifically-grounded assessments of the ecological requirements for species recovery separate from socio-economic considerations is necessary to ensure transparency in the decision-making process. The spatial coincidence of 28 "*non-essential*" LP's with areas of high economic value suggests these factors may have been confounded in the proposed RS.

Section 6. Broad Strategies and General Approaches to Meet Objectives

We note one reference to adaptive management in this section (Table 4, p.16, under Landscape Level Planning). However, an adaptive management framework could act as a scientifically defensible platform for the entire section. The general framework could be established under 6.2, *Strategic Direction for Recovery*, and all threats and limitations, as well as research and management approaches identified in Table 4 (the Recovery Planning Table) could then be integrated using a science-based approach. The desired transparency in decision-analysis and policy response under SARA would thus be 'hard-wired' into the recovery strategy, as well as subsequent processes of action planning and implementation. This sets the stage for broad engagement in recovery efforts by establishing the parameters and direction for moving ahead regionally, with a set of tools to help facilitate that process.

Section 6.3, *Narrative to Support the Recovery Planning Table*, identifies many important considerations and caveats, but in the absence of the integrative framework suggested above, there is no clear pathway for incorporating these into the decision-making process. We think this is a serious yet avoidable limitation, given that these considerations could and should inform range-specific population and habitat recovery planning.

Section 7. Critical Habitat

A fundamental concept in both the Scientific Review and Scientific Assessment was that the appropriate scale at which to identify the habitat necessary for the survival and recovery of boreal caribou (the SARA expression of critical habitat) was the local population range. Habitat conditions at the scale of local population ranges affect the demography of boreal caribou, which ultimately determines whether or not the population is self-sustaining over time. Critical habitat for boreal caribou is therefore defined by a suite of habitat conditions (quantity, quality and spatial configuration) across the local population range that achieves a desired demographic outcome. These conditions are attributes of critical habitat, but in isolation, do not equal critical habitat.

The *description* of critical habitat in the RS is generally consistent with this definition, but the *identification* of critical habitat distorts the concept by reducing identification to a fixed amount of undisturbed habitat within the range, based on a management threshold. Where the amount of undisturbed habitat falls below the specified threshold, critical habitat identification becomes further restricted to the remaining undisturbed habitat. This is clearly not consistent with the range-level definition adopted by the Scientific Review and Assessment, nor does it meet the requirement under SARA to identify the habitat necessary for the survival and recovery of the species. A habitat-based disturbance threshold may be considered an attribute of critical habitat, and the resultant amount of undisturbed habitat a component, but conditions across the full range must be considered to maintain critical habitat.

From the perspective of recovery planning and use of management thresholds, maintenance of critical habitat may be supported by managing disturbances to within acceptable thresholds at the level of entire caribou ranges, and as a means of understanding whether or not CH has been destroyed, rather than applying them to the identification of undisturbed areas within ranges. This alternative application is consistent with the structure of the analyses conducted to support this process, whereas the current application in the RS is not.

We have a number of additional concerns related to the translation of the science into critical habitat (CH) identification, and application of resultant CH methodology to the green, blue and grey population categories. These include:

1) Application of a fixed disturbance threshold.
2) Provisions to reduce the amount of undisturbed habitat in ranges below the management threshold.
3) Problems with discrete management thresholds
4) Subdivision of caribou ranges into two categories of habitat, associated treatment of buffers on disturbances, and definition of habitat destruction.

Application of a fixed disturbance threshold

The RS identifies "*65% undisturbed habitat in a range as the threshold which provides a measurable probability (60%) for a local population to be self-sustaining*" (7.1.2, p. 25). While Appendix E identifies the selection of a particular management threshold as an expression of tolerance for risk (i.e. a policy choice), the wording in the main body of the RS suggests a more objective basis for selecting the threshold than the Scientific Review elaborated or discussed.

Having selected a threshold, the application in the RS then exemplifies many of the problems associated with application of management thresholds. In particular, the maximum level of disturbance (or in this case, minimum amount of undisturbed habitat) - the threshold - becomes the target to be met, rather than indicating a level of risk in achieving the recovery goal. Identification of CH in the RS uses the amount of undisturbed habitat as a hard line for assigning management strategies. As earlier elaborated under *Population and Distribution Objectives*, such deterministic application does not accurately reflect or make effective use of the science, implies unwarranted certainty in outcomes, and is not respectful of variability in the underlying relationships attributable to range-level idiosyncrasies (i.e. does not consider context), with a net result that management options are unnecessarily constrained. Again, recognition of some of these issues, and more appropriately nuanced application of thresholds is described in Appendix E, but there is no reference to this in the main body of the RS.

The resultant approach to identification of CH in the RS, which is described relative to population categories, and applied to local populations in Annex F, becomes therefore constrained to meeting a fixed threshold of 65% undisturbed habitat for all green and blue populations, as well as grey populations with 65% or more undisturbed habitat at present (7.2, p. 28-29). Our estimates, based on a literal interpretation of probable outcomes from this approach, under full implementation of the thresholds and associated provisions in the RS, is illustrated in Figure 3.

Overall, the likelihoods for the 17 LP's that are currently likely or very likely to be self-sustaining show reduced chances of maintaining that status (mean population probability drops from 0.75 to 0.60); the likelihoods for the 12 LP's prioritized for recovery show improvements (mean population probability increases from 0.25 to 0.60); and the 28 'non-essential' populations either stay at the same level of likelihood (mean probability of 0.35) or show reduced chances of being self-sustaining (mean probability of 0.20), if habitat conditions are allowed to decline.

Rather than using disturbance thresholds as a means to limit the amount of undisturbed habitat to be maintained within a population range, the methodology can be used to support a more flexible, scientifically-grounded application that treats disturbance thresholds as an attribute of critical habitat, and is used to inform range-level management to achieve specific habitat and population objectives. Such an approach acknowledges the uncertainty associated with understanding the maximum disturbance that a population can tolerate, and allows for the incorporation of range-specific information on population status and other measures of habitat condition. It also invites innovation in management to advance understanding through implementation of range-specific plans that include ongoing monitoring and revision in light of new knowledge.

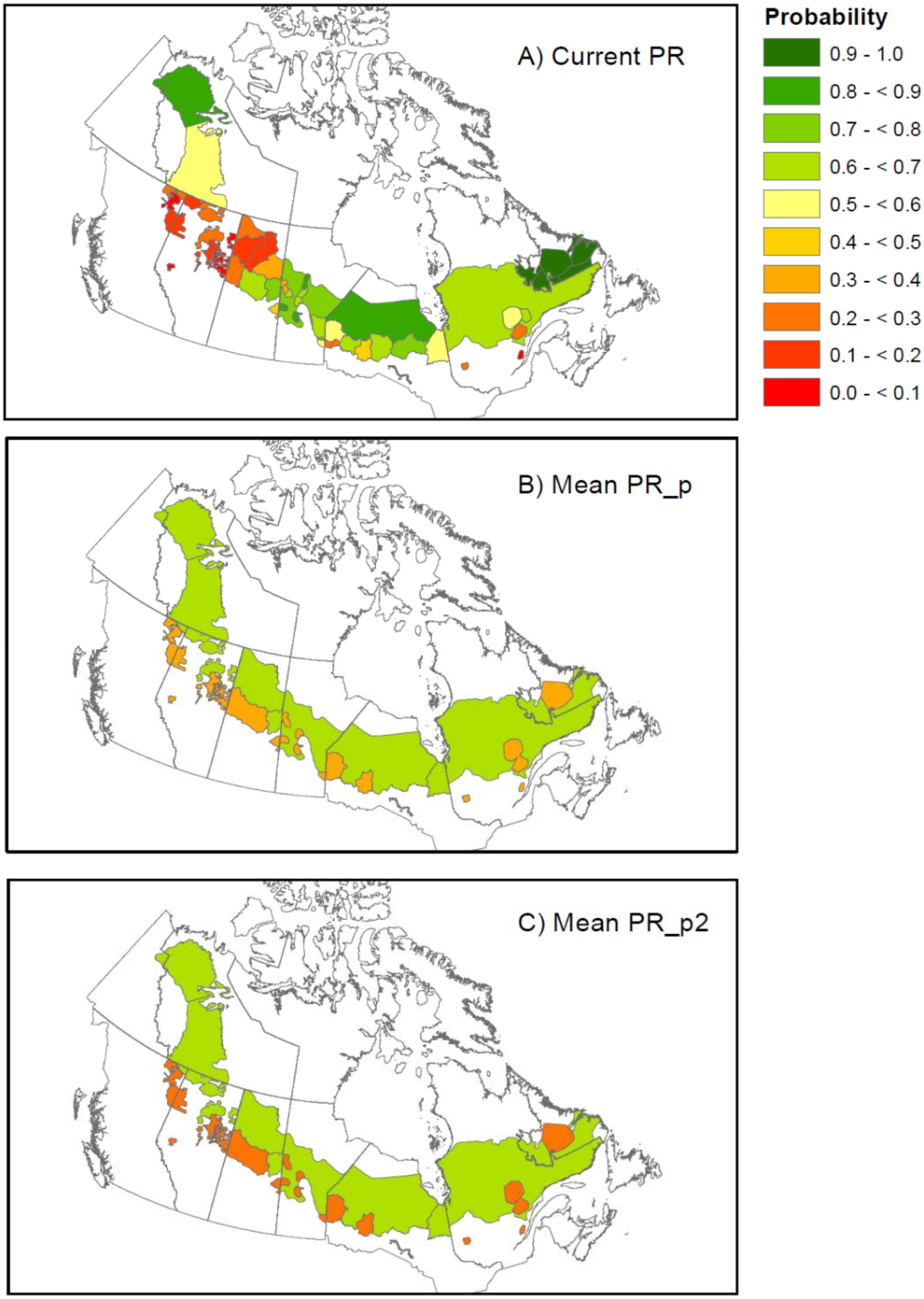

Figure 3. Mean probability of range conditions supporting a self-sustaining population based on the RS categories of green, blue and grey, at present (A), subsequent to implementation of management thresholds (B), and with allowable reductions in habitat conditions of grey populations (C).

Reduction in the amount of undisturbed habitat in ranges below the management threshold

Further illustration of the improper application of disturbance thresholds to restrict CH identification is offered by considering the 28 'non-essential' grey populations with existing undisturbed habitat more than 5% and less than 65% (22 in total). For such populations, CH is initially identified as the remaining undisturbed habitat. However, the RS provides for a reduction in this amount (theoretically to as low as 5%), if the jurisdictions provide a plan that will support stabilized local populations through use of tools for mortality management and habitat protection and/or restoration. No scientific rationale is provided for the reduced identification of CH for these 22 LP's. We are not aware of any evidence that 5% undisturbed habitat is a meaningful threshold for persistence. In any case, only one population, the Little Smoky, has 5% or less undisturbed habitat. As a result, these numbers seem ad hoc.

The provision for reduced CH would ostensibly permit reductions below thresholds in these areas, subject to an approved plan. However, evidence of prior population stabilization is neither specified nor required (just a plan to support this), and there is no requirement for the use of both mortality management and habitat protection at the same time. The RS should explicitly acknowledge that the best available science recognizes that predator control is not a long-term recovery strategy for any ungulate population, caribou included (Orians et al. 1997; Hayes et al. 2005). Thus, in these circumstances, we anticipate that long-term recovery of self-sustaining populations would require both active habitat protection and restoration measures in combination with short-term predator control. To propose otherwise indicates acceptance of diminished probabilities of recovery success for caribou.

The area encompassed by the population ranges of the 22 LP's to which the provision for reduced CH with predator control applies is approximately 240,000 km^2, or nearly 10% of the current distribution of boreal caribou (Figure 4). Studies indicate that at least 80% of the predator population must be removed on an ongoing basis to elicit a positive population response from caribou (Hayes et al. 2005). Beyond technical and societal considerations related to implementing predator control as a sole recovery measure over these population ranges, there is increasing evidence that widespread removal of wolves, a top predator in these systems, can alter ecosystem processes and create trophic cascades that result in long-term ecosystem degradation through both direct and indirect effects (Hebblewhite et al. 2005; Estes et al. 2011). These unintended and undesirable consequences represent additive risks of management strategies that rely on long-term predator control as a primary recovery measure.

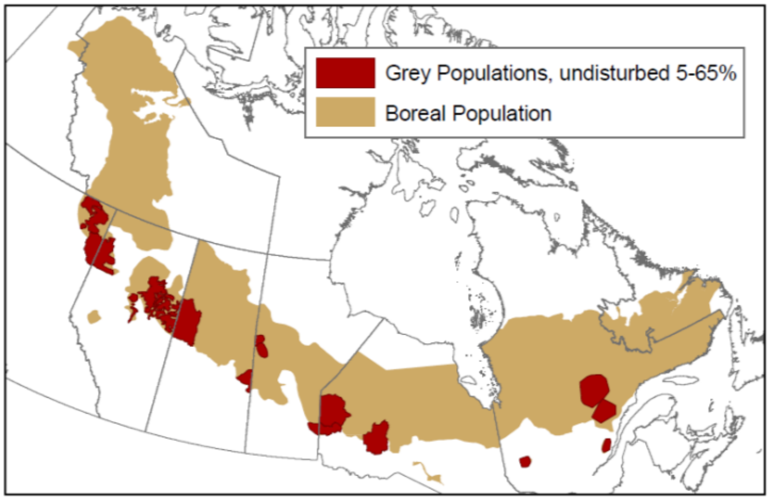

Figure 4. Theoretical extent of local populations to which predator control could be applied in the absence of habitat conservation measures.

Problems with discrete management thresholds

Two thresholds are used in the RS with respect to CH identification, and these have profound effects on the trajectory to which LP's are assigned, particularly in the case of the grey populations. At face value suggesting that 34% disturbance will result in a quantifiably different outcome than 36% disturbance, all else being equal (i.e. just above and just below 65% undisturbed habitat) as is implied by the methodology in the RS, once again does not make appropriate and effective use of the science, and results in populations receiving radically and apparently arbitrarily different treatments with respect to recovery planning. Similarly, the 5% cut-off for undisturbed area within a range has significant implications for recovery.

For the special case of caribou herds with ≤ 5% of their range undisturbed, such as the Little Smoky in Alberta (at 5% undisturbed), the RS defines CH as the existing habitat, where habitat is the area within the local population range that excludes fire disturbance within the last 40 years and unbuffered anthropogenic disturbance. For the Little Smoky LP, CH is identified as 264, 779 ha out of a total range size of 308,606 ha, or 85% of the total range of the Little Smoky herd (Appendix 3, Page 16). However, were the Little Smoky 94% disturbed and 6% undisturbed, critical habitat under the definition for grey herds from 5-65% undisturbed would be 6% - the remaining undisturbed habitat. This clearly nonsensical result illustrates another major problem with discrete management thresholds - what to do when, with active habitat recovery, the ranges for these severely at risk herds improve from say, < 5% to > 5% in undisturbed habitat. Would CH then revert from 85% habitat back to the > 5% threshold for undisturbed habitat? The process by which herds move from one classification to another, as habitat recovers or is disturbed, needs to be clarified in the RS. Further, as this simple example illustrates, we suggest that more thought needs to be given to the identification of critical habitat for LP's with 5-65% undisturbed habitat that is consistent with the principle of setting a recovery target that facilitates recovery.

Buffering, subdivision of ranges into two categories of habitat and habitat destruction

The buffering applied in analyses undertaken as part of the Science Review and Assessment is incorrectly conceptualized and applied in the RS. Buffers as defined and applied in the work described in the Science Review and Assessment did not reflect avoidance, but rather captured landscape-level effects of multiple, interacting stressors (cumulative effects) on caribou demographic response. Areas within the 500 m should not be indiscriminately assigned to low quality habitat and dismissed from further consideration, particularly in ranges with high levels of disturbance, where the interstitial spaces between anthropogenic disturbances may be crucial to continued occupation of the range. Application of buffers to divide caribou ranges into two categories of habitat discounts the value of areas within buffers to the extent that they receive negligible conservation attention in the RS. It also limits, for the most part, identification of critical habitat to the undisturbed portions of the range, which under the current definition in the RS, can result in highly fragmented pieces of land being identified as the habitat necessary for survival and recovery. To suggest that at some level of risk, all unbuffered area is critical habitat, regardless of its size, composition, structure or location, and the buffered area is not, confuses the issue of scale when applying the scientific findings, and unnecessarily constrains recovery options, and the likelihood of achieving the recovery goal of self-sustaining populations.

The series of images depicted in Figure 5 provide a graphic illustration of the potential pitfalls encountered when applying buffers, and subsequently treating disturbed and undisturbed areas as having fundamentally different values, regardless of other considerations.

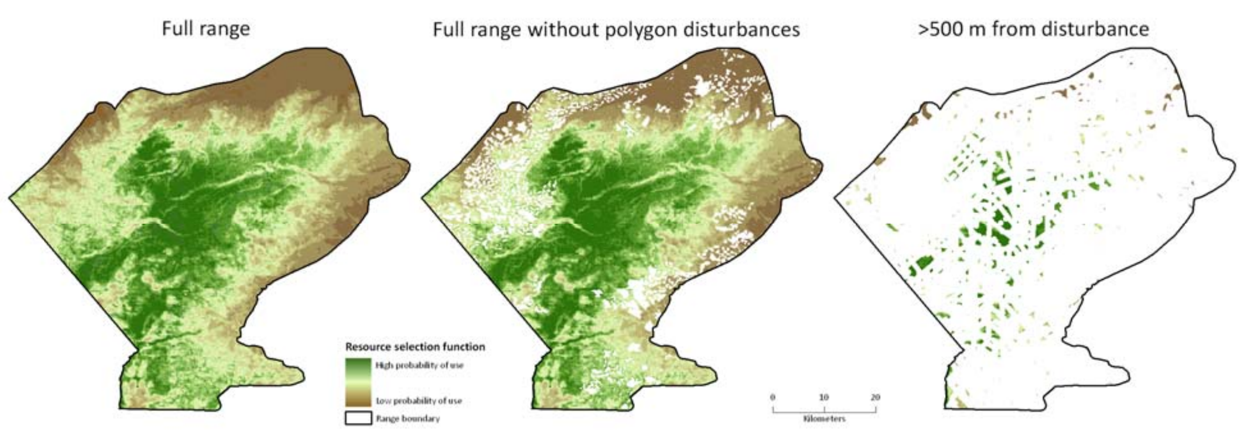

Figure 5. The distribution of the relative probability of caribou use across the Little Smoky Range in Alberta, using a resource selection function parameterized with caribou location data, and depicted relative to different representations of disturbance.

Caribou occur throughout the Little Smoky range, but habitat use is concentrated in central portions of the range (areas of high relative use appear in green). The resource selection function that predicts use accounts for polygonal and linear features within the range, although they are not depicted in the left hand panel. The centre panel showing only polygonal disturbances (principally cutblocks and well sites) is included as reference for the right hand panel, which shows only those areas outside the 500 m buffer applied to all anthropogenic disturbances. This demonstrates the implications for identification of critical habitat in ranges with high disturbance, under the definition in the draft RS. Our interpretation is that linear disturbances have a disproportionate influence on critical habitat identification, as defined in the RS, through the exclusion of buffered areas.

8. Measuring Progress

"*The ultimate performance indicator of boreal caribou recovery is self-sustaining local populations of boreal caribou found throughout the entirety of their distribution in Canada. Performance indicators for this recovery strategy are that each of the population and distribution objectives are met and boreal caribou as a species become less at risk*." (Section 8, p. 32)

At present, across the distribution of boreal caribou in Canada, the mean probability of a range supporting a self-sustaining local population is 0.46. Under the provisions of the RS, and assuming full implementation over a 50-year period consistent with the population and habitat objectives, we estimate the mean probability will be 0.47. If additional habitat deterioration is permitted in the 22 LP's with greater than 5% and less than 65% undisturbed habitat, to the minimum allowable undisturbed habitat of 5%, the estimated mean probability drops to 0.41.

Because there is large variation in the size of local population ranges, it is insightful to consider area-weighted mean probabilities under these same scenarios (present conditions 0.64; RS implementation without additional habitat deterioration 0.57; RS minimum allowable habitat provisions 0.55). It is also important to consider the potential for additional contraction of the distribution, should the 'non-essential' populations disappear.

Acknowledging that the figures above represent an interpretation of the measures described in the proposed Recovery Strategy, they nevertheless signal a highly challenging and uncertain future for boreal caribou in Canada. Overall, our assessment indicates that boreal caribou are likely to become more at risk under the proposed Recovery Strategy.

We think that better outcomes for caribou are possible. Throughout these comments we have referred to the use of decision-analysis and adaptive management to address uncertainties and improve the effectiveness of recovery planning. The same principles, applied in a coordinated fashion, can also support action planning and the implementation of recovery actions. Environment Canada has an important role to play in establishing the framework to enable these processes, and in facilitating coordination of activities across planning areas. The Recovery Strategy is the appropriate place to formalize this approach.

Acknowledgements

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