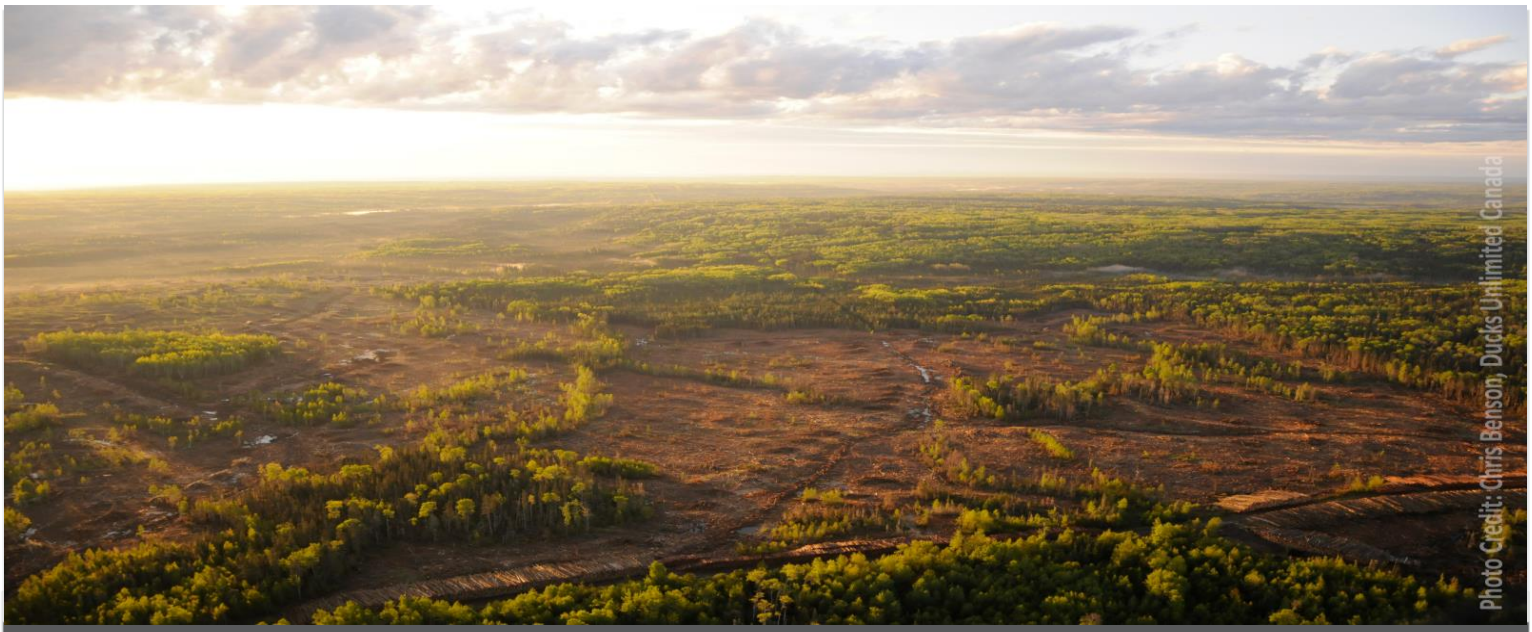

Ecosystem Based Management Challenges for Alberta and Saskatchewan Forests

Summary Report

Prepared for the fRI Research Healthy Landscapes Program

by: Richard L. Bonar

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fRI Research
Informing Land & Resource Management

About the Author

fRI Research is a unique community of Partners joined by a common concern for the welfare of the land, its resources, and the people who value and use them. fRI Research connects managers and researchers to effectively collaborate in achieving our vision and mission. Healthy Landscapes is a Program within the fRI Research community.

This report was prepared for the Healthy Landscapes Program on contract by Rick Bonar, Ph.D. Rick has 48 years of experience as a professional biologist; 18 years in B.C. and 30 in Alberta, working for government, industry, and as a private consultant.

Rick began working in the forest industry in Hinton Alberta in 1988, retiring as Chief Biologist for West Fraser Mills Ltd. on January 31, 2016. His main interests were the areas of policy and partnership towards implementation of sustainable forest management. Areas of focus were representing West Fraser in the activities of the Foothills Research Institute (now fRI Research), the Foothills Landscape Management Forum, numerous other policy initiatives, and implementation of the Ecosystem-based Management and Integrated Landscape Management programs for the Hinton Forest Management Area.

Rick was involved for 25 years with the initiative that is now fRI Research, a non-profit research and knowledge partnership based in Hinton. He retired from the position of President at the end of 2017. Rick remains the Co-chair of the Foothills Landscape Management Forum, a non-profit group of forest sector, energy sector, and Indigenous partners engaged in Integrated Landscape Management in western Alberta.

Rick participated in Alberta conservation initiatives including the Alberta Endangered Species Conservation Committee, the Alberta Athabasca Rainbow Trout and Bull Trout Recovery Plans, and implementation of the Alberta Caribou and Grizzly Bear Recovery Plans.

Note that the first few sections of this report were contributed by Dr. David Andison. The content of the methods and results sections are entirely those of the author.

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DISCLAIMER

Any opinions expressed in this report are those of the author, and do not necessarily reflect those of the organizations for which they work, or fRI Research.

The bulk of the author's professional career was divided between British Columbia and Alberta and his familiarity with forest management in Saskatchewan for this project was derived almost entirely from reading and subject-matter expert interviews. This disparity is almost certainly reflected in the use of examples and other emphases in the report. The author acknowledges that his interpretation of the Saskatchewan forest management scene may be inadequate and contain errors.

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I thank the many people who contributed to the project. Special thanks to David Andison, John Wilmshurst, John Parkins, and members of the HLP team: Alan Bell, Amy Carriere, Wendy Crosina, Tom Daniels, Tom Habib, Bob Mason, Neal McLoughlin, Melissa Nordin, Laura Trout, Trina Vercholuk, and Melonie Zaichkowsky.

The provinces of Alberta and Saskatchewan are covered by Treaty territories 2, 4, 5, 6, 7, 8, and 10 and are home for many Indigenous Peoples, including Dene Tha', Dene Chipewyan, Beaver and Metis Peoples. As the original practitioners of EBM, First Nations built the foundation for future opportunities.

PREFACE

When I was asked to lead this project, I saw it as a chance to look into how we manage forest lands and how better-pursuing ecosystem-based management could improve prospects for ecological integrity of future forests and the myriad benefits that forests provide to humans. My task sounded reasonably

straightforward. Look at what we do now. Research, interview, imagine and describe how things could be better if we are able to successfully deploy EBM. Identify the challenges that stand between now and a better future. Suggest opportunities (and some solutions) to move from here to there. Summarize the online body of knowledge, talk to other knowledgeable people, and draw on my 48 years of experience in the field. Come up with a report that, above all, provides food for thought and discussion. And hope that leads to continual change towards better futures through EBM.

Any form of forest management, EBM included, is tremendously complex, with *many* moving and interconnected parts that have to be managed over centuries, not just months or the next five years. Making good decisions in the present to achieve outcomes that may be 50 or 150 years ahead is a truly humbling process that tends to fade in the short-term focus and flow of human interest and engagement. EBM touches on all aspects of forests and how we manage them, and I tried to address the subject in a comprehensive and inclusive way.

Where there is challenge, there is also opportunity. Over the course of the project, I found hundreds of both, from big to small, short-term to long-term, easy fixes to intractable wicked problems, and so on. That led to a major communication challenge — how to organize the report into something logical and accessible. In the end, I defaulted to repeating challenges and recommendations that were linked to more than one EBM element or aspect. This seemed more logical than listing challenges and recommendations and then trying to cross-reference to all of the elements and aspects each relates to.

CONTENTS

DEFINITIONS

Active landbase – In commercial forests the active landbase is all areas that will be logged over time. The extent of the active landbase is defined as part of Forest Management Plans. See passive landbase.

Adaptive management – A learning approach to management that recognizes substantial uncertainties in managing forests and incorporates into decisions experience gained from the results of previous actions (Canadian Standards Association 2016).

Biodiversity (Biological Diversity) – The variability among living organisms from all sources, including inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Canadian Biodiversity Strategy 1995).

Biological legacies – The living organisms that survive a catastrophe; organic debris, particularly the large organically-derived structures; and biotically derived patterns in soils and understories (Franklin 1990).

Challenge – An aspect of human decision-making that hinders or stops further development and implementation of EBM in Alberta and Saskatchewan forests.

Coarse filter approach – An approach to the conservation of biodiversity that involves maintaining a diversity of structures within stands and a diversity of ecosystems across the landscape, in order to meet most of the habitat requirements of most of the native species (see Fine Filter Approach).

Coarse woody debris (CWD) – Dead trees and the remains of large branches on the ground in forests and in rivers or wetlands. Also called large woody debris when in water, downed woody debris or material, and dead wood.

Commercial forest – A forest landscape that is capable of growing commercially valuable timber on some ecosystems. Commercial forest DFAs are commonly allocated to forest companies through some form of tenure that allows them to grow and cut timber that supplies processing mills.

Critical habitat – Means the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species (Government of Canada 2002).

Cumulative Effects – Changes to environmental, social and economic values caused by the combined effects of past, present and potential future human activities and natural processes.

Defined forest area (DFA) – A specified area, including all internal areas of land and water (regardless of ownership or tenure), to use as the management unit for EBM planning and implementation (Canadian Standards Association 2016).

Designatable Units – Established where conservation of biological diversity requires protection for taxonomic entities below the species level using subspecies or varieties, or discrete and evolutionarily significant populations (Committee on the Status of Endangered Wildlife in Canada 2018).

Disturbance event – An individual disturbance episode of a forest fire, wind storm, flood, or insect outbreak. In this report disturbance events follow the classification developed by Andison (2003).

Ecological integrity – For a given area, ecological integrity exists when ecological conditions include all inherent natural diversity (species including genetic diversity, populations, ecosystems) and the ecological patterns and processes that maintain that diversity.

Ecological resilience – In ecology, resilience is the capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly.

Ecological succession – The process that describes how the structure of a biological community (that is, an interacting group of various species in an ecosystem) changes over time.

Ecosystem-based management (EBM) – In general, a management system that has a primary goal of concurrently maintaining ecological integrity and human wellbeing. There is no widespread agreement on an EBM definition. Published definitions include:

- A collaborative, integrated, science-based approach to the management of natural resources that focuses on the health and resilience of entire ecosystems, while allowing for sustainable use by humans of the goods and services they provide (Andison 2020a).
- Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term (Grumbine 1994).
- Management systems that attempt to simulate ecological processes with the goal of maintaining a satisfactory level of diversity in natural landscapes and their pattern of distribution in order to ensure the sustainability of forest ecosystem processes (Canadian Council of Forest Ministers 2008).
- A management system that attempts to emulate ecological patterns and processes, with the goal of maintaining and/or restoring natural levels of ecosystem composition, structure and function within stands and across the landscape (Canadian Boreal Forest Agreement 2015).

Endangered species – Means a wildlife species that is facing imminent extirpation or extinction (Government of Canada 2002).

Fine filter approach – An approach to the conservation of biodiversity that is directed toward particular habitats or species including those that may be threatened or endangered and might “fall through” the coarse filter. (See also Coarse filter approach).

Forest conditions – The state of specified forest ecosystem areas as determined by a range of variables associated with forest structure, composition, and processes.

Forest management – Management that is inclusive of all ecological processes and ecosystems in landscapes dominated by forest ecosystems. It also includes management of non-forested ecosystems that are interspersed with and linked to forest ecosystems. It also includes, but is not restricted to, forest management for commercial timber production.

Healthy forest – Forest health is a condition of forest ecosystems that sustains their complexity and resilience. Healthy forests have ecological integrity and resilience.

Hierarchical Planning – Refers to developing plans with outcomes and activities at two or more scales or levels that are linked into a hierarchy from strategic to operational scales.

Incidental take – Inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs (Government of Canada 2014).

Indicator – a variable that measures or describes the state or condition of a value (Canadian Standards Association 2016).

Indigenous Peoples – Culturally distinct ethnic groups who are native to a particular place. Also referred to as First people, First Nations, Aboriginal people, Native people, or autochthonous people. In Canada Indigenous Peoples also include Métis, Inuit, and status and non-status Indians as per the federal Indian Act.

Integrated land management (ILM) – Coordination of human activities to manage surface infrastructure to minimize environmental impacts and maximize efficiency.

Integrated resource management (IRM) – To manage the use of land and renewable and non-renewable resources in an integrated and environmentally sound manner to ensure ecological, economic, and social benefits for present and future generations. IRM preceded SFM in Alberta and Saskatchewan.

Interested party – An individual or organization interested in and affected by the management activities of a DFA (Canadian Standards Association 2016).

Invasive species – A species that causes ecological or economic harm in a new environment where it is not native.

Life cycle approach – An approach to planning for the full life cycle of roads and other human infrastructure. All features are planned, ideally in advance, as permanent or temporary depending on the expected duration of intended use. Temporary roads needed to support temporary activities (e.g., cutblock, wellsite) are scheduled for reclamation when no longer needed. Temporary features can exist for many decades.

Lowest common denominator – Something that is deliberately simplified or set to a specific standard so as to appeal to the largest possible number of people and make it possible for the least capable to achieve success.

Natural range of variation (NRV) – The range of natural ecosystem states and processes encountered over a long time period for a given area or aspect. In forest management, this commonly refers to the full range of ecosystem states and processes that occurred before major changes caused by non-Indigenous Peoples (pre-industrial). Because it is not possible to separate variation related to natural and anthropogenic sources (e.g. fire caused by lightning versus fire started by humans) NRV is sometimes termed Historic Range of Variation (HRV).

Objective – a broad statement describing a desired future state or condition of a value (Canadian Standards Association 2016).

Passive landbase – In commercial forests the passive landbase is all areas that will not be logged at some point over time. The extent of the passive landbase is defined as part of Forest Management Plans. See active landbase.

Patch – A relatively homogeneous area that differs from its surroundings. Patches are the basic unit of the landscape that change and fluctuate through a process called patch mosaic dynamics.

Precautionary approach – "*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*" (Conference of the Parties 1992).

Pre-industrial condition – A natural condition representative of a pre-industrial forest that has not been subjected to large scale logging. A data-based assessment generally providing insight into the forest types, age classes, and landscape conditions. (Forest Stewardship Council 2018).

Riparian areas – "*Riparian lands are transitional areas between upland and aquatic ecosystems. They have variable width and extent above and below ground. These lands are influenced by and exert an influence on associated waterbodies, including alluvial aquifers and floodplains. Riparian lands usually have soil, biological, and other physical characteristics that reflect the influence of water and hydrological processes.*" (Alberta Water Council 2013).

Species at risk – A species designated as at risk by national or provincial legislation.

Sustainable forest management (SFM) – Management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations (Canadian Council of Forest Ministers 2005).

Sustained Yield Management – A management policy that limits annual timber cut for forest products to levels that lead to no significant reduction of the forest ecosystem's capacity to support the same annual logging level in perpetuity.

Stand-maintaining disturbance – A disturbance that kills some of the trees in the previous stand.

Stand-replacing disturbance – A disturbance that kills all previous trees in the stand.

Stand structure – The horizontal and vertical distribution of components of a stand, including the height, diameter, crown layers and stems of trees, shrubs, herbaceous understory, snags and down woody debris (Helms 1998).

Stewardship – An ethic that embodies the responsible planning and management of resources for current and future generations.

Structure retention – Living and dead trees, shrubs, and downed wood that are retained in cutblocks and within logging disturbance events to provide biological legacies from the disturbance.

Target – A specific statement describing a desired future state or condition of an indicator. Note: Targets should be clearly defined, time-limited, and quantified, if possible (Canadian Standards Association 2016).

Threatened species – Means a wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction (Government of Canada 2002).

TRIAD approach – Refers to managing commercial forests in three zones (a triad) that include protected (ecological integrity emphasis), intensive (tree production emphasis such as plantations), and extensive (joint ecological integrity and timber emphasis) (Seymour and Hunter 1999). Also protected, converted and consistent (Gorley and Merkel 2020).

Value – A characteristic, component, or quality considered by an interested party to be important in relation to an SFM element or other locally identified element.

Watershed – An area of land that contains a common set of streams and rivers that all drain into a single larger body of water, such as a larger river, a lake or an ocean.

Zone – An area of land designated for a specific purpose, allocation, practice, or other difference when compared to other zone(s) established for the same purpose. Zones are commonly used as the basis for management priority or emphasis and to differentiate regulatory or policy requirements.

ACRONYMS

AFMPS	Alberta Forest Management Planning Standard
BAU	Business as Usual
CBD	Convention on Biological Diversity
CCFM	Canadian Council of Forest Ministers
CCME	Canadian Council of Ministers of Environment
CEA	Cumulative Effects Assessment
CESCC	Canadian Endangered Species Conservation Council
CLAWR	Cold Lake Air Weapons Range
COP	Conference of the Parties (COP), consisting of all governments and other organizations that have ratified the Convention on Biological Diversity treaty.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSA	Canadian Standards Association
CWD	Coarse Woody Debris (also LWD large woody debris, DWD downed woody debris, DWM downed woody material, and DW dead wood)
DFA	Defined Forest Area
EPFMA	Expert Panel on Forest Management in Alberta
EBM	Ecosystem-based Management
EIA	Environmental Impact Assessment
EMEND	Ecosystem Management Emulating Natural Disturbance
ENGO	Environmental Non-Government Organization
FMA	Forest Management Agreement or Area
FMP	Forest Management Plan
FMU	Forest Management Unit
FSC	Forest Stewardship Council
GIS	Geographic information system
GOA	Government of Alberta
GOC	Government of Canada
GOS	Government of Saskatchewan
HADD	Harmful alteration, disruption or destruction of fish habitat (Fisheries Act, GOC 2019)
HRV	Historic Range of Variation
ILM	Integrated Land Management
ISO	International Organization for Standardization
NGO	Non-Government Organization
NIMBY	Not in my Backyard
NRTEE	National Round Table on the Environment and Economy
NRV	Natural Range of Variation
SARA	Species at Risk Act
SFI	Sustainable Forestry Initiative
SFMPS	Saskatchewan Forest Management Planning Standard
SFM	Sustainable Forest Management
VBA	Values-Based Approach
VOIT	Value, Objective, Indicator, and Target

1.0 INTRODUCTION

Written by: D.W. Andison

The Healthy Landscapes Program (HLP) began as the Natural Disturbance Program (NDP) in 1996. The original goal of the NDP was focused largely on quantifying disturbance patterns as part of the growing trend of using pre-industrial patterns as guides for forest management. In 2012, the NDP transitioned to what is now the HLP, with a broader mandate; "***To understand natural and cultural patterns, and help partners explore how healthy landscapes (HL) approaches might contribute to sustainable resource management solutions***". Although without formalizing it by name at the time, the HLP was, and is now, a partnership interested in exploring if, how, and in what ways, an Ecosystem-Based Management (EBM) paradigm could be adopted for boreal and foothills forested landscape ecosystems of western Canada.

By 2015, after 15 years of research and communications products, many HLP partners shared a concern that the acceptance and uptake of HLP ideas and output was less than expected. This precipitated two separate but linked outreach projects aimed at addressing this concern. The first was a series of four *EBM Dialogue Sessions* in 2017 (Andison et al. 2019). The one-day facilitated workshop was designed to solicit, share, and gather information on EBM perspectives from a range of stakeholders and partners. The primary goal of the dialogue sessions was to identify the form and function of the potential road-blocks to the implementation of EBM. The sessions revealed that support for the EBM concept was very high across all jurisdictions and partner affiliations. The sessions also revealed that trust (to define, translate and integrate EBM ideas) was low among some sectors, and the definitions of EBM among and between partners varied widely.

The second project undertaken by the HLP to help address the lack of EBM uptake was a two-day EBM Roadmap workshop (Odsen et al. 2019). The intent was to follow-up with what we learned from the dialogue sessions by offering a safe space for stakeholders and partners to identify ways and means of moving forward with EBM while respecting the differences in definitions. The workshop results reinforced shared support for EBM, but also revealed that we are in many ways already moving towards EBM via some shared elements that are already embedded in the current direction of management-although without the EBM label.

Armed with a better sense of stakeholder and partner perspectives on EBM, this project takes the next logical step by identifying a more comprehensive list of institutional, jurisdictional, and regulatory challenges to EBM. In other words, if / how do the collective requirements, structures, intent, and interpretations of existing policies and practices hinder the implementation of EBM from a forest land management perspective? This report also includes recommendations by the author of how EBM challenges might be mitigated or overcome.

It is important to note that this report is technically a summary document that includes the most important challenges as chosen by the author. The original report includes a greater number of challenges organized into specific topic areas, and is available in a series of searchable and downloadable PDF documents at https://friresearch.ca/ebm-challenges.

Lastly, it is important to note that this report is a critical, but still intermediate step as regards identifying robust solutions towards greater levels of EBM integration. The contents of this report and the associated online documents still need to be synthesized, classified, and ranked in terms of both the relative risks and benefits, and linked to specific opportunities. Although this report does in fact include recommendations from the author, the main focus of this phase of the project was to generate a comprehensive, raw, information atlas of EBM challenges as a foundation. The HLP partners will determine the details of the next phase.

2.0 History of EBM

(Excerpt from Andison 2020b)

The vast majority of natural resources in Canada are owned by, and the responsibility of, Provincial /Territorial and Federal governments and/or Indigenous Peoples. Access to natural resources is granted to private companies or individuals through a vast array of government agencies (Pearse 1988). Although there are a wide range of resource rights allocation mechanisms, in general the generic process is to first identify a natural resource for which there is both value and competition (e.g., timber, water, fish, minerals, fur, natural gas), and then create a new government agency(s) responsible for overseeing the creation and delivery of the various frameworks and strategies for each value (*sensu* Figure 1). The access details are uniquely created for each natural resource by individual government departments creating a spectrum of "property" rights ranging from simple quota systems for water, to sophisticated long-term area-based tenure agreements for timber (Pearse 1988). However, details aside, most natural resource management processes in Canada follow a simple general management model that I will call a ***value-based approach*** (VBA). The value-based approach is represented largely by having a single primary (economic or social) value such as timber, protection, recreation, or sub-surface minerals, as the foundation of every management plan. The associated management planning process often includes the consideration of a longer list of other values (e.g., habitat, aesthetics, wildfire threat, other uses or exceptions) as *decision-making filters*. Figure 1 shows an example of how the VBA works for timber management (although note that the process is the same for protected areas and parks).

The context for VBA was largely the patchwork nature of economic development drivers; as a natural resource became more valued and scarce, demand grew to the point where more regulation was required (Pearse 1988). However, there is also ecological context for the VBA. Prior to *circa* 1980, it was commonly believed that natural ecosystems were deterministic, predictable, and balanced in the absence

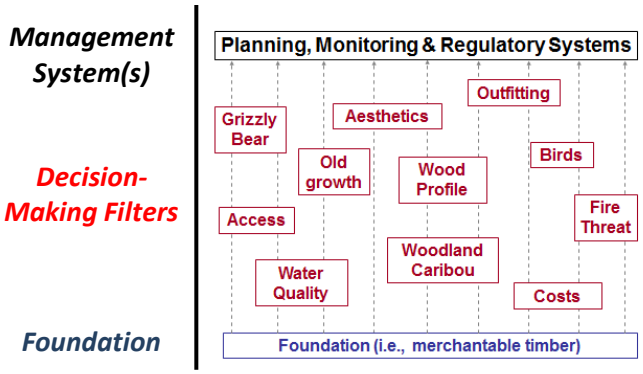

Figure 1. Generalized natural resource management process.

of disturbance (Odum and Odum 1959). Moreover, ecosystems were assumed to be *de facto* factories that could be manipulated to maximize the production of one or more values such as timber. Disturbance was mostly thought of as a negative process that threatened the flow of services. Given this backdrop, dividing up natural ecosystems into pieces, and creating individual departments with unique rules to maximize the dollar value of those elements was entirely rational.

By *circa* 1990, there was widespread and deeply rooted dissatisfaction with, and mistrust of virtually all natural resource management agencies (Grumbine 1994) for a number of reasons:

- The number of values being included in the filtering stage was increasing, making the technical elements of creating and comparing scenarios significantly more complex and less transparent.
- Some felt that a value-based approach was perpetuating a trade-off mentality and less objective outcomes where only those with the loudest voice were likely to benefit (Pickett et al. 1992). For example, forest harvesting designed to optimize harvest levels was compromising old-forest values (Nonaka and Spies 2005) and fire suppression policies were creating significant and negative shifts in habitat (Cleland et al. 2004) fuel types, ecological resilience (Moore et al. 1999) and wildfire risk (Hessburg et al. 2008).
- At the same time, researchers began questioning the assumption that it is possible to sustainably manage a complex ecosystem by optimizing the needs of a small fraction of its pieces (Lotze 2004). A growing body of evidence suggested that the needs of a small number of subjectively chosen values does not necessarily equate to ecosystem health and integrity (Seymour and Hunter 1999).
- There were increasing concerns that a value-based approach ignored the complex dynamics of natural systems in favour of attempting to optimize a small number of individual elements (Lotze 2004). The primary role of the foundation value (e.g., timber, water, minerals) biased the process, creating simplified ecosystems (Drever et al. 2006; Pickell et al. 2016).
- Concern over how to calculate and compare the costs and benefits of a growing list of services that have no clearly defined economic benefit, but play critical ecological roles (Salwasser 1994).
- Although the value of disturbance as a critical ecological process was being revealed through science, there was continued acceptance of outdated conceptual (management and policy) models that assumed ecosystems were stable and deterministic entities, and that disturbance was unhealthy (Botkin 1993). Ironically, one of the turning points for this perspective was the so-called “catastrophic” Yellowstone fire of 1988, which ultimately created rich, diverse, and resilient natural ecosystems (Turner et al. 2003).
- A value-based system by definition creates multiple independent silos of management activities on the same piece of ground, created by multiple management plans meant to serve different foundation values. These plans were generated independently of each other, and often had highly inconsistent requirements. For example, the comprehensive long-term plan requirements of the forest sector contrast sharply with the short-term planning requirements for much of the energy sector. Regardless of how robust indicators are, or how effective monitoring is for

individual activities, it is more difficult to demonstrate, or assign responsibility for the impact of the cumulative effects of all activities (Theobald et al. 1997).

The responses to these challenges within the many forest-land management agencies in Canada varied. Three main options dominated:

1) **Double down on the value-based approach**. This response was the most prominent for commercially managed forest areas, and manifested itself in several ways:

    a. Efforts to quantify ecosystem services in economic terms increased, potentially providing planners and decision-makers with the ability to better compare the trade-offs of future management scenarios in equal, economic terms (e.g., Costanza et al. 1997).

    b. Include a longer list of values using more powerful optimization modelling techniques. Computer models today can handle dozens of values and hundreds of parameters using multiple data sources across vast areas. Balancing a long list of values and a longer list of parameters by sophisticated pseudo-optimization computer models provides faster, more defendable solutions, but also decreases transparency, potentially to the point where it can be difficult to reconcile the outputs with the inputs (Nelson 2003).

    c. Upgrade and standardize VOITs (Values, Objectives, Indicators, and Targets). This effort was spearheaded in Canada by the Canadian Council of Forest Ministers (1997). The new CCFM standards soon became a part of the requirements for most forest management plans in Canada (e.g., Government of Alberta 2006), and the development of VOITs became increasingly scrutinized and adapted (Rempel et al. 2004).

    d. Upgrade the VBA model. In the early 1990's, the sustainable forest management (SFM) management model was being touted by many in Canada as "the" next management paradigm. The SFM organized all (foundational and filtered) values into one of three legs; ecological, economic, and social. At the heart of the SFM concept was the idea of identifying one or more optimal future landscape scenarios that lie at the intersection of these three SFM circles representing the ideal management scenario solution space (Purvis et al. 2019). The Canadian forestry sector in western Canada became the primary driver of the SFM model, in large part through the Sustainable Forest Management Network (SFMN) working out of the University of Alberta. Over more than a decade, the SFMN created a significant amount of new knowledge, outreach, and tools in support of a VBA vision (e.g., Hannon and McCallum 2004). Although not widely acknowledged at the time, the SFM model advocated by the SFMN overlapped in many ways with EBM. For example, in their collection of essays Adamowicz and Burton (2003) identified a *social stage of* forestry emphasizing the need to manage forests based on other forest values.

2) **Bridge the gap**. One of the new forest management concerns in the early 1990's was the recognition of the ***cumulative effects*** of overlapping and uncoordinated management activities on a single piece of ground. The concern over cumulative effects was twofold: 1) most

documented cases of cumulative effects were negative, and 2) the current monitoring and regulatory system(s) had no mechanisms for capturing or dealing with cumulative impacts. In response, a series of cumulative effects assessments (CEAs) (e.g., Smit and Spaling 1995) were designed and introduced to address the monitoring gap associated with aggregated activities (van Deusen et al. 2012). Others moved towards generic, objective, cost-shared monitoring programs. For example, Alberta created a universal, arm's length, science-based monitoring entity now known as the Alberta Biodiversity Monitoring Institute (ABMI). This unique initiative tracks changes to Alberta's wildlife and habitats, and provides ongoing, scientifically credible information on Alberta's natural ecosystems at multiple scales (Farr 1998).

At the same time, there were various attempts to resolve the issue of management silos at the front end by the integration of various planning processes (Rayner and Howlett 2009). Integrated Land Management (ILM) approaches that attempt to gather multiple plans on a single piece of ground re-emerged in the early 1990's (Brownsey and Rayner 2009). Efforts in support of ILM initiatives continue to this day, although the interpretation of the term varies from integrating science and models (Herrick et al. 2006), to an approach for resolving land use conflicts (Sawathvong 2004), to an approach for managing water resources (Ibisch et al. 2016). Alberta's recent version of ILM focuses on reducing human footprint (Government of Alberta 2010) through a series of tools such as shared planning, disturbance thresholds, and joint road development (O2 Planning + Design Inc. 2012).

3) **Shift to a new paradigm**. For some Canadian (and many US) jurisdictions, the response to the weaknesses of a VBA paradigm was to explore replacing it with one that addressed most or all of its limitations. Starting in late in the 1980's several visionary academics were exploring and promoting the concept of ecosystem-based management (EBM), although the concept is much older (e.g., Leopold 1949), and is more in line with how many parks and protected areas are managed. At its heart, EBM proposes a fundamental shift in the *management foundation* from one or more social, economic, and ecological values, to the health and integrity of the entire ecosystem (*sensu* Grumbine 1994). By recognizing ecosystems as values unto themselves, it provides an alternative to the value-based approach in which the needs of one or more species (or values) are used to guide planning and management (Rudd 2004). EBM is an alternative management paradigm that suggests that since we cannot ever know the details of all species and services in an ecosystem, let alone the millions of interactions, we should focus instead on the health, integrity, and sustainability of the ecosystem as a whole based on our best understanding of ecosystem drivers and dynamics (Drever et al. 2006). To most, this was interpreted as "emulating" Mother Nature. In other words, by maintaining ecosystems within, or moving them closer to their pre-industrial, historical range, we are allowing for a greater chance of survival for ***all*** inherent species and services, regardless of whether or not we can identify individual elements or processes (Christensen et al. 1996). Others take a step back to focus on using NRV as a critical link between sustainability, and ecosystem health and integrity

(e.g., Drever et al. 2006). Regardless of the specifics, adopting some version of an NRV strategy represents the ultimate version of the *precautionary principle* (*sensu* Kriebel et al. 2001).

Of the three options, the last one — shifting to EBM — was the most difficult and risky, but also the one with the greatest potential. The new EBM paradigm was in many ways the opposite of the previous one: pieces to wholes, stable to dynamic, deterministic to stochastic, and a complete reversal of the perceived value of disturbance. Not surprisingly, resistance from the scientific community lingered for many years (Tarlock 1994), and pushback is still evident today. For example, one need not look far to find references to the "destructive" nature of natural disturbances in the literature (e.g., Rieman and Clayton 1997; Christman 2010). Moreover, Imperial (1999) suggested that a shift to EBM represented considerable institutional evolution, and warned that it would be "…*unwise to underestimate the threat that such a shift represents to individual or institutional ideologies*". Grumbine (1994) referred to EBM as a "*seismic shift in thinking*".

3.0 Objective

Written by D.W. Andison

In the bigger picture, the adoption of any new management paradigm always includes challenges. In this case, the principles that form the foundation of EBM include several prevalent elements of sustainability, including collaborative management, integrated management, and adaptive management. On the other hand, EBM offers both fundamental and specific advice that, at first blush, seems to contrast with some current policy and practices.

Thus, the objective of this project is ***to identify the challenges of advancing the various EBM principles within forested landscapes of Alberta and Saskatchewan.***

This project is the first of its kind in Canada, and long overdue. We, collectively, have been testing and implementing various bits of the EBM concept for almost 20 years now, but those efforts have been piecemeal. Case in point, the advancement of EBM ideas in other jurisdictions (e.g., Ontario and Quebec) have come at considerable cost in terms of time, money, and trust. We can benefit by learning from those experiences towards the advancement of EBM in the western boreal.

4.0 Study Area

This project will cover the areas of forest-dominated landscapes of the provinces of Alberta and Saskatchewan, focused largely on commercial forest areas, but also including protected areas and non-commercial forest areas.

5.0 METHODS

5.1 DEFINING EBM

(Excerpt from Andison 2020b)

The output from both the EBM Dialogue Sessions and the EBM Roadmap Workshop HLP projects already identified the lack of agreement on a definition of EBM created confusion, and was counter-productive in furthering the evolution of the concept as a significant challenge to the advancement of EBM in western boreal Canada. In response, the HLP created a single, openly shared, generous, working definition of EBM. By "working" I mean a definition that can be used as a universal baseline for communication — but not necessarily universally accepted or more "correct" than any other definition. In doing so, we hoped to:

a. ***Foster Communication***. There are significant and long-running debates among and within forest management agencies across Canada about the definition, value, and application of EBM. The nature of these conversations has not advanced significantly in recent years. In fact, if anything, positions are becoming more entrenched. Rather than propose or argue for a single "correct" EBM definition, I am proposing a single version as a form of common currency.
b. ***Provide Context***. Managers, policy-makers, partners, and the public are more likely to consider new tools or methods if they understand exactly what it is they are buying into. Right now, no such clarity exists because of the lack of agreement on what EBM "is", which then becomes another source of mistrust.
c. ***Facilitate Learning***. The variable and fractured versions of EBM have made it more difficult to collect, summarize, and share learnings. Beyond the learnings from the *EBM Dialogue Sessions* and the *EBM Roadmap Workshop*, the lack of consistency in defining EBM has limited our ability to learn from others.
d. ***Make it More Grounded.*** EBM is perceived as being not only a significant leap, but also entirely foreign. A robust definition should potentially address both challenges.
e. ***Partition Definition Debates from Activity Debates***. Creating a single definition will not resolve the variety of perspectives, but if that definition is suitably clear and complete, it can refine such discussions. Moreover, a robust definition of EBM can potentially allow us to separate debates about definitions from debates about integration activities.

EBM was introduced into the scientific literature as a concept that was new, multi-dimensional, and in many cases vaguely defined. Thus, it is not surprising that the translation of the EBM paradigm into new policies and practices by managers and regulators has resulted in a wide range of interpretations. The challenge is that the lack of agreement on what EBM "is" is negatively affecting communication and trust — and thus forward movement on the integration of EBM ideas. The challenge is to create a single

definition of EBM that meets the five requirements described above. Towards that, Andison (Andison 2020b) developed the following definition design guidelines:

1) Objective. Although it is not always possible to get agreement from everyone, a more objective, science-based definition is less likely to create disagreement and/or sow mistrust.
2) Comprehensive. It is better to err on the side of being too inclusive than leaving something out. That way, debates are more likely to be around the relative importance of various EBM elements, as opposed to the inclusion or exclusion of an element.
3) Partitionable. Taken as a whole, EBM is a daunting concept because it is seen as being a) new, and b) multi-dimensional. To make it more tractable, EBM needs to be broken down into elements that can be discussed and evaluated on their own merits. This may also reveal those elements of EBM that are already well supported, but not necessarily recognized as EBM.
4) Practical. The literature includes a mix of practical and conceptual elements. The latter will require some translation.
5) A Journey. It is less intimidating to think of EBM not as a binary (yes or no) destination, but rather an ideal towards which we continually and deliberately aspire, the steps of which are more attainable than the end point. Introducing new management approaches in service of a new management approach often fail due to the sheer magnitude of the changes that are required (e.g., Brownsey and Rayner 2009). Armed with this knowledge then, we need to ensure that the journey has abundant, attainable, reasonable, and scientifically defendable possibilities that move us closer to an EBM ideal.

Based on these criteria, a thorough, objective review of the seminal published EBM literature (including and beyond forest management versions) was conducted to identify common theme areas. The nine chosen papers identified 13 common EBM themes, which were a combination of conceptual and practical ideas. Based on those 13 elements the HLP defines EBM as:

A collaborative, integrated, science-based approach to the management of natural resources that focuses on the health and resilience of entire ecosystems, while allowing for sustainable use by humans of the goods and services they provide.

These 13 theme areas were then interpreted into four pillars, each with three elements. This step was intended to eliminate the vagueness and subjectivity evident in many EBM definitions (Andison 2020b). Note that the elements were chosen to be inclusive, the idea being that everyone can see their EBM definitions in the wheel somewhere. It is also important to note that by breaking EBM down into 12 elements, it shifts the discussion from "what is EBM?" to "what are my/the important parts of EBM?". These are very different conversations.

Figure 2. The 12 elements of the EBM Wheel (Andison 2020b).

The final step in the process of defining EBM for the purposes of this project was to propose that we consider EBM as a journey, as opposed to a destination. This in part services the challenge of absolute (e.g. are you doing EBM or not?), but also acknowledges the importance of the journey itself in terms of research, partnerships, trust, collaboration, and shared goals.

The final report provides details on what the various stages of what an EBM journey looks like for each of the 12 elements in Figure 2 (Andison 2020b) and will not be repeated here. Table 1 provides an overview only. But towards the proposal that an EBM definition becomes a journey as opposed to a definition, the HLP defines an EBM journey as follows:

An EBM journey involves actively supporting and openly sharing science and leading-edge innovation that specifically and deliberately contributes to the advancement of one or more EBM elements.

For clarity and consistency, this definition of EBM will be used in this report.

Also for this report *forest management* is inclusive of all ecological processes, ecosystems, and human activities in landscapes dominated by forest ecosystems. This includes management of non-forested ecosystems that are interspersed with and linked to forest ecosystems, and all forms of land use designations.

Table 1. Transition overview from no EBM to Full EBM for the 12 practical EBM elements. The journey (i.e., transitions) in each case is either progressive or additive.

EBM Pillar	EBM Element	Options		
		No EBM	Transition Type	Full EBM
Strategy	The role of NRV	Not required	Progressive	Planning foundation
	Management focus	Individual activities	Progressive	Shared results
	Ecosystem components	Single component	Progressive	Complete ecosystem
Process	Operational tools	As required	Additive	Disturbance plan
	Monitoring	As required	Progressive	Active adaptive
	Knowledge acquisition	As required	Additive	All forms
Partners	Neighbours	Not applicable	Additive	All relevant neighbours
	The role of regulators	Command and control	Progressive	Co-managers
	Decision-making	As required	Progressive	Compreshsive and inclusive
Benchmarks	Defining NRV	Not applicable	Progressive	All types and scales
	Incorporating variation	Not applicable	Progressive	Representing full range of variation
	Defining targets	Regulator defined	Progressive	Science-based stakeholder process

5.2 Scope

5.2.1 Geographic

The geographic scope of the project includes all forested ecosystems of Alberta and Saskatchewan, including commercial (tenured) forests, non-commercial forests, protected areas, and other forest areas.

5.2.2 Land Use

The main emphasis was on commercial forest landscapes (also sometimes referred to as “working” or “active” forest) held under tenure by forest company licensees. Other forest users were referenced in relation to their impacts on ecological integrity for disturbances, ecological conditions, and biological outcomes. Non-forest and other passive landbase forest ecosystems embedded in commercial forest landscapes were included but related challenges were not assessed to the same level of detail. Management of non-commercial (non-tenured) provincial lands, provincial protected areas, and National Parks was referenced but was of secondary focus for the project. Indian reserves, military

lands, and private lands were excluded because they cover relatively small proportions of the forested lands of Alberta and Saskatchewan.

5.2.3 Regulations and Policy

The regulatory scope included all relevant provincial and federal (e.g., Fisheries Act, Species at Risk Act) legislation and related regulations, policies, and other government requirements.

5.2.4 Planning

The planning scope included higher-level land use plans, environmental and species management plans, area-based forest management plans, park management plans, and selected sub-planning levels within area-based plans.

5.3 Information Gathering

Three different sources of information were used in the creation of this report; 1) policy document review, literature review, and expert interviews.

5.3.1 Policy Document Review

Legislation and other policy, planning, or related documentation from government and non-government sources that have defined roles and interests in relation to forest management was reviewed for aspects that relate to EBM (see Appendix 1 at https://friresearch.ca/ebm-challenges).

5.3.2 Literature Review

Selected literature review was conducted to bolster the information available from organizations and the professional knowledge and experience of the author. The process used was to review 3–5 of the most cited and relevant references and 3–5 of the most recent applicable references on each subject. Preference was given to sources that covered forest management in Alberta, Saskatchewan and Canada. Rather than citing all supporting literature I usually cited one of the seminal references and one of the recent papers. Although each downloadable Section has its own literature review, the complete set of literature cited is available in Appendix 2 at https://friresearch.ca/ebm-challenges.

5.3.3 Expert Interviews

To augment the document and literature review and the author's knowledge, 19 interviews were held with selected EBM Subject Matter Experts (SME). Although they followed the same general line of questioning (see Appendix 3 at https://friresearch.ca/ebm-challenges), each 90-minute interview was open-ended and sought to gain additional perspectives about 'soft' EBM challenges that are not always evident from documents and literature.

5.4 Information Synthesis and Presentation

The information from the three main knowledge sources (policy documents, literature, and interviews) within the scope definitions above were summarized and blended with my personal knowledge and statements followed by either a document or interview reference can be attributed to the associated document or expert. Statements without references can be considered to be my expert knowledge, opinion, or recommendation.

6.0 Results

This section summarizes the most important topic areas, organized into four major theme areas based on challenge types or aspects: 1) human, 2) ecological, 3) scientific, and 4) policy and practice. For brevity, references were not included in this section. Readers can consider all the statements to be supported by the author and can refer to the more detailed report for a full list of references.

6.1 Human Aspects of EBM

6.1.1 What is EBM?

Exposure to and understandings of what EBM means vary widely. Many people have never heard of EBM as a forest land management approach. Others have moderate to high EBM knowledge, but there are significant differences of opinion about details. Consistent with what the HLP learned in the EBM Dialogue Sessions project, support in principle for EBM is generally high but EBM can mean different things to different people, suggesting that support is conditional. EBM "version conflict" can be a challenge, where people use their version of EBM to advocate for their values relegating EBM to just another value added to the growing collection.

EBM implementation is being hindered by the lack of knowledge and consensus about what EBM is.

The opportunity in all this is to capitalize on widespread support in principle for the EBM concept. Multi-stakeholder/partner discussions could start with identification of common ground from which to build.

6.1.2 EBM is a Big Idea

EBM is a comprehensive approach to managing forests that is very complex and attempts to 'juggle all balls at once'. This is a challenge because people find EBM difficult to understand and tend to recoil from the complexity and the size of the challenge. In response they tend to default to familiar values and practices. This suggests opportunities to frame EBM in understandable big-picture terms (all of the balls moving at once), and also to break down the elements and aspects into bite-size pieces (each ball) that are easier to understand. The EBM wheel suggested by Andison (2020b) breaks down EBM into 12 elements and represents a new tool that begins this process.

6.1.3 EBM Value Propositions

A *value proposition* is a promise of benefit(s) to be delivered, communicated, and acknowledged. In relation to EBM, successful value propositions should convince people interested in forest land management that EBM will be of more value to them than the status quo. An EBM value proposition answers the questions "*What's in it for me*?", or "*Why should we change?*". One of the largest EBM challenges has been a lack of persuasive value propositions that could further uptake of EBM. Value propositions need to be couched in terms that people are familiar with. For example, show how *old forest* will be better conserved through an EBM approach than through current approaches.

In theory EBM offers some attractive elements that could be improvements on existing planning and management goals, or even provide robust, science-based solutions to some of the complex problems of today. The objective is to build diverse, informative, and compelling value propositions that show what EBM is and how EBM can improve forest management to address known and future challenges.

There has been considerable progress in exploring and implementing EBM thinking and concepts in both Alberta and Saskatchewan. The opportunity is to develop specific engagement, communication, and dialogue processes designed to solicit and openly discuss value propositions more generally as a critical starting point.

6.1.3.1 The Economics of EBM

A key part of any value proposition is that the net value of ecological integrity and human wellbeing must be economically attractive, including both provisioning and non-provisioning goods and services. A major challenge to this is the lack of clear and understandable links between ecological integrity and ecosystem services. Traditional methods of gauging the economic value of management initiatives are focussed on physical goods and services that can be financially valued. It is far more challenging to devise comparative values for other aspects of natural systems.

At present there are no known assessments that attempt to value and compare the *status quo* approach to forest management with potential EBM approaches. The opportunity exists to do this within the HLP which would be very informative in deciding whether to pursue EBM.

EBM implementation costs must be realistic and affordable. A major challenge will be to find ways of redeploying resources to achieve outcomes — EBM is being added to everything else, which adds new costs that aren't being matched by elimination of previous costs that are no longer needed. A general recommendation would be to develop an options paper that shows the possible cost benefits of sub-regional EBM planning that could come from concentrating resources reallocated from multiple disconnected planning processes into a single comprehensive area-based EBM planning process.

There are also opportunities to reduce costs through better integration. For example, an Alberta pilot project estimated that coordinated road planning between forest and energy sectors could reduce overall roading and associated costs by at least 40%.

There may also be opportunities to share costs and increase funding for EBM implementation through improved use of non-standard economic instruments such as partnerships, payments for services, market creation (e.g., carbon offsets), compensation offsets or banks, and others. In support of this, there are opportunities for value propositions that identify both positive and negative aspects of both current approaches and the EBM alternatives. If propositions provide persuasive logic for why EBM approaches are as good, or better, than existing approaches, they are more likely to be understood and supported.

6.1.3.2 Economic Wood Supply

There is little question that the forest sector will be affected by EBM implementation. Impacts are likely to be regionally uneven due to regional industry processing needs versus wood supply, which vary considerably. Economic wood supply is essential to support forest products companies. Each forest management company has specific needs for wood in terms of tree species, quantity, and quality to each processing facility they own, at a maximum delivered wood cost for business viability. The forest management sector is highly integrated, with multiple business arrangements among companies to buy and sell wood fibre to get the right product to the right mill at the right time. Over time, the balance between economic wood supply and processing capacity is maintained or altered by the wood supply itself and other (often external) economic factors such as global market prices.

Current harvest levels (Annual Allowable Cut, or AAC) is determined using a model of maximum sustained yield, calculated using estimated growth and yield curves. In some areas of Alberta there are concerns about economic wood supply for a variety of reasons. As there are currently no FMPs with AAC determinations that follow “full” EBM principles, the potential effects on existing AAC and industry viability related to economic wood supply could include both negative and positive effects on both quantity and cost. The barrier is the lack of fully integrated EBM packages that reconcile negative and positive effects on economic wood supply.

6.1.4 Building Trust Relationships

EBM is a large, complex paradigm with many diverse participants and interested parties aggregating information from many sources. EBM does not necessarily resolve inherent conflicts over forest management, but it does offer space to discuss them openly and look for less contentious outcomes. This aspect of EBM provides opportunities for conversations about trust and what might be done through EBM to build trust. Successful EBM implementation requires cooperation and collaboration among stakeholders across social, political, jurisdictional, and natural boundaries. Collaboration depends on relationships based on trust. As the HLP EBM Dialogue Sessions found, low trust is a critical EBM challenge.

Widespread conservation conflicts that generate mistrust are intensifying as a result of growing pressures on natural resources and concomitant demands by some for greater accountability. Societal levels of trust in government, institutions, and other trustees have been declining for many decades. Multiple, complex goals and disconnected governance and planning coupled with increasing human

pressures lead to forest policy debates characterized by contention and competition, which are strongly associated with mistrust and distrust. Low levels of trust in public land management agencies and minimal space for public involvement create perceptions of a closed policy process that is dominated by industry and/or government and provides minimal space for other interests. The challenge is to expand policy networks to be more inclusive, transparent, and fair.Few groups or individuals fully trust the information they get on forest management, regardless of the source. The opportunity is to provide reliable and trusted forest information from trusted sources, and EBM that sets integrated targets and achieves them.

Trust-building requires effort and resources and opportunities for respectful dialogue among stakeholders. Effective communication and attention to perceptions and attitudes of local stakeholders helps build trust. A possible first step would be to review existing stakeholder communication platforms in each province that could be used to identify opportunities to increase EBM communication. This could include targeted communication and follow-up outreach to particular actors where increased trust is needed to implement EBM.

There are also opportunities to begin rebuilding overall trust levels through EBM implementation. One opportunity might be to develop messages about how EBM is delivered through land use regional and sub-regional plans with quantitative targets and adaptive management feedback loops that could be used to gauge performance and help to build trust as people see that objectives are being achieved.

6.1.5 Building Partnerships

EBM strives to be comprehensive by including and reconciling all ecological and human wellbeing aspects for whole landscapes. This requires partnerships among people and organizations with an interest in forest landscapes to work together to define and implement EBM within management units and with neighbours over larger ecological regions. Successful collaborations often develop from sustained long-term relationships with strong two-way commitments.

One of the associated challenges to EBM is that the current governance system(s) divides ecological values and their respective management systems into “silos”, with separate regulators, clients, and planning processes. Government levels and agencies have difficulty cooperating with each other. At the same time, companies within the various land management sectors compete with each other. This means that while business arrangements may be common, each company acts in its own interests and has little incentive to collaborate with others towards shared (in this case ecosystem-based) goals.

Challenges to participation in greater levels of partnership efforts include limited time for active participation, indifference to the issues, inadequate resources to support involvement, and misgivings about the intent of some participants (trust). The tendency for governments to consult, but not partner, with non-government organizations is also a significant challenge.

There are many good examples of partnerships that have formed for projects and to address common interest issues that cannot be resolved individually. Subregional EBM plans and access management are two EBM aspects that provide opportunities for cross-sectoral partnerships.

6.1.6 Managing Risk and Uncertainty

There will always be unpredictability about complex social-ecological systems. The challenges break down to recognizing and managing risk, uncertainty, ambiguity, and ignorance. EBM is a risk management approach that aims to reduce risks that rise from failing to maintain the natural world and the negative effects that would have on humans.

One of the greatest challenges in decision making includes recognizing uncertainty, making good decisions in the face of uncertainty, and reducing uncertainty where possible.

The challenge is to overcome reluctance to act based on the premise that the *status quo* is the preferred state and reform is less desirable. There are opportunities to compare current management with EBM, weighing options and don't assume that only perfection is tolerable. Scenario planning in subregional EBM plans is a good way to explore uncertainty and compare risks.

EBM risk assessment evaluates the probability that a particular management action will have an adverse impact on some component(s) of ecological integrity and, concurrently, on some component(s) of human wellbeing. There are opportunities to use risk assessment to evaluate both short- and long-term risks.

While EBM is unlikely to resolve all current challenges, it recognizes and addresses many of the shortcomings of the current forest management planning framework. Although work is progressing, definitive scientific verification of the many possible positive conceptual claims associated with EBM is in its early stages.

6.1.7 EBM Champions

Adopting EBM in principle is not the same as accepting and adopting EBM in practice. The *status quo* systems and frameworks for how forested land is managed have been in place a long time. Making changes to these institutions reflect many challenges, especially when it involves pressures related to conflicts and events such as natural disturbances.

People and organizations as change catalysts are both challenges and opportunities for future EBM implementation. The challenge is to identify and develop EBM champions who have the ability to recognize and lead change when conditions for change are favourable.

Organizations interested in EBM often already have EBM champions. Recognizing these people and providing support for their interest is an opportunity to benefit from and grow existing resources and capacity. Mandates and resources to pursue EBM are powerful tools to capitalize on this leadership. Efforts to improve participation of Indigenous Peoples in resource management will likely identify and develop additional EBM champions. More leaders, and more support, can also come from engagement at the community level, with EBM voices that people trust.

There are opportunities to promote EBM by engaging with initiatives that arise from conflicts, events, or progressive improvement, and communicating how EBM could assist or improve the initiatives. For

example, ongoing land-use and caribou landscape planning initiatives in both Alberta and Saskatchewan are EBM opportunities.

6.2 Ecological Aspects of EBM

6.2.1 Adopting an NRV Strategy

One of the key foundations of EBM is an understanding of natural patterns, including how they change and are sustained over time (Andison 2020b). This foundation recognizes that all forests change over time within measurable and predictable ranges that repeat over time within a Natural Range of Variation (NRV). One of the main tenets of EBM theory suggests that maintaining ecological aspects of forests within or closer to NRV over time is most likely to sustain ecological integrity and the capacity of ecosystems to support themselves and human wellbeing.

An NRV strategy manifests itself for managers and regulators as a tool (i.e., natural pattern knowledge) with which to inform the process of identifying indicators and setting targets for future forests.

Experience suggests that most people quickly understand the NRV concept when it is explained, and support management objectives with NRV in mind. However, as previously noted for the definition and application of EBM, the challenge in this case is uneven interpretation and uptake of the NRV strategy concept. Some question the degree to which NRV should be used to inform target-setting considering how much natural forest ecosystems have been altered, coupled with an uncertain future. Others support NRV strategies in principle but balk when it translates into change to their backyard (the NIMBY effect). Still others support specific NRV elements they like and oppose those they do not (i.e., cherry picking).

Incorporation of the NRV concept into commercial forest management in Alberta and Saskatchewan is well underway, but application has suffered from the tendency to crowd NRV considerations into existing management frameworks that retain requirements that contradict incorporating NRV into planning and practice.

In most situations, managers have opportunities to incorporate more NRV considerations in planning to gain incremental EBM improvements where NRV is not already being used. Using NRV as an EBM foundation can also offer opportunities to explore differences in interpretation, identify uncertainties, and inform decisions that incorporate adaptive management to reduce uncertainty. Other opportunities include building understanding of NRV through research and communications. Careful consideration and clear statements of how NRV is to be used, or not used, in policy and management would also be helpful.

6.2.2 Creating an Ecological Integrity Baseline

Humans depend on the sustainable provision of goods and services within the capacity of the natural world to sustain itself. This imperative is recognized in forest management governance through requirements for sustained yield of biological and ecological goods and services.

EBM opportunities lie in communications and examples that show how both current management and EBM aim to conserve ecological integrity and support human uses, and that choices lie in deciding the appropriate balance. In both cases, choices are limited by the imperative to sustain natural capacity. EBM has the additional advantage of starting with comprehensive natural capacity and then managing human uses to be more effective and efficient. These opportunities may lead to better societal understanding about EBM as an approach to improve overall outcomes.

6.2.3 Understanding and Integrating Disturbance

The boreal forests of the world, including those in Alberta and Saskatchewan, are not like the temperate rainforests of British Columbia where trees can live for 500–1000 (or more) years and forest structure and composition changes very slowly through infrequent gap-dynamic processes. Change is a more dynamic process in the boreal forest, and the dominant natural disturbance is fire. Historical fire activity in the study area occurs every 30–250 years, the vast majority of which is between 50–100 years. This means that very few areas are undisturbed long enough for trees to die of old age (Andison 2020a).

Alberta and Saskatchewan forests are a continually changing mosaic of different aged patches with age combinations dependant on mortality caused by fire (natural and human-caused) and the time between disturbances. Many other disturbance processes also occur and contribute to the mosaic. Many Alberta and Saskatchewan forests with altered natural disturbance regimes (mainly cessation of Indigenous burning and wildfire suppression) and increasing levels of human activities and footprints are showing increasing divergence from natural forest variability.

The primary EBM challenge associated with this topic is achieving social acceptance and support for management that embraces the need for disturbance as the key to maintaining dynamic forests for ecological integrity over the long term of natural ecological cycles. Some people resist, misunderstand, or mistrust claims of dynamic ecosystems. This is particularly true at local scales and over the short term due to effects on personal livelihoods and values. There is also a tendency to focus on the undesirable short-term effects of disturbance and to compare disturbed forests to undisturbed mature or old forests. The notion of disturbance as a source of many potential positive ecological benefits requires continual reinforcement.

EBM provides opportunities for conversations about the ecological need for change, the roles that natural disturbances play, and prospects for maintaining disturbance rates from both natural and human disturbances that create and maintain healthy forest landscapes.

6.2.3.1 Wildfire

Fire is a foundational ecological disturbance and agent of change in fire-adapted forests. Boreal species need periodic fire to maintain long-term viability, productivity, resilience, and diversity. Natural levels of

fire activity help to organize landscapes and ecosystems, ensuring ecological integrity at larger scales even as change occurs at local scales.

Despite the critical, mostly positive, ecological role of fire, humans have a love-hate relationship with forest fires. Fires can be very destructive to human values including life, health, and property. Societal views of the destructive nature of wildfire are reinforced by concerns about the health effects of smoke and increasing calls to protect forests and plant more trees to increase carbon storage and battle climate change. This perspective is a major challenge to EBM, which seeks to maintain fire as an appropriate ecological process. Humans have a love-hate relationship with forest fires for good reason. Fires can be very destructive to human values including life and property. On the other hand, fire and cultural burning supported Indigenous peoples. Today many people tend to view forest fire in terms of whether it can be prevented or controlled. These views are strengthened by concerns about the health effects of smoke and increasing calls to protect forests and plant more trees to increase carbon storage and battle climate change. This is a major challenge to EBM, which seeks to maintain fire as an ecological process.

To address fire threat, Indigenous use of fire was largely replaced with aggressive suppression of wildfires as the dominant Provincial policy in Alberta and Saskatchewan forests. Timber harvest partially replaced wildfire in commercial forests but only on part of the landbase, and prescribed fire partially replaced wildfires in protected areas, especially National Parks. Despite best efforts, wildfires continue to escape initial suppression and have had devastating impacts to human values when they do. Overall, the combined rate of fire and harvest has fallen behind the historic rates of fire, and this has changed forest age composition (towards older forest) with associated ecological effects and increasing risks from wildfires.

The EBM opportunity is to find ways to manage fire to obtain ecological benefits and reduce future risks of unmanageable fire. EBM can be a gateway to solve the challenges created by long-term wildfire suppression and societal aversion to fire. An initial step could be to prepare an overview document that describes the current situation, future challenges, and potential opportunities.

6.2.3.2 Floods

Floods are natural climate-mediated and weather-driven events that are influenced by watershed conditions. Floods fit the classic definition of a disturbance in that they are short-lived, intense, and local. Floods help to organize aquatic ecosystems and associated riparian ecosystems through hydraulic erosion and structuring of physical environments that support both aquatic and terrestrial biodiversity over the long term. Over long periods of time (i.e., decades to centuries), flood events occur in repeating cycles that define natural flow regimes.

Similar to forest fires, societal views about floods tend to be negative. Floods can and do destroy or damage human infrastructure and they can have negative short-term effects on aquatic ecosystems and biodiversity. Yet they also provide significant positive ecological benefits to aquatic ecosystems.

A potential first step towards addressing this challenge would be to pilot a number of medium-sized watershed EBM plans that are fully integrated with all activities and ecosystems.

6.2.4 Integrating Variation

In general, EBM strives to maintain natural ecological variation in forests to reduce risk and maintain resilience. An NRV strategy tries to meet Aldo Leopold's 1949 *first rule of intelligent tinkering*, which is to keep every cog and wheel that we observe in forests by trying to maintain complexity consistent with natural variation.

Federal, Provincial, and related forest management legislation, policies, and other regulatory requirements have historically tended to be simplified, specific and usually inflexible. Rules reduce the flexibility with which forestry activities are implemented, challenging the EBM objective to maintain variation in forestry outcomes. Most current management frameworks do not consider variation to be a desirable objective. They deliberately *reduce* variation, especially for large natural disturbances (e.g., fire suppression, flood prevention), but also for human disturbances (e.g., cutblock size, proportion of area harvested). The challenge is to build variation into EBM related planning, management, and monitoring indicators and targets.

The innovative nature of NRV integration means that both Alberta and Saskatchewan have a relatively flexible framework in terms of compliance to NRV, and variability in particular. This flexibility is an opportunity. Both provinces offer opportunities for forest companies to propose alternatives to minimum government standards in their forest management planning standards and their operating rules and have been willing to entertain plans that incorporate targets with variation over time. This caveat provides an opportunity to promote greater use of alternatives and plan-based variation through dialogue and innovation.

6.3 Scientific Aspects of EBM

6.3.1 Knowledge and Information Acquisition

The success of any robust management framework depends on complete, up to date information. Many of the information needs to support EBM are relatively new, and the current knowledge portfolio can be disconnected and divided among actors. While there exists a strong foundation sufficient to support EBM in most areas, it is geographically sporadic, and incomplete. Data ownership and access is also a substantial challenge. Opportunities include cooperative agreements among data owners to make key information accessible while respecting ownership. Significant advances in technology including data technology like LiDAR and GIS are opportunities to support EBM needs in the future.

Knowledge generation is also highly variable depending on the location and subject area, and tends to be driven by variable funding, local issues and priorities, regulation, established relationships, and the targeted interests of funding agencies and research institutions. Generally speaking, the existing research breadth and depth in Alberta and Saskatchewan, as well as current research agendas of many

Federal funding initiatives, are opportunities. It may also be possible to develop a strategic framework for EBM research that could be used to help coordinate EBM research, fill gaps, and secure long-term funding. Existing research partnerships such as ABMI, COSIA, EMEND, and fRI Research are good examples of institutions on which to build on and use to leverage new initiatives. Models such as the Alberta FRIP program that provide ongoing research funding could be reviewed for potential extension to other sectors and jurisdictions.

6.3.2 Monitoring

EBM requires setting quantitative targets for both ecological and human wellbeing indicators and specifying both actions and outcomes that are needed to achieve those targets across whole landscapes. Current management is primarily focussed on activities and to a lesser extent on targets, and monitoring is uneven and divided between institutions. Adaptive management (AM) is the current standard for comparing predictions to outcomes towards implementing changes designed to improve future EBM performance. Although there are some good examples of adaptive management, it is often assumed to be daunting, expensive, and risky by both government and industry. This sentiment is exacerbated by the fact that monitoring costs are not always evenly shared among the appropriate companies and agencies.

Adaptive management may be among the most challenging EBM challenges because it requires a substantial degree of organizational change, trust, and partnerships. There are opportunities to improve communication about what adaptive management is, the risks of not doing it, and the benefits that can be gained through thoughtful outreach and dialogue. Cooperative EBM planning provides opportunities to coordinate and focus monitoring and assessment on the most important aspects.

6.4 Policy Aspects of EBM

6.4.1 Legislation and Policy Framework

Current legislation and policy frameworks were developed over many decades, with pieces often developed in isolation of other, related legislation and policy. When taken as a whole, they tend to be a confusing array of terms and interpretations that sometimes do not provide clear or integrated direction to forest land managers.

Although government legislation and policy frameworks have not been developed with EBM in mind, there are many elements and aspects that are compatible with EBM principles. The clauses typically allow alternative proposals to standard requirements that may be used only with special review and approval. While rarely used today, these variance clauses could be very useful EBM tools if proponents and governments are willing to consider applying them. There may be opportunities to build persuasive partnership proposals for EBM innovation through variance approvals, perhaps on a research, demonstration, or pilot basis.

6.4.2 Forest Governance

The current governance system to managing forest resources in Alberta and Saskatchewan is organized around separate and disconnected human values and interests. With few exceptions, whole forest landscapes are not managed for shared and reconciled ecological and human wellbeing outcomes; values and pieces are managed separately through different institutions. Governments have historically controlled and constrained human activities using regulations, with multiple governance agencies and their clients each with unique institutions and rules to maximize the values they have responsibility for. New knowledge, pressures, and societal norms are typically incorporated into the same basic system by adding more rules to those already in place. This ignores the variable nature of the system to which it is intended to serve, and challenges EBM options to identify optimal solutions for multiple values. The governance system is a monumental challenge to EBM. Changing governance structure is likely beyond the scope of EBM and its supporters. The more tractable challenge is to improve process integration to improve management effectiveness and ecological resilience.

Another challenge to EBM is the nature of the relationship between long-term decision-making and politics. EBM is a long-term commitment with associated long-term plans. In contrast, International, Federal, and Provincial / Territorial Governments traditionally have difficulties implementing long-term programs given regular turnover of elected leadership and many senior staff. The result is often decisions based on short-term outcomes that avoids risk and maintains the status quo, which ultimately erodes efforts to coordinate, integrate flexibility, and manage for natural ecosystem dynamics.

Both provinces have incorporated some EBM elements into their forest management planning standards for commercial forests and Saskatchewan is now beginning to implement EBM for provincial protected areas. Overall EBM goals (i.e., ecological integrity, health, and resilience; human wellbeing) are widely accepted and incorporated into high-level policy in both Provinces. Federal and most Provincial governments have endorsed EBM as a policy direction. These are all huge opportunities to build upon.

6.4.3. EBM Planning Levels

6.4.3.1 Protection Vs. Exploitation

Forest land management is often framed as a choice between (value-based) concepts of *protection* and *exploitation*. In reality the line between the two concepts is often blurry. Protection is often interpreted as protection from some human impacts (e.g. timber harvesting) but not others (e.g., fire protection). Exploitation is often interpreted as either the conversion to other ecosystem types and uses (e.g., fringe forests being converted to agriculture), or widespread extraction of goods and services (e.g., forest harvesting). However, protected forests can, and do, have areas with intense human use, and exploited forests often have significant amounts of intact ecosystems.

The EBM challenge is to move dialogue and land use decisions from black and white protection or exploitation framing toward the rich complexity and possibility available through EBM, where all forest landscapes and ecosystems contribute to ecological integrity and human wellbeing in their own ways.

With this as context, an EBM challenge is that the current land management dialogue and regulatory system is often framed and/or perceived in these black and white terms (i.e., protection vs. exploitation). In contrast, EBM presumes landscape ecosystems are managed not in pieces, but as wholes where all forest landscapes and ecosystems contribute to ecological integrity and human wellbeing in their own ways.

EBM is concerned with managing for both ecological integrity and human wellbeing across a gradient of human uses from a very light human touch to a heavy hand, with the balance reflecting the land use decisions made by governments.

EBM opportunities arise at two levels. The first level is to frame and inform land use decisions about the relative proportions of forest to be protected versus available for other human uses. Although it is very challenging to change land use designations, land use plans are the place to do it.

The second level is to use EBM to inform decisions to achieve the best balance between ecological integrity and human wellbeing considering the land use designations that have been made. This can improve management to be more effective and efficient considering the mix of allowed human uses.

6.4.3.2 Land Use Planning

Provincial land use plans affirm or change existing land uses at large scales, designate new land uses, and provide direction to lower planning levels, including management of defined forest areas with specified allocations or uses.

A linked system of integrated plans of increasing detail for outcomes and activities is needed to implement EBM. Land use plans based on EBM have great potential as innovative processes to improve decision quality and reduce conflict.

Alberta and Saskatchewan both include various EBM aspects in their land use planning process and decisions. Neither province has specifically embraced EBM as a land use planning foundation paradigm or incorporated an EBM implementation framework into their land use planning processes.

The Alberta Land-use Framework (LUF) envisions seven regional plans that cover the province plus sub-regional plans that are based on individual values and activities not included at larger scales. The Alberta LUF covers the entire province but original timelines to complete regional plans by 2012 were not met, and regional plans have not been completed, due largely to a shift in political vision (see 6.4.1 above).

Persistent resistance from some actors, changing political leadership, and external events have prevented the process from achieving completion targets. Saskatchewan's land use planning system also covers the entire province in concept, but not in application. Saskatchewan does not currently have a plan to complete land use plans for the entire province and the land use planning process is largely inactive.

In summary, land use planning exercises have had mixed success, largely because they can become a political process dominated by government agencies and economic actors. Provincial governments have opportunities to pioneer innovative land use planning by reinventing how land use plans are developed and implemented through EBM. Discussion and concept papers describing how land use planning is currently done in each province and options to use EBM to strengthen them would be useful to support societal review and recommendations about how to improve and reinvigorate land use planning.

6.4.3.3 Sub-Regional Planning

A central tenet of EBM is that ecological integrity is associated with relevant ecological units using a whole landscape approach (i.e., includes all ecosystem pieces) over time. *Place* recognizes the unique ecological characteristics of landscapes and *time* recognizes that natural ecosystems are dynamic and change in response to disturbances and other processes. Human wellbeing is also linked to place and time, which forms yet another overlay on the place-time model. The ideal place to integrate all ecological values and human uses over time to capture and discuss possibilities of imaginable future forests and uses is within in a sub-regional plan. Planning and management integration in place and time is one of the biggest EBM challenges.

Alberta, Saskatchewan, and the Government of Canada (via National Parks) all have (different) versions of sub-regional plans, but they all fall short from an EBM perspective. For example, Provincial protected area management plans do not set targets for long-term sustainability or activities to achieve them. Provincial Forest Management Plans (FMPs) are the closest thing to a sub-regional plan in form, but technically fall under the purview of sub-regional plans (see next Section). However, FMPs still provide some useful tools and protocols that could be borrowed (see below). The biggest challenge to sub-regional EBM planning, in concept and action, is overcoming resistance from established government-client arrangements that hinder policy reforms towards more integrated frameworks. Area-based subregional EBM plans provide perhaps the single biggest EBM implementation opportunity in Alberta and Saskatchewan. For example, protected areas and commercial forest tenures already have managers that prepare area-based management plans that could potentially be transitioned to comprehensive and collective EBM plans. These are more likely to succeed if they are directed by higher-level policies and land use plans. A good first step could be to develop one or more concept papers that includes all of the potential aspects and processes to be included in EBM planning, and the associated value propositions to society and established governance/client arrangements and actors.

A related and potentially parallel opportunity could be to pilot several sub-regional EBM plans to demonstrate the concept and test processes prior to widespread implementation. Pilots could be done on a volunteer basis and piggy-back on scheduled revisions of FMPs and park management plans to increase efficiency and provide partial funding and capacity. Pilots could also leverage or piggy-back on current strategic intergovernmental initiatives such as the Pan-Canadian Approach to Transforming Species at Risk and the recent Species at Risk Act Section 11 Agreements for caribou recovery with both AB and SK. The agreements support or require area-based planning and could be joined to or transitioned to include greater levels of EBM perspectives.

6.4.3.4 Commercial Forest Planning

The current primary management objective for commercial forests is to produce maximum sustainable timber harvest to supply processing mills. Other human uses (e.g., Indigenous cultural, recreation, energy sector development, trapping) are accounted for often as constraints. In practice this creates a planning process where managers attempt to maximize annual allowable cut (AAC) while meeting external constraints for environmental, societal, and ecological values. The forest management tenure system also divides the landbase into two major classes; *active* (will be logged) and *passive* (will never be logged). Forest companies are responsible for establishing, growing, and harvesting timber on the active landbase. Government agencies are responsible for the passive landbase and non-timber resources and values on the active landbase. This divided responsibility model makes EBM a challenging goal from a strategic planning perspective. Depending on the type of tenure, forest companies or government agencies prepare long-term forest management plans that forecast harvest over a 200-year period to determine a sustainable AAC. Other indicators are also forecast including some EBM ecological indicators. However, forecasts do not set targets for whole landscapes, all human uses, or a full suite of EBM indicators.

The greatest EBM opportunity for commercial forests is to find ways to revise planning processes so they are comprehensive, involve all uses, and, through partnerships, set targets for all EBM indicators. I believe that there are two possible paths. The first is to revise the FMP process, and the second is to replace it with subregional EBM planning led by governments. A good first step would be a concept discussion paper that describes the intended planning outcomes and process options to achieve outcomes.

One opportunity for commercial forest tenure holders interested in integrating more EBM principles would be to design and support pilot projects that explore the potential for voluntarily expanding the current FMP processes through partnerships to produce FMPs that more completely achieve EBM ideals. These would require at least a minimum partnership between forest companies and government agencies to develop a Terms of Reference and agree to proceed. Synergies could be captured by aligning with scheduled FMP revisions. Pilot studies could be established in both provinces.

Other opportunities include further implementing smaller pieces of the many EBM principles through individual projects and processes at multiple scales. Examples include mixedwood management, regional access planning, harvest event planning, whole landscape planning, riparian management, and forecasting energy sector development. Some precedents for some of these exist today on which to build.

6.4.3.5 Protected Area Planning

Protected area forests are administered by Parks Canada (National Parks) and the Alberta and Saskatchewan governments (e.g., Provincial Parks). Many National parks now claim to be managed according to EBM principles, most notably including a system of "*ecological integrity*" indicators, many of which are EBM friendly. While National Parks and some Saskatchewan Provincial Parks areas use some EBM principles as their guide, protected area managers are still not directed by policy documents

that speak specifically to EBM and/or how they might use EBM as their approach to manage for ecological integrity. Management plans are in place for larger protected areas but most are heavily oriented towards short-term activities and have relatively few outcome targets. Another challenge to implementing EBM in protected areas is that protected areas funding is a perennial challenge. Good intentions aside, some parks do not even have the resources to create management plans.

Overall, NRV is not currently being widely used to inform management planning and targets within most protected areas in Alberta and Saskatchewan. Wildfire suppression is still common in protected areas with high levels of human use and more infrastructures to protect, and prescribed fires have not matched historic wildfire rates, which are pushing the amount of mature and old forest beyond historic levels. Active management of disturbance processes in protected areas is increasingly seen as necessary to maintain ecological integrity. The opportunity is for managers to fully embrace disturbance as a management objective and to develop management plans that include disturbance plans and targets.

Protected area managers have the advantage of management control over most ecosystems and uses and can use this built-in integration to develop and implement EBM plans. An initial opportunity would be to review their current policies and processes to identify improvements.

6.4.3.6 Non-commercial Forest Planning

Alberta and Saskatchewan both have large areas that are not allocated to any form of forest industry tenure. Such areas tend to be sparsely populated, consist largely of low productivity forests without commercially-valuable timber, and a lack of forestry infrastructure and distance to markets.

There are several EBM challenges associated with non-commercial forests. Non-commercial forest areas are generally not included in any form of management planning, let alone area-based EBM plans. Management responsibility is divided among government agencies. Indigenous Peoples comprise the majority of the population in areas dominated by non-commercial forest, but have relatively little forest management decision-making authority. Finally, some non-commercial areas have been protected from all forms of disturbance for several decades, which has potentially created a significant seral-stage imbalance relative to NRV.

There may be opportunities for innovative EBM partnerships for non-commercial forest areas among provincial governments, Indigenous Peoples, and other interested parties. As first steps, governments could initiate discussions that include EBM considerations and scenarios with Indigenous Peoples.

7.0 Next Steps

This report, combined with the more detailed online report https://friresearch.ca/ebm-challenges provides the raw research for the HLP and others to create a more synthesized, structured, and specific set of guidelines to identify and overcome EBM challenges. These provide alternatives for the greatest reward at the least cost, with important, long-term initiatives. This report, and the associated web

content, represent critical raw materials towards addressing the challenges of EBM, and are thus invaluable on their own.

However, the intent in this case is to take the output from this project to the next level and move towards if and how we might collectively shift towards EBM in a specific and meaningful way.

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