Provincial Government Standards, Criteria, and Indicators for Sustainable Harvest of Forest Biomass in British Columbia: Soil and Biodiversity

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Abstract

Sustainable forest management (SFM) is a cornerstone of forest management, whether the resulting forest products are destined for the manufacturing sector or for the emerging bioenergy feedstock market. In British Columbia, research on the environmental effects of forest management has generated scientific knowledge that has informed two linked areas of government responsibility:

1) a comprehensive set of science-based regulations and policies to ensure soil and water conservation, and
2) a monitoring program to ensure the effectiveness of these regulations and policies.

An increasing amount of biomass is being harvested from British Columbia's forests as a feedstock for bioenergy, and these removals have the potential to incrementally increase machine traffic and organic matter removals from forest sites, compared to harvesting operations focused solely on roundwood for timber or pulp. To the extent that existing standards support SFM, they may be sufficient for ensuring that biomass harvesting is also sustainable. Regardless of the new challenges created by intensive harvesting practices, the principles of soil and biodiversity conservation remain the same. The current framework for BC's SFM policy is reviewed to examine whether it addresses the major sustainability issues that are likely to arise in the province if intensive biomass harvesting becomes more prevalent. We conclude that intensification of biomass removals will require us to keep focused on stand and landscape sensitivity to coarse woody debris removals and biodiversity requirements, nutrient removals, and cumulative soil disturbance.

Keywords: regulations, soil conservation, biodiversity, forest biomass harvesting, mountain pine beetle.
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Background

The Canadian province of British Columbia has an area of 95 M ha, two-thirds of which is forested. Ninety-five percent of the forested area of the province is publicly owned Crown Land managed by the Ministry of Forests, Lands and Natural Resource Operations and harvested under tenure or contract. Many decades of research into sustainable forest management have helped inform a comprehensive set of policies and regulations that address a wide range of social, environmental and economic issues affecting the management of public lands. Until recently, most forest products removed from public lands were used in the manufacturing sector, especially for producing solid wood products and pulp, and hence forest policies largely addressed the effects of management for those products. The widespread interest in the use of forest biomass for energy production has coincided with an unprecedented epidemic of mountain pine beetle (MPB; *Dendroctonus ponderosae* Hopkins; Figure 1), which began in 1994 in the province; dealing with the trees killed by the beetle is viewed by many as both a business opportunity and a way to address climate change. The British Columbia Energy Plan (Ministry of Energy, Mines and Petroleum Resources 2007) and recent Bioenergy Strategy (Ministry of Energy, Mines and Petroleum Resources 2008) estimate that nearly

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90% of the potential biomass resource in British Columbia is present on public forest land: 34% from MPB salvage harvesting and 53% from sustainable forestry. According to these reports, sustainable forestry would provide “residues from logging practices, road clearing and other forestry activities. Site preparation, early tree removal and tree stand establishment could increase forest residues and be a source of biomass.”

Figure 1. *Lodgeople pine killed by mountain pine beetle in the interior of British Columbia. Photo courtesy of Lorraine Maclauchlan © 2012.*

As of 2008, the MPB epidemic had affected 17.5 million hectares and killed 46% or 620 M m^3 of the mature lodgepole pine (*Pinus contorta* var. *latifolia* (Engelm. ex S. Wats.) Critchfield) in the province (Ministry of Forests, Lands and Natural Resource Operations 2011). There is an estimated 10- to 20-year period during which the dead trees can be harvested before they decay beyond a commercially useful state. Over the past two decades, increased mechanization and a focus on improving operational efficiency have led to a gradual evolution away from bole-only (cut-to-length) harvesting, to whole-tree harvesting (full-tree, bole + branches + top). As a result, non-commercial tree tops and limbs (logging residues) that previously were left on site in close proximity to tree stumps have been piled at roadside. For the past 20 years, policies have encouraged the burning of such logging residues to reduce the perceived fire hazard. Soil conservation policy also adapted to the changing harvesting methods, in part by specifying special requirements for roadside work areas where mechanized log processing occurs.

Recently, a number of government policies have encouraged the use of roadside logging residues as a source of feedstock for the generation of electricity or for the production of wood pellets, largely for shipment overseas. In response, the forest industry is developing new harvesting systems to gather material that was previously thought of as waste. As policy change has previously been catalyzed by innovation and the adoption of new harvesting methods, the stage is now set for evaluating whether forest biomass harvesting might require policy development to ensure that productivity, biodiversity, and other ecological values continue to be sustained.

Existing Standards and Monitoring

British Columbia’s Forest and Range Practices Act and Regulations provide for a results-based, forest and range management framework. Under the results-based model, government evaluates compliance with the law (Compliance and Enforcement Program, C&E) and evaluates the effectiveness of forest and range practices in achieving management objectives, including sustainable resource management (Forest and Range Evaluation Program, FREP). The results of both C&E and FREP monitoring provide feedback via the Chief Forester to potential modification of guidance and policy as needed (Figure 2). In this paper, we focus on FREP.

The forest policy realm in British Columbia includes the Forest and Range Practices Act (FRPA 2002), which has regulatory components that focus on criteria or objectives set by government. The complete set of objectives addresses: 1) soils; 2) timber; 3) wildlife; 4) water, fish, wildlife, and biodiversity within riparian areas; 5) fish habitat in fisheries-sensitive watersheds; 6) water in community watersheds; 7) wildlife and biodiversity—at the landscape level; 8) wildlife and biodiversity—at the stand level; 9) visual quality; and 10) cultural heritage resources. In this paper, we focus on the objectives for soils and biodiversity at the stand level.

In the Forest Planning and Practices Regulation of British Columbia’s Forest and Range Practices Act (FRPA 2004), the objective set by government for soils is: “without unduly reducing the supply of timber from British Columbia’s forests, to conserve the productivity and the hydrologic function of soils.” The practice requirements embedded in the regulations set limits for the area affected by soil disturbance and permanent access structures (e.g., roads), prohibit activities that cause landslides or gully formation, and require that natural drainage be retained and that soils exposed by road construction or deactivation be revegetated.

The objective set by government for wildlife and biodiversity at the landscape level is: “without unduly reducing the supply of timber from British Columbia's forests and to the extent practicable, to design areas on which timber harvesting is to be carried out that resemble, both spatially and temporally, the patterns of natural disturbance that occur within the landscape.” The objective for wildlife and biodiversity at the stand level is: “... to retain wildlife trees.” The practice requirements for wildlife and biodiversity set limits on the maximum cutblock size, the timing of timber harvest adjacent to another cutblock, and the amount of coarse woody debris (CWD) to be retained, and also require the retention of wildlife trees and restrict the timing of timber harvest from wildlife tree areas.

The adaptive management approach to sustainable forest management involves monitoring compliance with regulations and effectiveness of legislation, as well as researching the validity of underlying assumptions. In BC, this approach is

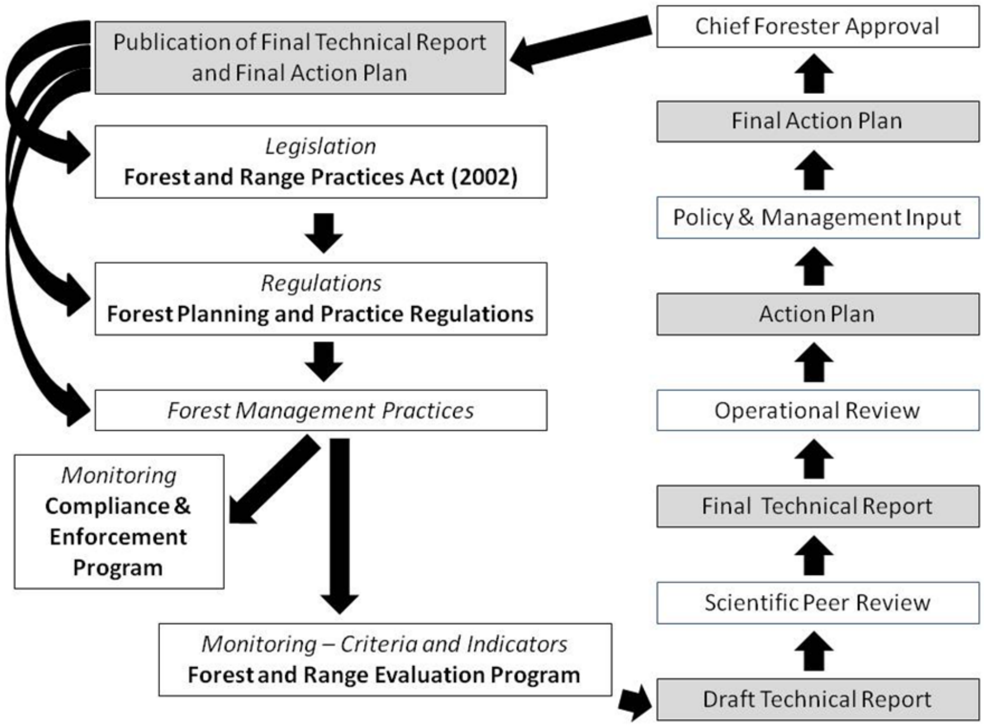

Figure 2. *Overview of the governance complex in British Columbia illustrating how the Forest and Range Evaluation Program provides scientifically and technically sound results that can feed back into modification of practices and guidance, regulations, or legislation.*

being used for defined resource values, such as forest soil conservation (Curran et al. 2005) and biodiversity. It is the responsibility of the Compliance and Enforcement Program of the provincial government to make sure forestry laws and regulations are followed, and to take action where there is non-compliance. Above and beyond enforcing existing laws and rules, however, government has also recognized a need to evaluate the effectiveness of forest and range practices in achieving the stated objectives. Therefore, the government of British Columbia has put in place the Forest and Range Evaluation Program (FREP 2011) “to evaluate whether practices under FRPA are meeting not only the intent of current FRPA objectives, but also to determine whether the practices and the legislation itself are meeting government’s broader intent for the sustainable use of resources.” FREP aims to accomplish this by: 1) evaluating the status or trends of resource and ecosystem values and determining causal factors; 2) determining whether resource values are being managed in a sustainable manner through proven or alternative forest practices; and 3) recommending options for changes to forest and range policies, practices, and legislation, where required. Research is a critical underpinning of BC forest policies; recognition of a need for further research is also a potential outcome of FREP monitoring. FREP monitoring for the criterion of maintaining soil productivity and hydrologic function involves assessing the status of five key indicators: 1) loss of productivity due to access construction; 2) landslides, erosion, and drainage diversion; 3) dispersed soil disturbance in the net area to be reforested; 4) green tree retention; and 5) retention of dead wood or CWD. Details of the monitoring program, from cutblock selection to data collected, can be found in Curran et al. (2009). FREP monitoring for the criterion of maintaining biodiversity (Province of British Columbia 2009) assesses six indicators: 1) green tree species and size; 2) live and standing dead wildlife trees; 3) invasive plants; 4) coarse woody debris; 5) windthrow of retained wildlife trees; and 6) wildlife tree retention patches are also anchored by important habitat features (e.g., high-value wildlife trees, mineral licks, or hibernacula).

Links to Policy

There are two main components of the process that links FREP monitoring with policy. The first is scientific and technical and includes the development and modification of the *monitoring program*, the development of a *draft technical report*, scientific and technical *peer review*, *operational review* from industry or government staff who would be implementing any proposed changes to practices, and production of the *final technical report*. The second component balances the scientific and technical findings and recommendations with social, economic, and political elements by taking the technical report though an *operational review* with industry, government policy specialists and Ministry executives, resulting in the development of an *action plan*. Before the final action plan and the final technical report are published, they must be approved by the Chief Forester, who is also responsible for the development and evaluation of forest practices legislation, and the determination of allowable annual cuts for most public forest land in British Columbia.

The first assessments under the FREP program were carried out in 2005. An early example that illustrates the link between FREP monitoring and policy development can be found in the recently published final technical report on stand-level biodiversity (Densmore and Nemec 2008a) and the associated action plan (Densmore and Nemec 2008b). Monitoring revealed that the density of long pieces (over 10 m) of coarse woody debris was much lower on cutblocks than in adjacent or in-block unharvested retention patches, and the action plan made several recommendations to address this discrepancy. As a result, a change in policy was developed that encourages a shift from thinking about unutilized woody material as logging "waste" to regarding it as dead wood with ecosystem values and thereby permitting a change in practice that allows more woody material to be left on logging sites where it can provide ecosystem services such as wildlife habitat, water retention, and energy for decomposer communities.

Forest Biomass Harvesting

A simple shift from forest harvesting for timber and pulp to harvesting of forest biomass to produce energy would probably not require development of new policies for ecological sustainability because existing sustainable forest management policy and regulations apply, regardless of the products made from the harvested material. With intensification, however, some modifications might be required. For example, excessive soil disturbance resulting from MPB salvage harvesting when the soil is too wet led to the publication of further guidance on soil conservation during MPB salvage harvesting (Berch et al. 2009) and the strengthening of the section of FRPA dealing with damage to the environment. Similarly, forest harvesting has recently left more woody material with ecosystem value on site than is required by law (Densmore and Nemec 2008a based on 643 cutblocks harvested from 1998 to 2004). However, concerns have been expressed that existing CWD requirements are inadequate, and therefore additional biomass removals that result in CWD levels approaching regulatory limits could force serious reconsideration of current CWD policy.

Intensification of removals through whole-tree or biomass harvesting, especially when un-merchantable trees are included, also raises concerns about: the potential for nutrient depletion, especially with respect to base cations; cumulative soil disturbance if biomass removal requires a second pass on the cutblock or roadside work areas; loss of ecosystem values provided by fine and coarse woody debris; and retention and promotion of biodiversity. To deal with intensified biomass removals, some Canadian jurisdictions have developed new policy (e.g., New Brunswick Department of Natural Resources 2008) that ranks the suitability of sites based on critical attributes such as soil depth and texture and nutrient removals. (See also reviews of biomass removal guidelines and policies in Evans and Perschel 2010, and Stupak et al. 2008.)

If the demand for forest biomass intensifies and biomass harvesting becomes an important consideration for sustainability of British Columbia's forest ecosystems, evaluating site sensitivity could become an important factor for planning at both the stand and landscape levels. Existing soil disturbance hazard keys (Curran et al. 2000) that are used for planning and application of soil disturbance standards are likely suitable for some aspects of this sensitivity (e.g., nutrient displacement or machine compaction). In addition, approaches to predictive soil mapping of British Columbia are currently being explored in collaboration with many agencies and the GlobalSoilMap.net (Sanchez et al. 2009) project to provide tools to evaluate site conditions that affect the responses of ecosystems to biomass harvesting.

Intensification of biomass removals, improvement in our ability to predict site sensitivity, and prioritization of options to supplement productivity (e.g., fertilization) would also require the reintegration of existing short- and long-term research into policy development. Information from research on site productivity responses to fertilization, tree improvement, site preparation and tending, soil and site restoration, and habitat and biodiversity would all be needed. Within BC, there are 14 sites of the North American Long-Term Soil Productivity study (LTSP 2011), and these are an example of long-term research focused on the critical soil factors that control productivity. Although established long before biomass harvesting for energy was on the industrial horizon in BC, the results from the intensive biomass removal component of these trials can be integrated and interpreted to inform this new demand for resource utilization.

Conclusion

At present, British Columbia has reasonably comprehensive science-based sustainable forest management policies, laws, regulations, and monitoring protocols that have been developed within the context of traditional levels of biomass removals through bole-only and full-tree-to-roadside harvesting systems. Existing policies incorporate adaptive management, with monitoring results linked to policy development that is built on science but interpreted from a socio-economic perspective. Intensification of biomass removals from cutblocks may require the development of new policies addressing stand and landscape sensitivity to CWD removals and biodiversity requirements, nutrient removals, and cumulative soil disturbance. Development of new policies based on site sensitivity would rely heavily on the availability of good soil, terrain, and ecosystem data and on sound, long-term data provided by forest research.

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