

# Next steps for Southern Mountain Caribou recovery in planning Unit 3A, the Revelstoke Shuswap Region

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## 1. Background

Southern Mountain Caribou populations in British Columbia (BC) are red listed and COSEWIC has formally recommended that their federal status be changed from threatened to endangered. To help direct the recovery of these populations, the BC Mountain Caribou Science Team (ST) released a report entitled *Management Options and Related Actions for Mountain Caribou in British Columbia* in 2006. The purpose of the document was to "... describe the broad-scale actions that the Mountain Caribou Science Team considers necessary to meet defined management options for mountain caribou, using consistent criteria and definitions."<sup>1</sup> Following the release of this document and subsequent workshops with the ST, the BC Ministry of Environment summarized management actions and options prepared by the ST<sup>2</sup>. The Ministry also released the Mountain Caribou Recovery Implementation Plan (MCRIP), with the objectives of stabilizing population declines within seven years (i.e. by 2014), and recovering the population to pre-1995 levels (2500 animals) within 20 years (2027).

Given the objectives developed by MCRIP and a decade has now passed since the ST report, it is appropriate to assess the level of achievement and if needed, chart a new path forward. This approach is consistent with the principle of adaptive management, where new information is incorporated into policy within a scientific framework. Therefore, the purpose of this document is similar to the stated objective of the 2006 ST report, but with several modifications: 1) the inclusion of new information following several major management actions will help alter or reiterate specific management actions; 2) the scope is restricted to Planning Unit 3A, the Revelstoke-Shuswap Unit where significant management and research has occurred over the last decade in this PU, making possible to objectively gauge the relative benefit of alternative management actions; 3) management actions are presented in the context of the **Assisted Long-term Sustaining (ALTS)**<sup>a</sup> option chosen by the BC Government for this Planning Unit. Previous ST documents presented a suite of options and management actions required for each, but intentionally avoided specifying which option was to be implemented. Given that an option has been selected, our task can be focused on the management levers that can achieve objectives from the option mandated by Government.

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<sup>a</sup> All terms in bold are defined in the Glossary at the end of the document

## 2. Summary of recent actions and population dynamics

The most notable management action in PU 3A has been to reduce moose densities to levels supported by a natural forest age class. This action was done to try and reduce wolf populations to match the lower moose numbers. This management experiment appears to have stabilized the decline of the Columbia North subpopulation<sup>3,4</sup>. This finding is consistent with other **population-based** management actions in Alberta and BC, in that single management actions have stopped the decline but not led to population increase. Gains in **lambda** have been roughly 4 to 7 units (i.e. from 0.95 to ~ 0.99-1.02) – whether it was wolf control in Alberta<sup>5</sup>, or moose reductions in the Parsnip or Revelstoke<sup>3,4</sup>. These trends are better than the alternative – continued population declines, but population growth is needed to achieve provincial and federal recovery objectives. These results have led several researchers (including an independent review conducted for BC<sup>6</sup>) to conclude that multiple population-based levers must be initiated simultaneously<sup>4,6</sup> to achieve growth.

Possible reasons for lack of pronounced population growth following the moose reduction in PU 3A are: 1) wolf densities that remain above ecologically based recovery targets (see Wolf section below) and 2) **additive or compensatory mortality** of caribou from other sources known to occur in this ecosystem (bears and cougars<sup>7,8</sup>), 3) the moose reduction was applied to only about 70% of PU 3A (and 2/3 of the Columbia North subpopulation; much of the PU occurs in Region 3, yet the moose reduction was applied only in Region 4), 4) a series of warm winters (2013 to 2016) has likely led to a re-emergence of the cougar – deer dynamic that dominated this ecosystem in the 1990s<sup>3,7</sup>. Recent increases in deer abundance are based on anecdotal<sup>b</sup> information, but increases in cougar predation on radio-collared caribou have been recorded (4 caribou killed in one drainage in the fall of 2015). A final possibility is that high levels of heli-skiing and snowmobiling may be having some effect although there has been limited research on this topic. Researchers have documented less caribou use in areas of high snowmobile activity<sup>9</sup>, and higher stress hormones in areas of heli-ski and snowmobile activity compared to areas without mechanized recreation<sup>10</sup>.

Although the Columbia North population censuses have suggested stability from 2003 to 2013, censuses have not been possible from 2013 to 2016 due to an inconsistent snowpack. We suspect that the Columbia North population has resumed its decline (recent recruitment surveys have all been <15%), likely because of continued cougar and wolf presence in the area, particularly on the west side of Lake Revelstoke.

***Of particular significance is that the Columbia South subpopulation (which overlaps Mt. Revelstoke and Glacier National Parks) is near extinction. It has declined from 120 animals in 1994 to 4 animals in 2016. Similarly, the Frisby-Queest subpopulation numbers less than 10 animals.***

Significant habitat protection has occurred in this PU. A total of 188,578 Ha has been placed in **GAR**, 30% of which is in the **THLB**. Of the **core caribou foraging**<sup>c</sup> habitat mapped during the 1990s (MAC land use

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<sup>b</sup> Supported by hunters and guide outfitters who work at the maternity pen and maintain a log of animals observed, and camera traps.

<sup>c</sup> **Core caribou foraging** is shown in Purple in Fig. 1, but note that this does not adequately include matrix or “anti-predator” habitat. Core caribou foraging habitat is defined in the glossary.

plan) and 2007 land-use planning processes, approximately 40% is protected by the GAR (Table 1), while the remaining portion is available for harvest. However, when these values are restricted to age class 8 and 9 (i.e. old growth, core habitat) forests, approximately 60 to 65% of the remaining old growth is protected by the GAR, while 40% of the remaining old growth is available for harvest. These percentages vary depending if THLB or “operable” forests are considered, and whether National and Provincial Parks are included in calculations. Details are summarized in Table 1.

**Table 1.** Absolute and relative (%) amount of area “protected” (i.e., where logging is prohibited) for core caribou foraging habitat under the Government Action Regulation (GAR). Core habitat is shown as purple in Fig. 1.

Case #	Core Habitat Planning Unit 3A	Revelstoke & Robson Valley TSA (Ha)	Okanagan & Kamloops TSA (Ha)	Total Hectares	Total Hectares Age Class 8 & 9 Only	% calculations (Case #s)	% of core habitat that is protected	% of core habitat that is protected (age class 8 & 9 only)
1	Total Area Core Habitat PU3A	346,251	105,772	452,023	242,864	2÷1	41.7	57.9
2	Total GAR Ha	160,826	27,752	188,578	140,656			
3	GAR Ha within Operable	53,146	16,090	69,236	58,042			
4	GAR Ha outside Operable	107,680	11,662	119,342	82,614			
5	Total Ha of Operable	126,048	46,579	172,627	92,257	3÷5	40.1	62.9
6	Total Ha of Inoperable	220,203	59,193	279,396	150,607			
7	GAR Ha within THLB	41,863	14,031	55,894	49,224			
8	GAR Ha Non-THLB	118,963	13,721	132,684	91,432			
9	Total Ha of THLB	103,606	35,477	139,083	75,204	7÷9	40.2	65.5
10	Total Ha of Non-THLB	242,645	70,295	312,940	167,660			
11	Total GAR Ha plus National & Provincial parks	200,912	28,506	229,418	162,525	11÷1	50.8	66.9

There have also been closures to mechanized recreation on public lands. Within the late-winter range of the Columbia North subpopulation, Caribou Basin was closed to all snowmobiling in 2012 (previously use was permitted on weekends and BC statutory holidays). Although the vast majority of the Columbia

North late-winter range is now closed to snowmobiling, use continues in late-winter habitat at Bourne/Pettipiece Pass and Mt. Grace where only partial closures or snowmobiling under permit are allowed. The entire late-winter range of the Frisby-Queest subpopulation is subject to mechanized recreation (snowmobiling at Eagle Pass, Frisby Ridge, Boulder and Queest, catskiing, heliskiing and ski touring). For Columbia South, snowmobiling continues to occur at Sale Mt. and at Keystone Creek/Standard Basin. In 2012 the partial closures at Keystone Creek/Standard Basin were expanded significantly to include the majority of high-value late-winter habitat. Within Mount Revelstoke and Glacier National Parks, ski touring is expanding in popularity and range. As a result, Parks Canada implemented a closure at Mt. Klotz in 2008 to minimize disturbance. Outside of the national parks, heliskiing is active throughout the vast majority of the study area. In the spring of 2013 a moratorium on new commercial backcountry recreation tenures within high value late-winter habitat was renewed for another 5 years.

Habitat protection alone cannot prevent extinction of mountain caribou in the short term, at least until the currently disturbed habitat has had time to recover<sup>11,12</sup>, so direct and indirect management of predators is needed in the short term to avoid further population decline. This is a consistent conclusion from independent research and management agencies throughout North America<sup>5,12-15</sup>. However, continued forest harvesting of critical habitat will further benefit the growth of moose, deer, and predator populations, and fragment habitat that increases predation on caribou<sup>16</sup>.

Maternity Penning was initiated in 2014 in PU 3A and continued annually but with mixed results. Unlike the moose reduction, maternity penning has shown little or no indication of increasing lambda. This result is partially because an insufficient number of adult females were penned to affect lambda. Additional factors include high post-release calf mortality in year 1, and pre-release mortalities of calves in years 2 and 3. Nonetheless, calculations have indicated that penning has had a net benefit on calf survival, but the effect is not as strong as initially anticipated. In 2015/2016, penning appeared to increase population-level recruitment for the Columbia North subpopulation from 11.8 to 14.8%. Over the course of 3 years, penning has added approximately 9 calves to the wild population, an addition of 24% relative to wild numbers over the same time period. In comparison, a combination of wolf removal (aerial and ground) and maternity penning in the Klinse-Za (formerly Moberly) caribou herd, which occurs just north of mountain caribou range, has resulted in a near doubling of this small herd over a 3-year period<sup>17</sup>.

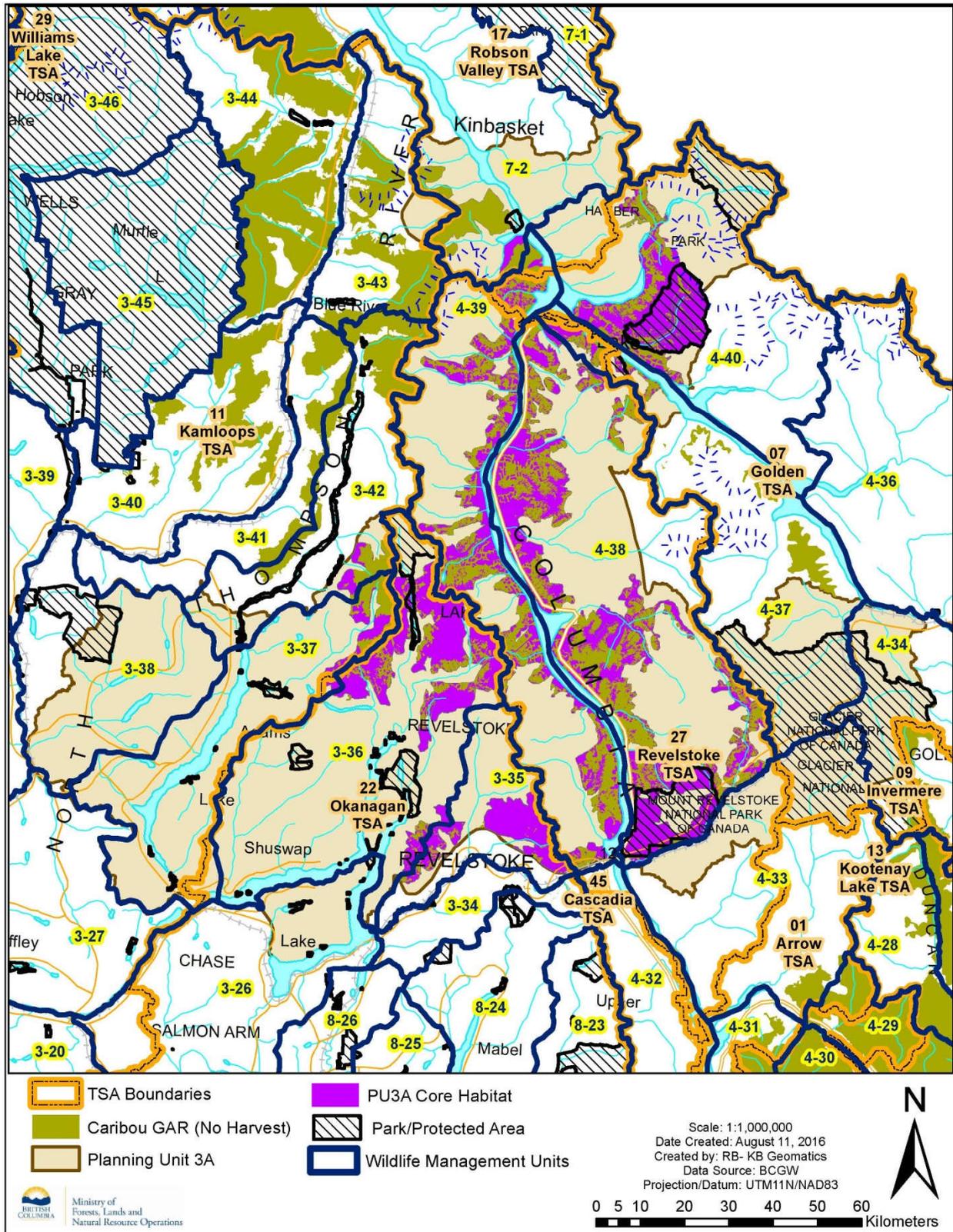


Figure 1. Core habitat refers to key caribou foraging and (anti) moose/deer areas, mapped during the MAC plan and the 2007 MCRIP processes. Includes all early and late winter caribou telemetry locations.

### 3. Management going forward

#### 3.1. Habitat

In Planning Unit 3A, forest harvesting still occurs in the **critical habitat** of Southern Mountain Caribou. Harvesting in critical habitat is somewhat unique to PU 3A because, unlike other areas, Southern Mountain Caribou spend much more time (30 to 50% of the year, mostly in early winter and spring/summer) at low elevations in this ecosystem<sup>18</sup>. Here, they overlap with cedar/hemlock forests that are very valuable to the forest industry. Because of habitat protected as part of the GAR, it appears that the rate of forest regeneration in old cut blocks is exceeding the rate of forest harvest (Appendix A). In other words, more forest is coming “off line” for moose and deer early seral foraging habitat than is being created by harvest. Although we do not provide a quantitative analysis, a visual summary from the University of Maryland’s Global Forest Watch (Appendix A) appears to support this assertion. Furthermore, the federal recovery process will be releasing draft maps of critical habitat for stakeholder comment. There will be substantial interplay between provincial and federal counterparts about how to implement management within critical habitat. This process will likely supersede any local policy in PU 3A so we defer to Federal/Provincial process. However, the MCRIP Predator/Prey Terms of Reference state: “1. Protect all high suitability early and late winter habitat...Government’s goal is to protect 100% of the high suitability winter habitat within identified herd areas.” Provincially, the level of protection for mountain caribou is approximately 95% of core habitat – it is likely 100% in most areas, but PU3A brings that average down to 95%.

#### 3.2. Wolves

Due to the moose reduction, wolf densities have declined from ~30/1000km<sup>2</sup> in 2007 to about 11/1000km<sup>2</sup> in recent years<sup>d</sup>. These values are still above targets set in the federal<sup>19</sup> and provincial<sup>20</sup> recovery strategies. There are no humane methods to directly reduce wolf numbers, but aerial removal is the only method of killing enough wolves (and entire packs) to reduce wolf densities with no risk of by-catch. To date, aerial removal has not been conducted in PU 3A. Wolves have been documented killing radio-collared caribou in this ecosystem<sup>8</sup>, including a calf released from the maternity pen<sup>21</sup>. Wolves are regularly photographed with game cameras near the maternal pen and release dates have been affected by their presence. The combination of aerial and ground removals of wolves, with maternity penning, has resulted in a near doubling of the Klinse-Za herd in northern BC<sup>17</sup>.

To achieve the ALTS option, targeted and limited aerial removals will be required to reduce wolf numbers to the densities stipulated in the Recovery Strategies. Two to three packs on the west side of Lake Revelstoke would be the primary groups for removal. The intensity and duration of wolf removals will be less than what would be otherwise needed because the moose reduction program will reduce immigration and recovery rates of wolves. We note that direct removal of wolves has been called upon by MCRIP (predator Prey Terms of Reference: “targeted removal of individuals or packs where necessary”), but has not occurred in this PU despite continued population declines and near extinction of the Columbia South and Frisby-Queest subpopulations, and lack of growth of the Columbia North

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<sup>d</sup> Note that these are winter densities when census occurs, summer densities which are more comparable to values from the boreal forest are about 1/3 these values.

subpopulation. Scientists involved with the moose reduction experiment have consistently stated that reducing both moose and wolf numbers concurrently is the most prudent approach to reducing predation rates on caribou<sup>4,22</sup>, and the moose reduction will greatly reduce the need for a long-term program of wolf removals.

### **3.3.Cougars**

Here we reiterate the recommendation summarized in BCMOE (2009): “It was also strongly recommended by the ST that where the home range of Cougars (where known) overlaps the home range of Mountain Caribou, these cougars should be targeted for removal.”<sup>2</sup> This action has not been occurring because it requires periodic monitoring of cougar distribution, either through camera traps, snow tracking, or local knowledge of biologists and guide outfitters. Focused hunting on the west side of Lake Revelstoke and the Bigmouth drainage could help remove cougars, but hired houndsmen would increase the likelihood of success. Low-intensity annual tracking combined with local knowledge and camera traps (already occurring around the maternity pen) can be used to target key areas (i.e. the Hub, and Bigmouth, Region 3 MUs).

### **3.4.Primary prey: Moose and white-tailed deer**

Moose numbers should be maintained at the ecological (i.e. in the absence of any anthropogenic change) carrying capacity for the ecosystem. This has been estimated to be ~300<sup>23</sup>. Limited entry hunting for antlerless moose has been shown to keep moose numbers at these levels and such a season should be maintained. Any direct predator control will result in a very rapid increase of moose populations, so these actions should be coordinated to ensure moose numbers to not increase dramatically.

In 2010, white-tailed deer harvest regulations were changed to allow more deer to be killed in Region 4. Similar changes in WMUs 4-38, 39, are required, as well as in WMUs in Region 3 that overlap with PU3A (3-34, 35, 36, 44). Caution should be employed to not to reduce deer numbers too quickly<sup>3</sup>, particularly given recent mild winters that would have contributed to deer population growth<sup>24</sup>. A winter hunt set for a short period and gradually lengthened would help mitigate the risk of suddenly reducing deer populations. However, recent mild winters mean that any severe winter in the near term will increase the chance of a deer population crash, which has been shown to be very detrimental to caribou numbers<sup>3</sup>. Immediate action on white-tailed deer is critical to avoid a repeat of the 1990s caribou declines.

### **3.5.Maternity penning**

Our optimism for maternity penning in PU 3A stems mainly for the impressive gains realized from the Klinse-Za herd, which is situated north of PU 3A. Lambda has improved by ~30 units through intensive removal of wolves and penning almost all the adult females in the population.

In PU 3A, roughly \$1.4 million spent has resulted in approximately 9 additional calves over the wild population (0 in 2014<sup>21</sup>, 6 in 2015, and 3 in 2016<sup>e</sup>). In comparison, the moose reduction likely generated

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<sup>e</sup> The 2016 value assumes 6 of 7 released calves will survive until March 2017.

additional income for the Province (even after including monitoring costs), and resulted in larger gains to lambda.

If calf mortalities in the pen can be resolved (no calf mortalities occurred in 2014, but several occurred in 2015 and 2016), penning can help achieve recovery, provided 3 actions are conducted simultaneously: 1) aerial *and* ground removal of wolves on the west side of Lake Revelstoke; 2) ground removal of cougars, and 3) 30 – 40% of the adult females (i.e. > 20 females) of the CN herd are penned; this target can be achieved with a gradual increase over the next two years, as was intended in the penning pilot plan. Unless these actions occur concurrently (particularly the former 2 actions), we recommend discontinuing maternal penning. The independent review conducted by Boutin and Merrill similarly recommended removing predators prior to releasing animals from the maternity pen, and also recommend *targeted* removals done at a broader scale, while penning<sup>6</sup>. Results from Klinse-Za strongly support this approach. The extreme cost and limited potential for success due to additional mortality factors will limit the effectiveness of the maternity pen. If this high level of funding is to be directed into maternity penning, then predator reduction should be added as this action is what was shown to help the Klinse-Za caribou population.

#### 4. Summary

In Planning Unit 3A, both forestry and wildlife user groups have made significant changes that have resulted in large areas of old-growth habitat being protected and changes in the numbers of alternative prey and their predators. In addition, these user groups and the management agencies have dedicated considerable resources to research and management actions such as maternal penning. Although one subpopulation appears to have stabilized under these actions, it has unfortunately not increased. Furthermore, the Columbia South and Frisby-Queest subpopulations are on the verge of extirpation.

These results suggest that to have the caribou population increase, more management levers must be applied. The rapid dynamics of the deer and thus cougar populations is thought to have been the major factor causing the rapid decline in Southern Mountain Caribou in the late 1990s<sup>3,7,25</sup>. White-tailed deer were never found in the Columbia Mountains north of Revelstoke until the late 1960s. Now, the occasional extremely deep snowpack in the valleys cause these deer populations to fluctuate enormously. They should be kept at very low numbers by sport hunting including a mid-winter hunt (both sexes). Similarly, some individual cougar should be targeted for removal. This will require cougar hunters are active in the area.

In addition, wolf packs that are known to overlap with caribou habitat should be removed. So far, we do not think a blanket wolf removal program is necessary – only the infrequent removal of targeted packs.

The early seral conditions at low elevation are rapidly changing and will become less beneficial to moose and deer. If logging in these areas can be further reduced, then the habitat conditions for these species will degrade and less intensive management of the predator-prey system will be needed.

Not all of planning unit 3A has been subject to the moose reduction, liberalized deer hunting, or other intensive recovery measures – WMUs in Region 3 that overlap with PU3A (i.e. 3-34, 35,36, 44, etc). The

limited implementation of population-based recovery actions in PU3A could be why the Columbia North caribou population growth has not been more pronounced. Policy across Region 3 and 4 should be aligned and coordinated with other measures in PU 3A.

Most of these actions were suggested by the ST more than a decade ago.

Small populations that have declined over the past decade since the MCRIP was released mean that ecologically based targets of prey, predator or habitat abundance<sup>23,26</sup> will have to be exceeded due to **allee effects** that are known to affect mountain caribou<sup>27</sup>. Going beyond previously set targets also adheres to the precautionary principle, a principle that is recognized as important when it comes to recovering an endangered species.

Dedicated annual funding will be required to implement these management actions and to gauge their success. A detailed monitoring plan has been prepared and reviewed by FLNRO staff. Continued communication will be required to align management and monitoring objectives.

## Glossary of terms in Bold

**Allee Effects:** When wildlife populations get smaller, recruitment rates (or another vital rate) often increase because there is more food per capita. This is classic density dependence, and keeps populations from going extinct or growing exponentially. However, an allee effect is *inverse* density dependence, so as a population gets smaller, a given vital rate gets progressively worse – this is rare in most wildlife, but is known to occur within Southern Mountain Caribou<sup>27</sup>.

**Assisted long-term sustaining:** Strategies applied in sufficient intensity and duration to achieve a population that is able to withstand random events and other environmental variables with ongoing habitat management and protection, management of backcountry recreation and relatively low but sustainable populations of specific caribou predators and their primary prey (through a mix of hunting and habitat management; targets have yet to be determined). Planning unit populations are sufficiently large and widespread to ensure regular exchange of animals with other planning units (i.e., a functioning metapopulation). Other options are described here:

[http://www.env.gov.bc.ca/wld/speciesconservation/mc/files/MC\\_Science\\_Team\\_Actions.pdf](http://www.env.gov.bc.ca/wld/speciesconservation/mc/files/MC_Science_Team_Actions.pdf)

**Lambda ( $\lambda$ ):** The finite rate of population change. A value of 1.0 indicates population stability. A starting population of 100, with  $\lambda = 0.95$ , means that over the course of 1 year, the population has changed from 100 to 95.

**Compensatory mortality:** Mortality that would otherwise still occur – for example, if predators are removed, ungulates would just starve anyway, due to density dependence. **Additive mortality** is the opposite case, where for example, animals that starve and those killed by predators do not offset each other, the two sources of mortality are cumulative.

**Critical habitat:** Here we mean caribou foraging habitat, habitat that affords protection from predation, and habitat that does not benefit the growth of moose and deer populations. When old forests are

logged, caribou foraging habitat is reduced, but most importantly deer and moose forage is increased plus increase roads and fragmentation that reduces predator-free space.

**Core caribou foraging habitat:** This habitat was mapped as part of 2 land-use planning processes – the MAC plan (1990s) and the MCRIP (2007). The focus was on including all early and late winter caribou telemetry locations. This represents foraging areas along with areas that would grow moose and deer if they were harvested. These areas often include Cedar/hemlock and Spruce/Fir stands that are valuable to the forest industry.

**GAR:** Government action regulation. Caribou habitat, usually old growth forest (age class 8 and 9), that is protected from forest harvesting, where “protection” means logging is prohibited.

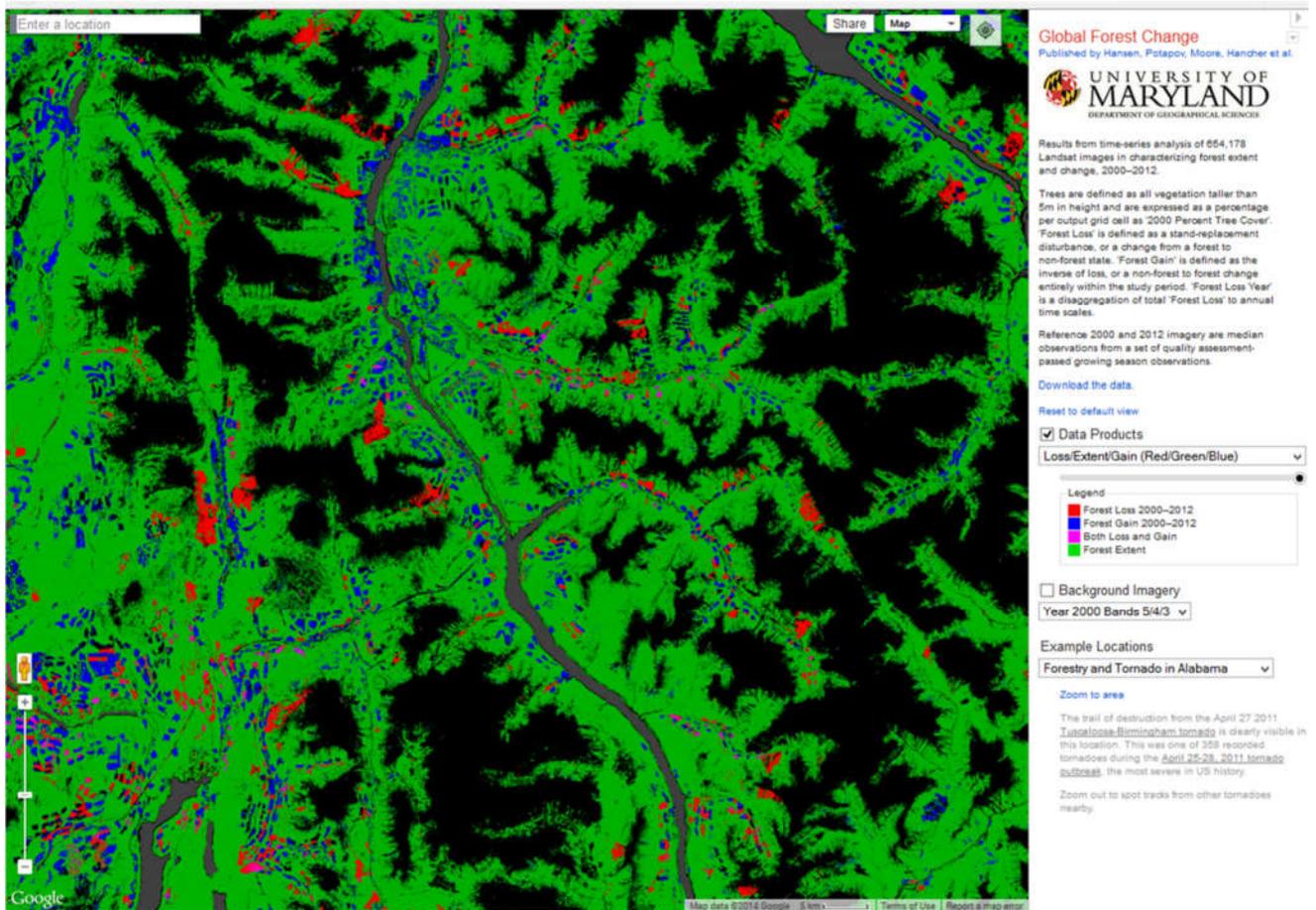
**THLB:** The timber harvest landbase, areas where trees are productive and accessible to the forest industry and thus economical to harvest. Similar to the “operability line”, though both can change with economics. **NHLB** is the non-timber harvest landbase.

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## Appendix A: Forest loss and gain in planning unit 3A.



Source: <https://earthenginepartners.appspot.com/science-2013-global-forest>

Results from time-series analysis of Landsat images characterizing forest extent and change. Trees are defined as vegetation taller than 5m in height and are expressed as a percentage per output grid cell as '2000 Percent Tree Cover'. 'Forest Cover Loss' is defined as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000–2014. 'Forest Cover Gain' is defined as the inverse of loss, or a non-forest to forest change entirely within the period 2000–2012. 'Forest Loss Year' is a disaggregation of total 'Forest Loss' to annual time scales. Reference 2000 and 2014 imagery are median observations from a set of quality assessment-passed growing season observations.