WCS CANADA COMMENTS AND RECOMMENDATIONS ON:

THE RECOMMENDED WHITEHORSE AND SOUTHERN LAKES FOREST RESOURCES MANAGEMENT PLAN 2019

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These comments are submitted in response to the Recommended Whitehorse and Southern Lakes Forest Resources Management Plan 2019. We present a summary of our comments, followed by detailed comments and recommendations that follow the structure of the Plan. We have not addressed all sections or sub-sections. Recommendations are in italics.

SUMMARY OF COMMENTS

What the Plan does well:

- It proposes a holistic approach to managing forest ecosystems using Traditional and scientific ways of understanding.
- It aims to recognize and accommodate numerous interests and values in the region.
- And, it aims to focus on the unique challenges of the region compared with other regional forest plans – particularly, minimizing wildfire risk to a large concentrated and dispersed human population.

Where the Plan falls short:

- There is an implicit assumption throughout the Plan that the forested landbase can be managed using a holistic approach that considers and accommodates the values of all users. This is not supported by information provided or referenced in the Plan including relevant quantitative and spatial analyses.
- It lacks clear descriptions of all identified values of the planning region, and clear links between values, guiding principles, strategic direction, goals, and indicators.

- There is inadequate attention to the natural processes that drive boreal ecosystems and shape forest condition, patterns, and biodiversity, particularly gaps in quantitative and spatial information on fire regimes and forest age-class distribution.
- The description of the forested landbase is incomplete and lacks a timber supply analysis. There is inadequate coverage of key forest management options (e.g., harvesting methods, silviculture).
- There are critical gaps in the suite of focal species and indicators necessary to meet the objective of assessing, managing, and monitoring forested ecosystems holistically.
- There is little strategic direction for monitoring and managing cumulative effects of human activity in the region.
- The Plan sets a target of 5 years after implementation to complete a timber supply analysis, compile data on indicators, and develop a monitoring framework. More progress should have been made on these activities in the 15-year planning process.

DETAILED COMMENTS AND RECOMMENDATIONS

1. THE NEED AND THE CHALLENGE

Overall, the Plan could be improved by some reorganization of the sections to more clearly fit the sub-headings. Section 1.1 'The Need' could be combined with Section 1.2 'The Challenge' as most aspects are linked, such as lack of regional planning, growing population with diverse and competing values, and multiple land administrations requiring coordination.

The Guiding Principles and associated approaches outlined in Section 1.1. should be moved to Section 1.6, 'Vision, Principles, and Process'.

In section 1.3, 'Purpose and Obligations', the list on page 6 is a blueprint for the Plan and might also fit better in section 1.6.

The section on 'Sustainable Management' (1.5) would flow more naturally after the section outlining the 'Vision, Principles, and Process'. We suggest 'Process' be separated from 'Vision and Principles'.

Section 1.7, 'Consistency with Other Planning', is a reasonable stand-alone section that provides necessary context.

Recommendation: Reorganize section 1 to ensure content fits the heading, and the information provided flows naturally throughout this section from framing the challenge, to identifying the purpose, through describing the vision, guiding principles, and finally the planning context.

1.1 THE NEED

The first guiding principle in the Plan – "Understanding the forest in a holistic way" – directs an approach to strategic forest management planning that can encompass both Traditional and scientific ways of understanding and managing forest ecosystems in the Whitehorse and Southern Lakes planning region.

We generally agree that the two listed approaches – consideration of cumulative effects and habitat conservation and management – are important components of a holistic approach to understanding and managing forests. However, these do not fully encompass the ways in which the Plan does, and should, provide strategic direction for understanding and managing forests holistically. What is missing here is a statement about the importance of understanding and managing for the natural processes that shape boreal forest ecosystems and the use of coarse- and fine-filter indicators in a ecosystem approach to forest management. Also missing is a statement that, as part of the holistic approach, the Plan will consider and plan for maintenance of all identified values in the planning region, including biodiversity, trapping, recreation, traditional use, and forest resource use, among others.

Recommendation – Provide a more complete list of approaches the Plan uses to adhere to this guiding principle.

Key aspects of an adaptive management framework are identifying management goals, selecting relevant indicators, implementing a monitoring program of indicators, and providing mechanisms for evaluation and feedback (Westgate et al. 2013). These features are mentioned or developed later in the Plan, but it would be useful to introduce them here in the first bullet under guiding principle 2.

Recommendation – Expand on the approaches in the Plan that are part of the adaptive management framework.

1.1 THE CHALLENGE

This section lays out substantial challenges that society will face in implementing this Plan. It strikes an aspirational tone, in stating that the plan can meet these challenges "…by supporting the maintenance and development of a healthy forest." The problem is that values driving peoples' behaviours and interests in the forest are often competitive or at odds, and that these differences are becoming more acute as the human population grows. This section does not address regional population growth and potential competing values as a principle challenge underlying the more specific challenges that are itemized, such as lack of regional planning or managing for wildfire.

Recommendation: The text needs to acknowledge the underlying bigger challenges of human population growth and competing interests on the land that drive the more specific challenges outlined in the Plan.

1.3 PURPOSE AND OBLIGATIONS

The stated purpose of the Plan is to "provide direction for the support and maintenance of healthy forests" (p 5). What are 'healthy forests'? The term healthy is used numerous (19) times in the Plan, and the notion of managing for 'healthy forests' is clearly a guiding concept. Yet the Plan does not provide a clear definition or set of defining characteristics, either in the text or in the glossary.

The text suggests that 'healthy' forests encourage and support natural processes (p 2) and provide for the needs of wildlife, water, land, and air (p 4). In contrast, the section on Forest Health (p 19) identifies biotic and abiotic factors that impact tree growth and survival, emphasizing disease and insect outbreaks. It is implied that a 'healthy forest' is one not afflicted by these factors (the forest management view of forest health). Disease and insect outbreaks certainly kill trees, but are necessary and desirable components of an ecologically healthy forest (so are positive values in the holistic view). Similarly, wildfire kills trees, yet is the driving natural process of boreal ecosystems, as is stated in section 2.1.4. Thus, a holistic understanding and approach to regional forest planning and management would include maintenance of forests that are diseased or killed by insects and wildfire.

By repeatedly invoking the notion of a 'healthy forest', but in the absence of a definition, there is an implicit leap of faith throughout the Plan that there can be a common definition that will integrate divergent values and interests and inform strategic direction that will meet desired outcomes for all forest users. It is not clear by what means (e.g., political negotiation, management zoning, harvest and silviculture policies and practices) the application of any view of 'forest health' can solve differences.

Recommendation. The Plan needs to provide a clear and explicit definition and/or set of defining characteristics for a 'healthy forest' and how it relates to values, strategic direction, and goals.

On page 6 of this section is a paragraph listing how the Plan will provide direction for forest management in the region. It is a solid list that should result in a comprehensive Plan, yet none are adequately addressed in the various sections of the Plan. It is stated that the Plan will, "identify the key forest values and issues in the planning area" and "recommend strategic directions for forest values". Values are listed on page 28 but there is no accompanying information to explain or describe each value. This is a significant gap in the Plan. A complete understanding of each value – what it is, where and when it occurs, etc. – is critical to development of relevant strategic direction, management options, and goals and indicators.

Also stated is that the Plan will, "identify the potential land base for forest management activities". The Plan divides up the land base into 3 zones (section 3.1), but there is no accompanying information to support this zonation, either a timber supply analysis or spatial and quantitative information of other values. This will be addressed in more detail in our comments on section 3.1.

The Plan does identify goals and indicators related to forest values in section 3, but we found gaps and consistencies in the proposed framework, which will also be addressed later in our comments.

Finally, we found little concrete direction for addressing cumulative effects of forest management and other land use activities as suggested in the last item on the list.

1.5 SUSTAINABLE MANAGEMENT

The plan provides the following definitions in section 1.5: "Sustainable management is defined as managing resources in a way that benefits current and future generations. Sustainable management of forests in the planning area must be environmentally appropriate, socially beneficial and economically viable for present and future generations."

A different definition for sustainable forest management is in the glossary: "Management that maintains or enhances the long term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social and cultural opportunities for present and future generations."

There are nuanced but important differences in these definitions. Through its vagueness, the text definition relies on user interpretation of what is 'environmentally appropriate'. This suffers from the same issue as the term 'healthy forest', in which the interpretation is subjective and may be at odds with identified values and among forest users. In contrast, the glossary definition more closely adheres to a holistic approach to management in that it explicitly identifies the need to maintain forest ecosystems and the needs of all living things, including people, over the long term. The glossary definition is that used by the Canadian Council of Forest Ministers (https://www.sfmcanada.org/en/sustainable-forest-management).

Given the importance of the concept of sustainable forest management to the Plan, it would be helpful to expand this section to outline the concept of ecologically sustainable forest management, which is integral to achieving the broader goal of sustainable forest management for the benefit of all living things and present and future generations.

Ecologically sustainable forest management is defined as maintaining forest structure, species composition, and the rate of ecological processes and functions within the bounds of normal disturbance regimes while continuing to provide wood and non-wood values [for people] (Lindenmayer

and Franklin 2002). This adheres to the guiding principle of a holistic approach to understanding and managing forest ecosystems.

Achieving ecologically sustainable forest management requires (from Burton et al. 2006):

- understanding natural disturbance patterns and processes, including regional differences;
- models for planning and management at the regional/strategic level, landscape/tactical level, and stand/operational level;
- inclusion of coarse- and fine-filter aspects of biodiversity conservation;
- and, consideration of novel stressors and uncertainty about future conditions.

The Plan addresses each of these criteria to some extent. However, as noted in our comments for other sections, aspects are incomplete and insufficient for development and implementation of an adaptive management framework.

Further consideration should be given to how the Plan can guide forest management, set goals, and identify indicators that will assist in achieving social-ecological sustainability, which is clearly inherent in the Plan's guiding principles and vision. Chapin et al. (2009) state that, "Social–ecological sustainability [recognizes] that people are integral components of social–ecological systems and that people both affect and respond to ecosystem processes… Efforts that fail to address the synergies and tradeoffs between ecological and societal well-being are unlikely to be successful." The final paragraph of this section seems to address this concept, but requires revision for clarity. What does it mean to have a plan that is "adaptable to the variability of the economy, society and the environment"? What is meant by these being "three levels of sustainability"?

Recommendation: We recommend the Plan adopt a consistent definition of sustainable forest management. We also the Plan considers the 4 criteria of ecologically sustainable forest management and the concept of social-ecological sustainability in the development of strategic direction, management options, goals, and indicators. We recommend revising the text to improve clarity in how the Plan defines economic, social, and environmental variability and sustainability.

1.6. VISION, PRINCIPLES, AND PROCESSES

The Vision states: "Maintain a functioning forest ecosystem that incorporates holistic values and provides opportunities for adaptable forest management".

The Vision clearly has good intent, and seems to be worded to recognize the diversity of interests in the forests of the region. However, there are some problems with the wording.

First, we do not think there are such things as 'holistic values'. Values are specific to the interests they are associated with, and cannot individually encompass the full range of interests, components, and

processes in a forest, as implied by the word 'holistic'. It seems that what is meant here, is that the vision is for a forest that will include all components of a forest ecosystem, as well as values of interest to people, assessed and managed in a holistic manner. This interpretation of the Vision is supported by statements in other Plan sections, such as the previous section on sustainable forest management.

Second, in the absence of a definition, it is not clear what is meant by 'adaptable' forest management. Our interpretation is that adaptable forest management is generally responsive to changing situations, in contrast with the more structured framework of adaptive forest management.

Recommendation: The Vision statement needs to be reworded for accuracy and clarity.

In this section, the Plan states: "A forest is in a perpetual cycle of decay and regrowth, continually adapting to impacts, …". This statement is factually incorrect, ecologically. It implies that all forests in this region have a period of re-growth followed by decay, through time. In fact, growth and decay are ongoing and prominent processes in all stages of forest change following disturbance; they are not segregated sequentially through time, and their relative prominence varies at different temporal and spatial scales. This is particularly true of forests in the region that are closer to the coast and more influenced by single-tree or small-patch death and replacement (e.g., wind and some disease) in contrast to large stand-replacing disturbances (e.g., wild fire, insect infestation). Whichever is the case, decay is a prominent component of young forests because trees that died in the disturbance event, which subsequently created the opportunity for young growth, are now decaying. This decay process replenishes nutrients into the soil. Similarly, forests with trees that are old on average continue to grow significantly, and accumulate carbon through the various plant layers, even though some of the trees may be decaying and dying. If there are 'cycles' of change in regional forests, they are cycles of relative age of the canopy trees with widespread disturbances (fire and insect infestation) driving fairly abrupt shifts in the age composition.

Recommendation: This statement needs to be removed and replaced by a generic statement indicating that the age and composition of the forest, and therefore the suite of species it supports, can be expected to change over time due to a variety of natural and human-caused disturbances in a complex mosaic across the region.

2. THE PLANNING AREA

2.1 FORESTS

This preamble is one of the shortest sections in the document and is inadequate in describing the forested ecosystems of the Whitehorse and Southern Lakes planning region. The text references

Appendix C, which maps forests by age since wildfire disturbance. A simple summary of the age distribution of forests by dominant tree species is minimum information that should be included in the text of the Plan.

Figure 2 presents a graph of percent composition of forest stands by leading tree species. Without an area or volume reference for Figure 2, the percentages are meaningless. E.g. White spruce is the leading tree species in 50% of what area? The planning region? The forested landbase? The merchantable landbase? How was 'leading tree species' determined? Why are mixed conifer or mixed conifer-deciduous forests not included? How does age-class distribution vary by stand type? This information is critical to assessing and managing values in the planning region, such as wildlife habitat, tree use, and wildfire protection. This information is easily extracted from the Yukon Forest Inventory. Ideally, a complete summary of forest stands of the planning region would incorporate information on associated landscape patterns (e.g. forest patchiness) and position (e.g. riparian).

The region's ecosystems are strongly influenced by topography (elevation, slope, aspect), surficial geology, soils, permafrost, and climate (Yukon Ecoregions Working Group 2004), in addition to natural disturbances described in sections 2.1.3 and 2.1.4. The nature and distribution of ecosystems, including forested ecosystems but also interspersed non-treed ecosystems, such as non-treed wetlands or south-facing grasslands, in turn influence landscape patterns of wildlife habitat and connectivity. While the Plan cannot include an exhaustive description of all ecosystems in the region, it can do a better job of describing forested ecosystems and non-forested ecosystems relevant to values, goals, and indicators.

Recommendation: Expand this section to include more complete descriptions of forest ecosystems and relevant non-forested ecosystems, particularly those related to key values, and including landscape context where relevant, so that it is clear how the Plan is taking a holistic approach to understanding and managing the forested landbase.

2.1.2. Current forest use

This Plan lacks a timber supply analysis, either within the body of the document or referenced by the document. This is a significant weakness for a strategic forest management plan, particularly when so many interests and values are expected to be satisfied in a 'holistic' way. There is clear expectation in the wording of Plan and, in Yukon government strategic direction around renewable energy supply (e.g., the Biomass Energy Strategy, Yukon Government 2016), that wood harvest will continue to be a substantial source of energy, and dimensional lumber, in Yukon. Indeed, this section states, "The Joint Planning Committee *believes* a healthy forest can continue to sustain a small-scale industry….". This statement lacks credibility and assurance when it is a belief rather than the clear outcome of a quantitative analysis that relates rate of timber removal to rate of growth in forests of defined species

composition on a specific land base, AND with defined limits in place to sustain values other than fibre flow.

Recommendation: The Plan needs to address the question of timber supply in a more quantitative way either in the text, or by reference to a stand-alone analysis. It should deal with the range of natural variation in age class distributions of key forest stand types; the current and future availability and demand for greenwood and deadwood harvest; and, the proportions of various stand types, by age and species that would need to be removed from the current forested landbase to satisfy other key values such as wildlife habitat supply.

2.1.3. Forest Health

We have previously discussed the issue of defining 'healthy forests', and the natural occurrences of tree and stand death due to disease and insect outbreaks. With respect to management of these ecological phenomena, the Plan needs to address how human management of forests, through fire suppression and climate change, are influencing the frequency and intensity of disease and insect outbreaks.

Recommendation: Address the role of human activity and land use, past and future, in the frequency and intensity of disease and insect outbreaks.

2.1.4. Forest fire

This section importantly addresses the prominence of fire and the risk it currently poses to human life, property and infrastructure in the Whitehorse and Southern Lakes planning region.

It lacks any reference to, or summary of, analyses that describe the historical natural disturbance regime of the region, including the scale and frequency of wildfires and the resulting natural range of variation of stand ages and types. This information is necessary to determine target range of stand ages within which forest management needs to aim in order to keep all components of the forest ecosystem present regionally. This section includes erroneous and misleading statements about natural disturbance regimes and age-class distributions in boreal forest, such as "In the boreal forest under natural conditions, older forests (over 130 years) are limited because wildfires continually burn the mature trees…". And, there is an underlying assumption in this section that the fire regime in this region is similar to that in other parts of Yukon, which leads to the conclusion that the forests are unnaturally over-mature.

Fire return intervals vary across boreal Canada. The mean fire return interval is the average time between fires within a defined spatial area and is calculated as the inverse of the average area burned (Coops et al. 2018). Several studies have examined fire return intervals across boreal Canada using the

Canadian National Fire Database (e.g. Boulanger et al. 2014) and more recently using 30-m resolution Landsat imagery (Coops et al. 2018). Based on the most recent, high-resolution analysis, mean fire return intervals for Canada's boreal ecozones ranged from 139 to >5,000 years for the period 1985 to 2015 (Coops et al. 2018). In this analysis, mean fire return interval for the Boreal Cordillera ecozone of Yukon and northern B.C. was estimated as 439 years but varied greatly among ecoregions. It was estimated at 101-150 years for Yukon Plateau Central; 151-500 years for the Klondike Plateau, Yukon Plateau North, and Liard Basin ecoregions; 501-1,500 years for the Ruby Ranges, Southern Lakes, and Pelly Mountains ecoregions; and, 1,501-5,000 years for the Yukon-Stikine Highlands and St. Elias Mountains. This analysis refines our understanding of fire regimes in the Boreal Cordillera, previously described as being extremely variable and ranging from 50 to >300 years (Haeussler and Kneeshaw 2003). These results highlight the variability in fire regimes across Yukon's Boreal Cordillera.

Theoretically, the expected stand age distribution for a forested region with a 100-year fire cycle is 1/3 of forest aged greater than 100 years (Bergeron 2004). Although this theoretical distribution rarely occurs, forested landscapes include stands older than the average return interval, and longer fire return intervals have flatter age distributions, with greater proportions of old forests (Haeussler and Kneeshaw 2003). Thus, based on the regional fire cycle, we would expect greater proportions of older stands in the Southern Lakes planning region compared with nearby ecoregions with shorter fire cycles. Trends in fire return intervals across the ecoregions of Yukon's Boreal Cordillera reflect the influence of coastal versus continental climates on forest conditions and prevalence of lightening strikes. Even without a reconstruction of the fire history, the lower incidence of lightning in the Southern Lakes and stronger influence of coastal climate on summer weather means that we should expect to find a higher proportion of old forest stands in this region than in central Yukon.

Wildfires do not only burn mature forests (e.g. Johnstone and Chapin 2006), and stands can experience multiple fire events (Johnson et al. 2003). So, even with a short return interval individual trees may be older than the average stand age and through size, decay condition, nutrient cycling, etc. contribute unique ecological values to the stand. Finally, within the planning region, we would also expect variation in fire regimes based on topography, microclimate, and forest type and conditions. There is evidence that riparian areas burn less frequently than nearby upland areas in parts of southern Yukon (AEM Ltd. 1998, Francis 1996).

Clearly multiple factors in the region, including human land use and fire suppression, have influenced the current age distribution of the region's forests. What has not been adequately assessed is the extent to which the current age distribution reflects the historical natural fire regime versus the recent contribution of human activity. Regardless, the statement that forests aged greater than 130 years are "limited" in boreal forest is clearly inaccurate and should not be provided as a rationale for concluding the forest of the Southern Lakes are over-mature.

Recommendation: The Plan needs to include analyses, or reference to analyses, of the regional fire regime, the associated natural range of stand ages, and the influence of human activity on both. The Plan should accurately portray the fire regime of the Southern Lakes in comparison to other ecoregions in Yukon's Boreal Cordillera.

2.2. Fish and Wildlife

This important section addresses only a few focal species – caribou, moose, grizzly bear, and salmon and freshwater fish. It is certainly valuable to provide specific insights and direction on these species. But there are additional species that should be considered, including species at risk, previously identified priority species for the region, and a suite of species that require a range of stand ages and types and landscape conditions, and thus are useful indicators for ecosystem management of the region's forests.

First, the Plan neglects federally listed Species At Risk, several of which may be impacted by greenwood or deadwood forest harvest and management practices, such as Little Brown Bat (*Myotis lucifugus*) (Patriquin and Barclay 2003), Common Nighthawk (*Chordeiles minor*) and Olive-sided Flycatcher (*Contopus cooperi*) (Cooke et al. 2019).

Second, the Plan neglects species assessed and identified as priorities for management and conservation by the Southern Lakes Wildlife Coordinating Committee (SLWCC 2012) and by Environment and Climate Change Canada in the regional Bird Conservation Plan (ECCC 2013). These are the most comprehensive assessments for wildlife in the planning region. The following taxonomic groups described by SLWCC (2012) and ECCC (2013) are neglected in the Plan and should be assessed for potential focal species: furbearers, small mammals, and upland, resident, and migratory birds. Habitat requirements and recommendations for species in these taxonomic groups in both reports should be carefully considered and incorporated into the Plan to the extent that it is anticipated forest management zoning and practices will impact the species of interest. For example, several species in the following recommendation by SLWCC (2012) should be considered for inclusion as focal species in the Plan as they are likely be impacted by forest harvest, "A monitoring program for small mammals should focus on traditionally-used species (e.g. ground squirrels, porcupine and snowshoe hare), species at risk (little brown bats and collared pika), and species that are particularly important to ecosystems (e.g. redbacked vole and snowshoe hare)." (SLWCC 2012, Volume 1, p 50). Similarly ECCC (2013) identified several priority landbird species that may be negatively impacted by harvest of old or recently-disturbed forests.

Third, this section and the Plan as a whole, does not address biodiversity, nor the broad ecological processes that regional planning and forest management need to consider to ensure biodiversity is protected. Biodiversity is mentioned only 3 times in the Plan, which puts into question the stated intent

of taking a 'holistic' approach to forest planning and management. Ecosystem management requires consideration of the suites of wildlife species that occupy forest stands of different ages (e.g., shortly post-disturbance, mid-seral, old forest) and landscape positions (e.g., riparian, various aspects and elevations). These can differ considerably, with many species requiring specific stand ages and landscape conditions. To be holistic as the principle outlines, the Plan must address the temporal and spatial patterns of change in forest stand ages and landscape positions that would be expected to exist in the absence of forest harvesting. As noted previously, this information is absent from this Plan.

Birds are excellent indicators of forest conditions and patterns at multiple scales, and thus for monitoring the effectiveness of ecosystem management of forests. They occupy a broad range of forest habitats and include specialists of different forest ages and types; are responsive to forest management at multiple scales; are cost-effective and unobtrusively monitored; require a diverse set of nesting and foraging micro-habitats within and across forest types and age; and, are priorities for conservation given declining populations (Rempel et al. 2016).

Addressing the habitat requirements of a suite of focal species that reflect different stage types, ages, and landscape positions is extremely important in forest management, as we can learn from experience in British Columbia. There, a suite of species that are dependent on old growth forests have been inadequately conserved because of a forest management regime that placed far too much of the harvestable landbase into harvest and stand rotation such that the great majority of old growth has been eliminated. Old-growth dependent species such as Woodland Caribou (*Rangifer tarandus caribou*), Northern Spotted Owl (*Strix occidentalis caurina*), Northern Goshawk (*Accipiter gentilis*), and Marten (*Martes americana*) have been eliminated from large portions of their ranges and are now species at risk. There is inadequate inventory of many of these species in Yukon, and poor integration of their habitat needs in assessments of annual allowable harvest.

Finally, in subsequent sections the Plan promotes the harvest of standing dead trees, both across recently disturbed forests and individually in older stands. Yet, it puts forth no focal species that are uniquely dependent on this forest condition, such as pyrophilous beetles and woodpeckers like the American Three-toed Woodpecker (*Picoides dorsalis*). We refer you to our recent report on the biodiversity values of burned and beetle-killed forests (Cooke et al. 2019).

Recommendation: The Plan needs to address the habitat needs of a more complete suite of focal species, including: species at risk; species identified as priorities by regional assessments of the Southern Lakes Wildlife Coordinating Committee and Environment and Climate Change Canada; and, a suite of focal species that are effective indicators of the natural range of forest ages and conditions at multiple scales, particularly species dependent on old-growth forest and on recently burned and beetle-killed forests. The Plan needs to specifically address habitat supply for the suite of species most at risk in the proposed forest management regime.

2.2.1. Woodland caribou

This section includes a useful and fairly detailed outline of the historical impacts on caribou and their habitat needs. However, it lacks explicit mention of a key element of caribou biology: winter range is predominantly in older forests that have lived long enough to self-thin and grow ground lichens in the understorey. There are significant areas in the region that were caribou winter range before the 1958 fires but no longer are (e.g., Agay Mene area, Ibex River valley). The reliance of caribou on old forests in winter is a key management issue because turnover of those forests to younger age classes (with fires and to a lesser extent insect outbreaks) will substantially decrease the carrying capacity of the region for caribou, and will increase the need for methods to enhance winter range in younger forests (hence the prominence of the University of Northern British Columbia study that is referenced in the Plan). These risks for caribou need explicit mention.

Recommendation: The text needs to lay out the relationship between caribou winter range and forest stand age and explain the management issues that managers face in maintaining a supply of winter range.

2.2.3. Grizzly bear

Grizzly bears certainly deserve attention in a forest management situation, and this section brings out some key points regarding how forest management might impact bears (e.g., food supply). It overlooks one of the main ways in which humans limit bear populations in a forest management situation – the disturbance, habitat alienation, and enhanced mortality all created by road networks used by people especially the general public. This issue has been studied in British Columbia where a threshold density of roads on the landscape at which bear populations are likely to decline has been identified (Lamb et al. 2018). To address this impact on grizzly bears, a strategic forest resources management plan needs to address thresholds on the building and existence of linear roads and trails, and the need for controlling access along those roads and trails.

Recommendation: The Plan needs to address the strong limiting factor that roads and trails put on grizzly bears through disturbance and mortality, and specify some of the management tools potentially available to managers.

Large mammals, such as grizzly bears, are often considered umbrella species in conservation planning (Carroll et al. 2001). This assertion is made in this section, and could be considered implicit in the gaps in other focal species or indicators of biodiversity presented in the Plan. Several studies of grizzly bears

and caribou have determined that under particular circumstances they can function as umbrella species for biodiversity (as measured by coarse- and fine-filters, e.g. Nielsen 2011) or for other taxonomic groups (such as mammals, birds, and insects; Bichet et al. 2016, Drever et al. 2019). However, there are several reasons we do not recommend using grizzly bears or caribou, or any other large mammal, as umbrella species for the region's wildlife and biodiversity.

First, existing studies have been done at different scales, in very different landscapes (i.e. with different topography and types and patterns of forested ecosystems), and on populations/herds with different ecology (e.g. boreal caribou vs northern mountain caribou). Thus, their applicability to the Southern Lakes is unknown. Second, these studies found areas of sink habitats (e.g. high grizzly mortality), low densities, and/or diminishing or extirpated populations (e.g. extirpated boreal caribou herds), frequently co-occurred with areas of higher and unique biodiversity values, such as valley bottoms. They conclude that effective use of these species as indicator species for conservation of regional biodiversity would require habitat restoration (e.g. decommissioning roads in high-value grizzly habitat) and population recovery in areas of historical importance to this species. This result is highly relevant in the Southern Lakes where valley bottoms with human development are associated with high mortality and poor habitat for both species.

Recommendation: We recommend against using grizzly bears, caribou, or other large mammals as umbrella species for biodiversity and wildlife in the Southern Lakes planning region.

SECTION 2.4 IMPACTS AND EFFECTS

2.4.2. Climate change

Although this section lays out the main patterns of climate change, and some pertinent possible ecological changes, it does an inadequate job of relating forest condition and management to climate change, and strategies for mitigation. In boreal regions, intact forests, left unharvested, are the best way to combat climate change because carbon continues to be built up in the forests through all age classes (photosynthesis) and the carbon already sequestered in the forest ecosystem (including soils) is not liberated to the atmosphere through the land disturbance that occurs in harvesting and the subsequent uses of the wood – most often burning for fuel in Yukon.

The Plan needs to clearly state that forest harvesting in Yukon acts as a net contributor to climate change. That fact results from the burning of wood as heating fuel, and also the fossil fuel energy used in building access roads and in the harvesting and transport of wood. If society were to place a high premium on mitigating climate change, forest harvest for fuelwood should be halted.

Using wood for biofuel is not carbon-neutral as asserted in this document (quote from Yukon Wood Producers Association in section 3.1). Burning moves carbon directly from wood to the atmosphere

where it produces a net increase in greenhouse gases because the ability of ecosystems to absorb those gases is already saturated as evidenced by the continually increasing level of those gases. Wood for biofuel creates a carbon debt, and time to carbon parity depends on natural rates of growth and decay, which are both delayed in the cold arid climate of Yukon. Thus, the carbon neutrality of societal energy use has to be accounted for on an annual basis, not the life span of a tree or the regeneration time of a forest.

Recommendation: The Plan needs to clearly state that one of the primary uses of harvested wood in Yukon - combustion for heat, either through personal fuelwood or district heating - is a direct contributor to climate change. Without this explicit statement, the Plan is disingenuous in the way it deals with climate change.

2.4.3 Cumulative effects

The text of this section identifies important concerns and encouragingly stresses the need to keep forest harvesting closer to communities rather than in backcountry areas. However, it includes a statement for which no quantitative data have been provided (a concern identified in 2.1.4 above) and which could lead to unsustainable approaches to forest management: "Forests have had their natural fire cycle disrupted which has resulted in aging, spruce and pine-dominated forests caused by long-term fire suppression." This statement asserts that fire suppression has created the current pattern of stand ages across the region. That assertion is not supported or referenced by any quantitative data anywhere in this document; it may or may not be true. Certainly there has been fire suppression. At the same time there has been an increase in fire ignitions caused by people. Fire suppression is a suitable management approach to dealing with the increased incidence of ignitions simply for the goal of maintaining fire frequency and impact within the range of natural variation let alone protection of human property. So, how do we know what the impact of fire suppression has really been, and what are the targets of stand age distribution to which we might manage?

A second problem with this statement is that it implies that older forests are of limited value. In contrast, they are extremely valuable ecologically as essential habitat for a suite of species (including caribou) and as ongoing sinks and storehouses of carbon that would otherwise increase the rate of climate change if liberated to the atmosphere through forest harvesting and subsequent uses.

Recommendation: The statement in question should be removed from the document, or, if substantiated with data and analyses, that evidence needs to be brought forward in section 2.1.4.

3. STRATEGIC DIRECTIONS

The preamble to this section lists 11 values that "form the guiding principles of this plan": adaptability, education, traditional use, heritage, trapping, community wildfire protection, tree use, recreation, biodiversity, connectivity, forest health, and wildlife. The guiding principles subsequently support the Plan's strategic direction, and associated goals and indicators.

If these are the values upon which the entire Plan is based, then each should be described, preferably with spatial and quantitative information, but at a minimum with qualitative information on the nature of the value – what is it, where and when it occurs, etc. The pathway from value to guiding principle is not provided, which makes it unclear how particular values are being addressed in the Plan.

Recommendation: Each listed value should be accompanied by a qualitative description, and summaries of spatial and quantitative characteristics as available.

The strategic direction associated with the principle of holistic understanding is relatively comprehensive – including cumulative effects, habitat protection, habitat connectivity, compliance monitoring, and forest management practices to protect key values. However the 'devil is in the details', and as we described previously and in subsequent sections, many of these details are lacking for values, goals, and indicators.

One concern with the strategic direction provided for this principle is the focus on the scale of timber harvest planning rather than the planning region as a whole. For example, it is stated that cumulative effects should be mitigated during timber harvest planning and that forest management practices such as buffers, retention patches, and seasonal restrictions should be implemented as necessary to reduce impacts on values. Absent is strategic direction for making decisions of what, where, when, and how much harvest should occur regionally to ensure protection of values and achieving desired outcomes for the region.

Recommendation: Ensure strategic direction is suitable to the scope and scale of strategic regional forest planning, and that each is adequately described so that it can clearly be followed by a set of goals and indicators.

3.1 LANDSCAPE UNITS AND FOREST MANAGEMENT ZONES

The process for designating management zones to landscape units is described as follows, "The Joint Planning Committee reviewed each unit and scored it, based on general consensus, on values such as timber, current use, access, forest fire risk, moose and caribou".

It is not clear the extent to which spatial, quantitative, and/or qualitative information is available and was used to assess values and designate zones. And, it is not clear if each landscape unit was evaluated and scored based on all values, including biodiversity and wildlife habitat for species other than moose and caribou. It is also not clear if the same set of values were considered in each unit.

Key values and concerns for each landscape unit are listed in Appendix D. As noted previously, the Plan lacks information on the nature, extent, and distribution of values within landscape units. Therefore, it is impossible to review the adequacy of zoning for achieving the overall vision and goals of the Plan.

Key direction in sustainable forest management at any stage (from planning to operations) is to answer the questions what, where, how much, and when. Several pieces of information are needed to answer this question:

- What are the values?
- What is the current condition of those values?
- What is required to maintain those values within their desired levels, and/or their natural range of variability?
- Based on this information, what can be harvested, where can it be harvested, how much can be harvested, and when can it be harvested?

The Plan lacks key information on the forested landbase that is necessary for addressing these questions. How much of the landbase is forested? What percent of forested land is merchantable for fuelwood and other timber uses?

What is the rationale, and what information was used, to designate 36% of the planning region as an interface management zone with the highest level of harvest, and 16% as provisional forest management zone. What forest stand types will provide the timber supply (e.g., proportions from standing dead vs. green tree harvest; proportions from what lead species and stand ages; etc.), and what proportions of those stand types will be removed under current harvest levels? What is the rationale for the planning units designated as high priorities for planning? And, what forest harvest practices (scale and intensity of stand level harvest; levels and patterns of retention) are suitable for this management zone? Again we highlight the apparent insufficiency of spatial and quantitative information on timber supply, and spatial, quantitative, and/or qualitative information on values that is necessary to justify designating the provisional land base overall and for individual planning units.

Figure 3 suggests the majority of the planning region will not be available to harvest, yet much of this area is situated at higher elevations with little or no forest cover. What percent of the non-contributing forest management zone is actually forested?

For the interface forest management zone, the Plan states, "the priority in this zone is to protect existing values" (p 33). We support prioritizing key wildlife values, particularly caribou habitat, and the reduction

of fire risk near communities. We agree with increasing use of timber and fuelwood from land cleared for other purposes.

However, for all management zones, we strongly object to the use of the term 'salvage' when referring to recently burned or beetle-killed stands. 'Salvage' infers a diminishment of value. There is clear ecological evidence that these forests are critical to boreal biodiversity, both in the short term immediately following a natural disturbance and over the long-term as a part of the natural processes in boreal ecosystems (Cooke et al. 2019). These forests and their biodiversity are part of the broader ecological values of the planning region and must be considered in a holistic manner along with other forest types. The Plan encourages harvest of deadwood and neglects strategic direction for management of naturally disturbed forests to ensure protection of associated values.

A planning process that successfully incorporates adaptive forest management also includes, "a well articulated set of management options, acting as hypotheses for achieving desired outcomes" (Burton et al. 2006). In the Plan, management options are presented for each forest resource management zone through descriptions of types of timber harvest plans and harvested activities to be considered in each (p 33). Some management options and goals are well linked, such as protection of community values through timber harvest to reduce fire risk in the interface management zone, but many are not.

Recommendation: Zoning designations should be clearly supported by quantitative and spatial information on the forested landbase. We recommend more explicit links between goals and management options (e.g. extent and type of timber harvest) for each forest resources management zone.

3.2 GUIDING PRINCIPLES, GOALS, AND INDICATORS

This section sets up a series of goals and associated indicators for each of the guiding principles. The purpose is to develop an adaptive management framework so that managers can monitor key indicators, be responsive to changing conditions, and ensure goals are being met.

Adaptive forest management requires a planning process with "a clear vision of desired outcomes and set of values" and "a comprehensive suite of indicators to track forest condition and values" (Burton et al. 2006). We have previously addressed gaps in the description of values, however the guiding principles do provide a vision for the forest management in the planning region. Desired outcomes are listed as goals in Table 4. Ideally, goals and outcomes adhere to the SMART principle - Specific, Measureable, Achievable, Relevant and Time-bound. Few of the goals in Table 4 include specific and measurable desired outcomes. This will make it difficult to monitor and know when the goal has or has not been achieved, and subsequently provide feedback in an adaptive management framework. Some of the indicators are actually goals, and with some refinement would adhere to SMART principle. For example, under the goal of "Habitat conservation, protection, enhancement, and management" each of the indicators are framed as goals, e.g. "maintain and enhance caribou winter habitat" and

"conservation of soils". These should be listed as goals, and refined to specify what is to be measured and over what time period.

We support the guiding principle, "Maintain the ecological integrity of the forest through a holistic understanding" but find the goals and indicators in Table 4 to be insufficient. As previously discussed, a holistic approach to understanding and managing forest ecosystems would include full knowledge of biodiversity, ecosystems, and natural processes. While this is impossible in planning exercises, there are approaches, such as ecosystem management, that provide 'shortcuts' to understanding and management forest ecosystems. In the context of boreal forest management, ecosystem management aim to maintain the natural range and variability of forest types and ages that result under natural disturbance regimes. The premise is that boreal ecosystems and organisms have evolved under the natural disturbance regime and will be supported if the landscape is maintained within that natural range of variability. This is often described as a coarse-filter approach and has previously been addressed in our review. The need to provide information on natural disturbance regimes and associated ranges and distributions in forest types and age-classes has also been noted repeatedly.

The coarse-filter approach is complemented by fine-filter management, where focal species are selected that have particular value to human society, are rare or otherwise not captured by the coarse-filter approach, or are indicators of ecological processes, forest conditions, or other groups of species. The Plan has previously adopted this approach (although not using this particular terminology) – recognizing the importance of understanding natural disturbance regimes and their influence on forest condition and patterns plus identifying a small selection of focal species important to human society. As we noted in section 2.2, the Plan presents an incomplete selection of focal species for tracking the coarse-filter approach using suites of species associated with different stand types and ages, and for tracking species of special interest or concern, such as species at risk and priority species for management and conservation.

In Table 4, under the vague goal of "Habitat conservation, protection, enhancement, and management", one indicator is "Percentage of age class distribution targeting a natural mosaic to meet habitat requirements for focal species (for example, moose, caribou and marten)". This mixes the 2 management approaches. If the target is "meeting habitat requirements for focal species", then management may shift the forest age class distribution resulting in declines in some forest ages and gaps in protection of forest biodiversity. There need to be clear and distinct goals for managing forests for maintenance of biodiversity, and managing forests to maintain habitat for focal species. Note, there is an inherent assumption that both can be achieved on the landbase. Monitoring, feedback, and adaptation is critical to keep this on track.

For the indicators included in Table 4, it is not always clear if or how monitoring them would help to determine if management action was successful in achieving the desired outcome. This can be due to lack of specificity in the goal and desired outcome (as described previously), or lack of sufficient detail

in the indicator itself, including what specifically will be monitored. Few indicators fulfill the 6 listed criteria for effectiveness (p 35), or at least there is insufficient information to determine if they would be effective. We have not reviewed each goal and indicator in Table 4, but hope our comments are helpful in improving all and producing a final set that are comprehensive, clear, and effective.

Finally, we note that the Indicator column of Table 4 lists goals, indicators, AND several management and monitoring strategies, such as "implementation of seasonal restrictions".

Recommendation: We recommend refining goals to be 'SMART', in particular to be more specific in describing a desired outcome that is measurable. We recommend reorganizing the table to clearly distinguish and link goals, indicators, monitoring strategies, and management strategies.

A previously stated, we recommend adoption of a full suite of coarse- and fine-filter indicators to adhere to the guiding principle of maintaining ecological integrity and taking a holistic approach to understanding and managing forest ecosystems.

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