FIA-FSP

Forest Science Board

Sustainability Program

Eligible Research Topics 2009/10

August 2008

NOTE: The 2009/10 Call for Proposals is focused on a subset of the Sustainability Program themes and topics. Although the complete set of themes and topics is provided in Appendix 1 of this document, only those identified as eligible for funding are included in the 2009/10 Call for Proposals.

Table of Contents

NOTE: The 2009/10 Call for Proposals is focused on a subset of the Sustainability Program themes and topics. Although the complete set of themes and topics is provided in Appendix 1 of this document, only those identified as eligible for funding are included in the 2009/10 Call for Proposals.

Sustainability Program
Eligible Research Topics 2009/10

Introduction

The research topics and issues described in this document are those eligible for funding under the Sustainability funding category of the Forest Investment Account Forest Science Program (FIA-FSP) in 2009/10. For simplicity of presentation, this document includes only the research topics and issues eligible for funding in 2009/10[1]. Other information related to the Call for Proposals is available from the PricewaterhouseCoopers website (www.bcfsp.com).

Research issues are organized by theme and topic, with the eligibility of each research issue specified by geographic region. The regions used are those of the Ministry of Forests and Range: Coast (C), Northern Interior (NI), and Southern Interior (SI). A map showing these regions is available at: http://www.for.gov.bc.ca/mof/maps/regdis/

The ten-year research strategy of the SPAC, *Sustainability Program Research Strategy 2008-2018,* will contain the complete list of research topics and will provide context for understanding research priorities. The Strategy is currently being updated and the final version will be available in December 2008. The complete list of themes, topics, and research issues considered in preparation for this Call for Proposals is presented in Appendix 1.

Submitting proposals

Proposals for research must be submitted using the appropriate proposal templates and guidelines, which are available at www.bcfsp.com.

[1] Note that the numbering of research topics does not imply ranking.

Eligible Topics and Research Issues for 2009/10

This list of research issues eligible for funding in 2009/10 are a subset of those identified in the Sustainability Program ten-year strategy and is provided by the SPAC at the request of the FIA-FSP Forest Science Board (FSB). The FSB made this request to identify the highest priority research issues as a means of ensuring that the FIA-FSP funds are used efficiently and effectively.

Theme 1.0 Ecosystem structure, composition, and processes related to sustainable management of forests

Biophysical information provides the fundamental knowledge for managing and developing decision support tools and for the subsequent development of indicators. This is the most basic form of research within the Sustainability Program. In addition to other experimental approaches, research that uses variable-retention harvesting and/or alternative silvicultural systems as a treatment framework for experimental research will be considered eligible for funding in all topics in this theme, and may be considered especially appropriate in some cases.

1.3 Maintaining biodiversity at the landscape scale

Maintenance of biodiversity at a broad scale is related to the maintenance of habitat attributes for a broad array of species using a "coarse filter approach" of allocating representative ecosystems across the landscape and providing connectivity between these patches. The scientific/technical basis for allocating these patches across the landscape is poorly established. A common theme or question is "single large or several small" (SLOSS) in reference to the trade-off inherent in distributing small patches across the landscape (potentially improving representation, but fragmenting the area) versus amalgamating patches into one large unit (thus providing relatively larger areas of undisturbed habitat that some species may require). The issue of scale further complicates this question in that different organisms require different areas of suitable habitat—a large patch for one species might only be a small patch for another. There is currently little authoritative information to guide selection of scale, amount, or distribution of desired habitats across the landscape, so different consultative processes in British Columbia are prescribing different approaches.

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 1.3	C	NI	SI
1	Effects of managing for landscape-level attributes (e.g., seral stage distribution, patch size frequency and distribution, tree species composition, ecosystem representation in reserves, non-timber resources, and riparian networks) on the achievement of coarse-filter biodiversity conservation objectives. Research proposals are particularly invited on the salvage, rehabilitation, or retention of stands killed by MPB, although research addressing other management issues will be equally considered.	✓	✓	✓
2	Effects of current management (e.g., variable retention, salvage and rehabilitation of stands killed by MPB) and traditional First Nations land-management practices on the creation or maintenance of structure, composition, and ecological processes at landscape scales.	✓	✓	✓

3	Effects of current management (e.g., variable retention, salvage and rehabilitation of stands killed by MPB, single-stem removal) and traditional First Nations land-management practices on individual species or groups of species at the landscape scale.	✓	✓	✓

1.5 Natural disturbance ecology

Natural disturbance ecology includes studies on the role of events such as windthrow, wildfire, floods, landslides, and insect and disease-caused tree mortality on the structure, composition and/or function of ecosystems, and the patterning of ecosystems on the landscape. The diversity of life in an ecosystem has evolved in response to the forces of natural disturbance. Maintaining biodiversity and ecosystem integrity requires that we understand the relationships between natural disturbance, ecosystem structure, composition and pattern, and habitat requirements of the organisms living in a given ecosystem. This will enable us to design and test human interventions in nature that are informed by an improved understanding of natural disturbance patterns and processes. In addition to providing information that is generally applicable throughout B.C., some of the questions about the tenets of "ecosystem-based management" (EBM) might also be addressed by research directed at the preceding.

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 1.5	**C**	**NI**	**SI**
1	Characterization of historic natural disturbance patterns (e.g., fires, wind, insect and disease infestations) in different areas of the province. Research proposals are particularly invited to examine the dominant type, intensity, frequency, pattern, and scale at which disturbances have occurred, and to outline rates of tree mortality, tree fall, and tree decomposition, although research addressing other aspects of natural disturbance patterns will be equally considered.		✓	✓
2	Effectiveness of emulating patterns of natural disturbance in managing for biodiversity.	✓	✓	✓
3	Effects of natural disturbance processes on soil productivity, forest regeneration, forest succession, and wildlife habitat at both landscape and site levels.		✓	✓
4	Comparisons of the structure and composition of managed and unmanaged forests. Research proposals are particularly invited on forest management of drier ecosystems, although research addressing other ecosystems will be equally considered.			✓
5	Effects of insects, disease, and subsequent forest regeneration on structural, compositional, and spatial diversity of forests; wildlife habitat; and occurrence of wildfire.		✓	✓
6	Contribution of large areas of dead trees (e.g., killed by insects, disease, drought, or windthrow) to resource management objectives.		✓	✓
8	Effects of grassland vegetation succession (e.g., forest in-growth and encroachment) on soil productivity and forage production for livestock and wildlife habitat at both landscape and site levels.			✓

Theme 2.0 Decision support tools for sustainable forest and range management

Approaches to making land-management decisions have changed markedly over the past few decades. Decision makers have grown increasingly aware of risks that accompany their decisions; the types of risks that need to be considered have also become more numerous, and the requirement for transparency in decisions has become standard. Tools used by modern era decision makers vary from simple "decision trees" to complex simulation models. Some tools are used to "record" the decision process while still others are used to derive salient information from enormous amounts of data and, by doing so, support decision making. Sustainable forest management is complex, involving a large amount of information about numerous resource values; the resulting land-management decisions can affect a wide variety of stakeholders. For these reasons, tools are required to support and document the decision-making approach thereby allowing for the required transparency and availability of a basis for monitoring results of decisions.

2.6 Ecological risk assessment frameworks

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 2.6	C	NI	SI
1	Development of frameworks and/or models for evaluating the resiliency and sensitivity of ecosystems to change and disturbances. Research proposals are particularly invited on the hydrological, geophysical, and aquatic resources at the watershed and landscape levels, although research addressing other management issues will be equally considered.		✓	✓
2	Developing integrated risk assessment frameworks for evaluating outcomes from trade-off analysis.		✓	✓

Theme 3.0 Indicators, thresholds, and monitoring systems

Indicator development enables assessments about whether management practices are meeting management objectives. However, the assessments are rarely conducted in a manner which allows for discrete or unqualified answers, so the development of thresholds has become crucial as a measure of risk. Topics pertaining to indicator development include indicators of ecological, socio-economic, and socio-cultural sustainability; identification of indicator thresholds; and methods to balance ecological, socio-economic, and socio-cultural indicators.

3.3 Socio-economic sustainability

Sustainable forestry today is a matter of balance. It involves making decisions about environmental, economic, and social values. These decisions are reflected in strategic land use plans developed through public planning processes and implemented by government, licensees, and other stakeholders through operational plans.

Effective implementation of these plans requires monitoring and reporting on a set of environmental, economic, and social indicators. These indicators must be representative, reliable,

and feasible. Collectively, the degree to which indicator targets are being met gives a measure of whether the values are being maintained.

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 3.3	C	NI	SI
1	Development of methods allowing for appropriate and effective participation of stakeholders, First Nations, and public in the valuation of non-timber resource uses (i.e., both consumptive and non-consumptive) and the process for their effective inclusion in forest and range management plans.	✓	✓	✓
2	Effects of social grouping and structure (e.g., stakeholder, First Nation, and public) on the relative importance of social, economic, and ecological values in defining sustainable forest and range management.	✓	✓	✓
3	Development of methods to aggregate social and economic data for inclusion in forest and range land-use planning processes.	✓	✓	✓
4	Development of approaches to quantify impacts on, and determine compensation processes for, parties affected by forest and range management activities.	✓	✓	✓

3.5 Socio-cultural sustainability

The health of communities can be measured by the vitality of the resources around them. Rural and First Nation communities will have unique socio-cultural ideas pertaining to the definition of uses and what constitutes sustainability. Traditional use of forest resources should be considered and researched as a measure of sustainability. In particular, the perceptions of each rural and First Nation community regarding the impacts of the MPB outbreak (and associated accelerated logging) on sustainability are likely to vary in reflection of many factors.

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 3.5	C	NI	SI
1	Development of indicators for assessing the well-being and resiliency of human communities affected by forest and range management and the respective tenure agreements.	✓	✓	✓
2	Development of methods to use traditional and/or local knowledge, and to engage rural communities and First Nations, in the development of indicators for sustainable forest management.	✓	✓	✓
3	Assessment of the use of social and cultural indicators in policy, planning, and operations associated with sustainable forest management.	✓	✓	✓

Theme 4.0 Scientific information to inform the development or refinement of policy, regulations, and practices

Research is required on topics linked to provincial or federal acts, regulations, policies, or practice requirements. Proposals should identify links with the regulatory mechanism, and clearly define how results will assist in developing, evaluating or improving the effectiveness of mandated activities. Key legislation includes the federal *Species at Risk Act* (SARA), the provincial *Forest and Range Practices Act* (FRPA), the provincial *Wildlife Amendment Act*, and the *Fisheries Act*.

4.2 Impact of changes in forest harvest levels on First Nations and rural community resiliency

Research is needed to help understand the impacts of potential changes in forest harvest levels on rural community resiliency.

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 4.2	C	NI	SI
1	Development and evaluation of strategies and mechanisms for enhancing resiliency of First Nations and rural communities in the face of changing timber harvest levels.	✓	✓	✓
2	Effects of policies, regulations, and practices on First Nations and rural community resiliency (e.g., how do communities adapt to changes in harvest levels).	✓	✓	✓
3	Development of knowledge, process, and tools to improve consideration of the resiliency of First Nations and rural communities in AAC determination.	✓	✓	✓
5	Evaluation of effectiveness of policy, regulations, and practices in achieving socio-economic objectives.	✓	✓	✓

4.4 Management of non-timber forest resources[2]

The forest has many values beyond conventional timber products, ranging from cultural and subsistence, to recreational and commercial. Non-timber forest products, such as wild edibles, florals, craft materials, and medicinals, as well as biomass for bioenergy, and subsistence wildlife harvest, are not adequately addressed within forest management and planning. Information is required to inform policy that would both ensure ethical and sustainable use of these resources, as well as enable opportunities for their development. Knowledge gaps include basic ecological information on many of the species, sustainable harvest levels, methods of monitoring both ecological and socio-economic effects of harvest or non-harvest, and opportunities and barriers for compatible management for both timber and non-timber values.

[2] Non-timber forest resources are all of the resources and associated services of the forest other than conventional timber and wood fibre products. Based on the definition provided by the Centre for Non-Timber Resources at Royals Roads University (http://cntr.royalroads.ca/about_ntfp_sector/definition_overview).

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 4.4	C	N I	S I
1	Development of information to enable policy, regulations, and practices addressing the sustainable management of non-timber forest resources.	✓	✓	✓
2	Determination of habitat requirements for non-timber forest products (e.g., salal, pine mushrooms, huckleberry) defined at the appropriate scale.	✓	✓	✓
3	Effects of forest and range management (e.g., forest road development, salvage and rehabilitation of stands killed by MPB, livestock use, exclusion/re-introduction of fire) on the sustainability of non-timber forest products.	✓	✓	✓

4.6 Wildlife habitat management in response to forest and range management and climate change

The following research issues are eligible for funding in 2009/10:

	Research issues for topic 4.6	C	N I	S I
1	Development and evaluation of knowledge to support forest and range policy, regulations, and practices that promote availability of and access to wildlife for subsistence purposes.	✓	✓	✓
2	Evaluation of the effects of increased timber harvest levels and road access on availability of wildlife for subsistence.		✓	✓
3	Evaluation of climatic trends (e.g., milder winters) for effects on wildlife and its availability for subsistence.	✓	✓	✓

Appendix 1 2009/10 Sustainability Program research strategy themes, topics and research issues

This appendix contains the complete set of themes, topics, and research issues considered for the 2009/10 Call for Proposals, and represents an interim position between historic (2006-2016) and new (2008-2018) versions of the Sustainability Program research strategy. Only a subset of this list is eligible for funding, as outlined in the main body of this document.

Table A1 **2009/10 Complete list of Sustainability Program themes, topics, and research issues.**
Columns 4 to 7 indicate relevance to the Future Forest Ecosystem Initiative (FFEI), identified First Nations interests (FN), Mountain Pine Beetle (MPB), and range. Numbers missing from the sequence in columns 1 and 3 indicate that the associated topic or research issue has been retired, or moved to another section of the hierarchy.

#	Theme/Topic		Research Issue	FFEI	FN	MPB	Range
1.0	**Ecosystem structure, composition, and processes related to the sustainable management of forests**						
1.1	Riparian ecology and stream management	1	Sensitivity of small stream and wetland ecosystems to alternative riparian management strategies (e.g., livestock use). Research needs are focused particularly on water quality, channel morphology, and biological effects		FN	MPB	Range
		2	Riparian biodiversity of small streams and wetlands, especially in dry interior ecosystems				
		3	Significance of small streams as sources of material and energy to downstream reaches			MPB	
		4	Consequences of managing the Mountain Pine Beetle epidemic (e.g., salvage, mortality, rehabilitation, and other related management activities) on the riparian character and function of small streams, wetlands, and other aquatic habitats. Research needs are focused particularly on channel morphology, stream temperature, and organic matter dynamics	FFEI	FN	MPB	
1.2	Soil biology, ecology, and productivity	1	Relationships between soil biological, chemical, and physical attributes and processes. Research needs are particularly focused on resilience of, and critical thresholds for, site productivity		FN	MPB	
		2	Effects of forest management (e.g., coarse woody debris retention, green tree retention, soil disturbance allowances, salvage of MPB-killed stands) on soil ecology and site productivity. Research needs are particularly focused on biological, chemical, and physical attributes and processes	FFEI			
		3	Impacts of natural disturbance (e.g., Mountain Pine Beetle epidemic, fire) and/or climate change on soil organisms, nutrient cycling and availability, and other soil processes	FFEI	FN	MPB	Range
		5	Improving the scientific basis for determining the sensitivity of soil as defined in the forest planning and practices regulations				

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
1.3	Maintaining biodiversity at the landscape scale	1	Effects of managing for landscape-level attributes (e.g., seral stage distribution, patch size frequency and distribution, tree species composition, ecosystem representation in reserves, non-timber resources, and riparian networks) on the achievement of coarse-filter biodiversity conservation objectives. Research proposals are particularly invited on the salvage, rehabilitation, or retention of stands killed by MPB, although research addressing other management issues will be equally considered	FFEI	FN	MPB	
		2	Effects of current management (e.g., variable retention, salvage and rehabilitation of stands killed by MPB) and traditional First Nations land-management practices on the creation or maintenance of structure, composition, and ecological processes at landscape scales	FFEI	FN	MPB	
		3	Effects of current management (e.g., variable retention, salvage and rehabilitation of stands killed by Mountain Pine Beetle) and traditional First Nations land-management practices on individual species or groups of species at the landscape scale	FFEI	FN	MPB	
1.4	Effectiveness of site-level structures in maintaining biodiversity and rangeland habitats typified by grass and shrub cover	1	Contribution of site-level attributes to wildlife habitat needs and maintenance of biodiversity. Research needs are particularly focused on identifying appropriate site-level targets and configurations of site-level structures in cutblocks including those resulting from salvage of sites killed by Mountain Pine Beetle	FFEI	FN	MPB	Range
		2	Effectiveness of management strategies in creating site-level structures and in the maintenance of site-level biodiversity, non-timber forest products, and rangeland habitat	FFEI	FN	MPB	Range
		3	Identification of appropriate targets and configurations of site-level structures to maintain biodiversity in dry forest and open range (i.e., grassland, shrubland)	FFEI	FN	MPB	Range
		5	Effectiveness of riparian buffers and their design in maintaining site-level wildlife habitat and biodiversity. Research needs are particularly focused on upland, riparian, and aquatic habitats		FN	MPB	Range
1.5	Natural disturbance ecology	1	Characterization of historic natural disturbance patterns (e.g., fires, wind, insect and disease infestations) in different areas of the province. Research proposals are particularly invited to examine the dominant type, intensity, frequency, pattern, and scale at which disturbances have occurred, and to outline rates of tree mortality, tree fall, and tree decomposition, although research addressing other aspects of natural disturbance patterns will be equally considered	FFEI		MPB	
		2	Effectiveness of emulating patterns of natural disturbance in managing for biodiversity	FFEI		MPB	

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
		3	Effects of natural disturbance processes on soil productivity, forest regeneration, forest succession, and wildlife habitat at both landscape and site levels		FN	MPB	
		4	Comparisons of the structure and composition of managed and unmanaged forests. Research proposals are particularly invited on forest management of drier ecosystems, although research addressing other ecosystems will be equally considered	FFEI	FN	MPB	
		5	Effects of insects, disease, and subsequent forest regeneration on structural, compositional, and spatial diversity of forests; wildlife habitat; and occurrence of wildfire	FFEI	FN	MPB	
		6	Contribution of large areas of dead trees (e.g., killed by insects, disease, drought, or windthrow) to resource management objectives		FN	MPB	
		8	Effects of grassland vegetation succession (e.g., forest in-growth and encroachment) on soil productivity and forage production for livestock and wildlife habitat at both landscape and site levels				Range
1.6	Watershed function	1	Connectivity and linkages between up-slope disturbances including MPB mortality and MPB salvage and stream channel response			MPB	
		2	Effects of road construction and layout on streamflow and watershed processes	FFEI	FN	MPB	
		3	Developing methods for landslide risk assessment and landslide avoidance				
		4	The implications of different patterns, levels and methods of tree removal (e.g., variable retention, cable logging versus helicopter-grapple logging) on slope stability	FFEI			
		5	Evaluating the physical, biological and cumulative effects of forest management (including salvage harvesting), natural disturbance (e.g., fire, mass wasting, MPB mortality), and range practices on watershed processes (e.g., streamflow quantity and timing, water quality, water table response), channel morphology, and aquatic habitat (e.g., salmon spawning grounds)	FFEI	FN	MPB	Range
		7	How large woody debris recruitment relates to stream channel type and state				
		8	In what ways do First Nation traditional management techniques influence watershed functions (e.g., fire, stream alteration for fishing weirs), how extensive were (are) they, and do they have contemporary application for watershed management?		FN		

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
1.7	Invasive species (plants, animals, pathogens)	1	Impacts of exotic (alien invasive) species on diversity, productivity and resilience of grassland and forest ecosystems	FFEI			Range
		2	Characterizing population growth and range expansion of invasive species (including potentially harmful pests and pathogens), with an emphasis on early detection, prediction and control, and responses to forest and range practices			MPB	Range
		4	Detection and identification of invasive pathways and their ecological mechanisms, particularly as these are affected by forest and range practices				
		5	Characterizing the mechanism of interaction (e.g., predation and competition) between invasive species and species at risk				
1.8	Ecological restoration	1	Evaluating the effectiveness of restoration techniques on mitigating forest encroachment and in-growth in NDT4 ecosystems		FN		Range
		2	Evaluating the effectiveness of diversity enhancing techniques, such as introducing snags and gaps, as a means of restoring biodiversity in stands or landscapes dominated by homogeneous second growth forests		FN		
		3	Evaluating the effectiveness of methods for controlling the populations or impacts of invasive species		FN		Range
		4	Evaluating the effectiveness of in-stream aquatic habitat restoration techniques		FN		
		5	Evaluating the effectiveness of riparian habitat restoration techniques		FN	MPB	Range
		6	Evaluating the effectiveness of soil rehabilitation techniques in re-establishing soil productivity		FN		
		7	Utilizing traditional knowledge to understand the pre-harvest values of the land to define rehabilitation practices that result in desired future landscapes and promote important species associations at different stages of regeneration		FN	MPB	
1.9	Climate Change	1	Identification of the species most affected by climate change that subsequently have the greatest impact on ecosystem composition and function. Research needs are particularly focused on species response, and the controlling variables causing species response to climate change	FFEI			
		2	Understanding how biological communities and ecological processes, at both the stand and landscape levels, might respond to projected changes in climate	FFEI			

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
		3	The influence of climate change on the interactions among wildland fire and wildland fire behaviour, the appropriate management responses, and the ultimate impacts of wildland fire on other resources	FFEI	FN		
		4	Effects of climate change on the range, distribution, and impact of exotic and invasive species (e.g., role of insects and disease as biotic agents of change, and the controlling variables)	FFEI	FN	MPB	
2.0	**Decision support Tools for sustainable forest management**						
2.1	Habitat supply modeling	1	Developing, calibrating, and validating habitat models related to priorities identified in theme 1.0 (Ecosystem structure, function, and processes...), topic 3.2 (Indicator thresholds of ecological sustainability), and for decision support related to priorities in topic 4.1 (Species-at-risk recovery research) and 4.4 (Management of Non-timber Forest Products)		FN	MPB	
		2	Evaluate the effectiveness of fish habitat capability models in identifying high value fish habitat				
		3	Development of tools to explore the spatial and temporal dynamics of habitat values in both natural and managed forest stands at both stand and landscape levels. Tools focused within stands may include multi-species irregular stand structures and/or patterns resulting from variable-retention harvesting. Needs are particularly focused on the development of new, or the adaptation of existing, tools that use or improve the utility of existing inventory and other readily available data and that are responsive to external variables (e.g., stands killed by Mountain Pine Beetle, projections of climate change)	FFEI			
2.2	Population viability and spatially explicit population models	1	Developing spatially explicit habitat supply models for population viability analysis (PVA) applied to species at risk as outlined in topic 4.1 (Species-at-risk recovery)				
2.3	Watershed response	1	Developing, refining and validating spatially explicit watershed models. Research needs are particularly focused on: the effects of forest disturbances including mortality and salvage of stands killed by Mountain Pine Beetle, on peak flow, timing of flow, volume of flow, effect on critical aquatic habitat, and effect on ground water, and water quality		FN	MPB	
2.4	Refine ecological classification system	1	Updating, reconciling, and refining BEC or its components	FFEI	FN		
		2	Developing methods for identifying rare ecosystems				
		3	Developing, refining and validating classification systems for aquatic ecosystems				

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
		4	Define seral stages in all ecological sites grazed by cattle and wild ungulates				Range
2.5	Watershed stewardship tools	1	Predicting stream temperature regimes to support designation of temperature sensitive streams				
2.6	Ecological Risk Assessment Frameworks	1	Development of frameworks and/or models for evaluating the resiliency and sensitivity of ecosystems to change and disturbances. Research proposals are particularly invited on the hydrological, geophysical, and aquatic resources at the watershed and landscape levels, although research addressing other management issues will be equally considered	FFEI	FN	MPB	
		2	Developing integrated risk assessment frameworks for evaluating outcomes from trade-off analysis				
2.7	Cumulative impacts	1	What are the implications for ecosystem function of multiple resource uses (e.g., forest management, oil and gas exploration and development, access, and recreation)	FFEI	FN		
		2	What are the implications for social-cultural values of multiple resource uses (e.g., forest management, oil and gas exploration and development, access, and recreation)	FFEI	FN		
		3	Tools for strategic planning that integrate time/space/scales for assessing cumulative effects of multiple resource uses	FFEI	FN		
3.0	**Indicators, thresholds, and monitoring systems**						
3.1	Development of indicators and monitoring systems	1	How useful are the indicators and monitoring systems being developed for each of the 11 FRPA values as part of the Forest Resource Evaluation Program (FREP)?	FFEI			
		7	What aquatic species (benthic invertebrates, algae, fish, etc.) can be used as indicators of watershed health?				
		8	Developing and evaluating uses of remote sensing, information systems, and innovative technology to assess landscape- and stand-level characteristics			MPB	
		9	What are useful indicators and monitoring systems to detect impacts on species most affected by climate change that subsequently have the greatest impact on ecosystem composition and function?	FFEI			
		10	Are there species or groups of species that can be used to infer habitat condition for a variety of other species – if so, which ones?		FN		

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
3.2	Indicator thresholds of ecological sustainability	1	Defining the response curves for biodiversity indicators to assist in identifying thresholds for maintaining ecological resilience	FFEI	FN		
		2	Determining the likely range of natural variability (biological and biophysical) of coarse- through fine-filter indicators to aid in the determination of management thresholds	FFEI			
		3	Defining biophysical or indigenous knowledge-based criteria suitable for assessing the ecological representation, landscape, and site attributes needed to maintain wildlife and biodiversity, and how best to allocate them across the landscape?		FN		
		4	Assessing potential indicator targets and management thresholds for sensitive species and ecological communities, especially those species and communities designated under the Forest and Range Practices Act and regulations as: "at risk", "regionally significant", or "specified ungulates". (Also see 2.2 - Population viability and spatially explicit population models, and 4.1 – Species-at-risk recovery research)				
		5	Clarifying and (or) refining thresholds for indicators of change in watershed functioning (e.g., road density, equivalent clear-cut area)				
3.3	Indicators for socio-economic sustainability	1	Development of methods allowing for appropriate and effective participation of stakeholders, First Nations, and public in the valuation of non-timber resource uses (i.e., both consumptive and non-consumptive) and the process for their effective inclusion in forest and land management plans.		FN		
		2	Effects of social grouping and structure (e.g., stakeholder, First Nation, and public) on the relative importance of social, economic, and ecological values in defining sustainable forest and range management		FN		
		3	Development of methods to aggregate social and economic data for inclusion in forest and range land-use planning processes		FN		
		4	Development of approaches to quantify impacts on, and determine compensation processes for, parties affected by forest and range management activities		FN		
3.4	Methods for balancing social, economic, cultural and environmental indicators of sustainability	1	Process and criteria for setting thresholds, establishing targets, and balancing ecological, economic, and social indicators		FN		
		2	Implications and management of changing access patterns on non-timber resource use (e.g. fish, wildlife, recreation)		FN	MPB	
		3	Development and assessment of methods for assessing public attitudes, values and preference related to resource management policy, actions and outcomes				

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
		4	Developing methods for the inclusion of First Nations-specific values into planning processes		FN		
3.5	Indicators for socio-cultural sustainability	1	Development of indicators for assessing the well-being and resiliency of human communities affected by forest and range management and the respective tenure agreements		FN		
		2	Development of methods to use traditional and/or local knowledge, and to engage rural communities and First Nations, in the development of indicators for sustainable forest management		FN		
		3	Assessment of the use of social and cultural indicators in policy, planning, and operations associated with sustainable forest management				
4.0	**Scientific information to inform the development or refinement of policy, regulations, and practices**						
4.1	Species-at-risk recovery research	1	Determination of critical habitat requirements for species at risk, defined at the appropriate level of habitat classification			MPB	
		2	Clarification and/or assessment of threats to species or ecosystems at risk, particularly those with cumulative effects or where empirical evidence is apparently conflicting		FN	MPB	Range
		3	Effects of management practices (e.g., forest road development, salvage and rehabilitation of stands killed by Mountain Pine Beetle, livestock use, exclusion/re-introduction of fire) on the ecology of species at risk	FFEI		MPB	Range
		4	Determination of how specific threats to habitat may be mitigated or how recovery mechanisms could be developed to assist recovery of species at risk			MPB	Range
4.2	Impact of changes in forest harvest levels on First Nations and rural community resiliency	1	Development and evaluation of strategies and mechanisms for enhancing resiliency of First Nations and rural communities in the face of changing timber harvest levels		FN	MPB	
		2	Effects of policies, regulations, and practices on First Nations and rural community resiliency (e.g., how do communities adapt to changes in harvest levels)		FN	MPB	
		3	Development of knowledge, process, and tools to improve consideration of the resiliency of First Nations and rural communities in AAC determination		FN	MPB	
		5	Evaluation of effectiveness of policy, regulations, and practices in achieving socio-economic objectives		FN	MPB	

#	Theme/Topic	Research Issue		FFEI	FN	MPB	Range
4.3	Ecosystem-based management	1	Comparing the effectiveness of EBM with current planning and management approaches		FN		
		2	Effectiveness of protected areas and inoperable areas for meeting ecosystem objectives				
		3	Ability for second growth (including second growth following variable retention harvesting) to meet ecosystem objectives		FN		
4.4	Management of non-timber forest resources	1	Development of information to enable policy, regulations, and practices addressing the sustainable management of non-timber forest resources		FN		
		2	Determination of habitat requirements for non-timber forest products (e.g., salal, pine mushrooms, huckleberry) defined at the appropriate scale		FN		
		3	Effects of forest and range management (e.g., forest road development, salvage and rehabilitation of stands killed by MPB, livestock use, exclusion/re-introduction of fire) on the sustainability of non-timber forest products		FN	MPB	
4.5	Biomass for bio-energy	1	Environmental consequences of utilization of harvesting debris and/or increased removals of biomass (normally left on-site) from harvesting or silviculture sites for the purposes of bio-energy		FN		
4.6	Wildlife habitat management in response to intensive forest management and changing climate	1	Development and evaluation of knowledge to support forest and range policy, regulations, and practices that promote availability of and access to wildlife for subsistence purposes		FN	MPB	
		2	Evaluation of the effects of increased timber harvest levels and road access on availability of wildlife for subsistence				
		3	Evaluation of climatic trends (e.g., milder winters) for effects on wildlife and its availability for subsistence				