
FSB

Forest Science Board

Forest Growth and Value Program

Research Strategy 2009–2014

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Abbreviations

AAC	Allowable annual cut
BEC	Biogeoclimatic ecosystem classification
EBM	Ecosystem-based management
FFEI	Future Forest Ecosystems Initiative
FFE-CRI	Future Forest Ecosystems Collaborative Research Initiative
FIA	Forest Investment Account
FIA-FSP	Forest Investment Account Forest Science Program
FNAG	First Nations Advisory Group
FPAC	Forest Growth and Value Program Advisory Committee
FSB	Forest Science Board
GY	Growth and yield
GYM-CRI	Growth and Yield Modelling Collaborative Research Initiative
LOI	Letter of intent
LTR	Long-term research
LTRI	Long-term research installation
MFR	Ministry of Forests and Range
MPB	Mountain pine beetle
NTFP	Non-timber forest product
PAC	Program Advisory Committee
PFEP	Provincial Forestry Extension Program
PwC	PricewaterhouseCoopers
SFM	Sustainable forest management
SPAC	Sustainability Program Advisory Committee

Forest Growth and Value Program Research Strategy 2009-2014

1.0 Context

Forest Science is one of five programs in British Columbia's Forest Investment Account (FIA) to promote sustainable forest management (SFM). The FIA Forest Science Program (FIA-FSP) focuses on applied research to develop knowledge that addresses crucial short- and long-term forest management challenges, and the extension of forest science results and existing information to meet the needs and priorities of those who plan and manage British Columbia's public forest lands.

The FIA-FSP funds three major programs: Sustainability, Forest Growth and Value, and Forest Extension. A fourteen-member Forest Science Board (FSB) advises the Deputy Minister of Forests and Range (MFR) on FIA-FSP strategies and priorities. The FSB relies on Program Advisory Committees (PACs) to assess forest management challenges and information needs within their program areas; evaluate available knowledge; identify knowledge gaps and strategies to address them; and make recommendations on themes, topics, and research issues for annual funding.

This document sets out the strategy for the FIA-FSP Forest Growth and Value (Forest GV) Program. It is updated periodically to reflect changing management priorities and the expectations of the FSB. Section 2 describes the Forest GV Program strategic framework. Section 3 outlines the mandate and structure of the Forest GV Program Advisory Committee (FPAC). Section 4 presents an overview of the Forest GV Program research themes and topics. Section 5 outlines the process of establishing research priorities. Section 6 discusses program delivery, including the link to extension of research results. Appendix 1 contains descriptions of the research themes, topics, and issues. Appendix 2 presents the process and criteria for scoring research issues.

2.0 FIA-FSP Strategic Framework

Investments made through the FIA-FSP are expected to contribute to the government's goal of having a leading-edge forest industry that is globally recognized for its productivity, environmental stewardship, and sustainable forest management practices. The Board and its PACs work to focus investments on high-priority research and extension that address user needs, avoid duplication, and leverage funds by attracting money from other sources. Figure 1 illustrates the strategic framework for FIA-FSP research.

Figure 1 Strategic Framework for FIA-FSP research.



2.1 Program Strategies

The *FIA-FSP Strategic Plan 2009–2014* sets out the vision and strategic goals of the FIA-FSP, and identifies priority themes in each program area. Within the parameters of the Strategic Plan, each PAC evaluates available knowledge, identifies gaps, examines opportunities for cooperative research and leveraging funding, and makes recommendations to the Board pertinent to its program area. Component strategies for the Sustainability, Forest Growth and Value, and Provincial Forest Extension programs outline the priorities and methods to achieve each program's mandate.

2.2 Research Priorities and Project Selection

Each year, the Sustainability Program Advisory Committee (SPAC) and FPAC review their program strategies in consideration of current management challenges to determine whether any new topics or research issues should be added. Following adjustments to the strategies, the PAC members engage in a process of ranking the research issues to define regional priorities for research. Based on these priorities, the PACs recommend to the Forest Science Board the research issues that should be eligible for funding. Following Forest Science Board review and recommendation to the Deputy Minister of Forests and Range, the approved research issues shape the annual Research Call for Proposals.

In addition to priorities for research identified through the Research Program strategies and funded through the Call for Proposals, collaborative initiatives may be established to address specific research topics that lend themselves to a collaborative effort by a discrete set of researchers, based on 3-year business plans approved by the Board. The first two pilots of this approach were initiatives focused on growth and yield modelling and future forest ecosystems (see Section 6.3).

2.3 Implementation, Monitoring

The Forest Science Board and PACs obtain feedback on FIA-FSP processes and projects through several mechanisms, including:

- involvement of the provincial forest extension provider (FORREX) on the Board, committees, and working groups
- information from the FIA-FSP Program Administrator, PricewaterhouseCoopers (PwC) (Call for Proposals process, project implementation, project deliverables)
- analyses and support from the FIA-FSP Secretariat, Cortex Consultants (e.g., analysis of funding allocations and project outcomes, relative to the Program Research Strategy)
- communication with members of the PACs and the First Nations Advisory Group
- periodic surveys of the researchers and users of forest science
- review of programs, proposals and project deliverables.

2.4 First Nations in the FIA-FSP

The FIA-FSP operates under the following principles with respect to First Nations involvement in the program:

- First Nations and non-First Nations have parallel paths and processes
- Each contributes understanding to the other's path
- Harmonization is possible on issues where the groups share common interests
- The harmonization process is respectful and equitable.

These principles are applied to ensure that indigenous interests are included in program strategies and considered in identifying research priorities, determining eligible topics for funding, and setting guidelines for the annual Call for Proposals. The FIA-FSP has developed a First Nations Harmonization Strategy that will guide harmonization activities for the period 2009-2014.

A First Nations Advisory Group (FNAG), consisting of approximately ten First Nations people with experience in research (including Aboriginal forest research) and forest land-base activities, identifies First Nations research and extension interests related to the FIA-FSP and works with the FPAC and SPAC to update the research program strategies and determine annual research priorities. Currently, FNAG members represent the coast, northern interior, and southern interior, and academic, community, and industry perspectives.

3.0 FPAC Mandate and Structure

3.1 FPAC Mandate

The FPAC mandate has two components:

- develop and periodically update a 5-year strategy for addressing short- and long-term research priorities related to improving forest growth and yield of products and services
- develop and implement an efficient and effective process for determining annual research priorities.

In fulfilling this mandate, the FPAC:

- advises the Forest Science Board on critical issues and knowledge gaps relevant to the Forest Growth and Value Program
- annually recommends research priorities for the FIA-FSP Research Call for Proposals
- annually reviews and comments to the Forest Science Board on other components of FIA-FSP (e.g., long-term research installations, graduate student research funding, directed research).

3.2 Relationship between the Forest Growth and Value Program and the Sustainability Program

The Forest Growth and Value program is focused on the growth of forests, interactions within and among forest stands, responses of forests to disturbance, and how forests yield valued products and services. The Sustainability program is focused more broadly on the forest ecosystem and how key components of the ecosystem function to produce services (e.g., productive soils, water, habitat, and biodiversity). The Sustainability program also considers how land management activities affect social and cultural values. Both programs emphasize efforts to develop new data, knowledge, and tools that support sustainable management of forest ecosystems and yield the appropriate mix of ecosystem services and other products valued by society. As a result the boundary between the two programs is fuzzy and there is some overlap in topics and issues. The PAC chairs meet on a regular basis to minimize the overlap and to ensure that the strategies allow the Forest Science Board to focus research priorities and to guide researchers when submitting funding applications.

3.3 FPAC Membership

The FPAC consists of approximately fourteen members from across the forest sector and two members representing the provincial forest extension provider. Membership reflects a geographically balanced complement of people from government agencies, First Nations, forest companies, the consulting community, academia, and research institutions. Members have knowledge and expertise in topics and issues related to the Forest Growth and Value Program. Although there is no official Board representation on the FPAC, Board members may attend FPAC meetings and PAC Chairs are encouraged to attend FSB meetings.

The FPAC meets several times each year to discuss research priorities, set out a strategy for delivery, and address other issues at the request of the Forest Science Board. PAC members are encouraged to consult with providers and users of forest science within their area of expertise or geographic region, including groups that collect and maintain resource information.

4.0 Overview of the Forest GV Program Research Strategy

The Forest Growth and Value program is focused on trees, stands, and forests. The intent of the program is to increase understanding of how the forest grows and how it yields products and services of value to British Columbia society. To do this, the program has six major themes (Table 1). Each theme is directly tied to issues that have been raised by forest managers and other users of forest science information around the province. Forest managers face new challenges due to changing markets, natural disturbances on unprecedented scales, and emerging opportunities for enhancing production of non-traditional forest products and services. Answering these challenges requires a combination of basic and applied research at all scales from tree to landscape.

4.1 Research Themes, Topics, and Research Issues

The Forest GV Program strategy consists of themes, topics, and research issues that address knowledge gaps relating to forest growth and product yield. Each research theme contains several topics, and each topic is further refined into issues requiring research. Table 1 lists the current themes and topics (complete descriptions can be found in Appendix 1).

Table 1 Forest Growth and Value Program current themes and topics¹

	Theme (bold)/Topic (not bold)
1	Basic research on tree growth, stand development, and yield of valued forest products
1.1	Complex stands, including those arising from partial cutting and variable retention
1.2	Early stand growth
1.3	Old trees and stands
1.4	Ecological responses of trees to climate change
1.5	Factors influencing the supply of forest products and services other than timber
2	Design and analysis of silvicultural systems
2.1	Complex stands, including those arising from partial cutting and variable retention
2.2	Even-aged stands
2.3	Compatible management of forest products and services
3	Stand dynamics modelling
3.1	Complex stands, including those arising from partial cutting and variable retention
3.2	Wood quality

¹ Missing numbers in this table indicate themes and topics that have been retired from the program as a result of shifting priorities or reorganization of program structure. Furthermore, the numbering indicates the order in which themes or topics were added to the program, and does not indicate priority.

Theme (bold)/Topic (not bold)	
3.4	Predicting effects of climate change on growth and productivity
4	Response of trees and stands to disturbance
4.1	Stand and forest dynamics following the mountain pine beetle epidemic
4.2	Estimating and/or mitigating stand-level losses
4.4	Site productivity impacts
4.5	Influence of genetic factors on stand response to insect and disease attacks
4.6	Effects of climate change on forest health and condition
4.7	Salvaging MPB-killed timber
4.8	Management responses to climate-induced ecosystem shifts
5	Analytical techniques and models for strategic analysis
5.1	Development of novel methods to integrate data and models across scales
5.2	Development of novel methods to link growth and yield models to process, climate, hydrology, wildlife, and other models
9	Enhancing forest values
9.1	Designing and evaluating novel systems for producing biomass for bioenergy
9.2	Market and non-market valuation of forest products and services other than timber
9.3	Assessing the emerging market for forest-based carbon

4.2 Research Implementation Timeline

The ability to establish long-term research goals in a 5-year strategy is limited for several reasons. First, biophysical research often requires 5–10 years before meaningful results are achieved. Second, the structure of the FIA-FSP restricts long-term planning because projects are limited to 3 years before having to reapply for funding, and the specific projects selected through the competitive call process is uncertain. Finally, unforeseen management issues arise that may shift priorities for the program (e.g., the need to address issues arising from the MPB epidemic or concerns about global climate change).

Given the challenges associated with setting long-term research goals, the Forest Growth and Value Program research strategy has been designed with the flexibility to address uncertainty about future management needs and funding availability. The strategy encourages proposals across many themes and topics, while avoiding the danger of spreading research efforts too thinly. Interaction between this focus and funding cycles means that some important issues will not be addressed in the annual Call for Proposals. The specific themes, topics, and research issues funded in a given year will be the result of balancing the urgent needs of high-profile management issues against addressing the longer term knowledge gaps related to implementing sustainable forest management.

4.3 Long-term Research

Long-term studies are vital to achieving the goals of the FIA-FSP; however, the FIA-FSP does not have sufficient funding to create a separate envelope for new long-term research. Proponents of new long-term studies are encouraged to identify short-term scientific and extension goals and

products within the longer-term context of their studies and to submit proposals for funding through the Call for Proposals. Once a long-term research project has produced meaningful results within a 3-year project timeframe, it can continue to submit proposals for portions of the research, or submit proposals for maintenance or remeasurement activities (e.g., to collect data to quantify treatment effects) through the Long-term Research Installation (LTRI) envelope. The LTRI envelope provides a small amount of funding for the maintenance of infrastructure, basic and repetitive measurements, and some remeasurement of experiments where such measurements are essential to long-term success and do not have an immediate scientific objective. Both FPAC and SPAC will evaluate the success of this approach on an ongoing basis.

The FSB recognises that this process places significant limitations on the funding of new long term research and has struck a Long-term Research Working Group to evaluate the successes and failings of the existing process and to make recommendations for improvement.

5.0 Setting Annual Funding Priorities for Research

Each year in late April the PACs begin a process of ranking research issues to define the eligible topics for the Research Call for Proposals. The extent to which the research program strategy is updated, and the amount of information the PACs take into consideration for scoring research issues (e.g., research syntheses, gap analyses), depends on the research funding cycle, with the greatest effort expended in years with larger amounts of funding available for allocation to new projects.

5.1 Considerations

During the priority-setting process the PACs consider:

- the existing research program strategy
- direction from the Forest Science Board regarding priority research
- allocation of funding to date under program themes, topics, and research issues
- research results to date in addressing defined management issues
- research carried out by other agencies
- new issues and (or) priorities identified by PAC members since the previous year
- scoring criteria (see Appendix 2 for more detail).

5.2 General Principles

The FPAC follows five general principles in establishing annual priorities for research:

- continue with strategic priorities as outlined, keeping focused on identified needs; some topics may not necessarily be addressed by FIA-FSP in each year of funding

- where possible, fund research in each of the six themes
- consider regions explicitly in identifying priority research issues
- review potential overlap and opportunities for collaborative funding with other research programs
- review specific research issues and account for emerging or urgent management issues and priorities.

5.3 Scoring Process

The scoring process has four steps:

1. Confirm and, if necessary, amend the topics and research issues under each Program theme.
2. Score each research issue and identify where new topics or research issues are needed (done by individual FPAC members based on their expertise and consultation with colleagues).
3. Compile the responses of individual members and distribute as background for a group discussion on the score for each research issue.
4. Confirm the final score for each research issue, by region, based on the compiled responses and group discussion among PAC members.

Scores are assigned to each research issue based on i) size of knowledge gap, ii) level of urgency, iii) regional significance, and iv) importance to sustainable forest management.²

The system for scoring research issues is not intended to produce final recommendations for priority research; rather, it is used as a tool to facilitate discussion. The scores are used to focus discussion where a research issue is close to the threshold priority for funding, or there is significant disagreement among FPAC members about the priority of a particular research issue. In these cases, the individual scoring criteria are used to focus discussion on the final priority for each research issue. Through discussion the FPAC may adjust the final score based on the scoring criteria and other factors they feel are relevant. This process is intentionally subjective, recognizing that even a fully automated scoring system would be subjective in the way criteria were chosen and applied. Setting the final priority for research issues through discussion ensures that the resulting decision is based on sound reasoning rather than artifacts of a formulaic approach.

Research issues are scored separately for each provincial forest region³ to aid in ranking research needs across highly diverse provincial forests. There is no expectation of equal funding being allotted to each region; rather, efforts will be made to address the highest priority needs across the province.

² See Appendix 2 for details on the system for scoring research issues.

³ Ministry of Forests and Range administrative regions are used (Coast, Southern Interior, and Northern Interior).

6.0 Program Delivery

6.1 Program Delivery Models

Effective program delivery is facilitated by administrative and contractual mechanisms that maximize the portion of program funds directed to research activities while meeting fiscal and legal requirements. Program delivery mechanisms are the responsibility of the Forest Science Board.

Research resources and needs vary with the type of research. Considerations in the choice of delivery mechanism for specific research themes or topics could include:

- abundance and availability of human resources capable of undertaking the work
- dispersion or centralization of expertise needed for the work (centralized in one group vs. dispersed across many agencies or companies)
- access to knowledge capital, including models that are not readily transferred for further development
- access to research installations and data that are not readily available to other researchers for logistical or technical reasons
- project longevity (short-term vs. long-term and ongoing research).

Possible administrative mechanisms include an open call for proposals administered and monitored annually to collaborative research initiatives delivered and monitored in accordance with an approved business plan. Table 2 summarises the factors used to determine which approach is used. The FIA-FSP has employed primarily a Call for Proposals process, but will pursue collaborative research initiatives (based on directed program delivery), where considered appropriate.

Table 2 Considerations in employing a call for proposals or a collaborative research initiative

Considerations	Call for proposals preferred	Collaborative research initiative preferred
Abundance/scarcity of human resources	abundant	scarce
Dispersion/centralization of expertise	dispersed	centralized
Access to knowledge capital	accessible	not widely accessible
Access to research installations and data	accessible	not widely accessible
Project longevity	short	long

6.2 FIA-FSP Call for Proposals

The FIA-FSP currently uses a Call for Proposals process to solicit research projects consistent with the Forest GV Program and Sustainability Program research strategies. This is managed by PricewaterhouseCoopers (PwC) and does not directly involve the FPAC and SPAC members although they may serve on project review panels.

The Call for Proposals follows a two-stage competitive process. Proponents submit letters of intent (LOIs) for their projects, which are evaluated based on logistical criteria such as the cost of the project, its fit with annual research priorities, and the appropriateness of the project team. Based on these criteria, a subset of LOI proponents are invited to submit a full proposal (second stage), which undergoes a scientific peer review. The final list of funded projects is based on the outcome of this peer review and available funding.

Available funds for new research initiated through the Call for Proposals are allocated annually to maintain approximately equal funding of the Sustainability and Forest Growth and Value programs. The Board seeks to balance funding among projects of 1 to 3 years, to ensure that new projects of varying terms can be approved each year. Once approved, a multi-year project will be funded for its full term (up to 3 years), contingent on an annual review of progress against deliverables and submission of an updated workplan. Projects requiring longer than 3 years must submit a new letter of intent to the Annual Call every 3 years.

6.3 Collaborative Research Initiatives

Within FIA-FSP, collaborative research initiatives are intended to foster a more strategic, efficient, and stable funding environment for priority research of a collaborative nature. A steering committee annually evaluates and sets priorities based on input from the Board and PACs, and key strategic documents from other sources in British Columbia. Based on these priorities, the committee constructs an annual business plan that identifies priority projects and project leaders to develop project plans. The committee reviews the resulting project plans and provides feedback to enhance project effectiveness and collaboration. Delivery of the annual research business plan to FSB coincides with the annual PAC planning cycle in preparation for the annual FIA-FSP Call for Proposals.

Research proposals initiated under the collaborative research initiative are submitted for review by external experts. Approved collaborative research projects are administered by PwC, similar to other FIA-FSP research projects. The collaborative research steering committee reviews each project yearly in conjunction with annual business planning. Continued funding is based on performance (with PwC input) and continued alignment with the evolving collaborative research initiative strategy.

Currently, there are two collaborative research initiatives, the Growth and Yield Modelling Collaborative Research Initiative (GYM-CRI) and the Future Forest Ecosystems Collaborative Research Initiative (FFE-CRI).

Growth and Yield Modelling Collaborative Research Initiative

In 2007, the FSB established a Growth and Yield Modelling Collaborative Research Initiative (GYM-CRI) under the Forest GV Program. The GYM-CRI is the Board's first collaborative research initiative.

The GYM-CRI is intended to foster a more strategic, efficient, collaborative, and stable funding environment for priority growth and yield (GY) research. GY models have become critical tools in predicting future forest values under a wide range of alternative management regimes, natural

disturbances, and climate change scenarios. Stand structure predictions from GY models serve as key inputs for predictions of future timber and non-timber values including habitat, biodiversity, and visual quality. GY models increasingly serve as synthesis platforms to integrate applied research in other fields (e.g., genetics, nutrition, pathology, entomology).

The GYM-CRI builds on the priorities established by FPAC for GY modelling (Theme 3 in the Forest Growth and Value Program) and previous FIA-FSP investments in GY modelling. The GYM-CRI is developed by a standing GYM-CRI committee representing GY model users and researchers. The committee annually evaluates and sets GY modelling priorities based on input from the Board and PACs, and key strategic documents from other B.C. sources (e.g., First Nations, Future Forest Ecosystems Initiative, MPB). Based on these priorities, GYM-CRI constructs an annual business plan that identifies priority projects and works with project leaders to develop project plans. The GYM-CRI committee reviews the resulting project plans and provides feedback to enhance project effectiveness and collaboration. Delivery of the annual GYM-CRI business plan to FSB coincides with the annual PAC planning cycle in preparation for the annual FIA-FSP Call for Proposals.

The Growth and Yield Modelling Subprogram Business Plan and Strategy 2009–2012 (July 2008) outlines the development of five projects: four strategically important and established GY models reflecting different approaches and applications, and one short-term project focusing on post-MPB regeneration. The four models (FORECAST, PrognosisBC, SORTIE, and TASS) have all received prior FSP support and are the main established models in B.C. at this time.

Research proposals initiated under the GYM-CRI are submitted for review by external experts. Approved GYM-CRI projects are administered by PwC, similar to other FIA-FSP research projects. The GYM-CRI committee will review each project yearly in conjunction with annual business planning. Continued funding will be based on performance (with PwC input) and continued alignment with the evolving GYM-CRI strategy.

The GYM-CRI strategy explicitly relies on the FIA-FSP annual Call for Proposals to encourage and support new innovation in GY modelling (FPAC Theme 3).

Future Forest Ecosystems Collaborative Research Initiative

Climate change is a major issue confronting forest and range managers in British Columbia and elsewhere. Although the FIA-FSP has been funding research related to this topic since its inception, priority rankings on all of the many topics associated with climate change have increased in the last 2 years. At the same time, the MFR has begun the Future Forest Ecosystems Initiative (FFEI), which is focused on understanding the necessary forest and range management actions that are required to respond to the climate change challenge. This includes changes in policy, regulations, inventory, and other aspects of forest and range management, and a research funding initiative involving collaboration between MFR scientists and scientists outside the agency.

Similar to the GYM-CRI, the collaborative research portion of the FFEI is being partially funded through the FIA-FSP as a direct delivery initiative, based on a focused business plan.

Coordination of MFR research and other research agencies will take place through the PACs and the FFEI Project Committee.

Proposals for climate change research separate from the collaborative projects featured in the FFEI Business Plan will be solicited through the FIA-FSP annual Call for Proposals process.

6.4 Moving from Research to Synthesis and Extension

The primary purpose of the FIA-FSP is to provide credible, relevant, and accessible scientific knowledge to support sustainable forest management policies and practices. As an applied research program, the results of research funded by the FIA-FSP should inform a current or emerging management issue, and should be communicated to policy-makers and practitioners in a way that ensures application of the knowledge. The FIA-FSP funds the Provincial Forest Extension Program (PFEP) through FORREX, to support extension activities that make research results available to managers and practitioners (end users) and increases understanding of their research needs.

The PFEP ensures that priority extension needs are being addressed by employing a suite of communication tools. Among these tools are assessments of the needs of end users, and syntheses, such as gap analyses, that address topics of interest to end users.

To facilitate the linkage between research and extension, PFEP representatives participate on the PACs as extension specialists, in addition to bringing technical expertise to the process. At the start of the each annual PAC priority-setting process, PFEP representatives make formal presentations outlining the results from their internal strategic and operational planning processes. They may also communicate the result of research gap analyses that are relevant to the upcoming priority-setting process – especially where these analyses are directly related to the Program research strategy.

During the process of determining which topics will be eligible for funding, PAC members identify what is known on a particular subject, and whether knowledge gaps are the result of insufficient research or a lack of synthesis and extension. Recommendations for synthesis or extension are communicated to the PFEP through its representatives on the PAC. If PAC members are uncertain about what research exists on a specific topic, they may identify the need for a research gap analysis related to that topic. The PACs present this need to the FSB along with recommendations on how the need should be addressed. Possible approaches are:

- including the requested synthesis in the regular annual call for proposals
- asking FORREX to include the requested synthesis in their annual work plan
- issuing a direct award to carry out the synthesis.

The completed gap analysis would be available to PACs for consideration of decisions on eligible research in future funding cycles.

Appendix 1 – Research Themes and Topic Descriptions⁴

Theme 1 Basic research on tree growth, stand development, and yield of valued forest products

Knowledge of basic biological processes that regulate tree growth and stand development and the relationships between trees and other components of the forest ecosystem is essential for developing decision support tools for managers intent on maintaining and improving the supply of products and services from the provincial forests. Over many years much knowledge has been developed on B.C. trees and stands, but there are information shortages in key areas.

Environmental changes are placing the forest under increased stress, and growing demands for more varied products and services from forests require novel approaches to management. Consequently forest managers are required to manage older, more complex stands while responding to threats from natural disturbances and climate change.

1.1 Complex stands, including partial cutting, variable retention

Complex stands include multiple species, stands with structural diversity, and mixed stands of conifers and broadleaves.

The following issues are the focus for research under this topic:

1.1.1 Species interactions.

1.1.2 Microclimatic influences on tree and stand growth in multi-storied stands.

1.1.4 Natural regeneration processes in multi-storied stands.

1.1.6 Mortality in seedling, sapling, and pole stages.

1.2 Early stand growth

Early stand growth of most major tree species is well understood. This topic focuses on dynamics of early stand establishment and growth that affect crop tree performance.

The following species are the focus for research under this topic:

1.2.1 Subalpine fir (*Abies lasiocarpa*).

1.2.2 Western redcedar (*Thuja plicata*).

1.2.3 Yellow-cedar (*Chamaecyparis nootkatensis*).

1.3 Old trees and stands

Old trees and stands are retained on the landscape to meet specific management goals (e.g., maintaining biodiversity) or as a result of age structure and cutting practices in specific management units. Stand dynamics have not been well studied in older stands and this

⁴ Missing numbers in this section indicate themes and topics that have been retired from the program as a result of shifting priorities or reorganization of program structure. Furthermore, the numbering indicates the order in which themes or topics were added to the program, and does not indicate priority.

information is required for management prescriptions and plans. Successional processes and natural disturbance regimes are topics covered under the Sustainability Program.

The following issues are the focus for research under this topic:

- 1.3.1 Stand dynamics of older stands (e.g., volume loss, decay, succession, stand break-up, mortality); includes, cedar, hemlock, aspen, birch, true fir stands.

1.4 Ecological responses of trees to climate change

Forest ecosystems are predicted to change in response to climate change, but the nature of these changes is highly uncertain. Forest managers require information on management strategies and operational practices to create forests that are more resilient to these changes. Research is needed to develop an understanding of ecological responses of tree species under future climatic conditions.

The following issues are the focus for research under this topic:

- 1.4.1 Quantifying plant-climate relationships and estimating the future range and deployment of B.C. tree species and genotypes, including bio-climatic modelling and opportunities for facilitated migration to match genotypes with future environments.
- 1.4.2 Quantifying the adaptation and productivity of select seed from British Columbia and neighbouring jurisdictions when grown in current and forecast future climates.
- 1.4.3 Understanding the physiological stress response of trees and genotypes to changing environments, with linkages to species and seed zone ranges.
- 1.4.4 Assessing effects of climate change on traditionally used plant communities.

1.5 Factors influencing the supply of forest products and services other than timber

Interest in the production and marketing of non-traditional forest products (often referred to as non-timber forest products or NTFPs) is growing rapidly. Forest managers have relatively little information on which to base management decisions that influence the flow of these products and services from the forest.

The following issue is the focus for research under this topic:

- 1.5.1 Ecological research (autecology, synecology) on NTFPs singly or in combination. Research proposals are particularly invited on heavily utilized and impacted NTFP species, including those affected by the mountain pine beetle epidemic.

Theme 2 Design and analysis of silvicultural systems

Silvicultural systems are management systems that are used by forest managers to control the flow of products and services from the forest. Changing demands for products and services require novel approaches to management that may require the design of more complex stands than in the past. This theme has been developed to provide the information needed to develop such approaches and to evaluate their success.

2.1 Complex stands arising from partial cutting, variable retention, and multi-species planting

Development and monitoring of silvicultural systems for complex stands (multi-species, multi-cohort, structurally complex) at multiple scales (e.g., stand, landscape) will be considered for support.

The following issues are the focus for research under this topic:

- 2.1.2 The relationship between residual stand structure and understorey recruitment and development; evaluation of the results of partial cuts and the effects on stand establishment, early growth and yield, and response to management practices.
- 2.1.3 Experiments and analysis of various complex stand-treatment regimes.
- 2.1.4 The impact of complex stand management on stand genetics, genetic worth and stand productivity.
- 2.1.5 Use of fire and other silvicultural treatments to create resilient stands in dry forests (e.g., the Ponderosa Pine zone and parts of the Interior Douglas-fir zone).

2.2 Even-aged stands

Development and monitoring of silvicultural systems designed for efficient, high-yield timber production will be considered for support. Investigations of opportunities for joint production of other forest products and services are encouraged.

The following issues are the focus for research under this topic:

- 2.2.1 Assessment and analysis of fertilization experiments or trials for cedar, interior Douglas-fir, spruce, pine, and true fir. New research projects are limited to mid to late rotation cedar.
- 2.2.3 Field experiments studying the area-based impact of selected seed on timber growth across various stand densities and site qualities (referred to as genetic realized-gain trials). Linkage to existing breeding programs is critical and use of the Forest Productivity Council approved design is preferred.
- 2.2.4 Repressed stands. Investigations of joint production opportunities are encouraged.
- 2.2.5 Espacement trials. New trials are not eligible but investigations of joint production opportunities are encouraged.
- 2.2.6 Interactions among silvicultural treatments (e.g., fertilization, stand density, genetics). New trials are not eligible but investigations of joint production opportunities are encouraged.

2.3 Compatible management of forest products and services

Research into new ways of managing the extraction of wood products while maintaining or increasing supplies of other forest products and services (e.g., bio-energy, berries, carbon, fungi, visual quality, water) is encouraged under this topic.

The following issues are the focus for research under this topic:

- 2.3.1 Understanding the effects of existing forest and range practices on traditionally used plant communities. Research proposals, including new trials, investigating plant communities and species located in areas with accelerated timber harvesting or endangered ecosystems are encouraged.
- 2.3.2 Investigating effects of increased utilization levels of logging residues for wood and energy products on other forest products and services, including traditionally used plant communities, with particular emphasis on salvage operations in MPB-attacked stands.

Theme 3 Stand dynamics modelling

Developing and improving models and decision-support tools that predict tree and stand characteristics related to the production of forest products and services, with priority on models that support the provincial Timber Supply Review are encouraged under this topic. This research may also include estimating and evaluating the impacts of management decision impacts on products and services at multiple scales (stand, landscape, and forest).

3.1 Complex stands, including partial cutting, variable retention

Models of complex stands, including those with multiple species, multiple age cohorts, and structural diversity. Projects focused on site productivity will not be considered for funding.

The following issues are the focus for research under this topic:

- 3.1.8 Incorporating production of biomass for bio-energy in stand modelling.
- 3.1.9 Stand models designed to assist forest managers in the following BEC zones: interior (ESSF, IDF, MS, ICH, SBS, SBPS, BWBS, PP) and coastal (MH, CDF, CWH).

3.2 Wood quality

Stand management regimes are known to have strong effects on wood properties and the quality of wood for a variety of products.

The following issue is the focus for research under this topic:

- 3.2.1 Incorporating effects of silvicultural regimes on wood quality in stand models.

3.4 Predicting effects of climate change on growth and productivity

Forest ecosystems are expected to change in response to climate change. The nature of these changes is highly uncertain and subject to much speculation. But substantial changes are expected over the rotation of forest now being established following logging, fire, and the

mountain pine beetle epidemic. Forest managers require information on changes in practices that might create forests that are more resilient to climate changes. The topic includes the effects of climate change on tree and stand growth at multiple scales ranging from individual tree to forest and landscape.

The following issue is the focus for research under this topic:

- 3.4.1 Predicting the effects of climate change on tree and stand growth and incorporating these effects in stand models.

Theme 4 Response of trees and stands to disturbance

Effective management of forests requires understanding, predicting, and mitigating the effects of expected climatic changes and disturbances such as wind, fire, insects, and disease on the provision of products and services at the tree and stand level.

4.1 Stand and forest dynamics following the mountain pine beetle epidemic

This topic is directed at encouraging research aimed at understanding and quantifying how stands will develop following the extensive mountain pine beetle epidemic and subsequent salvage operations. Medium-term timber supply losses are predicted and consequently, research directed at investigating and comparing the effectiveness of ways of mitigating these losses is encouraged.

The following issues are the focus for research under this topic:

- 4.1.1 Growth, development, and health of residual stands of all ages following MPB attack, including research on the timber supply implications of losses.
- 4.1.4 Mitigating MPB losses. Research proposals are particularly invited on silvicultural treatments and regimes (e.g., fertilization of non-lodgepole pine stands, stand rehabilitation, treatment of repressed lodgepole pine stands, mixedwood management, broadleaved species management, and underplanting of attacked stands to accelerate stand development).

4.2 Estimating and/or mitigating stand-level losses

Managers require biologically robust, agent-specific models that move beyond simply estimating overall proportional reductions, including strategies and management practices that mitigate losses at an appropriate operational scale and in a cost-effective manner. This topic spans areas from silvicultural practices to resistance research and tree breeding, and deals with losses from factors such as root rot, pine rust, pine mistletoe, windthrow, and drought.

The following issues are the focus for research under this topic:

- 4.2.1 Windthrow.
- 4.2.2 Ips beetles.
- 4.2.3 Spruce bark beetle.

- 4.2.4 Root disease (*Armillaria*, *Phellinus*).
- 4.2.5 Rusts (*Dothistroma*, *Commandra*, western gall).
- 4.2.6 Spruce leader weevil.
- 4.2.7 Spruce budworm.
- 4.2.8 Dwarf mistletoe. New research projects are limited to studying infection processes and rates in the understorey of MPB-affected stands.
- 4.2.9 Wildlife and grazing impacts.
- 4.2.10 Growth and yield implications of stand management at the urban interface for fire hazard management.
- 4.2.11 Root collar weevil.

4.4 Site productivity impacts

Recent wildfires, the current MPB infestation, and the possibility of increasing incidence of such disturbances due to climate change are sufficiently widespread as to significantly impact hydrological cycles and tree growth at the site level. Forest policy makers and managers have little information about how major disturbances impact these site factors, and therefore how they impact stand establishment, growth, and health. Research under this topic aims to understand and assess the impacts of disturbance (especially extensive disturbance such as MPB mortality and salvage) on site hydrology and productivity.

The following issue is the focus for research under this topic:

- 4.4.1 Impacts of changes to site hydrology due to major disturbance (e.g., MPB mortality/salvage, fires) on productivity and growing conditions.

4.5 Influence of genetic factors on stand response to insect and disease attacks

Observations of genotypic preference and resistance in several tree species subject to insect and disease attacks have revealed promising avenues for research and possible ways of mitigating effects.

The following issues are the focus for research under this topic:

- 4.5.1 Mountain pine beetle (Lodgepole pine).
- 4.5.2 Leader weevils (spruces).
- 4.5.3 Rusts (lodgepole pine).

4.6 Effects of climate change on forest health and condition

Forest ecosystems are expected to change in response to climate change. The nature of these changes is highly uncertain and subject to much speculation. Increased fire incidence and insect

and disease attacks have been predicted. Forest managers require information on changes in practices that might create forests that are more resilient to climate changes.

The following issues are the focus for research under this topic:

- 4.6.1 Determining how insects and disease (as biotic agents of change) will respond to climate change, and the controlling variables in the response.
- 4.6.2 Methods for forecasting the effects of climate change on forest productivity, susceptibility to pests and pathogen outbreaks, and plantation health.
- 4.6.3 Effects of climate change on fire risk and behaviour.
- 4.6.4 Methods for assessing and managing the risk and uncertainty associated with climate change.

4.7 Salvaging MPB-killed timber

This topic includes forest engineering research aimed at enabling cost-effective and environmentally appropriate salvaging of timber killed by MPB. This topic does not include research related to manufacturing with timber killed by MPB (i.e., utilization of the MPB-killed logs after they reach the mill).

The following issues are the focus for research under this topic.

- 4.7.1 Forest engineering studies relating to designing efficient, cost-effective, and environmentally appropriate methods of harvesting and hauling and sorting MPB-killed trees (e.g., as logs, chips, bio-energy).
- 4.7.2 Studies to quantify the rates and amount of deterioration of MPB-killed timber for forest product use in relation to timber supply, harvest scheduling, and salvage operations.

4.8 Management responses to climate-induced ecosystem shifts

Forest ecosystems are expected to change in response to climate change. The nature of these changes is highly uncertain and subject to much speculation. But substantial changes are expected over the rotation of forest now being established following logging, fire, and the MPB epidemic. Forest managers require information on changes in practices that might create forests that are more resilient to climate changes. Research will include investigation of alternative management responses to projected changes.

The following issues are the focus for research under this topic:

- 4.8.1 Determining how the regeneration of disturbed stands can incorporate effective responses to changing climate and associated ecological changes.
- 4.8.2 Mitigating timber supply losses due to climate-change effects.
- 4.8.3 Determining timber supply and environmental implications of introducing exotic tree species.

Theme 5 Analytical techniques and models for strategic analysis

This topic includes development of new tools and improvement of existing tools to support analysis of the supply of forest products and services or the joint production of these products and services for resource analysis or local land-use planning.

5.1 Development of novel methods to integrate data and models across scales

The following issue is the focus for research under this topic:

5.1.1 Techniques for integrating various data sources for strategic analyses (e.g., forest inventory, remote sensing, GY, and non-conventional data layers such as traditional plant communities and tourism).

5.2 Development of novel methods to link GY models to process, climate, hydrology, wildlife, and other models

Development of new tools, and the improvement of existing tools to support analysis of timber and NTFP supply, or the joint production of timber and non-timber values for resource analysis or local land-use planning will be considered for support.

The following issues are the focus for research under this topic:

5.2.1 Hybrid, empirical, and process GY modelling.

5.2.2 Linking GY models with other resource models (e.g., climate, hydrology, wildlife habitat supply, NTFPs, and other models).

Theme 9 Enhancing forest values

Forests can produce a wide range of products and services. Valuation of these products and services also varies widely, from those with a well established market to those with no market and no prospect of a market in the foreseeable future. The recognition of products and services also varies over space and time. Well established products with markets can fade into insignificance and new products can become established in a relatively short period. Services without a market value can also rapidly rise to great social importance. This creates great uncertainty for forest managers, particularly when there are no clear market signals indicating social values. Research is encouraged on the valuation and management of emerging opportunities for creating additional value from provincial forests.

The research and management issues associated with this theme are currently under review, and more will be added in the next iteration of this document.

9.1 Designing and evaluating novel systems for producing biomass for bioenergy

This topic includes forest engineering research aimed at enabling cost-effective and environmentally appropriate recovery of biomass from timber harvesting operations.

The following issue is the focus for research under this topic:

9.1.1 Harvesting systems for biomass production in conjunction with timber.

9.2 Market and non-market valuation of forest products and services other than timber

Research and management issues associated with this topic are currently under review by the FPAC.

The following issue is the focus for research under this topic:

9.2.1 Exploring the potential of species not currently used as NTFPs.

9.3 Assessing the emerging market for forest-based carbon

Markets associated with the management of carbon emissions provide an opportunity to capture additional value from forest management activities. However, the questions surrounding carbon flux in forests are many and the process of establishing a market for forest-based carbon sequestration has not been established. Before research issues can be listed, a synthesis of current understanding is required.

Appendix 2 – Scoring Research Issues

Overview

A wide range of factors must be considered when determining annual research priorities. Complex interactions among factors, and differences in the reliability and importance of specific factors to each topic and research issue, make it difficult to adequately capture the full range of possibilities in a single index. However, an index can still contribute to the FPAC and SPAC determination of research priorities. The process for developing an index collates useful information regarding key factors that may influence decisions on ranking research issues. Furthermore, the index value itself provides a useful starting point for discussions on rankings by illustrating the net outcome of documented assumptions.

To be effective, a scoring index must be simple and transparent; the influence of factors chosen as input parameters on the final index value must be intuitive and easily discerned. Therefore, the parameters used to calculate the PAC scoring index are limited to those that are relatively easy to assess, and that best capture the factors that influence rankings across the entire strategy. This approach assumes that more complex factors, or factors specific to a particular issue, will be dealt with in discussions among PAC members. Thus, it is not necessary to capture *everything* in the rating index. Application of the index as a starting point for the rating process will ensure that the full expertise of the PAC is incorporated into the final rankings.

A weighted-sum index is used to score PAC research issues based on their priority for funding. Index scores and associated parameters are an input to a discussion-based process in which the PACs decide the final rankings of research issues.

A “score” for each research issue is determined using the following formula:

$$\text{Score}_j = \sum_i (C_{ij} * W_i)$$

where, for each research issue j , C_i indicates the assigned score for criterion i , and W_i indicates the *relative* weight assigned to criterion i . Currently, the FPAC uses equal weighting for all criteria. Specific recommendations on criteria and how the index should be applied are documented below to make this process, which is fundamental to establishing the annual FIA-FSP Research Call for Proposals, transparent.

Parameters

Importance to sustainable forest management

Research to support sustainable forest management is a key element of the FIA-FSP vision; therefore, importance or relevance to SFM is a key indicator of funding priority for research issues. When assessing this criterion, PAC members should consider whether obtaining answers to the questions posed by the research issue will improve the ability of practitioners to manage forest resources, improve our understanding of the issue, or support policy needs. Also, if the answers to the research issued are obtained, what would be the potential magnitude of change to forest practices?

Table A2-1 Scoring importance to sustainable forest management

Score	Description	Example
5 (high)	Research findings would provide substantial information or tools to address several key SFM issues	Improvements in growth models would lead to better prescriptions across several management units
4	Research findings would provide substantial information or tools to address one or more key SFM issues	Stand dynamics in old stands.
3 (moderate)	Research findings would provide some information or tools to address several key SFM issues	Assessing relationship between residual stand structure and understory recruitment
2	Research findings would provide some information or tools to address one or more key SFM issues	Investigations of forest products and services from repressed stands
1 (low)	Research findings would not directly inform any key SFM issues	Quantifying the value of the shovel-billed beese to the coastal forest industry

Knowledge gap

This criterion captures the size of the gap between what we currently know and what we need to know to address the issue. Factors to consider include the degree of uncertainty in current information, the nature of the gap (basic knowledge of processes, treatment response, etc.) and past research effort. This criterion is different from importance to SFM because there may be some large knowledge gaps that, if filled, would not necessarily lead to significant changes in practice or policy.

Table A2-2 Scoring knowledge gap

Score	Description	Example
5 (high)	The topic is broad in scope, very little is known and little or no research has been done	Effects of climate change on tree and stand growth
4	The topic is fairly broad in scope, little is known and few research studies have been done	Effects of forest and range management on riparian biodiversity of small streams and wetlands
3 (moderate)	Knowledge gap uncertain	Effects of increased utilization of logging residues for energy products on NTFPs
2	The topic is narrow in scope, much is already known and there has been significant previous research	Effects of stock type and stock handling on early survival and growth of interior species
1 (low)	The topic is very narrow in scope, much is already known and previous research is abundant	Response of coastal Douglas-fir to salmonberry control

Urgency

This criterion assesses the importance of receiving additional information on a research issue in a timely manner and the consequences of a delay in finding the answer (e.g., potential loss of an endangered species).

Table A2-3 Scoring urgency

Score	Description	Example
5 (high)	Results are needed quickly to avoid irreversible consequences	Research on an exotic pest species that threatens a major forest type or threatened tree species (e.g., whitebark pine)
4	Findings could have immediate application or impact	Research on MPB salvage and utilization for biomass energy
3 (moderate)	Findings could have significant short- or medium-term application or impact	Research on complex stands to guide landscape planning
2	Findings could have medium- to long-term application or impact	Research on climate change affecting tree productivity
1 (low)	Findings will not have any initial application or impact, but may in the long term	Research on soil microbial diversity

Regional significance

This criterion addresses the proportion of a region affected by a particular research issue, and at what scale likely research results could be applied within the region.

Table A2-4 Scoring regional significance

Score	Description	Example
5 (high)	Applies to entire region	Incorporating bio-energy in stand modelling
4		
3 (moderate)	Applies greater than half of the region	Root disease in the southern Interior
2		
1 (low)	Applies to small portion of region	Impacts of balsam woolly adelgid on grand fir