Using geographic information systems to investigate uncertainty in forest planning outcomes

by Juan Pablo Cerda¹ and Stephen J. Mitchell²

Forests are complex systems with forest ecosystem, resource, stakeholder and policy subsystems. Knowledge about forest systems is always incomplete, and uncertainty pervades decision-making. Forest planning should account for complexity and address uncertainty, using feedback on past outcomes to inform future planning. Complexity in the forest system and uncertainty in planning have a spatial dimension, which can be represented and analyzed using geographic information systems (GIS). These principles apply to both strategic and operational planning. In this paper we present a GIS-based method for spatially analyzing forest planning outcomes and uncertainty (SAFEPLAN). Results obtained for a southeastern BC case study show how this method can be used to identify specific sources of uncertainty and remedies for improving the effectiveness of operational forest planning. Anticipating the effects of recurring events on plan outcomes will increase effectiveness of operational planning and will improve the ability of forest managers to achieve the desired results.

Key words: uncertainty, risk, forest planning, geographic information system, natural disturbance

Les forêts constituent des systèmes complexes composés de sous-systèmes d'écosystèmes forestiers, de ressources, d'intervenants et de politiques. Les connaissances relatives aux systèmes forestiers sont toujours incomplètes et l'incertitude s'insinue dans la prise de décision. La planification forestière devrait tenir compte de cette complexité et faire face à l'incertitude au moyen de la rétroaction en provenance des événements antérieurs pour alimenter la planification future. La complexité et l'incertitude entourant les systèmes forestiers au moment de la planification ont une dimension spatiale qui peut être représentée et analysée au moyen d'un système d'information géographique (SIG). Ces principes s'appliquent autant à la planification stratégique qu'à la planification opérationnelle. Dans cet article, nous présentons une méthode reposant sur un SIG pour une analyse spatiale des retombées de la planification forestière et des incertitudes (SAFEPLAN). Les résultats obtenus dans le cas d'une étude réalisée dans le sud-est de la Colombie-Britannique indiquent comment cette méthode peut être utilisée pour identifier les sources spécifiques d'incertitude et comment y remédier pour améliorer l'efficacité de la planification forestière opérationnelle. L'anticipation des effets des événements récurrents sur les retombées du plan accroîtra l'efficacité de la planification opérationnelle et améliorera la capacité des aménagistes forestiers d'atteindre les résultats désirés.

Mots-clés : incertitude, risque, planification forestière, système d'information géographique, perturbation naturelle

Introduction

In Canada, the majority of forest land is publicly owned and most timber is harvested under license. Each province has established rules for forest planning. At the present time in British Columbia (BC), licensees must prepare Forest Development Plans (FDPs) every two years. These operational plans describe specific areas proposed for harvest over the next five years. These operational plans must be consistent with strategic, higher level plans, such as local resource use plans and regional land use plans, and are referred to the public and government agencies for review. This is a lengthy process that allows for discussion and resolution of complex planning issues including competing stakeholder interests, economic feasibility, social acceptability, and environmental protection (BCMOF 2001). The cost of preparing and maintaining FDPs, coupled with their lack of success in predicting outcomes, has created general dissatisfaction with the process (BCFPB 2000, Cerda 2002, Hoberg 2002). Consequently, both operational and strategic planning processes are now under review and changes are expected to allow more flexibility and reduction of costs without compromising environmental quality. Requirements for planning are expected to be more result-oriented (BCMOF 2002a,

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BCMSRM 2002). Compliance will require new approaches for addressing uncertainty, managing performance and accounting for outcomes.

A common weakness of operational and strategic forest planning processes in BC, and elsewhere in Canada, is that they do not explicitly address uncertainty. They also take too narrow a view of forests as systems. A system is a network of related subsystems, components and processes that work as a whole to maintain a set of particular properties (Sinnott 1998, Ford 2000). Forest systems have ecosystem, resource, stakeholder and policy subsystems, each of which is dynamic. Systemic views of resource management are present in agriculture (e.g., Kropff *et al.* 2001), in fisheries (e.g., Robinson *et al.* 1999, Charles 2001), and in the solution of environmental and sustainability prob-

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Fig. 1. Compilation of planned and actual harvesting in ArcView®.

lems (e.g., Clayton and Radcliffe 1996). While there are examples of planning processes that address biological and social components of forest systems (e.g., Clayoquot Sound Scientific Panel 1995, Prabhu *et al.* 2001), the authors of these documents do not explicitly describe the forest system.

Forest managers design actions that shape the attributes of forest systems (Erdle and Sullivan 1998). In doing this, they must attempt to harmonize conflicting expectations in consideration of ecosystem limitations and socio-economic realities. Extending the ideas of Stewart (2000) to forest management, the environment for decision-making and prediction includes the forest system itself, the information channel that brings information from the system to the manager, and the decision context that influences the way in which decision-making is done. It is the combined properties of these three elements that make acquiring sufficient knowledge for management decisions difficult and prediction of outcomes uncertain.

Uncertainty is a state of incomplete knowledge. It reflects the confidence with which any estimate can be accepted as representing the future outcome of a process (US EPA 1999). If at least one of the possible outcomes represents a loss, then there is risk involved. In decision-making, irreducible uncertainty creates the need for judgement, which involves a combination of analysis and intuition. Adequate feedback about the accuracy and consequences of past judgements is a fundamental determinant of the quality of current judgements (Jamieson 2000). Outcomes that are unexpected or that differ from predictions become opportunities to learn and improve. Sufficient feedback makes addressing uncertainty a straightforward matter. For example, local probabilities of losses due to change in markets (e.g., Wood Markets Research Inc. 2002), and recurring natural disturbances such as beetle attacks (e.g., Shore and Safranyik 1992), fire (e.g., Thompson *et al.* 2000), windthrow (e.g., Mitchell *et al.* 2001), and landslide (e.g., Anbalagan and Singh. 1996) can be obtained. Predictions of future outcomes can be constantly evaluated against actual outcomes as they unfold (Pielke

et al. 2000). Retrodicting past events has been central in the assessment of climate change models (Rayner 2000), but has not been widely used in forest management.

Forest planning requires consideration of what could happen in the future and how management actions will contribute to the achievement of specified goals. Effective forest planning results in forest plans that remain robust when the forest system changes. Managers need mechanisms for checking the outcomes of past management activities and incorporating this feedback into future planning. These mechanisms are well-developed for stand-level planning, but are poorly developed for forest level planning, whether operational or strategic. Geographic Information Systems (GIS) can assist managers in designing forest-level plans and in monitoring the outcomes of management (Lang 1998). The mapping and analytical functions of GIS allow detection of discrepancies between expected and actual outcomes, and assist in identifying the causes of such discrepancies.

The objectives of this paper are to introduce a GIS-based method for evaluating forest planning outcomes and sources of uncertainty, and to demonstrate the value of this type of analysis in operational forest planning through its application in a case study in southeastern BC.

A GIS-Based Method for Spatially Analysing Forest Planning Outcomes and Uncertainty (SAFEPLAN)

SAFEPLAN is a GIS-based method for continuous evaluation of forest planning outcomes, and their relationship with sources of uncertainty. This method can be used to evaluate outcomes with a spatial component such as locations of roads and harvesting, preservation of timbered reserves or seral stage distributions. In this paper, stand-replacing disturbances such as harvesting, bark beetle and wind damage are emphasized because they produce an abrupt change in forest conditions. In the short term these disturbances have the potential to impact visual quality, water and habitat. In the longer term they re-initiate stand develop-

Fig. 2. Outline of Lemon Landscape Unit with points representing centroids of 1-ha grid cells.

ment and affect future forest condition. The primary emphasis of current development planning in BC is on reaching agreement on areas to be harvested (BCMOF 2001). Specific objectives of SAFEPLAN as applied to operational planning are to:

- assess forest development planning outcomes by comparing planned and actual harvesting;
- identify factors contributing to discrepancies between planned and actual harvesting;
- evaluate associations between factors contributing to these discrepancies and biophysical attributes of the landscape; and
- provide feedback within the planning process and improve the knowledge base.

SAFEPLAN consists of five consecutive steps:

Step 1. Compilation of information. Maps of planned and actual harvesting are compiled in ArcView® (ESRI 1998). In the current scheme for operational forest planning in BC, planned harvesting is represented by proposed cutblocks contained in

a map attached to an FDP submitted for approval to the BC Ministry of Forests (BCMOF). These proposed cutblocks form layer number 1. Cutblocks from successive FDPs form layers number 2, 3, and so on. Actual harvesting is represented by cutblocks harvested in a given year. These cutblocks are identified from BCMOF forest cover maps, high-resolution digital orthophotographs, aerial photos, and field inventories. Digitizing cutblocks harvested in successive years produces layers 1a, 2a, 3a, and so on (Fig. 1). Layers of planned cutblocks link to data tables with cutblock identification, cutblock category (“proposed,” “approved,” “salvage,” “cutting permit”), current year, and year in which harvesting is expected. Layers of actual harvesting link to data tables with cutblock identification and harvest year.

Step 2. Preparation of grid cells and centroids. The geographic boundaries of the planning area are digitized to form a new layer. This layer is then gridded to produce a raster map of 1-ha cells. The 1-ha size for cells is a compromise that reflects the

Point ID	7640
Cutblock	350-1
1995 FDP status	P
1995 FDP year	1998
Years in plan 1	2
R. Changes 95-96	/
1996 FDP status	P
1996 FDP year	1997
Years in plan 2	3
R. Changes 96-97	W. Reserve
1997 FDP status	A
1997 FDP year	1999
Years in plan 3	4
R. Changes 97-98	Beetle
1999 FDP status	CP (90-9)
Years in plan 4	5
Harvested	1999

Fig. 3. Attachment of feature data to cells.

BCMOF forest cover minimum polygon size of 2 ha, and the level of detail required to account for attributes that change over small distances within the landscape (e.g., topography, proximity to streams).

Finally, the whole raster is converted to a point shapefile using ArcView® *asPointFtab*, *asPolyLineFtab*, and *asPolygonFtab* avenues. Each 1-ha cell inherits a centroid. These equally spaced points allow for extracting data from the multiple layers of attributes that describe each cell (Fig. 2).

Step 3. Attachment of feature data. Layers and data-tables resulting from Step 1 are spatially joined to the 1-ha cells resulting from Step 2 using ArcView® *Assign Data by Location* function. As a result, clicking on any central point within the planning area displays a window describing planned and actual harvesting, legal history and biological features of the cell (Fig. 3).

Step 4. Querying the data. The data-table resulting from Step 3 is queried. Potential questions include: Which cells were proposed for harvesting? Which of these were approved for harvesting and had cutting permits issued? Which are harvested? How long did it take to harvest approved cells? Where were approved cells deleted without being harvested? Where are cells harvested without being proposed in an FDP (Fig. 4)?

From the answers to these questions, indicator ratios of forest planning effectiveness can be calculated. The numerator represents the number of hectares input into a given stage of the planning process. The denominator represents the number of hectares with the desired outcome at a later stage in the planning process. High ratios (e.g., high inputs relative to

outputs) indicate that forest planning effectiveness has been compromised by uncertainty during the design and execution of plans. It is also possible to document for each cell the number of years in transition from one planning status to the next. Indicator ratios can be calculated yearly, or for a period of time, and trends in indicators over time can be analysed. The planning area can be stratified according to characteristics of interest and indicators can be compared for different planning areas (Fig. 5).

Step 5. Investigating causes of unexpected outcomes. For areas with discrepancies (e.g., planned harvesting does not occur or unplanned harvesting does occur), or where indicator ratios are unexpectedly high, causes are investigated. Natural disturbances (e.g., windthrow, beetle outbreaks, fires), areas with high social value (e.g., community watersheds, visually sensitive areas, old-growth forests) and other features (e.g., forest types, wildlife habitat ranges, streams) are added as layers into ArcView®. Patterns of association between areas of discrepancy and these mapped features are investigated initially by visual scrutiny. Patterns of association between outcomes and mapped features can be quantified using queries. Contingency tables can be used to test whether associations are statistically significant. Forest managers and officials are interviewed to determine the reasons for specific outcomes. Large format ortho-photographs with overlays showing areas of discrepancy are very useful during interviews. The results of the interviews along with information from FDP documents, cutting permit submissions, BCMOF approval and rejection letters, and comments from the public complement the GIS analysis.

Fig. 4. ArcView® data query. In this example, cells that were harvested without having been proposed in any Forest Development Plan (FDP) are identified.

Test of the SAFEPLAN Method in the Lemon Landscape Unit

The SAFEPLAN method was applied to operational forest planning that occurred between 1995 and 1999 in the Lemon Landscape Unit (Lemon). This 41 000 ha unit is set in a mountainous area adjacent to the town of Slocan in southeast BC within the Arrow Timber Supply Area.

Orthophotographs, forest health surveys, forest covers, and salvage permit maps, with ecosystem attributes and disturbances were obtained from the BCMOF. FDPs, aerial photos, cutting permits, application and approval letters, and maps of community watersheds and visually sensitive areas were obtained from the licensee. Clearcut edge windthrow was mapped from 1998 aerial photographs. Actual harvesting was obtained from the BCMOF 1998 and 2000 forest cover maps, and the four FDPs submitted between 1995 and 1999 in Lemon³. Although most of these data were either in the possession of the licensee or available from the BCMOF, conversion between file formats and some correction and updating were necessary prior to analysis. Data from the BCMOF and licensees were compared, and polygons described as harvested in forest cover maps were double-checked with 2000 aerial photos and 1-metre pixel resolution 1998 digital ortho-photographs for Lemon. The high resolution of these ortho-photographs allowed identification of activities on the landscape. In 20% of cases, cutblocks in successive plans had the same shape but were shifted relative to each other or to the harvested cutblock on the orthophoto. These were considered to be obvious mapping shifts and were re-located to match

the cutblock locations on the ortho-photographs to avoid influencing subsequent analysis (Fig. 6).

Results and Discussion of the Lemon Case Study

Between 1995 and 1999 a total of 1914 ha were proposed in FDPs for harvesting in Lemon. Of these, 513 ha (27% of proposed) were approved, and cutting permits (CPs) were issued for 384 ha (20% of proposed) by March 2001. Of the total area proposed for harvesting in the 1995 through 1999 plans, 27% was harvested by March 2001. Of the 220 ha that received a CP prior to 1998, 68% had been harvested before March 2001. An additional 80 ha (equivalent to 21% of area under issued CPs) were harvested without being proposed in any FDP, either because of minor salvage, or because of boundary modifications prior to CP issuance that did not appear in any FDP.

Successive FDPs varied greatly. Entire cutblocks were discarded, and new ones were added. In the first year following proposal in an FDP, 44% of the proposed ha were dropped. As an example, of the 827 ha proposed in the 1995 FDP, 40% were dropped and only 9% appear as approved in the 1996 FDP. Nearly half of this 9% ha were dropped before the 1997 FDP. This high rate of attrition within the study period was due in part to new legislation. After the enactment of the BC Forest Practices Code (BCFPC) in 1995, licensees adjusted to new requirements, proposing new areas for harvesting, and completely discarding many of the areas proposed and approved in earlier FDPs. Quantification of discrepancies between planned and actual outcomes allowed for estimation of indicators of effectiveness. For the period of interest (1995–2001), 7.3 ha were proposed in FDP for each ha harvested and 1.5 ha were issued CPs for each ha harvested (Table 1). The declining ratios indicate increasing certainty of harvest as proposed areas progress through the stages in the planning process. From FDP documents, BCMOF cor-

³Before 1998 FDPs were submitted every year to the BCMOF. After 1998 FDPs were submitted every two years.

Fig. 5. Example of discrepancy where planned harvesting did not occur and unplanned harvesting did occur.

respondence, public participation, and interviews with managers, sources of uncertainty were identified for the majority (80%) of the hectares that were FDP approved but not harvested (Table 2). Unexpected outcomes reflected the dynamism of different components of the forest system in Lemon (Table 3).

The price of timber and operational costs fluctuated. The average cost of harvesting on public land in BC nearly doubled between 1992 and 1997 (PricewaterhouseCoopers 2000), while the price of timber declined. As a result, many stands thought merchantable when planning were not worth harvesting. The planning process in BC is public and is designed to identify and address public concerns, and societal goals are often in conflict. The BCMOF has the mandate to represent the broad public interest (BCMOF 2002b). However, within the study area, local groups often disagreed when the BCMOF gave licensees permission to harvest. This led to acts of civil disobedience (e.g., Slocan Valley Watershed Alliance 2001) and to disruption of harvesting (e.g., Slocan Forest Products 2001). Finally, a small portion of the planning area was affected by natural disturbances, including beetle attacks and windthrow. Some of the affected areas were salvaged, accounting for most of the areas that were harvested without being proposed in an FDP. In other cases, some of the affected areas were proposed for harvest in subsequent FDPs. Some of this proposed salvage was later rejected because of social concerns.

These sources of uncertainty had a spatial component and were associated with areas in the landscape with specific biophysical attributes. For example, social concerns were the principal reasons that harvesting was deferred in areas mapped as community watersheds or as having high visual quality. Economic factors were the principal reasons that harvesting was deferred in low-volume, high-elevation stands (Table 3).

Data quality was also a significant source of uncertainty for planners in the study area. Early FDP maps had been created using MicroStation. Where information was produced within

a GIS environment, it came in three different formats, Pamap, ArcView, and Arc/Info, under separate administration by the licensee and BCMOF. Compiling and translating this information and correcting obvious mapping shifts was time-consuming but was necessary in order to enable the more powerful GIS capabilities of querying and analysis.

Conclusion and Recommendations from the Case Study

Given the case study results, there are a number of measures that the licensee planners could take to improve their knowledge of the forest system and the quality of the information channel.

- 1) Prioritize collection of data concerning economic and social components in order to improve the information base for decisions. For example, trends in timber value by species can be projected forward and incorporated into a sensitivity analysis of stand operability. Similarly, the attitudes, values and behaviour of people and their responses to proposed harvesting plans can be quantified through surveys (e.g., Meitner *et al.* 2001). Planning processes can be redesigned to better engage local communities, such as in Stillwater Timberlands Pilot Project (Stillwater Timberlands Weyerhaeuser 2002).
- 2) Collect data that can be used in predictive models (see Point 5), such as history of fire, insect outbreaks, and occurrence of windthrow events, and history of climatic factors and logging history associated with these.
- 3) Improve the accuracy of forest cover updates. The BCMOF forest cover maps lack up-to-date information needed for accurate planning including recent harvest and natural disturbance.
- 4) Standardize data in digital format within a single GIS platform and geo-reference digital images and map layers. This would promote information exchange between licensees and agencies and minimize duplication of effort in data correction.
- 5) Use more fully the analytical capabilities of GIS. The SAFEPLAN method demonstrates how spatial data contained

Fig. 6. An example of obvious mapping shifts. In cases such as this, polygon boundaries were shifted to produce the best match with cut-block shape on the ortho-photo prior to analysis of planning outcomes.

in a GIS can be used to identify areas with special challenges for planning. GIS can be used to spatially assess social preferences (Webb and Thiha 2002) and visual quality of forest landscapes (Picard 2002).

6) Use predictive models. Decision-making should account for factors that will certainly occur, but it should also take in consideration uncertain and probabilistic events. With improved information, predictive models can be locally calibrated and validated and used to assist decision-making. For example, models to evaluate risk of beetle damage (Shore and Safranyik 1992), and windthrow (Mitchell *et al.* 2001) would reduce uncertainty in the Lemon LU, and in other areas susceptible to these agents. There are also tools for analysing timber operability based on constraints to harvesting and predictions of future states of the forest, such as CASH6 (Timberline Forest Inventory Consultants 2002), and ATLAS (Nelson *et al.* 1995).

7) New methods for effective public participation should be explored to resolve present and predict future social concerns. Visualization tools allow for an immersion in digital forests, making public participation an exchange of opinions “within” the forest (Sheppard *et al.* 2002).

8) Diversify options for harvesting. A robust operational plan provides some flexibility during plan execution so that licensees can respond to changes in the forest system, while still meeting strategic planning goals. For example, the stock of approved blocks, or issued CPs, should include a balance of opportunities that provides for fluctuations in economic conditions.

The case study results also highlight ways in which the government could improve the context in which operational planning is conducted in BC.

1) Allow more flexibility. The present rules require precise location of areas to be harvested in FDPs. Small modifications to proposed blocks require amendments. In Lemon, it was often the case that previously resolved issues relating to the entire cutblock were re-opened for discussion during this amendment process. Frequent amendments to approved and authorised activities reduce the trust of all parties who contributed to the FDP process. This trust is further eroded when CPs are issued for expedited salvage outside of the normal FDP review process.

2) Focus the strategic planning effort on defining short- and long-term target conditions for landscapes and landscape sub-units. The high ratio of proposed to approved blocks indicates a lack of clarity and agreement concerning strategic issues. The consistency of harvesting with landscape scale objectives and social desires should be resolved in higher-level strategic planning. Once desired conditions are negotiated for the landscape unit and sub-unit scale, the test for operational plans becomes their consistency with these desired conditions.

3) Strengthen “gates.” The stages in the FDP-CP approval process are sometimes viewed as one-way gates. As proposed cutblocks pass each gate, the confidence of the parties involved in the planning process that the block will be harvested should increase. The declining effectiveness ratios through the planning stages indicate that approval and CP issuance increased certainty; however, unresolved social issues and changing regulations along with responses to market fluctuations, still lead to frequent amendments and deferral of harvesting for areas with approved CPs. Given the dynamic nature of the forest system there should be a maximum time for which CPs are valid and a mechanism for review and amendment. However, there should also be recognition of added costs when policy changes

Table 1. Indicator ratios of forest planning effectiveness for the period 1995–2001 for Lemon case study

Indicator Ratio	Value	Meaning
Proposed/Harvested	7.3	7.3 ha were proposed for each ha harvested
Proposed / Approved	3.7	3.7 ha were proposed for each ha approved
Approved / Harvested	2.2	2.2 ha were approved for each ha harvested
Approved / CP ¹ Issued	1.3	1.3 ha were approved for each ha issued CPs
CP Issued / Harvested	1.5	1.5 ha were issued CPs for each ha harvested

¹CP = Cutting permit

Table 2. Sources of uncertainty for approved hectares that were not harvested

Source of uncertainty	Frequency (%)	Description
Economic or operational constraints	40	Area could not be harvested economically due to low pulp prices or difficult accessibility
Social concerns	35	Area was not harvested to prevent more social conflicts (e.g., appeals to courts; boycotts) and prevent further damage to licensee's image
Legal requirements	15	Area was not harvested due to new requirements from the BCFPC (e.g., to accommodate BCFPC requirements for reserves)
Natural disturbances	10	Area was not harvested after field layout showed that merchantability has been reduced by beetle/wind

Table 3. Association of sources of uncertainty and landscape attributes

Source of uncertainty	Landscape attribute	Column (a)	Column (b)
		% of total approved ha located in areas with this attribute ¹	% of total approved ha shown in Column (a) not harvested
Economic/operational	Problem forest type ²	56	87
Social concern	Visually sensitive area	50	73
	Community/domestic watershed	55	78
	Problem forest type	56	14
Legal requirements	Stream edge	7	4
Response to timber damaged by natural disturbances	Beetle outbreak	13	70
	Cutblock edge/windthrow	8	20

¹Approved ha can fall in more than one attribute area.

²Non-merchantable forest types, including stands of unfavourable stocking, low productivity sites, and stands with high waste and breakage.

mean that approved blocks no longer conform. The government should stand behind the results of the planning process and assist the licensees in resolving situations where social activism prevents harvesting of CPs that are consistent with the strategic plan.

The SAFEPLAN Method in a New Context for Planning in BC

Forest planning processes in BC are in transition. Innovative Forestry Practices Agreements (IFPAs) and Results-Based Forest Practices Code Pilot Projects have been implemented and new legislation is expected in 2003 (BCMOF 2002a, BCMSRM 2002). These changes emphasize strategic planning, and a key component of these innovations is the concept of evaluating more than one possible future scenario during planning (McGregor Group 2002).

To be realistic however, future scenarios must take into account the dynamic nature of the forest system and represent probable future conditions. By analysing performance of past plans using the SAFEPLAN method, the probabilities of recurring events can be calculated and the implications of past responses to these events can be considered. For example, the likelihood, effects of, and responses to bark beetle outbreaks, windthrow or major wildfires can be discussed with the public and agencies in advance of the next recurrence.

Conclusions

SAFEPLAN enables analysis of harvesting or other outcomes, the attribution of unexpected outcomes to sources of uncertainty, and provision of feedback for subsequent plans whether operational or strategic. In the Lemon Landscape Unit, application of this method revealed lack of effectiveness in the operational planning process resulting from too narrow a view of the components of the forest systems, unaddressed sources of uncertainty, and insufficient feedback. While improvements are underway in the operational planning process in BC, and scenario planning tools are now available for strategic planning, anticipating the effects of recurring events on planning outcomes will remain central to effective forest planning.

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