

3.0 Full Proposal Content

Section 1: Proponent Information

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Proponent Organization: Bulkley Valley Centre for Natural Resources Research and Management

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Section 2: Project Information

Project Title: Developing indicators of soil productivity, function and biodiversity through soil biotic communities

Keywords: ectomycorrhiza, soil fauna, cryptogams, biodiversity, biogeoclimatic classification, site series, bioindicator

Project Description:

Soil indicators of sustainability are currently limited to soil disturbance surveys and reductions in net areas to be reforested (Montréal Process 1995, Curran et al. 2005). More biologically-based indicators of soil function, productivity, and biodiversity would provide more sensitive criteria of management practices. Such indices would be similar to the Index of Biological Integrity (IBI) that is widely used in the United States to monitor water quality, and which is now being adopted in northwest B.C. for fisheries habitat and water quality (Ministry of Environment 2005). Soil indices could include soil fauna, ectomycorrhizal fungi, or terrestrial nonvascular plants (lichens/bryophytes/liverworts – ‘cryptogams’) (e.g. Pandolfini et al. 1997, van Straalen 1998, Kremsater 2003), both as indicator species or indirectly through community parameters such as functional diversity (Bengtsson 1998). For example, ectomycorrhiza communities are strongly affected by stand disturbance, and 12 mushroom species have been identified as late-seral dependent in the interior cedar-hemlock zone of northwest British Columbia (Kranabetter et al. 2005). These species provide an excellent cost-effective monitoring tool that will clearly demonstrate the recovery of fungal biodiversity in managed stands. Further development of similar indicators is needed to examine issues such as soil disturbance (e.g. compaction and organic matter loss), soil biodiversity (e.g. green tree retention), and soil sustainability (e.g. nutrient cycling under alternative silviculture systems).

A logical step in the development of soil indicators is a better characterization of biotic communities across sites representing full gradients in ecosystem productivity. Species that are limited in distribution to poor ecosystems, for example, could serve as biological indicators of site-degrading forest practices. Better information on species distribution and community composition is also essential in providing unambiguous indicators across spatial scales. For example, the 12 mushroom species limited to late-seral stands in the ICH were only tested on submesic ecosystems, and might not be valid for richer ecosystems in that landscape. We also have very little information on the natural range in variability for community measures in soils, such as total species richness or relative evenness in species distribution between sites. Targets or criteria extrapolated from studies limited to mesic sites could lead to poor assessments of management impacts on soils across variable landscapes. Ultimately, the goal of a forest manager is to maintain the historic, natural range of species within ecosystems of all kinds, so characterizing these biotic communities across the landscape gradient is an essential first step.

In British Columbia, forested landscapes have a range of common but distinct ecosystems that reflect differences in soil nutrient and moisture availability (from nutrient poor/dry to rich/wet across the edatopic grid). A network of replicated sites encompassing a full gradient in forest ecosystems (the 02

Pl – Cladonia; the 01 Sxw – Huckleberry; the 06 Sxw – Oak fern; and the 09 Sxw - Devil’s club) will be established in the SBSmc2 in mature stands with a mix of lodgepole pine, hybrid white spruce and subalpine fir. Three large and important biotic communities will be assessed (repeatedly where necessary): ectomycorrhizal species (mushrooms and fine root ECM fungal colonization); soil macro- and mesofauna; and plant (especially the terrestrial bryophyte/liverwort/lichen) species. Taxonomic expertise will be utilized to allow for as complete a species inventory as possible. Species distribution will be compared across site series and tested against measured soil parameters such as N availability and moisture content.

The study will provide information essential to the development of accurate monitoring systems by testing the similarity and uniqueness of soil ecosystems across site series. The study will also identify those soil species indicative of certain habitats or soil conditions which will provide more sensitive tools in the ongoing research of forest soil management. The research will allow for a more complete biodiversity inventory and taxonomy of soil biota in the northern interior, and will lay the groundwork for further ecological studies of soil biota and site productivity.

Target Audience/ End users

The results from this study will be of use to individuals and organizations creating monitoring programs for assessing land use and forest operations. This will be of most interest to licensees who are developing indicators for Sustainable Forest Management Plans, for monitoring of the Forest and Range Practices Act by the Ministry of Forests, and for monitoring land use plans administered by the Integrated Land Management Bureau. In the northern interior this would include Brian Fuhr (Integrated Land Management Bureau), Jane Lloyd-Smith (BCMOF, Skeena-Stikine District), Gary Quanstrom (Pacific Inland Resources), and Karl Vandermark (Canfor). The results will also be valuable for forest scientists involved in research on many fundamental ecological processes, especially the relationships between soil biotic communities and site productivity. Examples would include soil scientists from the BCMOF (Graeme Hope, Shannon Berch, and Bill Chapman), CFS (Tony Trofymow, Brian Titus) and universities (Sue Grayston, Keith Egger), among others.

Objectives (long-term):

1. Establish the ecological relationships that are needed to develop a biological indicator system for soil health, including:
 - Establish relationships between BEC site series and soil-related species: ectomycorrhiza, macro/mesofauna, and cryptogam plants. Community data will include species identification where possible, and indices such as functional diversity and evenness of species distribution.
 - Test soil parameters such as N availability, pH, and soil moisture against soil biotic communities to examine processes influencing species distribution.
2. Develop indicator lists for species which are either generalists and widely distributed, or specialists and narrowly distributed to well-defined soil conditions. Also document species distribution as a function of mineral soil, forest floor and coarse woody debris habitat.
3. Recommend a potential indicators suite for soil productivity.

Objectives (2006-2007):

1. Locate 5 replicates of 4 site series and fully describe site features using the biogeoclimatic systems of ecosystem classification. This would include soil classification, especially humus forms, the extent of coarse woody debris and stand parameters.
2. Initiate soil fauna and epigeous ectomycorrhizal sporocarp surveys and taxonomic resolution.
3. Complete plant inventory, including detailed assessment of nonvascular terrestrial plants
4. Provide interim results of the soil biotic communities across site series and prepare a manuscript on nonvascular/vascular plant distribution.

Experimental Design and Methods

Site selection began in the summer of 2005 and 5 potential replicates of each site series (the 02 Pl – Cladonia; the 01 Sxw – Huckleberry; the 06 Sxw – Oak fern; and the 09 Sxw - Devil’s club) were located in the SBSmc2 along the McDonnell Forest Service Road (Fig. 1). These mature stands (age class 8) are a varying mix of lodgepole pine (*Pinus contorta*), hybrid white spruce (*Picea glauca x engelmannii*) and subalpine fir (*Abies lasiocarpa*), and have no mountain pine beetle attack at this time, which is one of the few areas in the northern interior where intact stands can be currently found. The sites will be fully described using standard BEC protocol, with soil descriptions (including detailed humus form classification), plant community assessments, coarse woody debris surveys and stand measurements. More intensive investigations will then be undertaken for ectomycorrhizal species, soil macro- and mesofauna, and cryptogam plant (bryophyte/liverwort/lichen) species. The biotic assessments will be across 45 m x 45 m (0.2 ha) plots, usually contiguous but occasionally as subplots for less extensive site series. Soil properties across site series, especially nitrogen availability and moisture levels, will be characterized through an ongoing linked study funded through the Forest Science Program.

Ectomycorrhizal fungal species will be assessed through epigeous mushrooms and morphotypes identified from fine roots. Both methods are needed to fully describe the diversity and functional differences in ECM communities. Mushroom surveys will take place two times over the typical fruiting period (week of August 22 and September 12) for three years with the assistance of taxonomic experts. A species list will be generated by searching the entire plot during each of the sample periods, and total species richness per site will be based on the cumulative species list collected over the 3 year sample period. Species frequency will be determined from transect lines, measuring 1 m in width, randomly located perpendicular to the central axis of the plot. Taxonomic identification will be based on macro and microscopic features (e.g. Thiers 1982). Representative voucher specimens will be dried and deposited at the Smithers Forest Service herbarium.

Ectomycorrhizal morphotypes on fine roots will be assessed on the *A. lasiocarpa* regeneration (< 1 m tall) found in the understory of these sites. Five seedlings will be excavated from each plot (100 in total), during which the substrate in which the seedlings were growing (forest floor, decayed wood and/or mineral soil) will be noted. Two hundred root tips from each seedling will be examined, both macroscopically for features such as colour and texture of the root tip, as well as microscopically for characteristics of the mantle layers and emanating elements. Morphotypes will be matched to species where possible (e.g. Kranabetter and Friesen 2002). Unknown but commonly occurring morphotypes will be assessed genetically (through either UNBC or UBCO laboratories) using RFLP techniques and matched to species from genetic databases whenever possible (e.g. Sakakibara et al. 2002). In addition to species, the ECM community will be characterized for its functional diversity using exploration types based on mantle features (Agerer 2001).

Soil fauna will be collected in the late spring (week of June 20) for 2 years. Specimens will be collected through pitfall traps, high-gradient extractors, and wet funnel extractors (Hendrix 2000). We will coordinate our sampling with the availability of extractors at the MOF Glyn Rd and Pacific Forestry Centre labs. Costs may be reduced by handling samples in Smithers and so we are also examining the feasibility of constructing extractors to be used in facilities of the Bulkley Valley Centre. Three pitfall traps will be installed per plot and set for two weeks, while three microsites of both forest floor and mineral soil will be excavated for faunal (dry and wet) extraction at each sample period. A soil core of PVC plastic (4.5 cm diameter) will be used to remove intact forest floor and mineral soil. The top 5 cm of both organic and mineral soil horizons will be sampled. Fauna will be collected into a 0.6% picric acid solution and then transferred into 70% ethanol. All samples will be initially sorted and counted under a dissecting microscope. Species identification for enchytraeids, collembolas, mites, diptera, beetles, millipedes, gastropods etc. will be undertaken with the assistance of taxonomic experts. In

addition to species identification and abundance (# of individuals), the fauna community will be characterized by biomass and diversity within trophic levels (fungivores, predators, detritivores etc.) for a comparison of functional differences in food webs across site series (Shaw et al. 1991, Faber 1991).

The cryptogams (nonvascular, spore producing terrestrial plants including lichens, mosses and liverworts) will be surveyed over each plot in midsummer of 2006. Abundance by species will be characterized within a 1 m x 1 m quadrat in 10 random spots over the 0.2 ha plot. The nature of the substrate (coarse woody debris, forest floor or exposed bedrock) for each species will be noted. Taxonomic resolution will be based on literature developed for the Pacific Northwest (e.g. Schofield 2002). Statistical analysis will be undertaken with the assistance of biometricians at BC Forest Service. All community plant, ectomycorrhiza and fauna data will be compared using nonmetric multidimensional scaling to examine the relationships to site series. Species distributions will be correlated with edaphic characteristics using multilinear or curvilinear regressions and multivariate techniques such as principle component analysis (McCune and Grace 2002).

Fig. 1. Potential sites identified for soil biotic assessments (red 02/cladina; green 01/huckleberry; blue 06/oakfern; purple 09/devil's club) along the McDonnell FSR near Smithers, BC.

Linkages

This proposal is linked to Y061080 'Interactions between light and nitrogen availability on juvenile tree growth in partial cut forests', where spatial variability in nitrogen availability is being investigated through relationships across these same sites (workplan Y072080). The data on soil resources provided through that project will be used in the testing of biotic communities in the current proposal.

The development of soil indicators will also be applicable to many other soil projects, including the long-term soil productivity study (Berch Y062084), and related faunal studies (Berch Y061085 and Berch Y062093). Biotic indicator development will be of use to researchers examining management practices such as green tree retention (Grayston Y062049 and Trofymow Y061183) and will complement other bioindicator initiatives (Beese Y061030, Bunnell Y062031 and Bunnell Y062045)

2006/2007 Schedule of Work

The proposal is for a 3 year term, the schedule of work for 2006/2007 is in the attached spreadsheet.

Section 3: Extension and Deliverables

An extension plan is under consideration in cooperation with Alan Wiensczyk of FORREX in Prince George. A number of peer-reviewed journal publications are expected on patterns in biotic communities across site productivity gradients in subboreal forests. The findings will be discussed in workshops and training on developing indicators and managing biodiversity with relevant government agencies through FORREX. Extension notes and discussion papers on soil biota will be submitted to the Journal of Ecosystem Management (FORREX online) and other relevant outlets (e.g. Pacific Northwest Fungi online). The findings will also be presented at scientific conferences (North American Forest Soil Meeting) and forestry meetings (Northern Silviculture Conference, Southern Interior Silviculture Conference) in British Columbia. Ongoing discussions of the results will be carried out with the MOF ecologists at the annual biogeoclimatic ecosystem classification meetings and the MOF soil scientists at the annual soils meeting. Presentations and discussions will also be made with forestry and biology students through seminars and classroom time at UBC, UNBC, UVIC and technical schools. The majority of extension will take place towards the final year of the projects (year 3) or soon after when results have been fully compiled. Interim results will be used in the extension effort where appropriate.

Extension products, Activities and Deliverables	Date	Year End Status	Peer review?	Target Journal
Journal papers	2008/09	Interim	Y	Oecologia, CJFR
Extension notes	2007/08	Interim/final	Y	FORREX

Section 4: Project Team

Marty Kranabetter (MSc, PAg) is the regional soil scientist for the Northern Interior Forest Region of the B.C. Forest Service. He has 14 years of research experience and has published 17 peer-reviewed journal articles. Marty will administrate the project, select/describe sites, undertake the ectomycorrhizal research (along with taxonomic experts such as Dr. Sharmin Gamiet and Paul Kroeger) and oversee much of the analysis and writing.

Ken White (MPM, RPBio, RPF) is the Regional entomologist for the Northern Interior Forest Region of the B.C. Forest Service. Ken has worked in the field of forest entomology for 13 years, and has worked on several projects requiring insect taxonomy expertise. He will assist in the soil fauna extraction and sorting, and will undertake identification of most insect specimens. He will also coordinate taxonomic expertise for mite, collembola and gastropod species identification (Dr. Jeff Battigelli, Dr. Jan Addison and Dr. Robert Forsyth).

Patrick Williston (MSc, RPBio), of Gentian Botanical Research, has been active for 12 years in bryophyte, lichen and vascular plant research in B.C. and Alberta, and has documented the first records for several species in these two provinces. He has also authored a COSEWIC report on Cryptic Paw Lichen (*Nephroma occultum*). He will undertake plant species inventory and taxonomic resolution (consulting experts such as Dr. Jim Pojar, Dr. Adolf Ceska and Trevor Goward where necessary).

Will MacKenzie (BSc, RPBio), is a provincial ecologist with the B.C. Forest Service. He is an expert on the biogeoclimatic classification system and has produced fieldguides for both terrestrial and wetland ecosystems. Will will assist in site descriptions and undertake the statistical analysis (nonmetric multidimensional scaling, principle component analysis) of the community data.

Section 5: Project Costs and Funding

Cost/benefit Description:

The Forest Science Program recognizes that information is lacking on indicators for soils, and research is needed towards developing a better understanding of species distribution in soil biotic communities. The results from this study will be extremely cost effective because of the involvement of the BC Forest Service. Site selection was initiated in 2005 and 20 potential plots (5 replicates of 4 site series) have been identified along the McDonnell Forest Service Road near Smithers BC. This location is only 20 km from Smithers and will greatly limit travel costs of fieldwork. Much of the time-consuming aspects to the study will be undertaken by MOF scientists so that funds can be better spent on experts involved in taxonomic work. We will also have some time contributed from MOF field staff (B. Borrett) towards the project. The Forest Service has a full laboratory and office in Smithers, and will provide vehicle use to the scientists. The Bulkely Valley Centre has an agreement with the Forest Service which allows for the use of MOF equipment and laboratory space by contractors. The proposed study is likely the most cost efficient approach possible for examining such a large and complex community. The desire for British Columbia to remain as a world leader in forest management hinges upon projects that continue to develop tools for understanding of soil function, productivity and biodiversity.

Funding request:

The proposal is for a 3 year term, the funding request for 2006/2007 (\$36,435) is in the attached spreadsheet. The funding request for 2007/2008 and 2008/2009 is \$27,000 each year.

Section 6: Literature cited

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Degree	College, University or Institution:	Subject:	Year:
BSc.	University of Saskatchewan	Biology	1987
MSc.	University of British Columbia	Soil science	1990
PhD candidate	University of British Columbia	Forestry	ongoing

Related Work Experience (last 10 years)

Position Held:	Date:	Department:	Organization:
Assistant soil scientist	1991-1995	Forest Sciences	Ministry of Forests, Prince George
Regional soil scientist	1995 -	Forest Sciences	Ministry of Forests, Smithers

Journal papers

Kranabetter, J.M. and Wylie, T. 1998. Ectomycorrhizal community structure across forest openings on naturally regenerated western hemlock seedlings. *Can. J. Bot.* 76:189-196.

Kranabetter, J.M. and Trowbridge, R. 1998. Soil nitrogen and lodgepole pine seedling responses to five years of legume cover. *For. Chron.* 74 (4):578-582.

Kranabetter, J.M., Hayden, S. and Wright, E.F. 1999. A comparison of ectomycorrhiza communities from three conifer species planted on forest gap edges. *Can. J. Bot.* 77: 1193-1198.

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Haeussler, S., Bedford, L., Leduc, A., Bergeron, Y., and Kranabetter, J.M. 2002. Silvicultural disturbance severity and plant communities of the southern Canadian boreal forest. *Silva Fennica* 36(1):307-327.

Kranabetter, J.M. and Friesen, J. 2002. Ectomycorrhizal community structure on western hemlock (*Tsuga heterophylla*) seedlings transplanted from forests into openings. *Can. J. Bot.* 80:861-868.

Kranabetter, J.M., Banner, A., and Shaw, J. 2003. Growth and nutrition of three conifer species across site gradients of north coastal British Columbia. *Can. J. For. Res.* 33: 313-324.

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Kranabetter, J.M. and Chapman, B.K. 2004. An analysis of litter nitrogen dynamics using artificial soils across a gradient of forest soil disturbances. *Can. J. Soil Sci.* 84: 159-167.

Kranabetter, J.M. 2004. Ectomycorrhizal community effects on hybrid spruce seedling growth and nutrition in clearcuts. *Can. J. Bot.* 82: 983-991.

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Kranabetter, J.M., Friesen, J., Gamiet S., and Kroeger, P. 2005. Ectomycorrhizal mushroom distribution by stand age in western hemlock-lodgepole pine forests of northwest British Columbia. *Can. J. For. Res.* 35: 1527-1539.



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EMPLOYMENT HISTORY

1996-2005 *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".

EDUCATION

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

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

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

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.

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

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

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- Education [**1985-1990**] **University of Victoria, British Columbia**
BSc. First Class Major with honors in Biology, Minor Environmental Studies,
Co-operative Education Distinction
- Professional memberships Registered Professional Biologist in good standing
- Professional experience [**1994-present**] **Ministry of Forests, Research Br., Smithers, B.C.**
Research Ecologist
Diverse Duties Include:
- Provincial expert in wetland/riparian and high elevation ecology
 - Creation of a provincial wetland and riparian classification system
 - Creation of a provincial Alpine/Subalpine zonal and site classification
 - Creation of a provincial seral classification
 - Data management of the Provincial Ecosystem Classification
 - Analysis and Correlation of Regional Site Classifications
 - Create methodology for Analysis of Association Integrity
 - Provides extension services to ministry staff, other agencies and individuals
- [**1992-1994**] **Ministry of Forests, Prince Rupert Region.**
Assistant Research Ecologist
- Co-author for “A field guide to Site identification and Interpretation for the Prince Rupert Forest Region. Land Management report 26.
 - Authoring research internal reports on “Effects of red alder girdling on understorey vegetation communities and planted seedlings,
 - Facilitating workshops and consulting on biogeoclimatic ecosystem classification.
- [**1991-1993**] **Self-employed Consulting Ecologist, Smithers, B.C.**
- Production of a Grizzly bear habitat map for the Firth River corridor, Ivvavik National Park, Yukon.
 - Creation of an ecosystem map for the Aleza Lake Research Forest.

Establishment and monitoring of vegetation plots in a fen ecosystem to research vegetation changes incurred by a duck enhancement project

- Monitoring of long-term vegetation succession plots
- Production of an ecosystem map and report for the Smithers Community Forest.

Publications and Reports

Banner, A., **W. MacKenzie**, S. Haeussler, S. Thomson, J. Pojar, and R. Trowbridge. 1993. A field guide to site identification and interpretation for the Prince Rupert Forest Region. B.C. Min. For., Res. Br., Victoria, B.C., Land Manage. Handb. No. 26.

MacKenzie, W.H. and J.R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Res. Br., B.C., B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 52. 285 pp. **[see attached]**

MacKenzie, W.H. 2005. Plant Associations as Ecosystems: Issues in Application to At-risk Status. In: Proceedings of the Species at Risk 2004: Pathways to Recovery Conference (2004 : Victoria, B.C). [electronic resource] **[see attached]**

MacKenzie, W.H. and R. Klassen. **2003**. VProXP: software for managing ecosystem classifications [Computer program].

Skills and Achievements

Volunteer activities: Board director BC Public Interest Research Group (1985). Board Director/Treasurer BV Pool Society (present), President: Smithers Squash Club (present), Executive Director Smithers Film Society, Ex Search and Rescue, Provincial Emergency Program

Interests: I am actively involved in many outdoor pursuits. Botany, bird watching, telemark skiing, hiking, rock climbing/mountaineering, fly fishing, whitewater kayaking and canoeing, outdoor photography. In addition, I enjoy guitar, choir, literature, squash, and rec hockey.

Skills and Certifications: Wilderness First Aid, White Water Raft Guide certified, Level 1 Squash Coach,

Software: Skilled use of Microsoft OFFICE, ACCESS, Adobe InDesign & PageMaker, Photoshop, Illustrator, ESRI ArcMap, PC-ORD

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Degree	College, University or Institution:	Subject:	Year:
BSc.	University of Victoria	Biology	1989
M.P.M.	Simon Fraser University	Forest Entomology	1992

Related Work Experience (last 10 years)

Position Held:	Date:	Organization:
Research Assistant	1993-1995	Canadian Forest Service, Victoria
Regional Entomologist	1996 - present	Ministry of Forests, Smithers

I have a keen interest in taxonomy, and worked for three summers in the insect collection at Pacific Forestry Centre preparing, identifying, and cataloguing submitted insect samples. As well, I took several courses in taxonomy at University. I am currently involved in a project on Ecosystem Recovery on the North Coast of B.C., where I am identifying soil fauna recovered from soil samples. I am a member in good standing of the Association of Professional Biologists of B.C., the Association of Forestry Professionals of B.C., and the Entomological Society of B.C.

**Forest Science Program
2006/07 Full Proposal Submission**

Partner Confirmation Form

Project Information

Project No: Y07-1010
 Title of Project: Developing indicators of soil productivity, function and biodiversity through soil biotic communities
 Proponent: Marty Kranabetter

Partner Information

Partner Organization: B.C. Ministry of Forests and Range, Research Branch
 Partner Contact Name and Title: Dr. D.J. Wilford, Forest Science Officer, Northern Interior Forest Region
 Partner Phone: 250 847-6392
 Partner Email: dave.wilford@gov.bc.ca
 Partner Address (mail): Bag 6000, Smithers, BC, V0J 2N0
 Partner Address (street): 3333 Tatlow Rd, Smithers, B.C.

In-kind support

Project Title: Developing indicators of soil productivity, function and biodiversity through soil biotic communities

Estimated Amount	Details
50,000 per year	The largest in-kind contribution will be salary dollars and support (vehicles, lab space and office) for the three MOF scientists involved in the study. Consulting on statistical analysis will also be through the MOF.
TOTAL	150,000

Cash Contributions

Amount	Details (please indicate if funds are from another source i.e., NSERC)

Partner Signature: 

Date: December 5, 2005

** TOTAL PAGE.02 **