

Ontario Species at Risk Evaluation Report
for
Caribou, Boreal population (*Rangifer tarandus*)

Committee on the Status of Species at Risk in Ontario
(COSSARO)

Assessed by COSSARO as THREATENED

May 2015

Final

Caribou – population boréale (*Rangifer tarandus*)

Il existe deux écotypes du caribou (*Rangifer tarandus*) en Ontario : la population forestière ou boréale et la population forêt-toundra ou migratoire. En Ontario, le caribou des bois, population boréale sylvicole, *Rangifer tarandus caribou*, est actuellement inscrit comme une espèce menacée. Des travaux taxinomiques récents donnent à entendre que la désignation « caribou des bois » pourrait ne pas être adéquate et que le caribou de l'Ontario devrait être reconnu à l'échelle de l'espèce. Afin de concorder avec les délibérations et les décisions du COSEPAC, on propose que l'écotype forestier en Ontario soit identifié comme faisant partie de la population boréale, conformément aux décisions du COSEPAC sur les unités désignables du caribou. Des travaux de surveillance récents ont apporté des renseignements afin de mieux définir la limite nord de la population boréale de caribous en Ontario. Il y a un chevauchement géographique entre les populations boréales et migratoires de caribous en Ontario, bien que les distinctions liées aux écotypes semblent valides du point de vue biologique et écologique.

Les densités de caribous sont généralement faibles et elles varient grandement dans les forêts matures dominées par des conifères. Le caribou a déjà été l'une des principales espèces de cervidés en Ontario. En effet, des occurrences ont été observées dans le nord de l'Ontario et aussi loin que dans le sud du Minnesota, sur la rive nord et sur les îles du lac Supérieur et même sur l'île Manitoulin ainsi que dans la région de Nipissing. La population boréale de caribous diminue en Ontario depuis plus d'un siècle et il y a une forte corrélation entre cette rétraction de sa répartition dans le nord, l'établissement humain et les aménagements. Bien que les caribous soient encore dispersés de façon continue dans le nord de l'Ontario, du Québec jusqu'à la frontière du Manitoba, l'aire de répartition continue a diminué de 40 à 50 p. cent vers le nord. Une sous-population relique demeure le long de la rive nord-est du lac Supérieur et des îles adjacentes, qui est isolée du reste de la zone de répartition continue du caribou par une zone de répartition discontinue. Plusieurs facteurs sont attribuables à ce déclin, y compris les pertes et les changements directs subis par les habitats ainsi que les modifications dans les habitats qui ont contribué indirectement à une augmentation des populations de prédateurs.

Des efforts considérables ont été investis pour le rétablissement du caribou depuis qu'il a été désigné comme une espèce menacée, y compris l'élaboration d'un programme de rétablissement suivi par un plan de conservation, des recherches élargies et des études de surveillance globale et de télémessure satellitaire. Les 14 aires de répartition du caribou qui ont été déterminées en Ontario sont des balises utiles pour les efforts de gestion, de surveillance et de rétablissement.

La population boréale de caribous compterait moins de 5 000 individus matures en Ontario. Des évaluations intégrées de sa répartition ont révélé que la tendance annuelle moyenne de la population (λ) était inférieure à 1,0 pour toutes les aires de répartition évaluées, ce qui donne à entendre que les sous-populations de caribous sont en diminution à court terme en Ontario. L'état de la répartition dans deux aires (15 %) est

considéré insuffisant pour assurer la survie du caribou, tandis que dans neuf aires (69 %), il pourrait être insuffisant et dans deux autres aires (15 %) il est jugé suffisant. Les analyses de la viabilité de la population indiquent que certaines aires de répartition individuelles peuvent ne pas être viables à long terme, malgré l'absence d'une analyse pour la population provinciale. Le caribou de l'Ontario, population boréale (*Rangifer tarandus*), est considéré comme une espèce menacée dans la province en raison du petit nombre d'individus matures décroissant.

Cette publication hautement spécialisée « Ontario Species at Risk evaluation report prepared under the Endangered Species Act, 2007 by the Committee on the Status of Species at Risk in Ontario », n'est disponible qu'en anglais conformément au Règlement 671/92, selon lequel il n'est pas obligatoire de la traduire en vertu de la Loi sur les services en français. Pour obtenir des renseignements en français, veuillez communiquer avec le ministère des Richesses naturelles par courriel à recovery.planning@ontario.ca.

Executive summary

Two Caribou (*Rangifer tarandus*) ecotypes occur in Ontario - the forest-dwelling or boreal population, and the forest-tundra or migratory population. In Ontario the "Woodland Caribou, forest-dwelling boreal population, *Rangifer tarandus caribou*" is currently listed as Threatened. Recent taxonomic work suggests that the Woodland Caribou designation may not be appropriate, and supports recognition of Ontario's Caribou at the species level. In order to align with COSEWIC deliberations and decisions, it is proposed that the forest-dwelling ecotype in Ontario be identified as part of the Boreal population, consistent with COSEWIC decisions on Caribou designatable units. Recent monitoring work has provided information to better refine the northern boundary of the Caribou Boreal population in Ontario. There is some geographical overlap between the boreal and migratory caribou populations in Ontario, although the ecotype distinctions appear biologically and ecologically valid.

Caribou typically occur in low densities, ranging widely over mature, conifer-dominated forests. Caribou were once the main cervid species in Ontario, occurring across northern Ontario and as far south as northern Minnesota, the north shore and islands of Lake Superior and even Manitoulin Island and the Nipissing area. The Boreal population of Caribou in Ontario has been declining for well over a century, and this northward retraction of distribution has been strongly correlated with human settlement and development. While Caribou are still continuously distributed across northern Ontario from the Quebec to the Manitoba border, the area of continuous distribution has receded northward by 40-50%. A remnant subpopulation remains along the northeastern shore of Lake Superior and adjacent islands, isolated by the rest of the area of continuous Caribou distribution by an area of discontinuous distribution. A number of factors are implicated in this decline, including direct habitat loss and change as well as habitat changes that have indirectly led to an increase in predator populations.

Considerable effort has been directed towards caribou recovery since its designation as Threatened, including development of a recovery strategy and subsequent conservation plan, expanded research and broad monitoring and satellite telemetry studies. This work has greatly increased the information available on which to assess and support recovery of caribou. The 14 Caribou ranges that have been identified in Ontario are useful references for management, monitoring and recovery efforts.

There are believed to be fewer than 5000 mature individuals in the Boreal population of Caribou in Ontario. Integrated range assessments have revealed that the average annual population trend (λ) was less than 1.0 for all assessed ranges, suggesting that Caribou subpopulations in Ontario are in short-term decline. Range condition in two ranges (15%) is considered insufficient to sustain Caribou, while in nine ranges (69%) it is uncertain if range condition is sufficient to sustain Caribou and range condition in two other ranges (15%) is considered sufficient to sustain Caribou. Population viability analyses suggest that some individual caribou ranges may not be viable in the long-term, although an analysis has not been conducted for the provincial population.

Ontario's Caribou - Boreal population (*Rangifer tarandus*) is considered Threatened in Ontario, based upon the small and declining number of mature individuals.

1. Background information

1.1. Current designations

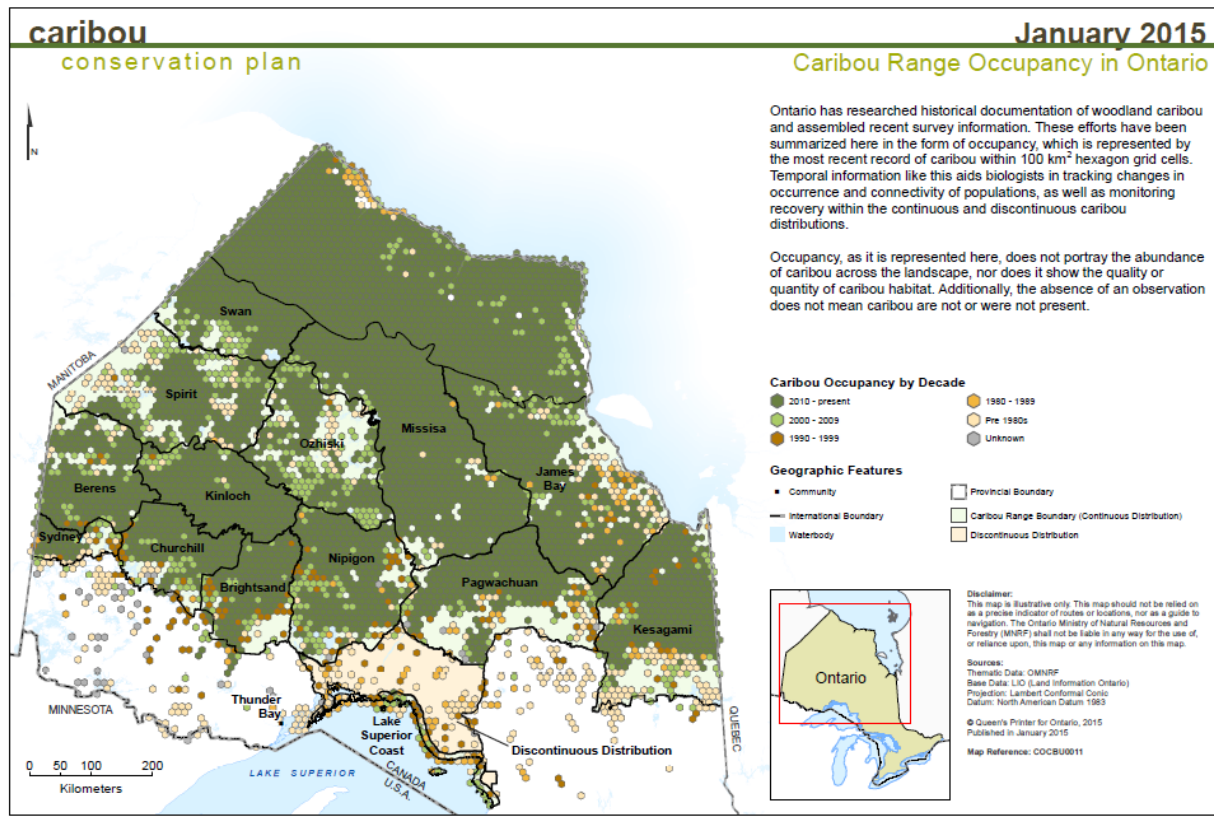
- G-RANK: G5TNR (Population 14 - Boreal population) (NatureServe 2015)
- N-RANK Canada: N4 (NatureServe 2015)
- COSEWIC: Threatened (Population 14 - Boreal population) (November 2014), (COSEWIC 2015)
- SARA: Threatened (Schedule 1) (Government of Canada 2015)
- ESA 2007: Threatened (Woodland Caribou, forest-dwelling boreal population, *Rangifer tarandus caribou*) (Government of Ontario 2015).
- S-RANK: S4 (NatureServe 2015)

1.2. Distribution in Ontario

The boreal population of caribou is distributed broadly across northern Ontario from the Québec to the Manitoba border (Figure 1). In the far north, boreal caribou overlap with migratory caribou, with forest-associated boreal caribou moving north and intermingling with tundra-associated migratory caribou that have moved south (Abraham et al. 2012, COSEWIC 2014). The northern boundary of boreal caribou is considered to be the southern boundary of the Northern Taiga Ecoregion (1E) (Crins et al. 2009), which is considered to be a reasonable, ecologically-based northern boundary for Boreal caribou, while recognizing that caribou movements across this zonal boundary do occur (Berglund et al. 2012, OMNRF 2014b).

Caribou were once the main cervid species in Ontario, occurring across northern Ontario and as far south as northern Minnesota, the north shore and islands of Lake Superior and even Manitoulin Island and the Nipissing area. The range of the boreal population of caribou has retracted northward by almost 50% across Ontario over the past century and a half, corresponding with increasing levels of human settlement and development (Racey and Armstrong 2000, Schaefer 2003, COSEWIC 2014). This range recession may have slowed in recent decades with additional efforts to conserve and recover caribou. However, some documented occurrences that caribou have used relatively young, harvest-origin forest “are likely not good examples of caribou re-occupancy or use of habitat that is likely to improve their chances of surviving over the long-term” (MNRF 2014a). As this range recession has occurred, the Lake Superior coastal subpopulation (eastern Lake Superior shoreline, Slate Islands, Michipicoten Island) has become separated from the more northern area of continuous caribou distribution (OMNR 2009, COSEWIC 2014). Thirteen contiguous caribou ranges have been delineated in Ontario, plus an additional range along the Lake Superior coast (Figure 2) (OMNRF 2014b).

Figure 1. Caribou range occupancy in Ontario (OMNRF 2015a).



ontario.ca/environment-and-energy/species-risk



1.3. Distribution and status outside Ontario

Caribou and reindeer (*Rangifer tarandus*) have a broad circumpolar distribution across boreal, subarctic and arctic biomes (COSEWIC 2014). Reindeer populations are found primarily in Russia and Scandinavia, while caribou occur across large areas of northern Canada, Alaska and Greenland (COSEWIC 2014). The boreal population of caribou is restricted to Canada, occurring from Labrador and Québec west to British Columbia, and northward to the Yukon and Northwest Territories (COSEWIC 2014). It previously occurred in, and is now extirpated from, the northern United States (i.e. Minnesota, Wisconsin, Vermont, Maine, and New Hampshire) (COSEWIC 2014).

Figure 2. Caribou range in Ontario (OMNRF 2014b).



1.4. Ontario conservation responsibility

The boreal population of caribou has an estimated extent of occurrence of 3 million km² in Canada (COSEWIC 2014). The 14 ranges in Ontario comprise 480,579 km² (OMNRF 2014b), representing approximately 16% of the estimated extent of occurrence. These two measures (estimated extent of occurrence, summary of range areas) are not precisely the same and are calculated by different methods, but provide a reasonable approximation of the proportion of the range of the Boreal population that occurs in Ontario.

1.5. Direct threats

Threats identified for the Ontario range of the boreal population of caribou include:

- habitat loss and degradation, and related indirect effects;
- habitat fragmentation;
- highways, roads and other linear features;

- disturbance by other human activities;
- hunting and subsistence harvest; disease and parasites;
- weather; and
- continued threats to the viability of isolated subpopulations (Ontario Woodland Caribou Recovery Team 2008).

The National Recovery Strategy categorized threats according to the degree of concern (Table 1). The IUCN Threats Calculator for this species identified an overall threat score of Very High-High, with the high threats being logging and predation (COSEWIC 2014). One of the primary threats concerns the interactions between habitat change and predation, and relates to anthropogenically-driven habitat change that creates improved habitat conditions for other prey species such as moose (*Alces alces*) and white-tailed deer (*Odocoileus virginianus*). The increase of available prey biomass for predators such as gray wolf (*Canis lupus*) and black bear (*Ursus americanus*) increases the predator biomass and increases predation levels on caribou to unsustainable levels (OMNR 2009, COSEWIC 2014).

Table 1. Threats to the boreal population of caribou, as summarized by the National Recovery Strategy (from COSEWIC 2014).

Degree of Concern	Type of Threat
High-Medium	Habitat alteration from anthropogenic disturbance (e.g. logging and wood harvesting)
High-Medium	Problematic native species (e.g. predation)
Medium-Low	Energy production and mining
Medium-Low	Linear features (roads, utility lines)
Medium-Low	Hunting (illegal, accidental, aboriginal)
Medium-Low	Noise disturbance
Low	Fire and fire suppression (e.g. habitat alteration from fire, climate change that increases fire risk)
Unknown	Recreational activities (e.g. snowmobiling, skiing, hiking, cabins)
Unknown	Problematic native species (e.g. parasites and pathogens)
Unknown	Habitat shifting (e.g. boreal forest peatland changing to wetlands)
Unknown	Pollution

1.6. Specialized life history or habitat use characteristics

Caribou occur in a very sensitive balance with predator populations. They typically exist at low densities on the landscape, spacing themselves across the landscape to maintain low densities, thereby reducing predation pressure and not supporting higher predator numbers. They do not appear capable of sustaining their population in areas with higher predator densities. This unique life history characteristic often interacts synergistically with anthropogenic habitat changes that increase the quality and quantity of habitat for other cervids such as moose and deer, leading to increasing predator populations that subsequently drive caribou populations to low or locally extirpated levels (Seip 1991,

OMNR 2009). “Although predation is a natural process, predation rates appear to be unsustainable in disturbed parts of the (Boreal Population) range” (COSEWIC 2014).

Caribou are less resilient in the face of predation pressure than other cervid species, due to their lower reproductive rate. They typically do not breed until their third year (2.5 years old), unlike deer (0.5, 1.5 years) or moose (0.5 years), and typically have only one calf per year, while moose and deer may have twins or even triplets, especially for deer. Thus, caribou are not able to recover from high predation pressure as rapidly or effectively as these other cervid species.

Woody browse is not a dietary staple for caribou, which rely heavily upon many species of both arboreal and terrestrial lichen during the fall and winter (Darby and Duquette 1986). While some have argued that lichen is not essential to caribou (see Darby and Duquette 1986), they are considered “important in the overwintering ecology of caribou that face the energetic costs of predator avoidance and migration” (Joly et al. 2010). A broad review of the use of lichen by wildlife has similarly concluded that there is “no other forage that can provide the basis for the continued survival of caribou” (Sharnoff and Rosentreter 1998).

2. Eligibility for Ontario status assessment

2.1. Eligibility conditions

2.1.1. Taxonomic distinctness

Yes. Caribou (*Rangifer tarandus*) is a distinctly recognized circumpolar species that occurs in many northern countries. It is typically referred to as reindeer in Russia and Scandinavia, and as caribou in North America and Greenland. Banfield (1961) recognized several subspecies, including woodland caribou (*Rangifer tarandus caribou*), which was considered the only subspecies in Ontario. The subspecies designation has subsequently been seen as problematic, and not supported by more recent taxonomic and genetic studies, and a taxonomic revision is seen as required (COSEWIC 2011). As a result, there has been a growing trend to refer to caribou according to ecotype, which classifies animals by their habitat type and migratory behaviour (Thomas 1992, Harris 1999). Ontario was one of the first Canadian jurisdictions to assess caribou status by ecotype (e.g. Harris 1999). Caribou was originally listed on the Species at Risk List in Ontario as forest-dwelling woodland caribou (*Rangifer tarandus caribou*), consistent with the provincial status report (Harris 1999), recovery strategy (Ontario Woodland Caribou Recovery Team 2008) and Caribou Conservation Plan (OMNR 2009). This is analogous to the boreal population of caribou as identified by COSEWIC (2014). Caribou is currently listed on the Species at Risk in Ontario List as “Woodland Caribou (Forest-dwelling boreal population) (*Rangifer tarandus caribou*)” (Government of Ontario 2015). The Boreal population designatable unit is considered discrete in Canada, as any annual range overlap occurs only during winter when there are no opportunities for genetic exchange (COSEWIC 2011b). Because of the ambiguities surrounding the subspecific status and growing constancy in the use of ecotypes and designatable units, it is proposed that the terminology for this

population be consistent with that used by COSEWIC (2014) and that this population be assessed and listed on the SARO List as Caribou, Boreal population (*Rangifer tarandus*).

The northern range boundary of this ecotype/population has been refined since the publication of range maps in Environment Canada (2011) and COSEWIC (2011, 2014). COSEWIC (2011) recognized that the northern boundary would be refined in Ontario based upon concurrent research and monitoring studies. The current northern boundary, as portrayed in Figures 1 and 2, reflects the southern boundary of the Northern Taiga Ecoregion (1E), and has an ecological basis for its location based upon caribou movements and ecology (Berglund et al. 2014).

A second caribou ecotype occurs in Ontario, the more northern forest-tundra ecotype (Harris 1999, Abraham et al. 2012), equivalent to the migratory caribou recognized by COSEWIC (2011). There is some overlap in distribution between the two ecotypes in Ontario, with the annual ranges of some forest-dwelling caribou extending as much as 95 km north of the Northern Taiga Ecoregion boundary (Berglund et al. 2014). The revised boundary line between the two ecotypes/populations has recently been officially recognized in policy by the OMNRF (e.g. OMNRF 2014c), and will be considered in the national status assessment currently underway for the migratory/forest-tundra caribou population (D. Elder pers. comm.). COSSARO is expected to evaluate the status of this latter population/ecotype in 2017. While there has been considerable discussion regarding the validity of the ecotype concept for caribou in Ontario, recent studies have confirmed the validity of the ecotype basis for classifying caribou on the basis of COSEWIC criteria for both discreteness and significance (Pond et al under review). The ecotypes showed clear bimodal patterns in both the percentage of observations within the Hudson Bay Lowlands and average distance south of the treeline (Figure 3). These were discrete spatial behaviours that did not vary on a continuum. These ecotypes clearly overlapped during the winter, but “the degree of geographic separation the rest of the year is remarkable”, particularly during calving and breeding periods (Pond et al under review).

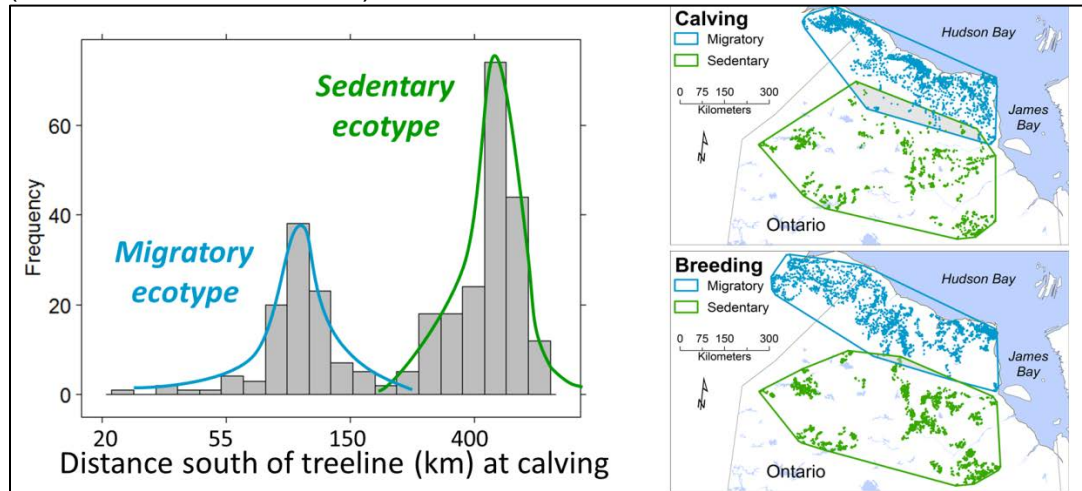
2.1.2. Designatable units

Yes – Boreal population. See above.

While the Lake Superior coastal subpopulation is isolated from the rest of continuous distribution in Ontario, this is not considered a valid DU because it is based upon anthropogenic disturbances resulting in isolation rather than as an evolutionary response to local ecological conditions (COSEWIC 2014).

Recent genetic research on caribou examining mitochondrial DNA haplotype distributions has confirmed the validity of boreal and eastern migratory caribou as separate DUs; the eastern migratory ecotype diverged from the woodland lineage during the post-glacial emergence of the land and vegetation in the Hudson Bay coastal areas approximately 7000 years ago (Paul Wilson, pers. comm.).

Figure 3. Spatial separation of Caribou ecotypes in Ontario during reproductive periods (Pond et al. under review).



2.1.3. Native status

Yes. Caribou are clearly native to Ontario, and were at one time the primary cervid across much of the province.

2.1.4. Occurrence

Yes. Caribou is currently extant in the province.

2.2. Eligibility results

Caribou, Boreal population (*Rangifer tarandus*) is eligible for status assessment in Ontario.

3. Ontario status assessment

3.1. Application of endangered/threatened status in Ontario

3.1.1. Criterion A – Decline in total number of mature individuals

Insufficient information. Data were insufficient to evaluate the criterion for long-term trend, although there are a number of warning signs. Meets A3b – A reduction in total number of mature individuals, suspected or projected to be met within the next 18 years (3 generations), based upon evidence from the integrated range assessments that:

- The average annual population trend (λ) ranged from 0.86 to 0.98 and was less than 0.99 for all ranges (OMNRF 2014a), with an average for the province of 0.93 from 2008 to 2013, suggesting that caribou subpopulations in Ontario are in short-term decline. In Alberta the mean λ of 0.92 for 11 subpopulations over 3-18 years resulted in a 57% decline (COSEWIC 2014). A λ of 1.0 represents a stable population while a $\lambda < 0.90$ equates to a 50% decline in 7 years (COSEWIC

2014). Across Canada an ongoing population decline of >30% is inferred (COSEWIC 2014).

- Population trend and survival could not be calculated for two ranges (Swan, Ozhiski) due to small sample sizes, but observed recruitment rates were lower than the assumed threshold required for a subpopulation to be considered stable or increasing (OMNRF 2014a).

The establishment of baseline probability of occupancy data will support future quantitative determinations of whether northward range recession is continuing to occur along the southern boundary of continuous distribution (OMNRF 2014a).

3.1.2. Criterion B – Small distribution range and decline or fluctuation

Does not apply. The 14 ranges in Ontario comprise 480,579 km² (OMNRF 2014b), far exceeding the criterion limit of 20,000 km².

3.1.3. Criterion C – Small and declining number of mature individuals

Threatened under criterion C1. Although the sum of minimum animal counts (MAC), including calves, from all range assessments is 3334, this represents the absolute minimum number of caribou of all ages in all ranges (except the Lake Superior Coastal Range) and is not intended to represent a population estimate; there are “likely many more caribou than suggested by the MAC” (OMNRF 2014a). A provincial caribou population estimate was developed in the mid-1990s by canvassing OMNR district and park staff (Cumming 1998). That effort resulted in an estimate of 5425 caribou, including calves, exclusive of the former Moosonee District (Cumming 1998), with the latter roughly approximating the area of distribution of the forest-tundra (migratory) caribou population. COSEWIC (2014) estimated a provincial population range for Ontario’s boreal population of 1284-5000. The Ontario boreal population almost certainly exceeds the endangered criterion limit of 2500 mature individuals, but is almost certainly less than the threatened criterion limit of 10,000.

Ranges with less than 35% disturbance, both natural (i.e. fires \leq 40 years) and anthropogenic (buffered by 500m) have a likelihood of stable or increasing population growth exceeding 0.6, which is the threshold at which the subpopulation is thought to be self-sustaining (Environment Canada 2011, OMNRF 2014a). Considering only this one line of evidence, five of 13 ranges (38%) are considered unlikely or uncertain to have stable or increasing population growth (Table 2).

Integrated range assessments combining all lines of evidence for the 13 contiguous caribou ranges indicated considerable variation in range condition (Table 3):

- range condition in two ranges (15% of the 13 ranges) (Kesagami, Sydney) was considered insufficient to sustain caribou;
- in nine ranges (69%) it was uncertain if range condition was sufficient to sustain caribou; and
- range condition in two ranges (15%) (Swan, Ozhiski) was considered sufficient to sustain caribou (OMNRF 2014a).

The 15% of Ontario ranges that are considered insufficient to sustain caribou, coupled with the average annual population trend for the entire boreal population in Ontario,

suggesting a short-term population decline (OMNRF 2014a), and a projected population decline of greater than 30% across Canada in the next 18 years as a result of negative population growth in many ranges (COSEWIC 2014), meets the Threatened criterion limit of an estimated continuing decline in total number of mature individuals of at least 10% over three generations. Most other Canadian jurisdictions are also experiencing

Table 2. Percentage of cumulative disturbance by area of the range in Ontario caribou ranges, and the likelihood of stable or increasing population growth (OMNRF 2014a).

Ranges	% Disturbance (Natural; Anthropogenic)	Likelihood of stable or increasing population growth ($Pr(\lambda \geq \text{stable})$)
Berens	28.7 (19.4; 9.3)	0.70
Sydney	62.7 (16.2; 46.6)	0.20
Churchill	41.3 (5.4; 35.9)	0.47
Brightsand	43.5 (10.4; 33.1)	0.45
Nipigon	38.4 (4.6; 33.8)	0.55
Pagwachuan	31.0 (0.5; 30.5)	0.65
Kesagami	43.7 (2.0; 41.7)	0.45
Swan	23.5 (20.3; 3.2)	0.78
Spirit	28.6 (25.1; 3.5)	0.70
Kinloch	19.6 (14.1; 5.5)	0.80
Ozhiski	27.6 (20.0; 7.6)	0.70
Missisa	14.4 (5.0; 9.4)	0.86
James Bay	6.6 (4.3; 2.3)	0.90

Table 3. Range conditions of Ontario caribou ranges as determined by integrated range assessments (OMNRF 2014a).

Range Name	Range Condition
Berens	Uncertain if range condition is sufficient to sustain caribou
Sydney	Insufficient to sustain caribou
Churchill	Uncertain if range condition is sufficient to sustain caribou
Brightsand	Uncertain if range condition is sufficient to sustain caribou
Nipigon	Uncertain if range condition is sufficient to sustain caribou
Pagwachuan	Uncertain if range condition is sufficient to sustain caribou
Kesagami	Insufficient to sustain caribou
Swan	Sufficient to sustain caribou; <i>additional population trend data is required</i>
Spirit	Uncertain if range condition is sufficient to sustain caribou
Kinloch	Uncertain if range condition is sufficient to sustain caribou
Ozhiski	Sufficient to sustain caribou; <i>additional population trend data is required</i>
Missisa	Uncertain if range condition is sufficient to sustain caribou
James Bay	Uncertain if range condition is sufficient to sustain caribou

Table 4. VORTEX Population Viability Analysis results for the Slate Islands woodland caribou population (Shuter et al.2005).

Trials	Probability of population persistence <50%	Probability of population persistence <10%	Probability of population persistence =/<0.01%
Trial I – without inbreeding	40 years	80 years	110 years
Trial II – with inbreeding	40 years	70 years	90 years

* approximate values used

negative population trends, with recent average λ s of 0.93 (Alberta), 0.95 (Saskatchewan), 0.90 (Manitoba), 0.98 (Quebec) and 1.05-1.13 (Labrador) (COSEWIC 2014). In addition, population viability analysis suggested that there is a high probability of extinction (<.01% probability of population persistence) of the Slate Islands Provincial Park caribou subpopulation (Table 4), which comprises a large proportion of the Lake Superior Coastal subpopulation, within the next century (Shuter et al. 2005), and at least some ranges with a high degree of anthropogenic disturbance also have a high probability of local extirpation (OMNRF 2014a).

3.1.4. Criterion D – Very small or restricted total population

Does not apply. Population exceeds 1000 mature individuals, with greater than five locations.

3.1.5. Criterion E – Quantitative analysis

Does not apply. As detailed below, quantitative analyses indicate that some subpopulations are at high risk of extirpation in the next 100 years, although caribou in anthropogenically undisturbed landscapes have a much higher probability of persistence. Thus while some local subpopulations may be at risk of extirpation, there is no PVA to predict whether the provincial population as a whole is at high risk of extirpation.

An initial population viability analysis (PVA) completed for the Slate Islands Park caribou subpopulation, which comprises a large proportion of the Lake Superior Coastal subpopulation indicated that there is a high probability of extinction within the next century (Shuter et al. 2005); this is the only range for which an integrated range assessment was not completed.

Spatially-explicit PVA models have been completed as part of the caribou research program. Preliminary results suggest that “caribou in the managed landscape (the Nakina study area, forming a significant part of the Nipigon Range) may have a low probability of persisting over the next 100 years, due to reduced access to food and elevated predation risk associated with high mixedwood cutovers and extensive road networks” (OMNR 2014a). In contrast, preliminary results suggest that caribou in the unmanaged landscape (the Pickle Lake study area, forming part of the Kinlock Range) “have a low probability of exhibiting dramatic declines in abundance” (OMMR 2014a).

Current landscape patterns in the managed landscape “may not be sufficient to enable caribou to persist in the long-term under current range (OMNR 2014a).

3.2. Application of Special Concern in Ontario

Not applicable. The species meets the threshold for Threatened.

3.3. Status category modifiers

No status modifiers are proposed for application.

3.3.1. Ontario’s conservation responsibility

Does not apply. The extent of the boreal population of caribou in Ontario is estimated to represent only 16% of the Canadian extent of occurrence.

3.3.2. Rescue effect

Rescue effect is theoretically possible, as caribou range in Ontario is contiguous with that in Québec and Manitoba and caribou movements across both provincial boundaries have been documented (Brown et al. 2003, Manitoba Boreal Woodland Caribou Management Committee 2014). However, adjacent subpopulations in Québec have declining recruitment rates, declining adult female survival and cumulative disturbance levels in excess of theoretical thresholds required for population persistence (Rudolph et al. 2012), and the population status of some adjacent ranges in Manitoba is under review (Manitoba Boreal Woodland Caribou Management Committee 2014). The Owl-Flintstone Range (#38) in southeastern Manitoba adjacent to the Sydney Range in Ontario (which is considered unlikely to sustain caribou), was considered by Environment Canada (2011) to “be as likely as not to maintain a self-sustaining caribou population over time”. Rescue effect from the south is not feasible, as caribou are extirpated in U.S. jurisdictions to the south and Ontario’s range has been receded northward over the past century and more (Racey and Armstrong 2000, Schaefer 2003). Additionally, while there is suitable contiguous habitat in adjacent jurisdictions, cross-boundary rescue effect would have a limited short-term population effect on a wide-ranging species such as caribou.

A number of studies have attempted to evaluate the potential of re-introductions as a recovery approach for extirpated or declining caribou subpopulations, and OMNR has committed to evaluating their feasibility (OMNR 2009). Reintroductions appear to have the most potential for success on predator-free islands (Bergerud and Mercer 1989, Cochrane 1996), although caribou re-introductions were felt to have a reasonable chance of success in some mainland situations (Jordan et al. 1998, Decesare et al. 2010).

3.4. Other status categories

3.4.1. Data deficient

Not applicable. There are sufficient data to make an assessment, although there are limitations on the information on adult survival and recruitment. Integrated range assessments indicated that for nine ranges (69%), it was uncertain if range condition was sufficient to sustain caribou or not (OMNRF 2014a).

3.4.2. Extinct or extirpated

Not applicable.

3.4.3. Not at risk

Not applicable.

4. Summary of Ontario status

Caribou, Boreal population (*Rangifer tarandus*) is classified as Threatened in Ontario based on meeting criterion C1 (A3b – insufficient information).

5. Information sources

Abraham, K.F., B.A. Pond, S.M. Tully, V. Trim, D. Hedman, C. Chenier and G.D. Racey. 2012. Recent changes in summer distribution and numbers of migratory caribou on the southern Hudson Bay coast. *Rangifer* 32: 269-276.

Banfield, A.W.F. 1961. A revision of the reindeer and caribou genus *Rangifer*. Department of Northern Affairs and National Resources, Ottawa ON.

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

Berglund, N.E., G.D. Racey, K.F. Abraham, G.S. Brown, B.A. Pond, and L.R. Walton. 2014. Woodland caribou (*Rangifer tarandus caribou*) in the Far North of Ontario: Background information in support of land use planning. Ontario Ministry of Natural Resources, Biodiversity and Monitoring Section Technical Report TR-147, Thunder Bay ON. 160 p.

Brown, G.S., F.F. Mallory, and J. Rettie. 2003. Range size and seasonal movement for female woodland caribou in the boreal forest of northeastern Ontario. *Rangifer Special Issue* 14: 227-233.

Cochrane, J. 1996. Woodland caribou restoration at Isle Royale National Park. A feasibility study. U.S. Dept. Int., National Park Service, Tech. Rep. NPS/NRISRO/NRTR/96-03. Denver, Colorado.

Crins, W.J., P.A. Gray, P.W.C. Uhlig and M.C. Wester. 2009. The Ecosystems of Ontario, Part I: Ecozones and Ecoregions. Inventory, Monitoring and Assessment, SIB TER IMA TR- 01, 71pp. Ontario Ministry of Natural Resources, Peterborough ON. viii +

76 p.

COSEWIC. 2011. Designatable units for caribou (*Rangifer tarandus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa ON. 88 p

COSEWIC. 2014. COSEWIC assessment and status report on the Caribou /*Rangifer tarandus*, Newfoundland population, Atlantic-Gaspésie population and Boreal population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa ON. xxiii + 128 p.

COSEWIC. 2015. [Wildlife species search](#). Caribou. Boreal population. Committee on the Status of Endangered Wildlife in Canada. Ottawa ON. [website accessed on May 6, 2015].

Cumming, H.G. 1998. Status of woodland caribou in Ontario: 1996. *Rangifer* Special Issue 10: 99-104.

Darby, W. R., and L. S. Duquette. 1986. Woodland caribou and forestry in Northern Ontario, Canada. *Rangifer* 6(2): 87-93

Environment Canada. 2011. Scientific assessment to inform the identification of critical habitat for woodland caribou (*Rangifer tarandus caribou*), Boreal population, in Canada – 2011 Update. Environment Canada, Ottawa, ON 104 p. + appendices.

COSEWIC. 2011. Designatable Units for Caribou (*Rangifer tarandus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa ON. 88 p.

Decesare, N.J., J. Whittington, M. Hebblewhite, H. Robinson, M. Bradley, L. Neufeld and M. Musiani. 2011. The role of translocation in recovery of woodland caribou populations. *Conservation Biology* 25(2): 365-373

Government of Canada. 2015. [Species profile. Caribou Boreal Population](#). Species at Risk Public Registry, Government of Canada, Ottawa ON. [website accessed on May 6, 2015].

Government of Ontario. 2015. [Endangered Species Act, 2007](#). Ontario Regulation 230/08 Species at Risk in Ontario List. Consolidation period: From March 31 2015 to the e-Laws currency date. Last amendment Ontario Regulation 66/15. [website accessed on May 13, 2015].

Joly, Kyle, F. Stuart Chapin III, and David R. Klein. 2010. Winter habitat selection by caribou in relation to lichen abundance, wildfires, grazing, and landscape characteristics in northwest Alaska. *Ecoscience* 17(3): 321-333.

Jordan, P.A., J.L. Nelson, and J. Pastor. 1998. Progress towards the experimental reintroduction of woodland caribou to Minnesota and adjacent Ontario. *Rangifer* Special Issue 10: 169-181.

Manitoba Boreal Woodland Caribou Management Committee. 2014. Conserving the

Icon of the Boreal, Manitoba's Boreal Woodland Caribou (*Rangifer tarandus caribou*) Recovery Strategy. Manitoba Conservation and Water Stewardship. Winnipeg, Manitoba. 30 p.

NatureServe. 2015. [Caribou \(*Rangifer tarandus*\), \(Population 14 - Boreal population\)](#). NatureServe Explorer. [website accessed on May 5, 2015].

Ontario Ministry of Natural Resources. 2009. Ontario's Woodland Caribou Conservation Plan. Ontario Ministry of Natural Resources, Peterborough ON. i + 24 p.

Ontario Ministry of Natural Resources & Forestry (MNR). 2014a. State of the Woodland Caribou Resource Report. Species at Risk Branch, Thunder Bay, Ontario. viii+ 156 p.

Ontario Ministry of Natural Resources and Forestry. 2014b. Delineation of woodland caribou ranges in Ontario. Technical Report, Ontario Ministry of Natural Resources and Forestry, Peterborough ON. vi + 148 p.

Ontario Ministry of Natural Resources and Forestry. 2014c. Range Management Policy in Support of Woodland Caribou Conservation and Recovery. Species at Risk Branch, Thunder Bay ON. 11 p.

Ontario Ministry of Natural Resources and Forestry. 2015a. [Woodland Caribou *Rangifer tarandus caribou*](#). Ontario Ministry of Natural Resources and Forestry, Peterborough ON. [website accessed on May 6, 2015].

Ontario Woodland Caribou Recovery Team. 2008. Woodland Caribou (*Rangifer tarandus caribou*) (Forest-dwelling, Boreal Population) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. 93 p.

Pond, B.A., G.S. Brown, K.S. Wilson and J.A. Schaefer. Under review. Drawing lines: Spatial behaviours reveal two ecotypes of woodland caribou. Draft MS submitted to Biological Conservation, June 2015.

Racey, G.D. and T. Armstrong. 2000. Woodland Caribou range occupancy in northwestern Ontario: past and future. *Rangifer* Special Issue 12: 173-184.

Rudolph, Tyler D., P. Drapeau, M. H. St-Laurent, and L. Imbeau. 2012. Status of woodland caribou (*Rangifer tarandus caribou*) in the James Bay region of northern Quebec. Scientific report presented to the Ministère des Ressources naturelles et de la Faune du Québec and the Grand Council of the Crees (Eeyou Istchee), Montréal PQ. xi + 72 p.

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

Seip, D.R. 1991. [Predation and caribou populations](#). *Rangifer* special Issue 7: 46-52.
Sharnoff, S. and R. Rosentreter. 1998. Lichen use by wildlife in North America.

Shuter, J., S. Kingston and G. Lipsett-Moore. 2005. Slate Islands Provincial Park - Detailed life science report. Ontario Parks Report, Ontario Ministry of Natural Resources, Thunder Bay, Ontario.

Appendix 1: Technical summary for Ontario

Species: Caribou, Boreal population (*Rangifer tarandus*)

Demographic information

Demographic attribute	Value
<p>Generation time. Based on average age of breeding adult: age at first breeding = X year; average life span = Y years.</p>	6 years
<p>Is there an observed, inferred, or projected continuing decline in number of mature individuals?</p>	Yes
<p>Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.</p>	Unknown
<p>Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.</p>	Unknown
<p>Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.</p>	See below
<p>Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.</p>	<p>The average annual population trend (λ) ranged from 0.86 to 0.98 and was less than 0.99 for all ranges (OMNRF 2014a), suggesting that caribou subpopulations in Ontario are in short-term, decline. A λ of < 0.90 equates to a 50% decline in 7 years (COSEWIC 2014).</p> <p>Population trend and survival could not be calculated for two ranges (Swan, Ozhiski) due to small sample sizes, but observed recruitment rates were lower than the assumed threshold required for a subpopulation to be considered stable or increasing (OMNRF 2014a).</p>

Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. Unknown b. Yes c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and occupancy information in Ontario

Extent and occupancy attributes	Value
Estimated extent of occurrence. (Request value from MNRF or use http://geocat.kew.org/)	Approximate EAO - 480,579 km ² (area of all caribou ranges in Ontario)
Index of area of occupancy (IAO). (Request value from MNRF or use http://geocat.kew.org/)	Not available
Is the total population severely fragmented? (i.e. is >50% of its total area of occupancy is in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?)	a. No. b. No The Ontario distribution of caribou is continuous and contiguous with the exception of the Lake Superior coastal range which is separated by an area of discontinuous distribution from the rest of continuous caribou distribution
Number of locations (as defined by COSEWIC).	14 ranges (OMNRF 2014a) 2 areas of continuous distribution separated by an area of discontinuous distribution (OMNR 2009)
Number of NHIC Element Occurrences (Request data from MNRF)	16 (M. Oldham pers. comm.) The 16 EOs currently in the NHIC database were entered some time ago prior to the large digitization effort by OMNRF. The compiled data were uploaded to the locally tracked layers in LIO as EOs, but not following the NatureServe methodology/definition for EOs. Thus, these data cannot simply be uploaded into NHIC's Biotics database (Don Sutherland pers. comm.).
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	Unknown – range recession may still be underway

Is there an observed, inferred, or projected continuing decline in index of area of occupancy?	Unknown – range recession may still be underway
Is there an observed, inferred, or projected continuing decline in number of populations?	Yes – PVA indicates Lake Superior Coastal Range in danger of extirpation; range condition in Sydney and Kesagami ranges considered insufficient to sustain caribou; in nine ranges (69%) it was uncertain if range condition was sufficient to sustain caribou; (OMNRF 2014a)
Is there an observed, inferred, or projected continuing decline in number of locations?	Unknown
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Yes – habitat threats remain: continued/expanded resource development into area of caribou distribution anticipated (e.g. Ring of Fire mineral development, Far North road expansion, northward forestry expansion)
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of mature individuals in each sub-population or total population (if known)

Sub-Population (Range)	N of Mature Individuals (Minimum Animal Count, includes calves)
Berens	237
Brightsand	224
Churchill	262
James Bay	177
Kesagami	178
Kinloch	113
Missisa	745
Nipigon	172
Pagwachuan	164
Ozhiski	143
Spirit	373

Swan	491
Sydney	55
Total (13 ranges, excluding Lake Superior Coastal Range)	3334
Lake Superior Coastal Range)	Unknown

Quantitative analysis (Population Viability Analysis conducted)

- Not completed for entire area of distribution
- PVA Indicated that there is a high probability of extinction of the Slate Islands Provincial Park caribou subpopulation, which comprises a large proportion of the Lake Superior Coastal subpopulation, within the next century (Shuter et al. 2005)

Rescue effect

Rescue effect attribute	Likelihood
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Yes – immigration has been documented on both Manitoba and Quebec borders, but unlikely to lead to rescue effect
Would immigrants be adapted to survive in Ontario?	Yes
Is there sufficient suitable habitat for immigrants in Ontario?	Suitable habitat present but the degree of sufficiency unknown
Is the species of conservation concern in bordering jurisdictions?	Yes
Is rescue from outside populations reliant upon continued intensive recovery efforts?	Possibly

Appendix 2: Ontario and adjoining jurisdiction status rank and decline

Information regarding status rank and decline for Caribou, Boreal population

Jurisdiction	Subnational rank	Scientific name	Sources	Population trend
Ontario	S4 S4 S4	<i>Rangifer tarandus</i> – <i>Boreal population</i> (Population 14) <i>Rangifer tarandus caribou</i> <i>Rangifer tarandus</i>	NatureServe (2015)	See text
Quebec	S2S3 S4S5 S5	<i>Rangifer tarandus</i> – <i>Boreal population</i> (Population 14) <i>Rangifer tarandus caribou</i> <i>Rangifer tarandus</i>	NatureServe (2015)	Adjacent ranges declining (Rudolph et al. 2012) Provincial λ of 0.98 (COSEWIC 2014)
Manitoba	SNR S2S3 S4	<i>Rangifer tarandus</i> – <i>Boreal population</i> (Population 14) <i>Rangifer tarandus caribou</i> <i>Rangifer tarandus</i>	NatureServe (2015)	Under review (Manitoba Boreal Woodland Caribou Management Committee 2014)) Provincial λ of 0.90 (COSEWIC 2014)
Michigan	SX	<i>Rangifer tarandus</i>	NatureServe (2015)	Extirpated
Minnesota	SX	<i>Rangifer tarandus</i>	NatureServe (2015)	Extirpated
Nunavut Only barren ground caribou are found in Nunavut.	SNR	<i>Rangifer tarandus</i>	NatureServe (2015)	NA
New York	SX	<i>Rangifer tarandus</i>	NatureServe (2015)	Extirpated
Ohio	Not present	n/a	n/a	NA
Pennsylvania	Not present	n/a	n/a	NA
Wisconsin	SX SNR	<i>Rangifer tarandus caribou</i> <i>Rangifer tarandus</i>	NatureServe (2015) NatureServe (2015)	Extirpated

Note: NatureServe has subnational ranks for a variable number of jurisdictions for the boreal population (population 14), the formerly recognized woodland caribou subspecies (*Rangifer tarandus caribou*), and the species (*Rangifer tarandus*) and there is some inconsistency in jurisdictional ranking (NatureServe 2015). All subnational ranks are indicated where appropriate for each jurisdiction.

Acronyms:

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

COSSARO: Committee on the Status of Species at Risk in Ontario

ESA: Endangered Species Act

GRANK: global conservation status assessments

IAO: index of area of occupancy

MAC: Minimum animal counts

MNRF: Ministry of Natural Resources and Forestry

NHIC: Natural Heritage Information Centre

NNR: Unranked

NRANK: National conservation status assessment

PVA: Population viability analysis

SARA: Species at Risk Act

SNR: Unranked

SRANK: subnational conservation status assessment

SX: presumed extirpated

S2: Imperiled

S3: Vulnerable

S4 : Apparently secure

S5 : Secure