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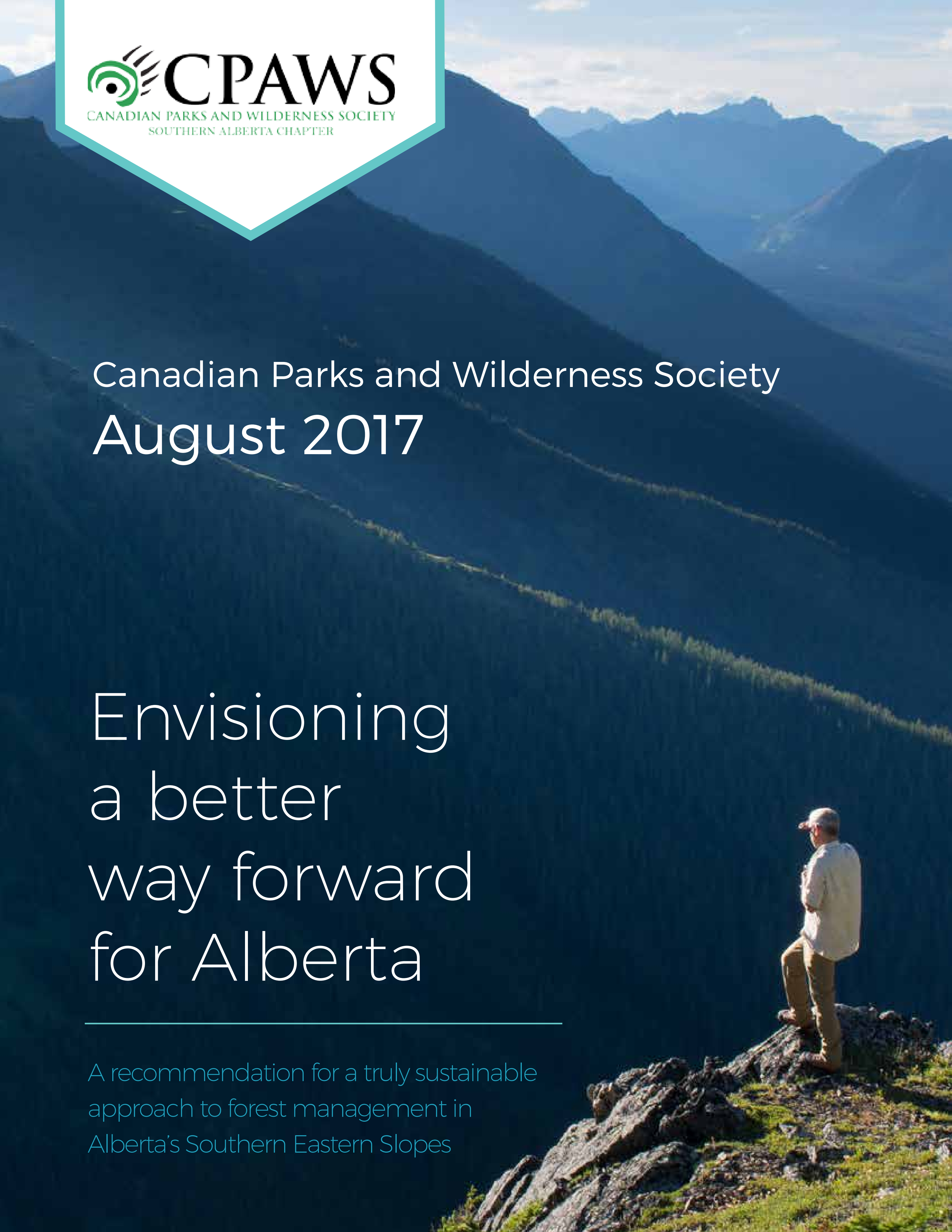

Canadian Parks and Wilderness Society

August 2017

Envisioning a better way forward for Alberta

A recommendation for a truly sustainable approach to forest management in Alberta's Southern Eastern Slopes

Acknowledgements

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The photography in this report was kindly donated by Stephen Legault.

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> “The recommendations in this report provide direction to implement a landscape approach to ecosystem-based forest management on the Southern Eastern Slopes that prioritizes ecosystem values over timber values and preserves the structure, function and composition of the natural system.”

Executive Summary

The Southern Eastern Slopes of the Alberta Rocky Mountains are in a narrow band of land on the western edge of Alberta, extending along the Rocky Mountain Front, from the Red Deer River, south to the Montana border (Figure 2-1). This mostly forested area contains a mosaic of vegetation including coniferous and mixedwood forests, open grasslands, and rich riparian areas. This region has some of the highest biodiversity in the province. The Southern Eastern Slopes are also home to diverse land-uses including commercial forestry, cattle ranching, recreation, and oil and gas.

The main features of the Southern Eastern Slopes of the Alberta Rocky Mountains are diversity and connection. Within a relatively short total distance, the landscape transitions between many different ecosystems; from rocky mountain peaks, to alpine meadows, to subalpine forests, to montane forests, to riparian drainages, to grasslands. Connectivity of this landscape is important for movement of wildlife, and to maintain natural flows and processes on the landscape.
The Southern Eastern Slopes house the headwaters of clean-flowing rivers that provide water to communities across the prairies. These rivers support a diverse community of large mammals, such as grizzly bears, elk, and bighorn sheep; native fish, including bull trout and westslope cutthroat trout; numerous birds; and a high diversity of insects. They also provide a wide range of recreational opportunities for families and intrepid adventurers.

Albertans are increasingly concerned about the cumulative effects of logging, other industrial uses, and recreational uses on the Southern Eastern Slopes (SFS 2007, Government of Alberta 2010, Praxis 2012, Fiera 2013, CPAWS SAB 2014). Individuals and groups from Calgary, the Ghost, Bragg Creek, Black Diamond, Crowsnest Pass, Livingstone, Lethbridge, Pincher Creek, and Beaver Mines have all spoken out strongly against industrial forestry practices that degrade forest health, water security, and detract from wilderness recreation experiences.

Widespread forest clearing increases density of industrial roads, and the accompanying off-highway vehicle use, decreases water quality, changes seasonal runoff patterns, and degrades key wildlife habitats (Trombulak and Frissell 2000). These effects can be seen throughout the Southern Eastern Slopes.

The current condition of the Southern Eastern Slopes indicates the need to manage this landscape under an ecosystem-based model, to protect the full range of forest values and functions, and implement restoration. One critical piece of implementing an ecosystem-based forest management approach is to change from the current system of commercial timber-driven forestry in our headwaters to prioritizing a suite of values including water, biodiversity, connectivity, and quiet recreation.

This approach would preserve the structure, function, and composition of the natural system by prioritizing ecosystem values over timber values.

This report outlines a series of recommendations, appropriate for Southern Alberta, which would move management towards this goal. This includes officially adopting a mandate of ecosystem-based management on the Southern Eastern Slopes by:

- **Designating new protected areas on the Southern Eastern Slopes;**
- **Maintaining landscape connectivity and integrity;**
- **Maintaining natural age structures on a landscape level;**
- **Restoring damaged and fragmented areas;**
- **Designating areas for recreation and other low-impact land uses;**
- **Designating areas for timber management, and implement site-level ecologically sustainable timber management;**
- **Applying adaptive management practices.**

These on-the-ground changes would require recognizing the public value of these public lands, and would facilitate increased public input into management decisions. Examples of ways this could be achieved include:

- **Open and transparent processes and exchange of information;**
- **The involvement of a broad contingent of stakeholders in managing forests, including:**
    - **Creating a cross-sector decision-making body;**
    - **Allowing co-management or community-based tenures to be held;**
- **Requiring third-party review and public input for management plans.**

A full summary of specific recommendations to move towards ecosystem-based forest management is provided in Section 6 of this report.

The Southern Eastern Slopes provides an ideal ecological, geographic, and socio-economic case for changing forest management away from timber-driven industrial forestry to a system reflecting a full suite of values in our headwaters. Embracing multiple values will support local economies, communities, and natural functions and processes.

Implementing ecosystem-based management on the Southern Eastern Slopes, as outlined in this report, is a step towards achieving the vision of healthy nature and communities in Southern Alberta.

1. Introduction

The Canadian Parks and Wilderness Society – Southern Alberta (CPAWS SAB) is the voice for wilderness in southern Alberta, and works collaboratively to develop solutions to conserve natural landscapes and watersheds now and for future generations.

The information in this report is part of a larger project intended to contribute to the conservation and restoration of the ecological health of the Eastern Slopes, and to ensure low-impact recreation opportunities from the Ghost watershed to Waterton National Park.

Conserving the ecological integrity and recreational value of southern Alberta forests requires collaborative, science-based solutions toward achieving changes to forestry policy and regulations to prioritize ecosystem objectives rather than just timber volume.

While this report focuses on forestry, it is hard to separate the effects of motorized recreation from forest management. Logging roads and other linear features often create recreational access to previously inaccessible areas, particularly the development of new unregulated motorized recreation trails. While the report uses forestry to illustrate the required changes, the principles and recommendations apply to all land uses on the Southern Eastern Slopes, including motorized recreation and other industrial land uses.

To that end, this report describes potential ecosystem-based forest management practices that meet the objectives of managing the Southern Eastern Slopes for social and ecosystem objectives such as water, wildlife and recreation. Combined with recent work to identify the policy, regulation and management barriers to ecosystem-based forest management, and gain insight into stakeholder perceptions of current forestry practices on the Southern Eastern Slopes, this report creates a basis for conversations to more clearly define the vision of ecosystem-based management of the Southern Eastern Slopes.

2. The Southern Eastern Slopes

2.1. Description of the Southern Eastern Slopes

The Eastern Slopes of the Alberta Rocky Mountains (also called the Rocky Mountain Front) form a narrow band of land, narrowest at the southern end of the province and widening on the northern boundary. For the purposes of this report the Southern Eastern Slopes are defined as the green zone public lands south of the Red Deer River (Figure 2-1).

The forests of the southern Eastern Slopes are vital to Albertans' health and quality of life. These lands offer more than gorgeous vistas – the Southern Eastern Slopes house the headwaters of clean-flowing rivers that provide water to our communities across the prairies, support a diverse community of large mammals such as grizzly bears, elk, and bighorn sheep; native fish, including bull trout and westslope cutthroat trout; numerous birds and a high diversity of insects. They also provide a wide range of recreational opportunities for families and intrepid adventurers.

The Southern Eastern Slopes are found within the Rocky Mountain Natural Region and the Foothills Natural Region, which consist of five natural subregions (Natural Regions Committee 2006; Figure 2-1):

- **Alpine (1,525.5 km2, 14.8% of the study area)**
- **Subalpine (5,037.5 km2, 49% of the study area)**
- **Montane (2,370.1 km2, 23.1% of the study area)**
- **Lower foothills (860.7 km2, 8.4% of the study area)**
- **Upper foothills (480.6 km2, 4.7% of the study area)**

The Southern Eastern Slopes contain a mosaic of vegetation types. This region provides essential habitat for a diversity of plant and animal species, and is the origin of many essential resources for humans, such as clean and abundant water (Government of Alberta 1984).

The rugged topography of the Southern Eastern Slopes creates distinctly varied habitats, which differ in slope, aspect and microclimate (Koerner 2004). North- and east-facing slopes are generally wet, while south- and west-facing slopes are typically dry. Strong winds, usually from the west, redistribute snow and dramatically alter soil moisture across the landscape. This variety of moisture regimes creates similarly dramatic changes in vegetative cover.

The forested landscape, dominated by conifers, exists between low timberline (roughly 1300 m) and high timberline (roughly 2200 m). It is best characterized by dense stands of lodgepole pine and subalpine fir trees which, even when they are in excess of 100 years of age, are typically about the size of a teepee pole. The dry conditions, steep slopes and soil conditions of the region make forest regeneration in the montane region challenging (Natural Regions Committee 2006). As a result, the ecosystems within the Southern Eastern Slopes are easily disturbed and slow to recover (Koerner 2004, Alberta Wilderness Association 2011).

“The forests of the southern Eastern Slopes are vital to Albertans' health and quality of life. These lands offer more than gorgeous vistas – the Southern Eastern Slopes house the headwaters of clean-flowing rivers that provide water to our communities across the prairies, support a diverse community of large mammals such as grizzly bears, elk, and bighorn sheep; native fish, including bull trout and west-slope cutthroat trout; numerous birds and a high diversity of insects.”

These varied and unique ecosystems create areas of high species diversity including pockets containing the highest level of biodiversity in the province. The Southern Eastern Slopes contain some of Alberta's rarest tree species, including Canada's easternmost ponderosa pines, western white pines and western red cedars. These forest ecosystems form the province's rarest, most species diverse forest community. These unique forests are largely concentrated in the headwaters of the Crowsnest River, and extend south-eastward into the northernmost headwaters of the Castle River.

Other tree species found in the montane forest of the Southern Eastern Slopes include Douglas-fir, white spruce, river birch, paper birch, Rocky Mountain juniper, limber pine and Rocky Mountain maple. Western larches are also present in the montane forest, particularly in extreme southwestern Alberta, where they grow eastward along the Castle, Crowsnest and Oldman rivers.

The forests of the Southern Eastern Slopes extend downslope into relatively cold valley bottoms where they sharply transition into grasslands and riparian forests. Cottonwoods, balsam poplar and willows dominate these forests, although they can also contain species found only in extreme southwestern Alberta like rare narrowleaf cottonwood and black cottonwood.

The forests of the Southern Eastern Slopes are disturbance dependent; wildfires have shaped the montane forest, and their history is rich and complex. A mosaic of grasslands occurs within the montane forest and, in some cases, extends upward through the subalpine zone into alpine meadows. Forest pathogens such as mountain pine beetle also play a critical role in shaping the forest community of the Southern Eastern Slopes.

The rich vegetative diversity of the Southern Eastern Slopes provides a variety of habitat for Alberta's wildlife, including several threatened species. Among the animal species of concern inhabiting the Eastern Slopes are the grizzly bear, which is listed as threatened in Alberta (Government of Alberta and Alberta Conservation Association 2010), the westslope cutthroat trout, a threatened native fish species which occupies five percent of its former range in the Bow and Oldman watersheds (Fitch 2011, Government of Alberta 2013a) and the bull trout, which is also designated as threatened and occupies less than 30% of its historic range (Government of Alberta 2012).

Climate change continues to introduce more threats and unknowns. But the emerging picture suggests that grasslands will invade low timberline, summers will be drier, more precipitation will fall as rain in the winter and the incidence of wildfires and the impact and spread of forest pathogens will increase (Hebda 2010). It is increasingly important that these forests are managed to protect the ecological functions that support nature and communities in southern Alberta.

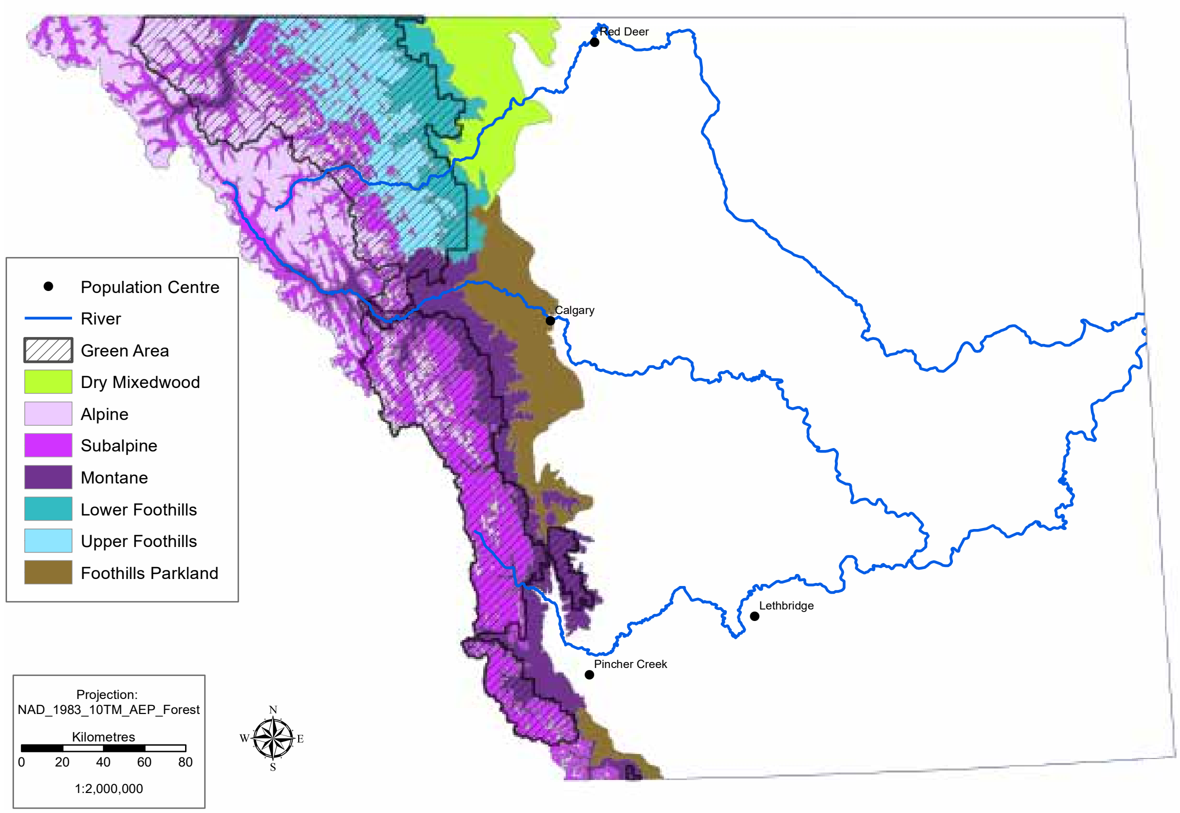


Figure 2-1: Natural Subregions in the Southern Eastern Slopes

2.2. Condition of the Southern Eastern Slopes

The cumulative impacts of widespread clear-cutting and the associated roads network created by logging activity and other industries have major impacts on watershed values and wildlife (Trombulak and Frissell 2000). Rogeau (2016) states that the ca. 1950 aerial photography showed no signs of harvest blocks, roads, mining, or settlements confirming that at this time the forests were in a pristine state. Forest clearing, increasing densities of linear disturbances attributed in part to forestry activities, and the accompanying off-highway vehicle use have increased the disturbance on the landscape throughout the region and have led to decreases in water quality, changes in seasonal runoff patterns, and disturbances or degradation to key wildlife habitats.

The Southern Foothills Study (2007; 2015) found that the Southern Eastern Slopes are currently experiencing significant logging and a slow steady decline in environmental quality. The report states that under current management, forestry companies harvest the net merchantable area at least every 100 years, which is done largely through clearcutting. Projecting into the future, this suggests that under a Business as Usual scenario that the industry will minimally log 1,000 ha annually for the next fifty years and total cutblock edge will increase from a recent 2,500 km to over 6,500 km by 2055 (SFS 2007). Figures 2-2 and 2-3 show cutblocks on the Southern Eastern Slopes and the approximated decade in which they were cut from 1940-2012 based on Alberta Biodiversity Monitoring Institute (ABMI) data.

Some of the key landscape changes that result from this level of industrial logging which affect the ecological health of the region are habitat loss and fragmentation and changes to water quality and natural flows.

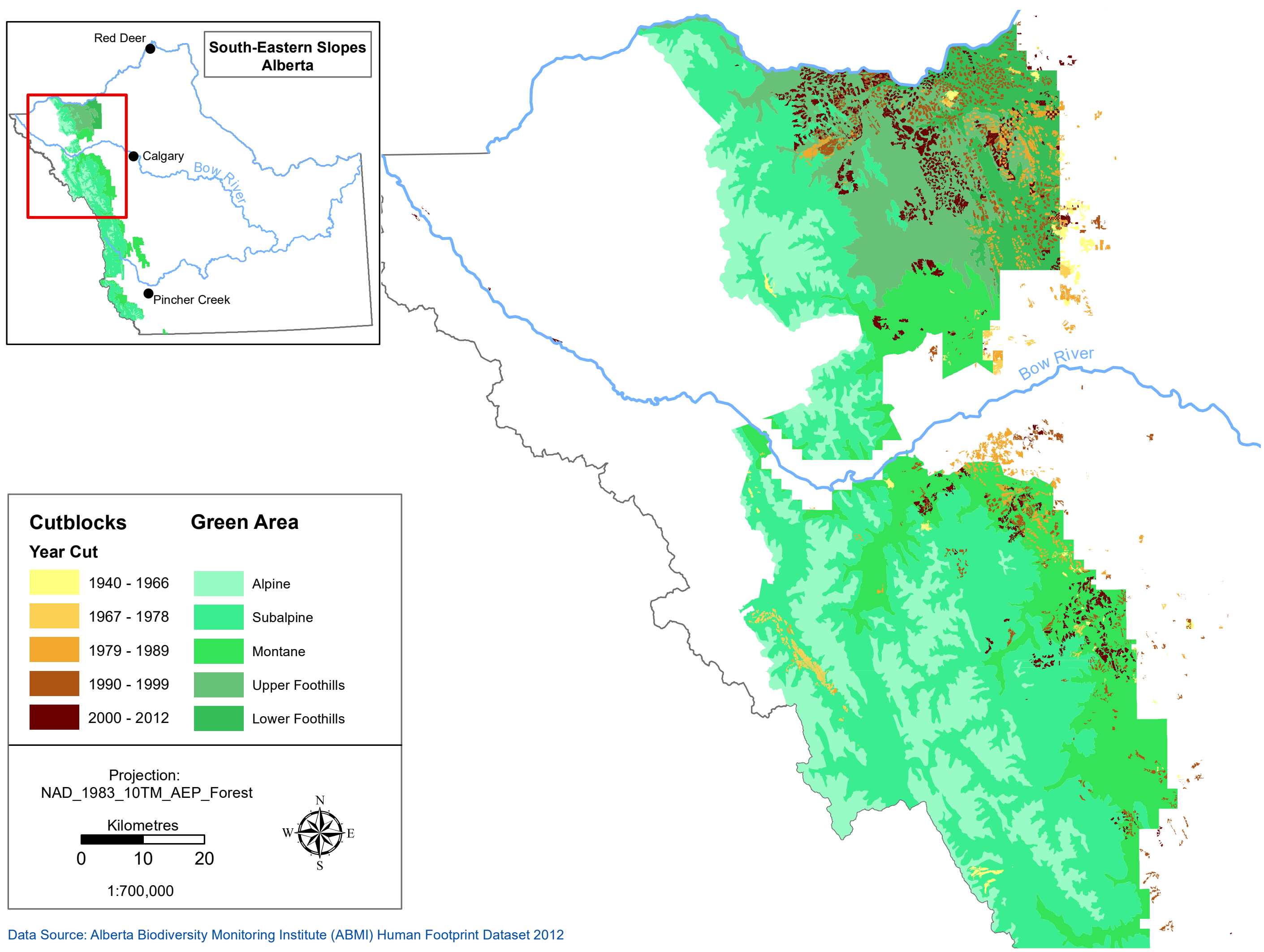
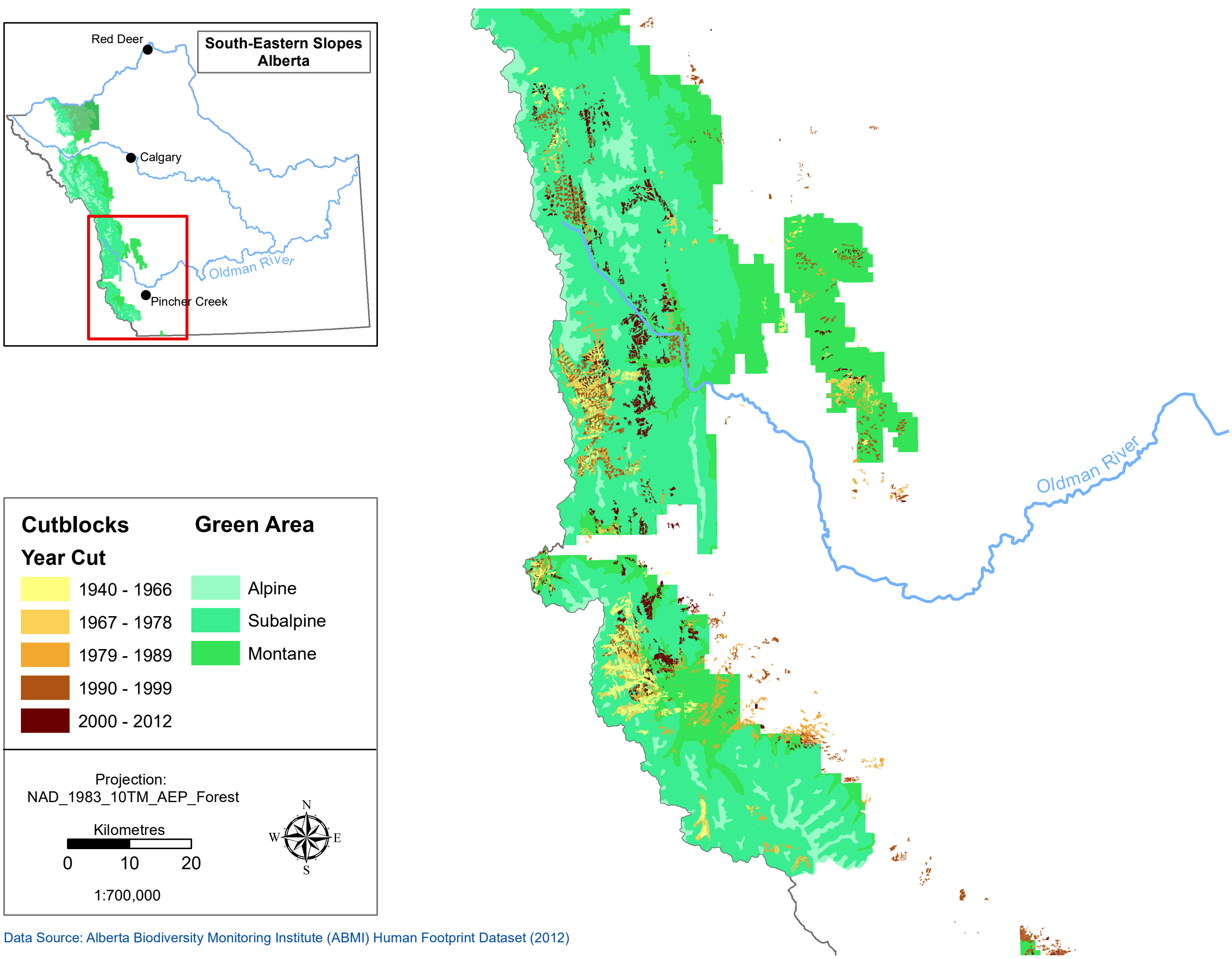


Figure 2-2: Cutblocks and Approximate Decade of Logging in the Southern Eastern Slopes (North)

2.2.1. Habitat & Landscape Connectivity

Habitat loss is a key conservation concern worldwide affecting many ecological processes and species functions. The effects of habitat loss and fragmentation on wildlife and ecological processes are intertwined. Habitat loss reduces the amount of habitat available to plants and wildlife and often leads to fragmentation and loss of connectivity. At the same time fragmentation further reduces habitat quality of surrounding areas, creating greater edge effects and reducing the amount of core or secure habitat needed for many animals to survive and move through the landscape.

The Eastern Slopes are important for connectivity locally and internationally. They are part of the Yellowstone to Yukon (Y2Y) region and represent one of the most important and strategic areas for carnivores in the entire interior mountain corridor (Nature Conservancy of Canada 2016). Within this landscape, habitat connectivity is particularly important for movement of wildlife and to maintain natural flows and processes on the landscape. As the climate changes, plant and wildlife communities will need to move to new areas in search of more favorable climates and will need large areas of connected land in order to adapt.



Data Source: Alberta Biodiversity Monitoring Institute (ABMI) Human Footprint Dataset (2012)

Figure 2-3: Cutblocks and Approximate Decade of Logging in the Southern Eastern Slopes (South)

Note that in Figure 2-3 areas of the Lost Creek Fire are considered cutblocks. While fire is not the same as clear-cut logging, much of the area was salvage logged. Logged and unlogged burned areas of the Lost Creek Fire are not distinguished in the ABMI data.

The loss of forest habitat and loss of landscape connectivity in the Southern Eastern Slopes has been quantified in several recent reports (Fiera 2013; Weaver, 2013; SFS 2007; Lee and Hanneman, 2011; Smith and Cheng, 2016a). The Southern Foothills Study (2007) found that the landscape is becoming increasingly fragmented due to new roads, industrial development from the energy and forestry sectors, as well as new residential acreages. As an indication of this, The Oldman Watershed Council, Headwaters Indicator Project (2013) found that 32 percent of the Oldman Headwaters were highly fragmented (moderate and high risk categories for intact landscapes), particularly between North Racehorse Creek, and the upper Oldman River, and the north-western most extent of Oldman River, largely as a result of forestry activities.

Figure 2-4 and 2-5 show some of the fragmentation from cutblocks and major linear features such as roads and pipelines along the Southern Eastern Slopes based on ABMI data. However, these maps do not include the many smaller linear features, including quad trails, cutlines, and in-block logging roads and therefore only give a general idea of the extent of linear features on the landscape.

The true extent of linear features and resulting fragmentation is much more extensive, as revealed in studies of the Castle Area (Lee and Hanneman 2011; Smith and Cheng 2016b, Smith and Cheng 2016c). These studies include the smaller linear features and show linear densities in the Castle sub-watersheds ranging from 0.4 km/km2 to 3.4 km/km2 (Smith and Cheng 2016d). These densities far exceed thresholds for species such as grizzly bear, elk, amphibians, westslope cutthroat trout and bull trout.

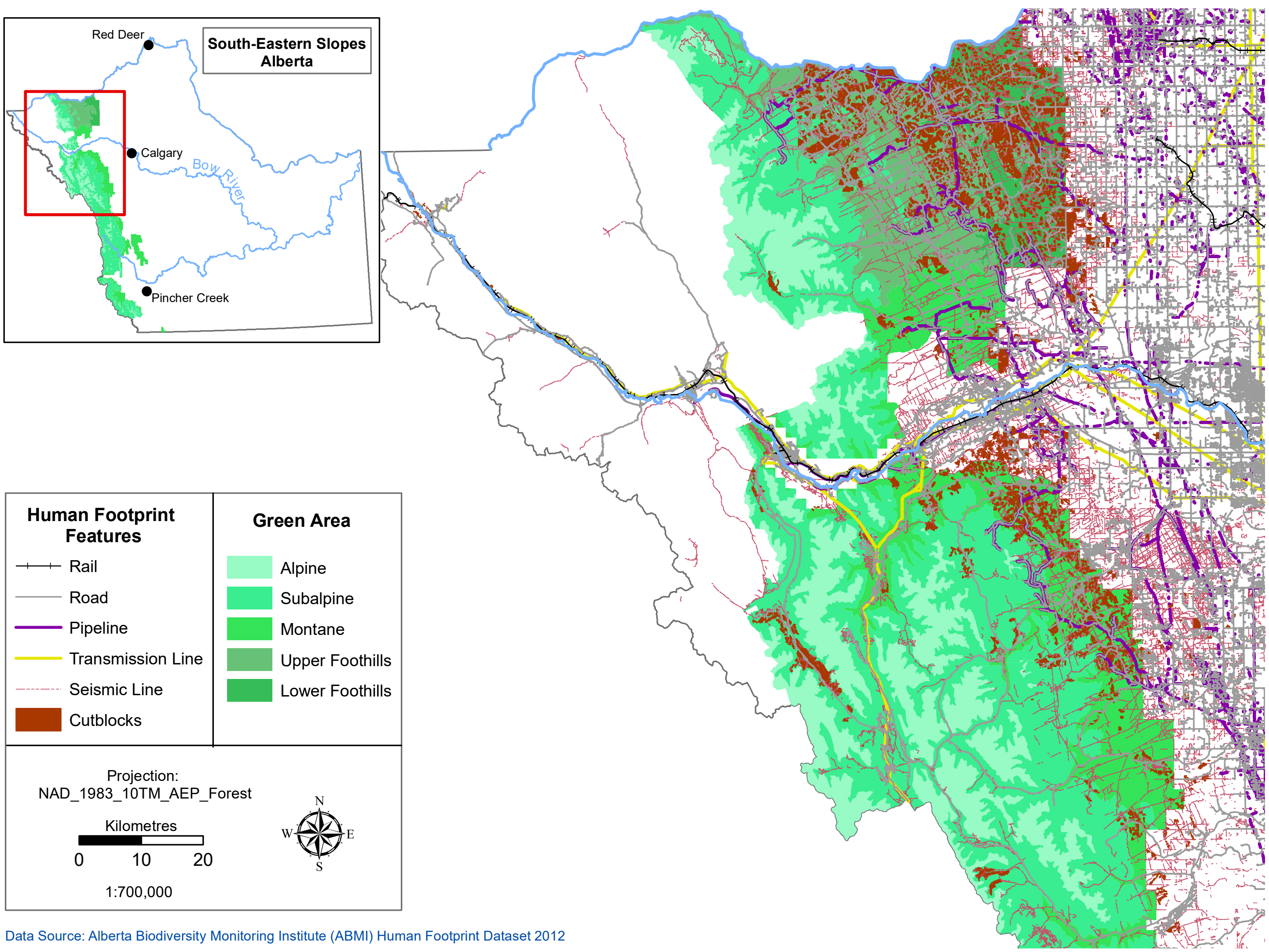
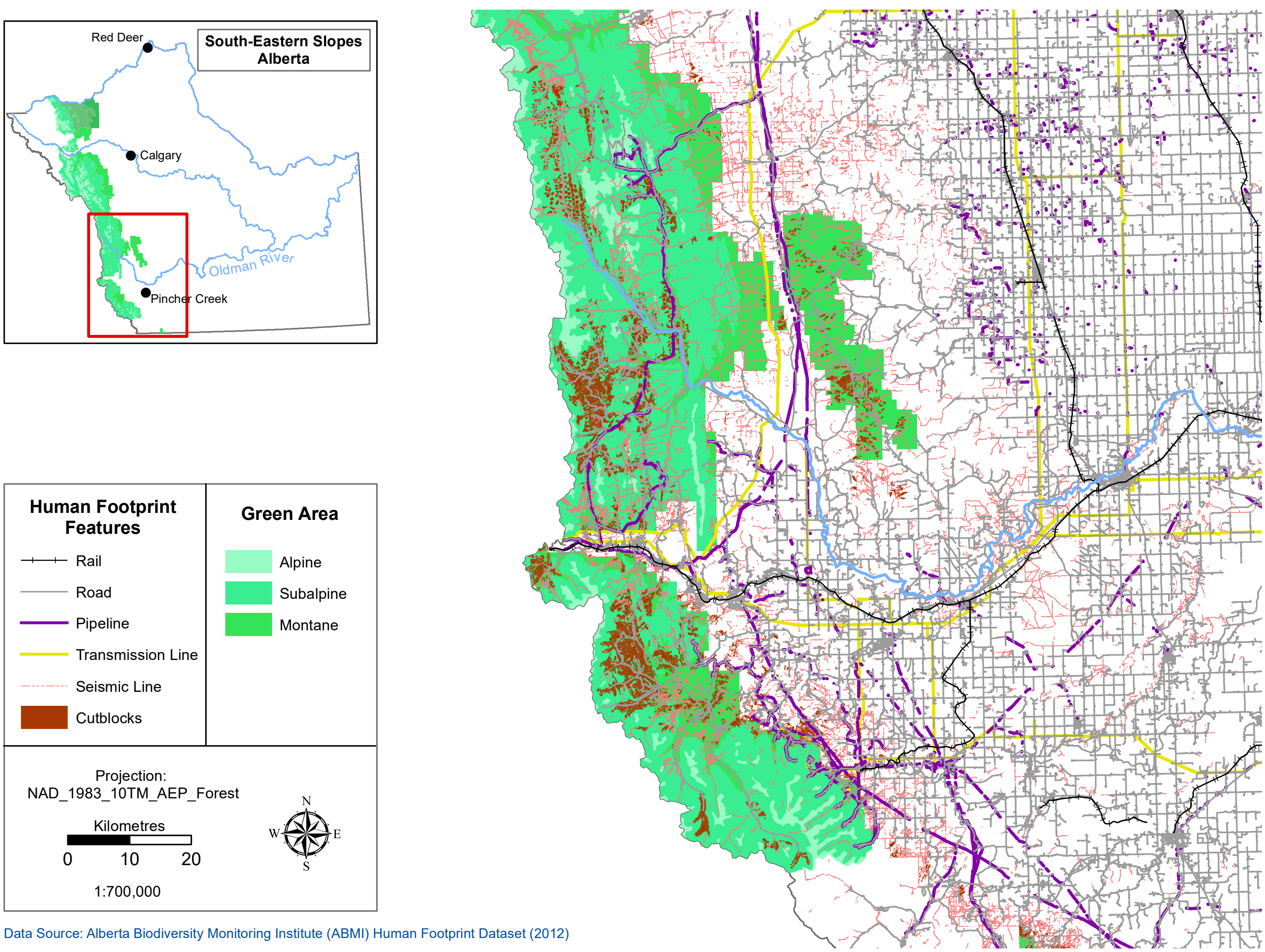


Figure 2-4: Cutblocks and Major Linear Features in the Southern Eastern Slopes (North)

Road densities as low as 0.1 km/km2 have been shown to have negative impacts on bull trout spawning (BCMWLAP 2002, Ripley et al. 2005) and depressed populations of bull trout are associated with average road densities of 0.87 km/km2 (USFW 1998). Elk and amphibian species richness all show reduced activity or richness at road densities of 0.5 km/km2 (Frair et al. 2008, Findlay and Houlahan 1997).

Many species on the Southern Eastern Slopes require large intact areas to thrive. Habitat fragmentation can also reduce the amount of effective habitat, particularly for interior-forest dependant species. Analyses done for the Eastern Slopes Conservation Collaborative suggests that on the Southern Eastern Slopes only 34% of intact native habitat patches are >10km2 (Eastern Slopes Conservation Collaborative 2017). Although the patch sizes of 10 km2 is somewhat arbitrary given that area requirements are species dependent, it represents the average daily home range of a female grizzly bear (Gibeau 2000).

Smith and Cheng (2016b) also show that Intact Forest Landscape Fragments (contiguous mosaic of undisturbed ecosystems (e.g., forest, bog, water, tundra, and rock outcrops) of at least 10 km2 in size) cover only 46% of the Castle region and have decreased by 10% since 2000. The study also reports a loss of 39.9 km2 of habitat in the Castle from 2000-2015.



Data Source: Alberta Biodiversity Monitoring Institute (ABMI) Human Footprint Dataset (2012)

Figure 2-5: Cutblocks and Major Linear Features in the Southern Eastern Slopes (South)

2.2.2. Changes to Water Quality and Natural Flows

The Southern Eastern Slopes are the headwaters of Southern Alberta and the Canadian prairies, providing a clean, reliable water supply for communities, agriculture and natural areas downstream. Clean water relies on healthy landscapes. Intact forests provide clean water and help regulate natural water flows including floods and droughts (O2 Planning and Design 2013, Pike et al. 2010, Feller 2005).

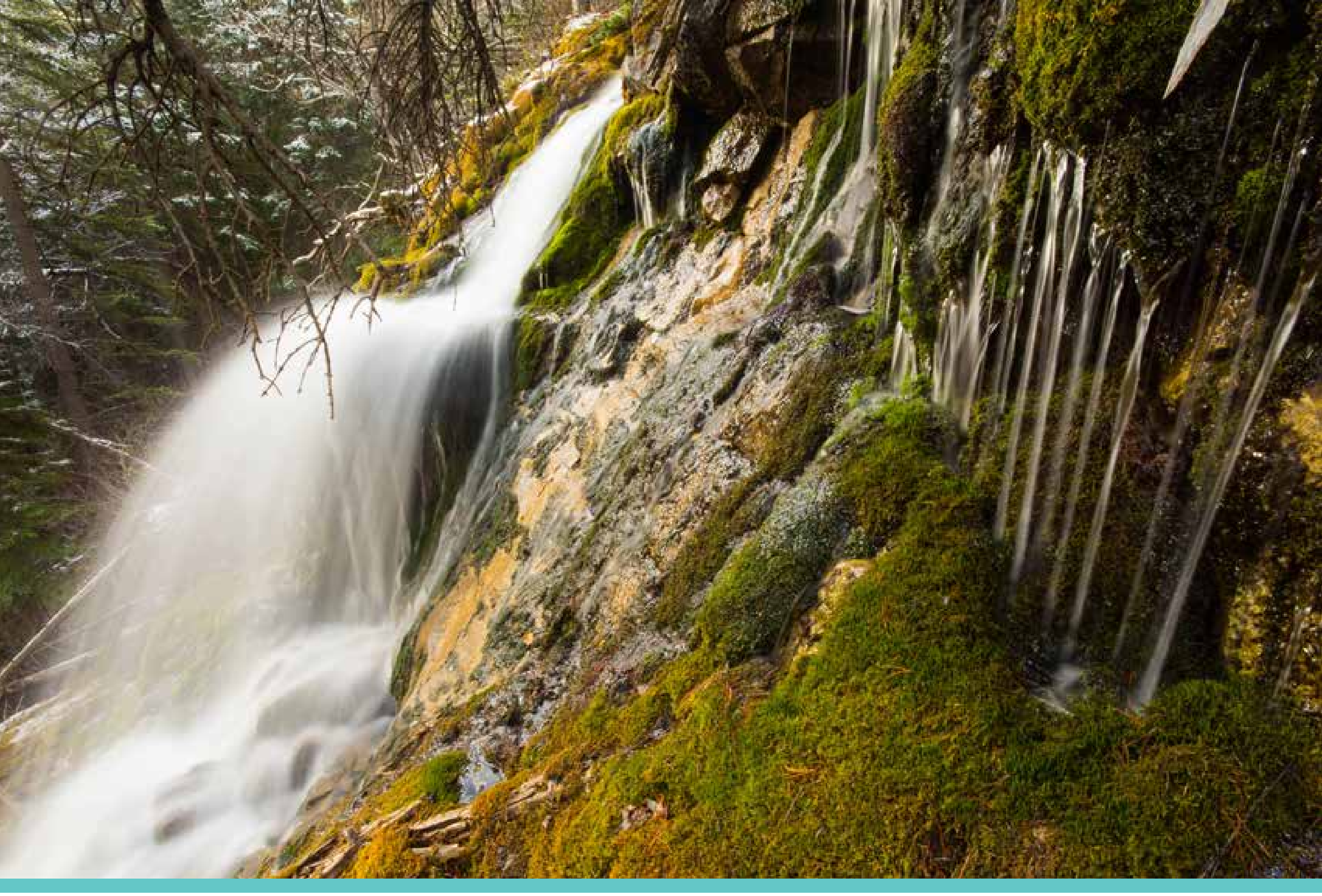
Forestry activity, particularly roads (Nitschke 2005), have been linked to degradation of water quality and to alteration of water levels and flow in the Southern Eastern Slopes (Fiera 2013; Ghost Watershed Alliance Society, 2012). The Southern Foothills Study states that water quality and quantity are declining on the Southern Eastern Slopes due to the cumulative effects of forestry and other land uses and will continue to decline even under best management practices (SFS 2007; 2015). The study notes that the cumulative footprints of the forest sector can lead to increased surface water runoff and erosion, particularly during heavy rain events. Increased surface water runoff can also reduce the amount of water that seeps into the ground and recharges aquifers. The loss of trees (and their influence on water retention after snow melt) may have a significant impact on water quality and natural flows.

Forest harvest can also impact aquatic habitat for fish and other aquatic species. For example, Ripley et al. (2005) found timber harvest on up to 35% or more of individual sub-basins was projected to result in the extirpation of bull trout from up to 43% of stream reaches, especially those that support high densities of bull trout.

In the Oldman Watershed headwaters, linear features in habitats with high erosion risk are pervasive. Fiera (2013) calculates that 71% of watersheds mapped in the Oldman Watershed headwaters were moderate or high erosion risk, defined as amount of linear features that occur in areas that are at high risk of increased rates of soil erosion. This included areas with steep slopes (>40% slope – high elevation areas) or wet habitats (lakes and wetlands including both permanent and semi-permanent water bodies).

Erosion risk is in important factor to consider when deciding whether a landscape is suitable for commercial logging. The Canada Land Inventory (CLI) is a rating system of land capability for various purposes including Soil Capability for Forestry (Government of Canada 1969). Using this system of land classification based on soil conditions and potential for erosion, with some exceptions, the forest land in the Southern Eastern Slopes of Alberta is classified as having "severe limitations" to "severe limitations which preclude the growth of commercial forests."

As the climate changes, water conservation becomes more important. A critical part of becoming more resilient to water scarcity is increasing or restoring the ability of the natural landscapes to retain water. Forest Management on the Southern Eastern Slopes must use headwaters protection and water conservation as the guiding principle in management decision.



3. Albertans' Values for the Southern Eastern Slopes

Albertans are increasingly concerned about the cumulative effects of logging and other industries on the Southern Eastern Slopes (SFS 2007, Government of Alberta 2010, Praxis 2012, Fiera 2013, CPAWS SAB 2014). Individuals and groups living and working in communities such as Calgary, the Ghost, Bragg Creek, High River, Crowsnest Pass, Livingstone, Lethbridge, Pincher Creek and Beaver Mines have all spoken out strongly against industrial forestry practices that degrade forest health and water security and detract from wilderness recreation experiences.

Clear-cut logging and associated roads are often identified as a key concern of communities in Southern Alberta. For example, in the survey on community values in the M.D. of Pincher Creek, The Praxis Group (2012) found that clear-cut logging was considered to be the third most inappropriate form of economic development (after mining and big box stores) and the third biggest concern for the future of the M.D. (after losing agricultural land to subdivision and windmills destroying viewscapes). Likewise, much public feedback on the development of the South Saskatchewan Regional Plan (SSRP) advocated a reduction or end to clear-cut logging and the implementation of selective logging in the region (Government of Alberta 2010).

Studies also indicate that Albertans are aware that these forests deliver much more than an annual volume of timber and people do not feel that current forest management effectively manages for these other values (SFS 2007, Fiera 2013, CPAWS 2014).

Numerous surveys and studies have been conducted to define public values for the Southern Eastern Slopes. Some of the most common values and services that respondents of these studies felt the Southern Eastern Slopes provide are:

- **headwaters,**
- **wildlife and fish habitat,**
- **aesthetics,**
- **agriculture and ranching,**
- **low-impact recreation, and**
- **public involvement and consultation in forest management**

These values are summarized below to provide a picture of public values for this important ecological landscape.

3.1. Headwaters

The importance of managing the Southern Eastern Slopes to protect headwaters has been consistently expressed by local communities and the wider public as the highest priority for the landscape. Clean water, water quantity and natural flows were all major concerns for forest and land management (SFS 2007, Government of Alberta 2010, SFCSI 2011, Miistakis 2011, Praxis 2012, Water Matters 2013, CPAWS 2014, Praxis 2015).

For example, The Southern Foothills Community Stewardship Initiative report (2011) recommends that to “maintain and restore the natural health of watersheds, all parts of a watershed should be managed and protected as a contiguous ecosystem, including its headwaters, tributaries and main stem.” Likewise, the participants of the Southern Foothills Study (2007) and the MD Ranchlands Community and Conservation Values Mapping Project (Miistakis 2011) expressed concern about damage to riparian areas and recommended that new developments show beyond a reasonable doubt that their activity will not pose a risk to the supply of clean water.

Many other organizations have called for prioritizing headwaters protection in the Southern Eastern Slopes and the need for changes to forest management practices to achieve this goal (e.g. Obad and Droitsh 2009, Alberta Wilderness Association 2012, CPAWS 2014).

3.2. Wildlife and Fish Habitat

Residents of Southern Alberta value the region's diversity of fish and wildlife species, and the healthy habitat that sustains them (SFS 2007, SFCSI 2011, Miistakis 2011, Praxis 2012, CPAWS 2014). In a number of studies, residents showed concerns about loss of wildlife and fish and supported habitat protection through setting aside land and by using thresholds on disturbances and roads to protect biodiversity (SFS 2007, Government of Alberta 2010, SFCSI 2011, Praxis 2012, Water Matters 2013, Praxis 2015).

For example, in the M.D. of Pincher Creek, residents believed the second-most important land use for the region was "setting aside land for habitat protection." While "allowing clearcut logging in the Castle Special Management Area" was rated as the second to least important land use (Praxis 2012).

Participants in the M.D. of Pincher Creek also spoke about the importance of the following: maintaining healthy and fully functioning ecosystems; conserving ecological diversity; sustaining wildlife habitat; saving native fescues and grasslands; maintaining the productivity and viability of the land; and protecting water resources. Some suggested that the social and economic well-being of the community hinges on a strong and sustainable natural environment (Praxis 2012).

The participants of the Southern Foothills Community Stewardship Initiative (SFCSI 2011) recommended that "all development—industrial, agricultural, residential and recreational—should be planned and managed to discourage the fragmentation of land, and to allow for, and support, landscape connectivity."

3.3. Aesthetics

The beauty and aesthetics of the Southern Eastern Slopes are recognized as an important value by local residents and other Albertans (SFS 2007, Government of Alberta 2010, SFCSI 2011, Miistakis 2011, Praxis 2012). The community values study of the M.D. of Pincher Creek indicates that preserving the M.D.'s natural beauty and viewscapes was a shared community value and in fact, residents suggested that "beautiful scenery" was the best thing about living in the M.D. (Praxis 2012). The aesthetics of the area, including the protection and conservation of natural areas and the need to maintain and preserve the natural landscape to protect fish and wildlife, is also considered to contribute to tourism and low-impact recreation (Government of Alberta 2010, SFCSI 2011, Miistakis 2011). Tourism and recreation was rated as the second-most important economic activity for the region, in public feedback on the development of the SSRP, after agriculture (Government of Alberta 2010).

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Public feedback on the development of the SSRP rated growth in agriculture as having the highest importance to the economy of the region and forestry as having the lowest importance.

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3.4. Agriculture and Ranching

Another key value of the landscape to local residents is agricultural and ranching. This was mentioned in several studies as both important to the economy and to the local culture and way of life (SFS 2007, SFCSI 2011, Miistakis 2011, Praxis 2012). Residents value the region’s character and heritage, epitomized by its vast open spaces and traditional, close-to-the-land cultures of ranching, cowboys and horses (SFCSI 2011).

Public feedback on the development of the SSRP (Government of Alberta 2010) rated growth in agriculture as having the highest importance to the economy of the region and forestry as having the lowest importance.

3.5. Low-impact Recreation

Community concerns about recreation pressures were evident in most studies reviewed with many people valuing the landscape for low-impact recreation opportunities on public land and their contributions to tourism (SFS 2007, SFCSI 2011, Praxis 2012, CPAWS 2014, Praxis 2015).

The Praxis Group (2012) found that in the M.D. of Pincher Creek, the abundance and diversity of recreational opportunities afforded by the natural environment was generally regarded as an attractive aspect of the region worth preserving. However, while recreational access was clearly valued, some participants raised concern because unrestricted recreational use on public land is damaging the environment. These individuals advocated for stricter regulations and more enforcement of recreational activities on public lands.

In the Southern Foothills Community Stewardship Initiative study (2011) Nanton’s then mayor, John Blake, notes that tourists and recreationists are looking for unspoiled nature. “If you’re going to have some recreational dollars spent in your area, you have to preserve it. That’s where tourism dollars come from – they want to see it natural.”

3.6. Public Involvement in Forest Management

A key theme expressed in most public surveys and studies was the need for more public involvement and consultation in land-use decisions, particularly with local people.

Many people feel that land-use decisions are made at the provincial level and often do not reflect the preferences and environmental values of the community (Praxis 2012). People expressed concern over whether public input was actually incorporated into forest management planning, and indicated that they felt that current forest management practices were not transparent, and did not facilitate independent planning processes (CPAWS 2014).

People called for meaningful community-based consultation and for greater local control over decisions on the land and water and the importance of having integrated, science-based plans and strategies for management (SFCSI 2011, Praxis 2012, Water Matters 2013, CPAWS 2014).

During the Oldman Watershed Council Source to Tap conversations (Water Matters 2013), participants acknowledged the importance of local and traditional knowledge (e.g. experiential, intuitive and spiritual understanding of ecosystems, watershed dynamics and appropriate stewardship practices) in good land and water management decision-making, suggesting it builds local buy-in of decisions and plans. The document also contains a number of recommendations from communities in the region for moving forest management towards an ecosystem-based model, including considering locally based timber operations, finding a more effective way for the public to have a legitimate voice in landscape planning and timber harvesting, and suggesting that the community sign off on harvesting plans since the community often has to bear the consequences (Water Matters 2013).

4. Ecosystem-based Management of Alberta's Southern Eastern Slopes

4.1. Overview of Ecosystem-based Management

The guiding premise for sustaining ecosystems now and into the future is to manage ecosystems such that structure, composition and function of all elements, including their frequency, distribution and natural extinction, are conserved. Conservation focuses on maintaining and restoring suitable amounts of representative habitats over the landscape and through time. (Kaufman et al. 1994)

Ample scientific literature supports ecosystem-based forest management to protect the full range of forest values and functions (e.g., Christensen et al. 1996, Perry 1998, Simberloff, 1999, Lindenmayer et al. 2006, Schulte et al. 2006).

Generally, ecosystem-based management aims to manage landscapes in a way that recognizes the full array of interactions within an ecosystem rather than considering single issues, species, or ecosystem services in isolation (Christensen et al. 1996). This approach provides for a wider array of uses, values, products and services from the land to an increasingly diverse public (Overbay, 1992). In the context of the Southern Eastern Slopes, management would prioritize values such as headwaters protection, fish and wildlife habitat, aesthetic values, agriculture and ranching and low-impact recreation (see Section 3).

To achieve conservation of these values on the ground, a suite of goals or objectives is required to encompass both the multi-faceted nature of ecosystems and the ways in which humans interact with them (Slocombe 1998, Burton et al. 2006). Ecosystem based forest management is not just about logging differently but about prioritizing social and ecological objectives. Thus ecosystem-based management starts at the landscape scale by designating protected areas including representative habitats, rare or unique species or areas and culturally important sites and then looking at management of lands outside of protected areas. Depending on the objectives of the area management of these public lands may or may not include logging.

While the term "ecosystem-based management" or "ecosystem forestry" is widely used, much of its application is little more than small modifications to industrial forestry practices at the site scale. Forest management is often purported to replace natural disturbance. However, while natural disturbance is an important ecological process in the Southern Eastern Slopes, the type and level of human disturbance from clear-cut logging does not replace or emulate natural processes. As outlined in Section 2, industrial forestry and associated infrastructure have had a major impact on the Southern Eastern Slopes. The recommendations in this report provide direction to implement a landscape approach to ecosystem-based forest management on the Southern Eastern Slopes that prioritizes ecosystem values over timber values and preserves the structure, function and composition of the natural system.

4.2. Alberta Policy Context

In principle, a suite of statutes, policies, regulations and guidelines govern forestry management and operations in Alberta. However, the policies that most affect commercial forestry operations on the Southern Eastern Slopes include The Forest Act, The Public Land Act, and the South Saskatchewan Regional Plan (SSRP; replacing The Policy for Resource Management on the Eastern Slopes). In order to apply ecosystem-based forest management on Alberta's Southern Eastern Slopes, changes to current policy and management would need to be implemented.

Province-wide, forestry practices are largely directed by the Forest Act, which is clearly designed to achieve the goal of an annual volume of harvested timber. The most recent Forest Act was passed in 1971, and retains the original tenure and quota system that was established in 1965. It explicitly states that timber yield is the first priority of forestry operations: "[a forestry company may] enter on forest land for the purpose of establishing, growing and harvesting timber in a manner designed to provide a yield consistent with sustainable forest management principles and practices" (Government of Alberta 2013).

Based on these policies, forestry companies cut large annual volumes of timber, ensuring that industry mills and forest products manufacturers have a short-term timber supply. As such, the calculation of the annual allowable cut (AAC) is geared toward meeting timber quotas rather than ecosystem function. In practice, tenured rights such as timber extraction and oil and gas development often trump protection of ecosystem integrity and non-consumptive use of ecosystems such as low-impact recreation.

The Alberta Land Use Framework is redefining how we manage lands in Alberta. However, while land-use policies and plans can create the overarching policy environment to implement ecosystem-based forest management, additional policy changes are need to fully adopt ecosystem-based management.

In the context of the Southern Eastern Slopes, the SSRP, released in 2014, is a land-use plan that guides decisions about development, recreation and conservation in southern Alberta. Regional land-use plans such as the SSRP may implement ecological thresholds, plan for cumulative effects and designate protected areas, among other things. However, the SSRP failed to designate adequate protected areas and exclude industrial logging from some of the most sensitive areas, which are the first steps in an ecosystem-based management plan, and does not provide the level of detail required to affect forest management practices. The management frameworks being developed as part of the SSRP such as the Draft Land Footprint Management Plan and Biodiversity Management Plan are important steps towards implementing thresholds on public land; however current drafts of these plans will likely not greatly affect forest tenures or forest management planning. Broader changes will be needed in order to implement ecosystem-based forest management on the Southern Eastern Slopes.

4.3. Recommended Changes to Forest Management in Southern Alberta

As shown in Section 2 of this report, Alberta's past and present forest management has led to the degradation of soil and water, damage to wetland complexes, habitat loss, and habitat fragmentation. When ecosystems are no longer intact, they cannot perform the natural functions on which we rely, including carbon retention, flood prevention, biodiversity conservation, water filtration, pollination services and erosion prevention. This creates a restoration debt with costs that are ultimately carried by the public. To restore and maintain the integrity and health of forest ecosystems in the Southern Eastern Slopes, fundamental changes to the way the land is perceived and managed are required. To this end, we recommend the official adoption of a mandate of ecosystem-based forest management on the Southern Eastern Slopes, including increased public participation, and enforceable changes to the legislation to support this mandate.

4.3.1. Officially Adopt a Mandate of Ecosystem-based Forest Management

As discussed in Section 3, Albertans value the forests of the Southern Eastern Slopes for clean, secure water, wildlife and fish habitat, beautiful scenery, rural lifestyles and low-impact recreation.

The Government of Alberta has the opportunity to lead on these issues by honouring what Albertans want. Adopting a mandate of ecosystem-based forest management policy and legislation would mean explicitly prioritizing ecological integrity, intact watersheds, connected landscapes and sustainable local community economies and ending the practice of an annual allowable cut as the goal for logging. This system would include cumulative effects assessments and modelling, that incorporates all forest values into decision-making.

The following recommendations would move forest management in southern Alberta towards an ecosystem-based approach:

- **Designate new protected areas on the Southern Eastern Slopes;**
- **Maintain landscape connectivity and integrity;**
- **Designate areas for recreation and other low-impact land uses;**
- **Maintain natural age structures on a landscape level;**
- **Restore damaged and fragmented areas;**
- **Designate areas for timber management and implement site-level ecologically sustainable timber management;**
- **Apply monitoring and adaptive management practices**

4.3.1.1. Designate New Protected Areas on the Southern Eastern Slopes

The Government of Alberta has committed to meeting the Convention on Biological Diversity goal of 17% protected lands by 2020. This is an achievable short-term goal to meet an international commitment, however conservation science indicates that to conserve biodiversity and the full range of natural processes and functions, we must protect 50% of our natural areas (Noss and Cooperrider 1994, Wilson 2003, Boreal Scientists' Letter 2007). Protecting half of our natural areas means not just meeting a target area but also protection of unique habitats, representative natural ecotypes, areas that are important for key ecological functions such as water quality and natural flow and habitat for provincially- and federally-listed plant and animal species at risk. These areas should be defined and designated before areas are identified for timber harvest or other high-impact human uses.

4.3.1.2. Maintain Landscape Connectivity and Integrity

Habitat connectivity is particularly important for movement of wildlife and to maintain natural flows and processes on the landscape within and between protected areas. The Southern Eastern Slopes are becoming more fragmented, reducing secure areas for wildlife and interrupting natural processes (see section 2.2.1). To maintain and restore connectivity and landscape integrity, more than 80% of a watershed (or sub watershed) should remain intact, consistent with research results on hydrological changes and impacts on native trout. Some watersheds should also remain unlogged to act as reference areas for study and adaptive management to properly measure effects of forest management elsewhere on the landscape.

Intact areas should remain intact. Forest management plans should protect large, intact, roadless areas to create a continuous mosaic of undisturbed landscape to meet ecosystem and biodiversity maintenance goals and avoid logging of watersheds containing sensitive populations of Westslope cutthroat trout and bull trout. Areas should be specifically designated where wildlife critical range and movement is the priority for management.

Maintaining connectivity and integrity also includes a focus on restoration of previously fragmented and damaged areas, prioritizing areas of high water value and habitat for species at risk.

4.3.1.3. Designate Areas for Recreation and Other Low-Impact Land Uses

Public lands along the East Slopes of Alberta provide some of the most iconic mountain and foothills landscapes in Canada, and are a major destination for recreation and tourism for local, national and international visitors. The recreation and tourism economic sectors are a major contributor to Alberta's economy, providing jobs and economic diversification opportunities to local communities and regional and provincial economies. Many areas on public land may be better suited and more valuable for low-impact human uses, such as quiet forms of recreation, than for intense timber extraction.

Growth and investment in tourism and quiet recreation rely on the knowledge that the "attraction" – intact natural areas – will exist over the long term. This is often incompatible with high-intensity timber harvest and other industrial activities which fragment the landscape and decrease the aesthetic value. While some low-intensity timber harvest may be appropriate in the same area as quiet recreation, this should be determined as part of the planning process and include input from quiet recreationalist and ecotourism operators.

Investment in the recreation and tourism sector has long been lacking in much of the Southern Eastern Slopes, as land access has been largely given up to oil and gas exploration and forestry. Where appropriate, ecotourism developments and recreation interests should be provided with a long-term (e.g. twenty-year) guarantee of undisturbed natural views or important areas. It is not realistic to promote investment in recreation and nature-based tourism while not providing security that the key attractant – undisturbed wilderness – will continue to exist in areas used by recreationalists, guides and outfitters. Aesthetic standards (i.e. viewscapes, size, shape and landscape layout of timber harvest) need to be incorporated to contribute to this security.

If motorized recreation is determined to be an appropriate use of an area (i.e. it will not have a significant impact on the conservation of headwaters, fish and wildlife habitat, or disturb quiet recreationalists and local residents), a designated trail network should be properly designed and enforced to minimize the impact of this land use. Motorized recreation access should be designated using ecological thresholds and the amount of designated access should be based ecosystem needs and on the proportion of motorized recreationalists to quiet recreationalists. Areas of quiet recreation separate from motorized recreation should be identified

To further develop the potential of this region, there should be a focus on developing economic opportunities where locally desired and appropriate that emphasise wildlife and headwaters conservation such as ecotourism and low-impact recreation such as hiking, fishing, horseback riding, hunting, biking and other sustainable activities.

4.3.1.4. Maintain Habitat Diversity and Natural Age Structures on a Landscape Level

Disturbances, and the diverse ages of forest stands that they create, are important for biodiversity and community resilience on the Southern Eastern Slopes. On an landscape where fire and other natural disturbance events are present, native vegetation of different stand types and ages offer a diversity of habitat types, microclimates and niches that support a rich diversity of plants, invertebrates, reptiles, mammals and other living organisms (Bergeron et al. 2001, Cyr et al. 2009, Cavard et al. 2011).

However, disturbances should be maintained and restored through ecosystem-based management rather than industrial forestry, which neither replaces nor replicates the ecological effects of forest fires (Armstrong et al. 2003, Hely et al. 2003, Le Goff, and Sirois 2004, Nitschke 2005, Cyr et al. 2009, Long 2009). For example, forest structure including retention and coarse woody debris, water flows and chemistry, the abundance and diversity of species, and community composition can all be very different after logging than after natural disturbances such as fire (Drapeau et al. 2000, Nitschke 2005, Schieck and Song 2006, Buddle et al. 2006, Durall et al. 2006, Brassard and Chen 2008, Hart and Chen 2008). The ranges of variation in habitat types, disturbance frequency and disturbance patch size that result from timber harvest are different than those resulting from natural fire conditions.

Fire return interval and fire severity vary across landscapes based on factors such as fire intensity, natural region, elevation and aspect, and the random distribution of fires (Rogeau 2016). For example, low to moderate intensity fires were historically common in the Montane and Foothills natural regions and would only kill small diameter trees. However, in the Subalpine, fires would burn less frequently, providing a greater opportunity for fuel load to develop and burning at higher intensity as a result (Rogeau 2016). On the Southern Eastern Slopes, forest fires ranging from low-intensity to stand-replacing, would naturally occur at a particular site every 26 to >300 years, depending on the above-mentioned host of variables (Johnson and Fryer 1987, Masters 1990, Johnson and Larsen 1991, Reed et al. 1998, Cumming 2001, Charron and Johnson 2006, Rogeau 2013, Rogeau 2016). Based on this wide range of fire intensities and return intervals, Rogeau (2016) recommends that forest and fire management planning should not be a uniform approach but should be adapted for natural subregion, landform type, fire intensity and fire return interval.

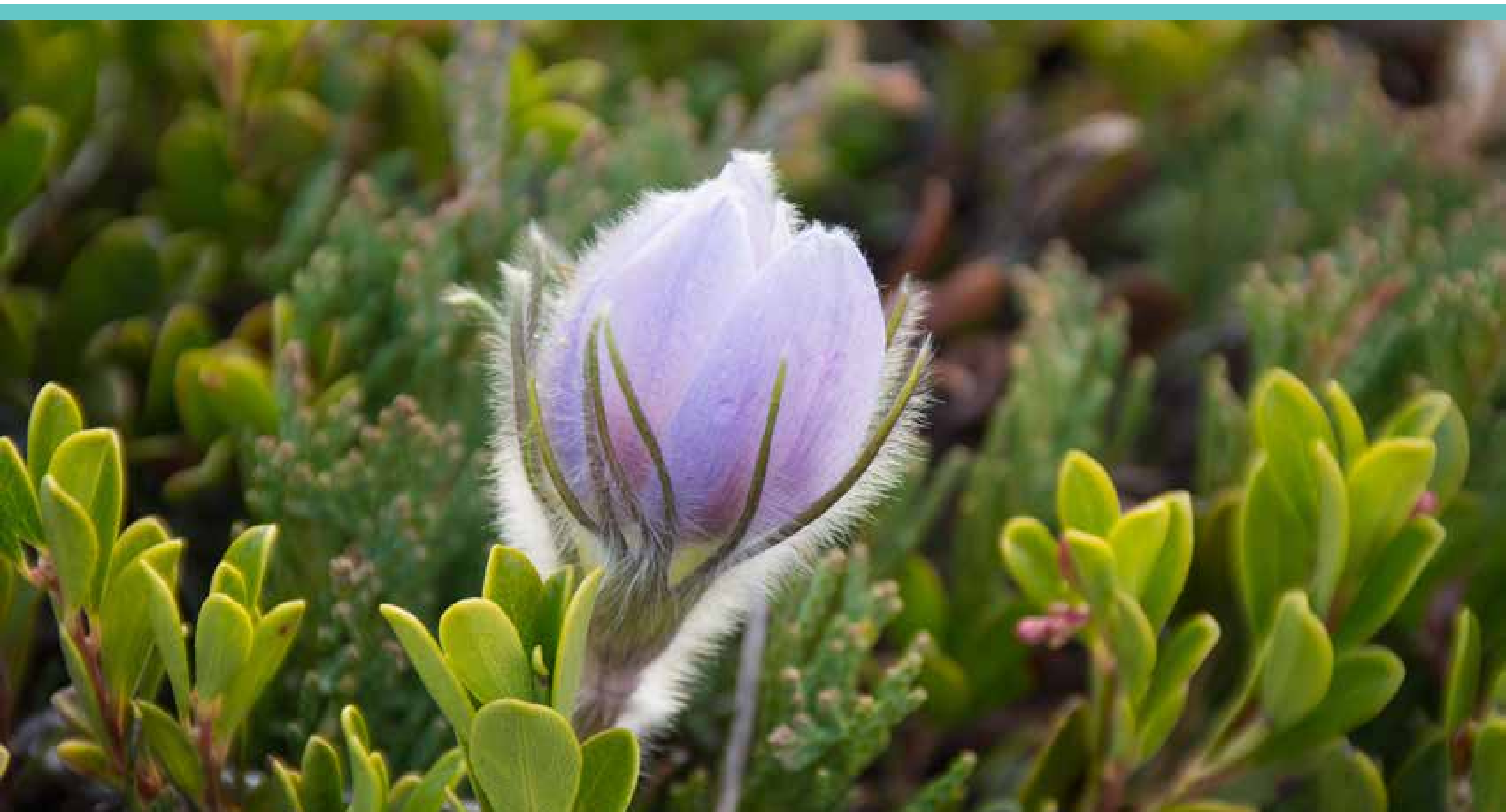
> “To help refocus forest management on establishing more natural disturbance regimes, additional research needs to be done into the historical distribution of forest age classes on the Southern Eastern Slopes.”

The forest harvest rotation cycles used by commercial forestry companies in Alberta is approximately 80-100 years and uses only clearcut prescriptions, and thus only mimics stand-replacing fires. This results in tree stand age distributions and structures that are profoundly different than those that were previously controlled by fire. For example, given the total landscape harvest approach taken by foresters, after one complete rotation in a region, there would be no stands older than this rotation age of 100 years (Chapin et al. 2004). This contrasts with the natural mosaic in which much of the landscape would be older than the industrial rotation of approximately 100 years, up to 300-400 years in some areas and younger stands could experience multiple low-intensity disturbances (Bergeron 2001). The exclusive use of an even-age management regime therefore eliminates old-growth fire refugia over the long term (Chapin et al. 2004). To help refocus forest management on establishing more natural disturbance regimes, additional research needs to be done into the historical distribution of forest age classes on the Southern Eastern Slopes.

On a landscape level, natural age structures should be maintained — particularly old growth fire refugia areas, which is the hardest age structure to attain. While more research needs to be done on the historic distribution of tree stand age classes on the Eastern Slopes, recent analysis done by the Eastern Slopes Conservation Collaborative (2017) suggests that 36% of the lodgepole pine and/or white spruce dominated forests are older than 116 years (origin of 1900). These stands are largely located in the northern part of the study area. Thus, using the precautionary principle, we recommend that no further harvest of old-growth fire refugia stands occurs on the Southern Eastern Slopes in order to maintain and restore the natural range of forest age classes. Timber management to restore younger forests should consider appropriate location and timber prescriptions consistent with natural disturbance. Where appropriate, prescribed fire and forest management actions geared toward ecological restoration should be considered while prioritizing the protection of headwaters and riparian zones (Rogeau 2016).

Forest management plans should support the maintenance and production of a mosaic of landscape types that could involve, for example, using prescribed fire in appropriate areas; not reforesting areas that might otherwise be restored to native montane grasslands; allowing non-coniferous regeneration including for fire breaks; encouraging forest diversity through regeneration of native tree species; thinning to promote development of large trees; maintaining areas of old growth fire-refugia consistent with ecosystem goals; and avoiding riparian areas, wetlands and source water areas, among other options.

While forest management should imitate natural patterns as closely as possible, industrial logging does not replace natural disturbances. In fact, natural processes such as fire can improve the resilience of an area to logging and other human disturbances. Forest management should plan for and incorporate the natural processes of fire (including prescribed burns), insects, disease, climate change and other disturbances that affect forest functions. Human-caused climate change in particular has emerged as a important driver of increased forest fire activity (Abatzoglou and Williams 2016, Harvey 2016). It will be particularly important under a changing climate to understand and incorporate climate change modelling, disturbance scenarios and landscape changes into forest management planning. The objective of restoration should be to eventually restore or maintain the natural structure to achieve a natural fire regime or a close emulation with prescribed fire (Allen et al. 2002) including consideration of climate change, while also maintaining and restoring the biodiversity, headwaters and species at risk values of the system that have been impacted by the cumulative effect of previous management.



4.3.1.5. Restore Damaged and Fragmented Areas

The ecological integrity of the Southern Eastern Slopes has been degraded by past and current land uses. As part of managing these forests, restoration of damaged and fragmented areas is needed. A focus on restoration should be a priority for the Southern Eastern Slopes by repairing riparian and upland areas and restoring watershed health and habitat for fish and wildlife species such as westslope cutthroat trout, bull trout and grizzly bear. This will help address current damages as well as help mitigate the impact of climate change on these sensitive systems and on our communities.

The Government of Alberta is currently developing a Land Footprint Management Plan. This plan should take into account landscape fragmentation and connectivity, including specific linear disturbance thresholds, clear guidelines and targets for restoration of disturbances.

Restoration can also contribute to community economies. In western Montana several multi-stakeholder groups of conservationists, motorized recreational vehicle users, outfitters, loggers, mill operators, state government and the U.S. Forest Service have developed systems of restoration forestry. Two of these initiatives include the Montana Forest Restoration Committee (MFRC) and the Southwest Crown Collaborative (SWCC).

These innovative approaches to forest management attempts to rejuvenate and recover natural structure, function, and process in a landscape context by using adaptive management and a flexible and open approach. These groups collaboratively create scientifically-defendable, socially-appropriate principles or objectives for a new type of forest management in the region, which prioritize management of social and ecological objectives (MFRC 2013).

These restoration principles provide a transparent on-the-ground approach for guiding and evaluating the effectiveness of forest management restoration projects, programs, and policies and for involving communities in forest management (MFRC 2013, SWCC 2012). A key part of this model is the collaborative approach not simply directed at timber management, but also diverse stakeholders reaching agreement on areas to set aside for recreation or conservation purposes. This approach also provides for a new forest economy in the region by moving labour from timber extraction to landscape restoration and in turn the restoration and maintenance of important ecosystem services (SWCC 2012). This model of restoring forests to meet ecosystem and social objectives is one that Alberta could adapt to fit our particular forests and communities as part of an alternative forest management model for the Southern Eastern Slopes.

4.3.1.6. Designate Areas for Timber Management and Implement Site-level Ecologically Sustainable Timber Management

Once the above steps are taken to meet ecosystem objectives, should small-scale logging be determined to be an appropriate use of an area, it can be determined how much timber and for what purpose timber is extracted. Determination of timber extraction should be based on conserving water, wildlife and low-impact uses of the region rather than prioritizing maximum yield of timber through annual allowable cut calculations that preclude maintenance or restoration of other forest values.

The designation of where timber harvest is appropriate or not should be based on an area's sensitivity to human disturbance as determined through the use of scientific information and thresholds (e.g. linear density or disturbance thresholds for trout or grizzly bears). As much as possible, harvesting should mimic the structural and spatial patterns of natural disturbances.

New management rules that would protect the health of the ecosystem, including mimicking natural disturbance, maintaining the integrity of the headwaters, optimizing biodiversity and maximizing carbon sequestration, would include the following:

- **Within areas deemed appropriate for tree removal, small scale areas may still be off limits to harvest. These areas could include riparian buffer zones, ecologically unique sites, wildlife corridors, sensitive wetlands, recreation use areas and/or culturally significant sites.**

- **Update operating ground rules for species at risk and provide better oversight and regulatory actions. Avoid sensitive and critical habitats for roading and timber layout and provide effective buffers. Use best available information on erosion risk to avoid areas prone to soil loss and uncertain restoration.**

- **River-bed floodplains in mountain landscapes such as the Southern Eastern Slopes are disproportionately important for diverse habitats, nutrient cycling, productivity of biota, and species interactions (Hauer et al. 2016). Where riparian areas, habitat patches or corridors are left, the size or width of the area or corridor should be based on the best available science, using the precautionary principle, and be consistent with the goals of the area. For example, a 100m buffer may help conserve riparian habitat for westslope cutthroat trout (Valdal and Quinn 2011), while Hannon et al. (2002) found that 20–100 m buffers did not serve as reserves for forest songbirds in managed landscapes, but that 200 m wide strips conserved the pre-harvest passerine bird community.**

- **At the edges of riparian areas streams, rivers, lakes, and/ or wetlands, no logging or infrastructure (e.g. roads) should occur within these appropriate buffers. On all native fish-bearing streams and waterbodies a minimum 100 m setback should be used from the edge of the riparian zone (McElfish et al. 2008, Valdal and Quinn 2011).**

• Incorporate higher standards for logging road planning, construction, maintenance, mitigation and restoration. Better oversight mechanisms, especially for erosion prevention and mitigation, are required to ensure compliance. No motorized recreational use should be allowed on resource extraction roads;

• Given the high level of fragmentation in the Southern Eastern Slopes, no new roads should be built in intact forest patches. Any new roads deemed necessary in fragmented areas should build to "permanent road" standards and be offset by proportionate or greater removal and reclamation of other roads and trails.

• Supporting infrastructure, including main roads, secondary roads, skidding roads, bridges, log-landing areas should only be constructed in appropriate areas, subject to standards that protect ecological values and within scientifically supported density thresholds (e.g. 0.6 km/km2 of roads and motorized trails; Alberta Grizzly Bear Recovery Team 2008). If, using the precautionary principle, supporting infrastructure cannot be placed to avoid harm or exceeds density thresholds, harvest should not proceed.

• Forest blocks should receive varying treatments depending on the location of the harvest area (Rogeau 2016) and the objectives, including prescribed burns, selective logging, harvest to promote old growth and small cuts. Surge cuts should not be part of timber harvest planning;

• A minimum of 20-75 percent of trees should be retained within areas designated for removal of timber (Halpern et al. 2005, Halpern et al. 2012, Work et al. 2010, Vanderwel et al. 2007, Pengelly and Carter 2010, MacDonald and Fenniak 2007, Craig and MacDonald 2009, Harrison et al. 2005). Trees of all ages, including mature and old trees, should be maintained in groups or as dispersed throughout depending on the site. Dead standing trees should also be retained. Retaining older trees maintains a more natural age structure and provides for continuity of ecosystem structure, function, and species composition in the postharvest forest (Lindenmayer et al. 2012).

• To reduce erosion only winter logging under frozen ground conditions should be considered.

• Under a natural forest fire, as well as under other disturbances (wind, forest pests etc.), all the materials and nutrients of dead and downed trees are maintained on site. This process is essential for maintaining ecological integrity. As such, logs should be limbed on location and materials spread near the harvest site to maintain as much woody debris and nutrients as possible on site.

• Where possible, plans for regrowth should be based upon natural regeneration rather than tree planting, as operational ground rules based on ecosystem-based forestry practices should optimize the conditions for natural regeneration. However, long-term monitoring as a part of an adaptive management regime would help determine whether tree planting was needed as a supplemental component of the management plan.

• Avoid re-entry into and area for any additional logging until previously logged areas have regained full ecological function.

4.3.1.7. Apply Monitoring and Adaptive Management Practices

An important component of ecosystem-based forest management is the practice of adaptive management. Countless studies have shown that human activities can, very easily, degrade sensitive ecosystems. However, available scientific knowledge cannot entirely predict which activities, in which areas, will result in degradation. As a result, there is a need to continuously monitor and analyze the outcomes of activities to figure out how ecosystems are being affected at various scales from the site to the landscape scales. Adaptive management can be applied to a wide variety of resource management contexts, but can fail when political, social or economic support is lacking. A key component of adaptive management is a long-term commitment to monitoring and changing management based on best available science (Everett et al. 1994, Noss and Cooperrider 1994, Rist et al. 2013).

Adaptive management should incorporate requirements for monitoring of biodiversity, water quality and runoff as a part of managing forests on public lands and for providing annual reports and performance results as a mechanism for compliance and assessment of future approvals. As part of this, forest management planning should use Environmental Impact Assessments for logging, consistent with policy for other industrial activities, especially in sensitive watersheds.

4.3.2. Increase Public Participation in Forest Management

To fully support and compliment ecosystem-based forest management, changes must be made to the ways in which information is shared and decisions about land-use are made. Numerous studies have indicated that Albertans are concerned about public input into forest management (see Section 3.6). Government should provide better, more inclusive forums for public input with commitment to use concerns to modify logging practices. A number of ways that transparency and public participation in forest management can be increased are by ensuring:

- Open and transparent processes and exchange of information are required;
- A broad contingent of stakeholders is involved in leading, managing and practicing forest management, including:
    - Creating a cross-sector decision-making body;
    - Allowing community-based tenures to be held;
- Third-party reviewing and public input is required for management plans.

4.3.2.1. Open and Transparent Processes

The forest landscapes of the Southern Eastern Slopes, like most in Alberta, are largely publicly-owned lands. These public lands should be stewarded with the needs of current and future generations of Albertans in mind.

To achieve this goal, free and open access to all information related to public land must be in place, including the financial information and contribution to local and provincial economies of resource management entities and tenure-holders. This would permit the public to evaluate the extraction and sale of timber resources in terms of public vs. private profitability. Prior to logging an independent cost/benefit analysis (full cost accounting) should be done to determine the contribution to and cost of logging to the government of Alberta compared to other forest values.

The inventories, studies, and research carried out by both government and private entities on public lands also needs to be readily available to the public so that plans and operations may be monitored. Requests for information should require a minimum of paperwork and be granted within a short, clearly-stated time period to maximize efficiency. Information should also be made available electronically. An additional benefit of making information public is that it increases the accountability of the record-keepers and holds all contributing parties to higher standards of precision, accuracy and ethics.

As part of this process and to ensure adaptive management is being used, an accessible, comprehensive and transparent mapping process and data should be created that indicates all the environmental information available, including existing access; planned access; other industrial footprints; other logged areas by size, shape and age; riparian areas, wetlands, lakes, source water areas; critical, sensitive fish and wildlife habitats; species at risk and other fish and wildlife populations, rare plants; recreation sites, historical sites; archeological sites and cultural sites (where appropriate).

4.3.2.2. A Broad Contingent of Stakeholders is Involved in Leading, Managing and Practicing Forest Management

Different types of human activities interact with one another on the landscape and result in cumulative impacts that degrade ecosystems much more than would a single activity. For example, the combined interactions of motorized recreational vehicles with timber extraction and road construction on the Southern Eastern slopes has a large impact on water conservation and wildlife habitat security. But every use of forested land, from hiking to horseback riding to random camping to seismic exploration, has varying levels of impact that need to be accounted for in land-use decisions. Therefore, a broad cross-section of stakeholders should be engaged to regulate, lead and practice forest management in the Southern Eastern Slopes.

There are a number of ways to increase broad, meaningful involvement of stakeholders. A few examples of ways that could be applied on the Southern Eastern Slopes are creating cross-sector decision-making bodies, allowing for co-management or community-based forest tenures and requiring third-party reviewing and meaningful public input into forest management plans.

Create cross-sector advisory or decision-making bodies

Collaborative, cross-sector decision-making in the Southern Eastern Slopes would support the goal of meeting ecosystem-based objectives and maintaining ecosystem integrity. The creation of an advisory or decision-making body would involve a diverse group of stakeholders including representatives from local First Nations, scientists, recreation communities, conservation groups, timber interests and others. The broad base of knowledge, interests and values of such a group could be used to identify and address the risk of cumulative impacts in a human use area. As a result, a single ecosystem-based management plan could be developed to regulate all the activities taking place in a particular human use area, including forest management and recreational use, for example. Such a comprehensive, cross-sector ecosystem-based forest management plan would govern the location of activities, standards of care for each activity, and the administration and monitoring of each activity. This would support development of solutions and management directives to mitigate the cumulative ecological degradation created by overlapping jurisdictions of human uses on the same ecological landscape.

A similar system can be found in western Montana where several multi-stakeholder groups of conservationists, recreational users, outfitters, loggers, state government and the U.S. Forest Service have developed systems of restoration forestry. Two of these initiatives include the Montana Forest Restoration Committee (MFRC) and the Southwest Crown Collaborative (SWCC). These groups collaboratively create scientifically-defensible, socially-appropriate objectives for forest management in the region (MFRC 2013). They focus not only on timber management, but also on reaching agreement about areas to set aside for recreation or conservation purposes. The MRFC was initiated by the realization that the "present system was failing – failing our timber workers and timber-dependent communities, failing the ecological health of our forests, and failing our responsibility to future generations" (MFRC 2013). These new initiatives aim to find a solution to these failures through collaborative, ecosystem-based management.

Allow for co-management or community-based tenures

While it is ultimately the government's responsibility, on behalf of the public, to protect the ecological integrity of the Southern Eastern Slopes and the natural resources within them, one way to incorporate community values into management is through forest co-management or community-based forest tenures.

Co-management focuses on power sharing between companies and/or provincial land managers and the local community. Decision making is at the local level, within the bounds of provincial regulations (Beckley 1998). This model requires industrial or government managers to reach consensus or agreements with local community and resource users (Beckley 1998).

Community forestry divests more authority to the local level and involves achieving consensus among various forest stakeholder groups within communities (Duinker 1994, Beckley 1998). Charnley and Poe (2007) identify three key characteristics of community forestry:

- **some degree of responsibility and authority for forest management is formally vested by the government to local communities;**
- **a central objective of forest management is to provide local communities with social and economic benefits from forests; and**
- **ecologically sustainable forest use is a central management goal, with forest communities taking some responsibility for maintaining and restoring forest health.**

While there are many models of co-management and community forestry, these approaches have different objectives than traditional industrial forestry and would require different tenure arrangement than traditional timber-based forestry which focus on fibre and maximization of profits (Beckley 1998). Specifically, co-management and community forests aim to maximize benefits of forest values to a different and usually wider range of stakeholders and thus require a tenure or management agreement that extends beyond timber (Beckley 1998, Charnley and Poe 2007).

> "A system of community ecosystem-based management has great potential to facilitate stronger cooperation and forest outcomes consistent with social and ecological objectives."

Although community-based management does not always result in better forest management, Charney and Poe (2007) found that there is evidence that greater local control over forest management has resulted in more ecologically sustainable forestry, stronger partnerships between diverse community stakeholders and land management agencies, creation of new forest restoration jobs, success of value-added businesses, and expansion of markets for restoration by-products (Charney and Poe 2007).

A model of co-management or community forestry on the Southern Eastern Slopes would need to consider the definition of community, process and structure of decision making, alternate tenure, broader public involvement, scale of management, scope of management, among other considerations (Duinker 1994, Beckley 1998, Charney and Poe 2007). Given the complex social and ecological context of the Southern Eastern Slopes, an appropriate model for co-management or community forestry would also necessarily include meaningful involvement of Indigenous groups and other legitimate non-local stakeholders (Beckley 1998). A system of community ecosystem-based management has great potential to facilitate stronger cooperation and forest outcomes consistent with social and ecological objectives.

Successful examples of community-based forestry exist in other areas of Canada. For example, the Harrop-Proctor Community Forest, located on the West Arm of Kootenay Lake (http://www.hpcommunityforest.org). The community forest is managed by the Harrop-Proctor Community Cooperative which has the mandate to practice socially and environmentally progressive forestry that protects local watersheds while creating sustainable jobs in the community. The management plan thus aims to protect ecologically important areas while sustainably harvesting others to produce a diversity of value-added wood products. Overall, the Harrop-Proctor Community Cooperative estimates it provides many more jobs for each tree cut than it would under conventional timber companies (Harrop-Proctor Community Forest 2017). The Cooperative recently received a Community Forestry award from the Ministry of Forests Lands and Natural Resource Operations.

Forest co-management or community forestry should be explored for the Southern Eastern Slopes as an option to improve public participation in forest management and broaden the objectives of forest management to include ecological and social values.

> “We recommend that all decisions made regarding human uses on the Southern Eastern Slopes should be driven by public values and allow for meaningful public input.”

4.3.2.3. Third-party Reviewing and Public Input

In Alberta, decision-making about forest management and forestry tenures and practices currently resides in the hands of the Ministry of Environment and Parks and the Ministry of Forests and Agriculture, and very little public input is either sought or required. When public input is sought, such as during the development of the detailed forest management plan (DFMP) or Annual Operating Plan (AOP), it is the responsibility of the forestry company and there is no requirement for it to be incorporated during the planning process nor is there an external third-party review of practices and impacts. Furthermore, although advisory councils and forest monitoring bodies exist, the members are hand-picked by the timber disposition holder and/or they do not have any real power to change forest management planning decisions. There is no substantial way for the public or other interested parties to direct management processes or outcomes. Public consultation should not be driven by the company responsible for timber removal.

We recommend that all decisions made regarding human uses on the Southern Eastern Slopes should be driven by public values and allow for meaningful public input. Independent, science-based assessments of ecosystem-based conservation plans while still in draft form should be required. Once approved and implemented, the on-the-ground forest management practices resulting from these ecosystem-based forest managements must be monitored in the field. In this way, the resulting environmental impacts can be measured and compared with the approved ecosystem-based forest managements, and evaluated against it. Consistent and regular third-party evaluations could also provide a form of long-term monitoring that could then inform adaptive management practices.

5. Conclusion

The Southern Eastern Slopes are a treasured Alberta landscape providing clean water to downstream communities, supporting biodiversity and offering gorgeous vistas for local recreationalists and tourists alike. Current and past management of these forests has degraded the natural values and puts the future of our water, wildlife, wilderness, and rural economies at risk. But we can change this negative trajectory and restore this important landscape.

One critical piece of changing management of the Southern Eastern Slopes is rejecting timber-driven industrial forestry in our headwaters and implementing an ecosystem-based forest management approach that prioritizes a suite of values including water, biodiversity, connectivity and quiet recreation instead of a maximum timber yield. This report outlines a series of recommendations, appropriate for Southern Alberta that would move management towards this goal. This includes officially adopting a mandate of ecosystem-based management on the Southern Eastern Slopes including:

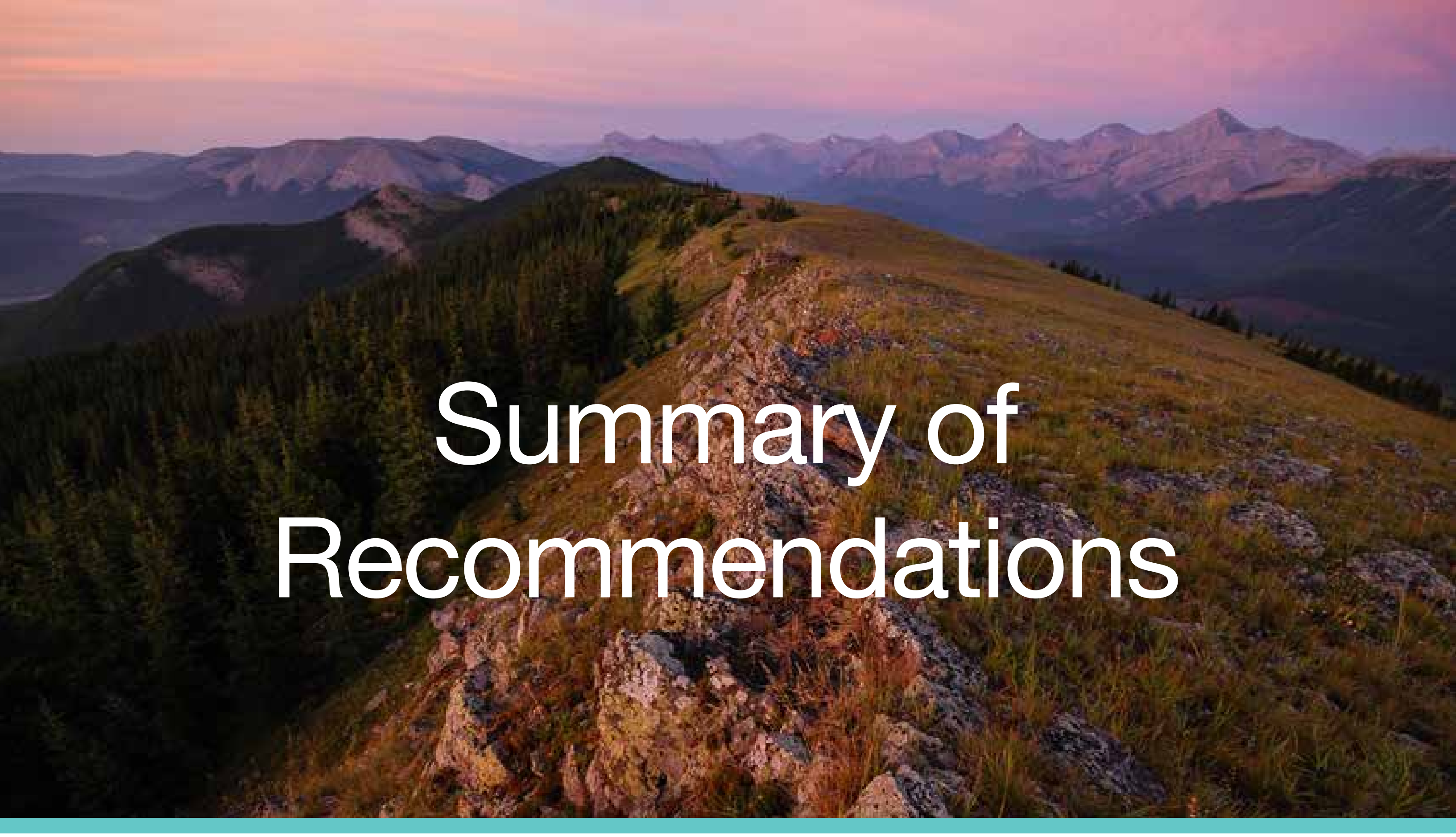
- **Designating new protected areas on the Southern Eastern Slopes;**
- **Maintain landscape connectivity and integrity;**
- **Designating areas for recreation and other low-impact land uses;**
- **Maintaining natural age structures on a landscape level;**
- **Restore damaged and fragmented areas**
- **Designate areas for timber management and implement site-level ecologically sustainable timber management;**
- **Applying adaptive management practices.**

These on-the-ground changes would require recognizing the public values of these public lands and would facilitate increased public input into management decisions. Examples of ways this could be achieved include:

- **Open and transparent processes and exchange of information;**
- **The involvement of a broad contingent of stakeholders in leading, managing and practicing forest management, including:**
    - **Creating a cross-sector decision-making body;**
    - **Allowing co-management or community-based tenures to be held;**
- **Requiring third-party review and public input for management plans.**

A summary of specific recommendations to achieve each overarching recommendation is provided below.

In Southern Alberta, our way of life depends on clean water, our ranching heritage and being surrounded by spectacular parks and wilderness. These values support our way of life and our ways of making a living. However, Alberta is growing and changing rapidly. To protect these special landscapes that support our communities, we need to move towards more holistic management of the land and prioritise the true values of the Southern Eastern Slopes – headwaters, biodiversity, connectivity and the ability to experience our wild lands through quiet recreation. Embracing these values will support our local economies, communities and natural functions and processes. Implementing ecosystem-based management on the Southern Eastern Slopes, as outlined in this report, is a step towards achieving this vision.



Summary of Recommendations

1. Designate New Protected Areas on the Southern Eastern Slopes

i. Create new protected areas representing unique habitats, representative natural subregions and ecotypes, areas that are important for key ecological functions such as water quality and natural flow and habitat for provincially- and federally-listed plant and animal species at risk.

2. Maintain Landscape Connectivity and Integrity

i. At least 80% of a watershed (or sub watershed) should remain intact, consistent with research results on hydrological changes and impacts on native trout;
ii. Some watersheds should remain unlogged to act as reference areas for study and adaptive management to properly measure effects of forest management elsewhere on the landscape;
iii. Intact areas should remain intact. Forest management plans should protect large, intact, roadless areas to create a continuous mosaic of undisturbed landscape to meet ecosystem and biodiversity maintenance goals and avoid logging of watersheds containing sensitive populations of Westslope cutthroat trout and bull trout;
iv. Areas where wildlife critical range and movement is the priority for management should be specifically designated;
v. Focus on restoration of previously fragmented and damaged areas to maintain and restore connectivity and forest health and viability, prioritizing areas of high headwaters value and habitat for species at risk.

3. Designate Areas for Quiet Recreation and Other Low-Impact Land Uses

i. While some low-intensity timber harvest may be appropriate in the same area as quiet recreation, this should be determined as part of the planning process and include input from quiet recreationalist and eco tourism operators;

ii. Aesthetic standards in cutblock and road layout (i.e. viewscapes, size, shape and landscape layout) need to be incorporated to provide security for recreationalists and tourism operators. Ecotourism developments should be provided with a long-term (e.g. twenty-year) sight line guarantee of undisturbed natural views;

iii. If motorized recreation is determined to be an appropriate use of an area (e.g. it will not have a significant impact on the conservation of headwaters, fish and wildlife habitat, or disturb quiet recreationalists and local residents), a designated trail network should be properly de signed and enforced to minimize the impact of this land use. Motorized recreation access should be designated using ecological thresholds and the amount of designated access should be based on the proportion of motorized recreationalists to quiet recreationalists. Quiet recreation areas should be designated separate from motorized recreation;

iv. There should be a focus on developing economic opportunities that emphasise wildlife and headwaters conservation such as ecotourism and low-impact recreation where locally appropriate such as hiking, fishing, horseback riding, hunting, biking and other sustainable activities.

4. Maintain Habitat Diversity and Natural Age Structures on a Landscape Level

i. On a landscape level, natural age structures should be maintained and restored through ecosystem-based management rather than industrial timber-driven logging;

ii. No further harvest of fire-refugia stands should occur on the Southern Eastern Slopes in order to maintain and restore the wide range of natural age classes;

iii. Forest and fire management planning should not be a uniform approach but should be adapted for natural subregion, landform, fire intensity and fire return interval.

iv. Where appropriate, prescribed fire and forest management actions geared toward ecological restoration and structural diversity could be considered with the aim of protection of headwaters, riparian zones, biodiversity and species at risk.

v. Additional analyses should be done on the distribution of age classes to strengthen the ability to manage for all age classes;

vi. Forest management should plan for and incorporate natural processes of fire (including prescribed burns), insects, disease, climate change and other disturbances that may alter forest management decisions. It will be particularly important to understand and incorporate climate change modelling, disturbance scenarios and landscape changes into forest management planning.
vii. Forest management plans should support the maintenance and production of a mosaic of landscape types that could involve, for example, using prescribed fire in appropriate areas; not reforesting areas that might otherwise be restored to native montane grasslands; allowing non-coniferous regeneration including for fire breaks; encouraging forest diversity through regeneration of native tree species; thinning to promote development of large trees; maintaining areas of old growth fire-refugia consistent with ecosystem goals; and avoiding riparian areas, wetlands and source water areas, among other options.

5. Restore Damaged and Fragmented Areas

i. A focus on restoration should be a priority for the Southern Eastern Slopes by repairing riparian and upland areas and restoring watershed health and habitat for fish and wildlife species such as westslope cutthroat trout, bull trout and grizzly bear. This will help address current damages as well as help mitigate the impact of climate change on these sensitive systems and on our communities.
ii. The Land Footprint Management Plan should take into account landscape fragmentation and connectivity, including specific linear disturbance thresholds, clear guidelines and targets for restoration of disturbances.
iii. Develop a model of “restoration forestry” to meet ecosystem and social objectives and support local communities.

6. Designate Areas for Timber Management and Implement Site-level Ecologically Sustainable Timber Management

i. Determination of timber extraction should be based on conserving water, wildlife and low-impact uses of the region rather than prioritizing maximum yield of timber through annual allowable cut calculations that preclude maintenance of other forest values;
ii. The designation of where timber harvest is appropriate or not should be based on an area’s sensitivity to human disturbance as determined through the use of scientific information and thresholds (e.g. linear density thresholds for grizzly bears or native trout);
iii. As much as possible, harvesting should mimic the structural and spatial patterns of natural disturbances;
iv. Within areas deemed appropriate for tree removal, small scale areas may still be off limits to harvest. These areas could include riparian buffer zones, ecologically unique sites, wildlife corridors, sensitive wetlands, recreation use areas and/or culturally significant sites;

v. Update operating ground rules for species at risk and provide better over sight and regulatory actions. Avoid sensitive and critical habitats for roading and timber layout and provide effective buffers. Use best available information on erosion risk to avoid areas prone to soil loss and uncertain restoration;

vi. Where riparian areas, habitat patches or corridors are left, the size or width of the area or corridor should be based on the best available science, using the precautionary principle, and be consistent with the goals of the area;

vii. At the edges of riparian areas streams, rivers, lakes, and/ or wetlands, no logging or infrastructure (e.g. roads) should occur within these appropriate buffers. On all fish-bearing streams and waterbodies a minimum 100 m setback should be used from the edge of the riparian zone;

viii. Incorporate higher standards for logging road planning, construction, maintenance, mitigation and restoration. Better oversight mechanisms, especially for erosion prevention and mitigation, are required to ensure compliance. No motorized recreational use should be allowed on all re source extraction roads;

ix. Given the high level of fragmentation in the Southern Eastern Slopes, no new roads should be built in intact forest patches. Any new roads deemed necessary in fragmented areas should build to higher standards and be offset by commensurate removal and reclamation of other roads and trails;

x. Supporting infrastructure, including main roads, secondary roads, skidding roads, bridges, log-landing areas should be within scientifically supported density thresholds (e.g. 0.6 km/km2 of roads and motorized trails; Alberta Grizzly Bear Recovery Team 2008). If, using the precautionary principle, supporting infrastructure cannot be placed to avoid harm or exceeds density thresholds, harvest should not proceed;

xi. Forest blocks should receive varying treatments depending on the objectives, including prescriptive burns, selective logging, harvest to promote old growth and small cuts. Surge cuts should not be part of timber harvest planning;

xii. A minimum of 20-75 percent of trees should be retained within areas designated for removal of timber;

xiii. To reduce erosion only winter logging under frozen ground conditions should be considered;

xiv. Logs should be limbed on location and materials spread near the harvest site to maintain as much woody debris and nutrients as possible on site;

xv. Where possible, plans for regrowth should be based upon natural regeneration rather than tree planting, as operational ground rules based on ecosystem-based forestry practices should optimize the conditions for natural regeneration. However, long-term monitoring as a part of an adaptive management regime would help determine whether tree planting was needed as a supplemental component of the management plan;

xvi. Avoid re-entry into and area for any additional logging until previously logged areas have regained full ecological function.

7. Apply Monitoring and Adaptive Management Practices

i. Long-term commitment to monitoring and changing management based on best available science;

ii. Adaptive management should incorporate requirements for monitoring of biodiversity, water quality and runoff as a part of managing forests on public lands and for providing annual reports and performance results as a mechanism for compliance and assessment of future approvals;

iii. Forest management planning should use Environmental Impact Assessments for logging, consistent with policy for other industrial activities, especially in sensitive watersheds.

8. Increase Public Participation in Forest Management

i. Free and open access to all information related to public land must be in place, including the financial information of resource management entities and tenure-holders;

ii. Prior to logging an independent cost/benefit analysis (full cost accounting) should be done to determine the contribution to and cost of logging to the government of Alberta compared to other forest values;

iii. The inventories, studies, and research carried out by both government and private entities on public lands also needs to be readily available to the public so that plans and operations may be monitored;

iv. Requests for information should require a minimum of paperwork and be granted within a short, clearly-stated time period to maximize efficiency. Information should be made available electronically;

v. An accessible, comprehensive and transparent mapping process and data should be created that indicates all the environmental information available, including- existing access; planned access; other industrial footprints; other logged areas by size, shape and age; riparian areas, wetlands, lakes, source water areas; critical, sensitive fish and wildlife habitats; species at risk and other fish and wildlife populations, rare plants; recreation sites, historical sites; archeological sites and cultural sites (where appropriate);

vi. Create an advisory or decision-making body involving a diverse group of stakeholders including representatives from local First Nations, scientists, recreation communities, conservation groups, timber interests and others;

vii. Explore forest co-management or community forestry on the Southern Eastern Slopes as outlined in Section 4.3.2.2;

viii. All decisions made regarding human uses on the Southern Eastern Slopes should be driven by public values and allow for meaningful public input;

ix. Independent, third-party review and science-based assessments of ecosystem-based conservation plans while still in draft form should be required.

Literature Cited

Abatzouglou, J.T. and A.P. Williams. 2016. Impact of anthropogenic climate change on wildfire across western US forests. Proceedings of the Natural Academy of Sciences 113(42): 11770-11775.

Alberta Biodiversity Monitoring Institute (ABMI). 2012. Human Footprint Dataset 2012. http://www.abmi.ca.

Alberta Grizzly Bear Recovery Team. 2008. Alberta Grizzly Bear Recovery Plan 2008-2013. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 15. Edmonton, AB. 68 pp.

Alberta Wilderness Association. 2011. Sustainable Forest, Sustainable Communities: The Future of Alberta's Southwestern Forests. Calgary, AB. 6pp.

Allen, C.D., M. Savage, D. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingel. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: a broad perspective. Ecological Applications 12:1418–1433

Armstrong, G.W., W.L. Adamowicz, J.A.Beck, Jr., S.G. Cumming and F.K.A. Schmiegelow. 2003. Coarse filter ecosystem management in a nonequilibrating forest. Forest Science 49(2): 209–223.

BCMWLAP (British Columbia Ministry of Water, Land and Air Protection). 2002. Environmental Indicators: Habitat in British Columbia. British Columbia Ministry of Water, Land and Air Protection.

Beckley, T.M. 1998. Moving towards consensus-based forest management: a comparison of industrial, co-managed, community and small private forests in Canada. The Forestry Chronicle 74(5): 736-744.

Bergeron, Y., S. Gauthier, V. Kafka, P. Lefort and D. Lesieur. 2001. Natural fire frequency for the eastern Canadian boreal forest: consequences for sustainable forestry. Canadian Journal of Forest Research 31: 384-391.

Boreal Scientists Letter. 2007. Available at http://www.borealbirds.org/sites/default/files/pubs/ScienceLetter-English.pdf

Brassard, B.W. and H.Y.H Chen. 2008. Effects of forest type and disturbance on diversity of coarse woody debris in boreal forest. Ecosystems 11(7): 1078-1090.

Buddle, C.M., D. Langor, G.R. Pohl and J.R. Spence. 2006. Arthropod responses to harvesting and wildfire: Implications for emulation of natural disturbance in forest management. Biological Conservation 128(3): 346-357.

Burton, P., C. Messier, W. Adamowicz and T. Kuuluvainen. 2006. Sustainable management of Canada's Boreal Forests. Ecoscience 13(2): 234 – 248.

Cavard, X., E. Macdonald, Y. Bergeron and H. Chen. 2011. Importance of mixed-woods for biodiversity conservation: Evidence for understory plants, songbirds, soil fauna, and ectomycorrhizae in northern forests. Environmental Review 19: 142 – 161.

Chapin III, F.S., T.V. Callaghan, Y. Berferon, M. Fukuda, J.F. Johnstone, G. Juday and S.A Zimov. 2004. Global change and the boreal forest: thresholds, shifting states or gradual change? Ambio 33(6): 361-365.

Charnley, S. and M. Poe. 2007. Community forestry in theory and practice: where are we now? Annual Review of Anthropology 36: 301-336.

Charron, I., and E.A. Johnson. 2006. The importance of fires and floods on the tree ages along mountainous gravel-bed streams. Ecological Applications 16(5): 1757-1770.

Christensen, N.L., et al. 1996. The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. Ecological Applications 6(3):665-691.

CPAWS. 2014. Summary Paper: Understanding Forest Management of Alberta's Southern Eastern Slopes. CPAWS – Southern Alberta Chapter.

Craig, A. and S.E. Macdonald. 2009. Threshold effects of variable retention harvesting on understory plant communities in the boreal mixedwood forest. Forest Ecology and Management 258: 2619-2627.

Cumming, S.G. 2001. Forest type and wildfire in the Alberta boreal mixedwood: what do fires burn? Ecological Applications 11(1): 97-110.

Cyr, D., S. Gauthier, Y. Bergeron and C. Carcaillet. 2009. Forest management is driving the Eastern North American Boreal Forest outside its natural range of variability. Frontiers in Ecology and Environment 7(10): 519-524.

Drapeau, P., A. Leduc, J-F Giroux, J-P.L. Savard, Y. Bergeron, W.L. Vickery. 2000. Landscape-scale disturbances and changes in bird communities of boreal mixed-wood forests. Ecological Monographs 70(3): 423-444.

Duinker, P.N., P.W. Matakala, F. Chege, and L. Bouthillier. 1994. Community forests in Canada: An overview. The Forestry Chronicle 70(6): 711-720.

Durall, D.M., S. Gamiet, S.W. Simard, L. Kudrna, S.M. Sakakibara. 2006. Effects of clearcut logging and tree species composition on the diversity and community composition of epigeous fruit bodies formed by ectomycorrhizal fungi. Canadian Journal of Botany 84(6): 966-980.

Everett, R., P. Hessburg, M. Jensen and B. Borman. 1994. Eastside Forest Ecosystem Health Assessment –Volume I: Executive Summary. USDA Gen. Tech. Rpt. PNW-GTR-317. USDA Forest Service, Pacific Northwest Research Station. Portland, OR.

Feller, M.C. 2005. Forest harvesting and streamwater inorganic chemistry in western North America: A review. Journal of American Water Resources Association 41(4): 785-811.

Fiera Biological Consulting Ltd (Fiera). 2013. Oldman Watershed Headwaters Indicator Project – Draft Report (Version 2013.3). Edmonton, Alberta. Fiera Biological Consulting Report #1346.

Findlay, C.S., and J. Houlahan. 1997. Anthropogenic correlates of species richness in southeastern Ontario wetlands. Conservation Biology 11:1000-1009.

Fitch, Lorne P. 2015. Two Fish, One Fish, No Fish – Alberta's Fish Crisis. 26 pp.

Frair, J.L., E.H. Merill, H.L. Beyer, and J.M. Morales. 2008. Thresholds in landscape connectivity and mortality risks in response to growing road networks. Journal of Applied Ecology 45:1504-1513.

Ghost Watershed Alliance Society (GWAS). 2012. Ghost River Watershed Cumulative Effects Study Phase 2: Beneficial Management Practices.

Gibeau, Michael L. (2000). A Conservation Biology Approach to Management of Grizzly Bears in Banff National Park, Alberta. Ph.D. Dissertation. Resources and the Environment Program, University of Calgary, Calgary, Alberta.

Government of Alberta and Alberta Conservation Association. 2010. Status of the Grizzly Bear (Ursos arctos) in Alberta: Update 2010. Ministry of Environment and Sustainable Resource Development. Wildlife Status Report No. 37. Edmonton, AB.

Government of Alberta. 2010. South Saskatchewan Regional Plan Workbook Results. Environment and Sustainable Resource Development. Edmonton, AB.

Government of Alberta. 2012. Bull Trout Conservation Management Plan 2012-2017. Alberta Sustainable Resource Development. Species at Risk Conservation Management Plan No. 8. Edmonton, AB. 90 pp.

Government of Alberta. 2013a. Alberta Westslope Cutthroat Trout Recovery Plan: 2012-2017. Alberta Species at Risk Recovery Plan No. 28. Edmonton, AB.

Government of Alberta. 2013b. Forests Act. Alberta Queen's Printer. http://www.qp.alberta.ca/documents/Acts/F22.pdf. Accessed October 18, 2016.

Government of Alberta. 2014. South Saskatchewan Regional Plan 2014-2024.an Alberta Land-use Framework Integrated Plan. Edmonton, AB. 207 pp.

Government of Canada. 1969. The Canada Land Inventory - Forestry Land Capability Class. Government of Canada; Natural Resources Canada; Earth Sciences Sector; Canada Centre for Mapping and Earth Observation.

Halpern, C.B., D. McKenzie, S.A Evans and D.A.Maguire. Initial responses of forest understories to varying levels and patters on gree-tree retention. 2005. Ecological Applications 15(1): 175-195.

Halpern, C.B., J. Halaj, S.A. Evans and M. Dovciak. 2012. Level and pattern of overstory retention interact to shape long-term responses of understories to timber harvest. Ecological Applications 22(8): 2049-2064.

Hannon, S.J., C.A. Paszkowski, S. Boutin, J. DeGroot, S.E. Macdonald, M. Wheatley and B.R. Eaton. 2002. Abundance and species composition of amphibians, small mammals, and songbirds in riparian forest buffer strips of varying widths in the boreal mixedwood of Alberta. Canadian Journal of Forest Research 32: 784-800.

Harrison, R.B., F.K.A. Schmiegelow and R. Naidoo. 2005. Stand-level response of breeding forest songbirds to multiple levels of partial-cut harvest in four boreal forest types. Canadian Journal of Forest Resources 35: 1553-1567.

Hart, S.A. and H.Y.H Chen. 2008. Fire, logging, and overstory affect understory abundance, diversity, and composition in boreal forest. Ecological Monographs 78(1): 123-140.

Harvey, B.J. 2016. Human-caused climate change is now a key driver of forest fire activity in the western United States. Proceedings of the Natural Academy of Sciences 113(42): 11649–11650.

Hauer, F.R., H.Locke, V.J. Dreitz, M. Hebblewhite, W.H. Lowe, C.C. Muhlfeld, C.R. Nelson, M.F. Proctor and S.B. Rood. 2016. Gravel-bed river floodplains are the ecological nexus of glaciated mountain landscapes. Sciences Advances 2(6):1-14.

Hebda, R.J. 2010. The Future of Flora: The Impacts of Climate Change on the Flora of the Canadian Southern Rocky Mountain Region and its Value to Conservation. For the B.C. and Southern Alberta Chapters of the Canadian Parks and Wilderness Society.

Hely, C., M. Flannigan and Y. Bergeron. 2003. Modeling tree mortality following wildfire in the southeastern Canadian mixed-wood boreal forest. Forest Science 49 (4): 566–576.

Johnson, E.A. and G. Fryer. 1987. Historical vegetation change in the Kananaskis Valley, Canadian Rockies. Can. J. Bot. 65: 853-858.

Johnson, E.A. and C.P.S. Larsen. 1991. Climatically induces change in fire frequency in the southern Canadian Rockies. Ecology 72 (1): 194-201.

Kaufmann, M.R., R.T. Graham, D.A. Boyce Jr., W.H. Moir, L. Perry, R.T. Reynolds, R.L. Bassett, P. Mehlhop, C.B. Edminster, W.M. Block and P.S. Corn. 1994. An Ecological Basis for Ecosystem Management. USDA Forest Service Gen. Tech. Report RM-246. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 22 pp.

Koerner, C. 2004. Mountain biodiversity, its causes and function. Ambio, Special Report No. 13, 11-17.

Le Goff, H. and L. Sirois. 2004. Black spruce and jack pine dynamics simulated under varying fire cycles in the northern boreal forest of Quebec, Canada. Canadian Journal of Forest Research 34: 2399–2409.

Lee P.G. and M. Hanneman. 2011. Castle Area Forest Land Use Zone (Alberta) – Linear disturbances, access densities, and grizzly bear habitat security areas. Edmonton, Alberta: Global Forest Watch Canada 1st Publication for International Year of Forests. 58 pp. + Appendix: Photographs from October 5-6 2010 Field Check 44 pp.

Lindenmayer, D.B., Franklin, J.F., and Fischer, J. 2006. General management principles and a checklist of strategies to guide forest biodiversity conservation. BiolCons 131: 433-445.

Lindenmayer, D.B., J.F. Franklin, A. Lohmus, S.C. Baker, J. Bauhus, W. Beese, A. Brodie, B. Kiehl, J. Kouki, G. Martınez Pastur, C. Messier, M. Neyland, B. Palik, A. Sverdrup-Thygeson, J. Volney, A. Wayne and L. Gustafsson. 2012. A major shift to the retention approach for forestry can help resolve some global forest sustainability issues. Conservation Letters 5: 421–431.

Long, J.N. 2009. Emulating natural disturbance regimes as a basis for forest management: A North American view. Forest Ecology and Management 257: 1868-1873

Macdonald, S.E. and T.E. Fenniak. 2007. Understory plant communities of boreal mixedwood forests in western Canada: Natural patterns and response to variable-retention harvesting. Forest Ecology and Management 242: 34–48.

Masters, A.M. 1990. Changes in forest fire frequency in Kootenay National Park, Canadian Rockies. Can. J. Bot. 68: 1763-1767.

McElfish, J.M. R.L. Kihslinger and S. Nichols. 2008. Setting Buffer Sizes for Wetlands. National Wetlands Newsletter 30(2):6-17.

Montana Forest Restoration Committee (MFRC). 2013. Restoring Montana's National Forest System Lands Guiding Principles and Recommended Implementation. Montana Forest Restoration Committee.

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852.

Nature Conservancy of Canada. 2016. Bow Natural Area Conservation Plan.

Nitschke, G.R. 2005. Does forest harvesting emulate fire disturbance? A comparison of effects on selected attributes in coniferous-dominated headwater systems. Forest Ecology and Management 214: 305–319.

Noss, R.F. and A.Y. Cooperrider. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press. Washington, D.C. 417 pp.

O2 Planning and Design. 2013. Landscape patterns environmental quality analysis. Prepared for Oldman Watershed Council. Available at http://aep.alberta.ca/lands-forests/cumulative-effects/documents/LandscapePatterns-Presentation-Apr2013.pdf .

Obad, J. and D. Droitsh. 2009. Source of Opportunity: A Blueprint for Securing Source Water in Southern Alberta. Prepared for Water Matters Society of Alberta. Canmore, AB. 32pp.

Overbay, J. 1992. Ecosystem management. Speech delivered at the National workshop on taking an ecological approach to management. USDA Forest Service, Washington, D.C. Salt Lake City, Utah, April 27, 1992.

Pengelly, C.J. and R.V. Cartar. 2010. Effects of variable retention logging in the boreal forest on the bumble bee-influenced pollination community, evaluated 8–9 years post-logging. Forest Ecology and Management 260: 994–1002.

Perry, D.A. 1998. The scientific basis of forestry. Annual Review of Ecology and Systematics 29: 435-466.

Pike, R.G., M.C. Feller, J.D. Stednick, K.J. Rieberger and M. Carver. 2010. Water quality and forest management. In R.G. Pike, T.E. Redding, R.D Moore, R.D. Winkler and K.D. Bladon (Eds.) Compendium of forest hydrology and geomorphology in British Columbia (pp. 401-440). Land Management Handbook 66. Ministry of Forests and Range Forest Science Program and FORREX Forum for Research and Extension in Natural Resources.

Praxis Group. 2012. Community Values Assessment for the M.D. of Pincher Creek No. 9. For: The Southwest Alberta Sustainable Community Initiative and Municipal District of Pincher Creek.

Praxis Group. 2015. Albertans' Values and Attitudes toward Recreation and Wilderness. Prepared for the Canadian Parks and Wilderness Society – Southern and Northern Alberta chapters. Calgary, AB. 50 pp.

Reed, W.J., C.P.S. Larsen, E.A. Johnson, and G.M. MacDonald. 1998. Estimation of temporal variations in historical fire frequency from time-since-fire map data. Forest Science 44(3): 465-475.

Ripley, T., G. Scrimgeour, M.S. Boyce. 2005. Bull trout (Salvelinus confluentus) occurrence and abundance influenced by cumulative industrial development in a Canadian boreal forest watershed. Canadian Journal of Fisheries and Aquatic Sciences 62: 2431-2442.

Rist, L., A. Felton, L. Samuelsson, C. Sandström, and O. Rosvall. 2013. A new paradigm for adaptive management. Ecology and Society 18(4): 63.

Rogeau, M-P. 2013. An evaluation of pre-industrial forest condition, Spray Lakes Sawmills FMA, Alberta. Wildland Disturbance Consulting. Prepared for Spray Lakes Sawmills Ltd. 99pp

Rogeau, M-P. 2016. Fire regimes of southern Alberta, Canada. Ph.D. Dissertation. Forest Biology and Management. Department of Renewable Resources, University of Alberta. Edmonton, AB.

Schieck, J. and S.J. Song. 2006. Changes in bird communities throughout succession following fire and harvest in boreal forests of western North America: literature review and meta-analyses. Canadian Journal of Forest Research 36: 1299-1318.

Schulte, L.A., Mitchell, R.J., Hunter, M.L. Jr., Franklin, J.F., McIntyre, R.K., and Palik, B.J. 2006. Evaluating the conceptual tools for forest biodiversity conservation and their implementation in the U.S. Forest Ecology and Management 232: 1-11.

Simberloff, D. 1999. The role of science in the preservation of forest biodiversity. Forest ecology and management 115: 101-111.

Slocombe, D. 1998. Lessons from experience with ecosystem-based management. Landscape and Urban Planning. 40: 31 – 39.

Smith, W. and R. Cheng. 2016a. Canada's Intact Forest Landscapes Updated to 2013. Ottawa: Global Forest Watch Canada. 26 pp.

Smith, W. and R. Cheng. 2016b. A Special Series on the Castle proposed protected areas: Bulletin 1: Anthropogenic Disturbance and Intactness in the Castle. Ottawa: Global Forest Watch Canada. 14 pp.

Smith, W. and R. Cheng. 2016c. A Special Series on the Castle proposed protected areas: Bulletins 2: Linear Disturbance in the Castle. 16 pp.

Smith, W. and R. Cheng. 2016d. A Special Series on the Castle proposed protected areas: Bulletins 3: Linear Disturbance in the Castle: Implications for Grizzly Bear and Trout. 24 pp.

Southern Eastern Slopes Conservation Collaborative. 2017. Southern Eastern Slopes Conservation Strategy. Report for Miistakis Institute, Canadian Parks and Wilderness Society Southern Alberta Chapter, Yellowstone to Yukon Conservation Initiative, Southern Alberta Land Trust Society Eastern Slopes Conservation Project.

Southern Foothills Community Stewardship Initiative (SFCSI), 2011. Values and Voices: Stewardship Priorities for the Southern Alberta Foothills. Report of the Southern Foothills Community Stewardship Initiative. 28pp.

Southern Foothills Study (SFS). 2007. The Changing Landscape of the Southern Alberta Foothills: Report of the Southern Foothills Study Business as Usual Scenario and Public Survey.

Southern Foothills Study (SFS). 2015. A Future Worth Protecting: Beneficial Management Practices and the Southern Alberta Foothills. Report of the Southern Foothills Study East Slopes (Phase 3).

Southwest Crown Collaborative (SWCC). 2017. The Southwest Crown Collaborative. Available at: http://www.swcrown.org/ Accessed June 2, 2017.

The Miistakis Institute. 2011. MD Ranchland – Community & Conservation Values Mapping Project – Phase III Report. Prepared for Municipal District of Ranchland No.66. Calgary, AB. 33pp.

Trombulak, S.C., and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1): 18-30.

USFW (United States Fish and Wildlife Service). 1998. Bull Trout Interim Conservation Guidance. Lacey, Washington: United States Fish and Wildlife Service.

Valdal, E.J. and M.S. Quinn. 2011. Spatial analysis of forestry related disturbance on westslope cutthroat trout (Oncorhynchus clarkia lewisi): Implications for policy and management. Application of Spatial Analysis 4: 95-111

Vanderwel, M.C., J.R. Malcolm and S.C. Mills. 2007. A meta-analysis of bird responses to uniform partial harvesting across North America. Conservation Biology 21(5): 1230–1240.

Water Matters Society of Alberta. 2013. Source to Tap: Community Conversations on Headwaters Health and Stewardship in the Oldman River Basin: Summary of Community Dialogues. Prepared for the Oldman Watershed Council. Canmore, AB. 19pp.

Weaver, J.L. 2013. Protecting and Connecting Headwater Havens: Vital Landscapes for Vulnerable Fish and Wildlife, Southern Canadian Rockies of Alberta. Wildlife Conservation Society Canada Conservation Report No. 7. Toronto, Ontario, Canada.

Wilson. E.O. 2003. The Future of Life. New York: Random House.

Work, T.T., J.M. Jacobs, J.R. Spence and W.J. Volney. 2010. High levels of green-tree retention are required to preserve ground beetle biodiversity in boreal mixed-wood forests. Ecological Applications, 20(3): 741–751.