Ecosystem Based Management Challenges for Alberta and Saskatchewan Forests: *Introduction and Methods*

Introduction and Methods

fRI Research Healthy Landscapes Program

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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.

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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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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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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.

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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.

The material presented in the documents on this webpage represent the final output from the author organized into six logical classes. Note that there is also a shorter summary report available also for reading and download on the webpage.

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 includes recommendations from the author, the main focus of this phase of the project was to generate a comprehensive information atlas of EBM challenges as a foundation. The HLP partners will determine the details of the next phase (but see Section 6).

2.0 History of EBM

(Excerpt from Andison 2020)

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, parks, for example).

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,

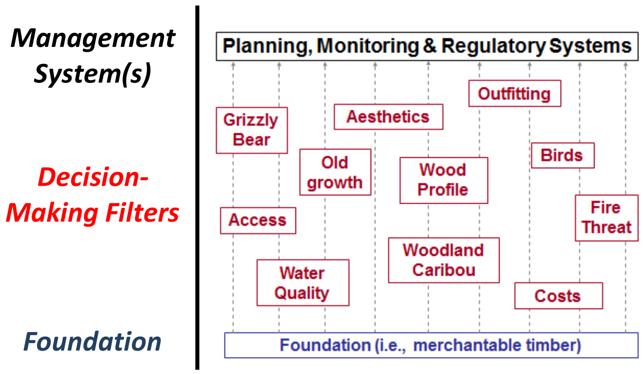

Figure 1. Generalized natural resource management process.

predictable, and balanced in the absence 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 largely 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 for positive change. 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 conflict 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 implementation 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 absoluteness (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 an EBM journey look 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 destination, 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, the definition above will be used in this report.

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 (see Appendix 1 at https://friresearch.ca/ebm-challenges) was reviewed for aspects that relate to EBM.

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 the author's 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 Next Steps

The material presented in the documents on this website represents critical raw materials towards addressing the challenges of EBM, and are thus an invaluable resource. The ultimate deliverable for this initiative is a roadmap for managers on what EBM elements can be advanced, using what types of actionable opportunities, and at what levels of risk and cost. The materials presented here provide the foundation for that deliverable. The next step will be to sort, synthesize, identify, and rank specific opportunities.

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