



Babine Watershed Monitoring Trust

2009 Annual Monitoring Plan

FINAL DRAFT

Babine Watershed Monitoring Trust
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1. Introduction

The Babine Watershed Monitoring Trust (BWMT) is directed through its Trust Agreement Document to be responsible for “*planning, prioritising, directing, facilitating and funding impartial monitoring research of the implementation and effectiveness of public land use plans and related natural resources management activities in the Babine Watershed*”; and “*providing credible monitoring research results as part of a formal rigorous adaptive management process that enables continuous improvement of public land use plans resulting in better management of environmental values in the Babine Watershed.*”

This document constitutes the 2009 Annual Monitoring Plan (AMP) for the Babine Watershed Monitoring Trust, which the Trustees are required to produce under Section 10.2 and Schedule C of the BWMT Agreement. The first Annual Monitoring Plan was approved by the BWMT in July of 2005. Since then, AMPs have been completed annually. Each year, some planned projects have not been completed and have carried over to subsequent years for a variety of reasons. These projects remain a priority of the BWMT, and appear in subsequent AMPs.

The 2009 AMP sets out the year’s budget, lists high-priority monitoring projects, describes projects approved for direct funding, and identifies topics requiring additional funding. The plan provides a synopsis and rationale for each approved project. The BWMT allocates funds to monitoring projects using the process for determining priorities and costs prescribed in the BWMT Agreement and described in the Babine Watershed Monitoring Framework (see www.babinetrust.ca).

2. Budget

The funds available from the Babine Watershed Monitoring Trust Revenue Trust Account (BWMT Agreement, Section 3.1.3) are set out in Table 1. The BWMT has received one major private donation as of February 2009 with a total value of \$35,000. These funds are available to directly support the 2009 AMP, and are matched by the remaining provincial government funds under the 2:1 private/public ratio rule. There are also funds carried over from 2008—unallocated or project surpluses—that are available for 2009.

Table 1. Budget for 2009.

	Contributed	Available under the 2:1 private/public ratio rule	Funds Available to be Distributed	Banked for 2010
Revenue Trust Account				
Private donations as of February 2009	\$35,000.00	\$35,000.00		
Donation 2008	\$350.00	\$350.00		
Levered funds: 2008	\$0.00	\$0.00		
BC gov't – remaining funds	\$8,523.10	\$8,523.10		\$0.00
Revenue Trust Account Funds Available		\$43,873.10	\$43,873.10	
Other Funds				
Banked Funds 2008			\$6,860.70	
Interest Income 2008			\$442.74	
Other Funds Available			\$7,303.44	
Total Funds Available			\$51,176.54	
Expenses				
Administrative & Technical Support			\$16,150.00	
New Projects 2009 (4 projects)			\$33,825.00	
Total Expenses			\$49,975.00	
Funds Available minus Expenses			\$1,201.54	\$1,201.54

3. Monitoring Priorities

The Trust supports monitoring projects, maintains the Babine Watershed Monitoring Framework and administers the monitoring program.

The Monitoring Priority Tables generated by the Monitoring Framework show priorities and associated costs for the following types of monitoring:

1. collecting indicator data (implementation monitoring),
2. monitoring to improve knowledge and reduce uncertainty (validation monitoring/research),
3. monitoring to detect negative consequences (effectiveness monitoring).

Appendix 1 summarises funding decisions for high-priority monitoring topics in each of the three types. The order within each list indicates relative priority assigned by the Monitoring Framework. The tables also provide a brief rationale for each funding decision. Not all topics can be funded. Higher-priority topics will usually be funded preferentially. When a lower-priority topic is selected for funding, a rationale is provided as to why the higher-priority topics were not chosen. All non-funded topics lower on ranked lists are not funded because of insufficient funds.

All feasible projects in the 5-year priority list in Appendix 1 will have been completed, or have funding committed for completion, by March 2010.

4. Approved Monitoring Projects for 2009

4.1 Ongoing Projects from Previous Years

Three projects will be completed by March 31, 2009, and are awaiting final reports and/or presentations and invoicing (Table 2). Three further projects have been held over to 2009 because of late start dates (Table 2). One project has been deferred from previous years (Table 2). The *Wilderness Value of Babine River Corridor* project will be deferred until the BC Parks Management Plan for Babine River Corridor is completed and implemented in 2009. After implementing the plan, BC Parks is interested in collaborating with the BWMT to monitor wilderness value. Deferring this project presents benefits in terms of in-kind funding and synergies.

Table 2. Projects carried from 2008.

Project Number	Title	Status	Funding Committed
2007-1	Human/bear Interaction and Open Road Density	Will be completed by March 31, 2009.	\$10,000
2008-3	Mountain Goat Habitat	Will be completed by March 31, 2009.	\$7,277.50
2008-4	Bull Trout Habitat	Will be completed by March 31, 2009.	\$10,250
2008-5	Visual Quality of Babine River Corridor	Timeline extended to March 2010.	\$5,125
2008-1	Update Knowledge Base and Priority Tables	Timeline extended to December 2009.	\$12,300
2008-2	Framework Manual and Extension	Timeline extended to December 2009.	\$5,125
2006-2	Water Quality in Relation to Stream Crossings	Work completed; final report not yet submitted	\$5,000
2006-3	Wilderness Value of Babine River Corridor	Deferred until completion of BC Parks Management Plan (expected by December 2009)	\$15,000
Total			\$50,097.50

4.2 New Projects

The allocation of available funds for this year is shown in Table 3. Four new monitoring projects are approved for full funding by the BWMT in 2009. These projects will investigate rare ecosystems, bull trout habitat, human/grizzly bear interactions and grizzly bear habitat. Funds are also approved for administrative and technical support and fundraising.

Table 3. Approved projects for 2009. “A” designates administrative and technical support.

Activity	Project Number	Title	Funding	% of Total
New projects	2009-1	Rare Ecosystems Phase I	\$3,075	6
	2009-2	Human/Grizzly Bear Interaction and Education Baseline Data	\$10,250	21
	2009-3	Grizzly Bear Habitat	\$10,250	21
	2009-4	Bull Trout Habitat Phase II	\$10,250	21
Administration	2009-A1	Technical Support	\$6,150	12
	2009-A2	Administrative Support	\$8,000	16
	2009-A3	Funding solicitation	\$2,000	4
Total			\$49,975	

New and ongoing projects are described in the following synopses. Synopses for completed projects are included in Appendix 2 until the results have been incorporated into the Knowledge Base and included in other processes (e.g. BWMT Plan Amendment Process and Criteria). Subsections listing consequences for the Knowledge Base and consequences for management summarise actions precipitated by each project.

5. 2009 New Project Synopses

Project 2009-1: Rare Ecosystems Phase I

Abstract:

This project will collect implementation data to allow an assessment of the risk and uncertainty associated with rare ecosystems. It will examine the percent of rare ecosystems that are in an appropriate seral stage to include the plant communities for which they are designated. Two independent sources of data are available. First, Sybille Haeussler identified rare ecosystems polygons in the Bulkley and Kispiox several years ago (some of this information was included in the Bulkley State of the Forest report). Second, predictive ecosystem mapping (PEM) will be completed by July 2009. Comparing the two approaches will be useful for determining monitoring methodology: PEM will likely be able to define rare ecosystems only for large polygons plus very wet or very dry ecosystems; Sybille's analysis is more intensive, but may not cover the entire Babine.

Phase I will investigate available information in hard and digital formats and assess the need for further work, including a comparison of the two methods. If necessary, Phase II (not funded in 2009) will complete analyses and compare the two approaches as recommended by Phase I. Phase II is contingent upon the recommendations of Phase I and future BWMT funding.

Status: Initiated in 2009.

Geographic scope: Babine watershed.

Objectives listed in land-use plans: The Kispiox SRMP and Bulkley LUPs include objectives for maintaining rare ecosystems.

Type of monitoring: Collecting implementation data

Potential leaders: To be determined through EoI process.

Potential partners: Allen Banner, Jane Lloyd-Smith, Sybille Haeussler

Funding: \$3,075

Consequence for knowledge base: This project will collect indicator data on rare ecosystems to facilitate risk analysis.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current protection and seral stage distribution of rare ecosystems. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Project 2009-2: Human/grizzly Bear Interactions and Education: Baseline Data

Abstract:

This project will collect information on human/grizzly bear interactions as a baseline for monitoring the effectiveness of education. After BC Parks' Management Plan and Bear-Human Management Plan are implemented, actions to educate park visitors at the park entrance will increase. This baseline study will provide an excellent opportunity for well-designed monitoring in the form of a before-after study of people's knowledge.

Within the Babine Watershed, the highest risk to people and bears exists around the Babine River Bridge and DFO weir area. This study will hence focus on this area. Priorities for other user groups, in order, include seasonal and permanent residents, hunter, natural resource works and finally, other user groups recreating in the area.

The study will collect survey data from people using the park. To improve the existing information on bear-human interactions, the study will also ask about previous experiences, as well as compile information from Park Rangers and MoE records. Because of people's concerns that their use of the area may be impacted, it will be crucial to invest in a constructive, sensitive and well-directed survey design. Surveys in other areas (e.g. Kluane Park) will be very useful to help with the detailed design of this project.

Status: Initiated in 2009. Because this project has not been designed in a previous project, Requests for Proposals will be solicited, calling for methodological suggestions.

Geographic scope: Babine River Corridor Park entrance (i.e. BC Parks Upper Babine study area from the DFO weir to Nichyeskwa Creek).

Objectives listed in land-use plans: The entire plan area has objectives to minimise bear/human conflict. The Kispiox SRMP has a strategy for increased public awareness, and the Babine River Corridor MDS has a strategy to develop information and guidelines.

Type of monitoring: Collecting baseline data for effectiveness monitoring

Potential leaders: Debbie Wellwood. To be determined through RFP process.

Potential partners: BC Parks will provide time and in-kind activities to assist with the project: Scott MacMillan and Brandin Schulz

Funding: \$10,250

Consequence for knowledge base: This project will collect baseline data to examine the effectiveness of education on reducing human/grizzly bear interactions.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by providing baseline data for effectiveness monitoring of education. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Project 2009-3: Grizzly Bear Habitat

Abstract:

This project will reduce uncertainty about maintenance of grizzly bear habitat due to the variety of different strategies applied in different management areas. The project will develop a database relevant to grizzly bears in Babine Watershed, analogous to the database for mountain goats created in 2008/9. The database will include grizzly bear management areas, high-value habitat, critical habitat, other habitat classes, harvested areas, forest cover, strategies implemented within and adjacent to habitat. This database will build on the access database created during project 2007-1 (Human/ Bear Interaction and Open Road Density) this year.

The project will also initiate development of effectiveness indicators looking at grizzly bear use of habitat. The variety of strategies implemented presents an excellent opportunity for an experiment: this project will consider potential designs for such a project (funding is beyond the scope of the BWMT).

Status: Initiated in 2009. Because this project has not been designed in a previous project, Requests for Proposals will be solicited, calling for methodological suggestions.

Geographic scope: Babine watershed.

Objectives listed in land-use plans: All land-use documents include objectives to maintain grizzly bear habitat.

Type of monitoring: Collecting implementation data

Potential leaders: Debbie Wellwood, Johanna Pfalz. To be determined through RFP process.

Potential partners:

Funding: \$10,250

Consequence for knowledge base: This project will collect indicator data on grizzly bear habitat to facilitate risk analysis.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current protection of grizzly bear habitat. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Project 2009-4: Bull Trout Habitat

Abstract:

This project will build on project 2008-4 by ground-truthing portions of the database. Project 2008-4 estimated the amount of bull trout habitat protected within different zones (e.g. park, special management zone, riparian corridor) and developed a first approximation of the amount of habitat protected based on a GIS approach.

This project is contingent upon successful completion of project 2008-4 and cost-benefit analysis of the work that can be completed for the available funds.

Status: Initiated in 2009 contingent upon acceptable design. A decision about whether to solicit proposals or expressions of interest will be made after the completion of recommendations in project 2008-4.

Geographic scope: Babine watershed.

Objectives listed in land-use plans: The Kispiox SRMP includes an objective to conserve critical bull trout habitat in the Shelagyote River and its tributaries. The MDS for Babine River Corridor Park includes objectives to protect bull trout.

Type of monitoring: Reducing uncertainty and detecting negative consequences

Potential leaders: Ralph Kossman (to be determined through RFP or EOI process).

Potential partners: Jeff Lough, Ministry of Environment

Funding: \$10,250

Consequence for knowledge base: This project will improve indicator data on bull trout habitat collected in project 2008-4 to facilitate risk analysis.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current protection of bull trout habitat. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

6. Ongoing Project Synopses

Combined Project 2008-1 and 2008-2: Update Knowledge Base and Monitoring Priority Tables and Framework Manual and Extension

Abstract: The first part of this project will update the Knowledge Base by including information gathered from all completed BWMT projects to date, adding objectives and strategies from the Park Management Plan, investigating and incorporating existing information on landslides¹, timber salvage and fish passage² and consulting experts as necessary for new research and missing model variables. It will also re-analyse risk and revise project priority tables.

The companion part of this project aims to increase the number of people able to use the monitoring framework. It has three components: a short promotional description of the framework for use in fundraising, a plain-language manual to complement the framework and a training workshop. BWMT trustees will provide contractors with a list of relevant information for inclusion in the Framework Guidebook.

Status: Initiated in 2008 (first update since 2004). Timeline extended to December 2009 because of late start date.

Geographic scope: Babine watershed

Objectives listed in land-use plans: All objectives and strategies.

Type of monitoring: All types of monitoring.

Project team: Karen Price, Dave Daust, Liz Osborn, Megan D'Arcy, Jeff Anderson

Funding: \$12,000 (2008-1) + \$5,000 (2008-2) for a total of \$17,000

Consequence for knowledge base: This project will update the knowledge base and priority tables. It will facilitate monitoring decisions for 2009 and beyond. Training under this project will increase the pool of trained technical advisors and improve the trustees' ability to work with the Trust's technical advisors. A plain-language manual will assist communication with potential funding sources.

Consequence for management: This project feeds back information into the Knowledge Base and highlights information to be passed on to bodies responsible for management decisions through appropriate processes.

¹ This information was to come from Jim Schwab. As he has recently retired, it will be necessary to consult with his replacement.

² Based on information from a Forest Practices Board report on fish passage.

Project 2008-3: Mountain Goat Habitat

Abstract: This project was designed as part of project 2007-3P (see report at www.babinetrust.ca). In conjunction with the Ministry of Environment, it will develop a database relevant to mountain goats in Babine watershed. The database will include Ungulate Winter Range (Kispiox), mapped goat habitat (Bulkley), forest cover, harvested area, harvested patch size, roads and access. GIS buffers will be used to analyse activities (harvesting and roads) within mapped habitat, and within 200m, 500m, 1,000m and 2,000m buffers around the habitat. The project will also initiate development of effectiveness indicators looking at goat use of habitat by designing a protocol and database for recording sightings that can be used by people flying over goat habitat.

Status: Initiated in 2008. Will be completed March 2009.

Geographic scope: Babine watershed

Objectives listed in land-use plans: Bulkley LUPs include specific objectives for goats. The Kispiox LRMP includes objectives for goats, and a new Ungulate Winter Range Order includes objectives for the Kispiox/Cranberry TSA.

Type of monitoring: Reducing uncertainty and detecting negative consequences

Leader: Megan D'Arcy

Partners: Darren Fillier, Ministry of Environment

Funding: \$7,000

Consequence for knowledge base: This project will decrease uncertainty in relation to harvesting near goat habitat, and during the natal period. It will also address the lack of appropriate indicators of goat presence in mapped habitat necessary to detect negative consequences as identified by project 2007-3P.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with harvesting near goat habitat. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process. Collaboration with Ministry of Environment will facilitate feedback of results into management decisions.

Project 2008-4: Bull Trout Habitat

Abstract:

This project will estimate the amount of bull trout habitat protected within different zones (e.g. park, special management zone, riparian corridor). Bull trout habitat has not yet been delineated for the Babine (although work has been completed for spawning and rearing habitat in the Shelagyote). Because bull trout are highly mobile, their use of the Babine may be extensive. Bull trout are sensitive to activities upstream, particularly if water temperatures rise beyond their threshold. A GIS map-based approach, with limited field checks, will provide a first approximation of the amount of habitat protected.

The first task would be to construct a habitat model based on assumptions from existing literature and knowledge. For example, it would delineate areas accessible to fish with a gradient < 12%, areas with known salmonid spawning (hence bull trout foraging), and areas with known bull trout use from inventory or angler information. Attaching probabilities of potential presence and importance would be useful (e.g. possible habitat, probable feeding habitat, known habitat, known staging area). Because bull trout are sensitive to changes upstream, these areas should also be considered. Information from a radio-telemetry study completed in the Morice would be useful. Other sources of information include Dave Bustard and Jeff Lough.

Once bull trout habitat is approximately delineated, GIS will be used to overlay land designations on habitat and calculate the amount protected in different zones.

An additional element of the project will examine the distance between road bridges and bull trout staging areas.

Status: Initiated in 2008. Will be completed March 2009.

Geographic scope: Babine watershed.

Objectives listed in land-use plans: The Kispiox SRMP includes an objective to conserve critical bull trout habitat in the Shelagyote River and its tributaries. The MDS for Babine River Corridor Park includes objectives to protect bull trout.

Type of monitoring: Reducing uncertainty and detecting negative consequences

Leader: Ralph Kossman.

Partners: Jeff Lough, Ministry of Environment

Funding: \$10,000

Consequence for knowledge base: This project will collect indicator data on bull trout habitat to facilitate risk analysis.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current protection of bull trout habitat. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Project 2008-5: Visual Quality in Babine River Corridor

Abstract: This project investigates visual quality in the Babine River Corridor in collaboration with Glen Buhr, Ministry of Forests and Range. MoFR is planning on implementing and testing a new field protocol (established by FREP) for assessing current visual quality condition to determine if established visual quality objectives are being achieved. Tasks include assessing current visual quality condition using the new protocol and comparing against established visual quality objectives; conducting user surveys to determine if wilderness values are currently met from a public perspective; and professionally evaluating the protocol itself, providing a suite of comments and recommendation to be supplied to FREP program coordinators. Division of tasks between BWMT and MoFR will be decided in collaboration with Glen Buhr.

Status: Initiated in 2008—late start due to low number of proposals. MoFR funding currently frozen. Project currently based on BWMT funds alone—awaiting decision on MoFR funding.

Geographic scope: Babine River Corridor.

Objectives listed in land-use plans: Both the Kispiox and Bulkley LRMPs include objectives for visual quality as well as objectives to maintain the visual elements of wilderness value along the Babine River Corridor.

Type of monitoring: Reducing uncertainty and detecting negative consequences.

Leaders: Ralph Kossman, Megan D'Arcy

Partner: Glen Buhr, Ministry of Forests and Range

Funding: \$5,000

Consequence for knowledge base: This project will reduce uncertainty and detect negative consequences in relation to perceptions of visual quality as an element of wilderness value in Babine River Corridor. It will also test new protocols for monitoring visual quality to allow standardisation of measurements over time.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current visual quality. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Project 2005-3 / 2006-2: Water Quality in Relation to Stream Crossings

Abstract: Changes in benthic invertebrate communities are frequently used to indicate water quality. This project investigated the relationship between stream crossing quality (as measured by project 2005-2 / 2006-1; Stream Crossing Quality) and water quality by looking at benthic communities. It used a multi-variate index to compare communities in unharvested reference streams with those below stream crossings.

Eleven streams were sampled below stream crossings in the Nichyeskwa watershed. Only one of these had a high concern rating based on the Stream Crossing Quality Index. All streams but one had unstressed communities of benthic invertebrates. The single, slightly stressed stream was fairly large (8m wide) and had no sedimentation concerns. Data are currently insufficient to relate the two indices.

Awaiting report for final results and conclusions.

Status: Data collection and analysis complete. Awaiting final report.

Geographic scope: Nichyeskwa watershed in 2005. Awaiting report for 2006.

Objectives listed in land-use plans: The Kispiox SRMP includes an objective to maintain water quality within its natural range, and presents specific targets relating to sediment introduction at stream crossings within Nichyeskwa, Shelagyote and Babine mainstem watersheds. The Bulkley LRMP includes an objective to maintain existing levels of water quality.

Type of monitoring: Collecting indicator data.

Leader: Ian Sharpe (Ministry of Water, Land and Air Protection)

Partners: FSP (funded a larger, multi-year project of which the BWMT contribution is part—the BWMT contribution allows more sample sites to be located in the Babine Watershed than would otherwise be possible), MoE.

Funding: \$5,000 in 2005; \$5,000 in 2006

Consequence for knowledge base: This project will assist in definition of the risk curve relating stream crossings to water quality (currently not defined). In addition, the project will allow for improved assessment of current risk and associated uncertainty to water quality in relation to stream crossings.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with stream crossings. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Project 2005-4 / 2006-3: Wilderness Value of Babine River Corridor

Abstract: This project has been deferred until completion of the BC Parks Management Plan for Babine River Corridor. At that time, a non-biased methodology to investigate perceptions of wilderness value in the Babine River Corridor will be designed in collaboration with BC Parks. A background to potential methodologies exists from work completed in 2005.

The project will implement the methodology to consider socially acceptable levels of sustainable use, with particular focus on the Natural Environment Zone of the Park. It will also investigate perceptions of auditory disturbance throughout the Park, and sustainable use in the Wilderness Recreation Zone.

Status: Initial methodology designed in 2005/2006. Funding deferred to allow completion and implementation of the Babine River Corridor Management Plan by BC Parks, of the Quality Waters Strategy and Angling Management Plan and a subsequent risk analysis of new strategies.

Geographic scope: Babine River Corridor Park

Objectives listed in land-use plans: The Babine River Corridor Park Management Direction Statement includes an objective to maintain a wilderness experience in the corridor, including a sustainable level of recreation. The Kispiox SRMP includes an objective to maintain the aesthetic quality (visual and auditory) of the Babine River Corridor.

Type of monitoring: Detecting negative consequences (sustainable use); reducing uncertainty (auditory disturbance).

Leader: John Shultis, University of Northern BC (2005); to be determined for current phase.

Partners: Real Estate Foundation Partnering Fund (provided matching funds; 2005), ILMB (provided logistic support); BC Parks (Brandin Schultz and Scott MacMillan) current phase.

Potential partners: The Ministry of Environment has begun a Quality Waters Strategy and aims to develop a Babine River Angling Management Plan by March 2009.

Funding: \$5,000 in 2005; \$15,000 budgeted in 2006, deferred to 2009

Consequence for knowledge base: This project constitutes the first step in detecting negative consequences to sustainable use and wilderness value of the Babine River Corridor.

Consequence for management: This project will monitor targets developed through the processes that will be undertaken by the Ministry of the Environment. These targets will be developed by the end of 2009.

Project 2005-6P / 2007-1: Human/bear Interaction and Open Road Density

Abstract: This project will measure road density per sub-watershed (by road status) within the Babine using a roving window approach. To improve the robustness of the study, it will include nearest community and estimates of the amount of bear use per watershed as model variables and will investigate the success of access controls, through field checks as per BC Parks methods, and the extent of mitigative activities (e.g. screening, line-of-sight). Orthophotos and digital access-control points exist for the Bulkley and Kispiox TSAs. Road status has recently been updated for the Kispiox portion of the Babine. A similar update is not yet planned for the Bulkley portion. The project will be designed to incorporate updated road status.

Status: Proposals for large projects to Grizzly Bear Conservation Strategy in 2005 and 2006 were unsuccessful. Hence BWMT initiated a smaller project in 2007. This funding was carried from 2007 to allow completion of the Kispiox road status update. Will be completed March 2009.

Geographic scope: Sub-watersheds within Babine watershed

Objectives listed in land-use plans: The Babine LUP (Bulkley) and the Kispiox SRMP include objectives and associated strategies relating to road use and forest harvesting, for reducing the number of human-bear interactions. The SRMP includes specific road density targets for two watersheds.

Type of monitoring: Collecting indicator data.

Leaders: Debbie Wellwood and Johanna Pfalz

Funding: Unknown amount (less than \$1,500) from proposal development budget for 2005 (not listed as a separate item under BV Research Centre budget). \$10,000 for 2008 (carried over from 2007).

Consequence for knowledge base: This project will allow for assessment of current risk and associated uncertainty to human/bear interactions in relation to open road density.

Consequence for management: This project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current open road densities in each watershed. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

7. Administration

Project 2009-A1: Technical support

Abstract: Continuity of technical support is necessary for effective and efficient management of the monitoring framework, and the BWMT in general. Karen Price will provide technical support to the BV Research Centre and the BWMT as needed. Tasks include

- advise BWMT as necessary on Monitoring Framework
- prepare agenda, facilitate meetings and provide minutes
- communicate with BV Research Centre
- present monitoring priorities (as resulting from Monitoring Framework) to BWMT
 - provide initial description of projects and cost estimates
 - facilitate discussion in relation to project selection
- write draft AMP and revise based on BWMT comments
- liaise with contractors to ensure that projects meet needs of framework and BWMT
 - meet to confirm project design
 - discuss project as necessary
 - review and edit report
 - supervise summary of study to ensure that it allows Knowledge Base to be updated, and describes consequences for the Knowledge Base, for management and for future monitoring
- communicate project status to BWMT as necessary

Status: Initiated in 2007

Geographic scope: Not applicable

Objectives listed in land-use plans: Not applicable

Type of monitoring: Not applicable

Leader: Karen Price

Potential partners: BV Research Centre

Funding: \$6,150

Consequence for knowledge base: Not applicable

Consequence for management: Not applicable

Project 2009-A2: Administrative Support

Abstract: The BV Research Centre provides administrative support in the form of contract management, meeting support, website maintenance, and communications. Tasks include

- maintain independent financial records
- manage contracts
 - prepare calls for proposals
 - select contractor
 - prepare and implement contract
 - oversee contracts to ensure quality and timeliness of reporting
- add documents to website.

Please see contract schedules for further information.

Status: Ongoing since 2005

Geographic scope: Not applicable

Objectives listed in land-use plans: Not applicable

Type of monitoring: Not applicable

Leader: BV Research Centre

Potential partners: Karen Price

Funding: \$8,000

Consequence for knowledge base: Not applicable

Consequence for management: Not applicable

Project 2009-A3: Funding Solicitation

Abstract: The BWMT needs to broaden its funding base, especially if existing sources of private and government funds decline. In partnership with the BV Research Centre, this project explores options for long-term funding for monitoring. Options for partnering with appropriate government ministries also will be investigated.

Status: Initiated 2008.

Geographic scope: Not applicable

Objectives listed in land-use plans: Not applicable

Type of monitoring: Not applicable

Leader: Michelle Larstone

Potential partners: BV Research Centre, Government ministries (particularly MoFR and MoE)

Funding: \$2,000

Consequence for knowledge base: Not applicable

Consequence for management: Not applicable

Appendix 1: Decision Tables

Appendix 1 summarises funding decisions for high-priority topics in three types of monitoring:

- Table A1 (p. 21) **Collect Indicator Data** (Implementation Monitoring)
- Table A2 (p. 24) **Improve Knowledge and Reduce Uncertainty** (Validation Monitoring/Research)
- Table A3 (p. 26) **Detect Negative Consequences** (Effectiveness Monitoring).

Table A 1 Collect Indicator Data (Implementation Monitoring).

Funding decisions for high priority topics for collecting indicator data. Topics are ordered by relative priority as determined by Monitoring Framework⁴. Shaded projects are completed, ongoing or planned for 2009. Topics below the dashed lines have a low priority for funding within the first 5 years.

Objective	Indicator	History	Project #	Project name	Funding	Project length	2009 Status	Rationale
Stand structure	% of natural	Successful proposal funded 2005; funded 2007.	2005-5P ⁵ , 2007-2	Stand-level biodiversity	\$776 in 2005 \$7,000 in 2007	1 – 3 years	Complete	
Fish habitat	% of natural riparian habitat	Funded 2005	2005-1	Riparian ecosystems	\$15,000	1 year	Complete for Nichyeskwa.	Low priority to complete in other watersheds
Riparian biodiversity	% of natural riparian habitat	Funded 2005	2005-1	Riparian ecosystems	as above	1 year	Complete for Nichyeskwa.	As above
Rare ecosystems	% of natural	Funded 2009	2009-1	Rare ecosystems: phase I	\$3,000	1 year for phase I	Initiated 2009	
Human/bear interaction	Road density	Unsuccessful proposal funded 2005; funded 2007; deferred to 2008.	2005-6P, 2007-1	Human/bear interaction and open road density	< \$1,500 in 2005. \$10,000 in 2007.	1 year	Will be complete March 2009	
Human/bear interaction	Screening	Possible within 2007-1	2005-6P, 2007-1	as above	as above	1 year	May modify project 2007-1	Assess during project 2007-

⁴ Ordered by secondary score (all topics have high priority for data collection; see Monitoring Framework for methods www.babinetrust.ca).

⁵ Project numbers followed by a “P”: proposals will be prepared to seek funding (i.e. no operational budget in 2005).

Appendix 1: Decision tables

Objective	Indicator	History	Project #	Project name	Funding	Project length	2009 Status	Rationale
Human/bear interaction	Education	Funded 2009	2009-2	Human/grizzly bear interaction and education: baseline data	\$10,000	1 year for baseline	Initiated 2009	1.
Water quality	Stream crossing	Funded 2005/2006	2005-2, 2006-1 and 2005-3, 2006-2	Water quality and stream crossings	\$12,500 to 2005-2 \$15,000 to 2006-1; \$5,000 to 2005-3 and 2006-2	2 years	Completed in two watersheds.	Low priority to complete in other watersheds
Water quality	Landslides	Funded 2008	2008-1 (part)	Update Knowledge Base	\$2,000	1 year	Include with 2008-1	
Bull trout	Protected habitat	Funded 2008	2008-4	Bull trout habitat	\$10,000 to 2008-4; \$10,000 to 2009-4	1 year	Mapping complete 2009; ground-truthing funded 2009	
Bull trout	Bridge location	Funded 2008	2008-4	Bull trout habitat	as above	as above	as above	
Steelhead	Repeated capture	Not funded	—	—	—	—	—	
Water quality	Planning	Not funded	—	—	—	—	—	
Deciduous stands	% of natural	Not funded	—	—	—	—	—	
Wildlife	% of wildlife areas in ETDs	Not funded	—	—	—	—	—	
Water quantity	ECA	Not funded	—	—	—	—	—	
Connectivity	Winter logging	Not funded	—	—	—	—	—	
Timber salvage	% susceptible	Not funded	—	—	—	—	—	
Timber salvage	% controlled	Not funded	—	—	—	—	—	
Timber salvage	% salvaged	Not funded	—	—	—	—	—	
Backcountry	Amount	Not funded	—	—	—	—	—	

Appendix 1: Decision tables

Objective	Indicator	History	Project #	Project name	Funding	Project length	2009 Status	Rationale
recreation	primitive							
Gunanoot Lake	Visual quality	Not funded	—	—	—	—	—	
Pine mushroom habitat	% mature sites	Not funded	—	—	—	—	—	
Huckleberries	% sunlight in cutblocks	Not funded	—	—	—	—	—	
Huckleberries	% soil disturbance	Not funded	—	—	—	—	—	
Access to recreation	Inaccessible destinations	Not funded	—	—	—	—	—	

Table A 2. Improve Knowledge and Reduce Uncertainty (Validation Monitoring/Research).

Funding decisions for high-priority topics for monitoring to improve knowledge and reduce uncertainty. Topics are ordered by relative priority as determined by Monitoring Framework⁶. Shaded projects are completed, ongoing or planned for 2009. Topics below the dashed lines have a low priority for funding within the first 5 years.

Objective	Indicator	History	Project #	Project name	Funding	Project length	2009 Status	Rationale
Natural seral	% of natural old and old + mature	Funded 2007	2007-4P	Spatial distribution of mature and old forest	\$5,000	1 year	Complete	
Tree species	% of natural	Successful proposal funded 2005. Funded 2007.	2005-5P, 2007-2	Stand-level biodiversity	See Table 4	1 – 3 years	Complete	
Pattern	% of natural (biggest patch)	Funded 2007	2007-4P	Spatial distribution of mature and old forest	See 2007-4P above	1 year	Complete	
Connectivity	% of mature and old	Funded 2007	2007-4P	Spatial distribution of mature and old forest	See 2007-4P above	1 year	Complete	
Grizzly habitat	% high-value	Funded 2009	2009-3	Grizzly bear habitat	\$10,000	1 year	Initiated 2009	
Goat habitat	% unmodified nearby	Funded proposal 2007; funded 2008	2007-3P, 2008-3	Mountain goat habitat	\$2,000 in 2007; \$7,000 in 2008	2 years	Will be complete March 2009	
Goat habitat	Harvest during natal period	As above	2007-3P, 2008-3	Mountain goat habitat	As above	2 year	Will be complete March 2009	
Wilderness value of BRC	Auditory disturbance	Funded 2005; funded 2007; project deferred	2005-4, 2006-3	Wilderness value of BRC	\$5,000 in 2005, \$15,000 deferred	2 – 3 years	Deferred	Deferred to allow collaboration with BC Parks after completion of Management Plan

⁶ Ordered by priority to reduce uncertainty and then by secondary score (see Monitoring Framework for methods www.babinetrust.ca).

Appendix 1: Decision tables

Wilderness value of BRC	Visual quality	Funded 2008	2008-5	Visual quality of Babine River	\$5,000	1 year	Initiated 2008	Collaboration with MoFR in assessing new protocols
Grizzly bear habitat	% critical habitat	Funded 2009	2009-3	Grizzly bear habitat	\$10,000	1 year	Initiated 2009	
Goat habitat	Kotsine connector	Funded proposal 2007; funded 2008	2008-3	Mountain goat habitat	\$2,000 in 2007; \$7,000 in 2008	2 years	Will be complete March 2009	
Goat population	Road density	Funded proposal 2007; funded 2008	2008-3	Mountain goat habitat	As above	2 year	Will be complete March 2009	
Timber growth	% old	Not funded	—	—	—	—	—	
Grizzly bear disruption	Forest harvesting	Not funded	—	—	—	—	—	
Grizzly bear disruption	Other activities	Not funded	—	—	—	—	—	
Sustainable use	Campsites	Not funded	—	—	—	—	—	
Timber salvage	% susceptible	Not funded	—	—	—	—	—	

Table A 3. Detect Negative Consequences (Effectiveness Monitoring).

Funding decisions for high-priority topics for monitoring to detect negative consequences. Topics are ordered by relative priority as determined by Monitoring Framework⁷. Shaded projects are completed, ongoing or planned for 2009. Topics below the dashed lines have a low priority for funding within the first 5 years.

Objective	Indicator	History	Project #	Project name	Funding	Project length	2009 Status	Rationale
Sustainable use	Encounters in Natural Environment Zone	Funded 2005, 2007; project deferred	2005-4 2006-3	Wilderness value of BRC	See Table 5	2 – 3 years	Deferred	Deferred to allow collaboration with BC Parks after completion of Management Plan
Natural seral	% of natural old and old + mature	Funded 2007	2007-4P	Spatial distribution of mature and old forest	See Table 5	1 year	Complete	
Tree species	% of natural	Not funded	—	—	—	—	Not funded	Difficult to detect
Pattern	% of natural (biggest patch)	Not funded	—	—	—	—	Not funded	Difficult to detect
Connectivity	% of mature and old	Not funded	—	—	—	—	Not funded	Very difficult to detect
Goat habitat	% unmodified nearby	Funded proposal 2007; funded 2008	2007-3P; 2008-3	Mountain goat habitat	See Table 5	1 year	Will be complete March 2009	
Goat habitat	Harvest during natal period	As above	2007-3P; 2008-3	Mountain goat habitat	See Table 5	1 year	Will be complete March 2009	
Timber salvage	% susceptible	Funded 2008	2008-1 (part)	Update Knowledge Base	\$2,000	1 year	Included in 2008-1	
Wilderness value of BRC	Auditory disturbance	Funded 2005; 2007; project deferred	2005-4 2006-3	Wilderness value of BRC	See Table 5	2 – 3 years	Deferred	Deferred to allow collaboration with BC Parks after completion of Management Plan
Sustainable use	Floatcraft encounters	Funded 2005; 2007; project	2005-4 2006-3	Wilderness value of BRC	See Table 5	2 – 3 years	Deferred	Deferred to allow collaboration with BC Parks

⁷ Ordered by priority to detect consequences and then by secondary score (see Monitoring Framework for methods www.babinetrust.ca).

Appendix 1: Decision tables

		deferred					after completion of Management Plan	
Wilderness value of BRC	Visual quality	Funded 2008	2008-5	Visual quality of BRC	\$5,000	1 year	Initiated in 2008	Collaborate with MoFR

Appendix 2. Completed monitoring projects

Synopses of completed monitoring projects are included in the Annual Monitoring Plan until the results are incorporated into the Knowledge Base and included in other processes as appropriate (e.g. BWMT Plan Amendment Process and Criteria). Subsections listing consequences for the Knowledge Base, consequences for management and recommendations for monitoring summarise actions precipitated by each project.

Project 2005-1: Riparian Ecosystems and Fish Habitat

Abstract: This project examined the status of riparian forest ecosystems adjacent to fish-bearing and non-fish-bearing streams within the Bulkley portion of the Nichyeskwa watershed. A group of experts designed the project in 2005. The project included analysis of existing remote data, new air photo data and limited field checks to assess the status of riparian forest around unmanaged and managed streams.

Classification by biogeoclimatic subzone, size and gradient captured the variation in 302 stream reaches in 6 study sub-basins. Unharvested riparian forest was mostly old (91% > 140 years in the ESSFmc and 73% > 140 years in the SBSmc2), with relatively open canopies. Deciduous trees were rare.

Forest harvesting has affected a small portion of the riparian forest within a 60-m ribbon in the study area. Sixty-metre strips provide an ecologically precautionary estimate of the extent of riparian forest. In the ESSFmc, harvesting primarily affected forest around small, gentle streams. In the SBSmc2, harvesting affected all stream types. The highest proportion of harvested riparian forest within a 60-m ribbon was 15% (11 – 27% by sub-basin) for small streams with a gentle slope in the SBSmc2.

Streams containing fish were somewhat disproportionately harvested, although only 8% of riparian forest within 60 m of fish-bearing streams have been harvested. Field work next to five fish streams found that buffers ranged from 20 – 50m. Hence, much of the harvested forest was likely beyond these buffers.

Field work in buffers and paired unmanaged riparian forest corroborated the observation from the air that blowdown poses little risk in the Bulkley portion of the Nichyeskwa watershed.

Status: Complete

Geographic scope: Bulkley portion of Nichyeskwa watershed

Objectives listed in land-use plans: Legislation and planning documents pertinent to this project include: 1) FRPA, which establishes objectives for conservation of ecological values associated with riparian areas, 2) The Kispiox LRMP, which includes an objective (within the goal of maintaining biodiversity) to maintain riparian areas, and 3) The Bulkley LUP, which include objectives (within goals of maintaining fish habitat) to retain structure within riparian management zones. Both the Bulkley LUPs and Kispiox SRMP include maps of Landscape Riparian Corridors.

Type of monitoring: Collecting indicator data about standing riparian forest; reducing uncertainty in relation to windthrow.

Project leaders: Ruth Lloyd and Karen Price

Partners: Ministry of Forests (provided data), Pacific Inland Resources (shared helicopter time and provided data), Canadian Forest Service (time for Phil Burton to assist with remote data collection); Research design participants: Phil Burton (CFS), Steve Gordon (MoE), Tom Pendray (DFO), Karen Price (consultant), Dave Wilford (chair, Bulkley Aquatic Resources Committee).

Funding: \$15,000

Consequence for knowledge base: In the Bulkley portion of the Nicheyskwa watershed, current levels of harvesting pose low risk to ecological function or fish habitat. Exceptions to low risk were due to a rare stream type or to low levels of natural old forest in sub-basins. Forest within 60m of moderately-sized, steep streams in the SBSmc2 covered only 25ha. Almost half of this area lay within a single cutblock, posing moderate risk.

In addition, buffers in this area have very low susceptibility to windthrow, reducing associated uncertainty.

Consequence for management: This project supports current strategies of riparian retention.

Recommendations for further monitoring: The low levels of harvesting next to streams means that further projects of this type are currently not a high priority. As harvesting increases within sub-basins, risk to riparian ecosystems and fish habitat should be monitored for increased levels of risk. Existing databases, modified by silvicultural prescriptions, should be sufficient for coarse-filter monitoring in accordance with the indicators included in Babine Watershed land-use planning. A similar project in the Nilkitkwa watershed, and in other watersheds over time, would be useful to assess risk and uncertainty levels elsewhere in the Babine watershed. Unless blowdown is more prevalent elsewhere, field work should not be necessary for coarse-filter monitoring.

Project 2005-2 / 2006-1: Stream Crossing Quality

Abstract: Roads are a dominant source of sediment introduced into riparian systems, particularly where they cross streams. This project examined the quality of stream crossings in the Nichyeskwa Watershed and Upper Babine River Corridor, using a Stream Crossing Quality Index developed by Pierre Beaudry. The index assesses the hazard level of accelerated erosion and sediment delivery associated with roads. It does not assess the impacts of changed sediment regimes on the aquatic ecosystems (see Project 2005-3 / 2006-2; Water Quality in Relation to Stream Crossings).

The project sampled 60 streams in the Nichyeskwa in 2005 and 103 in the Upper Babine in 2006. In the Nichyeskwa, 17% of streams had a water quality concern rating of high to very high; in the Upper Babine, only 4% had this rating. At these levels, sediment potentially impairs fish habitat. Larger streams generally fared better than small streams: all crossings of streams greater than 5m wide had low or nil concern ratings; in the Nichyeskwa, about two-thirds of crossings of streams between 0.5 and 5m had low or nil concern ratings and in the Upper Babine, about 85% had low or nil concern ratings.

The project provided maps of the location of each sampled streams, with associated concern rating.

Status: Complete

Geographic scope: Nichyeskwa watershed and Upper Babine River Corridor

Objectives listed in land-use plans: The Kispiox SRMP includes an objective to maintain water quality within its natural range, and presents specific targets relating to sediment introduction at stream crossings within the Nichyeskwa, Shelagyote and Babine mainstem watersheds. The Bulkley LRMP includes an objective to maintain existing levels of water quality.

Type of monitoring: Collecting indicator data; Improving Knowledge and Reducing Uncertainty

Leader: Pierre Beaudry

Partners: None

Funding: \$12,500 in 2005; \$15,000 in 2006.

Consequence for knowledge base: This project assesses current hazard associated with individual stream crossings. In collaboration with project 2005-3 / 2006-2 (Water Quality in Relation to Stream Crossings), it will define the currently undefined curve relating stream crossings to water quality. Site selection was coordinated between the two projects. Data analysis is complete, but conclusions have not been released to BWMT as of February 2009.

Consequence for management: This project assessed each crossing for its potential to produce sedimentation, and ranked them into hazard groups (nil, low, moderate, high, very high concern). These rankings have been used by forest managers through appropriate processes which are separate from the BWMT.

Recommendations for further monitoring: Future monitoring of crossings with high to very-high concern ranking, particularly following any efforts at mitigating hazard could be useful.

Project 2005-5P: Stand-level Biodiversity in Natural Stands

Abstract: Forest management prescribes retention of structural attributes in harvested stands, but questions remain about the amount of each attribute to retain. This study documented the range of natural variability in the number of standing and dead trees, and the volume of downed wood, remaining after fire, insects and wind disturbances in and around the Babine watershed, to allow risk assessment of management options relating to structural attributes.

The project measured structural legacies in 140 plots in 27 sites that had been disturbed by fire, wind and insects over the past 50 years. In the study area, fire caused the most extensive catastrophic disturbances; beetles were extensive, but often not catastrophic; wind disturbance was least common. Salvage of disturbed stands severely reduced the number of potential sites.

Overall, the range of natural variability was large, and covered all possible values of retention. However, the mean and standard error of numbers of snags and volume of downed wood left after disturbance can guide risk analyses (Table 1). Analyses found very few significant effects of biogeoclimatic subzone or site productivity on the amounts of structure retained. The only exception for standing live and dead trees was in stands disturbed by balsam bark beetles: this effect was related to the proportion of subalpine fir in the stand. For downed wood, the only pattern detected was that mesic-rich sites had a higher proportion of larger-diameter downed wood.

Table 1. Structural legacies of natural disturbance (mean \pm standard error) for disturbances within the past 10 years.

	<i>Live trees (#/ha)</i>	<i>Dead trees (#/ha)</i>	<i>Downed wood (m³/ha)</i>
Fire (n=2)	55 \pm 11	1140 \pm 94	216 \pm 62
Beetles (n=6)	422 \pm 59	328 \pm 59	165 \pm 35
Wind (n=4)	281 \pm 29	172 \pm 48	632 \pm 28

Wind and beetles left more large than small snags and downed wood. Size-class distribution of snags following fire initially was negatively exponential, but became unimodal over time as the smallest snags fell. This size-class distribution suggests that within-stand retention guided by natural patterns should either leave snags in a size distribution that matches the pre-disturbance distribution of live trees (to mimic fire) or should bias retention towards larger snags and downed wood (to mimic beetles and wind).

Status: Complete. Proposal development funded in 2005. Project funded by FSP.

Geographic scope: 1:250,000 NTS sheet 93M (which includes the Babine Watershed), but expanded to include sheet 93L and parts of 93E

Objectives listed in land-use plans: Both the Bulkley LUPs and the Kispiox SRMP include objectives to maintain structural attributes and diversity within managed stands. Indicators include wildlife tree patches (both Forest Districts) and amounts of specified attributes

(Kispiox)³. The Bulkley LUPs also include an objective, and associated indicators, to maintain a diversity of tree species.

Type of monitoring: Collecting indicator data related to natural amounts of stand structure; reducing uncertainty related to tree species composition.

Leaders: Ruth Lloyd, Phil Burton, Karen Price

Partners: FSP (provided \$63,000 funding), CFS (provided \$11,500 in-kind funding), University of Northern BC (provided \$10,000 in-kind funding), MoFR (provided data).

Funding: \$776 from proposal development budget for 2005.

Consequence for knowledge base: To estimate the risk to biodiversity associated with different levels of stand retention, it is necessary to compare retention in managed stands with retention following natural disturbance. Before this study, no data existed to estimate stand-level retention following natural disturbance and hence it was not possible to estimate risk to biodiversity. This project thus provides the natural baseline for in-stand retention. It allows for assessment of future risk and associated uncertainty based on targets included in land-use plans. In combination with project 2007-2 (Stand-level biodiversity in managed stands), it will allow for assessment of current risk and associated uncertainty to stand structure and to tree species composition in relation to forest harvesting activities.

Consequence for management: In combination with project 2007-2, this project will support management decisions, through appropriate processes which are separate from the BWMT, by showing the level of risk and uncertainty associated with current and target levels of stand-level retention. It may increase confidence in current activities, suggest further monitoring projects or lead to initiation of a plan-amendment process.

Recommendations for further monitoring: No further estimation of natural retention levels in the area is necessary: improving the power to detect trends would require a vast investment. This project forms the natural baseline for comparisons with retention in managed stands (Project 2007-2).

³ See Knowledge Base for details and rationale for indicator (www.babinetrust.ca)

Project 2007-2: Stand-level Biodiversity in Managed Stands

Abstract: This project measured stand structure in young managed stands. Project 2005-5P estimated the range of natural variability in stand structure following fire, beetle and wind disturbance in three productivity classes of the SBSmc2 and ESSFmc. This project compares remnant structure in managed stands (the number and size-class distribution of standing live and dead trees and the volume of downed wood) with the range of structure found following natural disturbance, and hence allows for assessment of current risk.

Structural legacies in terms of live and dead standing stems and downed dead wood were measured in 30 plots in 8 sites that had been harvested between 1992 and 2000. Results were compared to equivalent data collected previously in young stands originating from natural disturbance (wildfire, beetle attack and windthrow) within the same general area. Six of eight study blocks included reserve areas accounting for 4-13% of the total area.

Overall, timber harvesting left fewer standing stems than fire, beetle attack or windthrow. In particular, timber harvesting retained significantly fewer snags than any form of natural disturbance, and no snags were retained in cutblocks without reserve areas. The abundance of “functional” snags (>20cm dbh) was much lower after timber harvest than after natural disturbance. Residual live stems were less abundant after timber harvest than after beetle attack or windthrow, but more abundant than after wildfire; however, nearly all the residual live trees encountered after timber harvest were in the smallest diameter class, and cutblocks without reserves did not include any large (>20cm dbh) live trees at all.

Downed dead wood was somewhat less abundant after timber harvest than after any form of natural disturbance, although differences were statistically significant only with windthrow. Diameter class distribution and decay class distribution were comparable between all forms of disturbance, but timber harvesting resulted in much shorter pieces than any form of natural disturbance.

The project showed that structural legacies following clearcut logging (with or without reserves) do not fall within the RONV of structural legacies following natural disturbance, especially as regards “functional” snags and large live trees (Table 1). Clearcut timber harvest follows the distribution pattern of wildfires (clumped) as far as large live trees are concerned, but the low numbers and limited distribution of snags is unlike any natural disturbance. CWD volume and attributes present a lesser issue in the first two decades following harvest, but are expected to deviate markedly from that left by natural disturbance within three or four decades after harvest unless provision is made for CWD recruitment from standing stems at the time of harvest.

Table 1 Percent of natural structure retained in managed stands in the first decade after disturbance, calculated using mean values in each case. Large standing trees are those > 17.5 cm dbh; long CWD are those > 10m.

Disturbance	Live	Dead	CWD	Large live	Large dead	Long CWD
Fire	262	3	68	69	3	32
Beetles	33	9	52	9	7	14
Wind	51	17	18	21	13	4

Status: Completed 2008

Geographic scope: Available funding limited field work to easily accessible sites.

Objectives listed in land-use plans: Both the Bulkley LUPs and the Kispiox SRMP include objectives to maintain structural attributes and diversity within managed stands. Indicators include wildlife tree patches (both Forest Districts) and amounts of specified attributes (Kispiox)⁴. The Bulkley LUPs also include an objective, and associated indicators, to maintain a diversity of tree species.

Type of monitoring: Collecting indicator data related to stand structure in managed stands

Leader: Ruth Lloyd

Funding: \$7,000

Consequence for knowledge base: By reducing uncertainty surrounding the amounts of residual structure present, this study enables a more accurate assessment of risk associated with current levels of retention during timber harvest. Based on the risk curve included in the stand structure section of the Knowledge Base, showing a sigmoidal increase in risk to biodiversity related to the % of natural amount of structure retained, current levels of retention within cutblocks poses a high risk to biodiversity (i.e. are below 30% of natural levels), particularly in relation to snags (small or large). Amounts of large live trees (> 17.5 cm dbh) and long CWD pose moderate risk when compared with fire (the most prevalent natural disturbance in the area).

A finding of high risk requires consideration of other questions. First, stand level retention is only one of several strategies designed to maintain biodiversity. The first task is to examine the landscape context. If sufficient levels of forest are retained within the landscape, stand-level retention is less crucial. BWMT is currently investigating seral stage patterns over the landscape. The results from that project should be used to inform any conclusions based on this study. Unfortunately, very little work anywhere has investigated the interaction between stand-level and landscape-level retention.

Another avenue of consideration would re-examine the risk curves in the Knowledge Base to determine if there is any new evidence to improve the hypothesis. The Knowledge Base will be updated this year; the BWMT should ensure that the stand-level curves are considered.

Consequences for management: It is not possible for commercial timber harvesting to approach levels of structural elements found after natural disturbance, because harvesting removes much of the biomass of the original stand from the site. However, to approach more closely the natural levels and distribution, the following priorities are recommended:

1. Increase the number and size of standing live trees across the cutover area, particularly in larger cutblocks (even when part of the opening consists of a developing stand several decades old).
2. Increase the size of downed dead logs across the cutover area.

Determining consequences to management will require consideration of the importance of the stand-level objective. An objective to “lifeboat” species requires higher levels of retention

⁴ See Knowledge Base for details and rationale for indicator (www.babinetrust.ca)

than an objective to increase the rate of recovery of old forest structure. Discussion with the Community Resources Board should clarify this point.

The BWMT should initiate processes to pass this result to decision-making bodies.

Recommendations for further monitoring: The sample size in this project was relatively small. Further monitoring would be useful, particularly if management practices or natural disturbance patterns change. For example, the current MPB disturbance is changing the landscape context, decreasing the amount of old forest, but increasing snags. This disturbance could change optimum retention from snags (currently at highest risk) to live trees.

Project 2007-3P/2008-3: Mountain Goat Habitat

Abstract: This project summarised existing work on harvesting near to goat habitat and on harvesting during the natal period. New targets exist for the Kispiox in the form of Ungulate Winter Ranges and an associated legal Order. Data on harvesting exist for the Kispiox (Table 1), but need to be refined to be specific to habitat within the Babine. The canyon population at Gail Creek is known to have declined; further analyses should examine each population separately.

Table 1. Harvesting in and near goat winter range for the entire Kispiox.

	<i>Forested area (ha)</i>	<i>% harvested</i>	<i>Estimate of future harvest % (i.e. THLB)</i>
Winter Range	15,919	1	15
500m buffer	26,788	6	34
1,000m buffer	58,063	6	36
2,000m buffer	128,919	7	39

This project proposed further work that was approved by the BWMT for funding in 2008 (see project 2008-3 *Mountain Goat Habitat*).

Status: Complete

Geographic scope: Babine watershed.

Objectives listed in land-use plans: Bulkley LUPs include Mapped Habitat and specific objectives for goats. New Ungulate Winter Ranges for mountain goats have been created in the Kispiox subsequent to the SRMP.

Type of monitoring: Reducing uncertainty and detecting negative consequences

Leader: Megan D'Arcy

Funding: \$2,000

Consequence for knowledge base: This project outlined new targets developed for the Kispiox. It also summarised harvesting levels for the Kispiox. However, before these numbers can be used to update the Knowledge Base, they must be refined to look at each goat population separately (see Project 2008-3).

Consequence for management: This project suggested further monitoring projects.

Recommendations for further monitoring: This project recommended further monitoring of goat habitat and of goat habitat use. Project 2008-3 will complete current monitoring of harvest in and near goat habitat and will suggest a methodology for monitoring goat use.

Project 2007-4P: Spatial distribution of mature and old forest Phase I

Abstract:

Forest management in the Babine River Watershed aims to “attain a natural landscape pattern” to maintain biodiversity. Strategies create harvested patch size distributions that are similar to natural-disturbance patch size distributions. Two uncertainties limit our understanding of the effectiveness of these strategies. First, uncertainty exists about the relationship between young forest pattern and old forest pattern. By creating patches of young forest within a matrix of older forest, harvesting alters the spatial arrangement of both young and old forest: Will a near-to-natural harvest pattern create a near to natural pattern of old forest? Second, uncertainty exists about the ecological merit of different patterns: Does pattern really influence biodiversity? This project examined two simulation studies that address these uncertainties.

The first study examined the influence of disturbance rate and type on old forest pattern. Disturbance rate was set to produce either the historical average (32%) or the recommended future target (11%) of old forest (>140 years) in the SBSmc. Patch size distribution resulting from natural disturbance was set to be typical for the SBSmc; the probability of natural disturbance did not vary with stand age. Four harvest patterns were examined: “checkerboard” harvesting with and without greenup rules; and “guidebook” harvesting with and without greenup rules. The checkerboard pattern used 80 hectare cutblocks; the guidebook pattern used the cutblock size distribution recommended in the Biodiversity Guidebook.

The second study, led by Doug Steventon (MoFR Research, Smithers) simulated mountain pine beetle disturbance and a range of harvesting strategies and patterns in the Nadina Forest District. It modeled territory formation and dispersal, both a function of old forest pattern, for a wide range of “virtual” animals. Virtual animals varied in territory size (25 – 2,500 ha), affinity for old forest and dispersal ability.

The first study found that near-to-natural harvest patterns do not create near-to-natural patterns of old forest. First and most importantly, the amount of old forest had a large influence on old forest patch size distribution. Reducing old forest from 32 to 11% reduced the percent of large patches, greater than 1,000 ha, from 48 to 5%. Second, even with old forest amount fixed, harvesting generated different old forest patterns than natural disturbance. Furthermore, guidebook harvesting did not always produce more natural patterns than checkerboard harvesting, over the long term.

The second study found that harvest pattern had a minor effect on “populations” of virtual animals and that no harvest pattern emerges as clearly beneficial. The amount of old forest and life history traits were much more influential than harvest pattern. A second aspect of the study showed that under specific conditions, old forest pattern could influence population size.

Together, these studies confirm that a very weak relationship exists between harvest pattern and old forest pattern and between harvest pattern and old forest habitat use.

Status: Complete.

Geographic scope: Simulations in SBSmc and in Nadina Forest District.

Objectives listed in land-use plans: Maintaining biodiversity is a general goal of all the land-use plans for the watershed and of legislation. Legislation and land-use plans also include objectives to create harvest patterns that reflect the spatial patterns of natural disturbance. The objective in the Kispiox SRMP specifically focuses on patch-size distribution while the objectives in the Bulkley LUPs and in legislation are more general (i.e., pattern).

Type of monitoring: Reducing uncertainty

Leader: Dave Daust

Partner: Doug Steventon

Funding: \$5,000 (total for Phases I and II)

Consequence for knowledge base: Two premises underlie the use of harvest patch size as an indicator for biodiversity: that near-to-natural harvest size distributions produce near-to-natural patterns of old forest; and that some harvest patterns create patterns of mature and old forest that are beneficial to a range of species. This project rejects both premises. Hence, harvest patch size is not useful as an indicator of biodiversity. Better indicators would measure the pattern of mature and old forest directly. Another alternative is to not measure pattern at all, because amount of old forest is an important indicator of pattern.

Consequences for management: Current strategies to manipulate cutblock pattern pose a high risk to the objective of “attaining a natural landscape pattern” (similar wording in Kispiox SRMP Table 2 and Bulkley LUPs Table 5). This objective cannot be met by strategies that focus on harvest pattern without increasing the amount of old forest retained. Because the strategy and objective are inconsistent, one should be changed. The BWMT should initiate processes to pass this result to decision-making bodies.

Cutblock size targets derived from the Biodiversity Guidebook should still be used. Although they create old forest patterns that deviate considerably from natural, they still create a “more natural” old forest patch size distribution than do uniform 80-ha cutblocks or large cutblocks with no leave areas.

Recommendations for further monitoring: Future monitoring should focus on amount of mature and old forest. If pattern is to be monitored, indicators should measure pattern of mature and old forest directly.

Project 2007-4P: Spatial distribution of mature and old forest: Phase II

Abstract:

This project aimed to reduce uncertainty relating to the distribution of mature and old forest by quantifying the current distribution of mature and old forest relative to biogeoclimatic variant, site productivity class and leading tree species in the Babine Watershed. The project summarised the current area of each seral stage in each biogeoclimatic variant-site productivity combination (e.g., spruce-good in the SBSmc2), distinguishing between logging and natural disturbance. It then compared the current proportion of mature and old seral forest in each Variant-site combination to the natural proportion of mature and old seral forest in the Subzone in which the site occurs (based on the Biodiversity Guidebook).

Analysis showed that medium and high-productivity pine and spruce sites in the ESSFmc currently fall below the mean natural proportion of mature and old forest. Low pine sites in the ESSFwv and SBSmc2 also fall below natural. High pine sites in the ICHmc1 are entirely logged; in addition, high pine and spruce sites in the ESSFmc show the greatest difference from natural. However, because leading species may change following harvesting, site productivity alone may provide a more reliable, albeit coarser, classification of ecosystem variation. With this coarser approach, analysis found that no sites fall below the average natural proportion of mature and old forest (Figure 1).

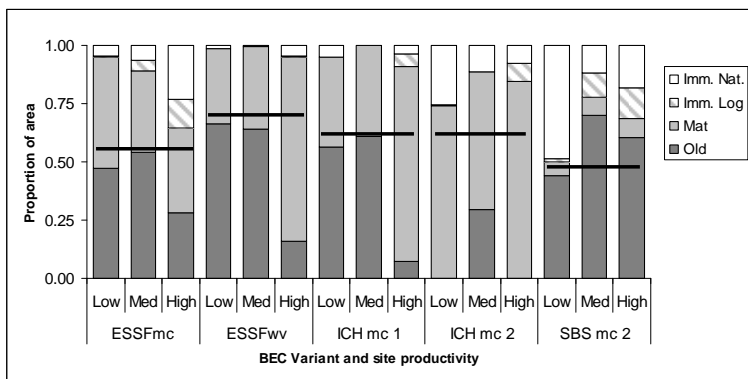


Figure 1. Proportion of each site productivity class within each BEC variant that is mature/old or immature (logged or natural). Horizontal bars show average natural proportion of mature and old forest in the variant.

Results showed that logging has preferentially target high productivity sites (Figure 2) and low elevation, more accessible variants (i.e. SBSmc2).

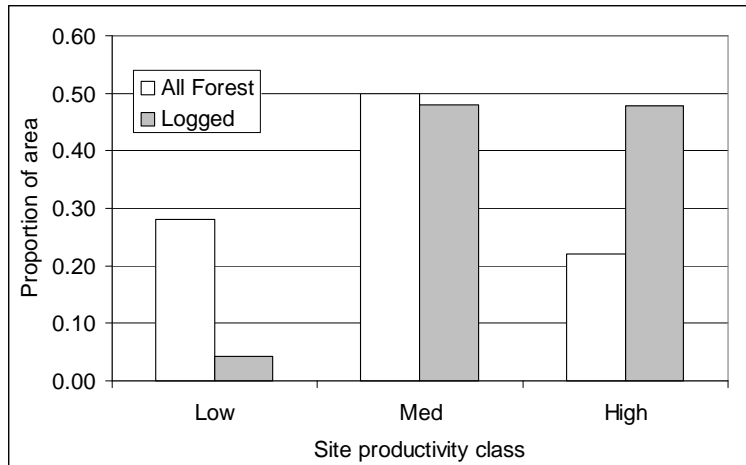


Figure 2. Proportion of forest area and of logged area in each site productivity class.

The study concludes that, in comparison to the average natural amount expected, mature and old seral stages are currently well represented across the range of ecosystem types considered. Although five ecosystem types have less than 90% of natural (med- and high-spruce and med- and high-pine in the ESSFmc; high-pine in the ICHmc1), most of these calculated shortfalls appear to have limited reliability, for the following reasons. Spruce sites cannot be adequately distinguished from fir sites in the ESSFmc. Similarly, pine sites cannot be distinguished from hemlock sites in the ICHmc1. High pine sites in the ESSFmc cover very little area and most medium and high pine sites in the ESSFmc are nearing maturity (> 80 years old). With all coniferous species combined, mature and old seral stages are well represented across all site productivity classes.

There is a clear trend towards preferentially harvesting high productivity sites and the SBSmc2 Variant. Representing mature and old forest across a range of ecosystems requires harvesting in proportion to the amount of each ecosystem type on the entire landbase. Only a small proportion of the forest in the Babine River Watershed has been harvested to date. If the tendency to harvest high productivity sites and SBSmc2 sites continues, these sites will become poorly represented in the future.

Status: Completed march 2008.

Geographic scope: Babine watershed. Although a larger scale is required for calculation of the natural benchmark (these calculations already exist), it is acceptable to calculate current spatial distribution of mature and old forest at the watershed scale, particularly for a large watershed such as the Babine, for comparison with this benchmark

Objectives listed in land-use plans: Maintaining biodiversity is a general goal of all the land-use plans for the watershed and of legislation. The objectives of creating core ecosystems and landscape corridors are a large part of the strategy to fulfill this objective. However, to ensure sufficient representation, the land-use plans call for analysis over the entire landscape rather than just within core areas.

Type of monitoring: Reducing uncertainty and detecting negative consequences

Leader: Dave Daust

Partner: Doug Steventon

Funding: \$5,000 (total for Phases I and II)

Consequence for knowledge base: This project reduced uncertainty about the amount of old and mature forest in the Babine Watershed. It determined that current levels of old and mature forest are sufficient to pose low risk to biodiversity within the Babine Watershed.

Consequence for management: This project supports current management in the short term, but suggests that, because harvest is not random with respect to productivity, risk to these ecosystems might increase in the long term following current management. The report recommends limiting harvesting of high productivity sites, particularly in the ESSFmc and SBSmc2. The BWMT should initiate processes to pass this result to decision-making bodies.

Recommendations for further monitoring: Future monitoring should focus on the amount of mature and old forest in high productivity sites. Monitoring should be completed every 5 years to track trends. This process takes about 1 day.

Appendix 3: Abbreviations

BRC.....	Babine River Corridor
BWMT	Babine Watershed Monitoring Trust
CFS	Canadian Forest Service
DFO.....	Department of Fisheries and Oceans
ECA.....	Equivalent Clearcut Area
ETD.....	Enhanced Timber Development Zones
FREP	Forest Resources Evaluation Program
FRPA.....	The British Columbia Forest and Range Practices Act
FSP	Forest Sciences Program
GIS	Geographic Information System
LRMP.....	Land and Resource Management Plan
LUP.....	Landscape Unit Plan
MoE.....	Ministry of Environment
MoFR.....	Ministry of Forests and Range
MDS	Management Direction Statement
PEM	Predictive Ecosystem Mapping
SFM Network.....	Sustainable Forest Management Network
SRMP	Sustainable Resource Management Plan