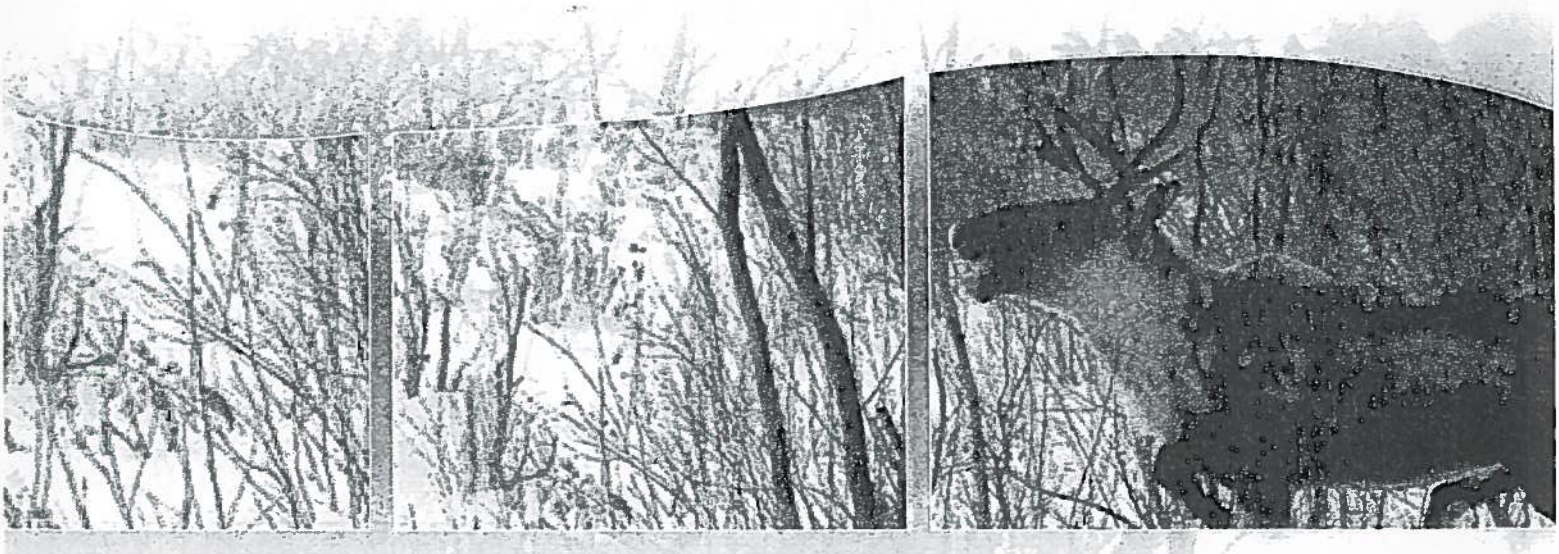
Environment Canada Environnement Canada

SCIENTIFIC ASSESSMENT TO INFORM THE IDENTIFICATION OF CRITICAL HABITAT FOR WOODLAND CARIBOU (*Rangifer tarandus caribou*), BOREAL POPULATION, IN CANADA

2011 UPDATE



Canada

Key Findings

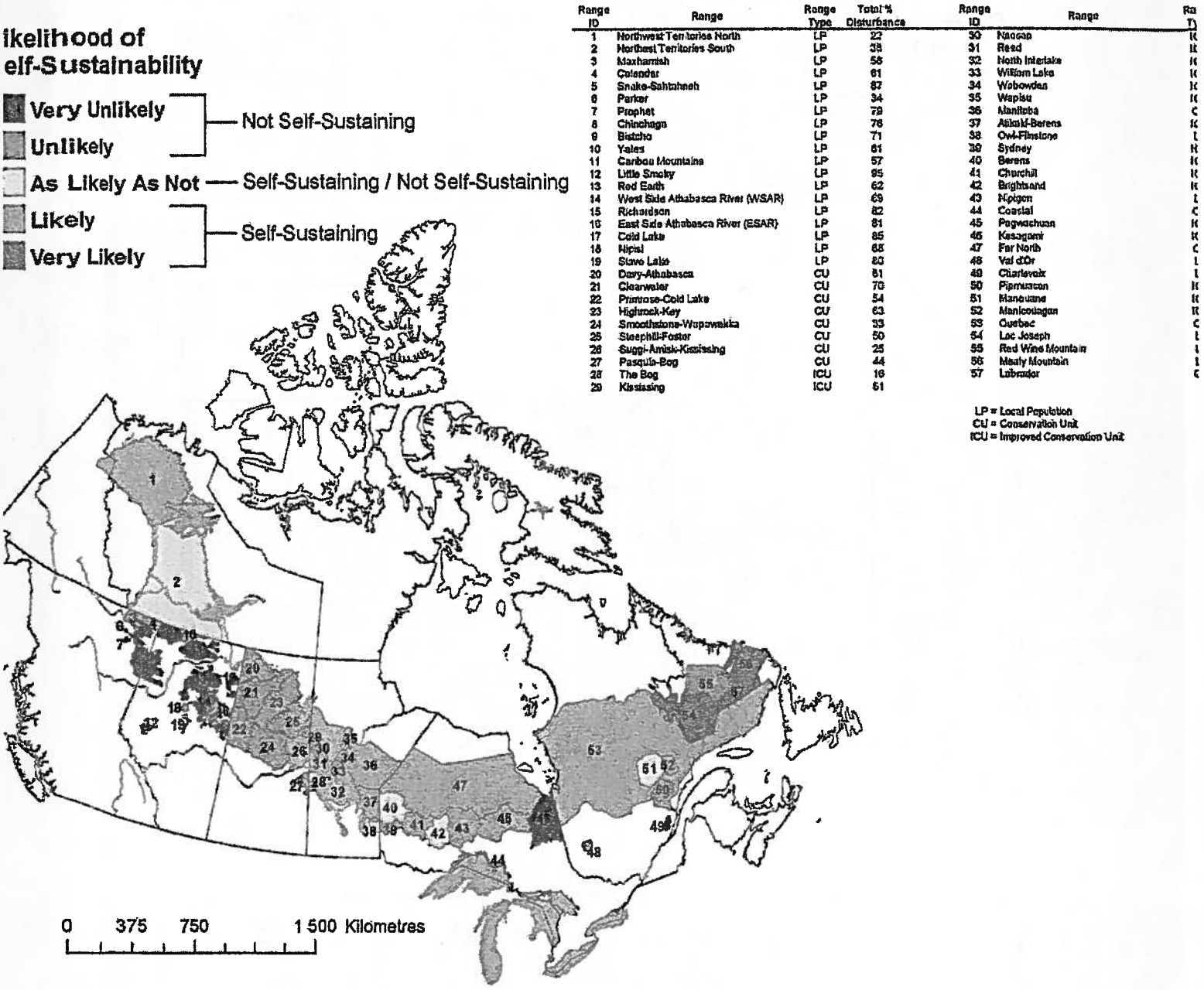
The information and analyses presented in this report address limitations identified with implementation of the work presented in the 2008 Scientific Review. However, neither the approach nor the results of this assessment represent a fundamental shift from the 2008 Science Review conclusion that range is the appropriate geographic delineation for critical habitat description. Further, the amount of total disturbance within a range remains the primary criteria for identifying critical habitat to meet a goal of self-sustaining local populations of caribou.

While improved data would enhance our understanding and address outstanding uncertainties, this report concludes that sufficient information exists to support a scientifically-grounded assessment of critical habitat for populations of boreal caribou across Canada, and provides a scientific basis to inform critical habitat identifcation for each of the 57 identified ranges that comprise the full extent of occurrence of boreal caribou in Canada.

Highlights of the application of the conceptual framework and associated analyses supporting this 2011 assessment include:

- **Nearly 70% of the variation in caribou recruitment across twenty-four study areas spanning the full range of boreal caribou distribution and range condition in Canada was explained by a single composite measure of total disturbance (fire + buffered anthropogenic), most of which could be attributed to the negative effects of anthropogenic disturbance.** Little statistical support was found for distinguishing different types of anthropogenic disturbances (e.g., linear and polygonal types). However, supporting analyses of a range of buffer widths demonstrated that a 500 m buffer on anthropogenic disturbance provided an appropriate, minimum approximation of the zone of influence of these features on caribou demography.

- **Of the 57 identified boreal caribou ranges in Canada, 17 (30%) were assessed in the "self-sustaining" (SS) category, 7 (12%) in the "not self-sustaining/self-sustaining" (NSS/SS) category, and 33 (58%) in the "not self-sustaining" (NSS) category (Executive Summary Figure 1).** Through the integrated risk assessment, these designations were refined to five likelihood categories ranging from very likely (SS) to very unlikely (NSS) with respect to the probability that current conditions would support a self-sustaining boreal caribou population.

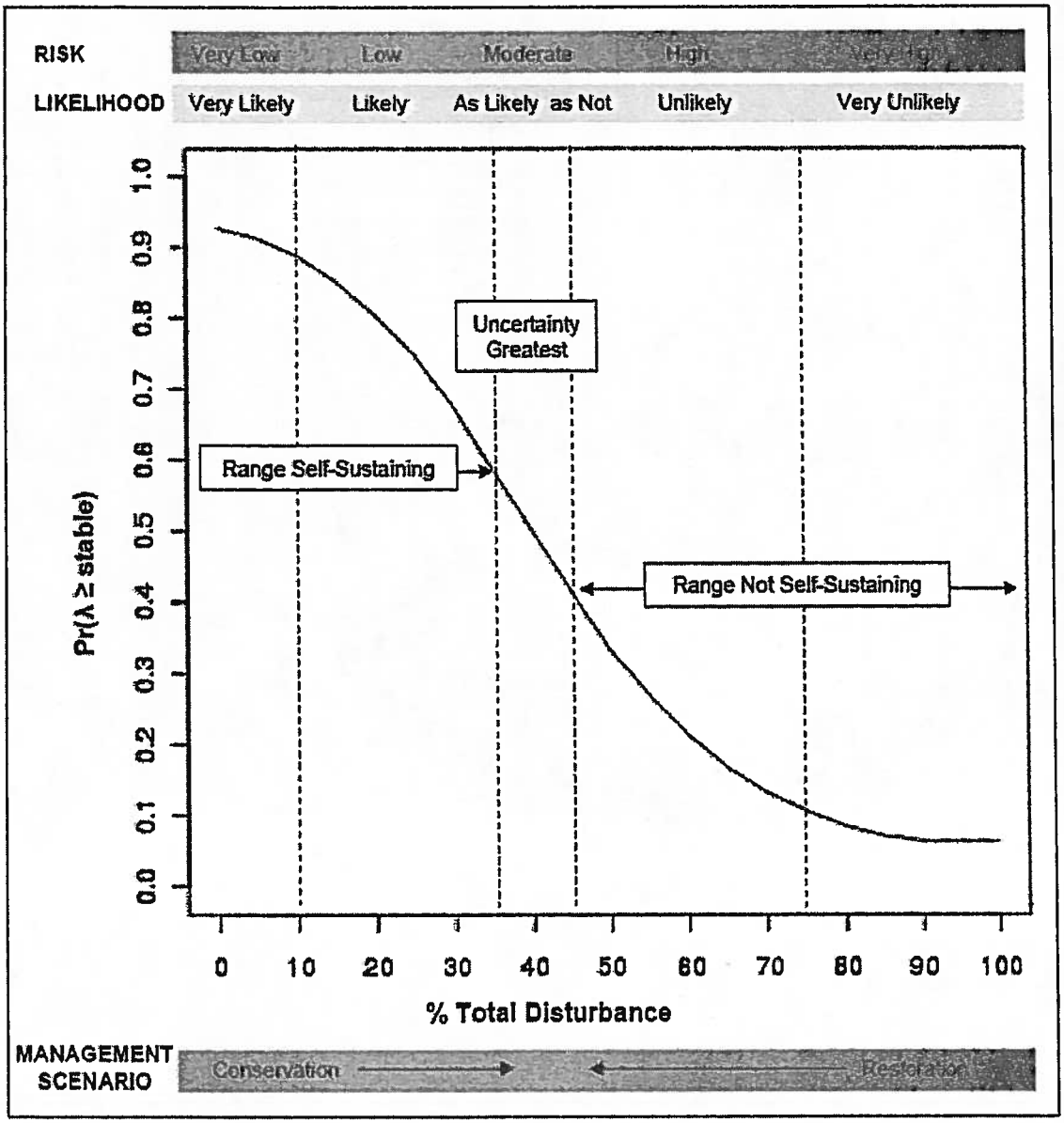


Range ID	Range	Range Type	Total % Disturbance	Range ID	Range	Ra T
1	Northwest Territories North	LP	22	30	Nacaon	R
2	Northest Territories South	LP	38	31	Reed	R
3	Maxhamish	LP	56	32	North Interlake	R
4	Calendar	LP	61	33	Willow Lake	R
5	Snake-Sahtahneh	LP	87	34	Wabowden	R
6	Parker	LP	34	35	Wapisu	R
7	Prophet	LP	79	36	Manitoba	C
8	Chinchaga	LP	76	37	Atikaki-Berens	R
9	Bistcho	LP	71	38	Owl-Flinstone	I
10	Yates	LP	61	39	Sydney	R
11	Caribou Mountains	LP	57	40	Berens	R
12	Little Smoky	LP	95	41	Churchill	R
13	Red Earth	LP	62	42	Brightsand	R
14	West Side Athabasca River (WSAR)	LP	69	43	Nipigon	I
15	Richardson	LP	82	44	Coastal	C
16	East Side Athabasca River (ESAR)	LP	81	45	Pagwachuan	R
17	Cold Lake	LP	85	46	Kesagami	R
18	Nipisi	LP	88	47	Far North	C
19	Slave Lake	LP	80	48	Val d'Or	I
20	Dory-Athabasca	CU	81	49	Charlevoix	I
21	Clearwater	CU	70	50	Pipmuacan	R
22	Primrose-Cold Lake	CU	54	51	Manouane	R
23	Highrock-Key	CU	63	52	Manicouagan	R
24	Smoothstone-Wapawekka	CU	33	53	Quebec	C
25	Steephill-Foster	CU	50	54	Lac Joseph	I
26	Suggi-Amisk-Kississing	CU	25	55	Red Wine Mountain	I
27	Pasquia-Bog	CU	44	56	Mealy Mountain	I
28	The Bog	ICU	16	57	Labrador	C
29	Kississing	ICU	61			

LP = Local Population
CU = Conservation Unit
ICU = Improved Conservation Unit

Executive Summary Figure 1. Integrated risk assessment for boreal caribou ranges in Canada.

- **Range-specific disturbance-based management thresholds can be derived from a generalized disturbance-population growth function in conjunction with range-specific information (Executive Summary Figure 2).** A methodology was developed to extend the critical habitat description for consideration of disturbance-based management thresholds when acceptable risks are defined by managers. A core component of the methodology is a disturbance-based population growth function that can be used in conjunction with range specific information to derive range specific disturbance thresholds. Examples of the application of the methodology to derive range-specific disturbance thresholds are presented.



Executive Summary Figure 2. The disturbance-based population growth function used in conjunction with range-specific information to derive range-specific management thresholds once an acceptable level of risk by managers has been specified.

DEFINITIONS

Bio-Physical Attributes	Any and all geological, vegetative, topographical, climatological, physical, chemical, or biological attributes, or suite of attributes, that constitute habitat for the species at risk.
Critical Habitat	The habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species (*Species at Risk Act*, S.2).
Current Distribution (Extent of Occurrence)	The area that encompasses the geographic distribution of all known boreal caribou ranges (COSEWIC 2010 – Adapted from IUCN 2010), based on provincial and territorial distribution maps developed from observation and telemetry data, local knowledge (including in some cases Aboriginal Traditional Knowledge), and biophysical analyses.
Demographic Parameters	Refers to the characteristics of a group of animals within a defined area. They include population trend, size, adult female survival and calf recruitment.
Habitat	The suite of resources (food, shelter), and environmental conditions (abiotic variables such as temperature, and biotic variables such as competitors and predators), that determine the presence, survival, and reproduction of a population (Caughley and Gunn 1996).
Local Population	A group of caribou occupying a defined area distinguished spatially from areas occupied by other groups of caribou. Local population dynamics are driven primarily by local factors affecting birth and death rates, rather than immigration or emigration among groups.
Persistence	The survival of a population, expressed as a given probability or likelihood over a specified time frame. The likelihood of not achieving specified persistence levels is a measure of risk of extirpation (i.e., local extinction).
Range	A geographic area occupied by a group of individuals that are subjected to the same influences affecting vital rates over a defined time frame.
Self-Sustaining Population	A local population of boreal caribou that on average demonstrates stable or positive population growth over the short term ($\leq$20 years), and is large enough to withstand stochastic events and persist over the long-term ($\geq$50 years), without the need for ongoing active management intervention (e.g., predator management or transplants from other populations).

anthropogenic disturbance and the configuration of disturbance (M9), and evaluated the influence of undisturbed habitats (M10-12) including high quality caribou habitat (hqh) as derived from the habitat selection model (Model 12).

Table 2. Specification of candidate models for the national meta-analysis.

Model	Predictor variables	Description
M0	total_dist_2008	Total non-overlapping disturbance from 2008 (see EC 2008)
M1	anthro_2011	Anthropogenic disturbance (500m buffer; reservoirs removed)
M2	fire_2011	Fire proportion (unbuffered)
M3	total_dist_2011	Total non-overlapping disturbance (500m buffer; reservoirs removed)
M4	lnlinear_2011	Percent buffered linear disturbance (500m buffer)
M5	poly_2011	Polygonal anthropogenic disturbances (500m buffer; reservoirs removed)
M6	lnlinear + poly_2011	M4 + M5
M7	anthro + fire_excl_anthro_2011	M1 + fires exclusive of anthropogenic disturbances
M8	total_dist + fire_prop_dist_2011	M3 + fires as proportion of total disturbance
M9	total_dist + ln_nn_2011	M3 + area-weighted mean nearest neighbor distance (500m buffer)
M10	ifl_2011	Proportion intact forest landscape exclusive of anthropogenic disturbance
M11	ifl_nofire_2011	Proportion intact forest landscape exclusive of anthropogenic disturbance and fire
M12	total_dist + hqh_2011	M3 + proportion of high quality habitat

The top model (M3) explained 69% of the variation in calf recruitment across a sample of twenty-four (24) ranges based on the percent total disturbance (fire + 500 m buffered anthropogenic disturbance; Figure 8) on each range. This model was analogous to the top model used in the 2008 Scientific Review. However, the new disturbance maps, which allowed better temporal matching of demographic data with disturbance data, and exclusion of reservoirs from the disturbance estimates, resulted in a 12% gain in explanatory power over the 2008 model. Most of the negative effects of disturbance were attributed to human development (60% in isolation), while only 5% of the variation in recruitment could be attributed to fire alone (see Appendix 7.5). Nevertheless, their combined influence was greater than the sum of their individual contributions. Decomposing anthropogenic disturbance into linear and polygonal features did little to improve the predictive power of the recruitment model, but the negative effect of linear disturbance features was greater than the negative effect of polygonal disturbances (see Appendix 7.5).

2.4.5.2 Future conditions

A semi-spatial habitat-dynamics model was developed (Appendix 7.7) to forecast future changes in the spatio-temporal patterns in habitat conditions and their impact on the assessment of a range's ability to maintain a self-sustaining population. These projections of natural disturbance were used as input data for the estimation of the habitat indicator of population growth through time (see Table 3) which in turn provided information to support the consideration of range-specific disturbance thresholds. The three (3) steps required to estimate the indicator were:

1. The current state of habitat conditions within each range was characterized by information about fire regimes, anthropogenic disturbances, water bodies, and different habitat types identified by the Moderate Resolution Imaging Spectroradiometer (MODIS, a sensor on the Terra satellite). All features within the range were time stamped to track their change through time. Time since last fire was used to determine the age of forests following fires. Anthropogenic disturbances were assumed to have been created in the same year of the Landsat imagery that was used to digitize the disturbance (section 2.4.3.1). An expected stable or equilibrium age structure for the different forest types was created using long-term simulations (see Appendix 7.7).
2. The current range maps (from step 1) were projected 100 years into the future using the Spatially Explicit Landscape Event Simulator (SELES; Fall and Fall 2001) according to four broadly contrasting scenarios:
    i. Static conditions: Current conditions remain unchanged (i.e., there are no new anthropogenic or natural disturbances, ecological succession or recovery of disturbed habitat). While this is not intended as a realistic scenario, it is an analogue of the 2008 Scientific Review "static" analysis and extends it to allow estimation of demographic stochasticity in the habitat-based PVA model (Appendix 7.6).
    ii. Recovery only: This projects the effect of passive (i.e., no active restoration) of disturbed areas over time on range condition (see Appendix 7.6 for rules of passive recovery). This allows for an assessment of the partial effect of reducing current levels of fire and anthropogenic disturbance on the range upon the population parameters irrespective of the confounding effects of other dynamics.
    iii. Natural disturbances only: This scenario was used to estimate the partial effect of natural habitat dynamics (see Appendix 7.6 for rules of natural habitat dynamics), given current levels of anthropogenic disturbance upon the population parameters.
    iv. Recovery + natural disturbance: This scenario was used to examine the combined effects of range dynamics assuming no further increase in anthropogenic disturbance upon the population parameters.

The spatial simulation maps were used to calculate annual estimates of the percent future total disturbance (fire and 500m buffered anthropogenic) for each of the four scenarios.