

Which Caribou?

Misnaming Caribou Population Units Leads to Conservation Errors

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Abstract

In reviewing the genetic, morphological, behavioural, and ecological distinctiveness of caribou throughout Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (2011) divided “Southern Mountain caribou” (c.f. COSEWIC 2002) into three designatable units (DU) for conservation purposes: Northern Mountain (DU7), Central Mountain (DU8), and Southern Mountain (DU9) populations of woodland caribou. These new designations mean that each is considered a “wildlife species” according to the Species at Risk Act. Recent federal and provincial government reports refer to “Southern Mountain caribou,” conflating Southern Mountain, Central Mountain, and nine of the 45 subpopulations of Northern Mountain caribou into one pseudo-population, with clear conservation consequences. For example, in 2018, a federal decision on an emergency order required the Minister of Environment and Climate Change Canada (ECCC) to ascertain whether there were immediate threats to the survival or recovery of the Southern Mountain population of woodland caribou. By conflating two ecotypes and part of another into “Southern Mountain caribou”—an obsolete, geographical grouping not used since 2002—ECCC’s assessment falsely informed the Minister that there were 3,764 “Southern Mountain caribou,” when in fact there were only 1,240 in the Southern Mountain (DU9) population. Other errors arising from the first distorted the number and trajectories of extant subpopulations. Instead of issuing the emergency order, the Minister entered into protracted negotiations with the province on recovery planning that continue at this writing. The nomenclatural ambiguity can be resolved by 1) using the currently accepted taxonomy naming Osborn’s caribou a valid subspecies, *R. t. osborni*, instead of Northern Mountain population of woodland caribou, 2) using original English names for Mountain caribou and Rocky Mountain caribou, and 3) basing conservation actions on these distinct phylogenetic units as per COSEWIC (2011, 2014).

KEYWORDS: caribou; subspecies; ecotype; population; subpopulation; designatable unit

Background

Our three western montane caribou ecotypes were originally described as full species—Mountain caribou *Rangifer montanus* Seton-Thompson (1899), Osborn’s caribou *Rangifer*

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osborni Allen (1902) and Rocky Mountain caribou *Rangifer fortidens* Hollister (1912)—and remained so until Banfield (1961) revised the reindeer and caribou genus (*Rangifer*). This revised classification grouped the migratory montane caribou with the sedentary woodland caribou (*R. t. caribou*) of the boreal forest from the Yukon to Labrador. McTaggart Cowan (1962, p. 169) objected immediately, noting that Banfield had lumped subspecies that Banfield himself considered distinctly different, used inappropriate statistical methods, did not provide quantitative differences characterising adjoining subspecies, failed to show how his data supported the conclusions drawn, and even “exceeded this quota” on spelling and grammar mistakes. Other mammalogists and systematists also objected (e.g., Eger et al. 2009, Geist 1998, 2007; Groves & Grubb 1987, 2011; Markov et al. 1994, Nagorsen 1990). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2011) stated that Banfield (1961) “is out-of-date with respect to current science and does not capture the variability of caribou across their range in Canada” (p. 88). The current world authority on mammalian taxonomy (referenced, for example, by the American Society of Mammalogists) Wilson and Mittermeier (2011) joined Wilson and Reeder (2005) in recognizing three Canadian subspecies—including Osborn’s caribou, *R. t. osborni*—that Banfield (1961) had grouped with woodland caribou.

In 2002, COSEWIC assigned western montane caribou into National Ecological Areas (NEAs). Populations in the Southern Mountain Ecological Area became “Southern Mountain caribou” and those of the Northern Mountain Ecological Area became “Northern Mountain caribou” (Figure 1). This introduced nomenclatural ambiguity and gave rise to such awkward constructs as “the southern group of Southern Mountain caribou” (e.g., Environment and Climate Change Canada [ECCC] 2018; ECCC & Province of British Columbia 2017). Even COSEWIC (2002, p. vi) acknowledged that National Ecological Areas “are not a perfect fit for ecotypes of caribou in Canada.”

British Columbia uses somewhat different terminology, distinguishing “Mountain caribou,” so-named and described by Seton-Thompson (1899) as *Rangifer montanus*, from “northern caribou” and identifies a handful of Northern Mountain caribou subpopulations among the former.

Genetic studies have since confirmed that, at the broadest scale, woodland caribou (*R. t. caribou*) are well differentiated from barren-ground caribou (*R. t. groenlandicus*); at a finer scale, within woodland caribou are clades (genetically distinct groups that cluster together and apart from others) that have unique haplotypes (DNA segments that define a population) and are at least as different from each other as some subspecies are (Courtois et al. 2003, Cronin et al. 2005, Dueck 1998, Eger et al. 2009, Flagstad & Røed 2003, Klütsch et al. 2012, McDevitt et al. 2009, McFarlane et al. 2009, Serrouya et al.

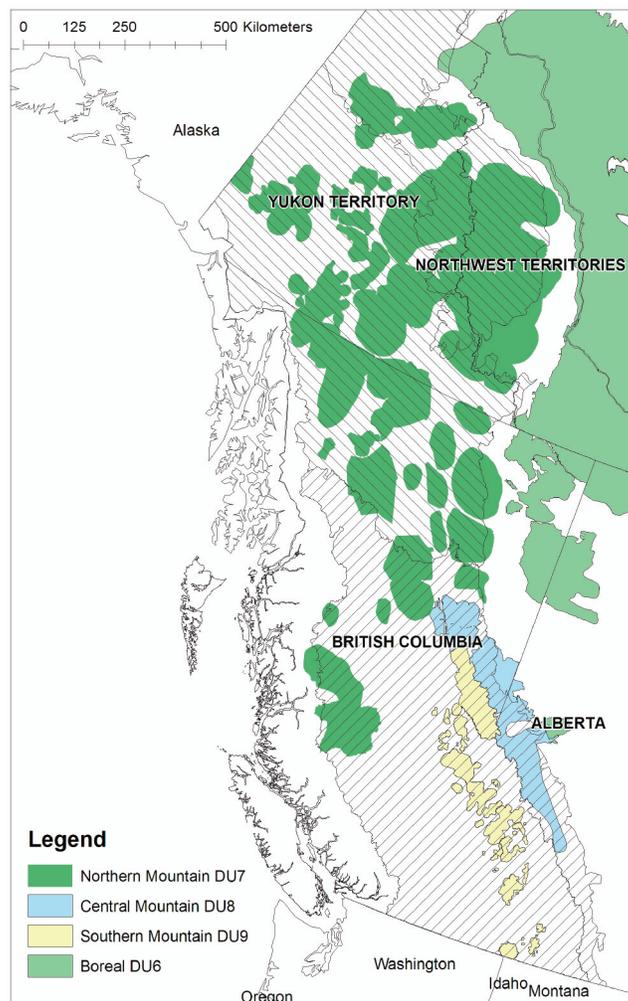


Figure 1. Map showing the caribou subpopulations from COSEWIC (2011) in the Boreal (DU6), Northern Mountain (DU7), Central Mountain (DU8), and Southern Mountain (DU9) populations. Boundaries were adjusted in 2014. The Southern Mountain and Northern Mountain National Ecological Areas (COSEWIC 2002) are cross-hatched. Designated units ArcMap layer provided by the Canadian Wildlife Service.

2012, Van Staaen et al. 1995, Weckworth et al. 2012, Zittlau et al. 2000). These studies also showed that the Northern Mountain population clusters phylogenetically and shares haplotypes with barren-ground caribou, but not with Boreal, Central Mountain, or Southern Mountain populations; and that the last two cluster are close to, but separate from, Boreal caribou.

Zittlau (2004) found strong differentiation among all Southern Mountain (DU9) subpopulations sampled, the South Purcells being particularly distinct. Serrouya et al. (2012) also found high differentiation among Southern Mountain (DU9) caribou, concluding that some adjacent Southern Mountain subpopulations were even more differentiated genetically than other caribou of different subspecies, and that the Peace River and North Thompson River were barriers to gene flow. Caribou from North Cariboo Mountains, Wells Gray, and the Hart Ranges had a few haplotypes in common with adjacent Central Mountain subpopulations, as did most of the sampled Chilcotin subpopulations that COSEWIC (2011) defined as Northern Mountain. Nevertheless, the “deep snow” (discussed below) subpopulations south of the North Thompson River valley (i.e., from Groundhog south) clustered together (except for the now-extirpated South Selkirk subpopulation that had some Northern Mountain [DU7] genes from 103 individuals translocated from the Chilcotin in the 1980s and 1990s).

COSEWIC (2011, p. 46) described how “extensive radio-telemetry monitoring conducted over many years” showed that Central Mountain (DU8) caribou are reproductively isolated from the Northern Mountain caribou (DU7), Boreal caribou (DU6), and Southern Mountain caribou (DU9) due to “dramatically different ecotypic adaptations” and migration patterns. Whether the morphological differences that Hollister (1912) reported when he described them as Rocky Mountain caribou (*Rangifer fortidens*)—if confirmed by a larger sample size with modern methods, as well as genetic, behavioural, and ecological differences—warrants taxonomic recognition or not, COSEWIC’s (2011) designation of the Central Mountain population is robust.

Subpopulations

Caribou subpopulations (“herds”) were variously defined until Wittmer et al. (2005a) reviewed all radio- and satellite telemetry data for the “mountain ecotype” i.e., Mountain caribou *sensu* Seton-Thompson (1899). Wittmer et al. defined 18 subpopulations, each consisting of individual caribou whose home ranges overlapped with each other but not with those of other subpopulations (Figure 2). Wittmer et al. (2005a) did not observe evidence of inter-subpopulation dispersal that would have defined a metapopulation. Other studies likewise found a lack of dispersal among subpopulations, fragmented by reservoirs and logging of lowland cedar-hemlock forests (Apps and McLellan 2006, Hansen et al. 2001, Kinley and Apps 2001, Terry et al. 2000). Van Oort et al. (2011), using an expanded telemetry data set, confirmed the lack of dispersal among the 18 subpopulations.

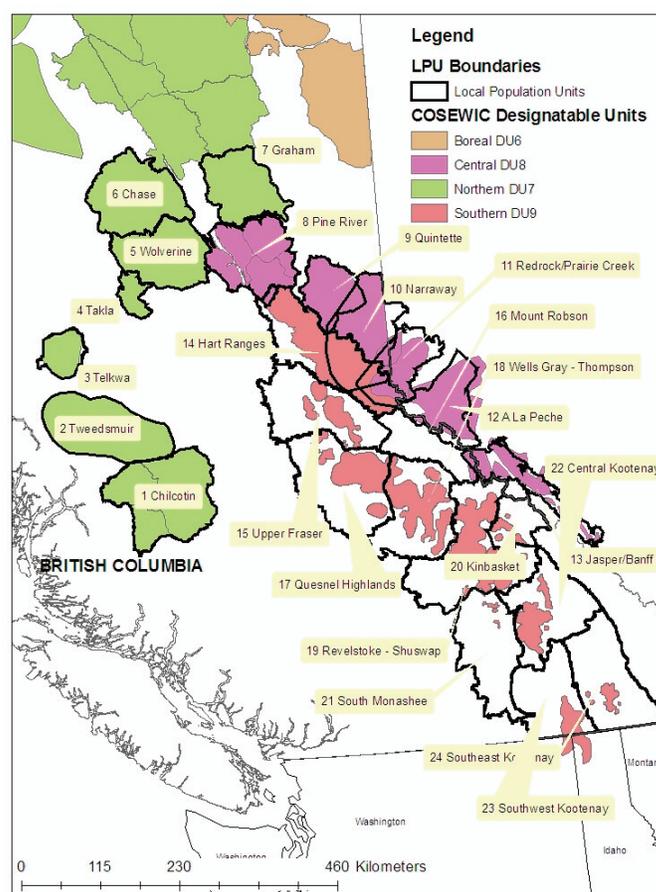


Figure 2. Map showing caribou subpopulations as defined by Wittmer et al. (2005) and Local Population Units (LPU) (ECCC 2018). Federal LPU boundaries ArcMap layer provided by the Canadian Wildlife Service.

Local Population Units

Since 2014, ECCC—but not COSEWIC—has combined subpopulations for all three montane ecotypes that occur within the obsolete “Southern Mountain caribou” pseudo-population into Local Population Units (LPU) without providing justification. The term “Local Population Units” does not occur in either the designatable unit report (COSEWIC 2011) or the COSEWIC assessment report (COSEWIC 2014). Local Population Units are defined differently from the “local population” structure that ECCC used for the Boreal caribou (DU6) recovery plan (see Weckworth et al. 2018 for a detailed evaluation). “Local population” is a specific phrase in population biology and conservation biology; it implies a metapopulation where there has been some gene flow, however recent, among its subpopulations (e.g., Hanski et al. 1997, Harrison 1994). Environment Canada (2014, p. 5) introduced LPUs in the federal recovery strategy, explaining that “subpopulations have been organized into ‘local population units’ (LPUs), which reflect likely larger historical subpopulations that have declined in number and become fragmented into the currently recognized subpopulations.” By this definition, LPUs were not expected to represent currently functional metapopulations. In fact, federal LPUs are identical to BC provincial “planning units” introduced in 2006 with no mention of metapopulation dynamics (Mountain Caribou Science Team 2006).

The assignment of these caribou populations to “designatable units” is not merely nomenclatural housekeeping. Under the Species at Risk Act (SARA), COSEWIC is charged with assessing the conservation status of taxa and may recommend listing under the Act. The designation makes each population a “wildlife species” within the meaning of SARA.¹ This is true whether the “wildlife species” is listed under Schedule 1 or Schedule 2, or not at all.

In 2014, COSEWIC classified both the Central Mountain and Southern Mountain populations as endangered and reported this to the Minister in September of that year, as required by law. On the Species at Risk Public Registry (Government of Canada 2019), under “COSEWIC Information,” the Southern Mountain population is given as “Endangered” and the “Legal Status” as “not on Schedule 1.” The Southern Mountain population are no longer “threatened” as they were in 2002 (c.f. COSEWIC 2002).

The law also compelled the Minister, within 90 days, to either recommend to the Cabinet that the species be listed under SARA as per the COSEWIC recommendation or not, and explain the recommendation on official public registries. This was not done (a statement was posted indicating delays for consultation that did not conform to SARA requirements).

Implications of mis-categorization

A federal government example

In response to four citizens’ petitions for an emergency order to protect specified subpopulations of the Southern Mountain population (Harding 2017, North Columbia Environmental Society (NCES) et al. 2018, Valhalla Wilderness Society 2017, Wells Gray Gateway Protection Society et al. 2017), ECCC (2018) completed an Imminent Threats Analysis (ITA), posted on the Species at Risk Public Registry on May 4, 2018. It was the basis of the Minister’s decision the same day, communicated to the four petitioners in identical language, that: “the Minister formed the opinion that Southern Mountain caribou is facing imminent threats to its *recovery*” but “the Minister also considered whether there were imminent threats to *survival* of the species and concluded that such threats do not exist at this time” (Sue Milburn-Hopwood, CWS, in lit. to L. E. Harding, May 4, 2018; emphasis added).

The difference between “recovery” and “survival” is crucial, because the latter would have forced the federal minister to recommend to the Governor-in-Council (i.e., Cabinet)

emergency orders under Section 80. Instead, ECCC entered into negotiations with British Columbia under Section 11 of SARA to develop an improved recovery plan. The conservation agreement, signed on February 21, 2020, like other recent documents, inappropriately lumps the Southern Mountain population with Central Mountain and nine subpopulations of the Northern Mountain population (ECCC 2020).

Errors from conflating populations

How reliable was the advice to the Minister? The ITA erred in stating that there were 3,764 “Southern Mountain caribou,” which included all Southern Mountain, Central Mountain, and nine subpopulations of Northern Mountain caribou (Figure 1). The total of all “Southern group” DU9 herds was actually 1,240 (range 1,217–1,245) at the time of writing the ITA (ECCC 2018, p. 41). Therefore, including Northern and Central populations inflated the population size by about three times and gave the Minister an erroneously optimistic view of their chances for survival.

Besides inflating total numbers, the ITA perforce gave different population trajectories for the expanded pseudo-population than would have been correct for the Southern Mountain population alone—critical criteria in assessing conservation status (c.f., COSEWIC 2018, IUCN Standards and Petitions Committee 2019).

Errors from aggregating subpopulations into LPUs

Numbers of subpopulations and the size and trajectory of each are crucial for assessing conservation status. The ITA confused the number of LPUs: in one instance, it states there are 23 LPUs, several of which were “stable or increasing,” while elsewhere it states “21 extant LPUs, most of which are connected” (ECCC 2018, p. 8). In fact, there are only 11 Local Population Units of the Southern Mountain population (DU9), three of which (LPU 16, LPU 20, and LPU 21; Figure 2) were extirpated by the time of completion of the ITA. Therefore, there were eight extant DU9 LPUs, none were connected and none were increasing (the combined Wells Gray-Thompson subpopulation was 341 in 2014 and 348 in 2017–2018—not a statistically significant increase—and the Barkerville population was said to be increasing in the ITA’s text, but it dropped from 78 in 2014 to 72 in 2016). The ITA statements were thus false.

Resilience is the ability of ecosystems to absorb changes, and generally means that the more individuals in a population, and the more populations there are, the better the species can cope with threats. The ITA used the number of LPUs as a measure of resilience: the greater the resilience, the greater the chances of survival for the species.

British Columbia split the large Wells Gray subpopulation (c.f. Wittmer et al. 2005a) into two: north and south. Followed by ECCC (2018), this arbitrarily increased the number of subpopulations and placed them in different LPUs. Likewise, they split the Hart Range subpopulation into Hart-South and Parsnip, increasing the number of subpopulations and thus apparent resilience.

Conversely, the province “merged” two subpopulations that Wittmer et al. (2005a) had identified as separate, based on lack of dispersal. The Duncan and Nakusp subpopulations were merged as Central Selkirk and the Allen Creek subpopulation subsumed into the Wells Gray South pseudo-subpopulation (Figure 2). In both cases, the province stopped surveying these two subpopulations. The Duncan subpopulation is presumed extirpated (two at last count in 2012 [DeGroot and Furk 2012]) but the Allen Creek subpopulation had 30 at last count in 2010 (De Groot 2010). Dropping these from population assessments altered the true subpopulation trajectories and prevented the Minister from being apprised of their extirpation.

The ITA (EEEC 2018: p. 3) introduced “critically small population thresholds (e.g., approximately less than 50 or 20 animals ...),” acknowledging a principal of conservation biology that very small populations are likely to go extinct from purely demographic reasons (such as inbreeding) or accidents (such as avalanches), regardless of continuing threats. This happened in Banff National Park, where the last five caribou were killed by an avalanche in 2009 (Hebblewhite et al., 2010). By aggregating subpopulations by LPU, the ITA counted more pseudo-subpopulations with numbers above these thresholds than actually existed, because most include subpopulations that were below the critical thresholds. The problem of counting populations below critical thresholds is twofold.

First, the conflation of Northern Mountain (part), Central Mountain, and Southern Mountain populations led the authors of the ITA (ECCC 2018, p. 37) to report that 12 LPUs had populations greater than 100, but only five of these (Hart, Wells Gray-Thompson, Quesnell Highlands, Upper Fraser, and Revelstoke-Shuswap) were Southern Mountain (DU9) LPUs.

Second, counting LPUs obscured for the Minister that, of the extant subpopulations of the Southern Mountain population, seven (Narrow Lake, Groundhog, Frisby-Boulder, Columbia South, Central Selkirk, South Selkirk, and Purcell South) were below the threshold of 50 individuals and six of these were below the threshold of 20. This is in addition to the seven subpopulations extirpated (or presumably so) between the 2007 BC recovery plan and the Minister’s statement of May 4, 2018 (George Mountain, Allen Creek, Mt. Robson, Kinbasket, Duncan, Monashees, and Central Purcell). As written, the ITA could not accurately inform the Minister to form her legally compelled opinion on whether survival of the remaining caribou was threatened; so many had become extirpated recently and so many others were below the “critically small population thresholds” (ITA, p. 3). That two more, South Selkirk and Purcell South, were extirpated in 2018 after the Minister’s statement (Reid and DeGroot 2018a, Reid and DeGroot 2018b), demonstrates the effect of these errors.

The conflation of the three DUs and aggregation of subpopulations into LPUs led the ITA to make errors other than strictly quantitative. For example, it said that “Wolves are the primary predator of southern mountain caribou across the range” (ECCC 2018, p. 4). This is true for Northern Mountain and Central Mountain populations, but not true for the Southern Mountain population range (Wittmer et al. 2005b). In multiple reports, following caribou census surveys, provincial biologists documented little or no wolf mortality, in contrast to frequent cougar mortality (e.g., DeGroot 2017a, Reid and DeGroot 2018a). In Columbia North, for example, just 8.2% of radio-tagged caribou deaths were known or thought to have been killed by wolves; the known-death caribou were more often killed by bears (34%), cougars (20%), and wolverines (17%) (Furk et al. 2008). The South Selkirk subpopulation went from 11 in 2017 to zero in 2018 *after* all 27 known wolves had been culled (Reid and DeGroot 2018b). The ITA’s incorrect assertions thus misled the Minister.

The ITA (ECCC 2018, p. 14) cited maternity pens as “effective mitigation measures that reverse the population trend in the short to medium term,” giving the successful Klinse-za pen as an example. Klinse-za is in a Central Population (DU8) area where wolves are the main caribou predator and terrestrial lichens the only winter forage. The ITA did not mention a failed maternity pen near Revelstoke in a DU9 subpopulation area. In five years, it had low post-release survival of cows and calves, virtually no increase in recruitment, and at least 17 in-pen mortalities reported through 2018 when the program was terminated (Revelstoke Caribou Rearing in the Wild Society 2019). There were also at

least two unreported deaths, since the number of calves born was two fewer than the number of cows that were pregnant when they were brought into the pen. Such selective use of data is scientifically unconscionable and is another example of the report's failure to accurately inform the Minister.

The ITA also erred by minimising the threat of winter-motorized recreation (snowmobiles and heli-skiing), a well-recognized threat in the Southern Mountain (DU9) population (DeGroot 2017a, 2017b, 2017c; Legebokow & Serrouya 2017) but hardly mentioned in censuses of Central Mountain and Northern Mountain populations.

Conclusion

Conflating three western montane caribou populations into an obsolete, geographical grouping and aggregating them into poorly defined LPUs is not biologically or legally justified, misapplies conservation criteria, downplays threats to their survival, and misguides conservation efforts.

This issue has not only affected Environment Canada publications: Serrouya et al. (2019), although acknowledging that their study included all three montane and the boreal ecotypes, nevertheless analysed growth rates of 18 subpopulations to detect effects of adaptive management, without including ecotype in their models. They concluded that wolf culling and maternity pens increased growth rates. However, Harding et al. (2020) reanalysed their data and showed that a model with ecotype as a predictor outperformed all other models, while management interventions fell to insignificance.

Weckworth et al. (2018) have provided a cogent analysis of COSEWIC's use of genetic data in defining designatable units and of ECCC's use of LPUs in recovery programs for Mountain caribou (*sensu* Seton-Thompson 1899) and the Boreal caribou of Alberta. They noted that the COSEWIC guidelines (citing COSEWIC 2015) were applied differently in the federal Boreal and Mountain caribou recovery strategies. For Mountain caribou, they concluded that, with the use of COSEWIC guidelines combined with LPUs, contrary to the intent of the SARA, "subpopulations within a greater Local Population Unit can become or remain extirpated, but still meet the strategy's objectives as long as other subpopulations remain" (Weckworth et al. 2018, p. 9). More generally, they recommended that local populations be defined on the basis of metapopulations with confirmed gene flow using genetic data, such as that in Serrouya et al. (2012) and Weckworth et al. (2013, 2012), and suggested approaches to anticipate new genetic data that could result in adjustments to DUs.

The solution to this nomenclatural ambiguity is, first, to use valid taxonomy. The internationally accepted subspecies *R. t. osborni* (Allen 1902), Osborn's caribou, should be used instead of "Northern caribou" in BC parlance and the "Northern Mountain population of woodland caribou" in the federal scheme. Second, even if not recognized as taxonomic units (pending a much-needed revision of the genus), the "Central Mountain population" and the "Southern Mountain population," designated by COSEWIC (2011) as separate and distinct phylogenetic units, should retain their original English names, as BC does for the latter: Rocky Mountain caribou and Mountain caribou, respectively. Third, until they can be defined on the basis of documented gene flow within a metapopulation (c.f. Weckworth et al. 2018), LPUs have no place in conservation biology of western montane caribou. These measures would focus conservation where it needs to be: on stable, accepted, distinct populations of caribou.

Acknowledgments

I thank three anonymous reviewers whose suggestions greatly improved the manuscript.

Note

1. Section 2(1): “*wildlife species* means a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism ...” (Government of Canada 2015).

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MISNAMING
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