

# **INNOVATIVE MONITORING AND ITS INFLUENCE ON RESOURCE DECISION MAKING**

**MARCH 13-14, 2007  
SMITHERS, B.C.**

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## **PROCEEDINGS**

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# INTRODUCTION TO PROCEEDINGS

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The number of plans and processes for managing the landbase in British Columbia has been growing rapidly with the completion of land and resource management plans, sustainable resource management plans, forest stewardship plans and numerous other plans. Most of these plans contain: objectives, strategies, targets, criteria and indicators, which require monitoring in order to measure the success of the strategies in the plan and to ensure a continuous improvement cycle. A 'feedback loop' that incorporates knowledge learned from monitoring back into the planning process is vital. Changes to results-based models, such as that of the *Forest and Range Practices Act (FRPA)*, have further increased the need for monitoring so that changes can be attributed to practices.

Monitoring has been performed at various levels of resource management for a long time, but the amount of monitoring that is now needed to fulfill the requirements of newly completed land use plans and processes is unprecedented. While the need for monitoring has been growing rapidly, the amount of monitoring has not been keeping pace with that need. However, there are some good examples of monitoring initiatives in the Bulkley Valley area. The Bulkley Valley Centre for Natural Resources Research and Management (Bulkley Valley Research Centre) designed this conference to fulfill two purposes: 1) provide a 'call to action' by showing the need for monitoring, and 2) highlight some successful local monitoring initiatives.

A mix of past and present monitoring programs across the province was presented. This included the Forest and Range Evaluation Program (FREP), Babine Watershed Monitoring Trust, Wild Salmon Policy, Future Forest Ecosystems Initiative, Morice/Lakes Innovative Forest Practices Agreement (IFPA), Forest Practices Board, and the Skeena Region's Custom Venting Index for air quality. Some are strictly monitoring programs while others are part of larger resource management programs. Some monitoring programs begin at a small scale and expand due to local success, while others are initially established at the provincial scale.

This conference highlighted the many aspects of monitoring, including the different purposes and perspectives, temporal and spatial scales, types of organizations, and obstacles encountered during implementation. Projects can range from a large scale (e.g. Provincial) as shown by FREP, which addresses many aspects of forestry-related impacts, to single purpose monitoring projects, as shown by the bull trout monitoring project at Kemess Mine. The temporal scale can be immediate, as in the air quality monitoring in the Bulkley Valley, to longer-term as seen in the case of mining and acid rock drainage.

There are several challenges to overcome in order to achieve meaningful, repeatable and reliable results that answer the questions posed in land use plans and processes. This conference has highlighted several thought provoking and innovative presentations that have addressed some of these challenges. These include how to prioritize monitoring efforts to address those questions with the greatest risk and uncertainty, statistical challenges that need to be addressed and institutional structures to overcome perceived biases.

The Bulkley Valley Model emphasizes the importance of having people investing time and voluntary effort to make monitoring occur. This was termed 'social capital', and was represented by the Bulkley Valley Community Resources Board, the Babine Watershed Monitoring Trust, and the Bulkley Valley Research Centre.

# ROY MORRIS

# ANDREW GEORGE JR.

# GREG GEORGE

**Roy Morris**, Wet'suwet'en Hereditary Chief Woos



**Andrew George Jr.**, Wet'suwet'en Hereditary Wing Chief Skit'den  
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**Greg George**, Cas'Yex Ski'zeh



## TRADITIONAL WELCOME

### BIOGRAPHIES:

**Roy Morris** is Chief Woos, one of the hereditary chiefs of the Wet'suwet'en, and House chief for the Cas'Yex (Grizzly House) of the Gitumden (Bear) Clan of the Wet'suwet'en. Roy lives with his wife, Augustine, in Moricetown, where he continues to practice traditional lifeways as his ancestors did. He will be performing the conference's traditional welcome ceremony, as Smithers resides within Chief Woos' House territory.

Wet'suwet'en hereditary chief **Andrew George Jr.** has extensive experience in forestry and Aboriginal lands and resources management. Andrew was the Lands and Resources Manager at the Office of the Wet'suwet'en for eight years before leaving to pursue his culinary interests. He has established countless relationships with government, industry and academic institutions throughout British Columbia.

Andrew is a world-renowned chef and was a member of the Canadian Native Haute Cuisine gold-medal team at the World Culinary Olympics in 1992. He and his team mates were among 13,000 contestants from over fifty countries to enter the competition. They took first place and made history as the event's first native competitors. After winning seven gold, two silver and two bronze medals, George and his team are credited with establishing an Aboriginal presence in international cuisine.

In 1997, George published an aboriginal cuisine book entitled "FEAST". He will be catering the Innovative Monitoring Conference.

**Greg George** is a hereditary member of Cas'Yex and the Gitumden of the Wet'suwet'en. He has many years experience in Aboriginal capacity building, economic development and project management. His diverse background includes a degree in business and economics as well as certifications in economic development and management. He successfully runs his own consulting company which is complemented by working with various community based organizations.

# KEVIN KRIESE - CONFERENCE CHAIR

**PROJECT DIRECTOR, STRATEGIC INITIATIVES DIVISION, ILMB**

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**Kevin Kriese** is Regional Project Director with the Integrated Land Management Bureau of the provincial government. He is currently leading government to government negotiations with First Nations in the Sea to Sky LRMP area and with the Taku River Tlingit First Nation. He was trained as a forester and has a Masters Degree in Natural Resources Management. For the past 15 years, he has worked in various provincial ministries, largely focused on improving sustainable management through land use planning, research, community consultation, and collaborative management with First Nations.

Kevin is a past vice president of the Bulkley Valley Centre for Natural Resources Research and Management.



## CONFERENCE INTRODUCTION

Welcome to the Innovative Monitoring Conference. This conference is hosted by the Bulkley Valley Centre for Natural Resources Research and Management. The Bulkley Valley Research Centre is very interested in supporting local research and getting it into the hands of decision makers so that it can be applied.

This conference has been developing for a couple of years. There has been an expressed frustration locally with the level of monitoring, while at the same time there are some good examples where monitoring is working well. Discussions among local representatives of the Integrated Land Management Bureau (ILMB), the Ministry of Forests and Range (MOFR), and the Babine Watershed Monitoring Trust (BWMT) led to the idea of a conference to discuss issues and showcase examples, and resulted in formation of a steering committee which developed the agenda and structure for the conference .

The basic premise of monitoring is that there must be a goal for monitoring programs and a gathering of information. The many types and approaches to monitoring are described elsewhere – this conference is not about that, or about choosing the perfect monitoring system. Rather it is about a ‘call to action’.

By poll of this audience, it is apparent that everyone believes that monitoring is essential. About 60% feel that they have a reasonable ideas of what monitoring is supposed to be, few believe that the organization they represent or work with does a good or excellent job of monitoring, and everyone wants to improve what they are doing.

So what is preventing action? Factors of cost, time, technical and data issues, and responsibilities and governance all play a role. These can be addressed at this conference.

We can also reframe the problem based on the theory of ‘small wins’, wherein problems can be redefined to a smaller scale, so that people are more psychologically prone to tackle them. Often, monitoring is viewed as an expensive, complex, and risky endeavour. When reframed as ‘small wins’ or moderate problems, issues become a series of complete, concrete outcomes. They may seem unimportant, but a series of incremental ‘small wins’ creates building blocks for larger issues, gains new allies, and fits the attention spans of political decision makers. And, as we know, additional resources always flow to winners.

I hope that you look for ‘small wins’ during this conference and find transferable tools that you can implement to result in a series of small and positive outcomes in the monitoring field.



# JIM POJAR

## EXECUTIVE DIRECTOR, CANADIAN PARKS AND WILDERNESS SOCIETY, YUKON CHAPTER

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**Jim Pojar** is an ecologist and forester who lived and worked in British Columbia for over 30 years. He came to B.C. in 1970, for a PhD in Botany from UBC in 1974.

From 1975-78, he worked with B.C. Ecological Reserves Program in Victoria. Then he and Rosamund settled in the Bulkley Valley, where from 1978 to 2004 he was employed as a Forest Ecologist & Research Manager for the B.C. Forest Service.

They moved to Whitehorse, Yukon three years ago, where Jim is the Executive Director, Yukon Chapter of Canadian Parks & Wilderness Society.

Jim and Rosamund continue to take particular pleasure in natural history, gardening, their cats (the children are gone), and exploring the Northwest Cordillera.



### **Synecology and social networks: The watershed way through the end times**

The Skeena watershed is special, but over the past 50 years the management of its natural resources has been less than exemplary, one could say desultory. As a consequence, though there is still much to celebrate, the region's natural capital has been drawn down. An ecological and social debt has accumulated and must be addressed. The task of redress and the stewardship responsibility are too great and significant to entrust entirely to governments.

There are three different but overlapping periods of human impact on ecosystems: aboriginal, colonial, and global. The Skeena watershed is now in the period of global use, with intense, pervasive exploitation of marine, estuarine, freshwater aquatic, and terrestrial ecosystems and their fish, forest, wildlife, mineral, energy, soil, water, and even recreation resources. Such ecosystem exploitation is integrated into global patterns of resource consumption, and is characterized by more frequent exhaustion and substitution of resources. Forestry and fisheries lost no time getting a grip on "their" resources in Skeena. The energy and mining sectors are now rapidly consolidating their hegemony in western North America, aided and abetted by governments. West-central B.C. is one of many pawns in a continental and global chess game.

Resource management without monitoring is mere resource exploitation. To be useful, monitoring must be consistent and continuing, and part of a feedback system with the power to change management. Long-term monitoring must be sensitive to, and informative of, environmental change and new or emergent landscape patterns or phase shifts. Successful monitoring requires simple, repeatable observations or measurements, robust equipment/techniques, dedicated staff, a problem-solving orientation, management relevance, secure funding, and shielding from political meddling. Again, it would be unwise to place too much faith and reliance in governments to do the job. Perhaps a quasi-judicial advisory board or trust would be appropriate.

In contrast to the ecosystem trend, the human capital of the Skeena region has probably increased over the past several decades, on balance and despite perverse government policies. Notwithstanding the ecological, economic and institutional challenges, citizens of Skeena could still do things right. A possible path through the end times could be charted by convening a social network — a web of groups, organizations, and individuals who come together to address complex and shared "cross-border" problems, issues, and opportunities — to generate novel solutions and whole system innovations that no one member could achieve on their own. And the network would have to do more than talk, it would also need to generate financial and political clout.

# CONFERENCE INTRODUCTION & OVERVIEW

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## QUESTIONS & ANSWERS

Q – Can you expand upon your comment about the Balkanization of government through multiple agencies managing natural resources?

A – (Jim Pojar) Often government agencies do not know what other agencies are doing and there are not common management strategies to manage resources.

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Q –Do you think we need to monitor migratory bird species?

A – (Jim Pojar) Some of them. For some migratory species, population changes may be all about what is happening in their wintering area, while for other species it may be about changes occurring here, such as resources they depend upon, e.g. nesting cavities. Some species are affected by too many factors to be useful to monitor on a local scale. On a continental or international scale it makes much sense to monitor them.

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Q – How is science to participate or is there a role for science in government policy when government does not consider information contrary to policy? Is there a way to make science better considered by government when it makes decisions?

A – (Jim Pojar) There has to be a role for science in natural resource management, but we need to accept that we will only have an effect if it makes it easier for government to do its job, decreases the risk, or delivers the goods in a more efficient way. It has more to do with addressing the goals of the politicians and senior bureaucrats than with raising the profile of science.

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Q – You said that “you can’t look to government to lead”, but aren’t you just saying that there are two kinds of people, long-term and short-term, and the problem is that government is in power for only so long and must show itself to be doing something to lead? Is there anything we can do to overcome this?

A – (Jim Pojar) That is at the crux of the problem. I must clarify that I am talking about politicians and senior bureaucrats, as there are many people in government that know what is going on and can provide some leadership, but they are kept on a tight leash. The solution is partly through the social network, where it is possible for local people to wrest some control of resources from senior governments, especially if the government sees it as removing an irritant or helping them to solve a problem. This is essentially what happened on the coast with the Great Bear Rainforest, where politicians saw the opportunity, not only to solve a problem and remove an irritant, but also to make themselves look good.

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# CONFERENCE INTRODUCTION & OVERVIEW

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Q – How does the “small wins” concept deal with monitoring the impacts of cumulative effects?

A – (Kevin Kriese) Cumulative effects are big ideas that need lots of data. If you think that cumulative effects are an issue, you need to have a conceptual framework, but take a single issue of the framework and deal with it while keeping the bigger idea in mind. Deal with a manageable piece at a time.

# DR. BRUCE FRASER

## CHAIR, FOREST PRACTICES BOARD

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**Dr. Bruce Fraser** obtained his doctorate in plant ecology from the University of British Columbia in 1970, studying under Dr. Vladimir Krajina. He is former president of both Selkirk College in the West Kootenays and Malaspina College on Vancouver Island.

Dr. Fraser has extensive experience in public participation in forest management, including the post of special advisor on public involvement to the Ministry of Forests in the early 1980s. He was active in facilitation of land use plans, including the CORE process in the Kootenays and a number of LRMP's. His 17 years of independent consulting included projects in B.C. focusing on environmental mediation, community economic development and organizational strategic planning in over 30 resource-based communities.

International development projects included forestry, environment and human resource planning in 19 countries of Asia, Africa, Middle East and the Caribbean. Dr. Fraser was appointed to the post of chair of the Forest Practices Board in 2003 and re-appointed in 2006.



### **The influence of Forest Practices Board audits on industry and government performance**

The Forest Practices Board maintains a program of independent audit of licensee forest practices and the appropriateness of government enforcement of forest practices legislation. It also investigates complaints about forest practices brought forward by members of the public. As major issues accumulate, the board may conduct special investigations. In each of these cases the Board may indicate practice and regulatory issues that need attention and make specific recommendations for improvements. The Board tracks the outcome of all recommendations and has the authority to inform ministers and cabinet if recommendations are not being suitably followed. The overall objective is to contribute to the continuous improvement of practices. Specific examples of board influence will be given. Recently, the board is developing criteria and indicators of effective performance across the Forest and Range Practices Act (FRPA) values in order to contribute to the provincial transition to a results-based model of forest practices regulation.

# IAN MILLER

## MANAGER, FOREST PRACTICES BRANCH, MINISTRY OF FORESTS AND RANGE

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**Ian Miller**, RPF, is currently the Manager of Integrated Resources Section in Forest Practices Branch, B.C. Forest Service. He was a member of FRPA policy and legislation drafting teams from 2002 to 2006. His prior work spans operational and strategic planning and timber supply, including field work on the coast and in the northern interior.



### **Evaluating and monitoring the stewardship of BC's forest and range resources**

The Forest and Range Evaluation Program is a multi-agency (Ministries of Forests and Range, Environment, and Tourism, Sport, and the Arts) initiative to evaluate whether practices under the Forest and Range Practices Act (FRPA) are meeting the intent of current FRPA objectives, and to determine whether the practices, and the legislation itself, are meeting government's broader intent for sustainable management of our forest and range resources. The presentation outlines the program structure, and discusses recent activities and results, current issues and future directions.

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**Benjamin Weinstein** began his employment with the then Ministry of Water, Land and Air Protection in August 2003 on a one-year contract to compile a micro-emissions inventory for the Bulkley Valley-Lakes District airshed. In March 2005 he became the regional **Air Quality Meteorologist** with MoE and focuses his time on airshed management planning, air quality impact assessment and public education and communication. Ben graduated from UBC in December 2002 with a BSc and major in atmospheric sciences.



**Armel Castellan**, B.Sc. comes from an atmospheric sciences background, UBC. He has worked in carbon sequestration research as an instrument tech and more recently has been the **Air Resources Technician** forecaster for the Ministry of Environment Custom Venting Forecasting service for the past two burning seasons.

## Limiting air pollution impacts through innovation: Skeena region's custom venting index forecasting service

In the Bulkley Valley - Lakes District airshed there is a 'fall burning season', and air quality during this season is typically driven by a combination of open burning activities and meteorological conditions. Air quality episodes in the fall burning season often arise due to open burning before or during extended periods of poor atmospheric venting. To protect human health and the environment, operators burning under the Open Burning Smoke Control Regulation (OBSCR) are required to ensure that good atmospheric venting conditions exist prior to ignition. Several options are available for operators to determine the venting conditions, one of which is a customized venting index forecast (CVF) issued by the Ministry of Environment. These spot forecasts have been made available to any interested party by the Ministry of Environment for the previous four fall burning seasons (2003, 2004, 2005, 2006) through the use of an in-house meteorologist. CVF service involves combining knowledge of atmospheric conditions with risk management, ministry-client relationships, and also real time and forecasted air quality conditions. Through the past four years, the CVF service has repeatedly demonstrated its ability to increase open burning opportunities (relative to the other ways to determine atmospheric venting conditions) while simultaneously protecting human health and the environment.

# PROVINCIAL-LEVEL INITIATIVES

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## QUESTIONS & ANSWERS

Q – I am interested in the Forest and Range Evaluation Program, particularly in how it can be used in effectiveness monitoring. You gave an example of stand structure monitoring, which is a good first step in terms of implementation monitoring and giving us information on what we know is important for particular organisms. But does FREP have the mandate to go the next step to check 1) how these organisms are doing, i.e. true effectiveness monitoring, and 2) to examine how we check for the effectiveness for all those organisms for which we don't know what they need?

A – (Kevin Kilpatrick, for Ian Miller) The effectiveness evaluation program is set up to address many of your concerns. We have been assembling baseline data, for example, to see what amount of coarse woody debris is the right amount for each biogeoclimatic zone, by searching out inventory records and cruise data, etc. With riparian areas we are doing intensive evaluations to make sure that the information the resource stewardship monitoring is collecting is sufficient to answer the questions we need to answer. To do this, our specialists are doing more intensive sampling to compare to the resource stewardship monitoring data that is more extensive. We are also reviewing indicators to ensure we have the right indicators.

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Q – To try and improve management we need to understand cause and effect relationships, especially whether we caused the effect with our management. Does the Forest and Range Evaluation Program and/or the Forest Practices Board have the ability to do that kind of monitoring?

A – (Ian Miller) FREP probably does not have that ability in the first few years of the program, but are trying to start slow and get a good program developed of collecting information and training people. We are presently learning and once we get going we hope to be able to address those sorts of cause and effect questions, and have more resources to be able to address them. We hope to get there eventually, at present we measure very tangible things that one can see in the field, and are training stewardship staff.

(Bruce Fraser) This is the crux of moving from the Forest Practices Code (FPC) environment to the Forest and Range Practices Act (FRPA) environment. In the FPC environment one could look to see if you followed to code and if you did it was alright. Under FRPA, you need to be looking at the resource values and practices that may be affecting the sustainability of that resource. The biggest problem is attribution, and being able to show in a defensible way that the practices contributed to or detracted from the result that you measured, i.e. cause and effect. This is where the FPB is going. It's difficult as often the science isn't there to measure the quality of the value, and there may be multiple users on the same landscape, so there may be many sources of impact to a value. Attributing the effects to a single user will take a lot of evolution of monitoring before it can be done.

# PROVINCIAL-LEVEL INITIATIVES

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Q – Forest and Range Evaluation Program has a massive database, but who will have access to this data so they can analyze questions they have?

A – (Ian Miller) We are intending to make the data, as it goes through our quality control process, as widely available as we possibly can with web-based applications, certainly within government agencies. With respect to other stakeholders, I am not sure whether data access will go down to the general public or not, but we are trying to get it as widely distributed as we can. The results of riparian and biodiversity monitoring are available now.

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Q – As a member of a Land and Resource Management Plan (LRMP) implementation and monitoring committee, I am wondering how long it will be before we have something to do other than monitoring other groups that are monitoring things?

A – (Ian Miller) We are three years into the Forest and Range Evaluation Program, and are now getting enough data from enough sites to be able to give it to local practitioners. But don't have enough yet to be able to convince government to change legislation.

(Bruce Fraser) Ecosystem-Based Management (EBM) on the coast has yet to be monitored by anyone, mainly because it has yet to be practiced. The agreements on EBM have yet to find their way into Forest Stewardship Plans and operations, but First Nations and others are starting to use EBM formats. These practices will be monitored by the Forest and Range Evaluation Program and auditable by the Forest Practices Board (FPB). The FPB is talking to those who drafted EBM guidelines, companies and First Nations that are using them, and is waiting for practices on the ground to start so we can see if the claims being made for EBM are materializing.



# DR. KEITH MCCLAIN

## DIRECTOR, SCIENCE POLICY AND STRATEGY, ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT

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**Keith McClain**, PhD, is a Registered Professional Forester and is presently the Director of Science Policy with the Alberta Department of Sustainable Resource Development, Edmonton, Alberta. He has worked for the provincial government of Ontario and the federal government in British Columbia, primarily in the areas of research and research management; he also spent six years as a consultant. Most memorable times in his career were spent facilitating advanced education modules for professional foresters in B.C. and Alberta, and working on principles and determinations of sustainable forest management through various facets of the Model Forest Program (McGregor Model Forest and the Foothills Model Forest) that continue to this day. Keith's primary responsibilities in his current position include maintaining relations with the science community and ensuring that science is taken into consideration for the development of best practices and to inform decision-making and policy development. Keith has degrees from the University of Toronto and Oregon State University.



### Making social indicators work for us

By Keith McClain and John Parkins

From the early nineties until now, considerable attention has been paid to indicators – we've attempted to define them, select them, monitor them, interpret them and make sense of them. It's been said that one indicator tells one story, and many indicators tell many stories. So, how do we answer the question "are we managing in a sustainable manner?" and if we are not, "what changes can we make to our management strategies to ensure outcomes are desirable?" Of all the criteria and indicators, social indicators appear most problematic in influencing resource decision-making. Nevertheless, the human dimensions of resource management are integral to resource decision-making and our quest for sustainability. While we may know a considerable amount about communities in terms of incomes, education and preferences, we do less well at keeping our finger on the pulse of social attitudes towards resource management values, goals and outcomes. Several examples will be presented to illustrate our understanding and use of social indicators in Alberta.

# S. DENISE ALLEN

## SUSTAINABLE FOREST MANAGEMENT LAB, FACULTY OF FORESTRY, UBC

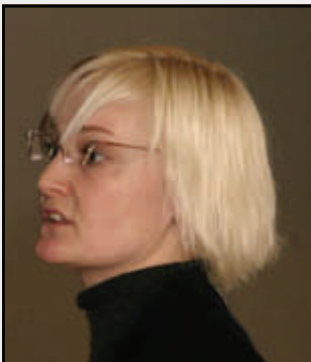
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**Denise Allen** is conducting an interdisciplinary PhD research project "Sustainability Reality Check: Measuring the Socio-Cultural Impacts of Forest Management in the Bulkley Valley" in the SFM Research Lab at the UBC Faculty of Forestry. Implemented in conjunction with the Office of the Wet'suwet'en First Nation Lands & Resources Department, her research uses methods from the social sciences to investigate local definitions of sustainable forest management and evaluate the sensitivity of social indicators of SFM to local social and cultural values. Denise has studied resources management in B.C., Ontario and Europe, done local level research with First Nations in B.C. and Quebec, guest lectured on social aspects of forest management at universities in B.C. and Germany, and worked as a consultant for a range of community, academic, professional, government, and non-government organizations projects since 1999. She has a particular fondness for the Bulkley Valley area, where she lived and worked for several seasons as a forestry field worker before returning to graduate studies.



### **Soft science for a wicked problem: Capturing concepts of sustainable forest management and territorial stewardship in the Bulkley Valley**

Sustainable forest management poses a wicked problem for resource managers and communities alike. Socio-ecological systems are moving targets with multiple futures: dynamic interactions between co-evolving domains such as institutions, ecological functions, technologies, values or policies that emerge at different temporal, spatial and social scales. Assessing how proposed forest management activities alter quality of life and sense of well-being, and how well communities adapt to change(s) caused by forest management, is even more complex in the context of overlapping — traditional (indigenous) and contemporary (industrial) — resource management regimes. Using interview-based research with the Office of the Wet'suwet'en Hereditary Chiefs and other communities on their traditional territories in the Bulkley Valley area, this research explores key concepts in local definitions of SFM, the perceived social and cultural impacts of forest management, and local expectations of social and cultural sustainability. This data is used to identify the nature of connections between the different interacting human-nature sub-systems in the landscape, and the elements and functions that maintain the adaptive capacity of local socio-ecological linkages in the forest management matrix.

# INCORPORATING SOCIETY'S VALUES

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## QUESTIONS & ANSWERS

Q – Do you think there is a scale at which people should make decisions, i.e. should the people who live in a region make those decisions or is it OK for people in Victoria or Ottawa to make those decisions?

A – (Keith McClain) Speaking from the heart, people should have the opportunity to make decisions about the community and the development that surrounds the community, but in reality policy decisions about development and dispositions are made by people in Edmonton. This is where it is really important for large companies to understand the impact they will have on communities. At one time large companies would provide all the housing for people that worked for them, and were fully responsible for that community. Things have switched where companies no longer want to have responsibility for the social requirements for the community, and the community is responsible for itself. But now the pendulum is swinging back towards the centre where there has to be a relationship between the corporation and the community. In some cases, such as Fort McMurray, they are very far beyond a break point where the mayor says they cannot do this any longer, and the stress is too high on the councillors. So now the provincial government has allocated \$300 million to assist with the infrastructure deficit in the community.

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Q – You showed two models, one showing social and economic well-being being embedded in ecological integrity, and the other showing the three circles of social, economic and environment being trade-offs. It is obvious that in Alberta the circles model is the dominant model, with economic prosperity the decision-making framework. Would the production of oil from the tar sands be as viable as it is presently perceived to be if the external costs that are associated with it, mainly being the impacts to rivers, biodiversity and climate change, were accounted for in the cost structures and the decision-making framework?

A – (Keith McClain) The rate of expansion of development has a cost to the social fabric and people of Alberta, but many of the oil companies are not owned by the people of Alberta. If everything was accounted for, you might slow things down, but globalization and the need to supply energy to the U.S. is not going to allow that. It is government policy that Alberta is open for business, with Premier Stelmach saying there is no way he is going to allow a slowdown to happen, despite calls for one. So government policy has position of public and ecological sacrifice to deal with. Deputy ministers are dealing with issues of how to make things better, without all costs being taken into account.

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# INCORPORATING SOCIETY'S VALUES

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Q – There is a big difference between being heard and being understood, one of the four sets of values includes property rights. First Nations have been working on plans, such as the Wet'suwet'en Territorial Stewardship Plan that has been in the works for ten years, but due to legal issues surrounding land claims it has not been shared. What are your thoughts on how legal land claim issues are systematic barriers to effective communities?

A – (Denise Allen) A key aspect of what we do is looking forward to sustainability and future generations, but we need to look back also to history to understand where we are now and build up trust relationships. One of the reasons I analyzed my data the way I did in my analysis was to pull out concepts while protecting the intellectual property rights of the people. There is a lot of distrust from past practices of cannibalizing traditional ecological knowledge so we need to build it back up again using small projects.

# LIZ OSBORN - MODERATOR

## CURRENT RESULTS NEXUS

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### THE BULKLEY VALLEY MODEL

#### BIOGRAPHY:

**Liz Osborn** helps people keep up-to-date on B.C.'s natural resources research with her online newsletter, Current Results. She previously facilitated the flow of information while vice-chair of the Forest Practices Board, as executive director of the Outdoor Recreation Council, and as a consultant. Liz has two masters degrees in natural resources and is a registered professional biologist.

# ADRIAN DEGROOT

## CONSULTING ECOLOGIST AND CHAIR, BULKLEY VALLEY COMMUNITY RESOURCES BOARD

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**Adrian deGroot** has been a member of the Bulkley Valley Community Resources Board since 2001 and has been the chair of the board for two years. He is a consulting ecologist who works in a number of areas, mostly related to vegetation or protected area management.



### **Genesis of the Bulkley Valley Community Resources Board and its role in resource management**

The Bulkley Valley Community Resources Board (BVCRB) was formed by the Hilltop Agreement in 1991. There is a long history of community activism around natural resource management before the BVCRB, with many of the players in these earlier efforts also involved in the BVCRB. This history contributed to formation of the board by having people who were experienced in community campaigns, and having local government employees that were aware that they needed to involve the public in management planning. The perspectives structure of the board, instead of a sector structure, and the consensus decision-making approach were key to the success of the board.

The BVCRB initially wrote the Bulkley Land and Resource Management Plan (LRMP) with the assistance of government agencies. Since the completion of the LRMP, the BVCRB has been monitoring the implementation of the LRMP. The current challenge is monitoring the effectiveness of the management direction in the LRMP. The Bulkley District has been a provincial leader in land management planning for many years, largely as a result of the efforts and dedication of the members of the board, and the good relationship between the BVCRB, provincial government agencies and industry.



# DR. SYBILLE HAEUSSLER

## PRESIDENT, BULKLEY VALLEY RESEARCH CENTRE

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**Sybille Haeussler**, PhD, RPF is president of the Bulkley Valley Research Centre. Sybille is a professional forester and research scientist whose work addresses the dynamics and diversity of plant communities and ecosystems — with a special interest in complex systems dynamics and the role of self-organizing processes in maintaining ecosystem diversity. Sybille has a BSF (Forest Biology) from the University of BC, an MSc (Forest Ecology) from Oregon State University, and a PhD (Environmental Sciences) from the Université du Québec at Montreal. Sybille currently works as a Killam (honorary) and NSERC post-doctoral research fellow for the Forest Sciences Department, University of BC, and before that was self-employed for more than 20 years as the proprietor of Skeena Forestry Consultants, based in Smithers, B.C.



### **The role of a local research centre in the monitoring cycle**

Sustainable monitoring of natural resources and effective resource decision-making rely upon a variety of pieces being in place. Three important components are: 1) credible knowledge about the state of resources and their response to environmental changes; 2) trusted institutions that ensure the knowledge is used; 3) engaged and informed citizens and communities. The Bulkley Valley Centre for Natural Resources Research & Management has a role to play in each of these areas. The Centre is a registered non-profit society with charitable status established in Smithers in 2001. We are a grassroots organization whose purpose is to advance scientific and technical knowledge as well as public understanding of sustainability in all of its ecological, social, and economic dimensions. Our membership includes provincial government representatives, university scientists, consultants, local industry, First Nations, ENGOs and interested community members and encourages communication and cooperation among these groups by organizing joint projects, workshops and conferences. Promoting locally-based, peer-reviewed scientific research and its use by resource managers is a big part of what the Centre does, but we also have projects proposed or underway that aim to better integrate scientific research with traditional, experiential and indigenous knowledge. The Centre provides scientific and administrative support to regional initiatives such as the Babine Watershed Monitoring Trust and the Wetzin'kwa Community Forest. Finally, we are building a program of community outreach, education, awards and youth employment whose goal is to retain and recruit talent and expertise in northwest B.C. and create some enthusiasm for sustainable resource management as a cool thing to do for a living.

# RICHARD OVERSTALL

## BABINE WATERSHED MONITORING TRUST

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**Richard Overstall** practices law with the firm Buri, Overstall in Smithers, with a particular interest in aboriginal and natural resource law.

He has worked in local sawmills, as a mining exploration geologist, and as an environmental researcher. He was the research director for the Gitksan and Wet'suwet'en peoples in their Delgamuukw court action and subsequently helped with treaty and other negotiations, particularly in the areas of restorative justice, self-government, and land and resources.



### **Using trusts to ensure monitoring impartiality: The Babine example**

The Babine Watershed Monitoring Trust emerged from attempts to resolve conflicting views on the effects of land-use plans in the Babine River drainage. Participants were prepared to accept what was, in their particular view, a less than ideal plan if its strategies could be readily amended based on robust science. Monitoring was seen as much as a solution to a political problem as a prescribed stage in the planning process.

To achieve this purpose, land-use plan monitoring in the Babine had to allow for the participation of diverse and conflicting interests with the assurance that no one of them would control the decisions or the results. The trust was chosen as the only governance structure that could achieve this. The resulting trust was established by commercial, community and government entities. A prescribed decision-making framework was developed to impartially rank plan objectives that were most at risk of not being achieved under current plan strategies. Trustees are duty-bound to follow the priorities that emerge from this process.

Over time, it is anticipated that the trust will provide reliable, even-handed monitoring information to assist in amending the more risky plan strategies. It has been able to do this by designing a governance structure and a ranking methodology that insulates the selection of monitoring projects, their execution and the dissemination of results from the influence of any particular interest.

# DR. KAREN PRICE

## CONSULTANT

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**Karen Price**, PhD is an intuitive scientist with a fairly unsullied sense of wonder about the natural world. She divides her time between a small cabin on Francois Lake, where she monitors her garden or the snow (as seasonally appropriate), and a somewhat larger cabin closer to Smithers' musical community. She and her partner Dave Daust enjoy consulting because it lets them ponder interesting questions about the relationship between science and resource management.



### **Making monitoring manageable: A framework for learning based on risk and uncertainty**

By Karen Price and Dave Daust

Resource managers, planners and the public—in the Bulkley Valley and elsewhere—are unified in their calls for monitoring of land-use plans. Unfortunately, many monitoring initiatives fall short of their potential for several reasons: 1) indicators are not explicitly linked to objectives, hindering feedback to planning; 2) knowledge is not represented in a manner that facilitates learning; and 3) monitoring priorities are driven subjectively. A monitoring framework based on risk and uncertainty, designed to meet the criteria of the Babine Watershed Monitoring Trust, offers potential solutions. The framework links indicators to existing objectives, presenting knowledge as hypotheses about the risk to an objective posed by various indicator levels. These explicit, graphical hypotheses represent current knowledge in a manner that is easily communicated and updated. The framework objectively prioritises projects to collect indicator data, detect consequences, and decrease uncertainty (respectively implementation, effectiveness and validation monitoring). Results from monitoring update the hypotheses in the framework. The hypotheses provide continually-revised decision support. The Babine watershed, with its high resource values, decades of controversy and decades of ineffective monitoring, provides an ideal test of the framework. The Babine Watershed Monitoring Trust successfully used the framework to sift through a variety of objectives and different types of monitoring studies to focus effort on the most critical projects for each type of monitoring. By concentrating on publicly-derived, regionally-applicable objectives and strategies taken from existing land-use plans, the framework provided relevant results and enabled rapid feedback.

# THE BULKLEY VALLEY MODEL

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## QUESTIONS & ANSWERS

Q – Have there been any successes in getting management change due to the activities of the Babine Watershed Monitoring Trust so far?

A – (Richard Overstall) The work we funded for monitoring stream crossings has resulted in the local forestry company fixing the stream crossings that were identified as being high risk. However, when we started the trust we thought it would be at least five years of monitoring before we got enough information to effect management change.

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Q – You're a local group with a cool idea, but how do you ensure that the ideas get buy-in from industry and government and don't get ignored?

A – (Richard Overstall) The critical element is the social capital spent by people in the community. I think the 30-year history of activism in the area has created a culture that is more important in the long run than any funding or government support. Government support may be most useful in transferring the trust model to other areas, and expanding it into other types of situations.

(Sybille Haeussler) The social network and social capital is very important as can be seen here in the panel, with Richard active in the 1980's and, later, myself in the 1990's, Adrian carrying on today, and others in this room likely being active in the future. We here on the panel have all found a community we want to live in and will stick with finding ways to make living here better.

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Q – Are there opportunities to reconcile the fact that LRMPs have not been signed off by First Nations?

A – (Richard Overstall) I feel that the trust framework is ideally suitable to involving First Nations as another institution in the trust. The idea of using a trust came about from my work with aboriginal groups, as a medium where you could design treaties, and we have used a trust model in designing house groups. The trust could be designed to include both aboriginal and western legal thinking and legal orders in the same framework.

# LARRY PEDERSEN

## DEPUTY MINISTER OF AGRICULTURE AND LANDS

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**Larry Pedersen** is a lifetime resident of British Columbia who was born in Summerland and has lived and worked in many regions of the province over the last 30 years of his career. He graduated from high school in Quesnel and entered the University of British Columbia in 1970. In 1975 he received his Bachelor of Science in Forestry. Since that time, he has worked in a variety of positions in the BC Forest Service. He also spent a number of years working in the private sector early on in his career. His career has taken he and his family to Victoria in 1975, and then onwards to Prince George, Salmon Arm, Williams Lake, Smithers and back to Victoria again in 1994.

From 1994 to 2004, Larry held the position of chief forester of the province. This prominent position gave him a strong background in public administration and positioned him in the often complex world of seeking balance between a wide variety of stakeholders and parties with an interest in the quality of forest management in B.C. Larry has developed strong interests in sustainability and has a healthy respect for managing to the triple bottom line of economic, social and environmental interests. Since the fall of 2004, Larry has held the position of assistant deputy minister of BC Timber Sales in the Ministry of Forests. In the spring of this year he was given the Distinguished Forester's award by the Association of BC Forest Professionals.

In June 2005 Larry was appointed deputy minister of the Ministry of Agriculture and Lands.



### Measure what counts

I am very pleased to be here and to offer my perspectives as a decision maker on how monitoring and feedback systems are used in decision-making and what I have learned.

Einstein was right – not everything that counts can be counted and not everything that can be counted counts!

I would like to talk about 4 themes:

1. Context for resource management in BC:

In resource decision making we must consider our rich terrestrial and aquatic legacy, our social context with a rich First Nations history, the fate of rural resource-dependent communities, the demands for resource development, and the public ownership model that we work with. Values and risks are high, and we must consider whether our management approach is appropriate.

2. Concepts and principles important to me as a decision maker:

It is important to me to be transparent - to be rigorous, repeatable and accountable. In dealing with uncertainty, risk must be minimized through consideration of all available information. If a decision is highly sensitive, this is where the time and money should be directed. The future is always uncertain so decisions should be revisited on a regular basis. Ultimately, people make decisions, not models. There is no substitute for good judgement. Finally, where there are weaknesses in decisions, instructions are given for further work or research. My feedback system has been in use for about a decade and seems to work.

3. Need for robust monitoring and feedback mechanisms:

There is a long history of various mechanisms - continuous improvement, adaptive management, and so on. It is very important to continuously check validity of decisions. The Forest Practices Code example - there were criticisms, such as the Code was costly to implement, better approaches were possible, and it was not leading to the right outcomes. Discussions over several years pointed to the need for something based on process – and what is happening on the ground. The FREP framework was introduced to bring in integrity and provide a feedback loop to legislation. It is concerned with asking what is going well and what can be done differently, and is complimented by other initiatives such as the MOFR research program.

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# LARRY PEDERSEN - CONTINUED

## DEPUTY MINISTER OF AGRICULTURE AND LANDS

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4. Of importance to me as I make decisions (some of my random observations):

- Context is everything with respect to goals and the process of setting goals. Process and outcomes are very important when dealing with a public resource.
- Listen to your critics!
- Think carefully about where you are applying your marginal funds when talking about monitoring and assessments and providing feedback to decisions. Be rigorous and thoughtful during this process.
- Public will prevail in a public forest.
- There will always be uncertainty. We need to understand the risks, but this is not a reason for not making decisions. It is a reason for making well-informed decisions. Use data, modeling, sensitivity analysis, good judgement, and consulting with others. Check whether you got what you wanted.
- Lastly, strive for openness and transparency in decision-making. It is how the information is used that can be dangerous. Make the data available. Set a high standard.

Take a rigorous consistent approach, be transparent, be willing to change, engage in an open dialogue, and do not be stuck on the status quo.



# JAMES CUELL

## STRATEGIC PLANNING BIOLOGIST, ILMB

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**James Cuell**, BSc, RPBio, is a Planning Officer with the Integrated Land Management Bureau in Smithers. James has been working with strategic land use plans in the Bulkley Valley and Kispiox for the last 10 years. He is interested in ensuring that land use plans remain relevant to the communities and stakeholders that developed them.



### **Making monitoring meaningful: Monitoring land and resource management plans in the Skeena sub-region**

The communities in the Bulkley Valley have made significant investments in land use planning over the last 10 years. This investment has triggered a number of monitoring initiatives including the Bulkley LRMP Implementation Reports, Bulkley Timber Supply State of the Forest Report, and the Babine Watershed Monitoring Framework. Experience from these initiatives has contributed to developing a conceptual framework for monitoring the implementation and effectiveness of land use plans across the region.

Monitoring the implementation of land use plans has evolved considerably over the last five years, with the requirements now reasonably understood. Implementation activities include the implementation of projects, compliance monitoring of practices and resource condition monitoring. Effectiveness monitoring, however, has typically been deferred given the complexity of interpreting resource outcomes and the often unclear linkages between these outcomes and land use strategies. To ensure the strategies associated with land use plans are effective, we are proposing a monitoring framework that ensures resources dedicated to effectiveness monitoring have a reasonable probability of evolving the land use plan. Effectiveness monitoring for land use plans is really about ensuring that the strategies used to meet objectives are relevant and the risk associated with the targets that are set, are understood. Additionally, monitoring for effectiveness is not required for every objective, in every instance. Where the risk associated with targets are low and the relationship between the objective and indicator is well understood, implementation monitoring (resource condition monitoring) is adequate. Finally, research plays a significant role in understanding the relationship between the indicator and objective, identifying better indicators (at a lower social cost) as well as improving the understanding about the risks associated with identified targets. The social mandate provided by a land use plan can make research around the land use objectives relevant, and the effectiveness framework can ensure this research contributes to improving the land use plan over time.

# DWIGHT SCOTT WOLFE

**OPERATIONS MANAGER, TESERA SYSTEMS INC.**

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**Dwight Scott Wolfe** is a Registered Professional Forester with thirteen years of experience in developing sustainable forest management systems in British Columbia. Dwight is currently the operations manager for Tesera Systems Inc. Dwight's focus is applying the Tesera Approach to Sustainable Forest Management (SFM) by using scenario planning, spatially explicit forest estate modelling and adaptive management techniques. Dwight received a Bachelor of Science in Forestry from the University of New Brunswick in 1989.



## **Indicator monitoring for the Morice and Lakes Innovative Forest Practices Agreement**

The Morice Timber Supply Area and the Lakes Timber Supply Area (TSA) encompass more than 2.5 million hectares of forest land in central British Columbia. Since 1999, forest licensees, government agencies, and public groups have participated in an Innovative Forest Practices Agreement (IFPA) for this area. IFPAs are provincial programs intended to encourage new approaches to forest management. A key project has been the development and implementation of certification-ready Sustainable Forest Management (SFM) Plans in each TSA.

Tesera Systems Inc. is leading the development and implementation of the SFM Plans through the innovative application of Scenario Planning, GIS, Spatial Modeling and Visualization tools. Indicator performance projections and indicator monitoring/reporting strategies have been prepared to assist the participants in designing, testing and implementing management strategies for a wide range of resource values. An effectiveness monitoring program has been in place for two years to assess over 40 different resource management indicators.

This presentation will focus on the development and implementation of the IFPA's Indicator Monitoring Program including:

- The approach used to select indicators and the targets and thresholds necessary for Sustainable Forest Management.
- The results of two years of effectiveness monitoring of selected indicators.
- The continual improvement process including changes in management practices and criteria for success.

# MONITORING & LAND USE PLANNING

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## QUESTIONS & ANSWERS

Q – Do you think that applying the framework that was used in the Babine would be useful if expanded and used across a larger LRMP area in order to decide on priorities for effectiveness and validation monitoring? And, do you think it could be used to decide which parts of plan implementation to focus on?

A – (James Cuell) Certainly I think the framework could be used at the TSA scale. Yes, the framework could also be applicable to prioritizing implementation, research or other information needs.

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Q – What efforts are being made among monitoring agencies to work together to increase efficiencies and reduce duplication of effort?

A – (Dwight Scott Wolfe) I would like to see more consistency among indicators so that they can be applied more widely. In the different projects I am involved with I am surprised at the level of consistency among projects. There is lots of talk around consistency but someone needs to take the lead to make things consistent. Some things can be set at a provincial level, but there will always refinements made at the local level to address local issues.

(James Cuell) This conference is one step along the way getting people involved in monitoring to talk to each other.

(Kevin Kilpatrick) The Forest and Range Evaluation Program tries to communicate with many agencies and individuals across the province and we try to ensure consistency in our monitoring across the province.

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Q – I have seen a focus on indicators here, but would like to see a focus on objectives. I would like to know what steps are being taken to ensure that indicators and targets are going to achieve the objectives?

A – (Dwight Scott Wolfe) Strategies are used to meet objectives and are measured with indicators. So you always need to keep the objective in mind when implementing strategies. Typically, indicators are used to measure whether strategies are being implemented, so for wildlife tree patches for example, we have operational indicators to measure whether patches are being left on the block, but do not measure whether the wildlife are using them. That is the next step up.

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Q – On the central and north coast, implementation and monitoring committees are faced with not knowing what the plan is really going to be, as there are many different levels of plans and orders. So I want to know if we will ever know what we will be monitoring in the future?

A – (James Cuell) You need objectives to start with that are in the land use plan and other documents should build upon that.

(Kevin Kriese) In the Babine, they took all the various plans and consolidated them into one document or package as a starting point for monitoring.

# MONITORING & LAND USE PLANNING

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Q – What is the legal status and purpose of the Innovative Forestry Practices Agreement (IFPA)? How does it relate to government land use plans and licensee forestry plans?

A – (Dwight Scott Wolfe) There is a Forest Practices Agreement regulation that sets the stage for the IFPA. Licensees are responsible for forest stewardship plans, and some of the objectives in them come from the IFPA as they have shown they can meet the targets for the objectives. The IFPA does not have legal status on the ground that is enforceable, but allows a Timber Supply Area level review of the Annual Allowable Cut.

(Kevin Kriese) There is a hierarchy of plans with the IFPA needing to be consistent with any legal government plans, then the IFPA can be used to draw up forest stewardship plans.

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Q – How long should we have to wait for all projects identified in a Land and Resources Management Plan (LRMP) to be addressed? Do you think that the multiple agencies responsible for land management in B.C. can be transformed into a single natural resource management agency?

A – (James Cuell) We have seen that a lot of projects have not been addressed in early LRMPs, as there was not a good implementation strategy. However, we feel that we are doing much better with more recent plans. The creation of the Ministry of Sustainable Resource Management (now Integrated Land Management Bureau) was an attempt to consolidate land management planning, but I think the jury is still out on the success of this initiative. There presently is still a mix of agencies doing their own thing that could use more coordination, especially in reporting on monitoring.

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Q – Can you give examples of the differences between operational indicators and analysis indicators?

A – (Dwight Scott Wolfe) Analysis indicators are typically those that relate to resource values across the landscape, such as age class and seral state distribution, tree species composition, road densities in Wildlife Habitat Management Areas, Riparian Management Areas that are less than three metres tall in sensitive watersheds, etc. Operational indicators typically are those that address social and economic questions that come out of the public input process. This might include Sustainable Forest Management (SFM) opportunities, opportunities for the public to learn about SFM, whether licensees are meeting smoke management targets, free-growing targets and how many infractions of the Forest and Range Practices Act (FRPA) incurred in the last year.

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Q – Can you give an example of an indicator that is not working?

A – (Dwight Scott Wolfe) There is an analysis indicator related to the total area of quality wildlife habitat for various species. There are more effective ways of monitoring than the model being used, so companies need to examine how this will be addressed, either by adjusting the model or finding a new method of monitoring.

# WENDY BERGERUD

## SENIOR BIOMETRICIAN, RESEARCH BRANCH, MINISTRY OF FORESTS AND RANGE

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**Wendy Bergerud** has worked as a statistician with the Research Program of the B.C. Ministry of Forests since 1981 and has presented several workshops on the use of statistics in research and monitoring.



### Using science and statistics to get meaningful results

Successful monitoring requires careful thought about the objective, suitable selection of study material (such as pieces of land), appropriate assignment of treatments to the study material and consideration of power, the ability to detect biologically significant effects. Wendy will be discussing these elements of monitoring.

#### Power Analysis – some references:

From the Ministry of Forests, Biometrics Website (<http://www.for.gov.bc.ca/hre/topics/biomet.htm>):

Nemec, Amanda F. Lennell, 1991. Power analysis handbook for the design and analysis of forestry trials. Biometrics Handbook #2.

Research Branch, B.C. Ministry of Forests. (online at <http://www.for.gov.bc.ca/hfd/pubs/docs/bio/Bio02.htm>).

Bergerud, Wendy and Vera Sit, 2001. Power analysis workshop. Workshop notes. Research Branch, B.C. Ministry of Forests. (online at <http://www.for.gov.bc.ca/hre/forprod/pwrwksp.pdf>).

Biometrics Pamphlets:

37: A general description of hypothesis testing and power analysis

41: Power analysis and sample size determination for contingency table tests

49: Power analysis and sample sizes for completely randomized designs with subsampling

50: Power analysis and sample sizes for randomized block designs with subsampling

51: Programs for power analysis/sample size calculations for CR and RB designs with subsampling

52: Post-hoc power analyses for ANOVA F-tests

61: ANOVA: Power of Linear Contrasts - Interpreting the Non-centrality Parameter

In the literature:

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Foster, Jeffrey R. 2001. Statistical power in forest monitoring. *Forest Ecology and Management*, 151: 211-222.

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Legg, Colin J., Laszlo Nagy. 2006. Why most conservation monitoring is, but need not be, a waste of time. *J. Environmental Management*, 78:194-199.

Peterman, R. M. 1990. Statistical power analysis can improve fisheries research and management. *Can. J. Fisheries and Aquatic Sciences*, 47: 2-15.

# DR. DAVE WILFORD

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**Dr. Dave Wilford** has been a research forest hydrologist with the B.C. Forest Service, based in Smithers since 1975. His work has focused on landslides, cumulative effects, watershed monitoring, alluvial fans, protection forests, and extension. Monitoring is central to watershed management and he is honoured to share his experience and perspectives at this conference.



### **Successful monitoring: Key practical and technical considerations**

It is easy to agree to undertake monitoring in watersheds, but it is challenging to monitor effectively. Money and human resources can easily be wasted on collecting the wrong data. This paper presents a series of key practical and technical considerations for effective watershed monitoring.

Monitoring can be undertaken of processes such as steps in planning, implementation and evaluation. This type of monitoring is also central to the due diligence defence if problems develop in watersheds.

Monitoring can also be of variables. There are two basic types of variables: direct and surrogate. Direct variables such as suspended sediment are of limited value in assessing land use activities if the source of the change in the variable is not identified (e.g., new sediment sources versus natural erosion). Choice of variables is a critical step because it is necessary to determine natural background processes in a watershed to understand which variables can possibly change as a result of the planned management activities, and whether the change in a variable will be at the site or watershed level. Surrogate variables provide an indirect measure of potential impact—that require fieldwork to explore actual impacts. Surrogate variables require a scientific link to be considered as reasonable monitoring variables.

Six steps are presented for monitoring projects: define objectives, develop a plan, define personnel and budgetary constraints, pilot project, full implementation, and implement results. A major consideration from the beginning of a monitoring project is securing a commitment to dedicate resources over the required time span.

Monitoring is a key aspect of watershed management. Done effectively, monitoring can ensure impacts are limited, particularly if management practices can be adjusted based on timely feedback.



# LOGISTICS OF MONITORING

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## QUESTIONS & ANSWERS

Q – How do you resolve the differences between information given by science and the social choices made when managing the landbase and monitoring?

A – (Dave Wilford) We can't ignore this issue as, for example, roads may not be causing an impact to water quality or fish, but the roads may not be safe to use so there is a social element. Some aspects of social impacts are addressed by WCB or other enforcement agencies. Others are much harder when the indicators are showing there is not a problem and there are not human impacts but the public is saying, 'yes but you shouldn't be doing that in a watershed.' That goes back to the question of commons.

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Q – There are many cases in monitoring where we will not have enough power to detect changes in monitoring. What role do you see for alternative statistical methods such as Bayesian statistics?

A – (Wendy Bergerud) There is a role for Bayesian statistics in monitoring, but many people have a hard enough time handling standard statistical methods and Bayesian statistics are much more complex mathematically. Also, there is a lack of computer programs to assist people, so there are technical hurdles to overcome, though the methods are worthy.



# MARK SAUNDERS

## WILD SALMON POLICY COORDINATOR, DEPARTMENT OF FISHERIES AND OCEANS

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**Mark Saunders** has been working for DFO for 25 years and is currently with the Policy Branch in Vancouver, where he was part of the team that developed the Wild Salmon Policy for DFO and is now the coordinator for its implementation. Prior to the policy work, Mark was based at the Pacific Biological Station in Nanaimo working as a fisheries biologist specializing in groundfish stock assessment and fisheries oceanography. He lives in Chemainus with his wife, two girls, one dog, two guinea pigs and six fish and enjoys kayaking, skiing and coaching soccer.



### **DFO's Wild Salmon Policy: The challenge of moving from monitoring to management action**

DFO's Wild Salmon Policy (WSP) was released in June 2005. The goal of the policy is to restore and maintain healthy and diverse salmon populations and their habitats. The WSP represents a departure from reactive, rules-based policy to a proactive, process-oriented approach. The policy requires the development of monitoring strategies for salmon, their habitats and ecosystems that will inform a strategic planning process to specify management objectives and actions. In this paper I briefly describe the policy, report on our progress in monitoring but focus on exploring the challenges of implementing the strategic planning process which ultimately results in taking management action. The challenges include the development of an appropriate governance structure and a planning approach that allows all of the interests to work together in a collaborative manner.

# DR. ALLEN GOTTESFELD

## SKEENA FISHERIES COMMISSION

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**The Skeena Fisheries Commission:  
Aboriginal salmon monitoring from  
headwaters to ocean**

No abstract available.

# MONITORING MIGRATORY SPECIES

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## QUESTIONS & ANSWERS

Q – What kind of strategies are you developing under the Wild Salmon Policy for monitoring salmon in the face of climate change and the impacts to fish?

A – (Mark Saunders) We are trying to treat the monitoring of the ecosystem and the habitat independent from the fish, so we don't have to see a decline in the fish before we think there might be a problem with the habitat. In terms of climate change, the Wild Salmon Policy will not be able answer these questions. We are engaged with the Fraser Salmon and Watersheds Program with the Ministry of Environment to try to put together all information in a forward looking model, so predicted changes can be modelled to see their effects on salmon.

Q – The Wild Salmon Policy came about from concerns about the abundance and diversity of wild salmon. How is this policy going to address the problems that led to the present situation with wild salmon abundance and diversity?

A – (Mark Saunders) We used to manage for large mixed stock fisheries, but we are now changing as we realize the importance of smaller stocks over time as things change.

(Allen Gottesfeld) The Wild Salmon Policy is the Department of Fisheries and Oceans (DFO) attempt to redefine itself from an agency whose focus was maintaining the size of the commercial fishery to one that is concerned about fish. This is a positive development, though the change is taking a while to occur.

Q – The Wild Salmon Policy is an important step for DFO. Do you think it will enable decision makers to have the strength and courage to make the changes that are needed in the political realm?

A – (Allen Gottesfeld) No.

(Mark Saunders) Yes. This has been one of the long, hard pieces in developing the policy. Decisions are ultimately the minister's to make, but if we can develop a plan using an open, transparent and inclusive process that takes into account the interests of the people and communities it will be difficult for the minister to ignore the direction given to him. Ultimately we may be able to go from an advisory structure to a co-management structure.

# IAN SHARPE

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**Ian Sharpe** has been a provincial government employee in the Environmental Protection Division for 15 years. He has progressed from Environmental Impact Assessment (EIA) Biologist to Section Head for the EIA Section, and for the past year, has been the Manager of the Regional office. Ian has a BSc from Brandon University, and an MSc Forestry from UBC. Prior to entering the provincial public service, Ian worked for the federal government as a National Park Warden, and as an Officer in the Water Resources Division of Indian and Northern Affairs Canada in Yellowknife. He also has experience as an environmental consultant, and as a fund raiser and public educator working for Ducks Unlimited Canada.



### **Skeena aquatic macroinvertebrate sustainability indicator**

There is a demand for ecosystem based sustainability indicators to support decisions aimed at protecting aquatic resources. This demand is based on the recognition of the need to protect and restore water quality and aquatic ecosystems. To date, no such indicators exist that are integrated into operational or planning level decision making systems in BC. This bioassessment system employs a multivariate Reference Condition Approach (RCA) using benthic macroinvertebrates in streams, and has been designed to assist in filling this gap. The geographic scope of the project is centered in the NW ¼ of BC, within the Ministry of Environment's Skeena and Omineca Peace Regions. Support for the project has been obtained from the Forest Sciences Projects (FSP) component of the BC Forest Investment Account (FIA), 3 BC forest industry licensees, the BC Ministries of Forests, and Environment, Environment Canada and the Babine Watershed Trust. Annual expenditures have been approximately \$150,000, shared among the partners. The biological sustainability indicator system integrates into adaptive management decision making processes such as landscape level plans, forest product certification efforts, and operational scale land and water management plans. It can also be used in watershed management processes, point source discharge regulation and non-point source pollution abatement and remediation efforts by governments and industries. Now that the sustainability indicator development project is complete, a rotational monitoring program to assess stream conditions over broad areas will be instituted. We are also now working on developing a province wide system involving several hundred sites (both reference and influenced) over the next 5 years. With ongoing partnership funding among land and water users such a system will be affordable.

# PIERRE BEAUDRY

## FOREST HYDROLOGIST, P. BEAUDRY AND ASSOCIATES LTD.

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**Pierre Beaudry** obtained an applied sciences bachelors degree in forest management from Quebec's Laval University in 1980 and went on to do his Master's of Science degree in forest hydrology at UBC. He was the assistant research hydrologist for the Ministry of Forests in Smithers from 1983 to 1991 and the regional research hydrologist, also for the ministry, in Prince George from 1991 to 1998.

Pierre is now the principal of P. Beaudry and Associates Ltd., a Prince George-based consulting firm that specializes in watershed management and riparian silviculture. He is also a member of the Association of British Columbia Professional Foresters and of the Canadian Water Resources Association and the International Erosion Control Association.

Pierre is a certified professional in erosion and sediment control, a *Watershed Management and Fish/Forestry Interactions* instructor at the College of New Caledonia and a sessional lecturer in watershed management at the University of Northern British Columbia.



### Evaluating erosion potential as an indicator of water quality

The Stream Crossing Quality Index (SCQI) was developed for Canadian Forest Products Ltd. (Canfor) as a sustainable forest management (SFM) indicator of protection of water quality. It was initially developed for the central-interior region of British Columbia where the terrain is gently rolling and forestry-induced landslides are relatively rare. The basic assumption underlying this indicator is that the biggest forestry-related hazard for water quality is associated with the building, use and maintenance of stream crossings. The indicator was designed to assess this hazard by scoring the potential for accelerated erosion and sediment delivery at stream crossings. The SCQI was initially conceived in 1999 and has undergone continuous refinements since that time. Extensive field validation was carried out between 2002 and 2005 to test how well the procedure can predict increases in stream turbidity caused by the crossing. Since 1999, over 6,500 stream crossings have been assessed using this procedure and it has been presented in numerous field workshops. In general, the procedure has been well received because it is a systematic and objective assessment which provides useful knowledge to the land manager about the potential of their operations to negatively impact water quality.

The SCQI scores are categorized into five hazard classes, termed the Water Quality Concern Ratings (WQCR). Once mapped, the WQCR can be used to identify the location and frequency of problematic areas in a watershed. This information can in turn be used to plan and prioritize road maintenance activities and provide direction for future improvement. Although the SCQI does not address all potential water quality hazards in a watershed, it does address what is generally agreed to be the most important hazard, which is the role of an SFM indicator. Because the SCQI is a field-based indicator it does a much better job at providing a true snapshot of potential hazards in the watershed than does a GIS-based indicator such as the Stream Crossing Density. This indicator will likely continue to be refined over time, much like what has happened to the Universal Soil Loss Equation.

# DAVID MALONEY & BRIAN CARSON

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**David Maloney**, P. Ag., is with the Ministry of Forests and Range in the Prince George Regional Office. He has a joint appointment with Stewardship and Integrated Resources Sections and acts as technical advisor in watershed science. He presently chairs the committee for developing the Water Quality Effectiveness Evaluation for the Forests and Range Evaluation program (FREP)



**Brian Carson**, P. Geo., is a private consultant with Carson Land Resources Management Ltd., Roberts Creek, BC, who has worked extensively locally and internationally in the field of erosion and sediment management.

## **Water quality effectiveness evaluation: A methodology to determine forestry and range effects on water quality**

Watershed managers want to determine the effects of forestry and range uses on water quality. When negative impacts are confirmed, they want to be able to prioritize actions that will economically mitigate those impacts. The Water Quality Effectiveness Evaluation procedure is a tool that;

- identifies common disturbed forestry sites (slope failures, road stream crossings, windblown riparian zones etc.),
- determines if and how much such sites affect water quality, and
- provides clear management options to reduce sediment generation at the particular site.

Based on this evaluation, the manager can decide how to better manage forestry operations whether associated with road location, construction, maintenance, deactivation or cutblock harvesting. The procedure has already begun to meet the needs of watershed managers by:

- providing a reasonable assessment of water quality degradation. The Forests Practices Board has used a modified form of this methodology to conduct a successful water quality audit of licensees working in community watersheds. Both government and industry felt it was a fair means to evaluate water quality impacts of forestry,
- being simple enough to be taught in a workshop setting and robust enough to be repeatable when conducted by independent users. A review of evaluations conducted by district MoFR staff participants showed a 90 percent agreement in water quality impact classes assigned to sample sites by trainees and the developers of methodology.
- providing direction for improvement in management, and Weyerhaeuser and Tolko road crews have been trained with a modified version of this evaluation methodology. They reported that the evaluation facilitated assessment of different management options to reduce water quality impact of their road network.

The procedure will be used by 14 forest districts in the upcoming field season to assess water quality for FREP. For more information contact Brian Carson or David Maloney.



# APPROACHES TO WATER QUALITY MONITORING

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## QUESTIONS & ANSWERS

Q – There are obvious overlaps between the two stream assessment methods presented here. Do you see them as complementary, competitive or are there opportunities for them to be integrated, and what are the differences I may be missing?

A – (Pierre Beaudry) The Forest and Range Evaluation Program approach has a wider scope and was developed in areas where mass wasting is a concern, whereas my program was developed in the central interior where mass wasting is not a concern. That there are similar components is not surprising as we have been collaborating, and in the near future there will be a merging of parts of the programs.

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Q – Has the macroinvertebrate index you have been working on been applied in a mining context? And has it been published?

A – (Ian Sharpe) Equity Mine is switching from a Before After Control Impact (BACI) design to a reference condition approach, and we did case studies on two different historic mines during development of the methodology. We are planning to have a report out in March and will try to notify people as widely as possible. We hope that in three years it will be a provincial system, but will need to develop a Resource Inventory Standards Committee publication to achieve this.

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Q – How do you distinguish between disturbance of stream ecosystems and degradation of stream ecosystems, as this is a real problem for terrestrial ecosystems where disturbance is an important natural phenomenon?

A – (Ian Sharpe) Streams do not go through seral stages as vegetation does, though there is a process of recolonization of benthic invertebrates after disturbance, but it happens very rapidly within months to three years, at the most. By using a reference condition approach we get an idea of the range of variability of sites. We try to ensure we include all of the different hydrological regimes – lake-headed, glacier controlled, rainwater controlled, snowmelt controlled – in our reference envelope and then match hydrological regimes so comparisons can be made to the appropriate group of reference samples.

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Q – Are there opportunities for community groups or classes to participate in collecting data that is useful in monitoring programs?

A – (Ian Sharpe) Yes, there are opportunities, but there can be problems with data quality, and uploading data to databases. So care must be taken when designing these sorts of programs.

(Pierre Beaudry) The methods I am using are strictly operational, but the concepts behind them are easy to teach and conducive to using in that context as the concepts are very visual. I think it would be difficult to use my methods for operational data gathering by public groups.

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# APPROACHES TO WATER QUALITY MONITORING

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Q – There appears to be a link between different people working on water at stream crossings taking different measurements for fish passage, water quality and benthic invertebrates. Is there a way to combine some of this work so it can all be done at one time instead of multiple trips to the same place?

A – (Pierre Beaudry) A lot of work is client driven, so we usually do what the client has asked for. There are numerous procedures that could be combined, but this could be a mistake if you are only looking for one aspect of the procedure, and so spend time collecting data that is not wanted. So it depends upon your objectives.

(David Maloney) We are going the way of doing multiple procedures at one place for economic reasons. We are investigating how this may affect our statistical models as far as randomness is concerned.

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Q – Do you think we will be able to use the results of our sampling for different purposes, such as certification and government for efficiencies sake?

A – (Pierre Beaudry) It is happening now, as we were meeting this week about this. There will have to be one standard for both purposes in the end.

# DAVE BUSTARD

## DAVE BUSTARD AND ASSOCIATES LTD.

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**David Bustard**, MSc, RPBio, is an aquatic biologist based in Smithers since 1974. Following a stint as the regional habitat protection biologist for northwest B.C. Dave has worked as a consultant on numerous projects including hydro, mining, highway and forestry-related programs. Dave's presentation at this conference focuses on the Kemess South Mine project where he has been involved in the early development and subsequent fisheries monitoring programs since 1994.



### **Kemess Char monitoring program: Some lessons learned**

The Kemess South Mine is a large open pit copper and gold mine operated by Northgate Minerals Corporation. It is located approximately 250 km northeast of Smithers in the Thutade Lake watershed in the Peace drainage. As part of the mine development, a program to monitor char populations in the Kemess Watershed and surrounding streams has been underway for the past 13 years. The monitoring program used a before and after impact approach with multiple undisturbed control streams. The program has provided valuable insights into understanding northern char populations and incorporating these findings into the design and operation of mitigation and compensation programs at Kemess South and for assessing a future mine development in the watershed. This presentation discusses some of the lessons learned while undertaking the monitoring program.

# DR. BILL PRICE

## MINE EFFLUENT SECTION, NATURAL RESOURCES CANADA

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**Dr. Bill Price** has his BSc and PhD in soil science. He was previously the senior mine reviewer for the British Columbia Ministry of Mines developing regulations, policies and guidelines and reviewing the 60 major mines with significant reclamation issues. Presently, he is a research scientist with Natural Resources Canada located in Smithers and conducts various review, research and technology transfer functions.



### Use of monitoring at mine sites

Monitoring is an important part of the mine management required to sustain environmental protection and reclamation and prevent problems before they cause environmental impacts. Many past mining failures resulted from decisions based on professional judgment, computer models and statistical assessment rather than adequate monitoring data. In the past, monitoring was primarily required to detect off-site impacts. Monitoring programs should be part of adaptive management. At a pro-active modern mine, monitoring must verify pre-mining predictions, fill information gaps, provide early warning of potential problems and inform corrective measures.

Monitoring is also crucial in dealing with site-specific variability and the lack of experience in natural resource management. Successful monitoring depends on personnel with adequate training, motivation, time, resources and organizational support. Challenges include the large number of potentially influential properties and processes, the need to collect information at unstable, remote sites at difficult times of the year, and the need for comprehensive, detailed and multi-disciplinary information. Regular review of the monitoring data is required to keep up with the many properties in flux and take action prior to adverse changes.

# MINING - HOW DOES MONITORING CHANGE DECISIONS?

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## QUESTIONS & ANSWERS

Q – Are there remediation bonds in place for mines for the life of liabilities rather than just for the life of the mines?

A – (Bill Price) Financial securities are in place for the life of the liabilities. All new mines go through a rigorous assessment of liabilities, using a net present values method. Equity Silver Mine goes through a detailed review every five years, due to an interested local person who makes sure that it happens. Other sites are more or less well secured. There is a problem now, as the Ministry of Mines no longer has reclamation inspectors who used to be responsible for these reviews.

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Q – What were the innovative parts of your monitoring projects?

A – (Dave Bustard) What we did at Kemess was not really innovative, just old-fashioned biology. We tried to focus on the activity going on and minimize our impact on that, but to make changes that got our results. The amount of input you can have into projects depends upon the managers you are working with.

(Bill Price) I wouldn't call what I did innovative either. I'd say common sense, cost-effective, responsible stewardship. The underlying science of geochemical and erosion issues, for example, have been known for a long time, they just need to be applied.

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Q – How do you handle cumulative effects of several operations in a watershed?

A – (Bill Price) It can be difficult, as it is hard enough to mitigate the impacts for one project that has good records. The simplest method is to add up the discharges of the different projects. The hardest part can be allocating the cumulative capacity of the receiving environment.

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Q – Was there any pre-monitoring of the stream above the falls before you created the fish ladder for bull trout to access this new area?

A – (Dave Bustard) The only pre-monitoring was for the fact there were no fish present, with a bit of work on water quality and temperature and for harlequin ducks. In hindsight, it would have been good to look at the benthic community to see what changes occurred when fish accessed this new area and also other areas where Dolly Varden were introduced to streams.

# HENRY BENSKIN

## DEPUTY CHIEF FORESTER

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**Henry Benskin** works for the Ministry of Forests and Range, where he is the Deputy Chief Forester. He has a Bachelor of Science in Forestry degree from the University College of North Wales (Bangor) and a Masters in Forestry from UBC.

He began his BC Forest Service career with the research division in 1974 as a research forester, then took on various management roles where he was responsible for silviculture research, growth and yield, forest genetics and tree physiology. He progressed to director for the Silviculture and Forest Practices Branches, and then to Research Branch Director until 2003.

In his current position, Henry works closely with the Chief Forester in providing leadership for forest stewardship at the provincial level. This includes setting Allowable Annual Cuts for Tree Farm Licenses; overseeing the Forests for Tomorrow Program, Tree Improvement and Research Branches; and working with other governments across Canada on national forestry issues through the Canadian Council of Forest Ministers. Henry is a Past-President of the Association of B.C. Forest Professionals.



### The Future Forest Ecosystems Initiative

British Columbia's forest ecosystems are already feeling the effects of climate change with the current mountain pine beetle infestation, and increasing temperatures are expected to continue to alter our forest and rangeland ecosystems over time. For example, wildfire frequency and intensity may increase, and tree species may become maladapted to their environment.

In early 2006, the chief forester established the Future Forest Ecosystems Initiative (FFEI) to focus efforts in developing a forest practices response to climate change. The objectives of FFEI are:

- o to increase our understanding of ecological processes and changes over time, and the associated risks to ecosystems and resources (through research, forecasting and monitoring projects), and
- o to use that knowledge to adapt the forest and range management framework to changing ecological conditions (through policy evaluation and change projects).

Monitoring changes to B.C.'s forest and rangeland ecosystems, and determining the agents of change, will be essential to adapting the policy framework governing forest and range management so that it remains effective well into the future.

The MoFR is currently identifying and planning priority projects under FFEI that will be delivered over the next three years. We are also determining how best to integrate FFEI objectives into our core business so they continue to guide our activities. An important part of this planning will be developing a long-term monitoring strategy that addresses these and other questions:

- How can we adapt the ministry's monitoring programs, initiatives, and systems to enable long-term monitoring of ecosystem change?
- How can we solicit the help of external partners such as universities, research institutions, and NGOs to monitor ecological changes and share their results with us?
- What can we learn from other jurisdictions about how they are monitoring ecological changes and the consequent implications to forest and range resources?

This presentation will provide an overview of the FFEI (with an emphasis on its monitoring objective), and will raise the above questions and invite feedback.

# A LOOK AT THE FUTURE

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## QUESTIONS & ANSWERS

Q – How will your program influence what I will be doing as a licensee in five years?

A – (Henry Benskin) I don't know, but I would like to see, and think it is important for, licensees to become more aware of climate change in the future. This can be done, for example, by giving consideration to operability of forests, how they build infrastructure and timber flow.

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### ***Poster Presentation***

#### **Local level vegetation indicators for boreal mixedwood forests**

Although plants and vegetation communities are among the most easily measured and best-understood indicators of sustainable forest management, monitoring protocols for B.C.'s FRPA Resource Evaluation Program include no non-tree vegetation indicators other than invasive alien plants. Our study addressed the need for locally developed vegetation indicators by identifying and testing candidate indicators for white spruce and aspen-dominated boreal mixedwood ecosystems of the Peace River region. The BWBSmw1/01 and /06 site series are ideal for such work because vegetation succession on well-replicated silvicultural trials has been monitored for up to 20 years and published in peer-reviewed journals. Moreover, we believed that the high frequency of wildfires in the BWBSmw1 would provide good benchmarks for assessing the range of variability on comparable naturally-disturbed ecosystems.

Our study pooled four 20-year post-treatment vascular and non-vascular vegetation succession data from four silvicultural trial sites (Inga Lake, Iron Creek, Wonowon, Kiskatinaw River; 543 quadrats) and compared them to vegetation data from four closely-matched six 23-year-old wildfires (Blair, Farrell, Siphon, Osborn; 42 quadrats). We identified a range of candidate indicators for monitoring sustainable forest management from our published studies (e.g., *Calamagrostis*, all grasses, non-native plants, berry-producing shrubs, moose browse species, epiphytic lichens) and compared the range of variability of these vegetation indicators after silviculture and wildfires using box plots, (partial) linear regression and AN(C)OVA.

It was difficult to find unsalvaged wildfire patches of sufficient size. Nonetheless, we found clear differences between wildfire and silviculture for most vegetation indicators, particularly after higher impact site preparation treatments that removed dead wood and exposed mineral soils. Single applications of glyphosate did not reduce berry-producing shrubs or moose browse shrubs at 10 to 20 years. Our proposed indicators require further testing because the wildfire dataset is too small, and the silvicultural trials differ from current operational practice. Long term silvicultural trials and unsalvaged wildfires are invaluable for monitoring forestry practices as well as the cumulative impacts of global warming, land use changes and invasive species. In future, larger unsalvaged benchmark areas should be retained after wildfire.



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## ***Poster Presentation***

### **Rangeland health assessments and remedial measures**

Consistency in range monitoring, data collection and determining remedial measures is challenging for government agencies. Technologies such as ArcPad, Microsoft Access and handheld computers are tools used to increase the consistency and efficiency of the data collection and analysis. Handheld computers and GIS software assist range staff to collect detailed range health information and upload that information onto a provincial database. Range staff use four range assessment checklists to monitor upland health, stream health, wetland health and compliance of range use plans. The health assessment checklists monitor the resource objectives outlined in FRPA for soils, forage, water, fish, wildlife and biodiversity. The compliance checklist is tier one monitoring that provides information about year to year use, seral stage of plant communities and suggests the need for more detailed monitoring. Remedial measures or management changes are implemented if monitoring reveals the functioning of the system is not meeting the goals for the site. The objective of this poster is to outline the role of monitoring in developing remedial measures to improve the overall health of rangeland in British Columbia.

# ERIC PARKINSON

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## MINISTRY OF ENVIRONMENT

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### ***Poster Presentation***

#### **The Watershed Evaluation Tool (WET)**

British Columbia's fisheries resources, including the watersheds upon which they rely, are an important social, economic, and ecological feature of the Province's landscape. Historically, there have been various fisheries management initiatives aimed at evaluating watershed sensitivity and protecting fish values. Typically, these were targeted at site specific stocks or locations, and identified areas in an ad hoc fashion with little consideration for assessing higher fish values at the watershed scale over the broader landscape. Recognizing the weaknesses of this method, under the new Forest Practices and Range Act, and using the Government Actions Regulation (GAR) to legally designate areas of land as Fisheries Sensitive Watersheds (FSW), Government has developed a prototype model called the Watershed Evaluation Tool (WET) to assess in a comparative fashion watersheds across the larger landscape. The WET is GIS (vector) based tool that has been designed to evaluate and numerically 'rank' 1:50,000 scale third order (or larger) watersheds. The tool uses a consistent methodology that can be applied to a variety of predefined geographic areas ranging in size from the entire province down to a sub-regional scale. The model uses an assortment of consistently available indicators to evaluate each watershed's inherent physical sensitivity and fish values. These indicators are derived from various sources including: interpolations of TRIM data, Watershed Statistics, Base Line Thematic Mapping, modeling, and inventories. The WET is structured such that the indicators are combined in a series of systematic, normalized, and linear process steps to determine a single relative score or rank for each watershed within a predetermined geographic population of watersheds. While the tool was designed to help legally designate FSWs for the purposes of GAR, it has other important applications including prioritizing watersheds for restoration, compliance monitoring, and was successfully used to prioritize watersheds for fish passage (culvert) assessment and improvements.

# XIAOPING YUAN

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### *Poster Presentation*

#### **Determination of year of mountain pine beetle attack from change detection using Multitemporal Landsat TM Imagery**

Determination of time (year) when a stand starts to die due to mountain pine beetle (MPB) attack is critical in shelf life studies for assessing wood quality after the MPB epidemic. The Ministry of Forests and Range's aerial overview survey or ground sampling measurement is either insufficient or costly. An operational trial has been conducted by Forest Analysis and Inventory Branch aiming at creating a raster map of annual MPB attack from low cost multitemporal Landsat TM images acquired annually between 1999 and 2006. The trial covers an area of approximately 3 million ha around Nadina/Vanderhoof/Quesnel forest districts. The spectral change due to MPB attack is characterized by a change of wetness index derived from Tasseled Cap transformation of Landsat TM data. Various change detection methods have been tested. It has been demonstrated that the wetness index is closely related to stand moisture conditions. Changes in the wetness index over several years for MPB-affected pine stands are much larger and more pronounced than normal fluctuations for healthy stands, therefore can be used as a measure of MPB attack. The raster map provides an annual MPB infestation as improvement or supplement to the aerial overview survey, or it can be used to derive accumulate mortality of pine stands at a particular year to support timber harvesting planning.

# CONCLUSION

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This conference coalesced different agencies and people that are involved or have an interest in monitoring. It also highlighted old relationships, forged new ones and fostered collaboration among various agencies. Those starting monitoring projects also benefited from this conference, as potential problems were identified, along with solutions to those problems. For those involved in planning, it suggested ways that they can assist monitoring, such as writing relevant and measurable objectives and strategies.

There are several future challenges for monitoring that have become evident through this conference. Firstly, it is important that special attention is given to making monitoring more efficient through coordinating efforts of monitoring agencies so that data can be shared, ensuring data collection methods are compatible among organizations and reducing overlap in data collection efforts. This is primarily an organizational challenge, involving writing standards, coordinating monitoring organizations to reduce overlaps and increase efficiencies and organizing data. Secondly, we must overcome the challenge of completing the 'feedback loop' and adjust and update plans using the knowledge gained from the monitoring process. This challenge is political and involves revisiting plans and processes if monitoring shows they are not meeting their objectives.

One of the principal themes that emerged from the conference was that of "small wins". This means addressing small projects that can be completed effectively, and building upon those small projects to attract additional funding and collaborations. Ultimately, this approach may allow us to address larger questions and scales more effectively.

# THE BULKLEY VALLEY RESEARCH CENTRE

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