

**FOREST SCIENCE PROGRAM 2005/06**

**PROPOSAL FOR:**

**LOI Y061134**

**Regeneration and Stand Structure in the East Ootsa  
and Entiako Areas after Infestation by  
Mountain Pine Beetles**

Submitted by:

Bulkley Valley Centre for Natural Resources Research and Management  
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## 1.0 Contact Information

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<b>Telephone Number</b>	250-877-7558
<b>Fax Number</b>	250-877-7552
<b>Title of the Project</b>	Regeneration and Stand Structure in the East Ootsa and Entiako Areas after Infestation by Mountain Pine Beetles
<b>LOI Number</b>	Y061134
<b>Keywords</b>	mountain pine beetles, stand structure, regeneration
<b>Geographic area</b>	East Ootsa area at the south end of the Lakes portion of the Nadina MOF District, and Entiako Park and Protected Area

## 2.0 Project Description

### 2.1 PROJECT DESCRIPTION

The south end of the Lakes TSA was one of the earliest areas in the province to experience epidemic levels of the mountain pine beetle (MPB) outbreak. Four years ago, at the beginning of the epidemic, researchers and resource managers identified a critical gap in knowledge relating to how forest structure and vegetation dynamics would respond to the epidemic. In 2001, Deborah Cichowski and Patrick Williston, in cooperation with Fraser Lake Sawmills and BC Parks, established research plots in the Entiako and East Ootsa areas to measure and monitor vegetation responses to the MPB outbreak. The purpose of this project is to remeasure existing research plots within MPB stands and to address knowledge gaps relating to advanced regeneration, ingress, stand structure and coarse woody debris.

### 2.2 RELEVANCE

The Forest Science Board has identified a number of priorities for Forest Science Program Funding (FSP) for 2005/06 (Forest Science Board 2004a, Forest Science Board 2004b). One of the priority topics is stand and forest dynamics following MPB attack. This proposal addresses Timber Growth and Value PAC Theme 4 – Timber losses to environmental factors and Topic 4.1 – Stand and forest dynamics following MPB.

There are very few research plots established in the epidemic area that can be remeasured. Therefore, most research proposals take a retrospective approach. This proposal is unique in that it has a system of research plots that were established while the stands were still red-attacked, and had not yet shown a vegetation response to MPB. Since the East Ootsa and Entiako areas were among the earliest affected by MPB in the province, this presents an excellent opportunity to determine the regeneration response in

the years following infestation. This one year project capitalizes on data already collected during Year 1 (2001) and Year 3 (2003), which will be compared to the data collected for this project in Year 5 (2005). Information from this project will also feed into two other Bulkley Valley Centre proposals that will develop empirical tree seedling recruitment relationships that can be used for modeling stand structure and dynamics. In addition, the lichen monitoring portion of the original project (funding for this portion is being sought elsewhere) will document the influence of MPB on important caribou habitat attributes such as forage and mobility.

### **2.3 PARTNERS**

In 2001, we established 80 permanent plots with funding from the Ministry of Water, Land and Air Protection and Fraser Lake Sawmills. Funding requested from Forest Science Program for 2005/06 will cover the stand dynamics portion of the original project (advanced regeneration, ingress, stand structure and coarse woody debris) as a stand-alone project (this proposal). The Ministry of Forests is providing \$5000 of in-kind support for this project in the form of personnel time for Dr. Dave Coates to participate in fieldwork and data analysis.

In addition, the Bulkley Valley Centre is seeking funds from Fraser Lake Sawmills (\$25,000) and the Ministry of Water, Land and Air Protection, BC Parks (\$11,000) to cover the lichen monitoring portion of the original project. This portion of the project will provide additional information on vegetation response to MPB and is not a part of the Forest Science Program proposal. If funding from Fraser Lake Sawmills and BC Parks is available, data on lichen monitoring will be combined with data from this study in the final report.

Letters of Support from Fraser Lake Sawmills and Ministry of Water, Land and Air Protection (BC Parks) are provided as appendices (Section 7.1).

### **2.4 TEAM MEMBERS**

Deborah Cichowski, RPF, RPBio, MSc, Ecologist, Caribou Ecological Consulting is the scientist leading the project. She has been involved with research and management of mountain pine beetles in the Tweedsmuir/Entiako/East Ootsa area since 1994 and has coordinated the research project on impacts of the mountain pine beetle epidemic on stand structure and lichen abundance since 2001, in collaboration with Fraser Lake Sawmills and BC Parks. She has 19 years of experience on ecosystems in the East Ootsa and Entiako areas through her work on the Tweedsmuir-Entiako caribou population.

Patrick Williston, RPBio, MSc, Botanist, Gentian Botanical Research is a partner scientist on the project. He has specialized in bryophytes, lichens and rare and sensitive plants for the last 9 years and has participated in a number of projects evaluating mountain pine beetle and lichen interactions in the Tweedsmuir-Entiako area since 2000. Together with Deborah Cichowski, he initiated the research project on impacts of the mountain pine beetle epidemic on stand structure and lichen abundance in 2001.

Dr. Dave Coates RPF, PhD, Research Silviculturist, BC Forest Service, is a collaborating scientist on the project. His research interests include: linking tree population dynamics to ecosystem processes, canopy understory interactions, spatially-explicit stand dynamics, gap dynamics and simulation modeling. He has extensive experience in research project management and has consistently published the results of his research in the leading forestry journals. Dr. Coates has been working for over 10 years toward a better understanding of how stands are affected by partial cutting. He has more than twenty

years experience in the study area and has 25 publications in refereed journals and numerous government publications.

The Bulkley Valley Centre for Natural Resources Research and Management is a not-for-profit society committed to engaging in high-quality research, which advances understanding of ecosystems in northwestern BC and their sustainable management.

## **2.5 LINKAGES**

The Bulkley Valley Centre is seeking funds from Fraser Lake Sawmills and the Ministry of Water, Land and Air Protection to cover the lichen monitoring portion of the project. That funding request will include costs above and beyond the stand dynamics and regeneration portion of the project. Therefore, completion of the lichen monitoring portion of the project will be highly dependent on FSP funding for the stand dynamics and regeneration portion.

Data from this study will be available for researchers and practitioners in the area who are modeling ecological impacts, regeneration and timber supply. The data will specifically support two other Bulkley Valley Centre projects: first, FSP LOI Y061148 – “Regeneration and Stand Structure following Mountain Pine Beetle infestation in the Sub-boreal Spruce zone” and second, FSP LOI Y061184 - "Predicting Advanced Regeneration Density in Lodgepole Pine Stands in the Northern Interior of British Columbia". Natural regeneration and advanced regeneration data from plots in our study will be provided to projects Y061148 and Y061184 to supplement their data collection. Support from those studies will be used to collect additional information at plots in this proposal.

In addition, information from this project will complement proposed research on the effects of the mountain pine beetle epidemic on caribou habitat use and population size.

## **3.0 Methodology**

### **3.1 SCIENTIFIC BASIS**

This project follows the sampling protocols developed by Caribou Ecological Consulting and Gentian Botanical Research (Williston and Cichowski 2002, Cichowski and Williston 2003, Williston and Cichowski 2004). This project will characterize the current stand structure of beetle-affected forests and make comparisons with measurements made in 2001 at the onset of the mountain pine beetle epidemic. Canopy tree mortality, standing tree density, canopy openness and seedling recruitment will be measured using contemporary methods (Frazer *et al.* 1999; Canham *et al.* 1999). We will also quantify coarse woody debris following procedures in use throughout British Columbia (Trowbridge *et al.* 1986; B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998). In addition, we are collecting supplemental data that supports other FSP 2005/06 proposals. See section 3.3 Experimental Design.

### **3.2 OBJECTIVES**

Specific objectives for the project include:

1. Measuring changes in overstory and understory stand attributes in response to epidemic levels of mountain pine beetles.
2. Measuring regeneration response following epidemic mountain pine beetle levels.

### 3.3 EXPERIMENTAL DESIGN

In 2001, we established 80 permanent research plots in the East Ootsa and Entiako areas of the Lakes TSA in mountain pine beetle attacked stands and in areas harvested to control mountain pine beetles. The study area was, at that time, at the front of the mountain pine beetle epidemic. Stands were selected based on presence of red-attacked trees and were located in 4 different biogeoclimatic subzones and 7 different site series to address whether ecological conditions affected response of understory vegetation. In addition, previously harvested sites were selected to compare differences in response between mountain pine beetle attacked stands and harvested stands.

Site series	Treatments	
	Cutblocks	Mountain Pine Beetles
<b><i>EAST OOTSA</i></b>		
ESSFmc/03	4	10
SBSmc2/01c	7	14
SBSmc2/02	5	10
SBSdk/03	7	7
<b><i>ENTIAKO</i></b>		
SBPSmc/02		5
SBPSmc/01b		5
SBPSmc/01a		5

Basic site information for each 200 m<sup>2</sup> circular plot (7.98 m radius) was collected including GPS location data (UTM coordinates), elevation, slope, aspect, stand age, dbh and canopy closure; and vegetation cover for shrubs, herbs, bryophytes and lichens was estimated. An oblique photograph of the plot was taken from the south side of the plot. Stand density was recorded by tree species and size ( $\geq 12.5$  cm dbh, 7.5-12.49 cm dbh, 1.3 m height to 7.49 cm dbh, <1.3 m height), and by status of mountain pine beetle attack for lodgepole pine trees. Coarse and fine woody debris was also measured to assess potential obstruction to wildlife mobility and as a indicator of falldown. Terrestrial lichen cover was documented by photographing permanently marked lichen colonies and fisheye photographs were taken to assess light penetration and canopy openness. In 2002, soil moisture data was collected at SBSmc2/01c plots in addition to other activities, and in 2003, all plots were remeasured.

In 2005, we propose to remeasure overstory and understory attributes (stand structure and regeneration), canopy openness, and coarse woody debris for all sites in the East Ootsa and Entiako areas. This will provide regeneration information 4 years following attack. Structural measurements will include tree species and MPB status (for live and dead standing trees); decay class, length class, mobility class and diameter (for downed wood), and canopy openness (fisheye photos).

#### Tree Structure and Regeneration

Each conifer tree within the 400 m<sup>2</sup> permanent plot will be counted, identified to species, classified as alive or dead, and classified into the following size classes:

- > 12.5 cm dbh;
- 7.5 – 12.49 cm dbh;
- > 1.3 meters in height to 7.49 cm dbh;
- > 10 cm - 1.3 meters in height;
- $\leq 10$  cm; and,
- Year 1 germinants.

In addition, lodgepole pine trees will be classified into the following categories:

- alive;
- mountain pine beetle – green attack;
- mountain pine beetle – faded (yellow/orange) attack;
- mountain pine beetle – red attack;
- mountain pine beetle – red/grey attack;
- mountain pine beetle – grey; and,
- dead (not due to mountain pine beetle attack).

### **Canopy Openness**

Canopy trees regulate the light available to understory plant communities. In the study area, mountain pine beetles have killed a high proportion of the canopy trees. Canopy tree mortality will result in changing light conditions in the understory, especially once the dead canopy trees defoliate and eventually fall to the ground. We will use fisheye photographs of the canopy, a standard approach that has been well documented in the literature (Canham 1988), to quantify the change in light availability in beetle-killed stands and in harvested sites.

A canopy photograph will be taken at each plot centre using a fisheye lens on a 35 mm camera with 400 ASA film. The camera will be mounted on a tripod 1.2 m above the ground and oriented so that the top of the camera is pointed north. The software program Gap Light Analyzer Version 2.0 (Frazer *et al.* 2000) will be used to determine the percent transmission of light through the canopy.

### **Coarse Woody Debris**

Coarse and fine woody debris measurements are adapted from Trowbridge *et al.* (1986) and from the Field Manual for Describing Terrestrial Ecosystems (B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998). Bearings for two transects 30 meters in length were selected randomly in 2001 and transects originated at the plot centre. For each transect in mountain pine beetle plots, the number of pieces will be recorded for the following diameter classes and transect distances:

- 0-0.5 cm diameter from 0-5 meters;
- 0.6-1.0 cm diameter from 0-10 meters;
- 1.1-3.0 cm diameter from 0-15 meters;
- 3.1-5.0 cm diameter from 0-20 meters;
- 5.1-7.0 cm diameter from 0-25 meters; and,
- >7.0 cm for all 30 meters.

For all coarse woody debris pieces >7.0 cm in diameter, we will measure the diameter using calipers and record the distance from plot centre, decay class, length class, and mobility class.

Decay classes will include:

- 1: log hard; bark, branches, and twigs <3cm still present;
- 2: log hard to partly decaying; bark and some branches still present;
- 3: log hard to partly decaying and round; trace of bark still present;
- 4: all of log on ground and sinking; bark absent;
- 5: all of log on ground and partly sunken; oval; and,
- 5+: all of log mostly sunken; overgrown by moss; part of forest floor.

Length classes will include:

- 1: <2 meters;
- 2: 2-5 meters;
- 3: 5-10 meters; and,
- 4: >10 meters.

Mobility classes will include:

- 0: top side of log <10 cm above ground; log mostly part of forest floor;
- 1: top side of log 10-40 cm above ground; log mostly branch free;
- 2: top side of log or branches 40-100 cm above ground; scattered branches;
- 3: top side of log or branches 40-100 cm above ground; dense branches, or top side of log >100 cm above ground (log mostly branch free); and,
- 4: top side of log or branches >100 cm above ground; dense branches with branches reaching down to the ground if log is raised off the ground.

### Data Analysis

We will use standard parametric statistics to examine relationships between understory vegetation responses, site and overstory conditions. We will focus on developing predictive equations for understory responses. For example, lichen cover as a function of overstory measured as time since death, number of standing trees, percent open sky or growing season ambient light availability at the forest floor. To develop predictive equations we will use a model selection approach (Johnson and Omland 2003) to select the most parsimonious model that predicts understory vegetation dynamics as a function of overstory conditions. We will use Akaike Information Criterion (AIC) (Burnham and Anderson 2002) to select the model(s) best supported by the data.

### 3.4 SCHEDULE OF WORK

Activity	Estimated Start Date	Estimated Completion Date	Estimated Cost	Responsible Team Member
Pre-fieldwork preparation	August 2	August 19	\$2,750	CEC/GBR <sup>1</sup>
Field sessions – East Ootsa	August 28	September 30	\$20,950	CEC/GBR
Field sessions – Entiako	October 3	October 15	\$12,800	CEC/GBR
Data compilation	January 2	January 30	\$3,450	CEC/GBR
Data analysis	January 15	February 24	\$6,200	CEC/GBR
Report write-up	February 15	March 24	\$3,500	CEC/GBR
BV Centre seminar	March 29	March 29	0	CEC/GBR
Poster	March 31	March 31	\$350	CEC/GBR

<sup>1</sup> CEC = Caribou Ecological Consulting (Deborah Cichowski)  
GBR = Gentian Botanical Research (Patrick Williston)

Also, see attached EXCEL spreadsheet.

## **4.0 Extension**

### ***4.1 EXTENSION PLAN***

Extension deliverables will include:

- a final report;
- a poster; and,
- a presentation of results at the Bulkley Valley Centre's seminar series.

The Bulkley Valley Centre will provide a review and edit of extension documents for the project, including desk-top publishing of the final report to a standard that is user-friendly. The final report will be posted on the Bulkley Valley Research Centre website and the results will be circulated to our membership of over seventy decision makers, resource managers, and researchers in north-west British Columbia. The report will also be provided directly to staff in the Ministry of Forests, Ministry of Sustainable Resource Management, Ministry of Water, Land and Air Protection and forest licensees in the Nadina and Skeena-Stikine Forest Districts, and will be linked to FORREX's Natural Resources Information Network. The results of this project will also be presented to an audience of over thirty foresters, researchers and managers in the BV Centre's very successful seminar series.

### ***4.2 PUBLICATIONS***

The primary publication associated with this project is the final report. This report will include analysis of data collected in 2005/06 as well as comparison to results from Year 1 (2001/02) and Year 3 (2003/04) of the original project. We will also produce a poster summarizing the project.

### ***4.3 EXTENSION PARTNERS***

The Bulkley Valley Centre will solely deliver all extension activities.

## **5.0 Financial**

### ***5.1 FINANCIAL PLAN***

See attached EXCEL spreadsheet

### ***5.2 CAPITAL ASSETS***

There will be no capital purchases associated with the project.

### ***5.3 EXTERNAL FUNDING***

The Bulkley Valley Centre is seeking funds from Fraser Lake Sawmills (\$25,000) and the Ministry of Water, Land and Air Protection - BC Parks (\$11,000) to cover additional costs associated with the lichen monitoring portion of the original project. This funding will be for work completed over and above that indicated in this proposal. Costs will include contractor's time for collecting, compiling, analyzing and writing up lichen monitoring data; film purchase and processing; and, logistics for collecting data (travel, accommodation, helicopter charter). If these additional funds become available, fees and expenses for the lichen monitoring portion of the project will be tracked and billed separately.

## 6.0 Literature Cited

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- Williston, P. and D. Cichowski. 2002. The Response of Caribou Terrestrial Forage Lichens to Forest Harvesting and Mountain Pine Beetles in the East Ootsa and Entiako Areas: Annual Report – 2001/02 – Year 1. A report to West Fraser Sawmills, Fraser Lake B.C., and Forest Renewal B.C. and BC Parks, Smithers, B.C. 67p.

## 7.0 Appendices

### 7.1 LETTERS OF SUPPORT

#### **FRASER LAKE SAWMILLS**

A Division of  
West Fraser Mills Ltd.

P.O. Box 100  
Fraser Lake, B.C.  
Canada V0J 1S0

Telephone (250) 699-6235  
Fax (250) 699-9821

December 15, 2004

PricewaterhouseCoopers LLP  
Chartered Accountants  
200 Granville Street, Suite 202  
Vancouver, B.C.  
V6C 1S4

Dear Sir or Madam:

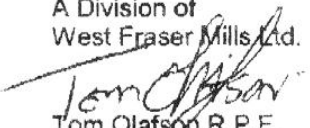
Re: Forest Science Program 2005/06

This is a letter of support for Forest Science Program LOI Y061134-  
"Regeneration and Stand Structure in Stands in the East Ootsa and Entiako  
Areas after Infestation by Mountain Pine Beetles".

Fraser Lake Sawmills has been funding through FIA the East Ootsa portion of  
this project since 2001 and fully supports the research proposed. We will  
continue to seek funding (\$ 25,000) through FIA for additional complimentary  
research on the response of terrestrial lichens to the mountain pine beetle  
epidemic in the East Ootsa portion of the study area.

If you require further information regarding the above please contact our office.

Yours truly,  
Fraser Lake Sawmills  
A Division of  
West Fraser Mills Ltd.

  
Tom Olafson, R.P.F.  
Forestry Operations Supervisor



FILE NUMBER:87420-11/Entiako

December 15, 2004

PricewaterhouseCoopers LLP  
Chartered Accountants  
200 Granville Street Suite 202  
Vancouver BC V6C 1S4

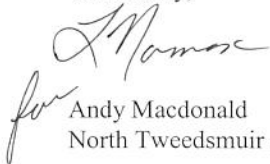
Dear PricewaterhouseCoopers LLP:

Please accept this letter as support for the Forest Science Program LOI Y061134 –  
“Regeneration and Stand Structure in Stands in the East Ootsa and Entiako Areas after  
infestation by Mountain Pine Beetles.”

BC Parks, within the Ministry of Water, Land and Air Protection, fully supports this  
research and has contributed funding to the project since 2001. We are currently in the  
process of seeking \$11,000.00 internal funding for additional complimentary research on  
the response of terrestrial lichens to the mountain pine beetle epidemic in the Entiako Park  
Protected Area portion of the study area. I cannot confirm the availability of this funding  
until the Ministry’s budget is finalized in early April, 2005.

If you have any further questions please do not hesitate to contact me at (250) 847-7260.

Yours truly,

  
for Andy Macdonald  
North Tweedsmuir Area Supervisor

cc: Rick Heinrichs, Ecosystems Specialist, Ministry of Water, Land and Air Protection,  
Skeena Region  
Rick Marshall, Wildlife Biologist, Ministry of Water, Land and Air Protection,  
Skeena Region  
Larry Boudreau, Section Head, Parks and Protected Areas, Skeena Region

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## **7.2 TEAM MEMBER CVS**

# Deborah B. Cichowski

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## **Education**

1985 – 1989 M.Sc. (Forestry), University of British Columbia  
1981 - 1985 B.Sc. (Hon. Zoology), University of British Columbia

## **Professional and Research Experience**

September 1999 – present: Ecological Consultant, Caribou Ecological Consulting

June 1991 – August 1999: Resource Officer, B.C. Parks, Northern Region / Skeena District

- developing, undertaking and coordinating land, water, fish, wildlife, forestry, heritage, mineral and other resource programs in parks, recreation areas, and ecological reserves in northern British Columbia

January 1990 - June 1991: Wildlife and Ecological Consultant

- Ministry of Forests, Smithers, B.C. - developing a management strategy for woodland caribou winter range and forestry practices in west-central B.C. using ecosystem mapping, caribou habitat use data and GIS.
- Spatsizi Association for Biological Research, Smithers, B.C. -field research on moose/wolf interactions in Spatsizi Wilderness Park in northwestern British Columbia.

May 1985 - December 1989: MSc Research

- Thesis: “Habitat requirements and limiting factors of woodland caribou in west-central British Columbia”.

May 1984 - April 1985: BSc Research

- Thesis: “Population studies of small mammals in the south western Yukon”

## **Memberships**

The Wildlife Society

Professional Forester in the Association of British Columbia Forest Professionals (ABCFP)

Professional Biologist in the College of Applied Biologists of British Columbia (CAB)

## **Selected Publications/Reports**

Cichowski, D. and P. Williston. 2003. The Response of Caribou Terrestrial Forage Lichens to Forest Harvesting and Mountain Pine Beetles in the East Ootsa and Entiako Areas: Annual Report – 2002/03 – Year 2. A report prepared for Morice and Lakes Innovative Forest Practices Agreement and BC Parks, Smithers, B.C. 33p.

Cichowski, D., B. Lawson, D. McLennan, P. Williston, J. Spears, T. White, C. Schell, B. Armitage, J. Carlson and N. Guy. 2001. Entiako Park and Protected Area – Ecological Background Information Summary. BC Parks, Smithers, B.C. 194p.

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- Gilbert, B.S., D.B. Cichowski, D. Talarico and C.J. Krebs. 1986. Summer activity patterns of three rodents in the southwestern Yukon. *Arctic* 39(3): 204-207.
- Seip, D.R. and D.B. Cichowski. 1996. Population ecology of caribou in British Columbia. *Rangifer* Special Issue No. 9, 73-80.
- Williston, P. and D. Cichowski. 2004. The Response of Caribou Terrestrial Forage Lichens to Forest Harvesting and Mountain Pine Beetles in the East Ootsa and Entiako Areas: Annual Report – 2003/04 – Year 3. A report to West Fraser Sawmills, Fraser Lake B.C., and Ministry of Water, Land and Air Protection, Smithers, B.C. 41p.
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### **Other Publications/Reports**

- A Strategy for the Recovery of Boreal Caribou (*Rangifer tarandus caribou*) in British Columbia – Draft #1. 2004. Prepared for the Boreal Caribou Technical Advisory Committee.
- Management Plan for Stikine Country Protected Areas. 2004. Prepared for Ministry of Water, Land and Air Protection, Skeena Region. 236p.
- A Strategy for the Recovery of Northern Caribou (*Rangifer tarandus caribou*) in the Southern Mountains National Ecological Area in British Columbia – Draft #6. 2003. Prepared for the Northern Caribou Technical Advisory Committee. 110p.
- Woodland Caribou Account – Identified Wildlife Management Strategy – Draft. 2003. Prepared for Ministry of Water, Land and Air Protection – Biodiversity Branch. 38p.



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## **EMPLOYMENT HISTORY**

1996-2004 *Botanist, Partner of Gentian Botanical Research*

Designing and conducting field-based research on bryophyte and lichen ecology and rare plant biology with a special focus on lichen-caribou interactions, epiphytic lichens of oldgrowth forests, and a family of rare ferns, the Botrychiaceae. Teaching field courses in lichen and bryophyte identification and ecology.

1997-1999 *Masters of Science Thesis, UBC*

Thesis title “Floristics and Successional Patterns in Microbiotic Crusts of Ponderosa Pine Forests in Southern Inland British Columbia”.

Sept 1997-Dec. 1999 *Biology Teaching Assistant, UBC*

Teaching assistant and laboratory instructor for courses on flowering plants, non-vascular plants, ferns, and bryophytes.

May-Aug. 1993 *Research Assistant, UBC Department of Geography*

Gathering field data on a group of selected species of plants to monitor the phenological effects of global warming in Alexandra Fjord, Ellesmere Island.

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## **EDUCATION**

1997-1999 M.Sc. in Botany, University of British Columbia

1990-1994 B.Sc. in Botany, University of British Columbia, honours

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## **RESEARCH INTERESTS**

- the ecology of rare plants and rare plant communities
- the fern genera *Botrychium* and *Polystichum*
- the distributional ecology of lichens and bryophytes in oldgrowth forests
- caribou, lichen and mountain pine beetle interactions

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## ASSOCIATIONS

- Registered Professional Biologists of British Columbia
- British Columbia Native Plant Society (Director)
- Alberta Native Plant Council
- Friends of Ecological Reserves
- American Fern Society

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## PUBLICATIONS AND REPORTS

**Williston, P.** and D.B. Cichowski. 2004. The Response of Caribou Forage Lichens to Forest Harvesting and Mountain Pine Beetles in the East Ootsa and Entiako Areas. Annual Report 2003/2004 – Year 3. Report to West Fraser Sawmills, Fraser Lake B.C. and Ministry of Water, Air and Land Protection, Smithers, B.C. 41 p.

**Williston, P.** 2004. Vascular Plant Species at Risk in the Beaver Valley Gravel Pit Study Area, Glacier National Park. Report to Parks Canada, Revelstoke, British Columbia. 21 p.

**Williston, P.** 2004 (accepted). A Brief History of Botanical Research and Collections from British Columbia's North Coast. Canadian Field-Naturalist.

**Williston, P.** 2003. A Rare Plant Survey for Rogers Pass National Historic Site, Glacier National Park. Report to Parks Canada, Revelstoke, B.C. Report to Parks Canada, Revelstoke, British Columbia. 14 p.

**Williston, P.** 2002. An Inventory of *Botrychium paradoxum* and *Botrychium pedunculosum* in southern Alberta. Report to the Alberta Conservation Association, Edmonton Alberta. 15 p.

**Williston, P.** 2002. The Botrychiaceae of Alberta: a survey of element occurrences of the genera *Botrychium* and *Sceptridium* in Alberta. Report to Alberta Sustainable Resource Development. 19 p.

**Williston, P.** 2002. Caribou Forage Lichens and Forest Management in the Dease-Liard Plain. Report to the Ministry of Sustainable Resource Management, Smithers, B.C. 7 p.

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**Williston, P.** 2001. The Botrychiaceae of Alberta. Alberta Environment, Edmonton, Alberta. 61 p.

**Williston, P.** 2001. Epiphytic lichens of forests with ecological continuity in the McCully Creek drainage. Report to the B.C. Ministry of Forests, Kispiox District, Hazelton BC. 20 p.

Cichowski, D., B. Lawson, D. McLennan, **P. Williston**, J. Carlson, C. Schell, T. White, B. Armitage and N. Guy. 2001. Entiako Park and Protected Area – Ecosystem Management Study. BC Parks, Smithers, B.C. 148 p.

# Dr. K. David Coates

Research Silviculturist

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## Education:

<i>Degree</i>	<i>College, University or Institution:</i>	<i>Subject:</i>	<i>Year:</i>
PhD	University of British Columbia	Silviculture	1998
MS	Oregon State University	Silviculture	1988
BSF	University of British Columbia	Forest Management	1979

## Related Work Experience (last 10 years):

<i>Position Held:</i>	<i>Date:</i>	<i>Department:</i>	<i>Organization:</i>
Research Silviculturist	1989-present	Research, B.C. Ministry of Forests,	Smithers, BC
Temporary Secondment	1999-2001	Université du Québec à Montréal	

## Research Background:

My field experience and research program encompasses coastal and interior temperate forests, subalpine forests, sub-boreal and boreal forests in BC. Also, in collaboration with researchers in the Sustainable Forest Management Network, I have expanded my research program right across the boreal forests of Canada (e.g., Green et al. 2002). My research addresses major issues facing forest management in British Columbia and across the circumpolar north. My work contributes to a solid scientific basis for sustainable forest management in temperate and boreal forests.

My early interests centered on how the emerging BC ecological classification system could be used to address regeneration problems following clearcutting. I developed the first-ever-silvicultural interpretations for ecosystems of northern British Columbia, which still act as the foundation for site-specific prescriptions in the region (Pojar et al. 1984). I undertook extensive research into the response of seedlings to site preparation and vegetation management. I co-authored guidebooks on autecology and management of competing plant species that remain the standard reference guide today for practicing forester (Coates et al. 1990; Haeussler et al. 1990). I was also the lead author of a comprehensive review of the silviculture and management of interior spruce in British Columbia (Coates et al. 1994).

In the early 1990s, I initiated the Date Creek silvicultural systems study (Coates et al. 1997). Also in the early 1990s, I was one of the first researchers in BC to promote and implement patch retention harvesting, now more commonly called variable retention (Coates and Steventon 1995). Through the 90's, I undertook studies to quantify the response of juvenile trees to variation in light in order to predict the effects of partial cutting on future forest composition and growth (Wright et al 1998, 2000; Coates and Burton 1999). My gap-related studies are widely cited internationally and have provided an empirical foundation for gap-based silviculture in BC (Coates and Burton 1997; Coates 2000, 2002; Bartemucci et al. 2002). Recently, I have been developing new approaches to understanding the growth of canopy trees in complex structured mixed-species stands (Canham et al. 2004). In addition to journal papers and technical reports, I have prepared comprehensive reviews of existing knowledge and provided written and oral extension of new research results for field foresters.

I have incorporated a modeling component into my research (Coates et al. 2003). Forest management decisions must be based on sound science and forest management must demonstrate sustainability. The sustainability of practices, however, must be assessed over long time frames and, probably, at multiple scales. Linking field studies to models provides insight into long-term forest response to natural or human disturbances and helps us understand the consequences and trade-offs involved in the use of different silvicultural prescriptions.

## Recent Contributions to Scientific Community:

1. Deputy Coordinator of IUFRO Research Group 1.05.12: Northern Forest Silviculture and Management.
2. Scientific Program Coordinator for the 4<sup>th</sup> International Disturbance Dynamics in Boreal Forests Conference, August, 2004, Prince George, BC

### Selected Publications:

- Canham, C.D., LePage, P. and **Coates, K.D.** 2004. A neighbourhood analysis of canopy tree competition: effects of shading versus crowding. *Can. J. For. Res.*, 34:778-787.
- Greene, David F., Charles D. Canham, K. **David Coates**, and Philip T. LePage. 2004. An evaluation of alternative dispersal functions for trees. *J. Ecology*, 92:758-766.
- Kranabetter, J.M. and **Coates, K.D.** 2004. Soil resource availability and conifer nutrition across canopy removal treatments in a northern temperate forest. *Can. J. For. Res.*, 34:800-809.
- Coates, K.D.**, Canham, C.D., Beaudet, M. Sachs, D.L. and Messier, C. 2003. Use of a spatially explicit individual-tree model (SORTIE/BC) to explore the implications of patchiness in structurally complex forests. *For. Ecol. Manage.* Vol 186, Issue 1-3:297-310
- Bartemucci, P., **Coates, K.D.**, Harper, K.A., Wright, E.F. 2002. Gap disturbances in northern old-growth forests of British Columbia, Canada. *J. Vegetation Sci.* 13:685-696.
- Coates, K.D.** 2002. Tree recruitment in gaps of various size, clearcuts and undisturbed mixed forest of interior British Columbia, Canada. *For. Ecol. Manage.* 155:387-398.
- Greene, D.F., Kneeshaw, D.D., Messier, C., Lieffers, V., Cormier, D., Doucet, R., **Coates, K.D.**, Groot, A., Grover, G., Calogeropoulos, C. 2002. Modelling silvicultural alternatives for conifer regeneration in boreal mixedwood stands (aspen/white spruce/balsam fir). *For. Chron.* 78(2):281-295.
- Coates, K.D.** 2000. Conifer seedling response to northern temperate forest gaps. *For. Ecol. Manage.*, 127:249-269
- LePage, P., Canham, C.D., **Coates, K.D.**, Bartemucci, P. 2000. Seed abundance versus substrate limitation of seedling recruitment in northern temperate forests of British Columbia. *Can. J. For. Res.* 30:415-427
- Wright, E.F., Canham, C.D., **Coates, K.D.** 2000. Effects of suppression and release on sapling growth for eleven tree species of northern, interior British Columbia, *Can. J. For. Res.* 30:1571-1580.
- Burton, P.J., Kneeshaw, D.D., **Coates, K.D.** 1999. Managing forest harvesting to maintain old growth in boreal and sub-boreal forests. *For. Chronicle* 75:623-631.
- Canham, C.D., **Coates, K.D.**, Bartemucci, P., Quaglia, S. 1999. Measurement and modeling of spatially-explicit variation in light transmission through interior cedar-hemlock forests of British Columbia, *Can. J. For. Res.* 29: 1775-1783.
- Coates, K.D.** , Burton P.J. 1999. Growth of planted tree seedlings in response to ambient light levels in northwestern interior cedar - hemlock forests of British Columbia. *Can. J. For. Res.* 29:1374-1382.
- Wright, E.F., **Coates, K.D.**, Canham, C.D., Bartemucci, P. 1998. Species variability in growth response to light across a climatic gradient in northwestern British Columbia. *Can. J. For. Res.* 28:871-886.
- Coates, K.D.** , Burton, P. J. 1997. A gap-based approach for development of silvicultural systems to address ecosystem management objectives. *For. Ecol. Manage.* 99:337-354.
- Coates, K.D.**, Banner, A., Steventon, D., LePage, P., and Bartemucci, P. 1997. The Date Creek silvicultural systems study in the Interior Cedar-Hemlock forests of northwestern British Columbia: overview and treatment summaries. *Land Manage. Handb.* 38, B.C. Min. For., Victoria, B.C.
- Kobe, R.K. and **Coates, K.D.** 1997. Models of sapling mortality as a function of growth to characterize interspecific variation in shade tolerance of eight tree species of northwestern British Columbia. *Can. J. For. Res.* 27:227-236.
- Coates, K.D.** and J. D. Steventon. 1995. Patch retention harvesting as a technique for maintaining stand level biodiversity in forests of north central British Columbia. *In: C.R. Bamsey (Editor). Innovative Silvicultural Systems in Boreal Forests, Symposium Proceedings Edmonton, Alberta, October 4-5, 1994.* Clear Lake Ltd., Edmonton, Alberta. pp. 102-106.
- Coates, K.D.**, Haeussler, S., Lindeburgh, S., Pojar, R and Stock, A.J. 1994. Ecology and silviculture of interior spruce in British Columbia. *Can/B.C. Economic & Regional Devel., FRDA Rep.* 220.
- LePage, P. and **Coates, K.D.** 1994. Growth of planted lodgepole pine and hybrid spruce following chemical and manual vegetation control on a frost-prone site. *Can. J. For. Res.* 24:208-216
- Coates, K.D.**, Emmingham, W.H. and Radosevich, S.R. 1991. Conifer-seedling success and microclimate at different levels of herb and shrub cover in a *Rhododendron-Vaccinium-Menziesia* community of south-central British Columbia. *Can. J. For. Res.* 21:858-866.
- LePage, P., J.C. Pollack, and **Coates, K.D.** 1991. Chemical and manual control of thimbleberry (*Rubus parviflorus*) in northwestern British Columbia: a rate and timing trial. *Western J. Applied For.* 6(4):99-102.
- Coates, K.D.**, Haeussler, S. and Mather, J. 1990. A guide to the response of common plants in British Columbia to management treatments. *Canada-B.C. Economic & Regional Devel. Agreement, FRDA Handb.* No. 008.
- Haeussler, S., **Coates, K.D.** and Mather, J. 1990. Autecology of common plants in British Columbia: a literature review. *Canada-B.C. Economic & Regional Devel. Agreement, FRDA Report* 158.
- Pojar, J., Trowbridge, R and **Coates, D.** 1984. Ecosystem classification and interpretation of the Sub-Boreal Spruce zone, Prince Rupert Forest Region, British Columbia. *B.C. Min. For., Land Manage. Rep.* 17. Victoria, B.C.